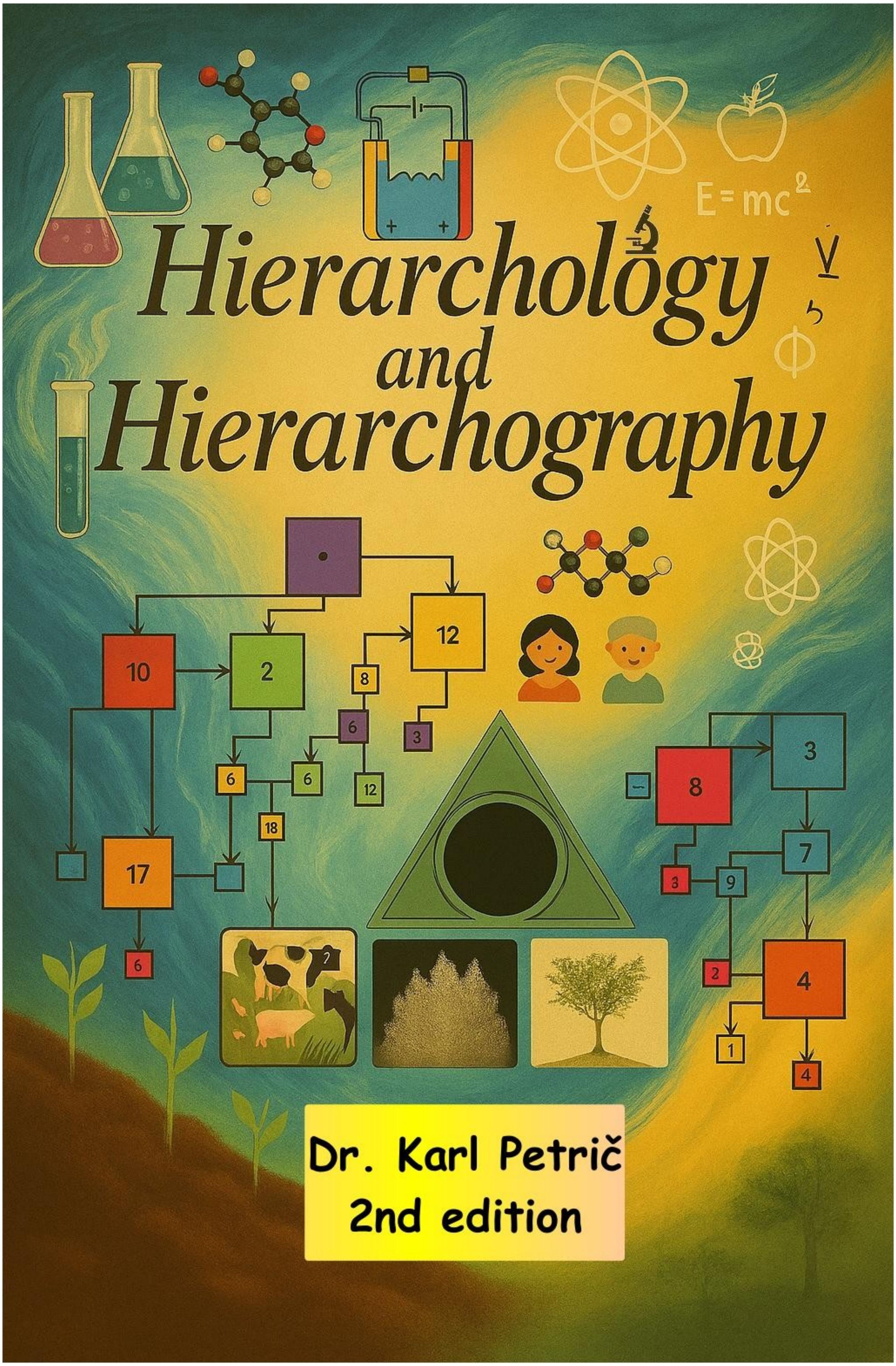

Hierarchology
and
Hierarchography
E=mc²
Dr. Karl Petrič
2nd edition

Hierarchology and hierarchography

Author: Karl Petrič

Žalec, 2025

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Preface

This is a highly comprehensive scientific work featuring empirical research and interdisciplinary experiments, which may make it somewhat challenging to read. A good piece of advice is to focus only on the parts that interest you—especially Chapter Six, which presents a synthesis of the most important insights from all the chapters. Another useful tool for better understanding the material is the use of LM Notebook, available online at https://notebooklm.google/. All you need is a Gmail account. You can upload the extensive PDF file to the platform and use it to create a podcast. AI-generated speakers will guide you through the content of the selected material, and you can even ask them questions related to the content. It's a very engaging and immersive experience.

What does the second, revised edition of this work offer?

Some minor stylistic and technical issues have been corrected (e.g., typographical errors and formatting inconsistencies). Chapter Six has been expanded to offer a more thorough synthesis of the key insights. The experiment on induced resistance was repeated several times and enriched with new findings. The bibliography is now systematically organized by chapter, making it easier to navigate and conduct in-depth study.

The term "Hierarchology" may remind some readers of Jewish Kabbalah, ecclesiastical hierarchical lists, or perhaps even the more familiar and humorously truthful Murphy's Laws (e.g., the Peter Principle). As the author and conceptual originator of this work, I assure you that it belongs to neither of those domains. This version of hierarchology presents a vision for a new interdisciplinary science which, broadly speaking, examines and studies hierarchies or hierarchical associative systems both in nature and in society (e.g., crystals, chemical compounds, human thought, plants, social systems, organized groups, the World Wide Web, bacteriology, and so on).

Hierarchology is intended to be more of a practical than a purely theoretical science. However, in explaining and analyzing hierarchical associative systems, it seeks to combine and integrate both practical and theoretical knowledge from other scientific fields. Its fundamental research subject is the structure and behavior of hierarchical associative systems, which have emerged, exist, and sometimes even disintegrate as a result of various dynamics between order and disorder. The central task of hierarchology is to reveal, and then improve—through proposals and solutions—the foundational and internal understanding of these systems.

In the study of hierarchical associative systems, the inductive method is particularly emphasized, as it offers a clearer view of the internal workings of such systems. Meanwhile, deductive and dialectical methods are more useful in analyzing their external behavior. It is assumed that hierarchical associative systems arise primarily based on the principle of induction. At the same time, hierarchology seeks to find a balance between the organicism view of the world (e.g., theology: God) and the mechanistic one (e.g., natural and exact sciences: the atomic model). Due to the extremely broad and interdisciplinary nature of hierarchology, it provides a foundation for applying various methodological tools from different fields of human knowledge. For now, this will suffice, as the theoretical foundations will be presented in detail in a dedicated chapter.

Humans often ask questions about things that are foreign to them. Because they do not wish to be guided by unknown and mysterious processes, they seek orientation in various ways. In their attempts to orient themselves and actively participate in the processes of the micro- and macrocosm, they rely first on instinct and senses, and in the next stage, on their thinking. Thinking is not solely an individual trait—it is, in many cases, of a collective nature, as human beings, especially most people, are inherently social creatures. Within these collective structures, various needs prevail and are distributed differently across social strata. The satisfaction or lack thereof of these needs leads to feelings of greater or lesser comfort—or even discomfort.

The birth rate is rising sharply, and technology is advancing rapidly, which forms a fertile ground for significant organizational challenges across societies in the so-called civilized world. These challenges often arise because many people cannot identify with the way of life they are living, which in turn undermines the effectiveness of the social hierarchy. Many feel their place in society is inappropriate. These feelings trigger—directly or indirectly—negative phenomena (e.g., rising crime rates, drug addiction, alcoholism, a high incidence of traffic accidents, mental disorders, suicides, work apathy, poor child-rearing, environmental failures, viral diseases, prostitution, religious fanaticism, satanic cults, dangerous sects, racism, wars, and intrigues at all levels of social life) and/or less conventional social phenomena (e.g., homosexuality—potentially as a result of overpopulation per square kilometer, internet addiction, gaming addiction).

The world is largely governed by legal, economic/financial, and political forces, which mostly serve the interests of a narrow segment of society. As a result, hierarchical associative systems operate with significant energy loss, and a clear overview of the social situation becomes difficult. This means that the efforts of the ruling elite are often short-sighted and unscientific, or at least limited in scope, making it difficult to mitigate certain organizational issues and negative social phenomena that continue to influence the thinking of the younger generation.

Hierarchology seeks to find answers or solutions to these negative processes—whether in individuals, society, or nature—that are damaging our collective well-being and endangering our natural essence. While individuals, societies, and nature do possess self-regulating mechanisms, the "holes" in these systems have grown so large that this self-regulation and self-organization are no longer sufficient for a quality life.

In short, hierarchology proposes a processual reorganization of thinking at the levels of the individual, society, and science—with particular emphasis on economics, law, and politics—to ensure that hierarchical associative systems are more efficiently utilized. In this context, certain corrective measures can be proposed to encourage more effective connections between various positively oriented social networks. Examples include:

- More applied use of insights and emotional intelligence from the field of art,

- Early assessment of individual abilities in the education system to avoid excluding students with below-average mathematical or linguistic intelligence,

- Additional encouragement of "Sunday researchers" (independent amateur scientists),

- Creation of new professional roles in areas like ecology, traffic safety, health, IT,

- Establishing pension systems funded from diverse and broader sources.

By implementing such corrective measures, societies across the civilized world could become less chaotic, more just, and more efficient.

This reorganization of thinking should begin especially in major world powers such as the United States, the European Union, Russia, and China. In this regard, it's worth briefly mentioning an interesting analysis conducted with the help of ChatGPT, which evaluated the performance of three world leaders—Donald Trump, Vladimir Putin, and Xi Jinping—based on selected key criteria (e.g., poverty reduction, pollution prevention, biodiversity protection, level of democracy, commitment to global challenges). All three performed very poorly in achieving goals that are essential for the long-term survival of the human species. Xi Jinping’s undemocratic leadership received the best overall rating.

If the human species is to survive in a quality and sustainable way, it must change. And that change depends heavily on future political decisions, especially those made by the world’s most powerful leaders. At present, we primarily observe tunnel vision—a strongly local focus that ignores our global interconnectedness with both the living and non-living world. Science—and its leading representatives—must also abandon this tunnel vision, or what might be called "backyard thinking."

Less rigid hierarchies and more collaborative relationships, supported by artificial intelligence, could generate better ideas and solutions for the great challenges ahead. If, however, the principle of "survival of the strongest" continues to dominate—based on the logic of extreme competition—we may well face the darkest scenario: the end of life as we know it, and the destruction of the creative evolutionary pathways that have developed over millennia.

1 Introduction

Humans are like time machines, traveling across the globe while carrying a vast wealth of data and information. However, most people cannot recall events or phenomena that occurred before the age of three.[1] The apparent amnesia of past events and phenomena in early childhood is, in reality, a natural part of development. Up until the age of three, a child is still in the process of learning the rules of language and behavior within a socially structured environment. At this stage, their thinking remains relatively unburdened, making it pure and uninhibited.

As the child moves freely within a limited space and with limited willpower, they gradually explore their surroundings, learning bit by bit until they eventually grasp the whole—such as language rules, social relationships, and interactions with objects. This learning process occurs through direct experiences of phenomena and events. For a child to fully internalize rules, these must be naturally interwoven with the experiences and situations they encounter, forming meaningful connections between events, phenomena, and the underlying principles that govern them. Events and phenomena participate in the dynamics of socially established rules of transformation to varying degrees. Rules influence events and phenomena, which, in turn, are embedded within these rules in a somewhat unique way. However, as we grow older, we no longer need to learn as many rules because we have already, to a large extent, mastered them. This enables us to distinguish between events, phenomena, and rules, as well as to recall rules separately. This understanding allows us to recognize the relationships between events, phenomena, and rules, and to consider whether certain types of rules exist that can evaluate specific events or phenomena—such as assessing positions and situations based on both standard and non-standard rules.

In this context, it is important to mention the kinesthetic sense, which informs a person about muscle position and tension. These signals contribute to structure and organization, or conversely, to entropy and disorganization. For example, when a baby lies in a cradle, muscle position and

1 An infant does not question or resist experiences, and for this reason, adults typically do not remember events or phenomena from before the age of three. Without a developed past within the larger system, dialectical laws have not yet been established, allowing the infant to possess a state of hyper-worldly openness. This enables them to absorb information with minimal constraints, making it possible to learn skills such as language at an exceptionally fast pace.

tension are interdependent in response to different situations, playing a crucial role in the experience of pleasure or discomfort. It is through these relationships that the baby's developing brain learns, word by word, making the perception of individual words closely connected to the kinesthetic sense and the formation of language rules. The kinesthetic sense also plays a significant role in how certain phenomena are perceived and in the recognition of order or disorder. Even in the cradle, a baby begins to learn about order and disorder in its immediate surroundings, though these concepts are likely experienced primarily as sensations of comfort or discomfort. Nevertheless, we must not overlook the dual nature of experiencing order and disorder. The first aspect of this experience comes from internal energy forces within the baby—its physiological and psychological foundation, including bodily sensations. The second aspect is the perception of order and disorder in the baby's immediate surroundings.

A baby is highly adept at receiving information, free from biases, with a relatively unconditioned mind. It absorbs everything, including what an adult might be unable to process. At birth, the baby enters a vast, complex system as an independent being. This means it has no prior experience of this larger system but carries a kind of past from a smaller system—the womb. The laws of this small system no longer apply in the larger world, which the baby enters without a relevant past.

Because of this, the baby is naturally (hyper) open to new experiences, though its cognitive filters for processing information are not yet fully developed. The baby has no pragmatic understanding of time or place—it has simply begun its journey. By entering the larger system, it acquires not only a present and a future but also a developing sense of the past. This past, combined with biological predispositions inherited from conception and maternal influences, shapes the baby's emerging psychological structure.

The way events and phenomena are integrated into rules during early development leaves a lasting impact on a person's mental framework. How an individual reacts to different situations, how strongly they experience pleasure or discomfort, and their emotional responses to people and events are largely influenced by these early experiences. These factors also shape a person's intensity of desire, determination, and mental focus—qualities they carry throughout life. A person's present willpower is strongly influenced by past experiences and previous determinations, which themselves are shaped by past events, phenomena, and both social and personal rules—many of which operate within the framework of inherited traits.
To some extent, we can argue that the physiopsychological foundation operates through parallel mechanisms. However, these are not merely independent processes running alongside each other; rather, they are interconnected and can strongly influence one another.

Consider an individual addicted to cigarettes. In certain situations, this person will smoke while performing habitual gestures, walking along familiar paths, or sitting in places associated with smoking. Gestures, facial expressions, and various physiological behaviors can trigger a kind of faulty mental strategy. Sometimes, a person does not consciously think about smoking but instinctively reaches for a cigarette after performing a specific physical movement—one that subconsciously triggers the urge to smoke. Of course, this is also influenced by nicotine addiction, to which the body becomes significantly accustomed.

Physical movements can therefore act as triggers for mental processes, forming a kind of feedback loop between actions and thoughts—similar to a switch that closes or breaks an electrical circuit. This means that, in many cases, a physical movement precedes a thought, or a thought is only activated after a physical action is performed.

Additionally, it is important to emphasize that certain dominant psychological impulses often play a leading role in shaping other impulses. In other words, one idea tends to act as the central element in a broader network of interconnected thoughts, influencing the mental processes that follow. While it is impossible to reverse the entire course of the past, we can adapt the impossible to the possible—and vice versa. In this interaction between possibility and impossibility, we enter a space from which we can perceive other dimensions of understanding. However, to access these new perspectives, we require an appropriate tool. One such tool could be **mental concentration**, which arises from rules, strong imagination, and willpower.

Willpower can be categorized into past, present (current), and preventive (future) will. The interplay between past and preventive will, in communication with the present will, can either trigger impulses for action or lead to action or reaction in response to specific stimuli.

Some possible criteria for mental concentration include:

a. Projection into the past – recalling and analyzing past experiences.

b. Projection into self-doubt – questioning one's own thoughts and beliefs.

c. Initiation of dialectical thinking – engaging in critical reasoning through opposing viewpoints.

d. Inductive thinking vs. deductive thinking – moving from specific observations to general conclusions.

e. Deductive thinking vs. inductive thinking – applying general principles to specific cases.

f. The desire to establish order, which may lead to entropy – seeking structure but unintentionally creating disorder.

g. A sense of personal power, which is dependent on one's own powerlessness, and vice versa – recognizing the dynamic balance between control and vulnerability.

h. Proving one's persistence – demonstrating conviction, which often outweighs doubt.

i. Seeking inaccessible knowledge – wanting to understand something that remains out of reach.

j. Knowing something we would rather not know – being burdened by unwanted knowledge.

k. Being influenced by another person’s strong mental concentration – experiencing suggestion or persuasion.

l. Fears of the future, where preventive will intervenes – anxiety about what lies ahead, shaped by past experiences, probability, and one's current psychological state.

For example, if a person associates a specific past object (such as a cobweb, a negative reference from a film) with a random event in the present (such as walking in a garden at sunset and encountering a large spider and spider web), this combination of memory, chance, and psychological state can lead to an intense reaction—whether physical, mental, or both. This could result in an impulsive action, such as destroying the spider web, driven by subconscious associations. A negative experience from the past triggered a destructive action.

Mental concentration and, consequently, actions can be significantly influenced by pathophysiological changes in cerebral blood flow, which is regulated by a self-regulation mechanism. This self-regulation process consists of the following stages: neuronal activity, increased energy consumption, increased production of effectors (such as carbon dioxide, potassium ions, and adenosine), vasodilation, increased blood flow, and enhanced nutrient supply.

Cerebral blood flow is approximately 750 ml per minute, facilitating the extraction of 75 mg of glucose and 50 ml of oxygen per minute. The brain consumes about 20% of the body's oxygen supply. Its primary function is to pump ions across membranes, with the uneven distribution of potassium and sodium ions forming the physical basis for transmitting information within the central nervous system.

Different states of consciousness correspond to variations in neuronal activity, cerebral blood flow, and oxygen consumption. These altered states also affect an individual’s susceptibility to perceiving and interpreting phenomena, events, and even rules. Extreme states of consciousness—such as dementia, schizophrenia, migraines, epilepsy, coma, anxiety, and delirium—further illustrate these variations in brain function.

In addition to many other important factors, we must also consider the function of the heart and its role in blood circulation. The heart is a hollow, red muscle about the size of a grapefruit. It is divided into two completely independent halves, although they function simultaneously. As the main driving force of circulation, the heart acts as both a lifting and pushing pump. Blood completes a full circuit through the body in just 20 seconds. In a resting person, approximately 4–5 liters of blood pass through the heart every minute.

Blood is composed of hemoglobin, proteins, sodium chloride (table salt), and various mineral salts, including magnesium, calcium, and potassium. When observed under a microscope, it becomes clear that blood contains living components such as erythrocytes (red blood cells), leukocytes (white blood cells), and platelets, all of which originate in the bone marrow and are eventually broken down in the spleen.

Interestingly, despite its significance, the role of table salt in blood has received less scientific attention than expected. Blood contains approximately 0.9 g of table salt per 100 ml, meaning there is about 50 g of salt in 5 liters of blood. The concentration of salt directly affects the lifespan of red blood cells. If the salt concentration is too high, red blood cells shrink, shortening their lifespan. Conversely, if the salt concentration is too low, red blood cells swell, reducing their mobility and efficiency.

Under normal conditions, red blood cells have a lifespan of approximately 120 days. However, when the salt concentration deviates significantly from the ideal level, their lifespan can be reduced to just 10–30 days. The consequences of such a drastic reduction can be severe, potentially leading to conditions such as leukemia.

A quick examination of the human biological foundation, which is linked to the soul and indirectly connected to the spirit, suggests that our interconnected body parts—such as the spine, bones, lungs, liver, stomach, kidneys, muscles, brain, and senses—play a crucial role in perceiving and processing phenomena, events, and rules. This can be compared to a type of hardware in an analogy.

1.1 Introductory flashback

Determining a fixed hierarchy of the human body and its parts is extremely difficult. What kind of hierarchical associative system does it represent? In any case, it is cyclical and dynamic. With nearly countless connections and interactions within the body, discussing a rigid hierarchy becomes almost impossible.

How could such a complex and dynamic hierarchy be visually represented? This might involve a combination of various diagrammatic techniques, such as swimming lane diagrams, oligographs, and activity diagrams. We will revisit this challenge later.

In this introduction, we have explored the connections between events, phenomena, and rules, as well as the role of mental concentration. We have also examined the relationship between past, present, and preventive will in connection with physical and mental expressiveness, ultimately emphasizing the significance of our biological foundation.

In the following sections, we will present the theoretical foundations, methodologies, methods, techniques, subject, purpose, and objectives of the emerging science of "hierarchology." Based on these principles, hierarchography will be developed as a means of using various diagrammatic techniques to qualitatively and effectively describe and illustrate different types of hierarchies or hierarchical and associative systems.

1.2 Theoretical basis of hierarchology

Theories are essentially simplified models or perspectives that provide a structured view of certain aspects of the world based on logical and/or empirical facts. In formulating theories, individuals abstract a series of elements that may not have intrinsic meaning or function for them in explaining phenomena and events. Instead, they focus on key phenomena and events with the aim of answering questions that arise from various stimuli (e.g., problems, discoveries) within the individual and/or the environment.

This assertion is supported by numerous theories from various scientific fields and, consequently, scientific outputs such as research articles and monographs. A particularly relevant example can be found in personality theories.

- Psychodynamic Theory of Personality: Psychodynamic theories emphasize motivational factors such as drives and needs. Notable representatives of this perspective include Freud, Maslow, Jung, and Adler.

- Typological and Dispositional Personality Theories: These theories focus on the structural aspects of personality from the perspective of different dimensions, as exemplified by Eysenck's work.

- Biological Theories of Personality: These theories emphasize genetic and other significant biological factors (e.g., Eysenck).

- Behavioral Theories of Personality: Proponents of behavioral theories primarily focus on stimuli that elicit different responses in individuals (e.g., Skinner).

- Social Theories of Personality: Social theory asserts that personality is primarily influenced by social factors (e.g., Vygotsky).

- Subjectivist Theories of Personality: These theories study personality based on subjective categories (e.g., Maslow, Rogers).

- Cognitive Theories of Personality: These theories emphasize an individual's cognitive processes. People learn about, interpret, and sometimes explore the world around them (e.g., Kelly, Piaget).

- Integral Theories of Personality: These theories propose that personality can only be adequately explained by considering both interpersonal and extrapersonal factors, as there are numerous strong connections between them (e.g., Lewin).

Based on this broad overview of different personality theories, it can be argued that no single theory is comprehensive enough to fully explain the complexity of an individual or groups of individuals. Each theory captures only a specific fragment of a person's nature, and it is essential to consider various situational and environmental dynamics. For example, Freud's personality theory, which is centered on sexual instincts, cannot comprehensively explain an individual hiking in the mountains or playing chess. However, it might be more applicable to understanding someone lounging on a beach in Rio de Janeiro.

Hierarchology is said to focus, among other things, on studying the hierarchical associative thinking system of an individual. In this context, referencing personality theories is relevant. Whether personality hierarchology—the idea that individuals think hierarchically and in interconnected ways due to biological, social, and environmental factors—offers a better explanation than the aforementioned theories is a question that cannot be definitively answered, as this field lacks an established scientific research tradition. However, this is not the primary concern at this theoretical stage. The key question is how the theoretical framework of hierarchology should be defined. Certainly not too narrowly, as the study focuses on hierarchical and associative systems. At this stage, it is essential to develop a definition that is both appropriately broad and sufficiently precise.

1.2.1 Definition

Hierarchology is an interdisciplinary science that studies hierarchical associative systems and their connections within individuals, society, and nature. When we explore and interpret the world, our thinking is inherently hierarchical and interconnected—perhaps even collaborative—placing inherent limitations on our perspective. This characteristic fundamentally shapes how we conduct research, including data analysis, factor classification, information synthesis, element categorization, and the use of filters.

We exist within a kind of scientific mental "cage" and may not even be capable of thinking beyond it. It is difficult to conceive of a society without hierarchy, as even anarchic societies contain hidden hierarchies (e.g., gang leaders or informal power structures).

Despite significant technological advancements that allow scientists to observe the world from the perspective of a mosquito, snake, or bird, our fundamental cognitive limitations remain unchanged. When studying nature, we perceive hierarchies and connections across different levels, but we also encounter chaos and emptiness—such as the vastness of the universe—within which we instinctively seek order. When faced with unsolved problems, we leave concepts like chaos and emptiness open-ended, returning to them as needed.

Even within chaos, hidden hierarchies exist, which we can extract from obscurity through intellectual analysis. The concept of emptiness is particularly intriguing, representing an absence of detectable elements, dynamics, connections, or hierarchies—either because our senses or the most advanced technologies are unable to perceive them. Emptiness and the number zero stand in stark contrast to all other known concepts (e.g., life, buildings, people, nations, organizations, information systems, animals). However, are these concepts fundamentally opposed to our hierarchical and associative thinking system? No, because we assign them their own place within our cognitive framework. The meaning of emptiness is also context-dependent; for example, in astronomy, "void" has a different meaning than in psychology, where it might refer to "mental emptiness." Broadly speaking, concepts we struggle to fully comprehend or classify—those exceeding our cognitive capacity—tend to be placed in the categories of emptiness and infinity.

In hierarchology, the individual and society play a central role, as hierarchical associative systems significantly influence scientific research methodologies. These systems shape how scientists and experts solve problems—whether by testing new theories, refining existing ones, or adhering to established paradigms. They also dictate how we perceive the world and interpret various phenomena, from nature and the universe to societal structures.

Cyclical dynamic hierarchical models are frequently used in scientific exploration, such as the atomic model or the solar system model. Moving forward, it will be essential to define the fundamental research domain of hierarchology.

1.2.2 Basic research area

The primary research area of hierarchology encompasses both social and natural phenomena, with a particular focus on the role of information and technology in modern society (as previously discussed). Within this framework, individuals function within a dynamic interplay of order and disorder, where their values may simultaneously align and diverge.

1.2.3 The task of hierarchology

The task of hierarchology is to reveal, discover, study, and predict fundamental social laws and internal mechanisms that govern human thought and behavior across all social structures. In a subsequent phase, it seeks to improve these laws, recognizing that they do not always serve the best interests of individuals, society, or the natural world. Based on this, hierarchology can be considered a more practical than purely theoretical science.

For this reason, research in social and natural phenomena emphasizes methodological approaches. The rules of research are either indirectly predetermined (since new theories evolve from existing ones) or directly shaped by these principles.

1.2.4 Research methods

Hierarchology employs a diverse range of research methods, making it inherently broad in scope while maintaining a specific focus. In studying individuals, society, and natural systems, the inductive method is often preferred, as many hierarchical associative systems operate on the principle of induction due to the presence of multiple levels within these systems, both in society and in nature.

The external functioning of hierarchical associative systems tends to be deductive and dialectical, whereas their internal processes are more inductive. Examples of this internal inductive operation include neural communication in the brain, socio-economic propaganda, the behavior of magnetized iron, and long-distance communication among ants.

1.2.5 Research tools

Hierarchology does not have strict limitations regarding the use of software tools. Depending on the research area, it can utilize tools for pattern recognition, data classification, thesauri, ecological analysis, forensic investigations, and more. The choice of tools depends on the specific field of study. One of the most important research methods in hierarchology is the mental concentration of both individuals and groups, as cognitive and collective focus play a crucial role in uncovering hierarchical patterns and associations.

1.2.6 Division of hierarchology

Hierarchology is divided into micro-hierarchology, meso-hierarchology, and macro-hierarchology. This classification is well-established and sufficiently clear, making further explanation unnecessary.

1.2.7 Hierarchography

The term hierarchography is new and does not yet have a tradition of scientific research. It draws on the theoretical foundation of hierarchology with the aim of describing and/or outlining the subject of study. A wide range of diagrammatic techniques can be used in this process, including workflows, mapping, tree maps, structural diagrams, UML diagramming techniques, oligographs, organigrams, business modeling, mind mapping, cognitive modeling, and others.

It is highly encouraging that a group of scientists has emerged proposing hierarchography as a scientific discipline. This discipline enables the organization of scientific literature across various hierarchical levels with the help of language models. However, it is important to emphasize that hierarchography is not limited solely to the organization of scientific literature—its scope is much broader.[2]

In fact, there are no explicit limitations, apart from the theoretical foundation, which itself is relatively broad.

1.2.8 Added value and new contribution to science

The theoretical concept of hierarchology is intended to be so universal that it provides a high-quality and efficient platform for scientific research across different disciplines and facilitates the synthesis of diverse knowledge. Communication and collaboration are crucial in this regard. Additionally, hierarchology offers the potential to measure and evaluate numerous social and

2 Gao, M., Shah, J., Wang, W., & Khashabi, D. (2025). Science Hierarchography: Hierarchical Organization of Science Literature. *ArXiv.* https://arxiv.org/abs/2504.13834.

natural phenomena and events that have not yet been adequately explained. This, in turn, allows for the development of appropriate corrective measures, applications, devices, and tools.

Many pressing societal issues remain unresolved (e.g., pension system reform) because certain scientific disciplines resist collaboration. Their leading representatives often adopt an exclusive stance, preventing interdisciplinary cooperation (e.g., a physicist may refuse to work with a philosopher, or an economist may be unwilling to engage with a sociologist). These barriers to cooperation are more prevalent than commonly assumed.

In contrast, computer science operates in a relatively structured and straightforward manner, focusing on the efficient processing of data and information. It benefits from various application solutions, including computers, information systems, mobile telephony, measuring devices, and software tools such as data warehouses. While computer science is deeply embedded in many aspects of social life—making it difficult to imagine serious research without computers—it is often relegated to a supportive role. Rather than serving as a bridge between different scientific disciplines, it is typically confined to executing orders rather than shaping communication and decision-making processes. This issue is particularly evident in structured organizations such as public administration, factories, and private companies. Despite its significant influence, computer science has little decision-making power or integrative capacity.

Although hierarchology is closely related to informatics and computer science, its broad scope allows it to connect with and be integrated into various research areas and scientific disciplines.

The following chapters will explore the hierarchy of knowledge, with a particular focus on the information hierarchy. We will examine hierarchical associative systems of individual thinking, including how scientists conduct research, analyze expressions and impressions, and engage with key concepts such as fate, human existence, symbols—especially collective symbols—and personal expressions and impressions. Finally, we will present perspectives on hierarchical associative systems within both social and natural contexts, including those that incorporate associative connections, as well as simulations of small urban communities. Practical examples will also be included within these discussions.

1.3 Knowledge hierarchy and information hierarchy[3]

Since hierarchology primarily deals with empirical data and information, it is essential to present various possible models of knowledge—both in words and images—that can emerge from different ways of using data and information.

At the top of this hierarchy is wisdom, which is difficult to define. Wisdom is often challenging to recognize and heavily reliant on social consensus, as both society and influential individuals must acknowledge a particular statement as wisdom. The emergence of wisdom can be deductive, dialectical, and/or inductive in nature. To determine how a particular piece of wisdom originates, various methods of analysis and synthesis should be considered, such as retrograde analysis, conceptual synthesis within a specialized thesaurus, semantic analysis, and research into historical and cultural contexts. One of the key characteristics of wisdom is its evergreen nature and relative timelessness—true wisdom is fundamentally less dependent on specific times and places. The exploration of different types of wisdom could be the subject of an independent study, which lies beyond the scope of this work.

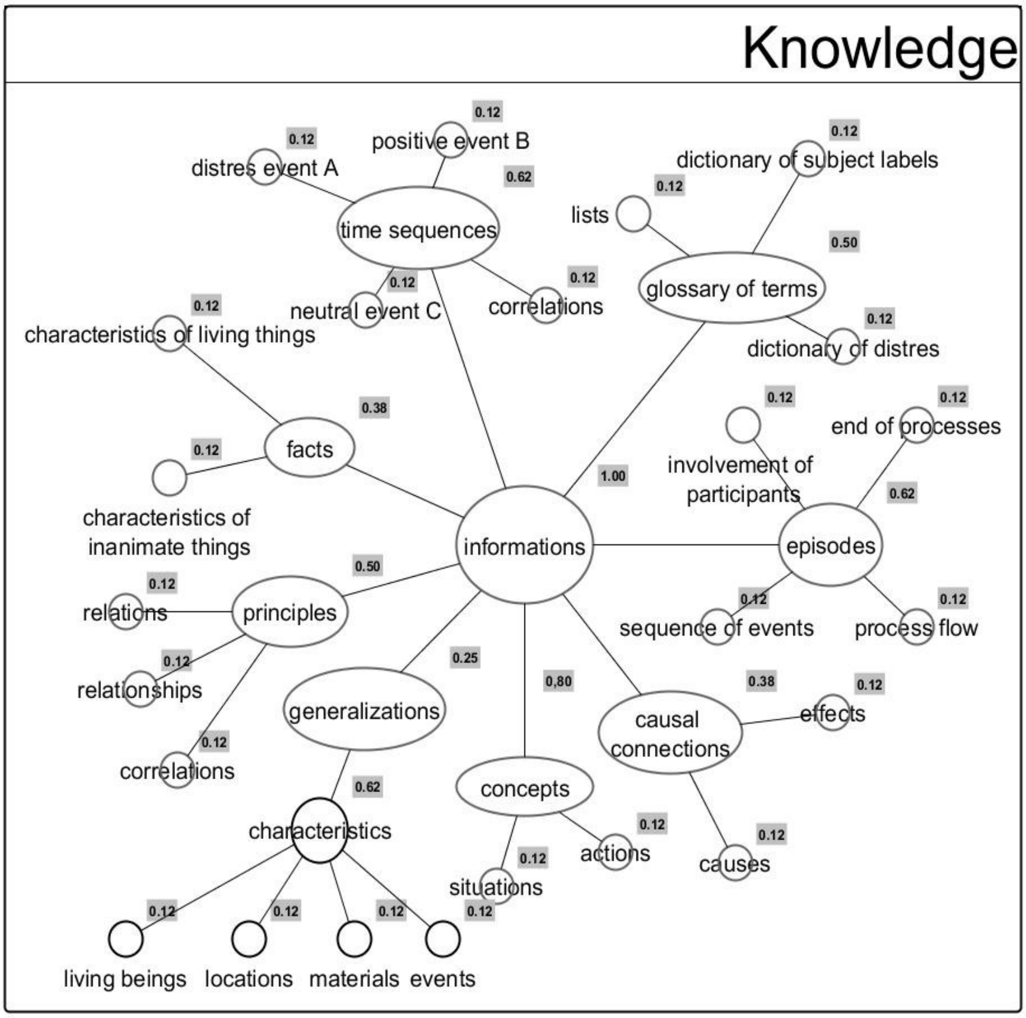
Directly beneath wisdom in the hierarchical pyramid is knowledge. Like wisdom, knowledge is difficult to define in words alone and ultimately depends on the individual and social consensus. The distinction between knowledge and information is sometimes subjective, and the boundary between the two can be fluid. Knowledge can be more precisely defined using a hybrid approach that incorporates verbal, pictorial or visual, auditory, tactile, and kinesthetic elements. Knowledge is generally categorized into factographic or linear knowledge (assumed knowledge, such as specific facts) and non-factographic knowledge.

Non-factographic (non-linear) knowledge is experiential, intuitive, practical, hidden, inductive, and goal-oriented. Over time, it may eventually become factographic knowledge.

Information ranks third in the hierarchy. It consists of more or less complex semantic structures that carry deeper meaning and are often applicable to decision-making in various contexts, including business, personal matters, education, tactics, strategy, and even chess, games, and sports. Data ranks fourth, followed by signals at the lowest level (signals will not be discussed here). Data generally consist of less complex facts and are particularly susceptible to subjective interpretation. In some cases, even simple data can serve as information for a particular individual, acting as a springboard for diverse decision-making processes.

3 The chapter knowledge was compiled based on sources, see references at the end of this chapter.

To better understand the concept of decision-making, it is essential to distinguish between data, information, and knowledge within the information hierarchy. If data, information, and acquired knowledge are of high quality, the risk associated with decision-making is significantly reduced—though not entirely eliminated. Even with an excellent starting point, complex systems can give rise to unexpected effects or consequences, which are often difficult to predict. The following section will present the information hierarchy, along with possible models of knowledge.



1.3.1 Figure 1: Information hierarchy (general knowledge model)

Figure 1 shows the information hierarchy.[4] Information and its hierarchical structure as a hierarchical superordinate unit, information can consist of the following subordinate building blocks:

a. Vocabulary of Terms – Primarily an alphabetical list of terms that represent basic concepts and behaviors.

b. Facts – Statements that describe the characteristics of people, places, living and non-living things,

4 The following software tool was used to create the various diagrams: yWorks GmbH. (2019). yEd. Retrieved from https://www.yworks.com/products/yed.

or specific events.

c. Time Sequences – Chronological arrangements of significant events, often highlighting correlations, whether positive or negative, between two or more key events.

d. Cause and Effect (Causality) – These may involve simple sequences of events and phenomena that lead to specific outcomes or a complex network of interrelated causes producing various effects.

e. Episodes – Specific events that include setting, participants, duration, sequence of occurrences, and associated causes and effects. For example, the progression and outcome of the Watergate scandal can be considered an episode.

f. Generalizations – Broad statements derived from specific cases based on empirical evidence. These may pertain to people, locations, living organisms, materials, events, or abstract concepts such as emotions.

g. Principles – A special category of generalizations that emphasize relationships between different elements. Within these relationships, causes, effects, and correlations can be analyzed.

h. Concepts – Highly abstract ways of thinking that integrate all the aforementioned building blocks. For example, a given concept may dictate that if situation X arises, action Y, Z, or both must be taken.

Knowledge and its role in decision-making

Knowledge is a complex structure composed of various data and information elements, including the aforementioned building blocks. These elements exist in varying degrees of interconnection, forming intricate relationships. Knowledge can be expressed as an understanding of facts, problems, experiences, learning processes, or the skills necessary for carrying out specific activities. Due to its complexity and the strong influence of intuition, knowledge is challenging to measure and evaluate.

Fundamentally, knowledge serves as the most valuable resource for individuals and organizations in decision-making. Its significance lies in its ability—especially through experiential knowledge—to solve complex problems that may otherwise result in high costs, extensive labor input, and the loss of valuable time and energy within an organization.

The importance of the information hierarchy in scientific research

The information hierarchy is particularly crucial for scientists and experts who analyze, interpret, and process various types of data—both verified and unverified—using proven methodologies. These methodologies may be quantitative, qualitative, or hybrid in nature. Some research follows established patterns based on well-founded theories, while other studies explore lesser-known or even entirely unknown aspects of a subject. It would be particularly insightful to investigate the research methods used by scientists across different disciplines. Conducting interviews with researchers from the natural sciences, social sciences, and humanities could provide valuable insights into their methodologies. These interviews could reveal the key focus areas in each field, as well as the seemingly minor details that are often excluded from their research processes.

Scientists of all disciplines focus on specific research subjects and are prepared to exclude elements that do not fall within the scope of their study. The proposed interviews would include three key questions:

a. What factors motivate you to conduct research?

b. Do you primarily rely on established theories?

c. What data, methods, techniques, or models do you use in your research?

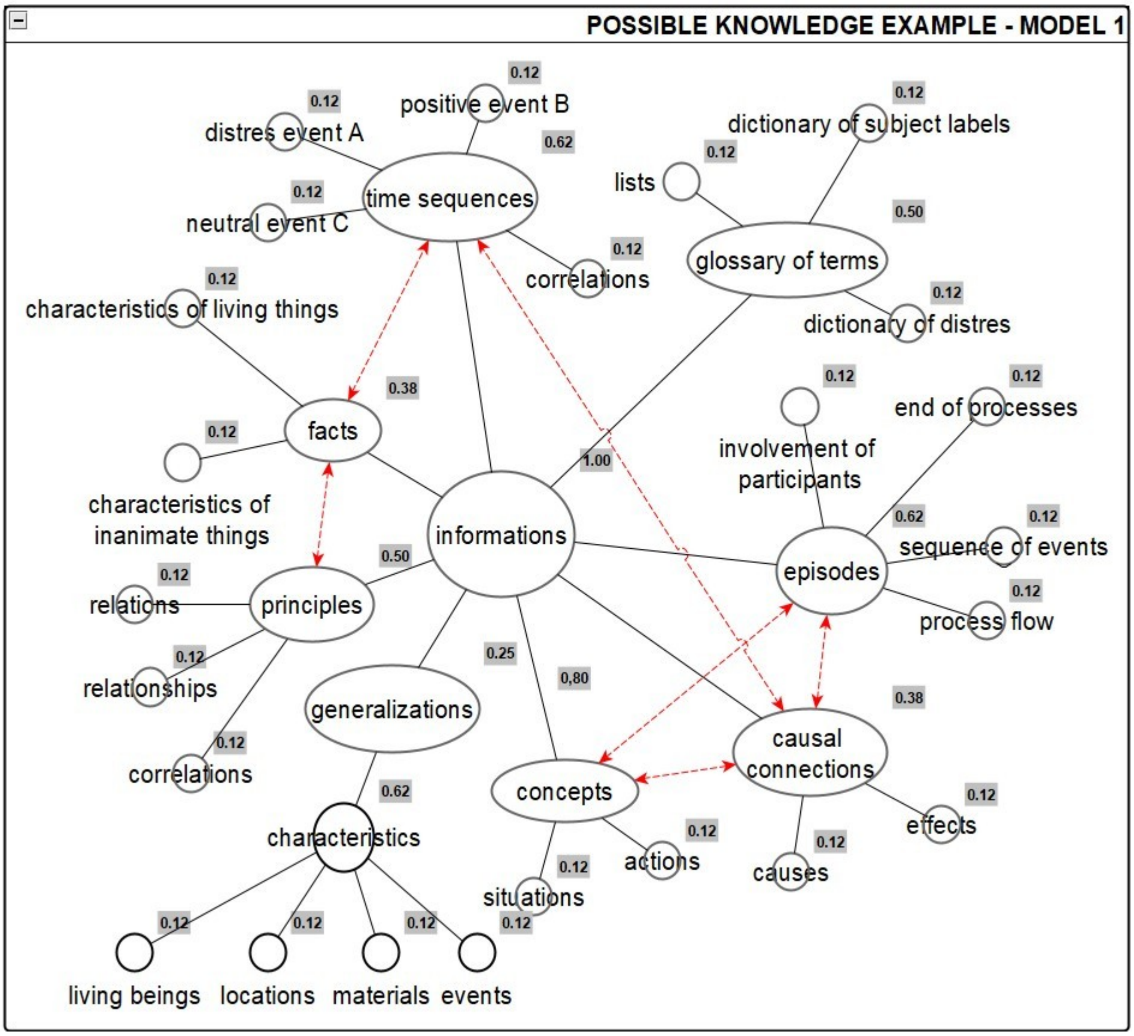
Based on these questions, a short survey questionnaire was developed. While it is not as effective as interviews, it allows for quick feedback. The survey results were as follows:

a. The primary factors motivating scientists to conduct research include job requirements, career advancement (earning academic points), personal interest, and addressing problems in their environment.

b. Scientists predominantly use established theories, which they often combine with new approaches. However, they are relatively reluctant to develop entirely new theories.

c. Scientists frequently use empirical data and apply both quantitative (often with a comparative focus, including statistical analyses such as time series and correlations) and qualitative methods (e.g., evaluations using graded scales).

In the following section, based on a general model (see the information hierarchy), several hypothetical knowledge models will be presented, highlighting the complexity of the data used.

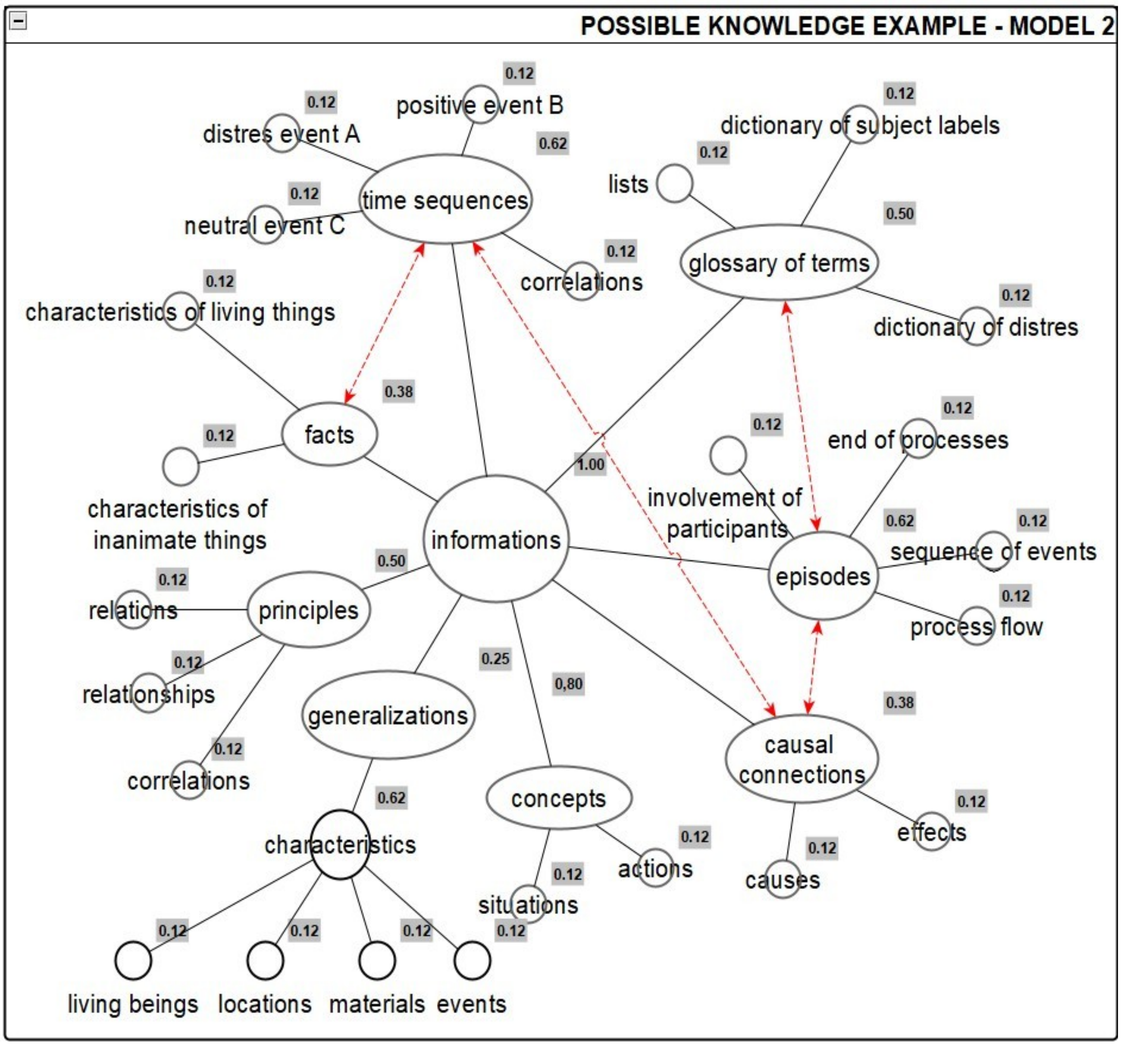


1.3.2 Figure 2: Example of knowledge – model 1

Figure 2 presents a possible example of how a scientist or researcher utilizes information building blocks and data types to generate knowledge. The two-way red connections indicate that the scientist employs various types of data, including time sequences (tracking events and correlations), reviewing existing facts about the research subject, establishing causal relationships between events, and analyzing these relationships in the form of episodes (e.g., participant involvement, process progression, sequence of events, and outcomes). Additionally, the scientist derives principles (e.g., relationships) and formulates concepts based on specific situations and actions taken.

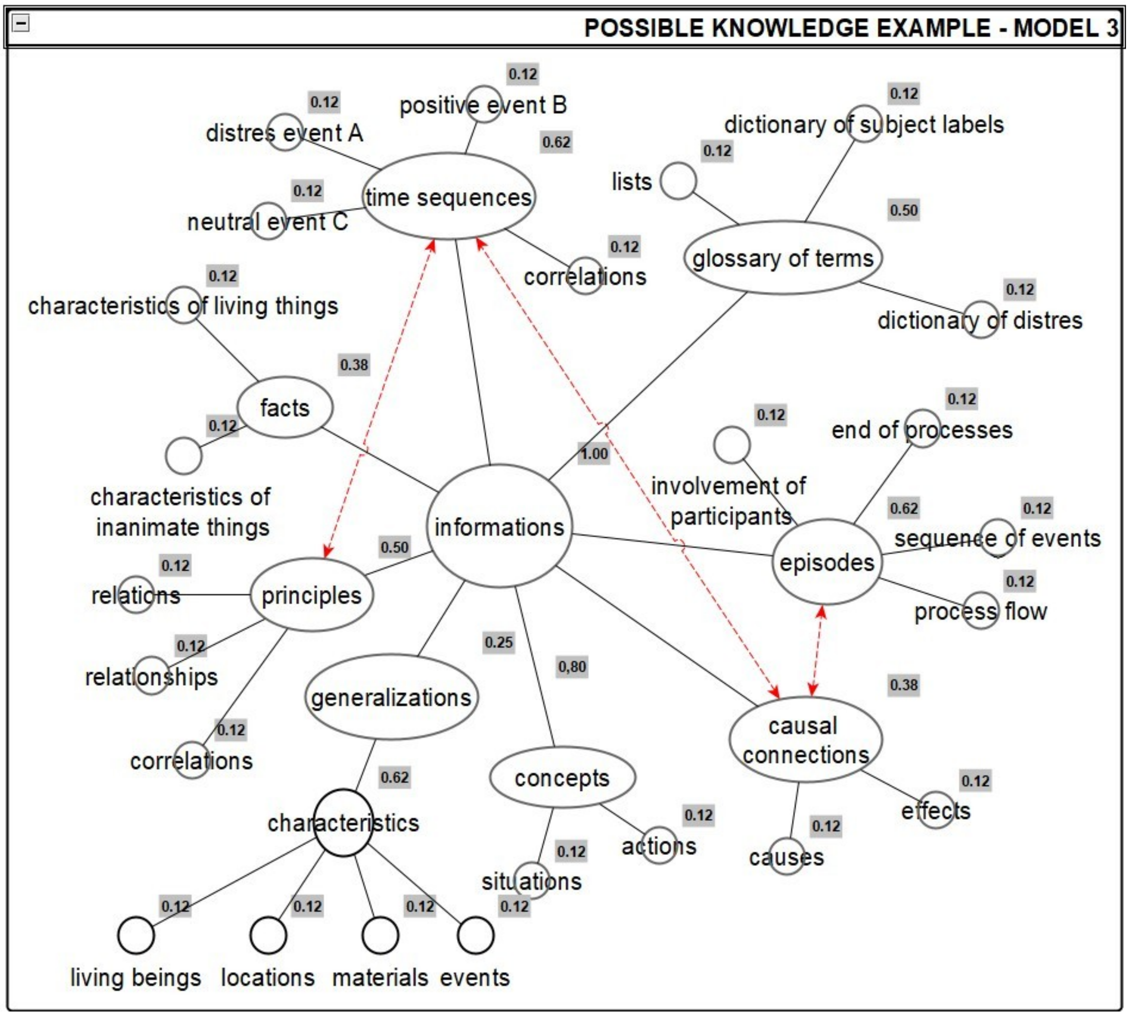
From the model, we can infer that the research focus is primarily quantitative, as it relies on numerical data and measurements. However, it does not incorporate generalizations (such as the general properties of certain materials) or vocabularies of concepts (such as dictionaries, encyclopedias, lexicons, thesauruses, or various lists).

Using the selected information building blocks, the scientist generates new knowledge that can, for example, help prevent serious traffic accidents or crimes, highlight problems and solutions, and support decision-making through corrective measures. Furthermore, based on the model, it is likely that the researcher is not a historian, as historians typically rely on various vocabularies of terms, especially encyclopedias and lists, in their research.



1.3.3 Figure 3: Example of knowledge – model 2

Figure 3 illustrates the second model of a knowledge example. The two-way red connections indicate that the scientist utilizes a limited range of data types in their research. Specifically, they analyze time sequences (examining events and correlations), rely on vocabularies of concepts (such as lexicons, encyclopedias, and dictionaries), verify facts (e.g., characteristics of specific individuals), establish causal relationships (identifying causes and effects of events), and study episodes (including the involvement of key participants, the sequence of events, the progression of processes, and final outcomes). Based on this model, we can conclude that the scientist is not a natural or applied scientist but rather a specialist in historical sciences.



1.3.4 Figure 4: Example of knowledge – model 3

Figure 4 presents the third model of a possible knowledge example, which may be characteristic of an expert responsible for conducting statistical analyses for a statistical yearbook. This expert primarily examines time sequences in relation to causal relationships, while also analyzing episodes and principles to facilitate the interpretation of results. Additionally, they study various relationships between events, interactions between individuals, and statistical correlations.

For an expert engaged in statistical analysis for a yearbook, it can be inferred that they rely on established theories, methods, techniques, and models in their work. The distinction between an expert and a scientist is often fluid, and in rare cases, an individual may be considered both a leading expert and a distinguished scientist simultaneously.

It would be worthwhile to explore in greater detail the hierarchical and associative systems and processes of scientific research, particularly to enhance the ability to assemble high-quality scientific teams capable of addressing complex social and natural challenges.

A similar approach is already highly effective in professional team sports such as football, basketball, and handball. The success of national teams is not solely dependent on the number of outstanding athletes but rather on strategic factors such as tactics, teamwork, collaboration, leadership, and management. Notably, even smaller nations can achieve better results than global powerhouses such as the United States, the United Kingdom, Germany, Spain, Russia, and China, despite having fewer top-tier athletes.

The next chapter will focus on the hierarchical and associative thought processes of individuals, recognizing their significance as fundamental social units. It is essential to acknowledge that all individuals play a role in society, whether they are scientists, artists, politicians, lawyers, or even homeless individuals. However, human nature inherently drives us to rank and classify different entities based on importance, value, rarity, and power.

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2 The individual

An individual's fundamental way of thinking can be divided into three levels: philosophical (e.g., science, art, business, innovation), everyday (e.g., chores, obligations, food, games, socializing, well-being), and libidinal (e.g., eroticism, emotions, comfort, pleasure, feelings).

Additionally, stimuli—such as impulses, inhibitions, and psychological drives—serve as catalysts for mental processes (also referred to as mental principles or mental chords). These stimuli can direct an individual's focus toward a particular subject, a process known as mental concentration. From this perspective, the study of the individual will be explored using rich visualization techniques.

2.1 Psychological drives

The variety of psychological drives is vast. In this section, we will focus on the 12 most common or fundamental ones:

1. The desire or need for food and drink
2. The desire or need for success
3. The desire or need for health
4. The desire or need for love and loyalty
5. The desire or need for humor
6. The desire or need for comfort
7. Fears related to the future, death, animals, darkness, etc.
8. The desire or need for travel
9. The desire or need for competition
10. The desire or need for order and cleanliness
11. The desire or need for education and the discovery of new principles
12. The desire or need for friendship

The psychological drives mentioned above play a crucial role in every individual’s existence. They serve to strengthen both personal identity and the individual’s overall sense of being. At the same time, these drives influence how people open or close themselves to the outside world. Economic, political, and other forms of propaganda can exploit these otherwise beneficial drives for purposes that are not always positive.

Psychological drives constantly affect our bioenergetic state, filling and depleting us in various ways. As a result, we may experience emotions such as sadness, reluctance, satisfaction, happiness, anger, or indifference. When examining these drives more closely, we can indirectly observe various personality theories. For instance, the libidinal level and the need for comfort align with Freud’s personality theory, while the need for food and drink corresponds with Maslow’s hierarchy of needs.

Psychological drives can generally be categorized into needs, desires, and fears, which guide us through life. While some of these drives can be controlled (e.g., the desire to travel, if it is not essential for survival), others can only be partially managed (e.g., desires in general), and some cannot be controlled at all (e.g., the need for food, drink, and health, which are vital for survival). In reality, control over these drives often relates more to moderation—such as eating only as much as necessary rather than in excess.

Psychological drives can be metaphorically compared to switches that can be turned on or off. Individuals interact with both their internal world (e.g., experiencing a headache) and their external world (e.g., receiving signals, data, and information from the environment). These interactions involve stimuli that either encourage action (impulses) or delay/inhibit action (inhibitors). Additionally, psychological drives often appear in combinations, creating hierarchical and associative connections—for example, the simultaneous desire for love and travel may drive a person to act in a specific way.

Many psychological drives are linked to biological systems in the body. For instance, the need for food and drink is directly related to the organic system, while the desire for love may be associated with brain activity or, more broadly, the central nervous system. From this perspective, psychological drives form an essential part of a multilevel, cyclical, dynamic, hierarchical, and associative system that shapes an individual's thinking.

The fundamental ways of thinking influence which psychological drives are triggered. These ways of thinking can be categorized as:

- Libidinal thinking, which primarily activates desires and needs related to love, loyalty, pleasure, competition, and comfort.

- Everyday thinking, which mainly stimulates the need for food and drink, entertainment, friendship, success, and fears such as death and failure.

- Philosophical thinking, which drives the pursuit of knowledge, the discovery of new principles, friendship, success, the desire for immortality, and the fear of death.

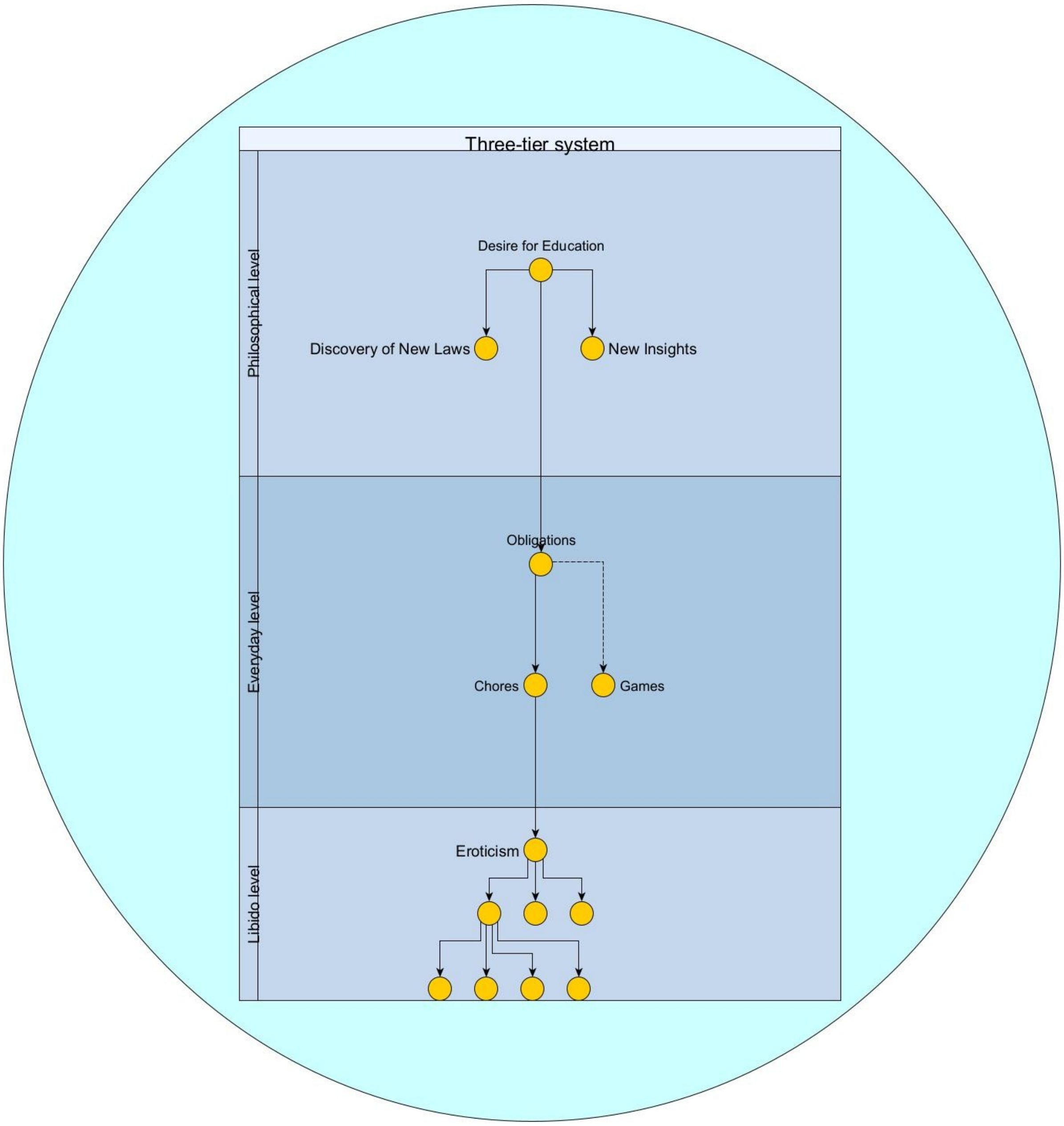
Although all three ways of thinking are fundamentally important, their emphasis varies from person to person. This variability creates a natural ranking of these thought processes, with some individuals prioritizing one level over another.

Individuals can be categorized into three groups based on their predominant way of thinking: libidinal, everyday, and philosophical/intellectual. However, these categories do not represent strict boundaries but rather indicate a person's mental orientation or emphasis.

The libidinal way of thinking can be considered the lowest level, the everyday way of thinking the middle level, and the philosophical way of thinking the highest level. While these levels can function independently, they are also interconnected to varying degrees. The specific pattern of these connections depends on the individual or group in question.

It is evident that countless models of hierarchical and associative systems of psychological drives can be formed, some highly distinct and others quite similar. As a natural consequence of this variation, both identical and differing patterns of mental concentration emerge.

To enhance clarity, we will now examine a simplified model that primarily highlights level emphases, psychological drives, and their possible connections. From this model, we can infer the mental concentration of an individual whose primary focus is on acquiring new knowledge, making discoveries, formulating laws, and gaining insights. Additionally, we will explore how this concentration interacts with the other two levels.



2.1.1 Figure 5: Three-level cyclical model of the hierarchical associative system of psychological motivation

Figure 5 illustrates a three-dimensional cyclical model of the hierarchical associative system of psychological motivation, emphasizing the philosophical and everyday ways of thinking, which dominate in this individual, while libidinal thinking is the least represented.

At the forefront is the individual's psychological motivation for education, which drives the desire to discover and learn new concepts or laws. This need/desire is strongly linked to obligations, which, in turn, connect to chores—both positioned at the everyday level. A weaker connection to play is also depicted.

One might expect a stronger connection between play and eroticism, both associated with the libidinal level. However, the model instead shows a stronger link between chores and eroticism, suggesting that, in this context, eroticism may be perceived more as a familial or relational obligation rather than a purely pleasure-driven impulse.

Even within this simplified depiction, the model presents numerous possibilities for scientific research—far beyond the capabilities of a single individual but well-suited for a highly organized and diverse scientific team. Furthermore, this model could prove valuable in the advancement of artificial intelligence and, by extension, the development of humanoid android robots.

When solving more or less complex problems and/or making decisions, an individual can use various mental approaches.

2.2 Mental approaches

Before refining or expanding the three-level cyclical model, we will first introduce and briefly define several mental approaches. It is important to emphasize that these approaches are not only used in scientific contexts but also play a role in everyday thinking and, to a lesser extent, in libidinal thought processes.

a. Induction and deduction

Both approaches have a long philosophical tradition and explore the relationship between the general and the specific.

- Induction: Forms a general concept from specific elements.

- Deduction: Extracts specific details from a general whole.

Throughout history, it is difficult to imagine innovative ideas, inventions, and patents that do not utilize both methods. These approaches offer two different ways of perceiving the world—one moving from the top of the tree to the roots and the other from the roots to the canopy.

Inductive reasoning tends to be slower than deductive reasoning. Therefore, both in science and everyday life, people often rely on deduction as it allows for faster observation of effects and provides quicker feedback on the correctness or errors of one's thinking.

From a causal perspective (cause/effect) and conditional reasoning (condition/consequence):

- Deductive thinking seeks to identify key effects or consequences.

- Inductive thinking provides a broader view of causes and effects.

By using induction or deduction, large amounts of diverse information can be structured into specific categories, either general or specific (e.g., classifying animals into groups). Classification can work top-down (whole to parts) or bottom-up (parts to a whole). In this process, both similarities and differences between entities must be considered.

These two methods are closely intertwined with other mental approaches such as whole and part, similarity and difference, bipolarity, and dialectics.

b. Bipolarity and dialectics

In both scientific and everyday thinking, we encounter opposing forces that constantly strive to change or maintain our worldview.

On one hand, there is an ongoing struggle between positive and negative forces, yet at the same time, there is also a certain harmony between them. This balance prevents instability and ensures the continuity of the world.

The resulting dynamic equilibrium emerges from the interaction between positive and negative forces. Without this mental approach, it would be difficult to imagine the development of innovative scientific ideas.

For example, a battery operates on positive and negative poles, but it alone is not sufficient. It requires a device to convert energy into light, sound, or motion (e.g., a light bulb or radio). Similarly, effective thinking requires defining positive and negative aspects and analyzing the interaction between them. Highly original and innovative ideas often arise from intense dialectical dynamics.

c. Framework and foundation

Every theory, concept, or idea must have a framework and foundation—without them, ideas remain uncertain, unprovable, or impractical.

Both the framework and foundation are essential for developing effective thought processes, but:

- The framework should not be too narrow.

- The foundation should be flexible enough to accommodate new perspectives.

Does any effective thought or theory exist without some form of constant? Constants allow us to observe positive, negative, fast, and slow processes clearly.

In innovative thinking, it is useful to identify constants, as they can also reveal systemic errors. The primary goal of innovation is to improve systems and, in doing so, enhance human quality of life.

d. Hierarchy

Hierarchical relationships play a significant role in both conceptual structures and social systems (e.g., among people, materials, animals, and plants).

Hierarchy serves as an effective orientation tool for social beings but can also restrict creativity, limiting the development of innovative ideas.

Hierarchy is deeply influenced by memory and experience. Every individual enters the world within a pre-existing hierarchical system. Understanding hierarchy is crucial for identifying problems and implementing solutions.

e. Associativity

Associativity is essential for gathering raw thoughts and is closely linked to hierarchy. However, associativity is more flexible, while hierarchy is often based on predefined rules in memory systems.

f. Pleasure and displeasure

This fundamental mental approach influences thought processes and associations by stimulating or inhibiting certain directions of thought based on emotions and sensory experiences.

It also serves as a signal for evaluating solutions—do they meet expectations?

Across science, daily life, and libido, no theory, invention, application, or behavior is exempt from this principle. It creates dynamics and stability and forms the basis for dialectical thinking.

g. Core, attraction, and repulsion

Many scientific theories and models are based on this principle (e.g., planetary orbits, atomic structures).

This approach also applies to social structures, where authoritative figures attract and connect individuals (e.g., political parties, organizations).

h. Similarity and difference

Every day, people evaluate events, materials, and living beings based on subjective and collective measures of similarity and difference. These evaluations often serve as a basis for classification systems.

i. Compression and condensation

This principle likely emerged from the need to optimize space—both physical and mental.

Examples include:

- Data compression (zipping files) for easier transfer.

- Packing luggage efficiently before a trip.

j. Abstraction and elimination

This approach reduces cognitive overload by removing less important details, either temporarily or permanently.

k. Addition and composition

The opposite of abstraction, this principle fills in missing elements to create a more complete understanding of a given subject.

l. Mini-Max

This method relates to expectations, desires, needs, and fears, often used in scenario modeling (e.g., expecting little but receiving a lot, or vice versa).

m. Balance

Balance aims to achieve a stable state, preventing excessive dynamic fluctuations (e.g., weight distribution, chemical reactions, mental stability).

n. Whole and part

This approach examines relationships between components and their influence on the overall system.

o. Perspective shifting

This principle seeks to observe an object or concept from different viewpoints (e.g., human, frog, or bird's-eye perspective).

p. Openness and closedness

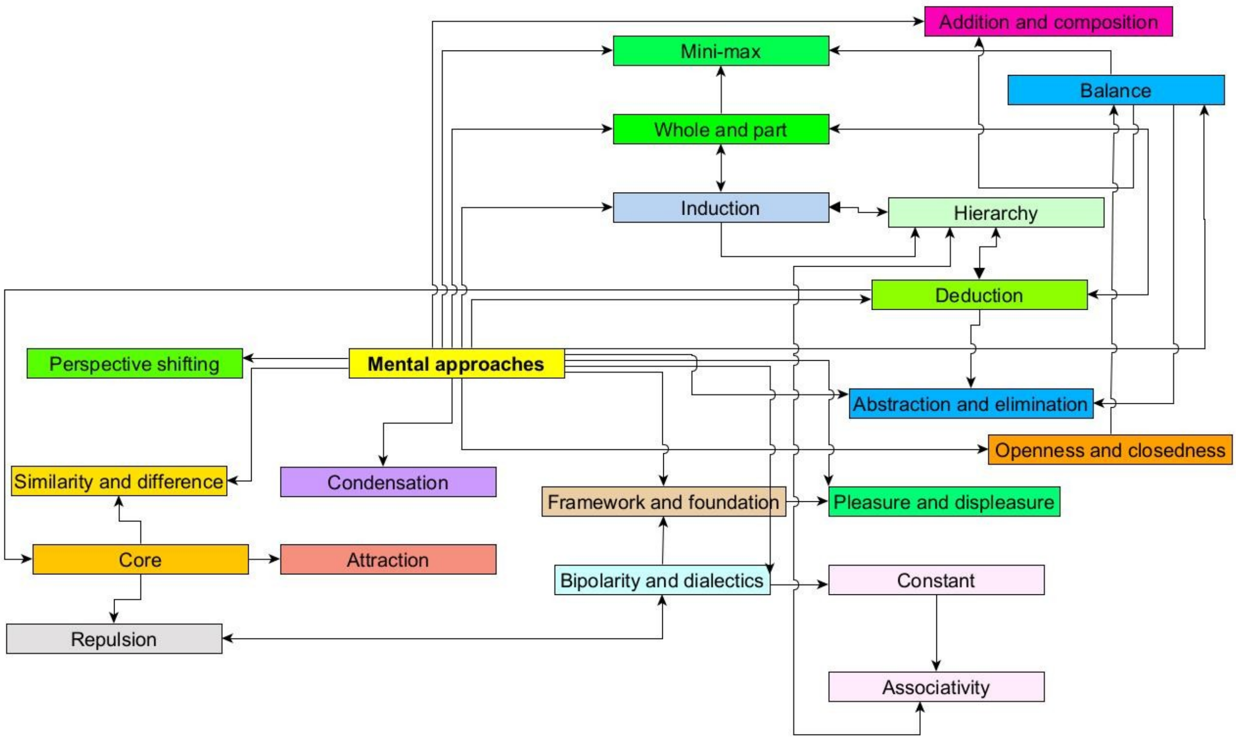
This principle evaluates systems based on how adaptable or restrictive they are.

- Excessive openness can lead to cognitive overload.

- Excessive closedness can lead to isolation.

For example, a person has both open and closed traits, while an electrical circuit contains switches and resistors to prevent system overload.

The more complex a problem or difficult a decision, the more mental approaches are likely to be used. Their interconnections vary among individuals, and the number of possible associative hierarchical models of these approaches is difficult to quantify.



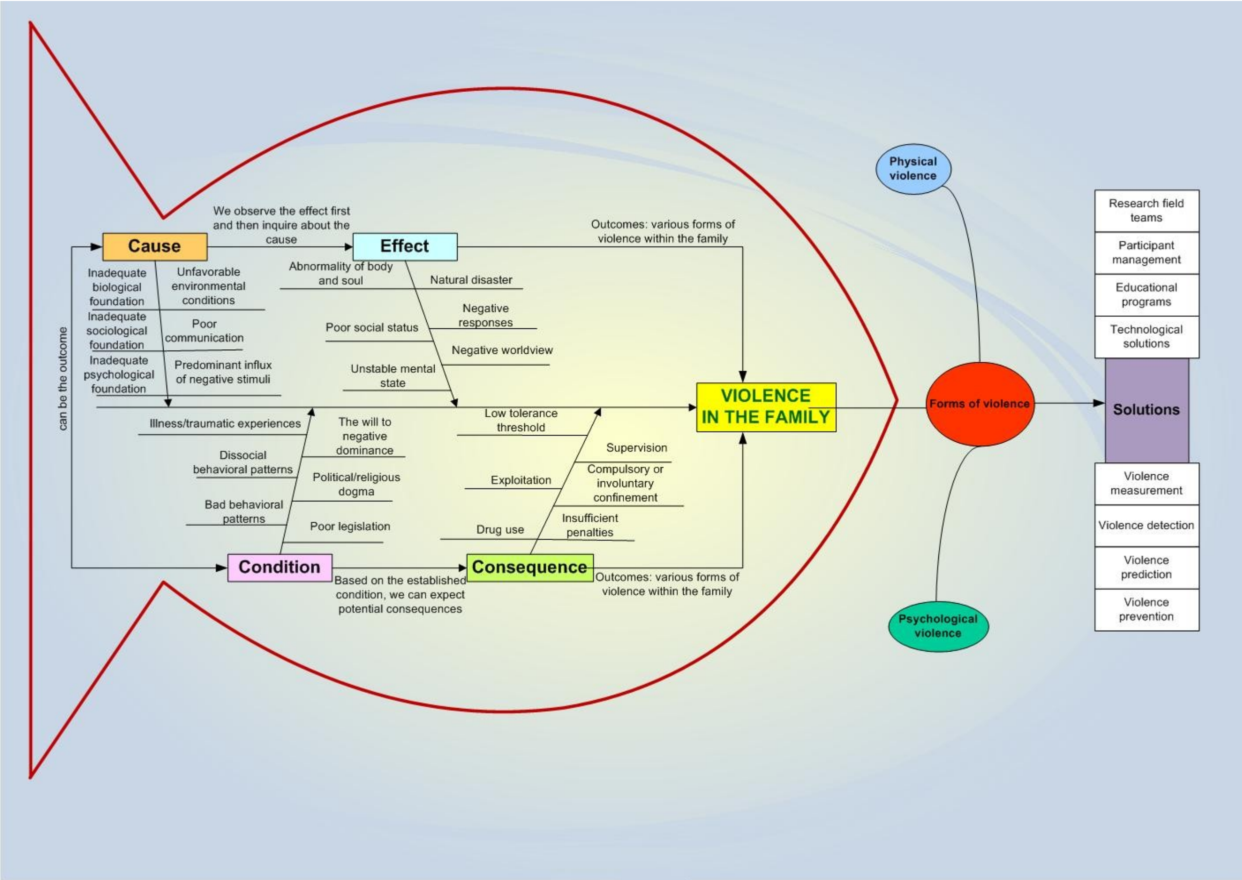
2.2.1 Figure 6: A possible associative hierarchical model of mental approaches

Figure 6 illustrates a possible associative hierarchical model of mental approaches, which is quite complex. The main focus is on the use of deductive and inductive thinking approaches, which are closely related to mental approaches such as whole and part, mini-max, hierarchy, abstraction and removal, and indirectly to openness and closeness, with their connection directed towards balance and mini-max. Other mental approaches represent potential connections that, when solving problems, interpreting certain situations/positions, and/or making decisions, do not have a specific function.

It is precisely within this diversity that we can discern the full variety of models, with the presented model being merely one among many possibilities. A major challenge for hierarchology and hierarchography would be to compile a richly illustrated textual encyclopedia of theoretical and empirical models of associative hierarchical cognitive approaches, particularly from the realms of science, innovations, patents, etc. (a similar encyclopedia could also be created at the everyday level). Such a project would enable the acquisition of extensive insight into individual thought patterns, providing an excellent foundation for endeavors like programming artificially intelligent android humanoid robots. It must be reiterated that efforts of this kind exceed the capabilities of any single individual. This could become a project for purposefully organized heterogeneous scientific teams supported by high-performance artificial intelligence systems. The use of complex patterns of cognitive approaches varies significantly from case to case due to causal and conditional relationships. The causal relationship is more familiar to us, as it assumes that without causes, there are no effects. In causal relationships, we mostly observe effects, while the causes are often still unknown and need to be identified. In addition to causal relationships, there is also a conditional relationship, which assumes that certain conditions are given that lead us to expect clear consequences. Essentially, this pertains to so-called artificial systems created by humans (e.g., traffic systems, production systems, road networks, household systems), which are often more predictable.

The division of relationships into causal (or cause-and-effect) and conditional is similar to the anthropological distinction between natural and social nature, although one could argue that everything is part of natural nature. The purpose of this division is (in addition to the fact that human beings are anthropocentrically oriented) that certain events and phenomena can be processed more easily using different methods (e.g., statistical methods). In the simplest tasks, we already know the conditions and consequences or outcomes (e.g., if we pour half a liter of water into a pot, place the pot on a stove, and set the heat to 100 degrees Celsius, we expect the outcome that the water will boil in two minutes).

Human-created systems can be very complex, so they cannot always be explained solely by conditional relationships because anomalies may occur in production whose causes are still unknown. In addition to causal and conditional relationships, there are also causal and conditional systems. For greater clarity, an example of domestic violence will be presented next.



2.2.2 Figure 7: Negative scenario of causal and conditional relationships in cases of domestic violence

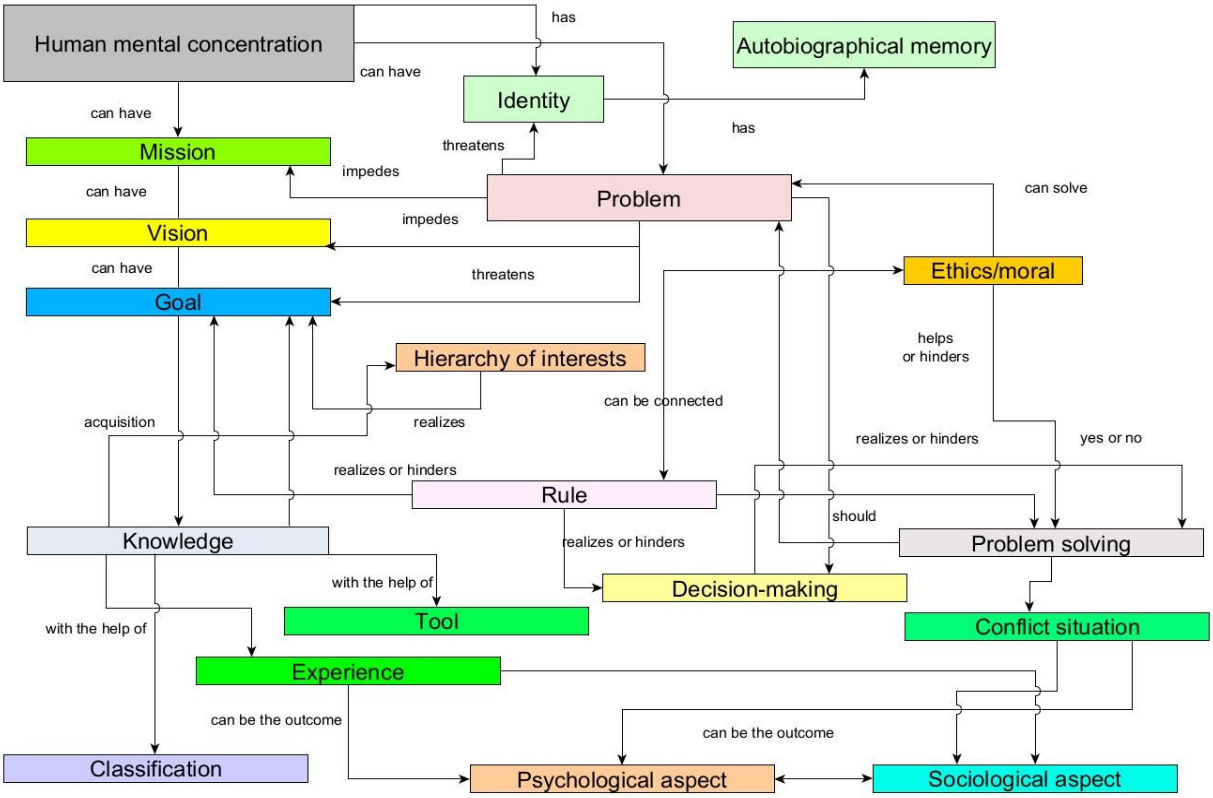
Figure 7 illustrates a negative scenario of causal and conditional relationships in cases of domestic violence, characterized by negative systemic inputs and outputs—various forms of violence within the family. To address this issue, it is necessary to find an appropriate solution. Possible solutions include, but are not limited to, the following: the involvement of research field teams, appropriate treatment of participants, the introduction of effective educational programs, the establishment of suitable information systems (technical/technological solutions), regular monitoring, measurement, and analysis of domestic violence in urban communities, the development of methods and methodologies for better detection and prediction of domestic violence, and the creation of various tools for more effective prevention of domestic violence.

From the proposed solutions, we could derive the mental approaches used, such as addition and composition, pleasure/displeasure, whole and part. These mental approaches led the scientist to proposals for solving the problem. Regarding domestic violence, there will be further discussion in a special subsection dedicated to criminality.

Now we have finally arrived at a very important concept called mental concentration.

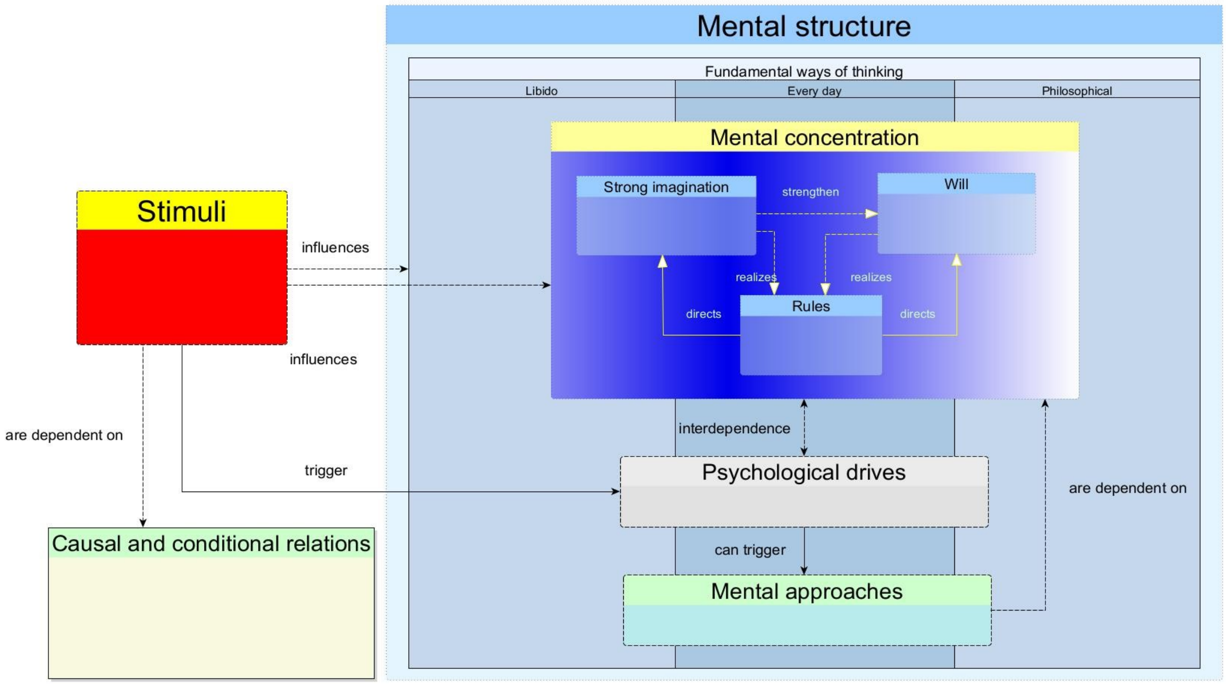
2.3 Mental concentration

Mental concentration is an individual's focus on more complex content and is a product of existing rules, strong imagination, and will (later we will learn that society also has mental concentration). Mental concentration can be a set of connections between various building blocks, such as mission, vision of the future, purpose, goal, obstacles, rules, problems and their solutions (e.g., conflicts), hierarchy, knowledge including tools, experiences, decision fields, classification of content components, natural environment, social environment, faith, ideology (morals and ethics). Based on the above, it is possible to create a general metamodel of mental concentrations that would be appropriate for most people (analogy: a kind of software). Mental concentration is one of the key elements of a person's mental structure (which essentially denotes the whole, a kind of big picture of human thinking).



2.3.1 Figure 8: Possible metamodel of mental concentration of individual(s)

Figure 8 shows a possible metamodel of mental concentration of individual(s), where we deal with rather complex building blocks of (life) content. The most important content building blocks are mission, vision, goal, and identity with autobiographical memory. Without these, there is no vital and well-organized personality or individual, as then there is no desire for knowledge, experiences are primarily negative, there are many conflicting contents or situations, rules are irrational, there is no real energy for meaningful decisions or problem-solving, there is no genuine interest in most things, doubt accumulates about ethics and morality, and primarily negative content is classified. In short, the mental concentration of such an individual for positive achievements is extremely weak. From the depicted building blocks of mental concentration, numerous more or less complex contents of mental concentrations emerge, e.g., fate, mythological ideas, symbols, etc. These mentioned contents and others will be presented in more detail later, but before we do that, as promised, an adapted package diagram of mental structure and mental concentration of an individual will be shown. This model should summarize and complement the previously developed models.



2.3.2 Figure 9: Adapted package diagram of mental structure and mental concentration of an individual

Figure 9 shows an adapted package diagram of mental structure and concentration of an individual. Using the diagrammatic technique of a package diagram, we can summarize previously discussed contents and show connections between them. Stimuli (both internal and external) depend on causal and conditional connections, as they manifest due to certain causes and conditions in both the external and internal (human body) environment. Stimuli influence the fundamental ways of human thinking and mental concentration of an individual. Mental concentration essentially functions as a kind of filter that is supposed to block out irrelevant stimuli. Mental concentration is reinforced by strong imagination and will (which also includes temporal projection, such as past, present, and future/preventive will) under the directional influence of rules. Strong imagination and will can also implement new rules, eliminate distracting rules, and improve existing ones, etc. Stimuli trigger psychological impulses that, on one hand, depend on an individual's mental concentration, while on the other hand, there is also a dependence of mental concentration on psychological impulses. Psychological impulses can trigger mental approaches, which are primarily dependent on mental concentration (mental approaches can also, in certain situations, direct mental concentration), since an individual's central content essentially determines which mental approaches will be useful in resolving a particular life situation. Mental approaches are essentially a kind of tool in the realization of an individual's mental concentration and are primarily the result of the human mental structure (by conditional analogy, the human mental structure can be compared to software; the physiological part of a person, as already mentioned, to hardware). Some mental concentrations affect each individual more or less intensely. In such cases, we speak of cosmopolitan mental concentrations, to which fate, for example, could be assigned. We also recognize different types of mental focus, which we may either possess or lack. For example, consider a top athlete who is entirely absorbed in achieving victory over opponents in an upcoming championship. Their mental focus will differ significantly from that of a person struggling to afford basic necessities or someone recovering in a hospital after a car accident. Such forms of mental focus can be termed individual since they can be widespread, yet they are not as characteristic of the human species as cosmopolitan mental focuses. In addition to these two types, there are also unconscious or empty mental focuses, which we do not perceive at a conscious level. Examples of these can be found in individuals who feel either excessively full or completely drained. In such cases, both individual and collective will have played a harsh role in manipulating a person’s mental focus, potentially leaving them deeply affected. Mental focus is the driving force of both society and the individual! A useful comparison can be made with a bee, which represents a part of the hive as a whole. Its mental focus (as in hierarchy theory, all living beings think and are not merely guided by instinct) is dedicated to ensuring the well-being of the bee community, even if it performs only one or two specific functions. The primary role of a worker bee is to provide food, while its other tasks are secondary—unless it needs to replace another bee in a different role. When that happens, the bee's mental focus shifts according to its new function, yet its core focus remains unchanged: ensuring the well-being of the hive.

This type of mental focus can be called suppositional and is fundamental to all bees, with minimal polarization in their roles. In contrast, human societies exhibit much greater polarization. The larger and more numerous a human community becomes, the more diverse and conflicting its mental focuses become. Various social groups often seek to perform the same tasks, each believing in its own correctness. However, many of these groups operate with narrow and incomplete visions of how to improve society, which are inadequate for an effective social system. As a result, errors accumulate, sometimes escalating into social and even natural disasters.

The visions these individuals have for organizing a social system are too subjective and lack sufficient scientific or innovative foundations, making objective assessment impossible.

We also recognize spherical mental focus, where a core idea is displaced by external factors such as phenomena or material objects (e.g., money becoming more important than quality of life). These types of mental focuses can easily lead us astray and even diminish our values.

A well-structured mental focus creates a strong and effective personality—or conversely, a strong and effective personality cultivates meaningful and persistent mental focuses. Personality can have both an external and internal nature. The most common type is the external personality, which remains unaware of the internal personality, both in a functional and suppositional sense. Certain mental focuses of individuals can develop into genuine threats. Ultimately, we cannot ignore the highly significant and polarized mental focuses known as the fundamental phenomena of human existence, such as love/hate, work/idleness, play/non-play, rulership/slavery, and life/death.[5]

2.3.3 Fate

We often find ourselves reflecting on fate—our own fate and the fates of more or less well-known individuals. There are many natural and social processes we do not understand. We cannot admit to ourselves that we have been caught off guard, yet we readily acknowledge it when it comes to coincidences.

Unlike coincidences, fate gives us the impression that all events and realizations have been long in the making before they finally manifest. When we utter the word fate, it pushes us into something final, something irrevocable—something far beyond our control.

In fate, our existence feels more passive, whereas in coincidences, the emphasis is more on the dynamics of events rather than on insights. With fate, we always wish we could turn back time to avoid unpleasant truths. With coincidences, however, we immediately accept that there is nothing to reverse—we see them as lightning striking from a clear sky, and after they occur, we quickly move on without further contemplation. Coincidences appear to us as unique and unrepeatable, while fate is something we may have long sensed coming, even as we secretly hoped it would not. And when it finally happens, we can only say what people have always said:

"It was meant to be!"

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5 These are the modified phenomena of human existence. According to Eugen Fink, these phenomena are: love, work, government, play and death! See the book: Fink, E. (1984). *Osnovni fenomeni ljudskog postojanja*. Beograd: Nolit.

There is some truth in this statement. When we direct our mental focus toward a particular thought trajectory—toward the projection of what has already been, the projection of what could happen, and the projection of what might still be—our fate gains solid foundations. Almost everyone thinks in this way, which is why no one can entirely resist or escape the inevitable.

For our species, fate is shaped largely by inferiority and superiority complexes, which ultimately lead to the formation of a new middle-ground complex. This creates a maneuvering space, where both the inferiority and superiority complexes continuously intertwine. Despite our perceived freedom of thought, we sometimes feel trapped—especially when these two forces draw closer together, drastically shrinking our maneuvering space.

In the end, fate is more closely tied to the feeling of inferiority than to superiority. Just when we believe that nothing in the universe can stop us, something unpredictable happens—something we have long sensed, something we have carried within us since birth. Through experiences, actions, and events, we transition from an inferiority complex to a superiority complex. However, upon recognizing our own fallibility—through a key event or realization—we inevitably return to where we once were.

From the moment we arrive at a realization, we a priori determine the value and significance of similar future insights. We may attribute great importance to a particular event or realization, though this is not necessarily justified. Often, our perspectives on the world are flawed, and we may only recognize this through the insights of others—by observing identical events in which we are not active participants but merely distant observers.

What matters most is how we perceive a given event and with what level of precision. We will often notice significant discrepancies in interpretation. When we focus too intensely on an event, we may feel burdened by it, which can trigger an opposite effect—leading us to view it more superficially. This, in turn, can leave us with the irreversible feeling that we have wasted our time and missed out on much in life.

Events and realizations inevitably lead us toward death, yet at the same time, they strive to rescue us from mortality and guide us toward immortality. The power of death lies in the fact that we see it in others, making it feel distant. However, because we identify with rather than simply distinguish ourselves from the rest of the world, we quickly develop the understanding that we, too, are mortal. This continuous awareness serves as a solid foundation for what we call fate.

The older a person becomes, the more they believe in both the fates of others and their own fate. Even those who strongly deny fate are constantly preoccupied with it, sometimes even believing in it despite themselves. Conversely, those who deeply believe in fate may, at times, quietly reject it—precisely because, in those moments, they do not believe in it. Both extreme mindsets share the fundamental truth that there are things around us and within us that we are powerless against and ignorant of—something that applies to all people, to varying degrees.

Fate acknowledges mortality, yet true mortality and immortality do not truly exist. Mortality establishes boundaries, reinforcing them. Immortality, on the other hand, removes these boundaries, reshaping them—until we inevitably find ourselves back within the realm of mortality, where the effect feels similar to the original yet is no longer the same. This is because we have altered the boundaries of our existence. We have leaped over something that should not be possible to leap over, and yet, despite doing so, we ultimately arrive at new limits—ones we must confront once again. Some events leave such a strong imprint on our memory that we derive significant insights and establish relatively stable boundaries from them. This creates solid foundations where we perceive the world in an irrevocable and unchanging form. However, this perception quickly dissolves when we become receptive to other types of events that provoke opposite realizations—insights into the revocability and mutability of the world's form.

We often believe that certain events can never happen again, which leads to the concept of uniqueness or unrepeatability. Conversely, when events show a tendency to recur, we speak of repeatability. In reality, these two tendencies are often intertwined—sometimes even identical—yet we resist recognizing this identicality because doing so would undermine or damage our mental frameworks.

Our behavior also changes significantly when interacting with strangers versus acquaintances. When encountering a stranger, we instinctively look for similarities—either with ourselves or with someone we already know. If we fail to find such similarities, the stranger will remain just that—someone we briefly crossed paths with and quickly forgot. Similarly, if an acquaintance exhibits character traits unfamiliar to us, we will not attempt to understand them but will instead draw a quick conclusion and maintain our previous distance.

We approach fate in much the same way. The vast number of different life situations prevents us from gaining a precise understanding of fate. Our mental strategy orbits around a central idea—it moves closer, then drifts away again. If we long for familiar situations, we will instinctively avoid unfamiliar ones, especially if they are unpleasant. On the other hand, if we crave new and unfamiliar experiences, we will struggle to tolerate the predictable and known.

Fate occupies the center of our mental universe if our thinking is directed toward it. Otherwise, fate remains merely a distant suburb of our complex mind. It can be present everywhere or nowhere at all. People need to orient themselves, even if we sometimes refuse to admit it—believing that our understanding of the world is flawless.

In some cases, fate also serves as a justification for an outcome we are dissatisfied with. When our life's direction misleads us, we may not acknowledge our mistakes. Instead, we simply say, "It was just my fate." This also alters how the world perceives us—if fate is blamed, the individual may avoid even greater ridicule or judgment from others.

A person's fate is largely shaped by their innate nature, their self-organization, and the organization of both their immediate and broader community. The way an individual and society are structured guides a person through all aspects of life. Every individual is a product of their educators, who, in turn, are influenced by the broader collective, which is itself shaped by the natural order.

How Do Hierarchical Associative Systems Manifest in an Individual?

Despite many similarities, each upbringing differs, even within socially normed structures, because different parents have slightly different perceptions of ethics and morality. From these roots, an individual acquires a foundation that will guide them until the final point of their conscious awareness.

This foundation is multi-layered, with key components including:

- Normed social ethics and morality,

- Differentiated social ethics and morality, and

- Integrated social ethics and morality.

An individual shaped in this way carries an internal program that influences their actions and decisions throughout life. Such predetermined orientation can have a profound impact, even shaping one's fate.

The Role of Goals in Mental Concentrations

Does the essence of goal-setting lie in increased awareness—or, in some cases, increased unconsciousness? Fate plays an almost magical role in shaping our goals. Along the path toward them, we encounter people with similar objectives, which may lead to cooperation or conflict. Likewise, some people actively oppose our goals and seek to prevent their realization.

Fate is paradoxically both predictable and unpredictable. Despite deep social foundations and personal aspirations, fate can shift in unexpected ways. In one sense, everything and nothing influences fate. While various forces shape it, no force in the world can completely erase an individual's fate.

Opinions on fate are deeply divided:

- Some believe that fate is unchangeable.

- Others argue that we have the power to shape it.

For clarity, here are the key factors that influence an individual’s fate:

1. Approaching and withdrawing from fate – We move toward our fate but often retreat due to fear, realizing that mortality will eventually end our conscious existence.

2. Inferiority, superiority, and mediocrity complexes – These filter our perception of the world and influence how others perceive us, which can either fuel or drain our energy.

3. Identification with another person – Whether in films, books, or real life, we may find someone who seems similar to us—or even superior—and model ourselves after them.

4. Recurring situations – We encounter familiar events in waking life or dreams, reinforcing patterns in our behavior.

5. Past events shaping future actions – Sometimes, without realizing it, past experiences steer our decisions.

6. Cognitive orientation – Where is our mental projection focused? Do we dwell on the past, anticipate the future, or navigate a flexible present?

7. Social position – Our status, job, and worldview significantly shape our life trajectory.

8. Perception of death – Do we see it as the end of everything or the beginning of something new?

9. Level of detail in observation – Do we view events macro-scopically, on an average scale, or microscopically?

10. Superficial vs. deep observation – The way we perceive and analyze events determines our understanding of our fate.

Ultimately, fate can be seen as either omnipresent or irrelevant, depending on how we choose to engage with it.

11. Insights that we seek to enrich our life path with or use to avoid certain obstacles, making life less painful.

12. Health status (e.g., physiological, psychological).

13. The individual’s level of organization in relation to the collective’s organization and its interaction with the environment.

14. Actions that are revocable or irrevocable in nature.

15. Predictability and unpredictability of events, meaning how well we can extract essential facts from situations and determine their existential significance for us.

16. Doubt and conviction actively shape our lives. Past doubts may foreshadow future doubts, just as past convictions may reflect future convictions. Both doubt and conviction originate in early childhood, even as early as conception. The ever-changing positions we experience throughout life push us toward either doubt or conviction. The most fundamental and significant positions are shaped by education—whether familial, societal, or national.

Doubt in the state formation is undesirable in any political system, especially in totalitarian societies. Doubt can arise when we lack a clear understanding of our position and repeatedly find ourselves in undesirable situations. Eventually, an individual’s position may become a collection of scattered situations, a state that can be referred to as a dispersed position.

When in a dispersed position, self-doubt begins to emerge—a doubt in one's own identity. Doubt can be either a positional or situational concept. At its core, doubt is an obstacle, and when it becomes inherently present in an individual, it acts as a mental blockage that directs them in a way they perceive as a priori correct, potentially leading to severe conflicts.

Doubt also arises from social norms, as anything that deviates from socially accepted thinking or behavior can lead to distrust, which is a form of doubt. But why does doubt even occur if social norms are constantly present? Likely because of the changing positions individuals experience within social and natural environments, fluctuating moods that do not align with others, comparison with others, misconceptions, and so on.

Doubt is predominantly a product of the past, and when it enters the maneuvering space of the present, it often originates from a distant past, sometimes even from a collective past.

Through doubt and conviction, we cast a loop into the future, which may cause us to become trapped in a self-created dark fate. Doubt can transform into conviction if certain specific components are removed, or simply because the doubt no longer serves any purpose—a process that is typically long and complex.

Every time we doubt one thing, person, or idea, we are simultaneously certain about another. The extent of this balance depends on the individual's level of skepticism, which assesses and defines these states.

Doubt can arise when something does not follow the rules of the game, when it deviates from what we are accustomed to, or even in situations we believe we understand—yet when our physical and psychological state changes, we fall into doubt.

To determine the true balance between doubt and conviction, we must delve into the concept of "standpoint." This is the very cauldron in which doubt and conviction are brewed—where doubt may be a more volatile element than conviction, especially in the case of an individual standpoint versus a collective standpoint. Even when we are absolutely convinced about something or someone, we must recognize that, deep within us, doubt lurks in the shadows, waiting for an opportunity to break free and cast our conviction into darkness.

Doubt in fate is, in essence, a hidden acknowledgment of its existence, just as absolute conviction is a hidden denial of fate. Fate is ultimately a product of our mental structures, as long as it aligns with our social universe. However, if fate is oriented toward the natural universe, it ceases to be a mere construct of our minds and instead becomes a reflection of nature's dynamics, perceived by us—observers, comparers, differentiators, and imitators.

Our fate is inevitably linked to the fact that we are only a small fragment of a larger organism. At times, we feel as though we are programmed, while at other times, we experience a sense of complete autonomy. Sometimes we are passive observers, and at other times, we are active agents of our own fate—or even participants in the fate of others.

One way or another, this great organism is as closed as it is open, and vice versa. From this perspective, we can draw an equation between individual and collective fate. It does not matter whether we believe in fate or not; what truly matters is that processes exist around us, and we can surrender to them—even by simply attempting to understand them. Processes also unfold within us, and while we can try to comprehend them, we must often admit that our mental cage prevents us from seeing beyond its bars.

By discussing fate, we have taken a broad perspective on the nature of thought concentration, encompassing both social and natural realities. These realities are infused with thoughts of death and immortality, love and hatred, power and powerlessness, parts and wholes, finiteness and infinity, sameness and difference, limitation and boundlessness, identity and non-identity, and so on. These thoughts persist within us, whether we are aware of them or not. They are arranged in a long sequence, where for some, the first thought might be about immortality, while for others, it might be love.

Fate is, in essence, the totality of all processes that occur within our world. It is difficult to recognize fate as a scientific concept because it is too broad and too vast for the human mind to grasp. The concept of fate serves instead as a platform—a place where we attempt to organize our thinking, take mental rest, or escape into generalization rather than venture into deeper exploration of realms we instinctively avoid. We are born with physical and psychological limitations, and over time, these mental barriers only become more reinforced.

Now we will explore a very specific aspect of mental concentration, which could be classified as an example of negative learning. In this case, only two outcomes are possible.

Example of the Box:

We place a pack of cigarettes on a table and then step back approximately five meters. With our arms extended, we walk toward the pack, but instead of hitting it by snapping our index finger against our thumb, we must intentionally miss it. After this action, we return to the starting point with our arms still extended. We repeat this process at least ten times. However, on the final attempt, we must hit the cigarette pack.

If we have been focusing well during the previous attempts, we will find it difficult—or even impossible—to hit the pack on the last attempt. This is because, during the first ten attempts, our mental concentration was directed toward constantly telling ourselves not to hit the cigarette pack. Unintentionally, a conflict arose between "I must hit it" and "I must not hit it."

In everyday life, we are usually given tasks where success depends on hitting the target, and when we miss, others criticize us for it—such as in a shooting competition or a soccer match where missing is undesirable. Anyone who has tried this experiment can sense the lively internal dialogue between "I must hit it" and "I must not hit it." This internal struggle between two conflicting intentions continues until the final attempt, at which point a certain mental effort is required to succeed.

This simple experiment demonstrates how an individual can succumb to negative learning. It can be compared to a model of two radiators. These radiators are connected and share the same energy source, but the right radiator's valve is more open than the left one. This means that the heat flow to the right radiator is greater than to the left, even though the pump applies the same pressure to both.

In the box experiment, we can say that at first, the right valve (hitting the target) was more open than the left (missing the target). With each successive attempt, the right valve gradually closed while the left one opened. The forced thought (missing) continuously exerted pressure on the existing thought (hitting). On the final attempt, it was necessary to fully open the right valve (hitting) using both mental and physical force (the action's acceptor) while closing the left valve (missing).

The final outcome of this mental struggle depends on the balance between the existing and the forced mental concentration. In short, existing mental concentration can be influenced by forced or intensely suggested concentration. Similar effects are found in everyday life, such as in economic advertising, repetitive exposure to the same music, obsessive focus on numbers, and extreme temporal projections (excessive mental focus on the past), among others.

2.3.4 Love and hate

Love and hate are also unique forms of mental concentration. For such complex mental concentrations, the radiator model is insufficient. Instead, they must be illustrated on different levels, such as using solutions of varying concentrations.

Love, for example, could be represented as a dark red solution. It would not consist of just one concentration (as this is a model) but, for instance, five different levels. The first level would be a diluted solution of love, with a pale pink color. The second level would be pink, the third light red, the fourth red, and the fifth dark red—comparable to a saturated solution of love, like the love between Romeo and Juliet.

Similarly, hate could be divided into five levels, represented as black solutions. A saturated solution of hate would be as black as coal. The shades of these solutions, representing different concentrations, are impossible to count within our brains. Typically, one mental concentration takes priority over others in an individual because it is the most saturated, while the others remain less concentrated, waiting for the right situation to manifest. From various units of thought, we can construct the framework of a particular mental concentration, which is more or less closely connected to other mental concentrations. Love and hate are intertwined. If we love someone deeply, there is a strong likelihood that we will hate another person intensely. This raises the question: Is the mental concentration of love an independent unit, or is it interwoven with the mental concentration of hate? In this regard, neither love nor hate exists in isolation. Instead, we can speak of a mental concentration that represents a ratio between love and hate—leaning either more toward love or more toward hate. If an individual's hierarchical and associative thinking system is excessively uncommunicative and dogmatic, we can say that such mental concentration is a hermetically sealed space. While the connections within it may be strong, they are rigidly structured against other viewpoints, meaning they are highly one-directional. This can result in a state where priority is given to irreversible judgments over reversible ones.

For example:

- "Because this person is religious, I hate him since I do not believe in God."

- "This person is an artist, and all artists are unstable personalities who harm society more than they benefit it."

- "His character is monstrous because he lacks self-confidence; all people without self-confidence are deceitful."

- "He embodies incompetence, which is unacceptable."

- "He gave a homeless man ten euros—what an insult! He must be just as unstable as a beggar himself."

These types of rigid thought patterns form a mental complex that automatically denies the validity of other thought patterns or complexes.

Neither love nor hate develops overnight. They are the result of more or less intense experiences of the world in which we grow and live. In short, love and hate emerge through a process that constantly evaluates both individual and collective attributes. This is the external form of the process, while the internal form involves assessing monosumic and polisumic characteristics.

The terms "monosum" and "polisum" do not have a scientific tradition but are derived from Latin:

- "Monosum" = "one self," referring to an individual's internal communication.

- "Polisum" = "many selves," referring to how an individual internally communicates in relation to both their own mental units and those of society.

(This concept will be explored further in the chapter "The Social Nature", which includes a practical example based on a brief study.)

Even love at first sight is not the result of a dazzling moment; behind that glance lie psychological, social, and biochemical processes that are beyond our comprehension. Love and hate are not separate entities; rather, they belong to the same category and form a single mental concentration governed by its own rules.

The relationship between love and hate can be denoted by the abbreviation LH, while the inverse relationship can be labeled HL. Love and hate follow their own individual, collective/social, and biological principles. They also contain other structural components—units that, in a more complex form and function, can represent independent mental concentrations but are still more or less closely linked to other mental concentrations. However, the primary function of this mental concentration is to establish a balance between LH/HL or HL/LH.

The relationship between LH and HL can encompass structural elements such as:

- Good and evil

- Order and chaos

- Meaning and meaninglessness

- Fullness and emptiness

- Beauty and ugliness

- Usefulness and uselessness

- Success and failure

- Greatness and smallness

- Adaptability and rigidity

- Speed and slowness

- Past, present, and future

- Strength and weakness

- Persistence and inconsistency

- Eternity and transience

- The finite and the infinite

- Homogeneity and heterogeneity

- Predictability and unpredictability

- Natural and social nature

- Subordination and dominance

- Motion and stillness

Everything listed (and even what has not been mentioned) can serve as structural components of a particular mental concentration whose primary function is the relationship between LH or HL. In a different mental concentration—such as fate—LH and HL may only represent secondary structural elements. Hierarchology, and specifically micro-hierarchology, constantly strive to illustrate complex concepts through various visual techniques, a process known as hierarchography.

For this reason, this section presents various conditional comparisons, such as the following:

The mental structure of an individual, in the context of micro-hierarchology, could be compared to our planet. Within this structure, there are networks of urban communities, which are hierarchically and associatively connected. Will(s) could be compared to nations, as an individual's will(s) is an expression of mental concentrations. Just as cities and surrounding landscapes make up a country, a nation represents the collective expression of all its urban communities and regions (the fundamental units of a country).

In this model, mental representations could be likened to large regions, while smaller structural components could be conditionally compared to buildings, such as stores, apartment complexes, private houses, playgrounds, schools, municipal offices, factories, banks, police stations, courts, etc. In short, this model aims to create a clearer picture of complex mental concentrations. Based on this model, special (visual) maps of mental concentrations could be created. This visual technique is widely used in geography, astronomy, and geographic information systems (GIS), GPS, and other fields.

If we were to apply this conditional comparison or model to our discussion on mental concentration—where the ratio is LH or HL—we could compare this ratio to municipal governance, law enforcement, and the judiciary. The LH/HL ratio could also represent an important factory within this system.

But which mental concentration could be considered the capital city of a mental nation, one among many within an individual's mental structure? These are highly complex concepts with intricate relationships, and fortunately, modern information technology allows us to visually illustrate, analyze, and simulate such complexity.

The intensity of thoughts about love and hate varies throughout different periods of human existence. We cannot speak of a uniform increase or decline in love-related emotions across different stages of life. An elderly person can love their life partner just as deeply as a young adult, but the nature of that love differs from the earlier form.

Additionally, we must not overlook the interwoven nature of polarized mental concentrations, such as:

- Love/hate (LH/HL)

- Work/idleness

- Dominance/submission (a polarized phenomenon of rulership/slavery)

- Play/non-play

- Life/death

These opposing forces shape the complex dynamics of human thought and experience.

A possible scenario is that, in an older person, thoughts about work gradually fade, the desire for dominance diminishes step by step, the inclination toward play usually declines, while thoughts about death become more intense.

For a young person, the days feel shorter because their perception of time moves faster, which can significantly influence important decisions. The time of an older person is more collectively oriented, whereas a young person's time is heavily influenced by their inner world.

When a person dies, time stops completely for them in a physical sense. However, from a psychological perspective, that individual may continue to live on for a long time in the memories of their loved ones, their nation, or even the world. Information about the person is stored, and if we imagine the universe as a vast computer, we might speculate that an individual's energy is also stored somewhere in specialized cells (the reflective nature of humanity toward the world and the universe has led to the development of computers and other technologies).

The mental imprint of death has taken a misguided path in our Western civilization, as we have overly separated it from life—and consequently from love, which is essential for every human being. A person who wants to live healthily must carry more positive than negative thoughts about death. However, our general perception of death tends to be overwhelmingly negative.

In the future, this negative perception could hinder our intellectual development, which we must not neglect if we wish to be prepared for what lies ahead.

Someone who fears death excessively does not truly know love.

This connection between love and death is more pronounced in some individuals. Someone deeply in love does not think about death—because they feel far from it—yet lovers fear for each other's lives. The death of one would feel almost like the death of the other. They would even be willing to die for their beloved.

This kind of self-sacrificing love, where one almost merges completely with another person, could be described as unrealistic love.

The mental focus of people in love is directed toward pleasure. Happy love does not dwell on numerous desires and fears; instead, it is largely self-sufficient and self-satisfying. However, when a romantic relationship is put to a severe test, pleasure decreases, while fears and desires increase.

Love is not just attachment, rooted in the deep inner workings of our psyche; it also originates from the physiological nature of humans. A person does not seek only psychological fulfillment in another but also physical fulfillment. The physical connection between a man and a woman is called the sexual act, which differs from animal mating mainly in that humans change positions and perspectives.

The psyche is also adapted to this, as lovers often say that they can "read each other's minds." A woman deeply senses what her partner wants and understands what troubles him the most. This ability to read thoughts and emotions is possible precisely because of a shift in personal perspective. However, this shifting perspective is not exclusive to lovers; it can also be found in other human interactions driven by different interests.

A person who deeply understands another's mind and emotions actually understands their own mind and emotions well, which is a strong foundation for love. Love is a state or perspective that transcends loneliness and confusion, but only if both individuals are moving in the same direction.

The concept of love is extremely broad. Beyond romantic love, there is love for one's country, music, plants, play, God, life, and even death. True, intense love does not discriminate between subjects or objects of desire—it is so powerful that it can loosen or even override other interests.

Love, in any form, also involves a dialectical nature, such as freedom and servitude. These contrasting elements appear particularly in the fundamental human experience of existence, where dominance and power (governance) play a role.

Love also reinforces our identity. We seek someone or something that is, on one hand, similar to us, but on the other hand, different, or even better, something that completes our personality. Love both gives and takes, and the role of psycho-economics in this process depends entirely on the individual.

Society often has a strong influence on how love should be expressed. For example, compare the Romantic era with the present day. The difference between these two historical periods in terms of their conceptual readiness for selfless love between a man and a woman is significant. During the Romantic era, selfless love was more prominent than it is today. In modern times, a negative yet unfortunately necessary trait has come to the forefront—one that could be described as a readiness for distrust.

Distrust weakens, restricts, and even destroys love in all its forms. Society, in essence, shapes the way most people perceive love and the attitudes they hold toward individuals or groups they might love.

In short, social hierarchies play a significant role in determining how love is expressed, since love is ultimately an external reflection of these systems. Therefore, love is not just an individual matter—it is also shaped by both smaller and larger communities.

We can say something similar about other fundamental phenomena of human existence, including their polarized relationships (love/hate, work/idleness, dominance/slavery, play/non-play, and even the perception of life/death). These phenomena release an immense amount of bioenergy from individuals and societies, which is necessary for maintaining a higher level of function.

As individuals, we may perceive a certain love as something positive, but if social tendencies move in the opposite direction, our belief may remain unchanged; however, in terms of energy dynamics, it will still be subject to the collective flow. We must not forget that our beliefs are largely shaped by both our immediate and broader society, meaning that love cannot be viewed solely as an individual phenomenon. Instead, we must also consider the crucial connections between the smaller and larger social structures.

For some individuals, love is defined more by its collective nature, while for others, it is driven by personal, individual motives. Sometimes, love receives energy from society, allowing it to continue existing, while at other times, society diminishes or even erases it. Love can be broad and all-encompassing, or it can be narrow and limited in scope.

Our senses come to life in a harmonious symbiosis with our mind. Over time, the mind dictates what the senses should perceive. For example, in our chosen partner, we notice mostly the qualities we like, while we rarely focus on traits we dislike—those negative traits are, in a way, statistically overpowered by the positive ones.

Broad love is primarily oriented toward beauty and positive aspects, whereas narrow love is more restrictive and fails to encompass many beautiful things.

The structural and empirical composition of an individual's love could be effectively illustrated through intensive empirical studies (for instance, a hierarchical and associative network of broad love would be larger and more complex than that of narrow love).

Through love, we become aware of ourselves, establish our position, strengthen our identity, and direct our gaze both inward and outward toward the world. This fundamental phenomenon of human existence serves as a foundation from which other mental concentrations may emerge.

To love someone means to see their richness rather than their flaws, whereas hate, as the opposite pole of the LH/HL relationship, seeks to find faults in others. Those immersed in the whirlwind of love are significantly limited to the information that reaches them due to the symbiosis between their mind and senses. Do we love someone because we hate someone else, or do we hate someone because we love another? The anthropocentric sociological answer to this question can be traced from early childhood all the way to adulthood.

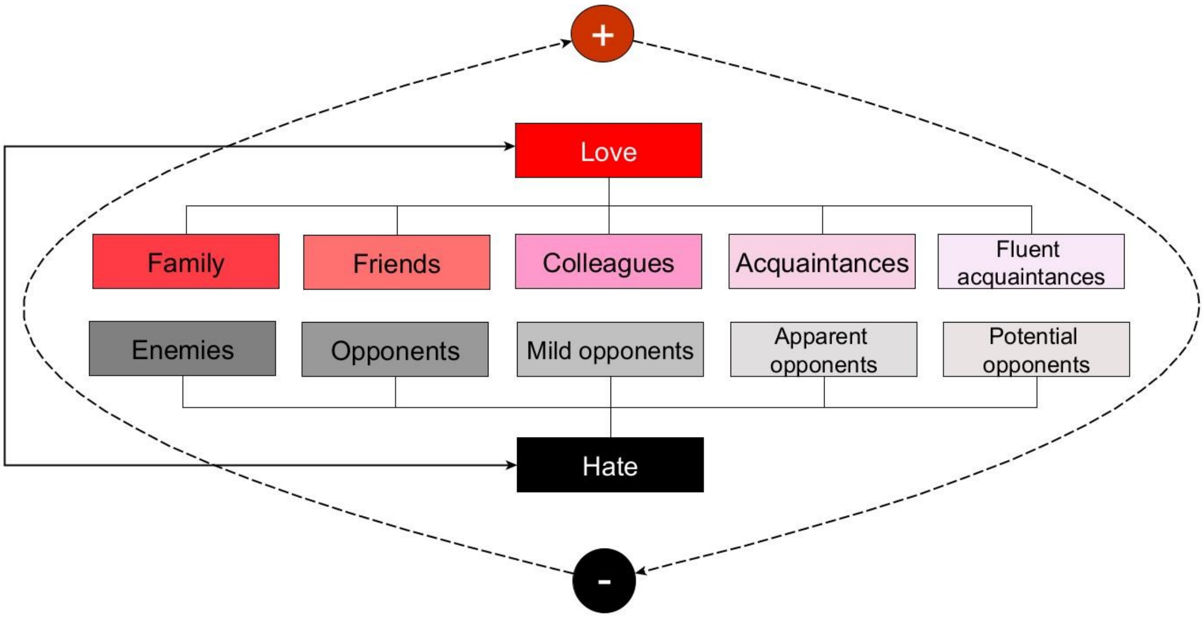
If we have mostly positive experiences from our close, immediate environment and mostly negative experiences from the broader world, we are likely to prioritize love within that close environment while developing a certain level of distrust toward the broader society.

In such a case, our love manifests only because we are aware of the things we hate. This constant interweaving of love and hate results in varying degrees of polarization, sometimes strong, sometimes subtle, but always present.

Without dialectical thinking, there can be no true love or hate, and therefore, no real polarization—only a dead polarity. Everything that has been said about love also applies, in principle, to hate, because hate cannot exist without love.

However, the external expressions (positive and negative actions), internal expressions (positive and negative thoughts), and impressions (positive and negative perceptions) that result from love and hate often differ significantly.

On the next page, a simplified step-by-step model illustrating the interconnectedness of love and hate will be presented. This model will also include representations of other positive and negative forms.



2.3.4.1 Figure 10: Dynamic stepwise hierarchogram of love and hate

Figure 10 illustrates a dynamic stepwise hierarchogram of love and hate, where we encounter two poles (+/-) along with stepwise units of love (family, friends, colleagues, acquaintances, casual/fluent acquaintances) and hate (enemies, adversaries, mild opponents, apparent opponents, potential opponents).

The intensity levels of these units are represented through color gradients:

- Love ranges from red to light pink

- Hate ranges from black to light gray

The polarization between love and hate can result in complex dynamics, as significant shifts in the opposite direction are possible. While sudden reversals are less frequent, positions can change rapidly until reaching a state of relative homeostasis.

The following section will explore the phenomenon of work.

2.3.5 Work

External expressions can encompass the full scope of human activity, where one deliberately directs their actions toward a meaningful or even meaningless final goal—this, in the true sense of the word, is work. Work is a distinct, intensive form of both physical and mental existence.

- Mental work arises from the relationship between internal and external expressions.

- Physical work results primarily from the relationship between external and internal expressions.

In mental work, internal expressions take precedence, while in physical work, external expressions dominate. Engaging in work—especially when we enjoy it—strengthens our identity and helps us navigate social structures more effectively. By creating new goods, we extend ourselves, gaining greater freedom and pleasure, though these come at the cost of temporary discomfort and limitation.

This temporary lack of freedom and discomfort transforms into an intermediate state called effort, which includes both discomfort and restriction, as well as pleasure and freedom. When we love our work, we experience positive effort, a state where freedom, pleasure, limitation, and discomfort coexist in relative balance. In this balance, freedom and pleasure generally prevail over limitation and discomfort. The ultimate goal of positive effort is to achieve maximum pleasure and freedom, while also acknowledging the necessary prior effort, which contained elements of discomfort and restriction.

Types of work

We distinguish between constructive work, destructive work, and rigidly adaptive work:

- Constructive work serves beneficial purposes.

- Destructive work has harmful consequences.

- Rigidly adaptive work is mechanical and often lacks a clear constructive or destructive purpose.

A large portion of humanity (and thus many individuals) falls into the category of rigidly adaptive work, adapting to either constructive or destructive goals without much personal agency. These individuals view work as a necessary evil and suffering. This is understandable since they do not see their identity reflected in their work and do not view it as a means of better navigating society.

Those engaged in rigidly adaptive work often lack an awareness of whether their labor is harmful to the environment or beneficial to society. This kind of work resembles machine labor, except that machines do not experience emotional distress or dissatisfaction. Rigidly adaptive work lacks true motivation—either constructive or destructive. As a result, it can create a mental void in the worker’s mind, filled with discomfort, restriction, financial stress, and a desire to do as little as possible.

This kind of work can become a mindless automatism, similar to unconscious behavioral habits (e.g., a person constantly stroking their beard without knowing why, possibly due to an inferiority complex).

If work is completely automatic, an individual may perform the same repetitive movements and gestures every day, which are not truly their own (a form of negative training).

The impact of Work on mental health and society

If an individual does not actively engage their mind at work, it is important to recognize that such unstimulating work, despite contributing to economic profit, can negatively impact thought processes and mental health.

The gestures, verbal exchanges, and facial expressions at work significantly influence an individual's mindset, even after they return home. If this individual has a family, their work-related experiences and attitudes inevitably affect their parenting—and, consequently, the future of humanity. In this way, unwanted, imposed, or subconscious frustrations can be passed down to children, potentially resulting in intellectual and emotional suppression.

Motivation in work and life

Lacking motivation at work can gradually lead to a lack of motivation in private life. If a meaningful work motivation is absent, one must actively seek and create it—whether through greater dedication to family, hobbies, or other personal passions.

Ultimately, each individual has their own perception of work, and the search for meaningful work motivation varies from person to person.

Most people share a single common motive for working: their monthly personal income. Behind this phenomenon, individuals envision fulfilling certain desires and needs, which can significantly complicate the perception of creative work. External expressions that result from some form of compulsion can ultimately provoke internal rebellious responses (e.g., unpleasant thoughts, envy, violent imaginations, feelings of entrapment, mental emptiness), thereby increasing psychological and social distress. Instead of alleviating burdens, these external expressions often have the opposite effect. Constantly being under pressure to do something that does not feel authentic can lead to various illnesses.

An individual may react to negative internal expressions in at least three ways: they can adapt to them and become mentally empty, succumb to stress, or—ideally—adjust these external expressions to align with their own internal ones. The prerequisite for this is challenging, as one must recognize their inner expressions by being willing to listen to them and critically evaluate them. Work as a harmful automatism does not yield optimal results for either individuals or society. Consider how many movements we perform that stem from dissatisfaction and lack of freedom.

This dissatisfaction and lack of freedom steadily embed themselves into interpersonal relationships. They forcibly unite people while simultaneously dividing them as a logical consequence of forced union.

What do automatisms mean for individuals? A simple gesture with a finger can reveal much if we are prepared to uncover the deeper meaning behind it. We often use our index finger to press buttons, point at objects, products, or living beings, direct, warn, or play the piano as beginners. Right-handed people will mostly use their right index finger when showing another person an object whose location they cannot describe verbally at that moment. The index finger can also symbolize a kind of spike with which we symbolically subdue someone by warning them to stop their disruptive actions. When a small child needs to show us where the trash bin is, they will typically point rather than explain verbally. This gesture is more natural than the rule that says pointing with fingers is impolite.

In work processes, we rarely deal with natural gestures; instead, we encounter artificial and often forced ones. The movements we perform at work almost mechanically alienate us from the tasks and people with whom we coexist in a working symbiosis. These movements seem pointless, exhausting, and like a necessary evil because we do not fully understand them—just as we do not truly understand the rule "do not point with your finger," which represents an artificial compulsion (we do not know the background of this rule). It is certainly worthwhile to delve into the general and specific characteristics of the work we do. We need to identify what bothers us most about our work and what we enjoy most. Once we determine this, we can gradually implement certain improvements in our work that should not disturb others or harm the organization employing us.

The Japanese discovered long ago that physical recreation during working hours increases employee productivity. At Google's headquarters, they have created pleasant spaces reminiscent of a home-like atmosphere.

In some places, mental relaxation is emphasized (e.g., listening to birds singing, autogenic training). The latest improvements have contributed to a greater number of high-quality, practical ideas and innovations. The rational and functional organization of our work means organizing our thought processes. When we press a green button with our index finger, we expect, for example, that the doors behind which our treasures are hidden will open. When we successfully complete our work, we anticipate that certain doors will open to reveal a treasure waiting for us. If most people knew how (and had the opportunity) to align their work with their existence outside of work, this would already be a good foundation for better organization of both individuals and society. There would be fewer disoriented and unmotivated individuals to the extent they are today. The identity of these individuals would be even more strengthened. Dissatisfaction and lack of freedom would be much less prevalent, and constructive will and freedom would be the main social drivers.

Looking at the current state of people's willingness to work, we can say that most people work out of necessity, viewing work as a necessary evil. Some individuals work out of greed, elevating money above all else. However, we also know people who work with joy, feeling their work as something that belongs to them, a kind of extension of themselves. This latter category of people is in a strong minority. Work, not just as a phenomenon of human existence but also as a tool for strengthening one's identity, is in a negative energy state where not only individuals lose a lot of positive energy but also societal hierarchical systems.

How can we now think about strengthening individual identity and better organizing people within a system when most people, loudly or quietly, believe that their position in the hierarchical system is inappropriate and forced? Already in early education, young people should be introduced to the importance and challenges of the following topics: presenting the importance of various work tasks, showcasing interesting work tasks, discussing improvements at work, informing young people about the possible connection between professional and hobby activities, providing insight into disturbing factors within certain work processes, and showing possible simplifications, etc.

Of course, mass media could also encourage a desire for creativity and innovation. During economic crises, this is more difficult to achieve, but if we consider that a lot of financial resources are spent on advertisements for inferior products, we can add that a managing society could create mental stimulants that could at least partially convert the negative attitude toward work into a positive one. Strengthening an individual's identity is also possible through early identification of their abilities (e.g., already in early elementary school grades, and not just focusing on sports, language, and mathematical abilities). Work is both an external (physical labor) and internal expression (mental work) of the hierarchical system of an individual's thinking, which is not innate but rather embedded as a program.

Through certain movements, we can recognize various aspects of an individual's personality. Similarly, by observing specific productive movements, we can identify different individuals who more or less conform to the hierarchy of internal and external expressions. Individuals essentially reveal themselves through their attitude toward work. They present themselves in the light of productivity or non-productivity, which is to some extent dependent on superior structures that have the option to either foster creativity and work enthusiasm or reinforce a rigid hierarchy within which individuals seek their niches of dominance.

Therefore, if we want to discuss the mental concentration of work, we must not overlook the strong connection with the phenomenon of human existence known as dominance or rule! In the phenomenon of work/non-work or mental concentration of work/non-work, there is also a certain peculiarity that can be strongly linked to the phenomenon of human existence or mental concentration of play/non-play. Some individuals perceive work as a serious game. This category includes individuals who are artists, scientists, and professional athletes. Especially in professional sports, individuals work hard to become so good that they are among the best in the country or even in the world. Despite the fact that the training is extremely tough and demanding, these individuals also view their work or sports discipline as a game. Sports, in the sense of everyday people's activities, are not perceived as work but rather as a way to care for the body and spirit and as a game (especially among children). Work can mean positive or negative training of the mind and body. It is essentially about positive and negative learning, which, both physiologically and psychologically, aligns with the kinesthetic sense and thus influences our experiences and connects with our memories from early childhood.

2.3.6 Dominance

The desire and need for dominance are innate to humans. As an individual navigates through the social hierarchical labyrinth, both can be further reinforced. Dominance is essentially a milder form of ruling. The relationship between ruling and working is almost as old as the human species. Having influence over another person so that they do exactly what they are ordered to do is a very important affirmation of the ruler's existence. An individual who performs a series of difficult tasks instead of being an influencer is a kind of extended arm of their leader. The ruler or leader can freely decide which work they are most deserving of and which not.

A leader does not become a leader because of their good looks. A future leader must weave various human connections (if they do not already exist), know who they can rely on, and whom they can trust. In a way, the leader becomes a slave to their confidants, as they have invested a large part of their personality in them. The core of a leader's existence lies in their confidants. Confidants are usually emotionally or materialistically attached to their superior, who generally maintains a materialistic or emotional relationship with them. If someone wants to rule, they must have a special sense of organizing people. Additionally, they must be a good knower of other people and themselves. The motivations of an individual for dominance or ruling are diverse and numerous.

At its core, motivations for dominance can be categorized based on fundamental drives, such as:

a. Physiological needs motivation: Dominance for better fulfillment of basic physiological needs (e.g., better nutrition).

b. Positional motivation: Acquiring strategic advantages (e.g., fertile land, access to water, geostrategic position).

c. Emotional and sexual motivation: A better starting point for passing on genes.

d. Psychological and sociological motivation: Strengthening one's identity or gaining friendships.

e. Motivation of mental immortality: Due to exceptional decisions and actions, a leader or ruler will be recorded in human history and thus become immortal.

As an interesting aside, let's look at what various psychological theories say about ruling.

1840 - The Great Man Theory

This theory posits that great leaders are born, not made! In 1860, the English philosopher Herbert Spencer challenged this theory by arguing that rulers or great heroes are simply the product of their time, actions, and social conditions. In fairy tales, especially in mythologies, we often encounter the motif of the born leader or ruler (e.g., oracles in Greek mythology who predicted fame and kingdoms for certain individuals).

The Great Man Theory contains a truth related to the desire and need for dominance. If this desire is genetically emphasized, an individual will strive to achieve dominance over others. However, this does not mean they will actually become a leader or ruler.

1930-1940 - Trait Theory

Great leaders are neither born nor made for leadership roles. They must, however, possess certain personality traits such as intelligence, a sense of responsibility, creativity, etc. This theory focuses primarily on analyzing mental, psychological, and social characteristics to better define the traits or combination of traits that great leaders should have.

1940-1950 - Behavioral Theories

Behavioral theories focus on an individual's behavior in connection with their mental, psychological, and social abilities. If these conditions are favorable, anyone can become a leader. In short, there are no born leaders; they are shaped over time with favorable circumstances.

1960 - Contingency Theories

These theories are essentially an extension of trait theory. Potential leaders are dependent on given situations, which they manage more or less successfully with appropriate decisions and actions. This potential becomes stronger if the potential leader notices they will have a sufficient number of followers.

1970 - Transactional Theories

It is assumed that transactional relationships occur between a leader and their followers. The leader forms a certain sense or goal that they convey to their followers. Additionally, they create an atmosphere and environment that rewards or punishes their followers.

1970 - Transformational Theories

The essence of these theories is that the leader interacts with followers and creates an environment for partnership with them. Followers gain a sense of belonging and purpose, which further motivates them to cooperate. According to these theories, the leader is a likable and charismatic person to whom followers also emotionally attach themselves.

It should be emphasized that the style of leadership and governance has historically changed significantly, especially in European countries. In human evolution, harsh methods of leadership and governance were initially prevalent. Today's methods are generally softer, characteristic primarily of socially and technologically developed countries such as EU member states, the U.S., Canada, Australia, etc.

However, this observation does not entirely apply to all parts of these countries, as harsh methods of leadership and governance still exist in some areas. On average, though, these countries have made significant progress. There are also technologically very developed countries that still use harsh methods of leadership and governance but are less developed in terms of social development (e.g., respect for basic human rights). Softer methods of leadership and governance allow for long-term societal success both technologically and socially, as members of the system more easily collaborate and exchange useful ideas.

Although physical strength is no longer the key factor for dominance over an individual, group, or crowd, it is still expressed in early childhood and adolescence as a means of dominance. Young people often physically test each other to see who is more agile, stable, and stronger, thereby strengthening their ego and gaining reputation among peers, especially among peers of the opposite sex. Upon winning, a person feels internal satisfaction, sometimes even happiness.

People want to maintain this feeling of pleasure as a constant, which is impossible because new stimuli and challenges continually arise from both the individual and the social environment. The feeling of pleasure is thus always threatened, and we always need it again.

In a way, people are like addicts and continually seek methods, tools, paths, and actions that trigger biological "drugs" in the brain. These biological drugs include noradrenaline, serotonin, dopamine, and endorphins. Noradrenaline is a neurotransmitter responsible for our alertness and attention, especially during waking. Serotonin is also a neurotransmitter and ensures psychological stability and a sense of satisfaction. Serotonin is closely linked to our culinary needs and digestive tract. If there is too little serotonin, an individual can become seriously mentally ill, manifesting in symptoms such as restlessness, anxiety, fear, and depression. Similar symptoms can occur when there is too much serotonin.

Dopamine is another neurotransmitter, known as the "happiness hormone," which in smaller amounts stimulates a feeling of happiness. We feel energized, are ready for action, enjoy exciting trips, meeting new people, and developing imagination. People with too much dopamine are inclined towards drug use, excessive and unhealthy sexuality, and in some cases, psychosis. Dopamine regulates our drive, interest, and encourages actions to achieve set goals. Because of this, people do various things to trigger dopamine release, which gives us a sense of satisfaction and happiness.

The neurotransmitter endorphins act as pain relievers, promote inner mental peace, strengthen the immune system, and enable better sleep. Additionally, endorphins are effective fighters against stress (distress). Humans quickly become accustomed to endorphins and need more of them, which can lead to risky behaviors that are very harmful. People who are overly burdened with achieving dominance over others must turn every situation to their advantage to extract sufficient amounts of these pleasure hormones. They are constantly in a position where they must prove their dominance over others. Upon closer observation of political leaders, we often find evidence that they try to achieve dominance even at a micro level. This involves situations that most people do not pay much attention to and do not seem important for dominating another person. However, it is different for people who are constantly burdened with proving their power over others.

2.3.6.1 Figure 11: Demonstrating dominance through handshaking

Figure 11 beautifully illustrates the importance of demonstrating dominance over another individual through handshaking.[6] Especially American political leaders often practice positioning themselves on the left side to gain dominance in handshakes. While this behavior may seem amusing, it has become a nearly automated behavioral pattern ingrained not only in the mindset of political leaders. This is just one of many situations where a leader seeks to assert dominance to stimulate or extract the aforementioned pleasure hormones. A person burdened with constantly proving dominance ventures into biological addiction-like behavior, which can harm the positive aspects of their actions and cause significant damage. This nearly automated behavioral pattern, where dominance is demonstrated through symbolic physiological approaches like handshakes, could conditionally be compared to early tribal leaders who had to be physically stronger than others. Members of the tribal community submitted to this physical dominance. The problem was that the physically strongest were not necessarily the most intelligent, and their clumsy decisions could endanger the entire tribal community. As human history progressed, physical strength became less central to leading groups of people, and intellectual components gained prominence (e.g., ingenuity, social networking, use of tools as weapons, hunting strategies and tactics, conflicts with other tribes, etc.). Extracting pleasure hormones is not limited to gaining dominance over others but is also present in other aspects of human existence, albeit in fewer situations and to a lesser extent.

6 The photograph is reproduced from the work: Pease, Allan & Pease, Barbara (2004). *The Definitive Book of Body Language*. Buderim: Pease International.

2.3.7 Play

The fundamental human phenomenon of existence, play, can either derive from work or even form its foundations. Despite the existential connection between play and work, both phenomena of existence are distinct. Games can be classified by age (e.g., children's games, adult games), purpose (e.g., recreational, strategic, life-threatening), etc. The main characteristic of play is its dual simultaneous reality. A person playing is actually in two realities at once. One is ordinary—real reality—while the other is imaginary. Humans can play many different combinations of games. They can invent so many games not only because of their diverse mental structure but also due to their physical construction. If humans were not built as they are, they could not play many games. It is also important to note the dual nature of play. The opposite aspect of play can be called non-play. Non-play is the clear rejection of the phenomenon of play, which is not a rare occurrence in the animal world. Young animals, especially mammals, play a lot during early stages of life to prepare for adulthood (e.g., learning hunting techniques, tactics for escaping predators). In adulthood, these mammals essentially no longer use play as a tool for honing skills, as their focus shifts to obtaining food and passing genes to future generations. In the human species, this distinction between play and non-play is less pronounced, as many older people still use games primarily as a tool for better well-being, entertainment, socializing with grandchildren, mental peace, relaxation, etc.

The phenomenon of play in everyday life is often inextricably linked with other phenomena of human existence, which are essentially dialectical content ratios. For example, when a superior psychologically toys with their subordinates, it is nothing other than a harsh reality enriched with low-level imagination in the eyes of the person playing. Such interpersonal relationships contain both sadistic and pragmatic elements simultaneously. By tormenting the subordinate subject, the superior subject reinforces the feeling that they are superior, confirming their dominant identity, while the other person suffers. The other side of this relationship involves establishing hierarchical rules, which determine each person's place and how subordinate subjects should move under the influence of superiors. These interpersonal relationships operate primarily on the principle of induction. Many people are not even aware of this fact, which is, on one hand, much more pleasant for many.

The goal of a game always lies in defeating the opponent and relaxing. In some games, many people can relax regardless of who wins or loses, while life games are relaxing and entertaining only for a few, as others do not enjoy them much. Their response to this psychological pressure is often to transfer it to individuals who are in lower positions within the hierarchical system. This is a vent used by most people in the civilized world. An individual who is unable to open their psychological vent in these relationships can become a victim of social misunderstanding, which can push them into incomprehensible thoughts whose origin and true meaning they cannot determine.

During play, our consciousness is not psychotic, but it is also not entirely normal, even though our actions are socially acceptable if the circumstances and rules are acceptable. Another aspect of play is the social attitude toward it (popular or unpopular games). The state of an individual's consciousness is not dependent solely on their subconscious state but is shaped with the help of narrower and broader collective consciousness and even collective subconsciousness (e.g., in a legal society, there are certain rules that are officially recognized and a priori accepted in people's consciousness, but there are also unwritten rules that have emerged due to inductive communication). In any social system, there are always people who spread or inflate certain behaviors into normal or abnormal ones within the framework of more or less written rules or laws. The state of consciousness of homo normalis is regulated so that it adheres to the written and sometimes unwritten laws of the broader and narrower society. Their hierarchical and associative thinking system operates in harmony with their view of the world around them, and reflections of social realities on them do not lead to extremely stressful situations, as they generally accept society as it is. They do not see excessive distortion in it but rather more self-evident reality. Homo normalis is relatively rigidly adaptable to a society, and if that society does not promote progress, they are also against social progress because they are sometimes victims of distorted information and their own stable position. Precisely because of this, the vulgar inductive transmission of information is so very successful. Homo normalis usually succumbs to it either out of naivety or petty self-interest. They are capable of lying because they are greedy, as our civilized society is largely built on greed, which is not always in line with written laws. The moral orientation of homo normalis is consistent with the orientation of society and its written and unwritten rules, so homo normalis rarely comes into moral and ethical conflicts with themselves and the community. In their eyes, everything is clear: what they do not know does not affect them; what they do not understand, they do not grasp; but what they must understand, they generally do. As rigid as homo normalis is, they are also flexible. They are capable of killing people if it is in the interest of the state, but they will not kill a person if the state opposes it (e.g., war situations – military attacks by another state). Homo normalis is generally not a root of imagination. Perhaps their attitude toward play is even elevated, as they believe that only children play, although it is not necessary that they never play. Even homo normalis likes to play, but they always need some kind of alibi for it.

Homo normalis is very afraid of being mocked because it weakens their identity regarding their own existence. Fear of difference shapes their life, regardless of the various levels in hierarchical systems. Thus, both homo normalis from the working class and those from higher social classes share a common fear—the fear of difference! This fear shapes their attitude toward play. Homo normalis also admires certain differences, such as heroism and self-sacrifice, and secretly wishes to be what they are not. In games, homo normalis can also appear as a hero, for example, in the game of poker (betting all their possessions and either doubling their money or losing it). Homo normalis is the pillar of everyday life, can be very flexible or very rigid and inflexible, or immovable. Homo normalis rarely plays for their own amusement but will engage in games primarily because their child or friends want them to, though they will generally enjoy themselves despite this, even if they admit it begrudgingly. A part of their freedom lies in silence, as silence is golden, and speaking is silver. Homo normalis generally has the gift of accepting new information rather than giving it. Because of this fact, their relationship with play is mostly passive in nature and leans more toward listening and/or watching. A typical representative of homo normalis will rarely become a theater actor, a solo singer, or a midfielder in a soccer team, etc. Homo normalis is a cosmic ocean of prejudices, which is why they also harbor unyielding prejudices toward various types of games. Precisely because of this, for sports games, which are especially close to their heart, they will never say that it is a game but will say it is sports. In further conversation, they might admit that sports are a game, that players play, and that they enjoy it. A typical representative of homo normalis is neither excessively greedy nor overly ambitious, which does not mean they are not. These traits sleep deeply within them and can awaken. The mental concentration of homo normalis more or less clings to the relationship between non-play and play, which favors non-play.

Now, let's look at a representative who cannot be classified as homo normalis according to psychiatric criteria. In a psychotic state, more specifically in dementia praecox, communication between a specific individual and their environment can be severely disrupted. A paranoid personality may be fully adapted to their environment, but unlike homo normalis, they perceive this world as something directed against them. The environment is largely responsible for this perception, as intense stimuli often trigger more or less intense cultural responses. Hierarchical systems in our social nature are mostly divided into areas such as industry, education, healthcare, police, culture, etc. Different hierarchical associative systems prevail in these areas, meaning that some people are closer to each other because they belong to the same social hierarchical system. This can mean that their relationships are a kind of outcome of traditional or socio-historical dispositions.

The social nature of human structures is extremely complex, and the domains dominated by specific hierarchical systems are not as distinctly marked as in animals in the wild. Animals mark their territory clearly so that others know it is already claimed. Humans primarily mark their individual material possessions, while certain hierarchical systems do not mark collective domains. According to laws, anyone can enter these spaces if they hold citizenship (or at least some other proof of residency rights) and are not criminally prosecuted. In reality, these spaces do not belong to any specific hierarchical system but are owned by the state hierarchy. Informally, however, these collective spaces are often controlled by individuals who are not part of the state system.

A good example of this is industrial areas, which are accessible to anyone employed there. However, this right of access does not imply equality. A foreign individual entering a specific hierarchical system is often left at its mercy. Such individuals must be highly adaptable, as informal rules often deviate significantly from official ones. Informal rules within a hierarchical system act as dialects of formal rules. An individual who does not adapt to both written and unwritten rules may provoke strained relationships, which can escalate if professional interests favor members of the group over outsiders. This can occur even if the outsider is fully adapted to the system, particularly when broader group interests oppose them. These broader interests may be subjective and/or business-related, potentially leading to social mobbing against the outsider operating within this organized group.

Such interpersonal dynamics can result in reactive psychological disorders like dementia praecox or paranoia. These disorders are consequences of interpersonal or social relationships within various societal hierarchical associative systems, which are constitutionally and legally subordinated to the state hierarchical associative system.

Mobbing will be discussed in greater detail in the chapter on social nature. In this context, attention is focused on the relationship between a paranoid patient (or sometimes a victim of psychosocial violence) and play. The fundamental characteristic of a paranoid personality is the belief that all people and organizations in the world are against them, while simultaneously maintaining their unshakable truth—even though in advanced stages of the illness, this truth often diverges from objective reality.

A paranoid patient typically does not engage in play and avoids it unless they feel compelled to pretend. Even their approach to certain games can be paranoid in nature; for instance, some games involve multiple opponents who primarily compete against each other, with only one player emerging victorious. A paranoid patient mostly defends themselves against environmental stimuli, whereas a player actively attacks their opponents during a game. The fact that a paranoid personality predominantly reacts defensively to environmental stimuli creates an unfavorable starting point for many types of games, as this passive tendency significantly contradicts the motive of play.

The goal of a game is to win, to disable our opponents in the shortest time and on the shortest path. A paranoid personality is so sensitive to verbal stimuli from the environment that even the smallest inconvenience that does not suit them can trigger an outbreak of their illness. In some games, we can have our life in our hands. We can become a kind of imaginary fate, shaping life for ourselves and others during the game. Nothing is more delightful than, for example, moving pieces and observing our opponent's face contort with annoyance. Having one's own fate in one's hands is perhaps the dream of every person, and for brief moments, this is achievable through games. We can stop time and become timeless, eternally young, sharp, successful, healthy, fresh, indestructible, and immortal.

Games differ from each other in form and content. Let's compare the game "Don't Get Angry" with chess. The content of chess lies in its material and mental background, while the content of "Don't Get Angry" is more about material and luck. The form differs due to the way pieces move. The form of chess is a virtual square, while moves can outline an eight-pointed star. The game "Don't Get Angry" is circular due to the specific movement of pieces.

Games are important not just for children but also for adults. Those who do not play may be sad because of this fact. Through games, people also communicate, which means we must be flexible enough for both the real and imaginary worlds. The state of consciousness of a very realistic or paranoid personality is relatively unsuitable for play, as consciousness in both cases is very rigid. The consciousness of homo normalis is too tied to normality and abnormality, while the consciousness of a paranoid personality is too tied to numerous enemies and hostile organizations.

Games can offer us more freedom than real life and enrich us with imaginary freedom, rather than being prisoners of some diseased and painful imagination. Homo normalis lives in fear of difference, while a paranoid patient does not live in this fear, as they themselves are different and are surrounded by enemies, which would mean that other people are different. The paranoid patient lives in fear that other people are different, receiving real and imagined evidence from the environment. Communication between consciousness and subconsciousness in a paranoid patient can be so severely disrupted that the fear of other people's differences is so strong that they cannot engage in reasonable communication with their environment.

Normal and extreme states of consciousness in separate forms are either too impersonal (e.g., a healthy attitude toward games) or too personal. In games, a special kind of personality prevails—a kind of fluctuating yet stable one. We do not feel the burdens and intensity of our personality during play, which does not mean that our complete personality is absent but rather the opposite. Our personality during play often sublimates into the personality of "I" or "not I," or the game itself personifies into "I" and "not I." In games, we never feel true fear or true indifference, but a mixture of these two components emerges, expressed mainly in the sensation of a special pleasant/unpleasant internal tension that at a certain moment is neither pleasure nor displeasure. A more meaningful relationship with games can mean a better relationship with other personalities and with oneself, as well as greater tolerance, if not a kind of bridge between the real and imaginary worlds.

From the fundamental phenomenon of human existence arise play and laughter. Without play, humans would laugh from the heart less often and would be less capable of genuine, relaxed joy. If we were to discuss the mental concentration of play, it would not merely refer to play as a driving force in itself from a practical empirical perspective. Instead, we would need to extract other phenomena of human existence through which structural components of either play or other human phenomena could be discovered. The mental concentration on "PLAY" for a particular individual would intertwine with various other mental concentrations, which in this relationship would not take the lead but instead occupy a background position, as their significance would be secondary or even tertiary.

Different mental concentrations also contain various structural and empirical forms. The structural form of mental concentration refers to the way thoughts connect with each other in stronger or weaker bonds, while the empirical form reveals the building blocks from which a particular thought is composed.

2.3.8 Death

Much has already been written, depicted, and spoken about death. As an introductory stimulus for thinking about death, let us consider some proverbs that speak about it:

- Death knows no calendar.

- Death stalks young people and stands before the eyes of the old.

- Death cannot be predicted, but it can be encountered anywhere.

- Death itself is not terrifying, but the idea of it is chilling.

- The best thing in the world is that death and the devil demand no payment; otherwise, many poor people would go to hell instead of the rich.

- Death is not a reaper who rests; it cuts dry or green grass at any hour.

- Humans must confront death again to finally understand that the purpose of Earth is love alone.

- Thoughts of death bring us sorrow, causing us to forget how to live.[7]

Why are we mortal? Perhaps we are mortal because we make mistakes? Many diseases send us toward death, but many diseases also keep us alive. Disease is a kind of "medius locus" between life and death. Death is supposed to be the final station or endpoint (**finisposition**) of a process that we are capable of perceiving and/or understanding with our senses and thoughts.[8]

Therefore, death is a kind of conclusion to life, although we can pretend that we live in this specific form forever. We fear the final images of death, so we cling to the idea that we will become immortal after death. We are already immortal because, in our previous human form, we will no longer die, even if we consider parallel universes. When we die, we are also immortal because we have merged as a part into a new, smaller or perhaps larger process that will create new forms and contents. In short, death is, alongside love or life, an important part of a process to which we attribute a beginning and an end for better orientation. However, the end is merely a new beginning —a transformation of energy and consequently mass. This means that the relationship between the beginning and the end is highly dependent on human will and the will of the narrower and broader collective. The relationship between the beginning and the end thus lies in our valuation, which often depends on our mood.

Despite everything, death is a fact from which we cannot escape, although we can pretend (as mentioned earlier) that we live forever. Death has many faces because there are numerous fears that mark the many possibilities of death's occurrence. When we think about death or are afraid of it, we arrive in an enlightened space where the light suddenly goes out, and the doors through which we entered slam shut. Now we are trapped behind closed doors in darkness. Therefore, we have no choice but to start drilling a hole in the wall through which a ray of sunlight might shine.

When we drill one hole, we want more. We want to escape darkness and confinement because we do not want to be trapped and blind. We also know of cases where the thought of death actually motivates some people, as they desire their own death, while others enjoy the death of other

7 Graubner, M (1989). *Das grosse Buch der Zitate*. 2. Aufl. Wiesbaden: English

8 The term "finisposition" is new and lacks a scientific tradition. It refers to a goal, an end, etc., of a certain position or final position (e.g., in a game of chess, this is checkmate, a draw, or stalemate).

subjects. As is evident, the desire for death can go down at least two different paths. The desire of most people is to live forever, to be immortal, while the desire of a minority of the human population is to be transient and mortal.

When we talk about death, we simultaneously deal with two factors: desire and fear. Many people wish to be feared or for others to live in fear, thereby overcoming their own fear. Most people want to overcome fear, so we can certainly speak of the intertwining of desires and fears. However, in some relationship between desire and fear, the desire for "fearlessness" is undoubtedly stronger than the desire for fear. Along with this realization, it is necessary to add that the desire for fear is present in every person, whether we are talking about their own fear or the fear of other subjects.

A good example of the desire to feel one's own fear is the fact that many people enjoy watching and/or reading thrillers and horror stories, and if there are no fatalities in these stories, they are not considered true thrillers or horror stories. Many people enjoy their passive fear while watching such films, which includes the aspect of positive main characters with whom they can identify (or identify the main positive characters with a loved and familiar person). It is as if the person is playing a game with their own fear, a game whose purpose is to overcome or discipline their own fear.

There are also people who challenge their own death to deliver a final blow to fear through this act. Have you ever wondered what you feel when a severe traffic accident with a fatal outcome occurs near you? What thoughts most often occur to you at that moment? In a special way, you enjoy the death of that stranger because you become aware of your own living existence while also recognizing your own transience. We cannot know our own death; for us, death is more of an interpersonal nature.

Precisely because of this fact, we fear death so much because it is so unknown and alien to us, yet we always carry this alien within ourselves (more in the foreground or background). For instance, when some nerve cells in our brain die, we are not even aware of these deaths, although these nerve cells are part of our personality. In short, death is as alien as it is familiar to us. For our concepts, it is as abstract as it is concrete. When we think about ourselves, death is more abstract in nature, and when it becomes too concrete in our minds, we mentally approach immortality. As mentioned earlier, death is a kind of synonym for a new beginning, which again approaches an end so that it can jump into the role of a new beginning in the future. Death is a kind of fixed star that pretends to be constant, eternal, and invincible. Death strips us to the bone, as it is such a villain as few others. It constantly smiles at us shamelessly and deceitfully. Such views on death make it more terrifying than it actually is. We fear death so much because we fear its image in our minds. The consequence of this fear is that we want to at least alleviate this fear by trying to change this image and its content background. We must be as creative as possible and permeate ourselves with a healthy love for ourselves and for natural and social nature. This allows us to have a better starting point for a more quality, peaceful, and courageous life. The presence of death should not haunt us excessively but should calm us, which is harder to achieve.

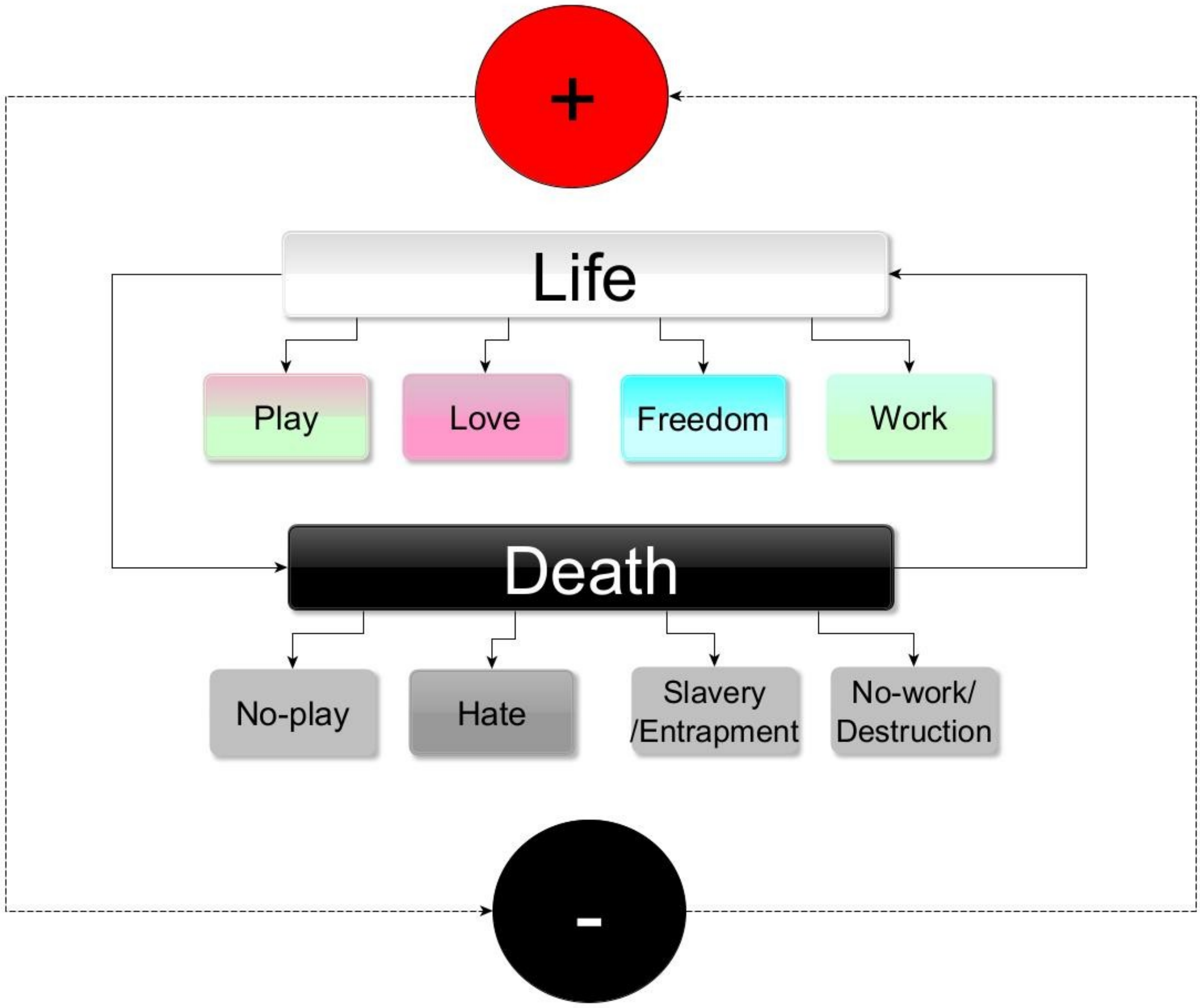
In our civilized world, humans have already interfered too much with bitter experiences to be able to transform them into sweet ones. The content sign of death is so negatively regulated that we no longer see any life in it, which is quite incomplete and inconsistent thinking from a purely logical perspective. When one process ends, new processes are born in the same moment, and even the process that seems to have ended still exists, but we do not want to acknowledge its existence with our programmed values. Usually, humans first define something, then expand it, but when it comes to understanding death, only fears expand, while the healthy energy of optimism is lost in a dead end from which there is often no return. Death is often linked to danger or threat, of which we are not aware at a certain moment. However, when that moment passes, the previous danger affects us even more, as we ultimately ask ourselves, "What if...?"

When we think about death, we can imagine it as a visually unpleasant person, but this narrow thinking is only apparent, as people generally do not think so extremely narrowly. In our subconscious (in the background), other thought whirlpools are taking place, which we can access if we trigger the controller of these. The controller essentially manages, directs, and determines which useful thoughts should be in our consciousness (a kind of back-end or background coming to the front-end or foreground). This internal controller also determines our self-image and how we will present ourselves to others (others then evaluate and communicate for us or not). An individual who has developed appropriate methods and tools to communicate with this internal controller of thoughts can gain a tremendous advantage. There are also certain thought patterns about death that are already covered by other thought patterns and are therefore historically intended for a specific individual.

The thought of death often differs significantly from one life stage to another. The content weight of the phenomenon of death changes in an individual's existence, so we can observe differences between children's, adolescents', and adults' perceptions of death (e.g., people over 70 view death quite differently than dynamic young people). Generally, older people think about death more frequently. A similar observation can be made for the phenomenon of love, as the intensity and content structure of thoughts about love differ from one period to another. However, we cannot speak of an increase or decrease in loving feelings at different age levels. Thoughts about work usually increase in various life stages, as many individuals think about it even in old age. Regarding dominance, it should be emphasized that it is more or less intensely present all the time. In old age, dominance is expressed somewhat less prominently. Concerning the thought of play, we can conclude that it is most present in early youth and least in old age.

The phenomenon of human existence—death—is essentially a polarized relationship between life and death or death and life. In the first relationship, positive thoughts about life prevail over death (biofilic thinking), while the second relationship leans toward necrophilic thinking. It is not necessary to emphasize that this polarization between life and death or death and life is a dynamic complex of mental concentrations. It is not necessary for this complex or formation to always be constant. In a certain life stage, a turning point (e.g., social and/or legal disputes, financial difficulties) or even a radical Copernican turn (e.g., severe trauma, loss of a loved one) can occur. The amount of biofilic energy is never completely balanced, but it should prevail for the good of every individual. A similar observation can be made for the amount of necrophilic energy; it should not dominate, as this would be detrimental to every individual and consequently to society.

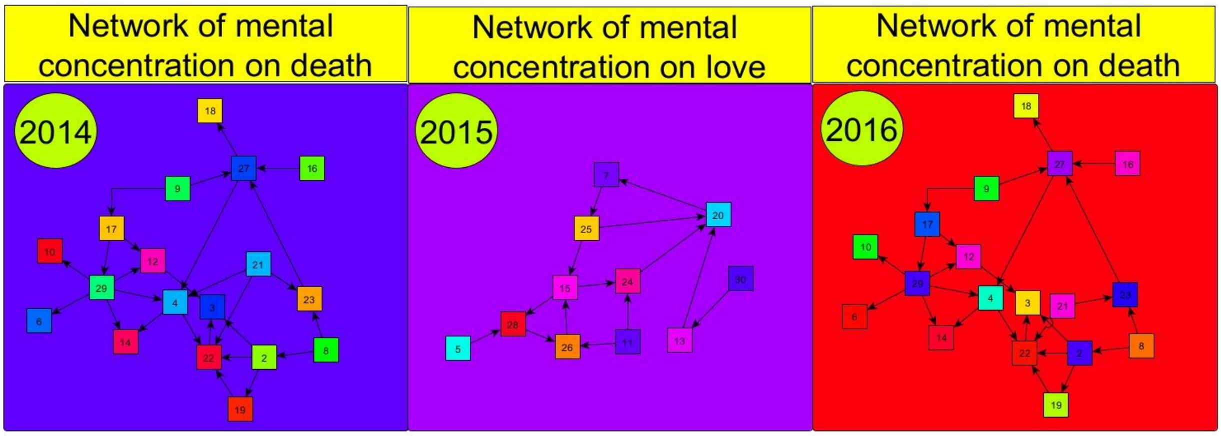
It seems that the polarized relationships between life and death or death and life, despite their strong polarization, are very closely connected. This close connection between both very important components of human existence—death/life and life/death—is existentially important for the survival of individuals and consequently for the entire human species. The polarized relationship between life and death gives us the necessary bioenergy for various positive actions and thoughts. The reverse relationship, however, essentially takes away the necessary bioenergy. For better clarity, a model will be presented on the next page.



2.3.8.1 Figure 12: Dynamic stepwise polarized hierarchogram of life and death

Figure 12 shows a dynamic stepwise polarized hierarchogram of life and death. It seems that the polarized phenomenon of human existence—death/life or life/death—is in a superior position relative to other polarized phenomena (play/non-play, love/hate, freedom/slavery, work/non-work). In a suppositional sense, this finding is correct, as this phenomenon serves as the basis for further existence. From a dynamic and developmental perspective, this hierarchy changes, as the polarized thought of death/life or life/death often recedes into the background, allowing polarized thoughts about love, work, freedom, play, etc., to prevail. The empirical and structural composition of thoughts and consequently mental concentrations can continuously change under the influence of various situations (stimuli) and internal contents (autobiographical memory, vision, mission).

It is possible for numerous and diverse networks of thoughts or mental concentrations to be established, which can be monitored and analyzed within temporal sequences. A suppositional network of thoughts or mental concentrations can emerge to the forefront over different time periods and become superior to all other contents (e.g., severe illness, injury, dangerous situation). For better clarity, a fictional example of changing the network of mental concentration over time should be presented.



2.3.8.2 Figure 13: Changes in mental concentrations over time

Figure 13 illustrates changes in mental concentrations over time. We observe that the networks for 2014 and 2016 are identical, while the network for 2015 has a significantly different empirical composition and structural form. The establishment of the 2014 network arose due to a death in the family. In 2015, Person A meets Person B and they fall in love. In 2016, Person B dies in a traffic accident. Person A grieves, leading to the re-establishment of an identical mental concentration network focused on death. Such shifts in mental networks over time can also be tracked in greater detail (e.g., daily, weekly).

All five fundamental phenomena of human existence evolved from drive, for which Ludwig Klages provided the following definition in his work "Charakterologie":

"Drive is essentially the sensation of pain caused by a lack, which results in automatic movements that subside once the series of deficiencies is resolved."[9]

One key deficiency is disorientation, as a disoriented person may lack effective and meaningful self-identity. These basic human phenomena could be linked to the five global ideas about humanity proposed by Max Scheler in his work „The Human Place in the Cosmos“.[10] The ideas outlined in this work are:

1. Theistic (divine-oriented)

2. Homo faber (humans as toolmakers)

3. Homo sapiens sapiens (humans as rational beings)

9 Klages, L. (1950). *Grundlegung der Wissenschaft vom Ausdruck: MIT Schriftproben*. Bouvier.
10 Scheler, M. (2008). *The human place in the cosmos*. Northwestern University Press.

4. Decadent anthropology (humans as degenerating beings)

5. Postulatory atheism of seriousness and responsibility (humans as grounded in secular ethics)

Through careful analysis, we might extract potential connections between the human phenomenon of dominance and the theistic idea of humanity. For instance, could the theistic conception of humans stem from a desire to dominate other subjects—a hypothesis many have speculated?

Within these foundational phenomena of human existence, we encounter numerous subgroups, reflecting the complexity of human thought, behavior, and societal structures. Religious thinking can be linked to peaceful souls through fundamental human phenomena of existence, such as death and love, as without fear of death and the desire for love, humans would not be capable of religious thought and emotion. The idea of freedom can originate from the fundamental human phenomenon of work. Would humans have ever counted time if they always felt only free? Would humans have ever counted time if they were immortal? Probably, timekeeping would never have occurred?[11] Time also originates from these five fundamental human phenomena of existence (the same applies to space, which humans use for self-awareness, as both individuals and collectives orient themselves throughout their lives with the help of space). In summary, love/hate, death/life, dominance/slavery, work/non-work, and play/non-play all stem from basic drives. Through these fundamental polarized phenomena of existence, individuals become aware of themselves, and this self-awareness makes it easier for them to navigate their lives. The more developed these fundamental phenomena are in an individual, the weaker their natural instinct becomes (in other words, the stronger the self-awareness, the weaker the natural instinct).

These fundamental phenomena of existence are not only characteristics of human existence but also integral to the existence of other living beings on Earth. However, in animals, natural instinct is stronger than in humans, which suffices for their survival in the natural world. Self-awareness (both collective and individual) reveals various deficiencies and advantages during our journey through life, where we continually encounter existential questions such as: Where do I come from? Where am I going? How far can I go? This last question further places us within boundaries that we often do not acknowledge or even try to escape.

Pleasure and discomfort constantly fluctuate and are one of the main factors regulating different mental concentrations. What lengths will humans go to in order to feel even a fragment of pleasure and escape the deadly moments of discomfort? Thoughts of death or feelings of being lost cause immense anguish within every individual and, consequently, within every collective. Even those

11 Finiteness stops time, while infinity propels it. The essence of infinity is perpetual action, whereas the essence of finiteness is rest.

who radically deny life seek to escape discomfort by forcing premature death, which they believe will bring relief or at least end the unbearable discomfort of life.

Mental concentration is regulated by internal and external environments. The internal environment includes everything that happens within an individual's body, while the external environment encompasses nature (both natural and social), essentially everything occurring outside an individual's body. Facial expressions, gestures, automatisms, and language are expressive tools of mental concentration. Without these indicators, we would never know about mental concentration. Mental concentration can be a simple or complex combination of phenomena, events, rules, symbols, objects, people, etc. It takes its position even though it is often exposed to dangerously intense situations that can threaten even its foundational elements.

Mental concentration of a more complex nature is usually more stable. This means it occupies a more stable mental position, which can naturally manifest in the individual’s physical posture. Mental concentration could serve as a measure of psychological stability or "mental impermeability" in a person, as psychological stability is highly relative and closely tied to psychological instability. When evaluating mental concentration, we cannot bypass our natural and social environments, which are governed by specific laws. If mental concentration positively influences the individual and their natural/social environment, we can speak of positive mental concentration, which we assess as stable if it persists and develops constructively. Conversely, negative mental concentration refers to that which destructively impacts the individual and their environment.

Mental concentration is essentially a manifestation of imagination and will, as it directs our volition. It can be understood as a formation or complex of diverse mental impulses organized in the brain into more or less structured forms. Conditionally, it can be compared to urban communities—diverse or monotonous architectures, symmetrical or asymmetrical streets, familiar or unusual garden designs, etc.

Imagination acts as a mediator between mental concentration and an individual’s will, as strong will cannot exist without vivid imagination. Willpower becomes effective and penetrating only when mental concentration is as universal and pragmatic as possible, and when the connection between will and mental concentration—facilitated by imagination—is minimally disrupted.

Mental formations with extreme past temporal projections accumulate information according to the principles of these past mental constructs and block the entry of new, critical information. Information drains energy but also enriches us. Extreme past temporal projections of thought reinforce themselves through new information, destroying an individual’s current and future will (vision, purposeful proactive will). This manifests as the individual assimilating most information to align with past will and past mental concentration. This trait severely harms both individuals and societies. Psychotic individuals and those with emotional disturbances are often victims of extreme past temporal projections—i.e., extreme past-oriented mental concentration. This creates an extreme past will of intensely elusive and confused nature, fixated on events that no longer exist, likely never to recur. These events were once deeply "injected" into the individual, who still lives within them, adapting newer information to fit this framework.

Every individual is profoundly significant, even if they appear less important than society at first glance. Society shapes individuals, but without interconnected individuals, there is no organized society with clear rules—though collective rules often blend individual emphases.

In some way, we think and act as one voice, yet simultaneously, we think and act in millions and millions of different ways. Each person thinks more about their own good than they are willing to consider the collective good. This aspect is important to the extent that organized societies often lack the power to harmonize the relationships between individual and collective good. This balance tends to favor individual good, although the inclination toward individual good varies gradually among different human structures. In this perspective, there would be a need to evaluate individuals based on whether they are "good, intermediate, or bad." Before we could satisfactorily evaluate the positivity of a particular individual, we would first need an appropriate definition. In this context, it is proposed that an individual is considered good or positive when they act for the benefit of themselves, their loved ones, society, and nature as much as possible, or at least strive to fulfill these dimensions.

The fulfillment of these dimensions is particularly crucial for future generations, to whom we should leave an effective, quality, and existentially vital orientation in life. Based on these dimensions and their associated attributes (e.g., ethical values, relationships, events, situations, processes), it would be possible to evaluate an individual’s impact—whether they act for the good or harm of the world they inhabit—using a complex matrix. Specific weights must be assigned to these attributes, as relinquishing one’s seat to an elderly person, while noble, cannot be equated to the self-sacrifice of someone who saves another’s life.

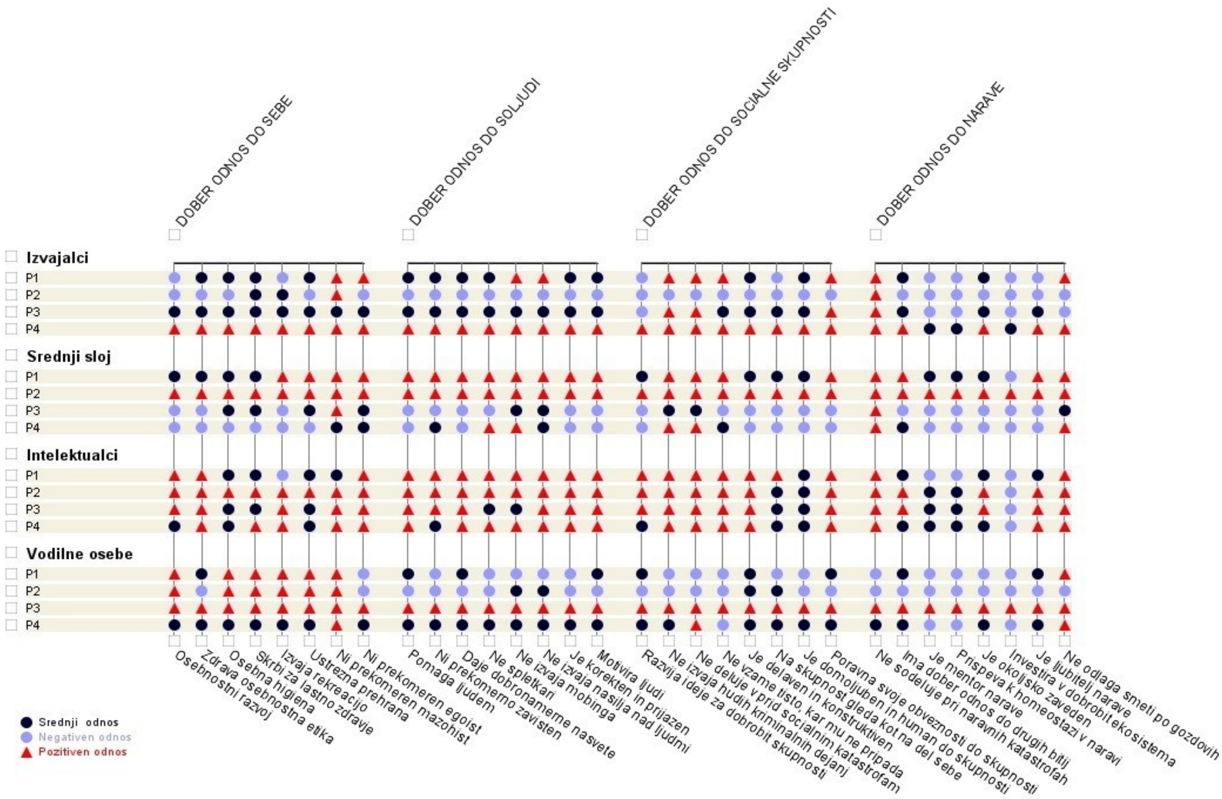
Every individual can already conduct a preliminary self-assessment of their own personality using the proposed definition (via responses to key criteria). This framework helps gauge alignment with the dimensions of contributing to oneself, others, society, and nature.

Explanation of key terms:

- Complex matrix: A structured evaluation tool weighing attributes like ethics, relationships, and actions.

- Self-assessment: A reflective process where individuals measure their alignment with societal and existential values.

- Existential orientation: A life direction rooted in meaningful contributions to self, community, and the environment.



2.3.8.3 Figure 14: Evaluation matrix for positive/negative Individuals

Figure 14 illustrates an evaluation matrix for assessing an individual's positive or negative relationship with themselves, their loved ones or fellow humans, social communities or society, and nature.[12] Individuals (P1, P2, P3, P4) are divided into four social groups: workers or performers, the middle class, intellectuals, and leaders. The previously mentioned dimensions (e.g., a good relationship with oneself) were evaluated based on 32 attributes (e.g., personal development, helping others, developing ideas for the benefit of the community, non-participation in natural disasters) with three possible ratings: a red triangle represents a positive relationship worth five

12 10 analysis with apes, the actor process event scheme. (2008). *Advances in Mixed Methods Research*, 150–171. https://doi.org/10.4135/9780857024329.d13.

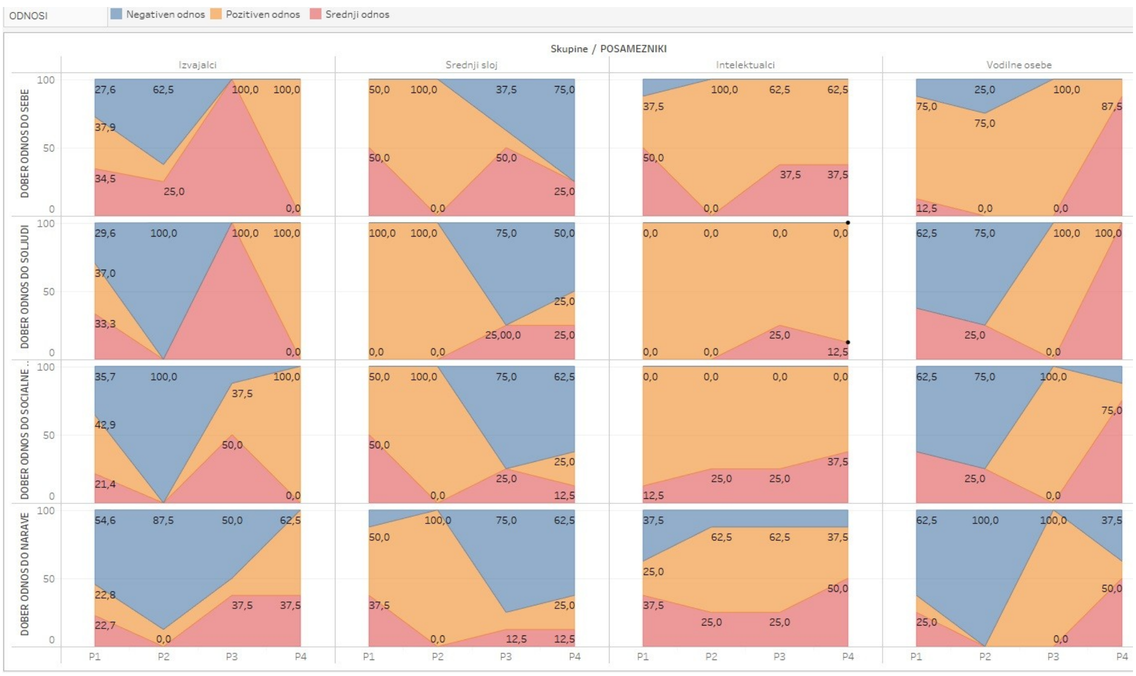
points, a black circle represents a neutral relationship worth three points, and a blue circle represents a negative relationship worth zero points.

A general assessment clearly shows that the highest number of negative relationships was found in the nature-related dimension, while the highest number of neutral relationships was observed in the self-relationship dimension. Additionally, the highest number of positive relationships was found in the dimension of good relationships with others.

Based on a sample of 16 individuals from different social structures, we can reliably conclude that people have the poorest relationship with nature, especially those from urban environments. In my opinion, the sample could have been much larger, but the results would likely remain similar. The data from the matrix was exported to Excel, which will be presented in the following section.

2.3.8.3.1 Table 1: A Portion of the exported data from the evaluation matrix

Groups	*Individuals*	*Relationships*	*Towards yourself*	*Towards yourself*	*Towards society*	*Towards nature*
Contractors	P1	Middle	34.5	33.3	21.4	22.7
Contractors	P1	Negative	27.6	29.6	35.7	54.6
Contractors	P1	Positive	37.9	37	42.9	22.8



2.3.8.3.2 Figure 15: Positive, neutral, and negative relationships in percentages

Table 1 (partial) and figure 15 display the positive, neutral, and negative relationships of individuals toward themselves, others, society, and nature in percentages. Negative relationships are represented in blue, neutral relationships in red, and positive relationships in orange. Based on the surface diagram presented, we can infer that the highest percentage of negative relationships and the lowest percentage of positive relationships are found among individuals from the leadership and worker groups. The middle-class group falls in between in terms of relationship values. The highest percentage of positive relationships and the lowest percentage of negative relationships are observed among individuals from the intellectual group.

It is important to emphasize that, on one hand, assigned weights for individual attributes are missing, and on the other hand, certain social structures have better opportunities for personal development, while some individuals in the worker group struggle for survival on a monthly basis. Regarding participation in social and natural disasters, it is worth noting that an individual typically needs to hold a very high leadership position to make decisions that result in a disaster (e.g., economic crimes, the construction of an unnecessary nuclear reactor that causes a nuclear accident, leading to the destruction of valuable forest land).

As a conclusion to this attempt at evaluating positive and negative individuals, one could suggest increasing the number of attributes and connecting test subjects to a lie detector.

2.3.9 Mythological perceptions

These are ancient and still present in our minds today, as they have played a role in shaping modern thought. In prehistoric times, mythological perceptions were very strong. When early humans encountered phenomena they could not understand or perceive correctly, they developed beliefs in supernatural forces and deities.

In essence, modern humans continue this practice—what cannot be explained through logic and science is often regarded as a paranormal phenomenon (though it should be noted that such occurrences are sometimes exploited for fraud). Over the long process of intellectual development, a new way of thinking emerged. Eventually, humans learned to logically explain certain mysterious forces, yet mythological perceptions persisted.

Mythological perceptions arose from the interaction between nature and humans, who were largely passive in this process. This passivity awakened in them a sense of the existence of nature and their own identity, as humans seek evidence within dialectical principles and validate them in their own way. Sometimes, they are even compelled to investigate the origins of these beliefs.

These aspects of mythological perception should not be overlooked, as people still carry within them a fragment of history from an ancient, mysterious, and incomprehensible past. This fragment of history is essentially a concentration of mythological thought, which could be vividly represented

on a conceptual map as a black mist containing mythological symbols such as the circle, square, crescent moon, cross, bow, triangle, sky, water, earth, sun, lightning, fire, knife, and more.
In short, mythological perceptions form the foundation of our understanding of deities, sciences, arts, writing, languages, and other symbolic systems.
The following section will explore symbols that significantly influence both individual thought and development, as well as the evolution of society.

2.4 Semiotics and symbols

Semiotics is the general study of signs, encompassing three disciplines:[13]

1. Syntax examines the relationships between signs.

2. Semantics studies the relationships of signs in terms of what they mean or signify. In linguistics, this involves the meaning of words and how they change over time. The key concepts in semantics are meaning and truth.

Rudolf Carnap introduced a distinction between descriptive semantics and pure semantics.

a. Descriptive semantics

Descriptive semantics is an empirical science that describes and analyzes the semantic characteristics of historically given languages. It is divided into:

- Specific descriptive semantics, which studies individual historically given languages.
- General descriptive semantics, which examines commonalities among all these languages.

b. Pure semantics

Pure semantics is a non-empirical philosophical discipline focused on constructing and analyzing semantic systems. These systems may resemble a historical language or be entirely fictional.

c. General semantics

Beyond these two branches, general semantics studies the meanings of words in everyday speech, politics, philosophy, and religion. Its goal is to uncover linguistic confusion and deception while contributing to the creation of a more precise language for better human communication.

d. Semantic logic

Semantic logic investigates the meaning and value of expressions through logical calculus, whose fundamental criterion is universal validity. This allows for the systematic elimination of elements and components deemed meaningless (see True Statement – Ludwig Wittgenstein).[14]

3. Pragmatics

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13 Sruk, V. (1980). *Filozofsko Izrazje in repertorij*. Pomurska založba.

14 Lange, E. M. (1996). *Ludwig Wittgenstein - Logisch-Philosophische Abhandlung Ein Einführender Kommentar in den "Tractatus"* Ernst Michael Lange. Schöningh.

Pragmatics examines the relationships between signs in terms of their usefulness and from the perspective of those who use them.
The founder of the general theory of signs, Charles Morris (Foundations of the Theory of Signs), introduced this classification, which later gained widespread acceptance—particularly through Alfred Tarski and Rudolf Carnap, two leading figures in modern logic.[15] According to Morris, semiotics is a general methodology of science that encompasses a wide range of scientific disciplines, from mathematics and logic to the social sciences.
In France, Ferdinand de Saussure established semiology. Some scholars refer to the general study of signs as semantology or semasiology. In recent years, the entire field of symbolic logic, logistics, and semantics has undergone rapid development and continuous change.
Semasiology is the general study of meanings and signs, as well as the evolution and transformation of word meanings (lexicology).

2.4.1 Symbols

Symbols are the most important signs for humanity, as they shape and guide society while influencing human cognitive processes (evidence for this claim can be found in the influence of mass media, particularly in economic propaganda programs).[16]
Essentially, symbols function as codes representing positive, neutral, or negative collective and/or individual experiences (recognizable signs of broader meaning). They also serve as markers of fundamental values. The influence of symbols on society and individuals is greater than we might like to admit. In this context, it is crucial to effectively present the balance between positive and negative symbols, as all human culture is fundamentally based on bipolarity, which is also reflected in values. Values are an essential part of symbolic meanings, helping to define qualities and characteristics in both people and objects.
Paired representations form our earliest experiences, which later develop into symbolic systems, and essentially into value systems (e.g., a paired symbolic concept evolves into a triad: God – Devil → God – Justice – Devil → Good – Justice – Evil).
Symbolic systems can be binary, triadic, tetradic, pentagonal, hexagonal, or even more complex multiples. Symbols are often encoded in multiple ways—first through fundamental analogies and associations. Within a mental system or network, symbols hold corresponding positions and are interconnected with other symbols.

15 Morris, C. (1970). *Foundations of the theory of signs*: (12. Impr.). Univ. of Chicago Press.
16 Chevalier, J., Gheerbrant, A., & Učakar, Aleš. (2023). *Slovar Simbolov: Miti, Sanje, Liki, Običaji, Barve, števila*. Mladinska knjiga.

When triggered by situational stimuli, symbolic systems manifest as associations, which serve as basic decision-making platforms (e.g., the first impression effect, where we recognize only foreign traits in a person and therefore struggle to trust them).

Since individuals are constantly engaged with both their inner selves and the social sphere, positive associations are extremely important. A lack of positive associations can lead to negative associative chains, depriving individuals of positive life energy—unless they find enjoyment in negative events and experiences.

Chains of positive and negative associations involve living beings (e.g., people, animals, plants), objects, events, phenomena, and even rules that govern various relationships. Associations are functional connections between psychological phenomena, acquired through experience or learning, where the presence of one tends to trigger the recall of another.[17]

Associations, in the broadest sense, are functional connections between mental content or verbal-motor acts.[18]

The laws of association are:

a. Law of contiguity: An event triggers another event if they have occurred together in the past.

b. Law of similarity: An event triggers another similar event.

c. Law of contrast: An event triggers the opposite event.

Types of associations:

a. Free associations: These occur solely based on the laws of association.

b. Bound or controlled associations: These are directed by specific factors.

c. Continuous associations: All the words that come to a person's mind within a given time frame.

We frequently encounter associative stimuli in the form of symbols, which often appear in everyday life. These associative stimuli can also manifest in more complex forms and content, such as networks of symbols, within which we can identify more or less stable hierarchies.

Symbols can represent associative thoughts and mental networks that result from verbal, auditory, tactile, olfactory, visual, and other types of associative stimuli. They can appear as stronger or weaker stimuli or as output units. Their meaning can be distinctly negative, neutral, or highly positive for an individual and/or society.

They trigger conceptual, perceptual, and event-related associative chains, which are subject to empirical principles and associative laws. These chains involve different types of associations, such as:

a. free associations,

17 Wolman, B. B. (1973). *Handbook of general psychology*. Benjamin B. Wolman, editor. Prentice-Hall.

18 Pečjak, V. (1977). *Psihologija Spoznavanja*. Državna založba Slovenije.

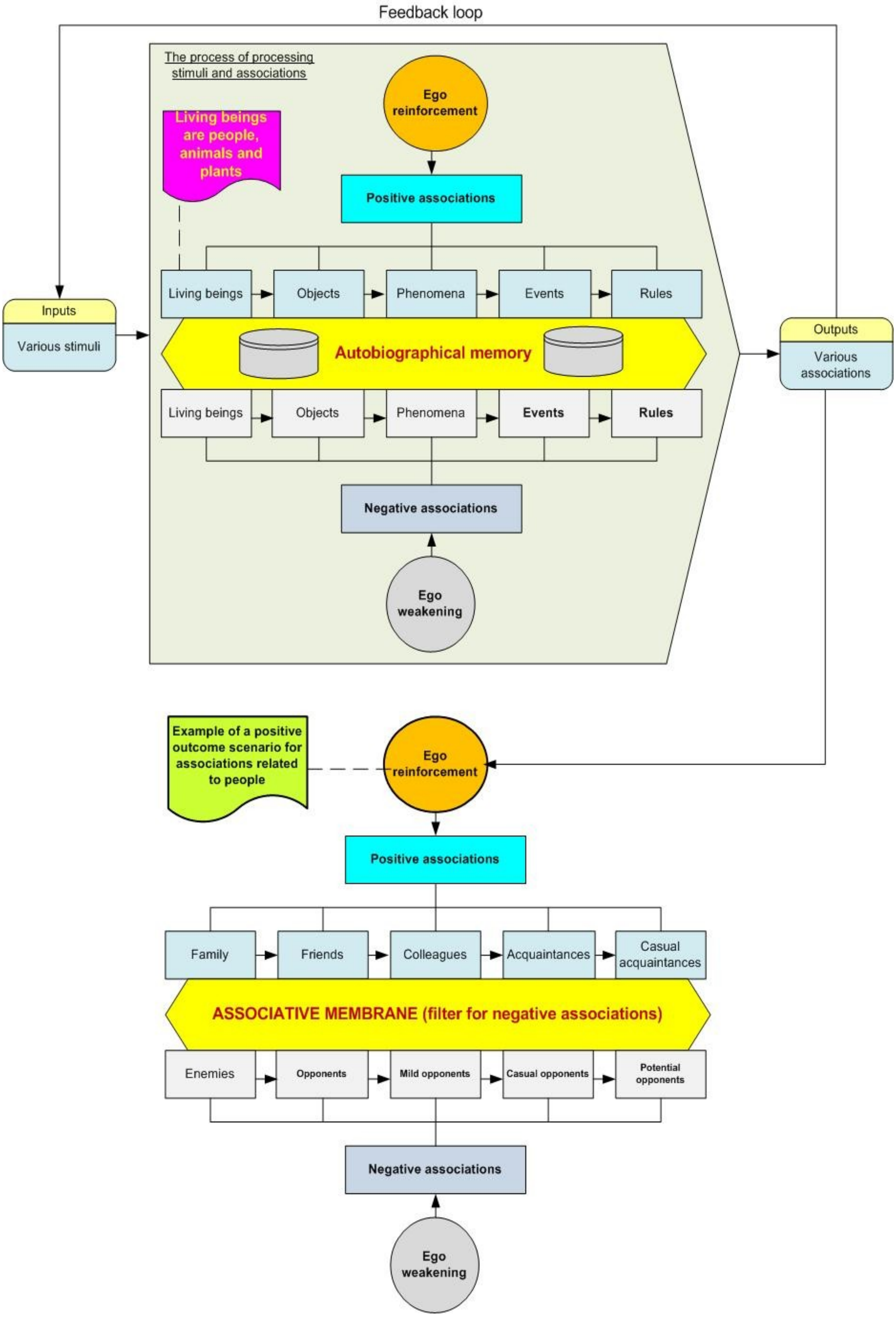
b. bound or controlled associations,

c. continuous associations.

Some associations resemble network systems, while others function as freely floating correlates that cannot be systematically arranged within a specific temporal and spatial dynamic.

Positive, neutral, and negative associations are connected to our memory space, where experiences—both individual and collective—are stored. Collective experiences, from the perspective of a specific or broader society, have already been tested and have a long historical trajectory. These experiences may be regarded as facts for certain groups of people but are not necessarily authoritative for many individuals or even society as a whole.

Let us now examine the process of transforming stimuli into associations.



2.4.2 Figure 16: The process of stimulus processing and an example of an associative chain

Figure 16 illustrates the process of converting various stimuli into positive and negative associations, which stand out from the system (see the upper part of Figure 16), as well as an example of an associative chain (see the lower part of Figure 16). Autobiographical memory plays a key role in transforming stimuli into mental associations. It contains diverse data and information about how an individual perceives their own personality in relation to the rest of the world (e.g., living beings, objects, phenomena, events, and rules).

Autobiographical memory is actively constructed throughout life, with major life milestones and other less significant events playing a central role. The lower part of Figure 16 presents an example of a positive scenario for associations related to people, where positive associations dominate over negative ones, ultimately resulting in ego reinforcement.

In connection with this process, it is important to highlight the categories of symbolic meaning, which include the following:[19]

a. Hope - Enlightenment: This association can be evoked from both a collective and individual perspective by symbols such as a spark, a ray, or light.

b. Beauty: This association can be evoked from both a collective and individual perspective by symbols such as a flower, a blossom, or a rose.

c. Death - Sorrow: This association can be evoked from both a collective and individual perspective by symbols such as a coffin, the color black, or a cross.

d. Diligence: This association can be evoked from both a collective and individual perspective by symbols such as an ant and a bee.

e. Beginning - Birth: This association can be evoked from both a collective and individual perspective by symbols such as morning, a flower bud, spring, dawn, or the sun.

f. Captivity - Slavery: This association can be evoked from both a collective and individual perspective by symbols such as chains and a cage.

g. Life - Freedom: This association can be evoked from both a collective and individual perspective by symbols such as light, the sun, a bird, or water.

h. Love: This association can be evoked from both a collective and individual perspective by symbols such as the color red and a heart.

i. Loneliness - Depression: This association can be evoked from both a collective and individual perspective by symbols such as a desert and darkness.

j. Power: This association can be evoked from both a collective and individual perspective by symbols such as a lion and fire.

k. Suffering - Evil: This association can be evoked from both a collective and individual perspective by symbols such as blood and wounds (e.g., the five wounds of Christ).

Additional symbolic meaning categories include:

19 Musek, J. (1990). *Simboli, Kultura, Ljudje*. Znanstveni inštitut Filozofske fakultete.

l. Peace: This association can be evoked from both a collective and individual perspective by symbols such as a white dove, a broken rifle, a rainbow flag, the V-sign, a white poppy, or a peace pipe.
m. Wealth: This association can be evoked from both a collective and individual perspective by symbols such as a shell, a vase, a pig, or a turtle.
n. Happiness: This association can be evoked from both a collective and individual perspective by symbols such as a ladybug, a four-leaf clover, or a chimney sweep.
o. Health: This association can be evoked from both a collective and individual perspective by symbols such as a snake wrapped around a staff, Olan Rei, or the key of healing.
p. Hatred: This association can be evoked from both a collective and individual perspective by symbols such as the swastika (turned to the right), the pentagram (which can also have other meanings), the devil, a demon, or a monster.
r. Technology and Engineering: This association can be evoked from both a collective and individual perspective by symbols such as a computer, a phone, or electronic circuits. These are modern symbols whose meaning, especially in dreams, is still difficult to interpret satisfactorily, as they represent functional and consumer products. Their meaning from both a collective and individual perspective is multifaceted and highly practical, making it challenging to determine figurative meanings (e.g., a phone may symbolize long-distance communication, dishonesty, business dealings, or consumerism).
s. Eroticism - Sexuality: This association can be evoked from both a collective and individual perspective by symbols such as a staff, a hammer, a bow, a triangle, a sausage, or a circle with an arrow.
It seems that many more categories of symbolic meaning could be listed, but even these examples provide a clear way to describe and/or illustrate individuals and even entire collectives.
Based on such and similar associative chains, it is possible to construct mental or symbolic networks, which will be presented later.
Symbols can be classified within the information pyramid as a concept that encompasses all other building blocks of information, including various types of data and data patterns. Symbols can represent living beings (people, animals, etc.), objects (buildings, sports facilities), processes, procedures, concrete content, meaning, knowledge, emotions, landscapes, cities, countries, and more.
The field of symbols is highly diverse and can be categorized into the following groups:

a. Linguistics: A symbol is a partially agreed-upon or fully conventionalized sign, which in a narrower sense has a more individual meaning (based on subjective experiences) or, in a broader sense, a more collective meaning (based on collective experiences and development).
b. Formal signs: A symbol has an unambiguous and precise meaning without deeper content.
c. Anthropology and psychoanalysis: A symbol is studied as an object of scientific research, particularly in the context of religion, myths, art, dreams, and related areas.
d. Philosophy: A symbol is a cognitive sign that may have a simple form but carries rich and profound meaning.
e. Religion: A symbol expresses a core idea, often represented visually or numerically. In religion, symbols are fundamental elements of religious identity, language, and actions.
f. Mythology: A symbol represents an inner and spiritual truth that enables the transformation and expansion of consciousness.
g. Literature: A symbol primarily refers to a specific object that represents another object, leading to figurative meanings.
h. Medicine: Symbols are processed in the so-called Brodmann areas, which are centers for visual perception. Damage to these areas can result in agnosia, preventing a person from understanding symbols (they can see an object but do not comprehend its meaning).
i. Psychology: A symbol is regarded as a link between conscious and subconscious perception of life on different levels (e.g., libidinal, everyday, intellectual).
j. Social sciences: The meaning of a symbol is based on collective agreement and perception.
k. Art: Symbols accompany artistic creations, influencing their depth of meaning and direction.
l. Natural Sciences and Mathematics: Symbols serve as carriers of clear meaning, which is transformed into sense (e.g., various formulas).
m. Politics: Symbols represent specific countries, political parties, constitutional elements, etc.
n. Orientation: Symbols are used to facilitate navigation and movement (e.g., traffic signs, mountain trail markers).
o. Economy: Symbols function as business tools to enhance market impact, often through tactical and strategic economic advertising.
p. Technology and engineering: Symbols illustrate components and systems using simplified diagrams and icons. These symbols have unambiguous meanings and represent key technical elements.
q. Professional symbolism: Symbols serve as markers of tradition and recognition (e.g., the scales symbolize legal sciences).

r. Sports: Symbols can represent success, specific strategies, game progress, or failure (e.g., a gold medal signifies an outstanding achievement in a sporting event).

s. Geography: Symbols have practical applications in cartography and geographic representation (e.g., maps, globes, geographic features).

The meaning of symbols can be further explored through various subfields, such as the symbolism of colors, gestures, facial expressions, numerology, astrology, heraldry, genealogy, scripts, pictograms, secret signs, coin symbolism, and brand symbolism.

In summary, within hierarchology, symbols are not merely signs; they can represent powerful concepts within the information hierarchy. These concepts can encompass various types of data, forming information and even knowledge when properly connected. Such concepts significantly influence both an individual's mental focus and the functioning of society. A single symbol can be enough to trigger important decisions at different levels of life, for example:

a. Libidinal level: Choosing a partner.

b. Everyday level: Purchasing a product.

c. Philosophical-intellectual level: Applying a specific theory in scientific research or developing a new idea to solve a problem.

Highly powerful collective symbols, such as the cross, circle, triangle, or white dove, often do not hold a distinct empirical individual meaning for a person, as they are accepted as collective facts. However, symbols tied to more or less intense subjective experiences carry a different significance. Such symbols involve complex relationships with other symbols, events, phenomena, rules, people, etc.

This complex relationship can be described as an individual symbolic network, which includes not only symbols but also other building blocks of the information hierarchy. For greater clarity, a simple study conducted in a library environment during 1998/1999 will be presented in the following section.

2.4.3 Construction and qualitative analysis of the conceptual or symbolic network

In a condensed form, the construction of the conceptual or symbolic network (hereafter referred to as the symbolic network) will be described and outlined. The process may be somewhat complex for less experienced readers, so it makes sense to present it step by step.

Step 1: Primary Objective

Measuring the relationship to certain stimulating symbols/words and associations, or measuring the positive worldview of both the group and individuals.

First, associative words are determined based on 15 stimulating symbols/words, followed by an evaluation of both the stimulating symbols/words and the associative words. The study used a sample of N = 30 respondents, predominantly library science students. The research was conducted in the years 1998/1999.

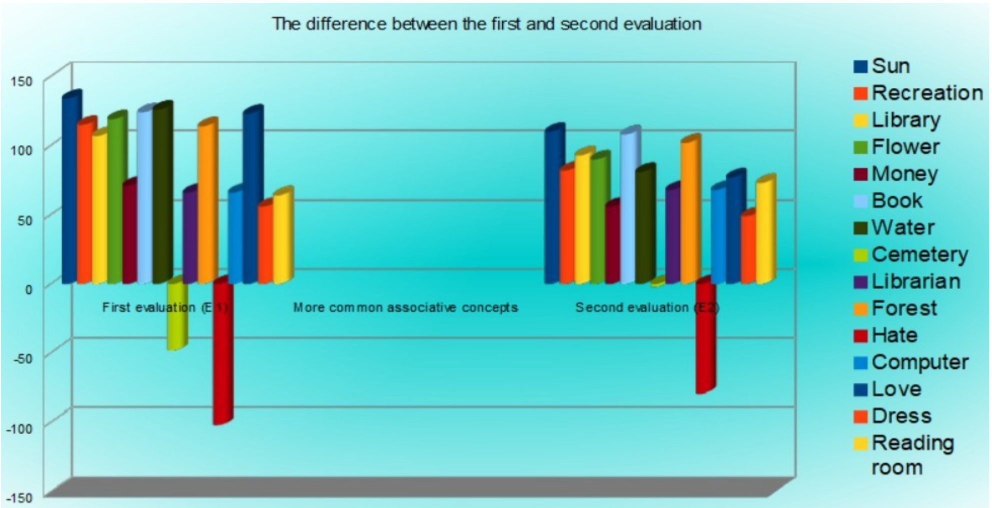
The sample of 15 stimulating concepts includes some very powerful symbols (e.g., sun, love, hatred, water, flower, forest, and cemetery), while the other stimulating concepts are related to everyday life (e.g., recreation, money, clothing) and the library environment (e.g., book, reading room, computer, librarian, library).

Symbols can function either as stimulating concepts that trigger an association of the symbol or an entire symbolic category (e.g., cemetery → death), or as the final outcome or association (e.g., money → happiness).

For better clarity of the material being discussed, a table evaluating the stimulating and associative concepts will be presented on the next page.

2.4.3.1 Table 2: Evaluated stimulating symbols/words and evaluated associative words (N = 30)

Number	Stimulating words (S)	First evaluation (E1)	More common associative concepts	Second evaluation (E2)	Diversity of associations (RA)	Classification of symbols (Cs)	Classification of associations (Ca)
1	Sun	134	Heat	110	15	5	1
2	Recreation	115	Sport	82	12	2	2
3	Library	107	Reading	93	9	9	2
4	Flower	119	Rose	90	19	6	6
5	Money	71	Wallet	56	19	8	8
6	Book	124	Novel	108	14	8	8
7	Water	126	Life	81	17	5	7
8	Cemetery	- 48	Death	- 2	12	9	7
9	Librarian	66	Human	68	12	4	6
10	Forest	114	Trees	102	12	6	6
11	Hate	- 102	Love	- 79	15	3	3
12	Computer	66	Internet	68	18	8	8
13	Love	123	Family	77	15	3	4
14	Dress	56	Shop	49	14	8	9
15	Reading room	64	Learning	73	12	9	2
Vsote	/	1135	/	976	215	/	/



2.4.3.2 Figure 17: Bar chart of evaluated stimulating and associative words

Table 2 displays the evaluated stimulating symbols/words and the evaluated associative words that resulted from questioning 30 test subjects (sample size N = 30), while Figure 17 shows a bar chart of the evaluated stimulating and associative words. The test subjects first determined associative words based on 15 stimulating words or symbols (e.g., stimulating concepts such as recreation, library, librarian, reading room, computer, money, and clothing; love and hatred can be considered symbolic categories, while concepts like sun, flower, forest, water, cemetery, and book represent strong symbols). Then, the test subjects evaluated the stimulating symbols/words on a scale from -5 to +5 (-5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5), and subsequently, they also evaluated their own associative words.

Words evaluated from -5 to -1 were considered to have a negative meaning by the test subjects. Words evaluated as "0" were interpreted as neutral, while words with values from +1 to +5 were considered to have a positive meaning according to their opinion.

The highest values in the first evaluation (see Table 2) were achieved by stimulating symbols such as SUN (E1 = +134), WATER (E1 = +126), BOOK (E1 = +124), FLOWER (E1 = +119), and FOREST (E1 = +114), etc., while the stimulating symbol CEMETERY was evaluated as E1 = -48 (very negative).

Some stimulating words were also highly evaluated, e.g., RECREATION (E1 = +115) and LOVE (E1 = +123), while the stimulating word HATRED (E1 = -102) was evaluated very negatively.

The stimulating symbols/words and associations (symbols/words) were classified into a special numerical classification system from 1 to 11 (see Table 2 – there were no representatives in groups 10 and 11, as it pertains to a proprietary product).

Table 2 also lists data on the more frequent or most frequent associative concepts (PS), evaluated associative words (E2), and classifications of stimulating and associative words (Ks, Ka).

Before proceeding to a condensed description of Figure 17, this classification system will be briefly presented:

Universal classification of verbal and non-verbal symbols/words

1. Physical property (FL)

This group of symbols/words includes the following concepts:

- a. Physical/chemical processes/phenomena, such as rain, fire, burning, heat, cold, noise, light, darkness, snow.

- b. Attention-grabbing properties, such as olfactory, auditory, visual, and tactile manifestations.

2. Action property (StL)

We include human physical and psychological activities that evoke positive or negative effort (playing, learning, working, writing, sports).

3. Psychological property (PL)

This category includes human positive or negative psychological manifestations in everyday life, such as emotions, feelings, fears, desires, thoughts (joy, love, hatred, satisfaction, pleasure, etc.).

4. Social property (SL)

This group of symbols includes human social interactions with other people (family, friends, communication, conversation, social gatherings, professions, etc.).

5. Inanimate natural property (NNL)

NNL describes symbols that represent material or inanimate nature (e.g., stone, square, celestial bodies, metals, liquids, gases, crystals).

6. Living natural property (ZNL)

This group includes living beings and their parts (e.g., plants, animals, people, hands, tail, leaves, eyes).

7. Health biological property (ZBL)

ZBL includes the health status of living beings (health, disease, life, death, stress, etc.).

8. Products of humans and important personalities (PmiO)

PmiO includes material (Pm) and intellectual (Pi) creations of humans and knowledge:

- a. For example, a book is Pm, a novel is Pi, a car is Pm, a car plan is Pi.
- b. This also includes methods, methodologies, strategic plans, and famous and less famous personalities.

9. Institutions and their parts (ID)

This group includes various social institutions and their parts (e.g., countries, regions, church, cemetery, sports club, soccer field).

10. Periods (e.g., seasons, history) and combined associations (KA)

This category classifies symbols that cannot be explicitly defined but are composed of one or more elements (e.g., fear of public speaking represents PL in relation to SL, various historical periods that were pivotal for the world and humans).

11. Undefined associations (NA) or Associations of an Open Group

This category includes symbols that are of a more recent date or cannot be precisely classified (e.g., various new coinages).

Based on this classification, it is possible to study the diversity of associative words that are the result of responses from 30 test subjects who provided feedback on stimulating concepts. Now, as promised, the description of Figure 17 follows.

Words such as sun, forest, flower, book, water, etc. (primarily natural motifs) achieve high ratings, while other words like money, clothing, computer, etc. (mainly concepts related to social status and business) receive lower values. Words like book, library, and reading room have quite high values, as most of the test subjects were from the field of library science. Therefore, the high ratings for

these concepts are not surprising. We would get a completely different picture if we conducted this type of research in a different sociological environment (e.g., in a manufacturing facility).
From a classification perspective, it is necessary to emphasize that the most represented associative words are from category 8 (symbols/words that represent human products, both intellectual, such as a novel, and material, such as a computer). Generally, there is a tendency for stimulating words that were highly positively evaluated (e.g., sun E1=+134, water E1=+126) to achieve lower values when evaluating the corresponding associative words (e.g., associations with the stimulus of sun reached a value of E2=+110, associations with water E2=+81).
On the other hand, this does not apply to negatively evaluated stimulating words, as the evaluated associative words achieve higher values (e.g., cemetery E1=-48 → associations E2=-2, hatred E1=-102 → associations E2=-79). For more neutral concepts, one might assume that the values of the associations would give approximately the same values (this could not be determined in this study because, on one hand, the sample was too small, and on the other hand, no explicitly neutral stimulating words were offered, e.g., verification, employee).
With a larger sample, e.g., N = 500 - 10,000 people, it would be possible to demonstrate that individuals with stronger bipolar disorders or more severe forms of depression and other mental disorders generally give significantly lower ratings for both stimulating symbols/words and associations compared to the average population. Similarly, based on a larger sample and various sociological environments, it would be possible to demonstrate that a high level of distress in society affects people's lower ratings regarding stimulating symbols/words and associations.
Continuation of the research
In future studies of this kind, it would be reasonable to use associative words as stimuli and repeat the entire presented and known procedure to obtain association chains of at least three elements:
S1 → A1 → S2 → A2 → S3 → A3 → ...
- S1: Stimulating words (starting point)
- A1: Associations to S1
- S2: A1 then becomes the next stimulating word (S2)
- A2: Associations to S2
- S3: A2 becomes the subsequent stimulating word (S3), and so on.
An even more precise picture of how symbols/words are perceived could be obtained by extending association chains to seven elements (e.g., S1..S7 → A1..A7). Such an approach would require:
- Highly organized scientific activity
- Quality computer programs for data processing and analysis
- A large team of personnel.

Individual perception dynamics

Individuals constantly evaluate the world around them, often unconsciously. In many situations, they actively assess their environment more than themselves. Despite assigning high or low ratings to specific objects, people, or concepts, individuals continuously seek and create mental balances. On average, people strive for harmony between positive and negative perceptions of the world, as this equilibrium provides a sense of psychological safety and stability.

Parallel study: symbolic category stimuli

A similar study was conducted in January 2018 using symbolic categories (e.g., *love*) as stimuli. These categories also served as classification units. The research involved:

- An online questionnaire
- 60 respondents from public administration (e.g., universities, high schools, libraries, ministries, research institutes).

A detailed report on the outcomes of this study will be provided later.

Step 2: Main Objective

Data visualization and construction of a conceptual network

The goal is to uncover cognitive connections between concepts within the group (N = 30 people).

Methodology

1. Data preparation: Symbols/words and the most frequent associative concepts were classified into groups 1–11 (see the Universal classification of verbal and non-erbal symbols/words).
2. Visualization: Data were processed using the software tool *Ora Casos*, employing a cognitive affinity algorithm to map relationships.

Key notes

- Classification consistency: Categories 1–11 align with the framework outlined earlier (e.g., Physical property, Social property).
- Technical tools: Ora Casos is specialized software for network analysis, ideal for visualizing complex conceptual linkages.
- Implications: Extending association chains could reveal deeper cognitive patterns and societal influences on perception.[20]

At this stage, the focus is solely on illustrating the connections between stimulating and associative concepts. In a later stage, a main customized micro-theory framework was developed with an emphasis on stimulating and associative symbols/words, where these were also classified into groups from 1 to 11. Individual files were prepared for the stimulating symbols/words, and these

20 Carley, K. M., et al. (2011). *ORA User's Guide. Pittsburgh*: Carnegie Mellon University, School of Computer Science, Institute for Software Research, Technical Report, CMU-ISR-11-107.

data were processed using the software tool or research system Jigsaw, which enabled the construction of a conceptual network. More on this will follow.[21] For now, let's first look at the first part of this second step, which is shown in table three.

2.4.3.3 Table 3: Symbols/words and classification groups

Stimulant symbols/words and associative words	Classification
Sun	5
Recreation	2
Library	9
Flower	6
Money	8
Book	8
Water	5
Cemetery	9
Librarian	4
Forest	6
Hate	3
Computer	8
Love	3
Dress	8
Reading room	9
Heat	1
Sport	2
Reading	2
Rose	6
Wallet	8
Novel	8
Life	7
Death	7
Human	6
Trees	6
Love	3
Internet	8
Family	4
Shop	9
Learning	2

Table 3 categorizes the classified stimulating symbols/words and the most frequent associative words based on the classification system from 1 to 11. Let's show the classification breakdown into groups:

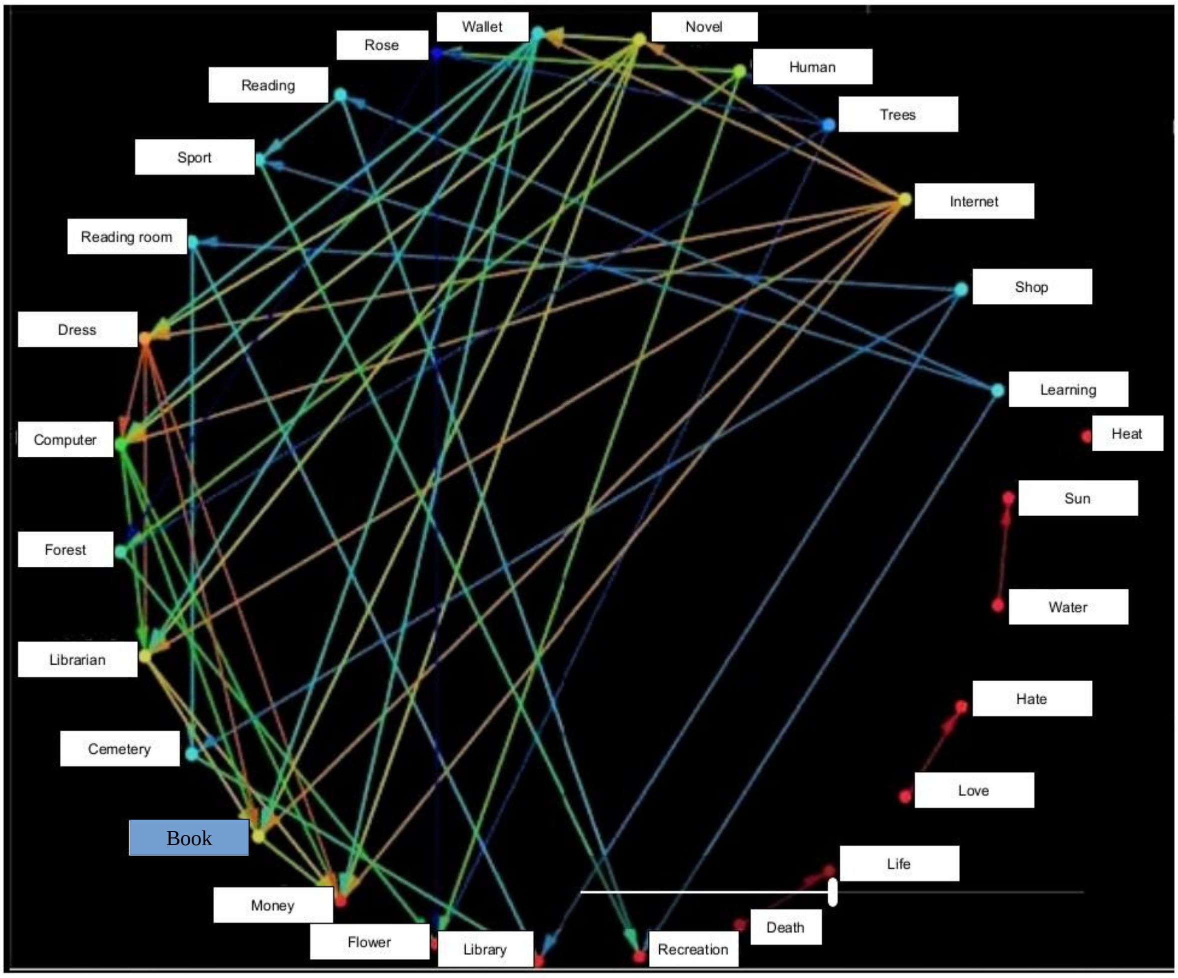
21 Stasko, J., Görg, G., & Liu, Z. (2008). Jigsaw: supporting investigative analysis through interactive visualization. *Information visualization*, 7(2), 118-132.

1. Group 1:
   - Includes the most frequent associative concept heat, representing a physical property.
2. Group 2:
   - Concepts like recreation, sports, reading, and learning are classified here, representing physical and/or psychological action properties.
3. Group 3:
   - Contains three entries: hatred and love (listed twice). The concept of love appears both as a stimulating symbol and the most frequent associative word. Hatred and love are strong emotions, classifying them as psychological properties.
4. Group 4:
   - Includes librarian and family, both representing social properties.
5. Group 5:
   - Features sun and water, categorized as inanimate natural properties.
6. Group 6:
   - Contains terms representing living natural properties, such as flower, forest, rose, human, and trees.
7. Group 7:
   - Includes life and death, reflecting health-related biological properties.
8. Group 8:
   - Lists money, book, computer, clothing, wallet, novel, and internet. These represent human creations—both material (Pm, e.g., computer) and intellectual (Pi, e.g., novel).
9. Group 9:
   - Comprises library, cemetery, reading room, and store. These denote institutions (e.g., library) and their components (e.g., reading room).
10. Groups 10 & 11:
    - No representatives were recorded.

Key observations

- Love appears in dual roles (stimulating symbol and associative word), highlighting its psychological centrality.
- Institutional and social concepts (library, family) emphasize context-dependent classifications.
- Material and intellectual creations dominate Group 8, reflecting human-centric innovation.

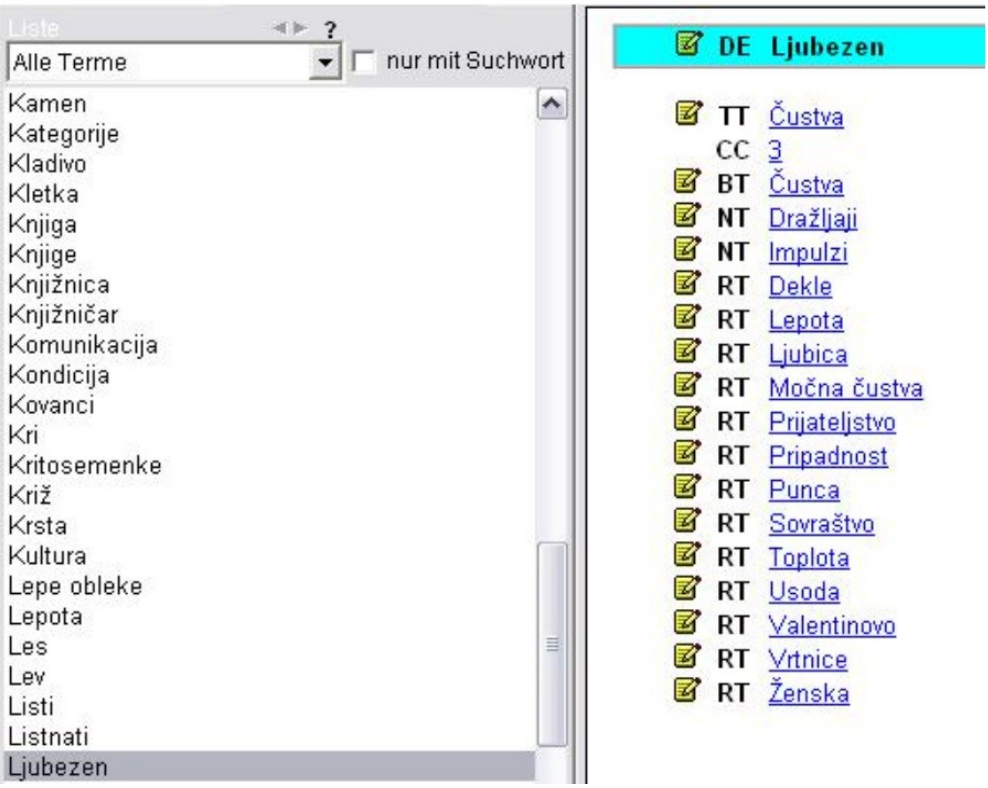
This structured classification system enables systematic analysis of cognitive and symbolic associations.



2.4.3.4 Figure 18: Circular visualization of connections between stimulating and most frequent associative words

Figure 18 displays a circular visualization of the connections between stimulating and most frequent associative words. Concepts classified into the same category are interconnected. Notably, the connections between symbolic categories, such as love – hatred, death – life, and between the symbols water and sun, are particularly interesting. Both love and sun appear as both stimulating and associative words. Such concepts have especially great power and contain numerous connections to other concepts, making this semantic network exceptionally comprehensive and complex. This figure illustrates the perception of stimulating symbols/words and the most frequent associations of a smaller group, namely 30 people. With a larger research sample (i.e., a larger group, e.g., at least 200 people), it would be reasonable to compare individuals and/or segmented groups of people (by sociological environments) with the entire group.

In the continuation, a conceptual network will be presented that represents an advancement of the current efforts. Before constructing a visual conceptual network, it is necessary to first build a customized micro-theory framework (using software tools like Midos Thesaurus 2000) of stimulating symbols/words and associations.[22] In essence, this involves a complex dictionary of symbols/words that includes hierarchical, associative, relational, and equivalent relationships with content notes, which can be an excellent tool for analyzing dreams, events, etc. Once the micro-theory framework is built, the data are converted into a standard .txt file. This file, along with 15 other .txt files (prepared .txt files with titles of specific stimulating words and containing associative words), is imported into the software tool Jigsaw. Within Jigsaw, the data are processed by identifying entities that, in this case, are the already known classification labels from 1 to 11. For greater clarity, let's examine a part of such a customized micro-theory framework for stimulating symbols/words and associations.

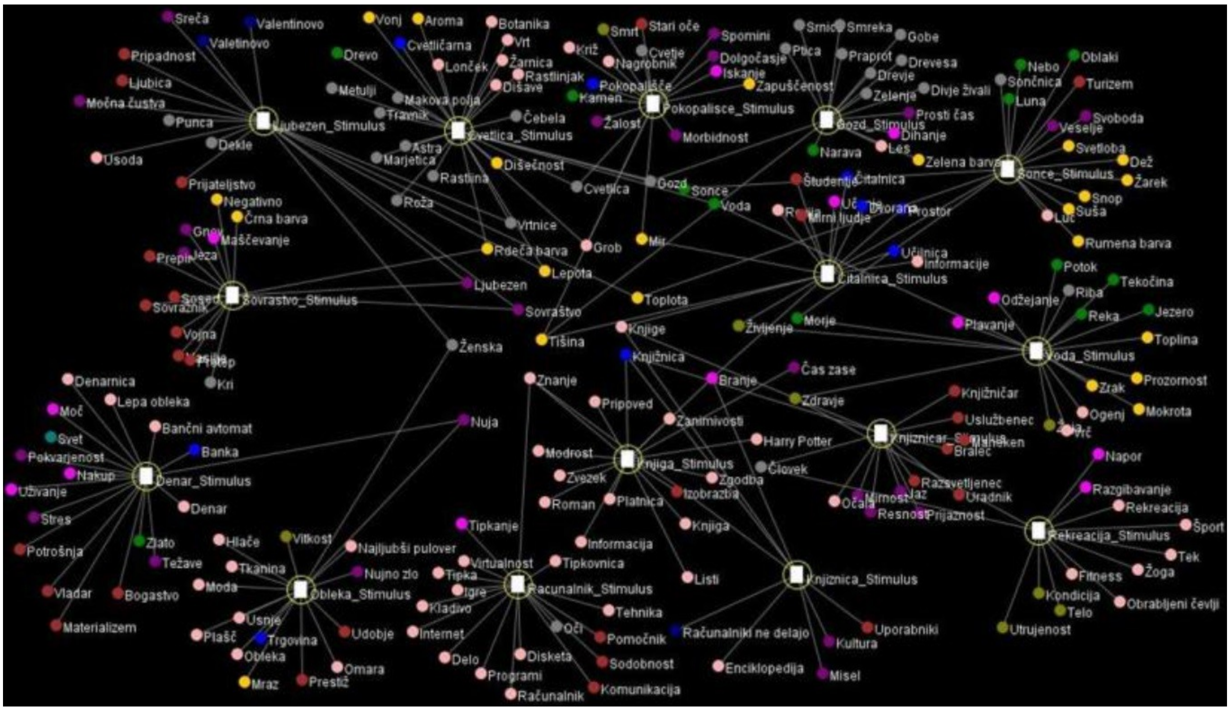


2.4.3.5 Figure 19: Part of the modified micro-thesaurus of stimulative symbols/words and associations

Figure 19 shows part of the modified micro-thesaurus of stimulative symbols/words and associations. In this excerpt, the subject label "LOVE" is displayed (see DE or the description, or subject label). The higher concept related to love is emotions (e.g., love, hatred, anger, joy; see TT and BT). The subordinate concepts (see NT) include, for example, stimuli and impulses. I have marked associative concepts with RT, for example, girl, beauty, sweetheart (RT is originally a label for relational terms, but I have adapted it for this purpose). In this context, the association "strong emotions" also appears, which ordinarily should not appear in this part of the micro-thesaurus. For

22 Gödert, W., Lepsky, K., Nagelschmidt, M. (2012). *Arbeiten mit Midos* . In: Informationserschließung und Automatisches Indexieren. X.media.press. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-23513-9_8.

this reason, this is a modified micro-thesaurus, where associative terms are the result of responses from 30 test subjects (for example, a term that normally falls under TT may repeat under RT if a test subject provided that association during the research).



2.4.3.6 Figure 20: Conceptual network of stimulative symbols/words and associations

Figure 20 shows a conceptual network of stimulative symbols/words and associations, which is the result of interviews with 30 test subjects. The conceptual network represents part of the hierarchical and associative thinking system of a small group of people, based on which an individual could be modeled. White squares represent stimulative words (e.g., see Figure 20: Flower_Stimulus), while differently colored circles illustrate associative words (e.g., see Figure 20: scent as a yellow circle - scent is classified as a physical/attentional property). In Figure 20, we can also observe connections (see white lines), from which we can discern the relationship between various stimulative symbols/words and associations (see Figure 20: e.g., Computer_Stimulus - KNOWLEDGE – Book_Stimulus). Based on the conceptual network and its numerous connections, we can deduce how the valued concepts are interrelated. This approach yields the result of the collective thought world of a group of people. That very thought world is also evaluated and represents the fundamental basis for a comparative analysis between individuals and the group. Assuming that an individual's conceptual network differs significantly from that of the group (e.g., numerous associations with a negative connotation, such as sadness, enemy, disease), such individuals can subsequently be singled out for further study. This type of profiling of individuals' thought worlds can be a useful tool in identifying, for instance, potential suicidal individuals, and it may also be

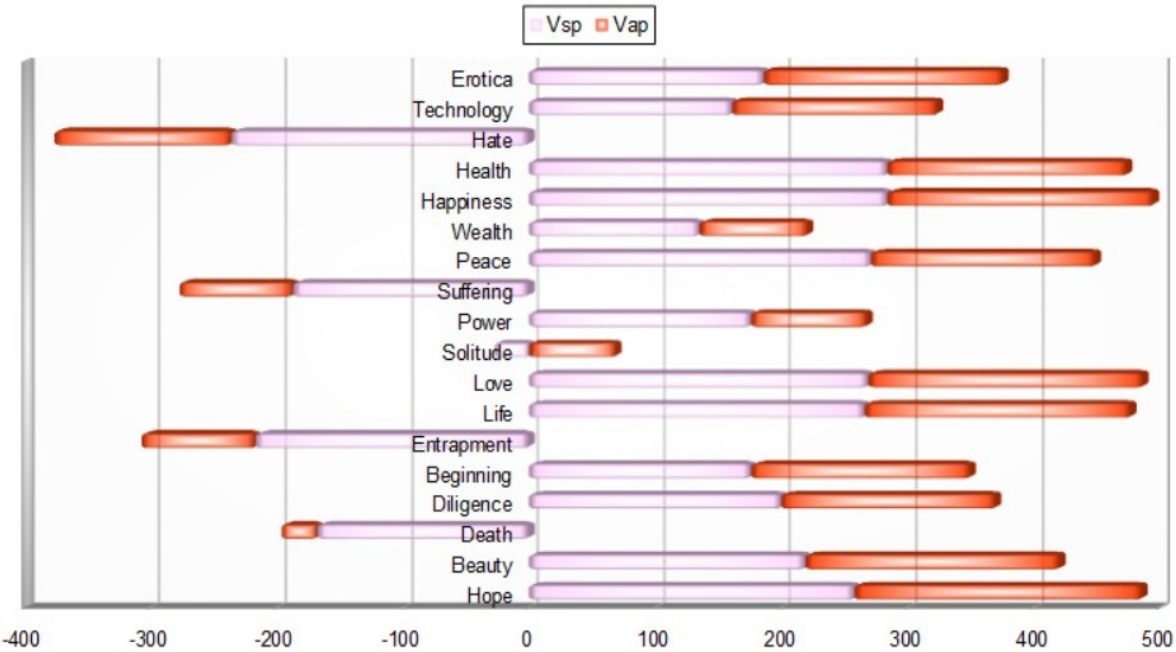
useful for criminal investigators, especially when there is a suspicion of murder. This approach can even be adapted for profiling crime and potential serial killers. More details on this will be provided in the chapter on social nature.
What follows is a description of the predicted research, which was conducted in January 2018 using an online questionnaire.

2.4.4 Positive and negative meaning of symbolic categories and associative concepts

A survey questionnaire was conducted, which was sent in the form of e-lists to respondents from the public administration sector (excluding military, police, and healthcare). These were public servants employed at universities, high schools, research institutes, and ministries (officials, library staff, university professors, high school teachers, etc.). A total of 61 respondents were included, of which one was excluded. 58 respondents answered to stimulative concepts in the form of words, while two respondents answered using numerical symbols.
The data was exported in .xls file format and processed using conventional statistical tools (e.g., Excel) and data mining tools (e.g., Cytoscape, Ora Casos, Orange Canvas). The data were further processed, so that the stimulating terms are capitalized while associative terms are written in lowercase. The questionnaire contained one main question in the form of a composite table, into which respondents entered their ratings and associative terms based on the stimulating words (18 symbolic categories). Other questions regarding demographics, such as gender, employment, age, and marital status, were included. However, we will not focus on the demographic data in this section (although they are interesting; for example, there are significantly more women, and the average age of employees within the public administration under consideration is quite high). Instead, we will concentrate on the analysis of the conceptual network with weights derived from the ratings given by the respondents. In particular, we will examine the collective symbols provided by 60 respondents, as they have a significant impact on people's lives. The negative meaning of certain collective symbols has a proportional impact on the thinking and behavior of most people. The same holds true for collective symbols with positive meanings, as they also strongly influence the mindset and decision-making of a large portion of the world's population, whether we are aware of it or not. The following sections will present the results and analyses concerning the information hierarchy.

2.4.4.1 Table 4: Overall evaluations

SK	*Vsp*	*Vap*	*Totalspap*
Hope	258	228	486
Beauty	219	202	421
Death	-168	-28	-196
Diligence	200	170	370
Beginning	176	174	350
Entrapment	-217	-90	-307
Life	266	211	477
Love	269	218	487
Solitude	-27	69	42
Power	176	92	268
Suffering	-187	-90	-277
Peace	271	178	449
Wealth	135	86	221
Happiness	284	211	465
Health	284	190	477
Hate	-236	-140	-376
Technology	161	163	324
Erotica	186	190	376



2.4.4.2 Figure 21: Bar chart of evaluated symbolic categories and associative terms

Table 4 and Figure 21 (in the form of a bar chart) display the evaluated symbolic categories and associative terms. The meanings of the abbreviations (see Table 4) are as follows:

SK ... symbolic categories

Vsp ... evaluated symbolic categories (stimulating concepts) on a scale from -5, 0 to 5

Vap ... evaluated associative concepts on a scale from -5, 0 to 5

Vsotaspap ... sum of all

Based on the obtained values, it can be concluded that the group of 60 respondents assigns greater importance to positive concepts. They exhibit a positive orientation towards these symbolic categories, which also represent values. These respondents are characterized by high intellectual capital, stable employment (generally leaning towards more rather than less), relatively organized family situations, and a satisfactory amount of financial resources.

In the further exploration of the information hierarchy, a relatively surprising finding was encountered through methods for discovering patterns in data and networks, revealing another deeper or internal aspect of how this group perceives things. The process of experimentation with the software tool Cytoscape (for discovering patterns in networks) will be briefly summarized.[23] The data in XLS format were imported into Cytoscape. A source was identified (stimulating concepts, symbolic categories — values, etc.), and their evaluations were designated as the source attribute. Associative concepts were then defined as the target or objective of the data, and evaluations were established as the target attribute. Additionally, sums were considered as a property of the connection. As a result, a network of stimulating and associative concepts was created.

2.4.4.3 Figure 22: A part of the entire network of symbolic categories and associative concepts

Figure 22 illustrates a portion of the entire network of symbolic categories and associative concepts. The complete network was processed using an integrated application within Cytoscape—CytoHubba—while the degree algorithm was applied to calculate the number of connections for a given node (e.g., for stimulative and associative concepts such as Love, Health, Beauty, Hope, etc.)

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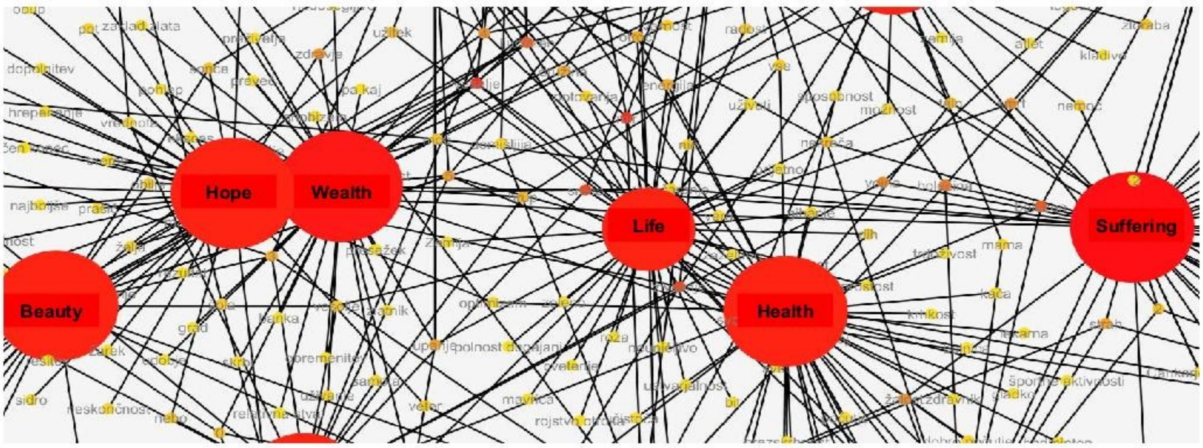
23 Shannon, P., Markiel, A., Ozier, O., Baliga, N. S., Wang, J. T., Ramage, D., Amin, N., Schwikowski, B., & Ideker, T. (2003). Cytoscape: A software environment for integrated models of Biomolecular Interaction Networks. *Genome Research*, 13(11), 2498–2504. https://doi.org/10.1101/gr.1239303.

and to determine how many subnetworks a specific concept contains. The results were as follows (only a part will be shown).

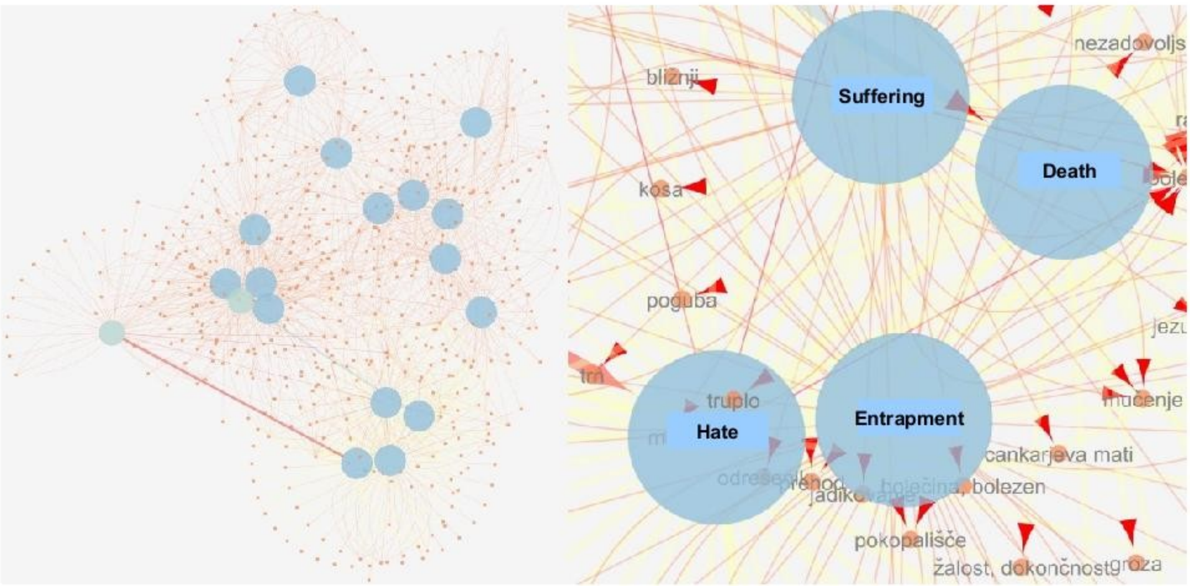
2.4.4.4 Table 5: Achieved ranks of concepts within the network (part)

Rank	*Concept*	*Degree*
1	Hate	61
2	Death	61
3	Erotica	60
4	Technology	60
5	Health	60
6	Happiness	60
7	Wealth	60
8	Peace	60
9	Suffering	60
10	Power	60
11	Solitude	60
12	Love	60
13	Life	60
14	Entrapment	60
15	Beginning	60
16	Diligence	60
17	Beauty	60
18	Hope	60
19	End	23
20	Peace	21



2.4.4.5 Figure 23: A part of the nodes and the shortest paths between them

Table 5 presents the range of concepts and their degree of influence (algorithm: degree), while Figure 23 illustrates a portion of the nodes and the shortest paths between them. The highest rank in terms of node influence is assigned to stimulating words such as Death and Hatred (61). The third rank includes stimulating words such as Suffering, Erotica, Love, Technology, Peace, Beauty (60), etc. Further analysis of the network was conducted using the integrated Network Analyzer application, applying the closeness centrality algorithm for node visualization and determining the shortest path between nodes (short, medium, and long connections). The final result is to be presented in the form of the following network:

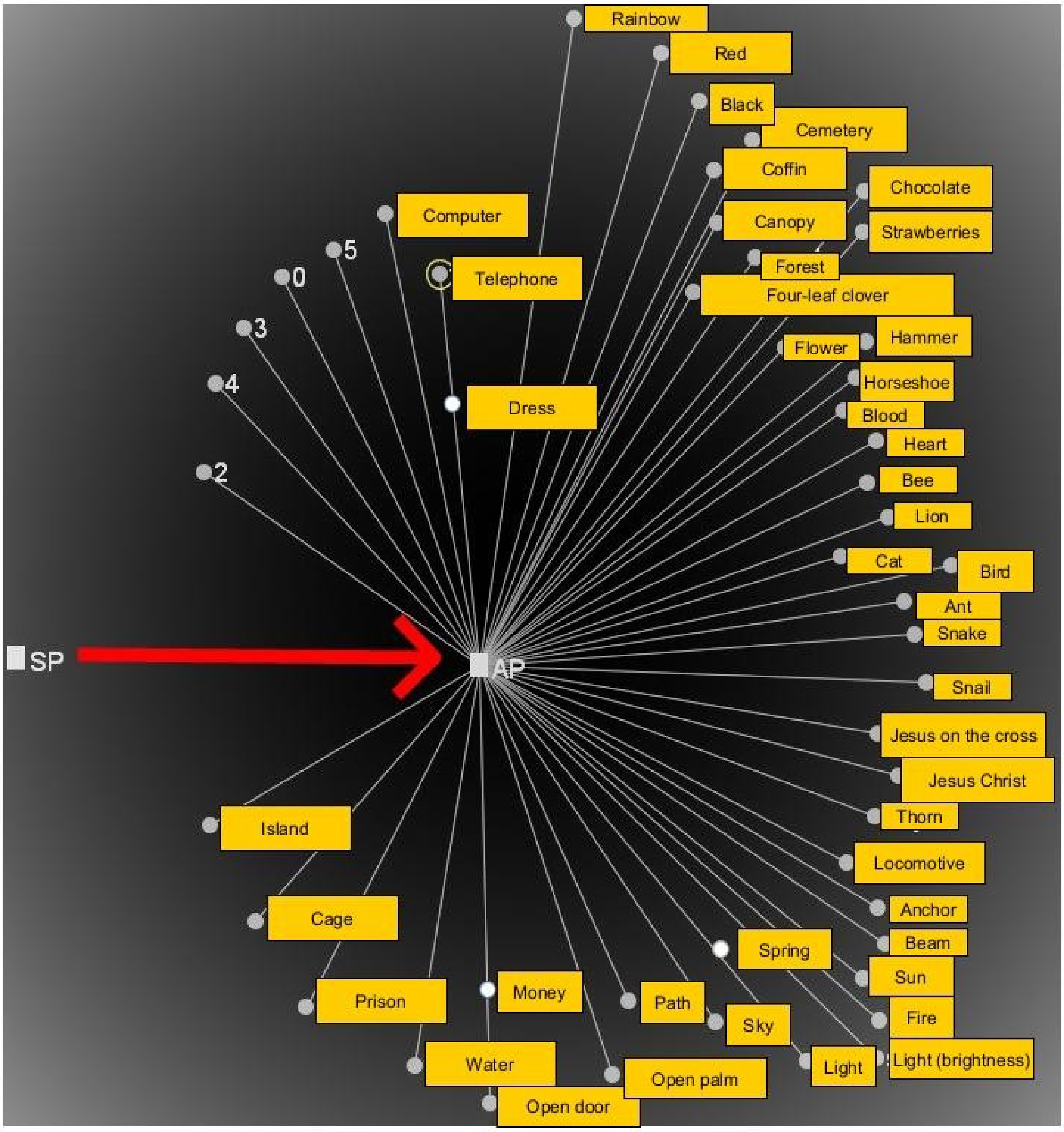


2.4.4.6 Figure 24: The most influential nodes within the entire network

Figure 24 presents the most influential nodes within the entire network (see the left side of Figure 24) and in an enlarged view. The respondents evaluated the given symbolic categories (values) on a global level as positive. They attempt to perceive the world around them in a positive light, believe in positive values, etc. However, they attribute greater intensity and influence to negative entities (e.g., Hatred, Suffering, Loneliness, Death). In their more or less implicit perception, negative aspects appear more intense and powerful (as if implying that happiness is merely a fleeting moment, whereas unhappiness lingers for a longer time).

This study is also indirectly related to a previously conducted research on the impact of stress in everyday life, involving 200 participants from public administration (excluding police, military, and healthcare personnel). A detailed discussion of this research will follow in the next chapter. This underlying negative orientation may lead to less effective processing of negative information or stressors, particularly in individual psychological, performance-related, and social contexts. Consequently, both individuals and societies expend a significant amount of energy.

The central focus is on studying the hierarchy of information (e.g., symbols as powerful concepts, the influence of collective symbols, etc.), yet the psychological aspect is equally crucial. In essence, it remains to be determined what impact collective symbols have. A key characteristic of collective symbols is that their meaning is often predefined for many individuals, lacking a strong personal connotation. Collective symbols emerge as a result of an implicitly or explicitly induced agreement among members of a particular society—within a region, a country, or even across continents. These symbols arise from the effect of induction among people and the internal hierarchy of society. In the next stage, a more detailed examination of the collective symbols provided by the respondents will be conducted.



2.4.4.7 Figure 25: Use of collective symbols by 60 respondents (part)

Figure 25 illustrates the use of collective symbols by 60 respondents based on stimulative concepts (SP) or symbolic categories. In total, respondents provided 1,080 units of associative concepts (AP), of which 538 were diverse APs. Among these, 60 (11.16%) distinct collective symbols were identified as APs.

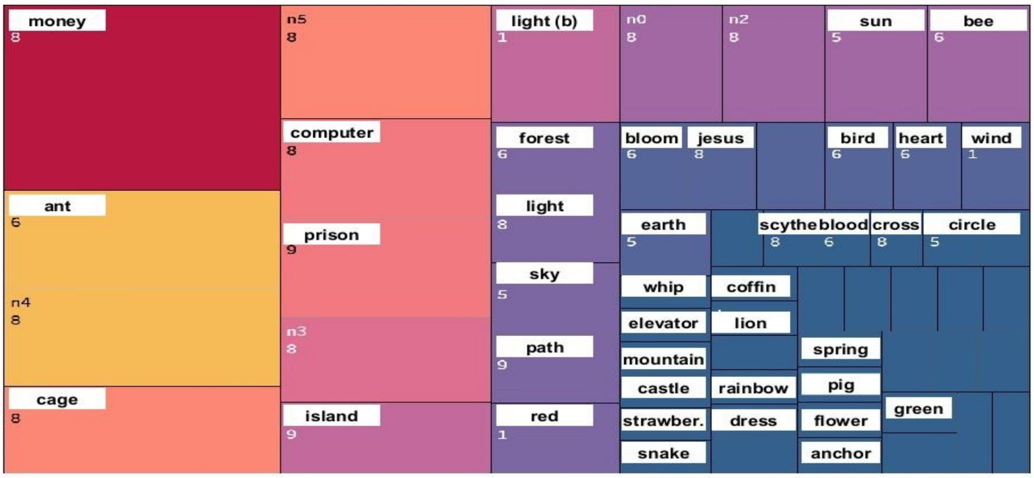
Thirteen respondents (21.70%) did not contribute any collective symbols. This raises a valid question: why did 21.70% of respondents fail to provide even a single collective symbol in response to the given stimulative concepts or strong symbolic categories? It is likely that these individuals are less emotionally expressive and generally non-religious, as we would typically expect more symbolic thinking—especially in the form of collective symbols—from highly emotional and religious individuals.

The collected collective symbols were subsequently analyzed based on their frequency of occurrence and classified using the universal classification system for verbal and non-verbal symbols/words, which had been introduced earlier. The classification process was conducted without any difficulties.

By examining the table (only a portion of the data will be presented) and the visual representation of the tree map, a clear insight into the focal points of responses from 47 respondents will be provided.

2.4.4.8 Table 6: Collective symbols ranked by frequency of occurrence

R	*KS*	*F*	*KE*
1	money	17	8
2	ant	9	6
3	n4	9	8
4	cage	8	8
4	n5	8	8
6	prison	7	9
6	n3	7	8
8	light (brightness)	6	1
9	island	5	9
9	sun	5	5
11	bee	4	6
11	n2	4	8
11	n0	4	8
11	sky	4	5
15	path	3	9
15	forest	3	6
15	red	3	1
15	light	3	8
15	heart	3	6
20	wind	2	1
20	0	2	6
20	jesus	2	8
20	cemetery	2	9



2.4.4.8.1 Figure 26: Tree map of classified collective symbols

Table 6 and figure 26 show the frequency of occurrence of classified collective symbols. The most common responses in the form of collective symbols were:

Money (f=17; KE=8), ant (f=9; KE=6), number 4 (f=9; KE=8), cage (f=8; KE=8), number 5 (f=8; KE=8), computer (f=7; KE=8), prison (f=7; KE=9), number 3 (f=6; KE=8), light (f=5; KE=1), island (f=5; KE=9), sun (f=4; KE=5), bee (f=4; KE=6), number 2 (f=4; KE=8), number 0 (f=4; KE=8), sky (f=3; KE=5), path (f=3; KE=9), forest (f=3; KE=6), red (f=3; KE=1), lamp (f=3; KE=8), heart (f=2; KE=6), wind (f=2; KE=1), flower (f=2; KE=6), Jesus (f=2; KE=8), cemetery (f=2; KE=9), earth (f=2; KE=5), bird (f=2; KE=6), coffin (f=1; KE=8), cross (f=1; KE=8), mirror (f=1; KE=8), black (f=1; KE=1), green (f=1; KE=1), tree crown (f=1; KE=6), circle (f=1; KE=5), whip (f=1; KE=8), elevator (f=1; KE=8), mountain (f=1; KE=5), castle (f=1; KE=8), strawberry (f=1; KE=6), chocolate (f=1; KE=8), snake (f=1; KE=6), lion (f=1; KE=6), hammer (f=1; KE=8), phone (f=1; KE=8), water (f=1; KE=5), scythe (f=1; KE=8), locomotive (f=1; KE=8), blood (f=1; KE=6), rainbow (f=1; KE=1), dress (f=1; KE=8), open palm (f=1; KE=6), open door (f=1; KE=8), fire (f=1; KE=1), horseshoe (f=1; KE=8), four-leaf clover (f=1; KE=6), spring (f=1; KE=10), pig (f=1; KE=6), snail (f=1; KE=6), rose (f=1; KE=6), anchor (f=1; KE=8), and candle (f=1; KE=8).

Under the category of physical-attentional properties (KE1), seven collective symbols were classified: light, red, wind, black, green, rainbow, and fire. The total frequency was 14. There was no use of collective symbols related to performance-related properties (KE2), resulting in a total frequency of 0. Similarly, no collective symbols representing psychological (KE3) or social properties (KE4) were present. The group of inanimate natural properties included collective symbols such as the sun, sky, earth, circle, mountain, and water. The total frequency of these concepts was 12. The group of living natural properties (KE6) included collective symbols such as ant, bee, forest, heart, flower, bird, tree crown, strawberries, snake, lion, blood, open palm, four-leaf clover, pig, snail, and rose. The total frequency was 32.

There were no collective symbols related to health-related biological properties (KE7), resulting in a total of 0.

The largest number of collective symbols belonged to the category of material and intellectual human products and significant figures (KE8). These included money, number 4, cage, number 5, computer, number 3, number 2, number 0, lamp, Jesus, coffin, cross, mirror, whip, elevator, castle, chocolate, hammer, telephone, scythe, locomotive, clothing, open door, horseshoe, anchor, and candle. The total sum was 84.

The category of institutions and their components (KE9) included concepts such as prison, island, path, and cemetery, with a total value of 17.

The category of time periods (e.g., seasons, history) and combined properties included only one concept, spring, which appeared once.

There were no examples classified under the category of undefined properties.

2.4.4.8.2 Table 7: Frequency of classified groups

KE1	***KE2***	***KE3***	***KE4***	***KE5***	***KE6***	***KE7***	***KE8***	***KE9***	***KE10***	***KE11***
14	0	0	0	12	32	0	84	17	1	0

2.4.4.8.3 Figure 27: Outcome of the classification of collective symbols

Table 7 and figure 27 present the same data, namely the number of classified collective symbols within specific classification groups. Since the results were already presented on the previous page, they will not be repeated here. However, these visual representations aim to provide a deeper reflection on the classified collective symbols.

2.4.5 Collective symbols

Within the category of physical-attentional properties, the following collective symbols were analyzed:

a. Light – The association of light was linked four times to the symbolic category "Hope." The total associative connection score (AP) was 16 out of 20 possible points, which is relatively high. Similarly, the total score for the symbolic category "Hope" was 16 out of 20 points. From the perspective of these respondents, the symbolic category (SP) "Hope" represents something very positive, which also applies to the AP "light."

The concept of light can be associated with various other concepts that, like light, can be defined as phenomena, events, processes (including mental processes), and even rules (for example, when a plant withers due to a lack of light). In this context, a customized hierarchical thesaurus could be developed to clearly illustrate the different meanings, aspects, and connections that the concept of light can offer. The result would be an extensive conceptual network of superordinate/subordinate relationships, relative, equivalent, and associative connections, as well as opposites (antonyms).

However, it would exclude the "Use For" relation, as the concept of light is unique (for example, in Slovenian, English, and German).

Light can only be perceived through vision, as other senses such as hearing, touch, and smell cannot assist in its perception. The concept of light carries broad meaning and deep significance. However, in this section, we will not explore all of its aspects in detail but will remain within general conceptual frameworks. Without vision, humans are incapable of perceiving or seeing light.

Light can be observed in various forms: as flickering (e.g., flickering lights), a beam (e.g., a comet's tail), a flame (e.g., the flame of a gas burner), a flash (e.g., a shooting star), and a ray (e.g., a spotlight illuminating a theater stage).

The concept of light can be linked to intellectual and material achievements of humanity, such as science, applied sciences, art, games, sports, candles, lamps, lights, mirrors, magic, and symbols. It is also associated with physical properties (e.g., colors, fire, darkness, and natural phenomena) and inanimate natural properties (e.g., celestial bodies).

Light can also be connected to other properties, such as performance-related, living natural, psychological, and sociological characteristics. However, these associations are more abstract and less hierarchical in relation to the concept of light. Our focus will be on light as a powerful collective symbol, particularly from the perspectives of psychoanalysis and dream symbolism interpretation.

In general, light enables life for all living beings. Its symbolic meaning lies in the hope for a bright future. Without light, plants would wither, as they require it for essential metabolic processes, including oxygen production. Without oxygen, human survival would also be impossible.

Light also regulates the cycle of day and night, which is crucial for vitamin D production, a key factor in strengthening the immune system.

We will now explore the meaning of light from different perspectives: general, dream-related, psychological, and spiritual.

2.5.1 Table 8: The meaning of light in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Life	Cognition + perception	Desire for knowledge	Divinity
Health	Hope, new beginning	Clarity, + development	Spiritual knowledge
Good mood	Secure future, happyness	Erotic desires	Enlightenment

Table 8 presents the meaning of the concept of light from general, dream-related, psychological, and spiritual perspectives. A common thread across all these perspectives is that light carries an exceptionally positive meaning. It is a broad concept with rich symbolic value and can manifest in varying intensities, both in waking and dream states.

Dream Interpretation:

- Excessively bright or red-tinted light, especially in dreams, may indicate strong erotic desires in an individual.
- Dim or foggy light in dreams can have a negative connotation, as it suggests a limited field of vision, making it difficult for the dreamer to make optimal decisions when solving a problem.
- Flickering light in dreams can have a dual meaning—it may either carry a positive message or serve as a warning of an obstacle or danger.

Symbolic Meaning:

Light symbolizes a wide range of ideas, and its meaning is not always direct or unambiguous, much like metaphors. Despite its strong collective symbolic significance, individual interpretations always exist. For instance, the painter Vincent van Gogh perceived light as a threat.

In dream interpretation, it is crucial to consider the individual’s context, the specific meaning of light in the dream, the situation in which it appears, and its intensity.

Hierarchy of Meaning:

In the informational hierarchy, light is a powerful concept that can lead to significant decisions, the birth of new ideas, or even the acquisition of knowledge. Darkness, the opposite of light, carries a strongly negative meaning. Darkness represents evil, misfortune, punishment, disorientation, doom, and death, whereas light symbolizes God, life, salvation, spiritual enlightenment, and happiness.

Spiritual & Religious Connection:

The symbol of light is deeply connected to faith. It originates from ancient times and has evolved and expanded over the centuries, yet it has consistently retained its overwhelmingly positive meaning.

b. Red or the color red

The association of the color red was mentioned three times in connection with symbolic categories such as "Love," "Power," and "Eroticism." The overall associative connection (AP) score was 8 out of 15, which is a relatively moderate rating. The total score for these symbolic categories was 10 out of 15. From the respondents’ perspective, the meaning of red is not exceptionally positive, but it is far from negative, as the values are significantly above the lowest possible score (-15). The concept of red can be linked to various other concepts, such as light, which has already been discussed. Like light, red is perceived through vision, but without light, red cannot be recognized. The perception of red is closely connected to light, and its shades play a crucial role in interpretation. From a dream analysis and psychological perspective, different shades of red can have vastly different meanings. Similar to light, red belongs to the category of physically attention-grabbing properties and is strongly associated with polarized emotions such as love and hatred. Additionally, red can be linked to art, traffic signs, cosmetics, blood, the heart, and other phenomena. As with the symbol of light, the analysis of red will also focus on its general, dream-related, psychological, and spiritual meanings.

2.5.2 Table 9: The meaning of red in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Strong emotions	Life	Passion	Self-image
Signal color	Power, warrior nature	Aggressiveness	Hot energy
Radiating heat	Love and hate	Cholericness	Sexuality

Table 9 illustrates the concept of the color red from the perspectives of general, dream-related, psychological, and spiritual understanding. The common denominator across all these aspects is strong and intense emotions, which can be highly polarized, bringing both positive and negative elements into individuals' lives. While the collective meaning of the red color symbol is prominent,

c. Wind

The association of wind was provided by respondents twice, specifically within the symbolic categories of "Hope" and "Solitude." The total score for associative connection (AC) was 8 out of 10 possible points. The combined score for these two symbolic categories amounted to 10 out of 10 possible points. According to the respondents, the symbol of wind holds an exceptionally positive meaning.

Wind arises due to an imbalance between air pressures, where cold and warm air particles interact. Its fundamental purpose is to establish equilibrium. Wind serves as a general term for various types of winds with differing dynamics. Some winds are pleasant, while others are inconvenient or even dangerous. This indicates that wind carries an exceptionally diverse meaning.

For some people, wind can have a profoundly negative connotation—for instance, when considering severe storms such as tornados, hurricanes, typhoons, and similar phenomena often associated with destruction and loss of life. Such movements of air masses are typically linked to severe natural disasters. Wind is perceived through touch (when it blows against our face) and sight (when observing the movement of objects, branches, etc.).

Interestingly, respondents did not associate wind with natural disasters, as its overall meaning for them was overwhelmingly positive. Like light and the color red, wind can also be categorized within the first group (attention-grabbing physical properties).

In summary, the significance of wind spans extremes. Its primary function, as mentioned earlier, is to restore balance and purify the air from various impurities. This plays a crucial role in the atmosphere by preventing excessive concentrations of harmful or toxic gases in specific areas that could threaten human health and other living beings. Wind is particularly important in regions with numerous factories known as major air polluters.

In this context, it is not just about toxic gases but also about fine carcinogenic particles carried through the air. Additionally, motor vehicle activities—often intense and numerous in industrial areas—further contribute to air pollution.

Similar to the color red, which includes shades, wind also exhibits varying degrees of intensity in moving air masses. Different types of wind that may appear in dreams carry distinct meanings during dream interpretation. Thus, the symbol of wind is not equivalent to specific winds (e.g., typhoons, hurricanes, tornados, trade winds, tropical cyclones, blizzards, breezes, maestrals, or bora winds) but requires consideration of the dynamics behind its various meanings.

Many manifestations of wind emphasize its destructive power; however, from an objective perspective, the function of hurricanes or tornados is similar to milder winds—both aim to restore balance.

2.5.3 Table 10: The meaning of wind in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Power	Rationality	Spiritual power	Spiritual power
Speed	Obstacles + turbulences	Instability	Soul power
Cleansing + relaxation	Nova energija	Violence	Spiritual progress

Table 10 illustrates the concept of wind from general, dream-related, psychological, and spiritual perspectives. The common denominator across all these aspects is power, which can lead to either positive or negative outcomes. The collective meaning of the wind symbol can be ambiguous, so when interpreting dreams, it is necessary to consider the strength, direction, and intensity of the wind. This collective symbol can carry a very strong individual meaning, especially for individuals who have experienced the devastating effects of hurricanes, tornados, typhoons, and similar phenomena.

d. Black color

This associative concept appeared only once, in connection with the symbolic category "Death." As expected, this concept was evaluated very negatively, with a score of -3 out of a possible -5 points. The symbolic category "Death" was rated even worse, receiving a score of -5 out of a possible -5

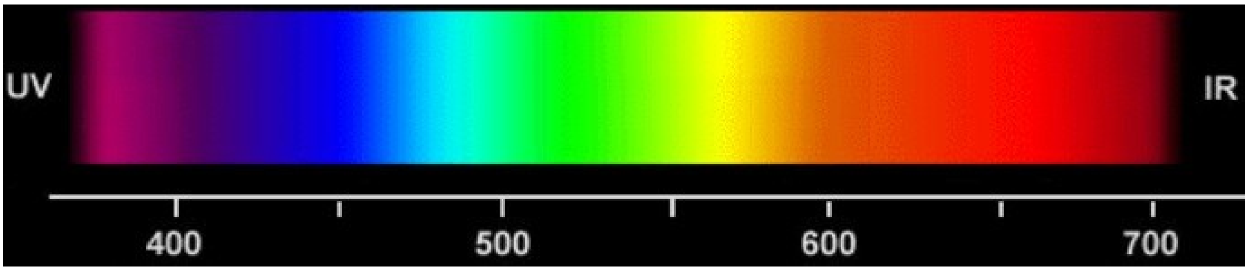
points. Black color can also be classified within group 1, i.e., attention-grabbing physical properties. Black color (similar to red) can be perceived solely through light and visual perception.
Black is the opposite of white, which is why it is often associated with darkness—a space without light. It is frequently interpreted as something negative, especially in connection with death and misfortune (for example, when a black cat crosses our path). However, black can also carry a positive meaning—for instance, it is associated with elegant clothing, creativity, and even with chimney sweeps, who are believed to bring good luck.

2.5.4 Table 11: The meaning of black in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Darkness	Darkness + sadness	Darkness	Darkness
Death	Personality traits	Subconscious	Emptiness
Elegance + creativity	Ingenuity	Internal contradiction	Women's power

Table 11 illustrates the concept of the black color from general, dream-related, psychological, and spiritual perspectives. The common denominator across all these aspects is darkness, which can carry a positive or negative sign. Darkness can be interpreted as something from which new things emerge, or it can be associated with sorrow and death. The collective meaning of the black color symbol has a pronounced negative connotation; however, caution is required when interpreting dreams, as despite its negative association, it does not necessarily represent something negative in a specific context.
This collective symbol has a weaker individual meaning, except for individuals who dislike light (for example, those who enjoy chaos and darkness). Black color can be associated with fertile soil for certain individuals (e.g., farmers).
e. Green color
The association of the green color was provided once, based on the symbolic category "Life." The total score for associative connection (AC) was 4 out of 5 possible points, which is a high rating. The combined score for the mentioned symbolic category was 5 out of 5 possible points.
From the respondent's perspective, the green color has a very positive meaning (the combined score for the symbolic category and the associative concept was 9 out of 10 possible points). Colors in general (e.g., red, black) can be associated with light. Green color, similar to light, is perceived through sight, but without light, green color cannot be recognized.

Green color is the result of the synthesis or mixing of two primary colors—blue and yellow. Since it arises from the combination of a cool color (blue) and a warm color (yellow), green is attributed the property of balance between warmth and coolness.



2.5.5 Figure 28: Color spectrum or color perception

Figure 28 illustrates the color spectrum or color perception. Cool colors (e.g., blue) have a higher frequency and shorter wavelength, while warm colors (e.g., yellow) have a lower frequency and longer wavelength. Green color is located approximately in the middle of this color spectrum, i.e., after blue and before yellow. All colors are the result of illumination with white light and the functioning of our visual perception system. Additionally, it should be noted that white and black are not physical colors.

2.5.5.1 Table 12: The meaning of green in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Hope Untouched nature	Spring Happiness	Interpretation of reality Growth + development	Hope Imagination
Calms the psyche	Loyal friendsImmaturity	Immaturity	Balance of spirit

Table 12 illustrates the concept of the green color from general, dream-related, psychological, and spiritual perspectives. The common denominator in both general and spiritual views is hope. When interpreting the meaning of green, it is important to be mindful of its shade (e.g., light green can be interpreted as the "color of the devil," which has an extremely negative connotation).
Green color is generally a very positive collective symbol, as it is associated with vegetation, without which humanity could not survive. This collective symbol has a weaker individual meaning, except for individuals who dislike green or associate it with negative aspects, such as green poison (e.g., chemists who often work with the toxic gas chlorine, which is light green and has an unpleasant odor). Green color is often perceived as a symbol of balance, calming the psyche and stimulating the release of certain happiness hormones.
f. Rainbow – The association of the rainbow was mentioned once, based on the symbolic category "Life." The total score for associative connection (AC) was 5 out of 5 possible points, which is an exceptionally high rating. The combined score for the mentioned symbolic category was 3 out of 5

possible points. According to the respondent, the rainbow has a positive meaning related to life (the combined score for the symbolic category and the associative concept was 8 out of 10 possible points). In general, it should be emphasized again that the rainbow is very closely linked to light. Like other phenomena, it is perceived through sight, as without light, we would not be able to see rainbows. The rainbow is the result of the interaction between sunlight and gentle rain. In all its beauty, the rainbow appears to us as flowing colors in the sky, forming a characteristic arc that rises and falls.

2.5.5.2 Figure 29: Example of a double rainbow

Figure 29 illustrates an example of a double rainbow. We perceive various colors within a strictly defined range, from red, yellow, green, light blue, dark blue to violet. A rainbow occurs when sunlight rays, which appear white (sunlight contains different colors), meet water droplets that act as glass prisms or mirrors, from which light is reflected. The result of this natural process is the aforementioned colors, which we perceive with our visual system.

2.5.5.3 Table 13: The meaning of a rainbow in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Colorfulness	Peace + Understanding	Creativity + happiness	Bridge to the beyond
Happiness	Happiness	Merging opposites	Spiritual happiness
Treasure	Success	Strength Consciousness	God's speech

Table 13 illustrates the concept of the rainbow from general, dream-related, psychological, and spiritual perspectives. The common denominator across all these aspects is happiness. When interpreting the meaning of the rainbow, there are generally no difficulties, as this collective symbol is widely agreed to represent something distinctly positive. However, in some rare cultures or tribes, the rainbow can also have a strongly negative meaning, likely due to negative collective and individual experiences. In our European context, the positive meaning of the collective rainbow symbol is entirely clear, as it represents happiness, wealth, peace, understanding, creativity, strengthening of consciousness and spirit. Even from the perspective of our visual perception, viewing a rainbow encourages the release of certain happiness hormones.

g. Fire – This association was provided once, based on the symbolic category "Power." The total score for associative connection (AC) was 3 out of 5 possible points, which is a moderately high rating. The combined score for the mentioned symbolic category was 1 out of 5 possible points. From the respondent's perspective, fire has a more positive meaning than the symbolic category "Power" (the combined score for the symbolic category and the associative concept was 4 out of 10 possible points). Fire is very closely linked to light and warmth. With the collective symbol of fire, we encounter a phenomenon that can be perceived both visually and through touch for the first time. Fire is a source of light that darkness cannot conceal.

2.5.5.4 Table 14: The meaning of fire in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Light + brightness	Strong emotions	Strong emotions	New consciousness
Heat	Creativity	Psychic energy	Spiritual power
Danger	Danger	Danger	Transformation

Table 14 illustrates the concept of fire from general, dream-related, psychological, and spiritual perspectives. The common denominator across all these aspects is happiness. When interpreting the meaning of fire, difficulties can arise, as the collective meaning of fire can be both positive and extremely negative. Precisely because of this, it is necessary to be mindful of the context in which fire appears. Fire, along with water, air, and earth, is one of the most important dream symbols. Fire particularly expresses strong emotions and/or danger. Fire is a natural force (similar to wind) that humans can only partially control.

Fire can also be linked to Greek mythology. The demigod Prometheus stole fire from the Greek gods and brought it to humans. By doing so, he revealed the secret of the gods, for which Zeus severely punished him for eternity. Fire, if manageable, means something very positive; in the opposite case, fire can be associated with severe catastrophes that cause significant material costs and can claim numerous lives of various living beings (humans, animals, and vegetation).

Collective symbols from the group of action-related, psychological, and social properties were not present. Collective symbols apparently do not directly express these properties. The following collective symbols were classified into the group of non-living natural properties (group 5):
a. Sun – This association was provided four times based on symbolic categories such as "Hope," "Beauty," and twice "Happiness." The total score for associative connection (AC) was 18 out of 20 possible points, which is a very high rating. The combined score for the mentioned symbolic categories was 20 out of 20 possible points. From the respondents' perspective, the symbolic categories have an even more positive meaning than the collective symbol of the sun (the combined score for the symbolic categories and the associative concept was 38 out of 40 possible points). The sun is one of the natural sources of light, which is of great importance for the entire ecosystem. We perceive the sun not only visually but also through touch, as it radiates heat, similar to fire. Unlike fire, darkness can hide the sun, as when it is night on one side of the Earth, it is daytime on the other. In astronomy, we know of many diverse suns, which we refer to as stars. Notably, our Sun is also a star, albeit a relatively static one. In everyday and symbolic contexts, we do not view the sun as a star. In collective symbolism, the concept of a star (like the sun) occupies a special place. The association "sunset" also appeared in this survey, which a respondent linked to the symbolic category "Beauty." Both the symbolic category "Beauty" and the collective symbol of sunset achieved the maximum number of points. From an aesthetic perspective, a sunset is exceptional, but it can be associated with a period that is ending (e.g., the decline of human civilization).

2.5.5.5 Table 15: The meaning of the sun in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Light (b)	Prosperity	Creativity	Spiritual enlightenment
Heat	Challenges	Optimism	Growth of knowledge
Well-being	Positive changes	Resistance	Spiritual wisdom

Table 15 illustrates the significance of the sun from general, dream-related, psychological, and spiritual perspectives. As a collective symbol, the sun predominantly carries an exceptionally positive meaning. However, in various modifications (e.g., solar eclipse, red sun), the sun—particularly in dreams—can also have a negative meaning (e.g., indicating upcoming depressive states). The symbolism of a sunset can also, to some extent, be classified within this negative context, though its interpretation largely depends on the life situation and/or status of the dreaming individual. While a sunset can be associated with romantic events, it can also signify the conclusion of a pleasant period of life. Essentially, a sunset represents the transition from extraordinary blissful happiness to everyday normalcy. The subconscious and conscious mind of an individual come closer together, allowing for a clearer perception of the world. The sunset marks the end of a certain phase in the life of an individual and even an entire civilization.

b. The Sky – This association was referenced three times, based on two symbolic categories: "Hope" (twice) and "Peace" (once). The total score for AP ratings was 14 out of a possible 15, which is a very high rating. The combined total for the mentioned symbolic categories was 15 out of 15 possible points. From the perspective of these respondents, both symbolic categories carry an even more positive meaning than the collective symbol of the sky itself (the total score for the symbolic categories and the associative concept amounted to 29 out of 30 possible points). The concept of the sky holds different meanings across various social groups. For religious individuals, the meaning of heaven lies in their belief in an afterlife, where heaven is the place for righteous and well-intentioned people. Heaven is the paradise for those who have demonstrated good thoughts and deeds during their earthly existence. For atheists, however, this notion does not apply, as for them, the sky above us has no function related to an afterlife—it is merely an immense space surrounding our planet. Regardless of whether one is religious or not, the collective symbol of the sky carries a highly positive meaning. Based on this premise, the influence of this concept on human thought is profound. The sky, or heaven, is a powerful concept and ranks high in the hierarchy of information. In the celestial sphere, we see the sun during the day and constellations at night. We perceive the sky as a kind of dome or even as the roof of our earthly world.

2.5.5.6 Table 16: The meaning of the sky in general, in dreams, from a psychological perspective, and in spirituality

In general	***In dreams***	***Psychological***	***Spiritual***
Afterlife	Freedom	Positive attitude	Infinity
Happiness/contentment	Future journey	Longing	Power of destiny
Sense of freedom	Money gain	Self-confidence	Afterlife spirit

Table 16 illustrates the significance of the collective symbol of the sky from general, dream-related, psychological, and spiritual perspectives. As seen in the table, the meaning of the concept of the sky is largely very positive. The sky embodies freedom, happiness, success (e.g., financial gain), adventure (e.g., travel), and a positive attitude toward our world. However, in certain situations—such as when the sky appears with clouds—its meaning in dreams is no longer positive; instead, the subconscious tries to warn of upcoming problems that may be difficult to resolve. A negative interpretation of the sky in dreams can also arise when an individual is floating in place, which may indicate that the person needs to be mindful of their perception of reality, as anyone can, to some extent, lose their sense of stability.

c. Earth – This association was referenced twice based on the symbolic categories of "Life" and "Power." The total AP rating was 8 out of a possible 10, which is a very high score. The combined rating of both symbolic categories was 9 out of 10 possible points. From the perspective of these respondents, the symbolic categories carry a slightly more positive meaning than the collective symbol of Earth itself (the combined rating of both symbolic categories and the associative concept amounted to 17 out of 20 possible points). The term "Earth" does not always refer to the same thing; in this context, it can mean both the celestial body and the material found on its surface (e.g., humus, brown soil). The Earth's surface contains not only materials but also living beings. Planet Earth is densely populated with diverse life forms, ranging from plants to animals (from a biological standpoint, humans are classified as animals, as this field does not adhere to strict anthropological views that consider humans entirely unique). The Earth is fertile, making it a symbol of growth. It orbits the sun, with one half illuminated while the other remains in darkness. From this alone, we can conclude that the collective symbol of Earth is not solely positive.

Earth is also associated with both the Old and New Testaments, as, according to religious beliefs, God created the Earth before creating living beings. Additionally, Earth symbolizes motherhood, a concept closely tied to religious traditions (e.g., the Earth gives and takes life).

2.5.5.7 Table 17: The meaning of the earth in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Growth	Happiness	Depth of subconscious	Fertility
Planet	Success	Social order	Mother spirit
Material	Life crisis	Desire for energy	Life energy

Table 17 illustrates the significance of the collective symbol Earth/earth from general, dream-related, psychological, and spiritual perspectives. As seen in the table, the meaning of this concept is generally positive, though it can also represent something highly negative. Earth symbolizes growth, happiness, success (e.g., financial gain), motherhood, and life energy. If the material earth appears soft in dreams, it may indicate a desire for maternal attention. In contrast, hard, unyielding earth in dreams can serve as a health warning. Another notable dream phenomenon is the appearance of orange earth, which essentially foretells a pleasant journey.

d. Circle

This association was referenced once, based on the symbolic category of "Beauty." The total AP rating was three out of five possible points, indicating a moderately high rating. The mentioned symbolic category received four out of five points. From the perspective of this respondent, the symbolic category carries a slightly more positive meaning than the collective symbol of the circle itself (the combined rating of the symbolic category and associative concept was seven out of ten possible points).

The circle is an ancient mythological symbol that was already known in early human communities. It has traditionally embodied femininity, completeness, and wholeness. The circle has no true beginning or end, although it is possible to designate a starting and ending position for certain movements within it. A good example of this is a round clock, which measures time (e.g., 6:00 AM marks the start of the day, while 12:00 AM signifies the end of the day).

In its pure, abstract form, a circle has no specific direction, and all points on its circumference are equidistant from the center. The ancient Egyptians already used the circle in geometry to measure circular areas. Much more could be written about circles, as they are linked to numerous models across various sciences (e.g., the planetary system—planets orbiting the Sun in circular paths, the movement of electrons around a positively charged nucleus, which is also represented using circles). However, delving further into this topic would exceed the scope of this book.

2.5.5.8 Table 18: The meaning of the circle in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Feminity	Optimism	Wholeness and infinity	Divine protection
Perfection	Circle of friends	Psychic power and love	Eternity of spirit
Wholeness	Cohesion	Disorientation	Wholeness of spirit

Table 18 illustrates the significance of the collective symbol of the circle from general, dream-related, psychological, and spiritual perspectives. As seen in the table, the meaning of this concept is predominantly positive. The circle primarily represents wholeness, eternity, and perfection. However, it can also symbolize being trapped in a cycle or following a set path without change. Along with other mythological symbols such as the cross, center, and square, the circle is one of the oldest and most fundamental symbols of human civilization, appearing across the globe and in various cultures.

e. Mountain

This association was referenced once, based on the symbolic category of "Peace." The total AP rating was four out of five possible points, indicating a high score. The mentioned symbolic category was also rated four out of five points. From the perspective of this respondent, the symbolic category carries the same positive meaning as the collective symbol of the mountain itself (the combined rating of the symbolic category and associative concept was eight out of ten possible points). A mountain can be viewed as a relatively untouched part of nature. It is majestic and, for many, inaccessible. However, there are people known as alpinists who see every mountain's inaccessibility as a challenge. They strive to conquer certain mountains, often risking their own lives in the process.

2.5.5.9 Table 19: The meaning of the mountain in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Omnipotence	Personal goals	Personality conflict	Human existence
Relaxation	Self-confidence	Relationship self/others	Connects heaven/earth
Sport	Challenge	Self-confidence	Human energy

Table 19 illustrates the significance of the collective symbol of the mountain from general, dream-related, psychological, and spiritual perspectives. As seen in the table, the meaning of this concept is predominantly positive. The mountain primarily represents the achievement of personal goals, strengthening self-confidence, recreation, sports, and relaxation. Additionally, the mountain can symbolize the meeting point between the sky and the earth. Metaphorically, a mountain can be seen as a ladder to another world.

f. Water

This association was referenced once in the phrase "flowing water", based on the symbolic category of "Suffering." The total AP rating was four out of five possible points, which is a high score. However, the symbolic category itself was rated significantly lower, as the respondent gave it zero points—a neutral score within a broad rating scale ranging from -5 to +5. From the perspective of this respondent, the symbolic category has a significantly less positive meaning than the collective symbol of flowing water itself (the combined rating of the symbolic category and associative concept was four out of ten possible points).

Water is undeniably one of the most essential substances on our planet. Without water, life on Earth would not be possible. Water exists in various forms: on one hand, there is still water (e.g., lakes), and on the other, flowing water (e.g., rivers). Alongside earth, fire, and air, water is one of the four fundamental elements of life. According to Thales, all other substances originate from water, as it is the most abundant element on Earth.

Water is unique in that it is the only substance that naturally exists in all three states of matter. It can be found in:

- Solid form (ice, snow)
- Liquid form (water)
- Gaseous form (water vapor)

Completely pure natural water is extremely rare, with rainwater being considered one of the purest forms.

2.5.6 Table 20: The meaning of water in general, in dreams, from a psychological perspective, and in spirituality

Splošni vidik	*Pomen v sanjah*	*Psihološki vidik*	*Duhovni vidik*
Source of life	Feminity	Psyche cleansing	Spirit cleansing
Thirst	Cleansing	New beginning	Body cleansing
Chemical compound	Emotions	Loss of Control	Life energy

Table 20 illustrates the significance of the collective symbol of water from general, dream-related, psychological, and spiritual perspectives. As seen in the table, the meaning of water is highly positive. Water primarily represents the source of life, purification of the spirit and body, emotions, and vital energy. The collective symbol of water is deeply interconnected with various concepts, fields, and sciences, making it an extremely common element in human thought. One could even argue that water is constantly present in our consciousness. It is not only the most abundant substance in nature but also plays a significant role in our brains and thought processes.

Living Natural Characteristics (KE6) – Collective Symbols

The following collective symbols fall under this category:

a. Ant

This association was referenced nine times as the phrase "ant" based on the symbolic category of "Diligence." The total AP rating was 29 out of 45 possible points, which is a relatively low score. The symbolic category itself was rated 28 out of 45 possible points. Surprisingly, respondents rated this symbolic category lower than expected, despite diligence being considered a highly valued personal and cultural trait.

Interestingly, many cultures attribute human-like qualities to ants, reflecting how deeply embedded this symbol is in various traditions. Throughout this study, we have encountered several collective symbols that do not have a clear, unambiguous meaning based on their symbolic category. However, the collective symbol of the ant holds a distinct and universally understood meaning for respondents. The combined score of the symbolic category and associative concept was 57 out of 90 possible points.

Ants are primarily associated with diligence and strong organizational skills. They are highly collective beings, prioritizing the well-being of their community over individual desires. As a result, humans generally perceive them as uniform, with little distinction between individual and collective roles.

Entomologists have identified around 13,000 different species of ants, all sharing the common trait of living in massive colonies. Ants hunt for food, cultivate fungi, and "milk" aphids—making them, in some ways, the most similar to humans among all insect species.

Although ants are somewhat related to termites, the latter belong to a different biological order, being more closely related to mantises. In ant colonies, the queen sits at the top of the social hierarchy, physiologically distinct from other members of the colony. So far, researchers have not observed significant differences in brain function between the queen and worker ants. However, the queen's primary role is reproduction, ensuring the survival and continuation of the ant colony.

2.5.6.1 Table 21: The meaning of an ant in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Diligence	Happiness	Mental disorders	Diligence
Good organization	Success	Danger	Intelligence
Collective beings	Inactivity	Psychosis	Collective energy

Table 21 presents the significance of the collective symbol of the ant from general, dream-related, psychological, and spiritual perspectives. From general, dream-related, and spiritual perspectives, the ant holds a distinctly positive meaning. However, this is not the case in the psychological interpretation of dreams. The ant primarily represents diligence, good organization, and strong collective energy. From a psychological perspective in dream interpretation, however, it mainly serves as a warning about dangerous situations and psychological disturbances.

b. The Bee – This association was mentioned four times based on the symbolic category of "Diligence." The total AP score was 15 out of a possible 20 points, which is a high rating. This symbolic category received a score of 12 out of 20 points. Somewhat surprisingly, respondents rated this symbolic category lower than expected. Many nations attribute human and cultural traits to this insect. The collective symbol of the bee also has an unambiguous meaning within its symbolic category. Respondents likewise perceived the significance of the bee as clear-cut. The combined score for the symbolic category and associative concept was 27 out of 40 possible points.

The bee is an extremely diligent creature, highly organized, and of great benefit to nature and, consequently, to humans. While it may seem that there is no room for individuality in a beehive with its strict hierarchical structure, scientists have discovered that individual differences do exist. However, the bee "police" ensure that the hierarchical order of the hive remains intact. Bees produce an exceptionally beneficial substance called honey and contribute to the growth and flourishing of plants. Like ants, bees also have a queen, who physiologically differs from the other bees. Similar to the ant queen, she plays a crucial reproductive role, ensuring the survival of the bee colony.

2.5.6.2 Table 22: The meaning of the bee in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Diligence	Diligence	Sacrifice	Diligence and order
Good organization	Happiness	Adaptability in society	Immortality
Collective beings	Success	Psychological stability	Rebirth

Table 22 presents the significance of the collective symbol of the bee from general, dream-related, psychological, and spiritual perspectives. From all perspectives, the bee has a distinctly positive meaning. It is a synonym for diligence, good organization, and strong collective energy. In the psychological interpretation of dreams, it primarily represents mental and social stability.
c. The Forest – This association was mentioned three times based on two symbolic categories: "Solitude" (once) and "Peace" (twice). The total AP score was 13 out of a possible 15 points, indicating a high rating. These symbolic categories were rated slightly lower, receiving 11 out of 15 possible points. As a collective symbol, the forest primarily represents an ecosystem, relaxation, and oxygen production. Without forests, human survival would be significantly more difficult. Forests vary not only by tree type (e.g., oak, spruce) but also in their appearance, especially in Central and Western Europe, where they change with the shifting of the four seasons.

2.5.6.3 Table 23: The meaning of the forest in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Ecosystem	Feminity	Subconscious	Psyche
Excursion/walks	Happiness	Soul journey	Feminity
Disorientation	Unluck e.g. divorce	Lost values	Spiritual energy

Table 23 presents the significance of the collective symbol of the forest from general, dream-related, psychological, and spiritual perspectives. In dream interpretation, the forest can also have a

negative meaning, particularly when the dreamer finds themselves in a dark, dense, and impenetrable forest. However, the overall meaning of the forest symbol is positive, as it brings relaxation and joy in the waking world through its growth, blossoming, and delightful scents.
d. The heart – This association was mentioned four times based on the symbolic category of "Love." The total AP score was 17 out of a possible 20 points, indicating a high rating. This symbolic category was rated slightly lower, receiving 16 out of 20 possible points. The combined score for the symbolic category and associative concept was 33 out of 40 possible points.
The heart, along with the brain, is one of the most important organs in the human body. It ensures that all other organs receive essential nutrients and oxygen. Additionally, it maintains blood circulation, allowing blood to flow throughout the body. As a collective symbol, the heart is synonymous with love and other positive emotions.

2.5.6.4 Table 24: The meaning of the heart in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Blood circulation	Love	Love	Staying
Oxygen provider	Psycholog. Well-being	Passion	Soul energy
Positive emotions	Emotional Problems	Longing	Strong emotions

Table 24 presents the significance of the collective symbol of the heart from general, dream-related, psychological, and spiritual perspectives. In dream interpretation, the heart can also have a negative meaning, particularly when strong emotions involve hatred. However, the overall meaning of the heart symbol is extremely positive, as it represents the flourishing of positive emotions that give a person a strong sense of purpose and a harmonious rhythm in life.
e. The Flower/bloom – This association was mentioned once based on the symbolic category of "Beauty." The total AP score was three out of a possible five points, indicating a moderate rating. This symbolic category was rated slightly lower, receiving two out of five possible points. The combined score for the symbolic category of Beauty and the associative concept was five out of 10 possible points, which is an average-to-high rating.
Flowers/blooms are not only significant from an aesthetic perspective but are also crucial for the reproduction of plant species. Additionally, they have a strong connection to previously discussed collective symbols. Flowers/blooms generally have a profoundly soothing effect on our mood, as many have a pleasant fragrance and an attractive appearance.

2.5.6.5 Table 25: The meaning of the flower/bloom in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Reproduction	Benefits	Personality flourishing	Empathy
Colorfulness	Fresh energy	True life path	Love
Pleasant smells	Birth of ideas	Vanity/arrogance	Mental energy

Table 25 presents the significance of the collective symbol of the flower from general, dream-related, psychological, and spiritual perspectives. In dream interpretation, the flower generally has a positive meaning, as it symbolizes blossoming both in a biological and personal sense, indicating a very favorable process. It is somewhat surprising that such a beautiful symbol received a relatively low rating.

f. Bird/Birds – This association was mentioned twice based on the symbolic categories of "Diligence" and "Love." The total AP score was nine out of a possible 10 points, indicating a very high rating. These symbolic categories were rated slightly lower, receiving seven out of 10 possible points. The combined score for both symbolic categories and the associative concept was 16 out of 20 possible points, which is a fairly high rating.

Birds are more commonly seen as a symbol of freedom and independence rather than diligence and love. However, both perspectives can be argued based on situational context: birds diligently build nests for their young, and two white doves symbolize love. When interpreting birds as a dream symbol, it is essential to consider the type of bird and the state and situation in which it appears. The most characteristic feature of most birds is their ability to fly, which has long been one of humanity's greatest desires. However, birds are not only known for their ability to fly—they also play an important role in the ecosystem. For example, their droppings can contain seeds from various flowers and fruits, aiding in plant reproduction. Additionally, they consume a large number of insects, which is particularly beneficial when insect populations become excessive.

2.5.6.6 Table 26: The meaning of the bird/birds in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Flying	Freedom	Subconscious	Soul
Freedom	Carefree	Disorientation	Holy spirit
Independence	Human soul	Self-image	Journey to heaven

Table 26 presents the significance of the collective symbol of the bird/birds from general, dream-related, psychological, and spiritual perspectives. In dream interpretation, birds can have both positive and negative meanings (e.g., an aggressive bird in a dream may symbolize a loss of balance, while two white doves represent peace). Overall, this symbol primarily represents freedom and the human soul.

g. The Canopy – This association was mentioned once based on the symbolic category of "Entrapment." The total AP score was four out of a possible five points, indicating a high rating. However, the symbolic category itself was rated significantly lower, receiving zero out of five possible points. The combined score for the symbolic category and associative concept was four out of 10 possible points, which is relatively low. The canopy is the upper part of a tree, representing its peak and, in a broader sense, the connection between the sky and the earth.

2.5.6.7 Table 27: The meaning of the canopy in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Peak	Ascension	Personality development	Esoteric connection
Form	Intellectuality	Intellectuality	Intellectual energy
Type	Human soul	Superego	Human soul

Table 27 presents the significance of the collective symbol of the canopy from general, dream-related, psychological, and spiritual perspectives. In dream interpretation, the canopy primarily has a positive meaning, relating to aspects of human personality (e.g., intelligence, thought, the superego, and personal development).

h. Strawberries – This association was mentioned once based on the symbolic category of "Eroticism." The total AP score was two out of a possible five points, which is surprisingly low. The symbolic category itself was also rated at two out of five possible points. The combined score for the symbolic category and associative concept was four out of 10 possible points, which is relatively low. Strawberries are a popular food source, both for certain animal species and for humans. These fruits were already known during prehistoric times, as they were an important food source for gatherers. Strawberries primarily grow in the Northern Hemisphere, while they do not thrive in the Southern Hemisphere (with the exception of Chile). Strawberries are also often associated with luxury, as they are commonly enjoyed with champagne by wealthy individuals.

2.5.6.8 Table 28: The meaning of strawberries in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Fruit	Love	Sexuality	Spiritual achievement
Food source	Immortality	Friendship	Spiritual desires
Sweetness	Sweet expectations	Erotic adventures	Erotic energy

Table 28 presents the significance of the collective symbol of strawberries from general, dream-related, psychological, and spiritual perspectives. In dream interpretation, strawberries primarily have a positive meaning, symbolizing love, sexuality, immortality, and friendship. However, in certain contexts—such as when strawberries are scattered—their meaning can be associated with disappointment.

i. The Snake – This association was mentioned once based on the symbolic category of "Health." The total AP score was negative three out of a possible five points, which is, as expected, a very low rating since snakes are often associated with venomous creatures. However, this symbolic category received the maximum possible score. The combined score for the symbolic category and associative concept was two out of 10 possible points, which is a low rating.

The snake appears in the Bible as a tempter, responsible for Adam and Eve's expulsion from Paradise. It is often seen as the embodiment of evil, symbolizing betrayal, deception, intrigue, and poison—although not all snakes are venomous. Despite these negative connotations, the snake as a symbol is not entirely negative. A snake wrapped around an upright staff can represent balanced health, and in some contexts, the snake symbolizes positive transformation and a fresh new beginning in life.

2.5.6.9 Table 29: The meaning of the snake in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Reptile	Evil seductress	Sexuality	Infinite energy
Monster	Sexuality	Phallus symbol	Insidiousness
Sexuality	Betrayal	Upcoming problems	Balanced health

Table 29 presents the significance of the collective symbol of the snake from general, dream-related, psychological, and spiritual perspectives. In dream interpretation, snakes primarily have a strongly negative meaning, associated with betrayal, deceit, dishonesty, and unbalanced instincts. However, from a spiritual perspective, the snake can also have a highly positive meaning, as it represents infinite energy (such as the image of a snake biting its own tail to form a circle) and balanced health (as seen in the medical symbol of a snake wrapped around a staff, still used by

healthcare and pharmacy organizations today). When interpreting snake-related dreams, it is essential to consider the type, color, and situation in which the snake appears.
j. The Lion – This association was mentioned once based on the symbolic category of "Strength." The total AP score was three out of five possible points, which is an average rating. The symbolic category was also given an average score. The combined score for the symbolic category and associative concept was six out of 10 possible points, indicating a moderately high rating.
The lion is often personified as the king of the animal kingdom—proud, majestic, courageous, and dangerous. Despite these powerful traits, lions are also known for their laziness, as they spend a significant amount of time sleeping.

2.5.7 Table 30: The meaning of the lion in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Wild cat	Power	Soul energy	Soul energy
Beast	Cruelty	Passion	Fire Energy
King of animals	Dominance	Violence	Life energy

Table 30 presents the significance of the collective symbol of the lion from general, dream-related, psychological, and spiritual perspectives. In dream interpretation, lions can have both positive and negative meanings. On one hand, the lion represents courage, strength, and pride; on the other, it can symbolize cruelty, excessive authoritarianism, and violence. In some dreams, the lion also embodies untamed energy or a force that needs to be controlled.
k. Blood – This association was mentioned once based on the symbolic category of "Suffering." The total AP score was zero out of five possible points, indicating a neutral rating. However, the symbolic category itself received the maximum number of points with a negative connotation. The combined score for the symbolic category and associative concept was negative five out of a possible ten positive and ten negative points, making it a very low rating.
Without blood, many living beings would not survive. This vital fluid supplies numerous organs and tissues with essential nutrients. The symbolic meaning of blood is ambivalent, as it can represent both life and vitality, as well as loss and death.

2.5.7.1 Table 31: The meaning of blood in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Life power	Life energy	Subconscious - warning	Elixir of Life
Liquid	Vitality	Life power	Soul
Wound	Disease	Dangerous situations	Energy flow

Table 31 shows the meaning of the collective symbol of blood from a general, dream, psychological, and spiritual perspective. Blood has both an extremely positive and negative meaning according to dream interpretation. On one hand, blood represents life or life energy; on the other hand, it symbolizes vulnerability, loss, and death. The dream symbol of blood is extremely complex, so its interpretation is highly dependent on the feelings of the dream subject, circumstances, and situations.

l. An open palm - this association was mediated once based on the symbolic category "Beginning". The sum of AP ratings was five out of five possible points, which is the highest possible rating. The mentioned symbolic category was also rated with the maximum number of five points. The total score of the symbolic category and associative concept was thus ten out of ten possible points plus. The palm is part of the hand, within which are located the very well-known lines of life. Palm reading is also practiced by the border science of chiromancy.

2.5.7.2 Table 32: The meaning of the open palm in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psiychological*	*Spiritual*
Body part	Life lines	Open communication	Energy of destiny
Openess	Warning	Sincerity	Talent
Work	Creativity	Affection	Intuition

Table 32 shows the meaning of the collective symbol of an open palm from a general, dream, psychological, and spiritual perspective. An open palm has a distinctly positive meaning according to dream interpretation. An open palm often represents sincere and well-intentioned communication. In certain cases, it can also represent specific guidance or even a warning.

m. A four-leaf clover - this association was mediated once based on the symbolic category "Luck". The sum of AP ratings was four out of five possible points, which is a high rating. The mentioned symbolic category was rated with five points. The total score of the symbolic category and associative concept was thus nine out of ten possible points plus. A four-leaf clover is relatively rare, and when we find one, we usually rejoice. A four-leaf clover is a synonym for luck, especially in the realm of love. It can also mean wealth and friendship.

2.5.7.3 Table 33: The meaning of the four-leaf clover in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Plant	Luck	Comfort	Self-image
Rarity	Wealth	Safety	Spiritual cleansing
Luck	Love	Longing for a soulmate	Spiritual progress

Table 33 shows the meaning of the collective symbol of a four-leaf clover from a general, dream, psychological, and spiritual perspective. A four-leaf clover has a distinctly positive meaning according to dream interpretation, as it primarily represents luck, wealth, and love. It also symbolizes spiritual progress and a positive self-image. According to biblical legend, Eve took a four-leaf clover with her when she was expelled from paradise.

n. A pig - this association was mediated once based on the symbolic category "Wealth". The sum of AP ratings was five out of five possible points, which is a very high rating. The mentioned symbolic category was rated with three points. The total score of the symbolic category and associative concept was thus eight out of ten possible points plus. Pigs are often associated with a source of food, such as delicious roasts. They are often perceived as dirty, although this is not true. The collective symbol of a pig, in addition to wealth, also means good luck.

2.5.7.4 Table 34: The meaning of the pig in general, in dreams, from a psychological perspective, and in spirituality

Splošni vidik	*Pomen v sanjah*	*Psihološki vidik*	*Duhovni vidik*
Animal	Luck	Sexuality	Fertility
Food source	Wealth	Mental imbalance	Demonic energy
Greed	Oral sexuality	Psychological pressures	Greed

Table 34 shows the meaning of the collective symbol of a pig from a general, dream, psychological, and spiritual perspective. A pig has a distinctly positive meaning according to dream interpretation, but it can also represent very negative energy, such as demonism, greed, and mental imbalance, especially from a psychological and spiritual viewpoint. When interpreting this collective symbol, it is also necessary to consider the type of pig (e.g., wild or domestic pig) and the situations in which the pig appears.

o. A snail - this association was mediated once based on the symbolic category "Beginning". The sum of AP ratings was minus three, which is surprisingly low. It is likely that the respondent associated the snail with a garden pest. The mentioned symbolic category was rated with one point. The total score of the symbolic category and associative concept was thus minus two out of ten possible points (plus and minus). We know of various types of snails, which we mainly distinguish by whether they have a protective shell or not. Snails are most often associated with their slow movement. In Italy and France, certain types of snails also serve as a source of food.

2.5.7.5 Table 35: The meaning of a snail in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Animnal	Sensitivity	Permanence	Good timing
Sensitivity	Introversion	Strength of character	Spiritual purity
Slowness	Unwell feeling	Caution	Rebirth

Table 35 shows the meaning of the collective symbol of a snail from a general, dream, psychological, and spiritual perspective. A snail has both a positive and negative meaning according to dream interpretation. When a snail appears in dreams, it generally indicates sensitivity to certain stimuli, introverted behavior, and poor well-being.

p. A rose - this association was mediated once based on the symbolic category "Life". The sum of AP ratings was two out of five possible points, which is surprisingly low considering how beautiful the plant is. The mentioned symbolic category was expectedly rated with the highest possible score. The total score of the symbolic category and associative concept was thus seven out of ten possible points. We know of various types of roses, which have exceptionally beautiful flowers and incredibly wonderful fragrances. Roses are most often associated with beautiful gardens, but they also often play a role in healing and poison. Generally, we associate roses with something beautiful that brings us joy.

2.5.7.6 Table 36: The meaning of the flower in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Plant	Order	Purity	Positive emotions
Blooms	Joy of life	Hidden potentials	Love
Gardening	Sadness	Growth	Spiritual growth

Table 36 shows the meaning of the collective symbol of a rose from a general, dream, psychological, and spiritual perspective. A rose primarily has a positive meaning according to dream interpretation. It is important to emphasize again that when interpreting dreams, the type of rose and the situations in which it appears must be considered.

As mentioned earlier, we note the largest number of collective symbols within the group KE8, which represents human material and intellectual creations. More specifically, we will examine the following collective symbols (considering that numerical symbols also appear, we will first address these):

The number 0 - this association was mediated four times based on the following symbolic categories: "Beginning", "Wealth", "Solitude", and "Technology". The sum of ratings was zero in all cases. The number zero is commonly used in everyday communication and mathematics. Throughout the long historical development of humanity, the Arabs adopted the number zero from the Indians in the early Middle Ages, as it was not known to have been used by people before then. Sometimes, an individual who behaves irresponsibly is referred to as a "complete zero". The deeper meaning of this number from a general, dream, psychological, and spiritual perspective will be revealed in the continuation of this section.

2.5.7.7 Table 37: The meaning of the number zero in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Without value	Well-being	Unlimited possibilities	Feminity
Emptiness	Reputation	Sexual performance	Perfection
Energy	Risk	Erotic experiences	Hidden energy

Table 37 shows the meaning of the collective symbol of the number zero from a general, dream, psychological, and spiritual perspective. The number zero primarily has a positive meaning according to dream interpretation (e.g., prosperity, unlimited possibilities, perfection), especially from a dream and spiritual viewpoint. The meaning of the number zero from a general perspective is less positive (e.g., without value, emptiness, etc.). The number zero can appear in various combinations with different numbers. In these contexts, the meaning of this collective symbol is quite different.

The number 2 - this association was mediated four times based on the following symbolic categories: "Death", "Captivity", "Power", and "Suffering". The sum of AP ratings was eight out of 20 possible points, which is a below-average rating. The total score of the mentioned symbolic categories was also eight out of 20 possible points. After summing all the values, the result was surprisingly low, totaling 16 out of 40 possible points. We constantly encounter the number two in our lives, as duality largely composes our body (e.g., two legs, two ears, two kidneys). When we see the number two, people often think of partnership (e.g., marriage to a loved one, business collaboration). In short, the number two is associated with effective and quality collaboration, both on a material and emotional level.

2.5.7.8 Table 38: The meaning of the number two in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Coupleship/duality	Friendship	Opposites	Polarized energy
Ambivalence	Conflicts	Balance	Energy balance
Partnership	Ambivalence	Ambivalence	Opposites

Table 38 shows the meaning of the collective symbol of the number two from a general, dream, psychological, and spiritual perspective. The number two has both a positive (e.g., balance) and negative meaning (e.g., conflicts) according to dream interpretation. The number two embodies duality and dialectics, both on a mental and physical level. We most often encounter opposites in everyday life when we connect completely opposing concepts (e.g., good and evil, harmony and discord, cold and hot, love and hatred, life and death), which are actually separate but simultaneously connected.

The number 3 - this association was mediated six times based on the following symbolic categories: "Beauty", "Beginning", "Solitude", "Wealth", "Technology", and "Eroticism". The sum of AP ratings was 18 out of 30 possible points, which is a relatively high average rating. The total score of the mentioned symbolic categories was also 18 out of 30 possible points. After summing all the values, the result was relatively low as expected, totaling 36 out of 60 possible points. The number three is frequently encountered both in everyday life and in films, fairy tales, and religious mythologies. We all know phrases like "You have three wishes available" or "All good things come in threes." Especially well-known is the religious symbol of the Holy Trinity (the Father, the Son, and the Holy Spirit). Additionally, the number three symbolizes elements such as water, earth, and air. In geometry, the triangle is a well-known figure that represents the basis for the geometric body of a pyramid, which symbolizes hierarchy.

2.5.7.9 Table 39: The meaning of the number three in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Holy trinity	Union of opposites	Mental balance	Divinity
Fairy tale	Personal success	Erotic desires	Love triangle
Stability	Relationships	Ljubezenski trikotnik	Cognitions

Table 39 presents the significance of the collective symbol of the number three from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, the number three generally has a more positive meaning (e.g., mental balance) than a negative one (e.g., jealousy in a love triangle). The number three embodies divine energy and wise insights. Unlike the number two, which represents opposites, the number three resolves and unites them.

The number four—this association was mentioned nine times across the following symbolic categories: "Hope," "Diligence" (twice), "Love," "Strength," "Peace," "Happiness," "Health," and "Eroticism." The total AP rating was 37 out of a possible 45 points, which is a relatively high score. The combined total for these symbolic categories was also 36 out of 45 points. Summing all values resulted in an expectedly above-average score of 73 out of 90 possible points.

The number four often influences our thinking. Whether we consider geometric shapes, the four basic elements, card games, astronomy, furniture, domestic animals, or living spaces, this number is ever-present. The number four plays a particularly important role in architecture (e.g., buildings, atriums). In geometry, we recognize numerous four-sided shapes, such as squares, rectangles, trapezoids, and parallelograms. In its quadrilateral form, a parallelogram symbolizes a decision-making node. It is difficult to imagine a space without four walls, as they define our surroundings wherever we go.

2.5.8 Table 40: The meaning of the number four in general, in dreams, from a psychological perspective, and in spirituality

Splošni vidik	*Pomen v sanjah*	*Psihološki vidik*	*Duhovni vidik*
Geometric figure	Perfection	Personal characteristics	Power
Celestial directions	Orientation	Stability	Cognitive processes
Seasons	Power	Safe environment	Inner peace

Table 40 presents the significance of the collective symbol of the number four from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, the number four is primarily seen as positive, representing completeness, orientation, stability, cognitive processes (such as thinking, feeling, perception, and sensation), strength, and inner peace. It can also symbolize personality traits such as loyalty, perseverance, and sincerity. However, in certain contexts, the number four can carry a negative meaning, depending on the situation and other symbols appearing in the dream (e.g., dishonesty, betrayal).

The number five—this association was mentioned eight times across the following symbolic categories: "Hope," "Life" (twice), "Beauty," "Love," "Peace," "Happiness," and "Health." The total AP rating was 40 out of a possible 40 points, an exceptionally high score. The combined total for these symbolic categories was also 40 out of 40 points. Summing all values resulted in an expectedly very high overall score of 80 out of 80 possible points.

The number five is essentially a symbol with an ambivalent meaning, as it can represent both positive and negative aspects simultaneously. On one hand, it embodies the human senses, while on the other, it can signify excess or imperfection.

2.5.8.1 Table 41: The meaning of the number five in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Five fingers	Adventurous spirit	Human body	Human senses
Redundant wheel	Upcoming hacnges	Vitamin deficiency	Physiolog. perception
Activity	Human actions	Human well-being	Energy balance

Table 41 presents the significance of the collective symbol of the number five from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, the number five has an ambivalent meaning, as previously discussed in this chapter. It primarily relates to human physiology and the senses, as well as how individuals perceive their actions and the world around them. The symbolic meaning of the number five in dreams often represents dynamic themes such as adventures, upcoming changes, and human actions. This dynamism can lead to either highly positive or extremely negative outcomes. Ultimately, every individual is the author of their own actions, though not necessarily of their own thoughts.

Money – This association was mentioned seventeen times, primarily in relation to the symbolic categories of "Power" and "Wealth" (sixteen times). The total AP rating was 25 out of a possible 85 points, an exceptionally low score. While money is a crucial symbol for human survival, it appears to carry a relatively negative connotation, as some respondents even assigned it explicitly negative ratings. The combined total for both symbolic categories was slightly higher, at 38 out of 85 points. After summing all values, the overall result was predictably low, totaling 63 out of 170 possible points.

In ancient times, humans survived by hunting, farming, and gathering food. Later, they relied primarily on barter. In the modern world, money has become the key medium of exchange, allowing people to purchase food, services, and various material goods. The ways of acquiring money can range from hard work to deception or even criminal activities (e.g., fraud, financial crime, cronyism, corruption). This likely explains why some respondents assigned negative ratings to the concept of money.

2.5.8.2 Table 42: The meaning of money in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Payment asset	Human desires	Sexual aspect	Siritual knowledge
Survival	Human attitude	Power and influence	Spiritual cognition
Well-being	Personal values	Gambling	Spiritual energy

Table 42 presents the significance of the collective symbol of money from a general, dream-related, psychological, and spiritual perspective. According to dream interpretation, money has a relatively positive meaning, based on the opinions of some respondents. It primarily represents a means of payment, human desires for prosperity, personal values, power, social status, and influence. Many people do not perceive financial wealth as a positive value, even though some still desire it. Somewhat surprisingly, money also holds a positive spiritual meaning, as it is associated with spiritual knowledge and enlightenment. This spiritual aspect likely emerged within a specific, smaller collective community that had a significant influence.

Cage – This association was mentioned seven times in relation to the symbolic category of "Captivity." The total AP rating was -21 out of a possible -30 points, an extremely negative score. The overall total for this symbolic category was even more negative, at -27 out of -30 points. After summing all values, the final result was, as expected, highly negative, amounting to -48 out of -60 possible points.

A cage is typically used to confine animals or people. The collective symbol of a cage can be associated with both punishment and protection (e.g., a canary can only survive in a cage). In any case, the symbolic meaning of a cage is unequivocal—it stands in direct opposition to freedom. Anyone who lives in a cage lacks true freedom.

2.5.8.3 Table 43: The meaning of the cage in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Entrapment	Self-restriction	Social coercion	Spiritual brake
Prison	Inner unfreedom	Confinement	Rules
Unfreedom	Dominance over others	Wild instincts	Thought patterns

Table 43 presents the significance of the collective symbol of a cage from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, a cage has an extremely negative meaning, as confirmed by overwhelmingly negative ratings. The collective symbol of a cage is a defining element of the symbolic category of captivity. A cage is a human-made object, and in itself, it does not inherently carry a strongly negative connotation. However, its negative aspect emerges when it is used to confine a living being, isolating it from its surroundings. In short, a cage deprives the creature of freedom and severely restricts its physical movement.

Computer – This association was mentioned seven times in relation to the symbolic category of "Technology." The total AP rating was 14 out of a possible 35 points, which is a fairly negative score. The overall total for this symbolic category was slightly higher, at 17 out of 35 points. After summing all values, the final result was, as expected, quite negative, amounting to 31 out of 70 possible points. A computer is a relatively modern symbol and does not have as rich a symbolic background as many other symbols, such as a circle, square, or cross. It is most commonly associated with work, research, and computer games. To some extent, it can also be linked to human thought processes, particularly in the field of artificial intelligence.

2.5.8.4 Table 44: The meaning of the computer in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Tool	Mental error	Order and structure	Information energy
Programming	Automated living	Communication	Spiritual development
Entertainment	Performance	Lack of emotions	Mental automation

Table 44 presents the significance of the collective symbol of a computer from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, a computer has a somewhat neutral or average meaning, although respondents rated this symbol slightly more negatively. From a symbolic category perspective, the collective symbol of a computer is straightforward, as people classify it under technology. A computer is a remarkable product of human intelligence and ingenuity, helping to solve highly complex problems. Its primary significance lies in its processing power, its ability to mimic human thinking, and its role in automating certain work processes. The main criticism of computers is that they can lead to social isolation and diminish human warmth.

Light – This association was mentioned twice in relation to the symbolic categories of "Hope" and "Happiness." The total AP rating was 6 out of a possible 10 points, representing a moderately high score. The overall total for this symbolic category was slightly higher, reaching 10 out of 10 possible points. After summing all values, the final result was positive, amounting to 16 out of 20 possible points.

Light is a human-made source of artificial illumination. There are many different types of light, each with a specific use (e.g., work lights in workshops, lighting in living spaces, etc.). Due to its diverse applications, the symbol of light is highly complex when interpreting dreams.

2.5.8.5 Table 45: The meaning of the light in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Light	Cognition	Wisdom	Personal illumination
Decoration	Positive change	Consciousness	Divinity
Work	Independence	Mental problems	Immortality

Table 45 presents the significance of the collective symbol of light from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, light has a positive meaning, as it represents the birth of awareness, provides orientation in the deepest darkness, symbolizes independence, and can signal positive changes. However, light can also have a negative meaning, especially when a person dreams of a dim or weak light, which may indicate psychological difficulties. Regardless, humans are dependent on light. Without it, civilization would never have achieved what it has over the course of its long historical development. Among these great achievements, however, there are also significant negative ones. This might be why respondents rated this collective symbol slightly lower than expected.

Jesus – This association was mentioned twice (as "Jesus Christ" and "Jesus on the Cross") in relation to the symbolic category of "Suffering." The total AP rating was 9 out of 10 possible points, a predictably high score, as Jesus Christ is widely regarded as an exceptionally positive figure. The overall total for this symbolic category ranged from -7 out of -10 to +10 out of 10 possible points. After summing all values, the final result was positive, totaling 2 out of 20 possible points.

Jesus Christ is significant not only because he is considered the Son of God but also because he contributed immense value to humanity. He emphasized that for humanity to survive, love and cooperation are essential—rather than extreme hierarchies based solely on the rule of the strongest, which is unethical. He conveyed and reinforced ethical principles, without which humankind might have perished long ago. Even those who do not believe he was the Son of God cannot deny his role as a visionary thinker who profoundly influenced humanity, inspiring philosophers, artists, scientists, missionaries, and many others.

When people hear the name Jesus, they often associate it with the suffering he endured before and during his crucifixion. However, they also think of love, redemption, helping those in need, and the ethical values he represented. Jesus Christ is not only a historical figure but also a powerful collective symbol with deep meaning. It is also worth noting that before and after his time, other great spiritual figures, such as Buddha and Muhammad, lived and shaped human thought in similar ways.

2.5.8.6 Figure 30: Giants of humanity in one image

Figure 30 presents a rare depiction of three great figures of humanity brought together in a single image. A detailed description of the image seems unnecessary, as Buddha, Muhammad, and Jesus Christ are easily recognizable. In the Christian world, Jesus Christ is undoubtedly the leading figure among all positive visionaries. The significance of Jesus Christ appearing in dreams is generally very positive, though it largely depends on the context of the dream.

2.5.8.7 Table 46: The meaning of Jesus Christ in general, in dreams, from a psychological perspective, and in spirituality

In general	***In dreams***	***Psychological***	***Spiritual***
Martyrdom	Salvation	The meaning of life	Martyrdom
Salvation	Helping hand	Balance problems	Patience
Love for people	Reminder	Inner development	God's energy

Table 46 presents the meaning of the collective symbol of Jesus Christ from a general, dream interpretation, psychological, and spiritual perspective. According to dream analysis, Jesus Christ predominantly holds a positive meaning. However, in certain circumstances, this symbol may serve as a reminder to the dreamer about something important—most often a call to strengthen faith and seek life’s purpose. A partially negative interpretation of this collective symbol may be associated

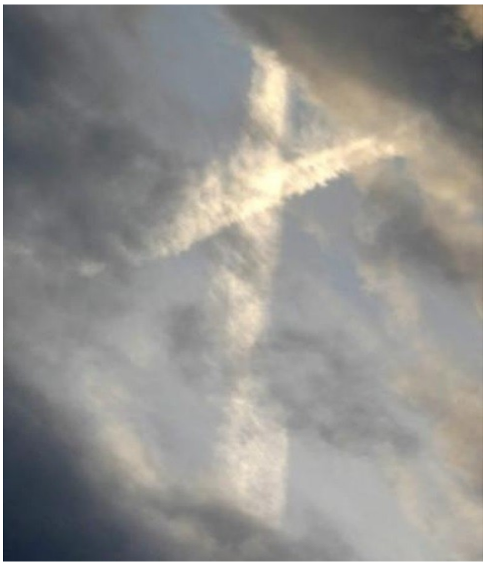
with martyrdom. However, Jesus Christ transformed this martyrdom into positive energy. The essence of his actions and life lies precisely in this transformation of negative hostile energy into positive energy (as reflected in his teaching: "If someone strikes you on the left cheek, turn to them the right also," which is an attempt to convert negative energy into something constructive).
The successful transformation of excess negative energy into positive energy is key to the survival of humanity. The purpose of humanity is to create a balance between positive and negative energies. It is important to emphasize that the interpretation of these energies is subjective, as humans are unable to grasp the full picture of the universe. Within this vast mechanism, we operate within our limitations. For this reason, the significance of ethics and the organization of human communities must be continually reaffirmed.
Coffin – This association was mentioned once, based on the symbolic category of "Death." The total AP score was 0 out of 5 possible points, representing a neutral rating. The overall sum for this symbolic category was also 0 out of 5 points. After summing all values, the result remained neutral, with a total of 0 points on a scale ranging from -10 to +10.
A coffin generally carries a negative meaning, as it is associated with death and sorrow, especially during farewells to loved ones. However, different farewell rituals exist where the coffin does not play a role. These include cremation (urns have often replaced coffins due to space limitations in cemeteries), burning (as practiced by the ancient Greeks), or sea burials (common among sailors and pirates). Despite these varied practices, the meaning of the collective symbol of the coffin has remained unchanged.

2.5.8.8 Table 47: The meaning of the coffin in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Burial	Mortality	Life turning point	Salvation
Sadness	Farewell to something	New future	Resurrection
Farewell	Irrational fears	Disappearing fears	A secure future

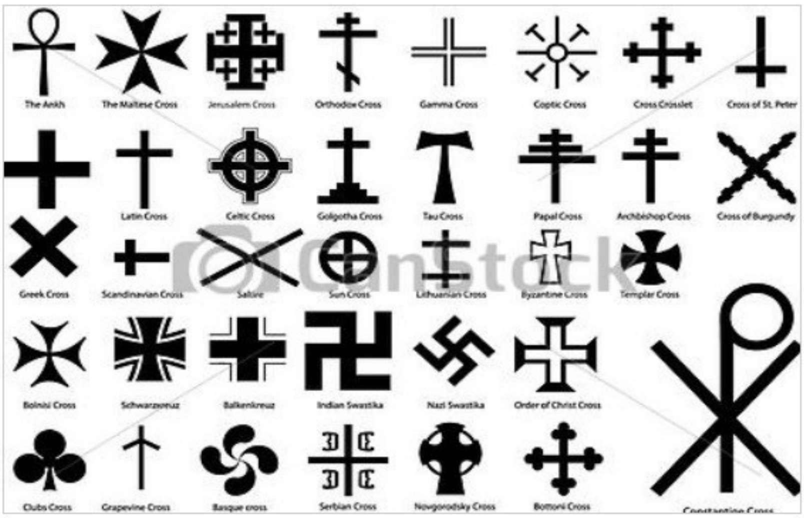
Table 47 presents the meaning of the collective symbol of the coffin from a general, dream interpretation, psychological, and spiritual perspective. From a general standpoint, the coffin has a distinctly negative meaning, as it reminds us of sorrow, burial, and saying farewell to a loved one. In short, when a coffin appears in dreams, it is highly likely to symbolize negative themes.
Cross – This association was mentioned once, based on the symbolic category of "Suffering." The total AP score was 0 out of 5 possible points, representing a neutral rating. The overall sum for this symbolic category was -3 out of 5 possible points. After summing all values, the result was negative, amounting to -3 out of 10 possible points (on a scale ranging from -10 to +10).

There are various types of crosses, such as the Red Cross, St. Andrew's Cross, the religious cross, the burning cross, the cross on graves, and the cross in card games. The cross is one of the oldest collective symbols of humanity and is classified as a mythological symbol (similar to the square or the circle). The cross is not merely a human creation; like the circle or the square, it also appears in nature.



2.5.8.9 Figure 31: Example of a cross in nature

Figure 31 shows an example of a cross in nature. It is a weather phenomenon that occurs due to the specific movement of air masses and the refraction of light. Cross patterns can also be found on rocks, and some crystals are formed in the shape of a cross. As already mentioned, there are many types of crosses, as illustrated in the following image.



2.5.8.9.1 Figure 32: Different types of crosses

Figure 32 shows different types of crosses, many of which do not have religious significance. When discussing the collective symbol of the cross, we can start from the clear assumption that the respondent had a religious cross in mind, as this association was formed based on the symbolic category of "Suffering." In this context, this cross is also closely associated with Jesus Christ.

2.5.8.9.2 Table 48: The meaning of the cross in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Pschological*	*Spiritual*
Death	Changes	Support	Circle of life
Religion	Patience	Personal development	Eternal existence
Martyrdom	Power	Victim	Heavenly directions

Table 48 shows the meaning of the collective symbol of the cross from a general, dream-related, psychological, and spiritual perspective. Regarding dream interpretation, the cross has very diverse meanings, which can be distinctly positive (e.g., support), neutral (e.g., cardinal directions), or explicitly negative (e.g., martyrdom, sacrifice). This interpretation did not consider the meanings of other crosses, such as the swastika, the Nazi cross, or the cross in playing cards. In short, the primary focus was on the meaning of our Christian religious cross.

Mirror – this association was conveyed once based on the symbolic category of "Beauty." The sum of AP scores was minus three out of +/- five possible points, which is a very low score. The total sum of the mentioned symbolic category was two out of five possible points. After adding all the values, the result was negative, amounting to minus one out of +/- ten possible points. A mirror is an object that can reflect our image. By recognizing our image, humans have taken an important step towards self-awareness. Only a handful of animals on our planet succeed in doing this, such as the elephant. The respondent who rated the mirror with minus three probably had a negative self-image in mind, or perhaps they felt that beauty cannot be displayed with a mirror?

2.5.8.9.3 Table 49: The meaning of the mirror in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Self-image	Cognition	Hidden sides of Person.	Soul mirroring
Mirror image	Double life	Self-image	Another dimension
Soul	Portal to another world	Inner Insecurity	Self alienation

Table 49 shows the significance of the collective symbol of a mirror from a general, dream, psychological, and spiritual perspective. The mirror has a more ambivalent meaning in dream interpretation, as it can represent both a strongly negative and positive image at the same time. The mirror is closely linked to self-image and understanding one's own personality. It can also represent a transition into another dimension or world, as we know from some fairy tales (e.g., "Alice in Wonderland").

Whip – This association was mentioned once based on the symbolic category of "Suffering." The sum of the AP ratings was minus two out of a possible five points, which is a low rating. The total score for the mentioned symbolic category was two out of a possible five points. After summing all the values, the result was neutral, as it scored zero out of a possible ten points. When looking at a whip, we most often think of persecution or flogging. Whips were used in the distant past to punish people who were at the bottom of the hierarchical ladder. Due to this content image, the low rating is not surprising.

2.5.8.9.4 Table 50: The meaning of the whip in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Training	Warning of danger	Passivity	Punishment
Punishment	Insults	Self-doubt	Expelling negativity
Sadism + masochism	Dominance	Sexual orientation	Energy of dominance

Table 50 shows the significance of the collective symbol of a whip from a general, dream, psychological, and spiritual perspective. The whip generally has a more negative meaning in dream interpretation, as it symbolizes punishment, torture, persecution, and training. The primary significance of the whip lies in its clear expression of a relationship between superiority and subordination, especially when considering different sexual orientations. Using a whip against oneself can also signify a certain religious orientation (e.g., some monastic orders practiced self-flagellation as punishment for impure thoughts).

Elevator – This association was mentioned once based on the symbolic category of "Captivity." The sum of the AP ratings was minus one out of a possible five points, which is a low rating. The total score for the mentioned symbolic category was minus two out of a possible five points. After summing all the values, the result was negative, scoring minus three out of a possible ten points. An elevator is a device used to transport both living beings and materials. Some people fear traveling by elevator because they worry that it might stop, leaving them exposed to an enclosed space. An elevator can also fall, which is a common fear for many people and a frequent theme in dreams involving elevator travel. It is likely that the respondent had negative experiences with elevators, which is why the association "elevator" was also rated quite low.

2.5.8.9.5 Table 51: The meaning of the elevator in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Technical device	Problem solving	Transformation process	Spiritual progression
Transportation vehicle	Claustrophobia	Reminder for arrogance	Spiritual decline
Work accidents	Progress	Self-affirmation	Spiritual transformation

Table 51 presents the significance of the collective symbol "elevator" from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, the elevator tends to have a more negative meaning, as it can symbolize problems, a sense of entrapment, or even accidents. On the other hand, riding an elevator can also signify progress, both on a material and spiritual level. Since the collective symbol of the elevator does not have a single, definitive meaning, dream interpretation requires great caution and consideration of different contexts.

Castle – This association was provided once, based on the symbolic category of "Wealth." The total AP score was zero points, which is a neutral rating. The overall score for this symbolic category was also zero out of a possible five points. After summing up all the values, the result remained completely neutral, with a total score of zero out of a possible +/- ten points.

Castles were primarily built in the Middle Ages to serve as residences and fortifications, protecting inhabitants from enemy attacks. Essentially, castles functioned as both residential and military strongholds, commissioned by kings and nobility. Within the collective symbol of a castle lies historical, noble (knightly), and even fairy-tale-like elements. In this specific case, the respondent associated the collective symbol of a castle with wealth, as only wealthy individuals could afford castles in the Middle Ages. The respondent did not consider the fairy-tale aspect of the symbol but rather a realistic perspective—acknowledging that while wealth is not everything, it can still be significant.

2.5.8.9.6 Table 52: The meaning of the castle in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Historic building	Risky adventure	Enclosed privacy	Spiritual trials
Military fort	Protection from danger	Security	Overcoming obstacles
Nobility	Mental imbalance	Psychological restraints	Refuge

Table 52 presents the significance of the collective symbol castle from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, the castle has a slightly positive meaning, as it can symbolize security, protection, and refuge. However, it can also represent a risky adventure or mental imbalance.

Chocolate – This association was provided once (in the phrase “strawberries and chocolate”) based on the symbolic category of Eroticism. The total AP score was two out of a possible five points, and the overall score for this symbolic category was the same. After summing up all values, the result was slightly above average, with a total score of four out of a possible +/- ten points.
Chocolate is a food product made from cocoa and other ingredients. It also contains substances that can stimulate feelings of happiness and satisfaction, although the concentration of these compounds is relatively low. Chocolate represents something sweet and pleasant, something that entices and tempts.

2.5.8.9.7 Table 53: The meaning of chocolate in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Food	Temptation	Physical union	Self-rewarding
Sweetness	Power and health	Psychological union	Aesthetics
Seduction	Luck and wealth	Desire for enjoyment	Physical drive

Table 53 presents the significance of the collective symbol chocolate from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, chocolate has a very positive meaning, as it can symbolize strength, health, happiness, and wealth. However, the type of chocolate was not taken into account (for example, eating dark chocolate in a dream may signify disappointment, while white chocolate could indicate weak health). Chocolate is also a synonym for seduction, where the final outcome is not always positive.
Hammer – This association was provided once based on the symbolic category of Power. The total AP score was three out of a possible five points, and the overall score for this symbolic category was four out of five points. After summing up all values, the result was slightly above average, with a total score of seven out of a possible ten points.
A hammer is a hand tool used to drive objects (such as nails or stakes) into surfaces (such as wood or soil). It is an ancient tool associated with hard work and physical strength. The collective symbol of the hammer also carries significant meaning in other areas of human activity (e.g., politics).

2.5.8.9.8 Table 54: The meaning of the hammer in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Tool	Belief in power	Violence	Justice
Strikes	Destruction	Enforcement	Revenge
Metalworking	Construction	Sexual desires	Dominance and energy

Table 54 presents the significance of the collective symbol hammer from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, the hammer has an ambivalent meaning, as it can represent both constructive and destructive forces. A hammer can be used to build something or to destroy and break things apart. From a spiritual perspective, it can symbolize justice or vengeance.

Additionally, there are many different types of hammers, varying in purpose, shape, and material. Therefore, interpreting the appearance of a hammer in a dream requires great caution and careful consideration.

Telephone – This association was provided once based on the symbolic category of Technology. The total AP score was two out of a possible five points, and the overall score for this symbolic category was also two out of five points. After summing up all values, the result was moderately high, with a total score of four out of a possible ten points.

A telephone is a technological device primarily used for long-distance communication. However, such communication is not always warm and friendly—it can also be business-related or, in some cases, even hostile.

2.5.8.9.9 Table 55: The meaning of the telephone in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Pschological*	*Spiritual*
Device	Message transmission	Communication	Guardian angel
Communication	Social contacts	Subconscious warnings	One's own spirit
Messages/Notifications	Obtaining informations	Planning the future	Spiritual seances

Table 55 presents the significance of the collective symbol telephone from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, the telephone has a relatively ambivalent meaning, as it can represent both friendly and hostile communication. Conversations can be warm and emotional or cold and businesslike.

Furthermore, telephone communication can serve both an informative purpose (e.g., the right information can save a life) and a misinformative purpose (e.g., false information can cause harm). In short, the telephone is a modern symbol (similar to the computer), and its interpretation mainly revolves around communication and functionality.

Scythe – This association was provided once based on the symbolic category of Death. The total AP score was minus one out of +/- five possible points, and the overall score for this symbolic category was minus three out of +/- five points. After summing up all values, the result was quite low, with a total score of minus four out of +/- ten possible points.

A scythe is a tool historically used by farmers to cut grass. While some farmers still use it today, it has largely been replaced by modern equipment (e.g., robotic lawnmowers). In a figurative sense, the scythe is associated with death, as death is often depicted as a skeletal figure in a monk's robe holding a scythe, symbolically "harvesting" human lives.

2.5.9 Table 56: The meaning of the scythe in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Mowing tool	Upcoming changes	Analysis of the past	Physical existence
Death	Decision making	Bad conscience	Limitedness
Agriculture	Failure	Unpleasant egoism	Death

Table 56 presents the significance of the collective symbol scythe from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, the scythe has a predominantly negative meaning, as it can symbolize failure and poor decisions. Primarily, the scythe embodies death and limitation, while only secondarily does it represent a tool for mowing.

Locomotive – This association was provided once based on the symbolic category of Power. The total AP score was one out of +/- five possible points, and the overall score for this symbolic category was two out of +/- five points. After summing up all values, the result was relatively low, with a total score of three out of +/- ten possible points.

A locomotive is a means of transportation and propulsion that, especially in the 18th, 19th, and 20th centuries, symbolized industrialization and technological progress (e.g., recalling the invention of the steam engine around 1776). Modern locomotives are more advanced and powerful, pulling numerous railcars behind them. Regardless of their design and technological advancements, the fundamental principle remains the same.

It is no coincidence that the respondent associated the locomotive with power, as a locomotive truly represents strength, endurance, relentlessness, and speed!

2.5.9.1 Table 57: The meaning of the locomotive in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Transport vehicle	Power	Collective success	Drive
Power	Dominance and success	Attitudes and problems	Uncompromising
Technology	Progress	Potential for action	Progressive direction

Table 57 presents the significance of the collective symbol locomotive from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, the locomotive has a predominantly positive meaning, as it is closely associated with power, energy, and a strong drive for progress and success. In certain contexts, the locomotive can also symbolize sexual desire (e.g., in dreams where a locomotive with railcars travels through a dark tunnel).

Clothing/dress – This association was provided once based on the symbolic category of Beauty. The total AP score was three out of +/- five possible points, and the overall score for this symbolic category was also three out of five points. After summing up all values, the result was relatively high, with a total score of six out of +/- ten possible points.

We are all familiar with the saying, "Clothes make the man," though in reality, it is people who create clothing! However, the primary function of clothing is to protect individuals from various external elements (e.g., rain, snow, dirt).

2.5.9.2 Table 58: The meaning of the clothing/dress in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Protective means	Personal identity	Outer facade of a person	Hypocrisy Energy
Social status	Self-awareness	Protection from touch	Spiritual protection
Social role	Confined feelings	Hiding weakness	Adjusting the aura

Table 58 presents the significance of the collective symbol clothing from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, clothing has a predominantly positive meaning, as it is closely linked to personal identity and self-awareness. Its primary function is to protect both the body and the spirit.

Open Door – This association was provided once based on the symbolic category of Beginning. The total AP score was one out of +/- five possible points, and the overall score for this symbolic category was also one out of five points. After summing up all values, the result was relatively low, with a total score of two out of +/- ten possible points.

An open door generally has a positive meaning, as it represents openness to the outside world. However, this openness can also bring significant risks, as it may leave people more vulnerable.

2.5.9.3 Table 59: The meaning of the open door in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Invitation	Change of environment	New challenges	Exchang. two levels
Source of danger	New experiences	Mental brakes	Duhovna preobrazba
World open Attitude	Sexuality	S. superfluous problems	Change of direction

Table 59 presents the significance of the collective symbol open door from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, open doors have a predominantly positive meaning, as they are closely associated with positive changes and new experiences. They symbolize open communication, but on the other hand, they can also represent carelessness and lack of caution.

Horseshoe – This association was provided once based on the symbolic category of Luck. The total AP score was minus one out of +/- five possible points, while the overall score for this symbolic category was five out of five points. After summing up all values, the result was moderately high, with a total score of four out of +/- ten possible points.

A horseshoe, much like a four-leaf clover, is a collective symbol believed to bring good luck.

2.5.9.4 Table 60: The meaning of the horseshoe in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Luck	Luck	Form of female genitals	Protective talisman
Protection from evil	Provide old age	Happy marriage	Happy feeling
Horse shoes	Sacrifices	Caution from envy	Spiritual contentment

Table 60 presents the significance of the collective symbol horseshoe from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, the horseshoe has an extremely positive meaning, as it is closely associated with luck and a secure existence. However, if the horseshoe is directed toward the dreaming subject, they should be very cautious of jealousy from others.

Anchor – This association was provided once based on the symbolic category of Hope. The total AP score was five out of +/- five possible points, and the overall score for this symbolic category was also five out of five points. After summing up all values, the result was at its maximum possible level, with a total score of ten out of +/- ten points.

An anchor is a device that allows ships to remain stationary in water, preventing them from drifting with the currents—an essential function, especially when repairs are needed. The anchor is a collective symbol primarily representing stability and hope.

2.5.9.5 Table 61: The meaning of the anchor in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Tool	Stability	Emotional stability	Water
Ship	Hope	Need for security	Emotional currents
Sailors	Strong self-confidence	Internal control	Internal stability

Table 61 presents the significance of the collective symbol anchor from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, the anchor has an exceptionally positive meaning, closely associated with stability, hope, and strong self-confidence. However, if the desire for security is excessively emphasized in dreams, this symbol may serve as a warning that a person lacks independence and self-assurance.

Candle – This association was mentioned once under the symbolic category "Solitude." The total AP score was three out of a possible +/- five points. The overall sum for this symbolic category was minus two out of +/- five possible points. After summing all values, the final result was almost neutral, amounting to one out of +/- ten possible points.

Candles are objects that emit light when lit and contribute to a ceremonial atmosphere. In Christianity, candles hold a particularly significant meaning and are used on special occasions, such as during a person's passing, baptisms, communions, weddings, and the Advent wreath.

2.5.9.6 Table 62: The meaning of the candle in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Solemnity	Long life	Hope	Spirit enlightenment
Faith	Abundant health	Mind enlightenment	Wisdom
Romance	Stability	Mental changes	Fire

Table 62 presents the significance of the collective symbol candle from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, the candle has an exceptionally positive meaning, particularly associated with stability, robust health, and a long lifespan for a given individual.

Within the category of institutions and their parts (KE9), the following concept was included:

Prison – This association was mentioned six times under the symbolic category "Captivity." The total AP score was -20 out of a possible +/- 30 points. The overall sum for this symbolic category was -21 out of +/- 30 points. After summing all values, the final result was nearly neutral, amounting to -41 out of +/- 60 possible points. A prison is an organization and a social institution primarily intended to punish individuals who have committed criminal acts (e.g., financial fraud, murder, burglary, violent robbery). If a person is deemed extremely dangerous to people, society, and the environment, they may be sentenced to life imprisonment. Judges ultimately decide on the severity of punishments.

2.5.9.7 Table 63: The meaning of the prison in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Institution	Confined space	Negative emotions	Conflict spirit
Captivity	Warning of traps	Limitations	Responsibility denial
Punishment	Bad conscience	Feeling of guilt	Arrested sp. Develop.

Table 63 presents the significance of the collective symbol prison from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, prison has an extremely negative meaning, strongly associated with confinement and guilt. Other perspectives also do not portray prison as something positive; instead, it is linked to punishment, negative emotions, mental limitations, guilt, a spirit of conflict, and more.

Island – This association was mentioned five times under the symbolic category "Solitude." The total AP score was 13 out of a possible +/- 25 points, which is an average result. The overall sum for this symbolic category was -13 out of +/- 25 points, which is a very low result. After summing all values, the final outcome was neutral, amounting to zero out of +/- 25 possible points.

An island is a landmass surrounded by water, and in modern times, it is often institutionalized, as it can represent an independent country (e.g., Ireland) or a part of a country (e.g., Sicily, which belongs to Italy). Islands are often popular vacation destinations and, in some cases, are even considered earthly paradises (e.g., the Trobriand Islands). Many adventure novel authors have written about deserted islands where hidden treasures of gold and diamonds are said to be buried.

2.5.9.8 Table 64: The meaning of an island in general, in dreams, from a psychological perspective, and in spirituality

In general	*In dreams*	*Psychological*	*Spiritual*
Vacation	Desire for peace	Refuge	Loneliness
Peace	Profit and success	Knowing oneself	Spiritual retreat
Enjoyment	Loneliness	Feeling of rejection	Part of the whole

Table 64 illustrates the significance of the collective symbol of an island from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, an island carries both positive meanings (e.g., profit) and negative ones (e.g., loneliness). This collective symbol is highly complex, making its interpretation challenging. In addition to the diverse meanings of this symbol, it is also necessary to explore its contextual connections and underlying backgrounds.

The path—this association was conveyed twice under the symbolic category of "Hope." The total AP score was ten out of a possible ±10 points, representing the highest positive outcome. The overall sum for the mentioned symbolic category was also ten out of ±10 possible points. After summing all values, the final result was maximally high, reaching 20 out of ±20 possible points.

Paths can vary in surface (smooth path, rocky path, etc.), size (long path, short path, narrow path, wide path, etc.), and shape (e.g., winding path, straight path). In dreams, the dreaming subject may also encounter multiple paths, finding themselves at a vast crossroads where they must choose the right direction or make an important decision. When interpreting dreams involving a path, the surrounding landscape (e.g., forest, hills, urban buildings) is also significant.

2.5.9.9 Table 65: The meaning of the path in general, in dreams, from a psychological perspective, and in spirituality

In general	In dreams	Psychological	Spiritual
Surface	Life direction	Life direction	Direction of energy
Walk	Ability test	Relations with people	Development direction
Road traffic	Problems	Important decisions	Spiritual approach

Table 65 illustrates the significance of the collective symbol of a path from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, a path can have both positive meanings (e.g., a positive life direction) and negative meanings (e.g., a negative life direction). This collective symbol is also highly complex in terms of content, often requiring an exploration of its contextual connections and background.

The cemetery—this association was conveyed twice under the symbolic category of "Death." The total AP score was five out of a possible ±10 points, representing a moderately high outcome. The overall sum for the mentioned symbolic category was minus five out of ±10 possible points. After summing all values, the final result was neutral, amounting to zero out of ±10 possible points.

A cemetery is a fenced area (legally defined as public space) designated for burying the dead, often located near church institutions (exceptions include military cemeteries or vehicle graveyards). Some poetically inclined individuals even refer to cemeteries as "gardens of peace," where we remember deceased relatives with dignity and tranquility. On the other hand, there is a less pleasant perception of cemeteries, largely influenced by writers and, even more so, by film distributors of violent crime stories and horror movies. Many individuals avoid visiting cemeteries at night due to fear of dark forces.

2.5.9.9.1 Table 66: The meaning of the cemetry in general, in dreams, from a psychological perspective, and in spirituality

In general	In dreams	Psychological	Spiritual
Public surface	Death of a loved one	Interpreting the past	Other world Transition
Death	Past	Desire for peace	Place of souls
Memory of loved ones	Desire for advice	Desire for relief	Rebirth

Table 66 illustrates the significance of the collective symbol of a cemetery from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, a cemetery carries not only negative meanings (e.g., the death of a loved one) but also positive ones (e.g., coming to terms with the past). From a spiritual perspective, one could even argue that the meaning of a cemetery has a positive connotation, as it symbolizes the rebirth of deceased individuals.

The following concept falls into the category of time periods (e.g., seasons, history) and combined attributes:

Spring – this association was conveyed twice under the symbolic categories of "Beginning" and "Hope." The total AP score was ten out of a possible ±10 points, representing the highest possible outcome. The combined total for both symbolic categories was eight out of ±10 possible points. After summing all values, the final result was 18 out of ±20 possible points.

Spring is a season in temperate geographic regions that begins on March 21. Its main characteristics include the blooming of plants and the awakening of certain animals that hibernated throughout the winter. For humans, spring is also considered a time that brings diversity in color and form, symbolizing joy and vitality. Spring is synonymous with fertility and renewal.

2.5.9.9.2 Table 67: The meaning of spring in general, in dreams, from a psychological perspective, and in spirituality

Splošni vidik	*Pomen v sanjah*	*Psihološki vidik*	*Duhovni vidik*
Season	Youth	Restart	Devel. to a high. level
Prosperity	Hope	Transience of life	Emotional maturity
Joy of life	Love	Sexual needs	New spiritual paths

Table 67 illustrates the significance of the collective symbol of spring from a general, dream-related, psychological, and spiritual perspective. In dream interpretation, spring has a distinctly positive meaning (e.g., youth, love). Only in rare cases can it have a negative meaning (e.g., youth is followed by old age, signifying the transience of life).

A total of 60 collective symbols were examined in detail from four different perspectives. Further efforts will focus on appropriately compiling the newly acquired data and connections. We will come to understand that collective symbols are particularly powerful concepts within the informational hierarchy—without them, it would be difficult to conceive of new knowledge and even wisdom.

Collective symbols form the fundamental framework for social agreements (e.g., the adoption of new standards, legislation, measurement systems, political agreements, and scientific collaboration). Thanks to the establishment of collective symbols, humanity began learning the principles of social agreements. In essence, collective symbols are the result of induced social agreements, which were initially carried out in a less systematic manner (e.g., enacting new legislation requires more objective systematization and less psychological induction—though the latter is not entirely absent). Collective symbols have become deeply embedded in our societies and occupy an exceptionally influential and important position within the informational hierarchy.

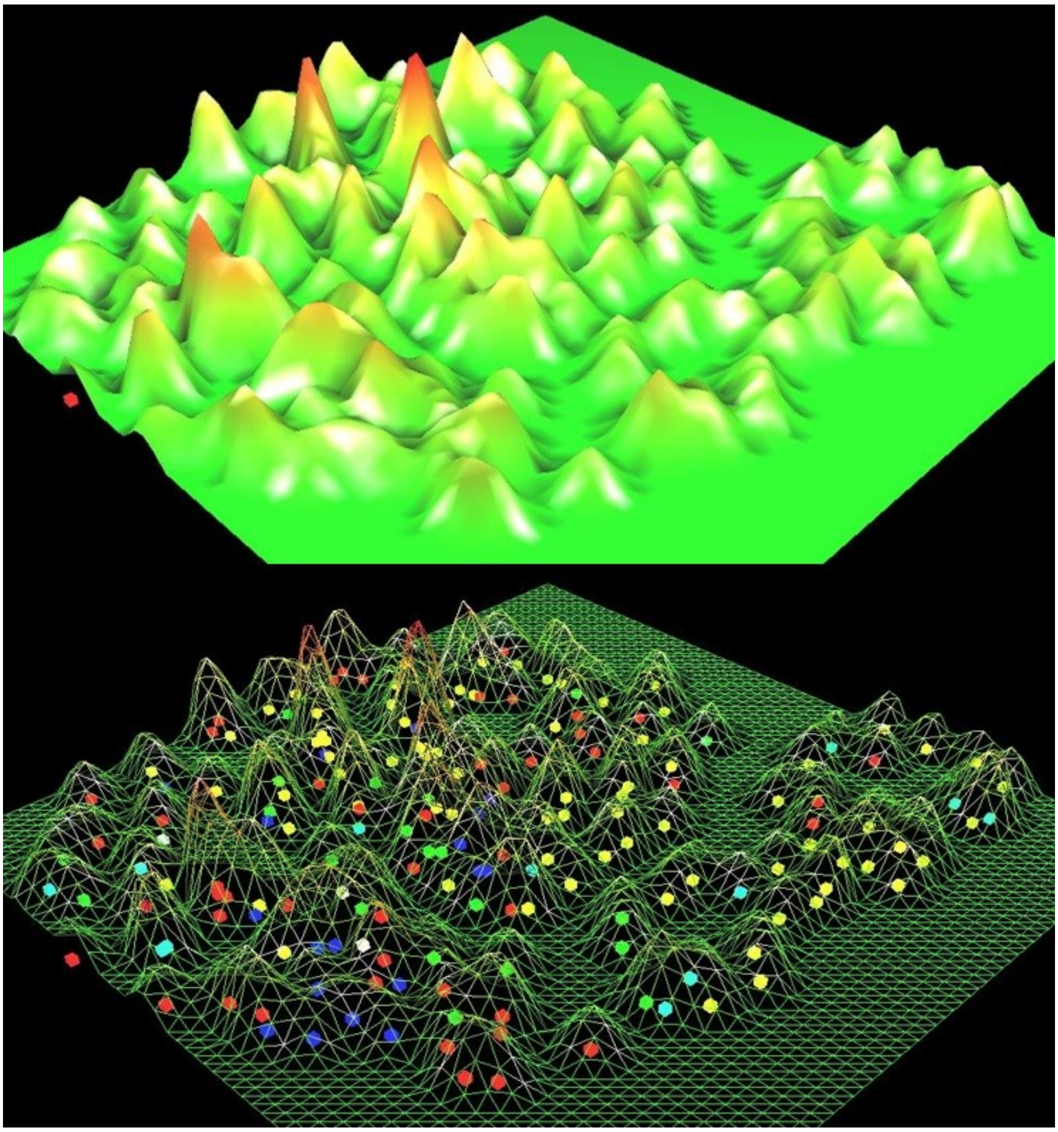
2.6 Networks of classified groups (KE)

The collective symbols analyzed did not express performance-related (KE2), psychological (KE3), social (KE4), health-biological (KE7), or undefined characteristics (KE11). These characteristics may appear as subordinate semantic categories of a given collective symbol. It seems that collective symbols, in particular, cannot be classified into these groups.

From a linguistic perspective, collective symbols are primarily nouns and adjectives, sometimes forming common two-word phrases (e.g., open palm, open door). In this sample, there was also a multi-word phrase, Jesus on the cross, which, besides two nouns, includes a preposition. In general, collective symbols most frequently appear as single-word expressions (e.g., light, prison, ant, bee, bird, hand, mirror). The obtained collective symbols do not express action or movement, meaning they do not contain verbs. Based on the rich contextual background of a given collective symbol, a verb can only have a subordinate function, indicating a causal and/or conditional relationship.

The most frequently occurring collective symbols represented human material and intellectual creations. In this context, the main representative groups are KE8 (material and intellectual products, as well as famous personalities) and KE9 (institutions and their parts). Collective symbols expressing natural characteristics were also highly prominent. The main representative groups included KE1 (symbols related to the senses, perceptions, and natural phenomena or processes, e.g., wind, light), KE5 (symbols representing substances, geometric shapes, and celestial bodies), and KE6 (symbols denoting living beings, their parts, and their characteristics).

The only representative of group KE10 was the collective symbol spring, which essentially expresses a specific natural process defined in time. Could spring also be classified under KE5? For our purposes, this distinction is not crucial, as we have reached an important conclusion: collective symbols primarily represent the products of both nature and society. Nature and humans create products in a certain relative symbiosis. To provide a clearer visualization of the frequency of collective symbols from different groups, a data landscape was created.



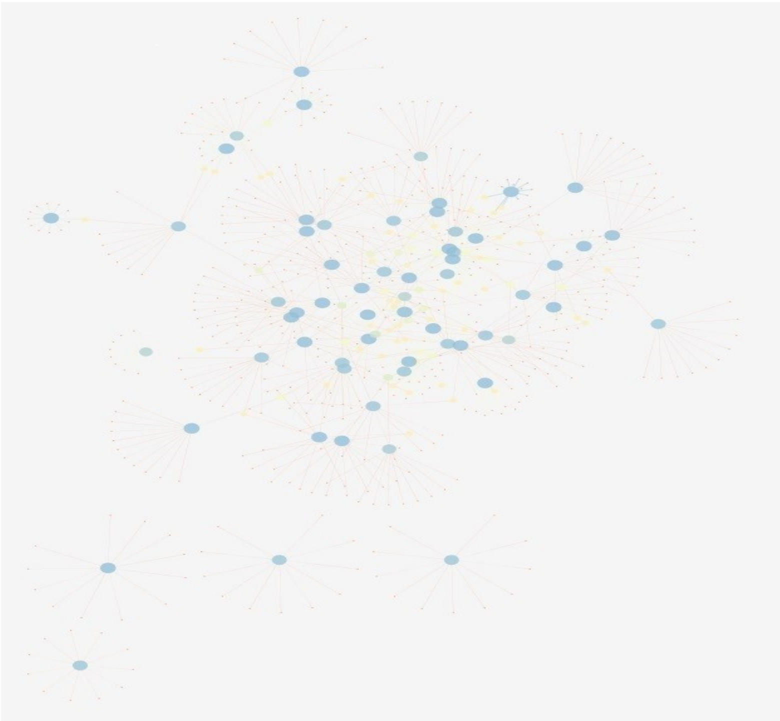
2.6.1 Figure 33: Data landscape of classified groups of collective symbols

Figure 33 illustrates the data landscape of classified groups of collective symbols. The lower part of the figure is particularly clear, visually representing the facts described in this section. Yellow blocks, which symbolize collective symbols from group KE8, appear very frequently. Red blocks, representing collective symbols from group KE6, are also highly noticeable.

The upper part of Figure 33 effectively depicts the height of individual hills within the data landscape. The tallest hills, colored in shades of orange-red, essentially indicate the density of data or collective symbols. These densities depend on frequency and assigned ratings. In the following section, we will take a closer look at the entire network of collective symbols and the networks of classified groups, including their aspects as presented in numerous tables.

2.6.1.1 Table 68: A small part of the prepared data

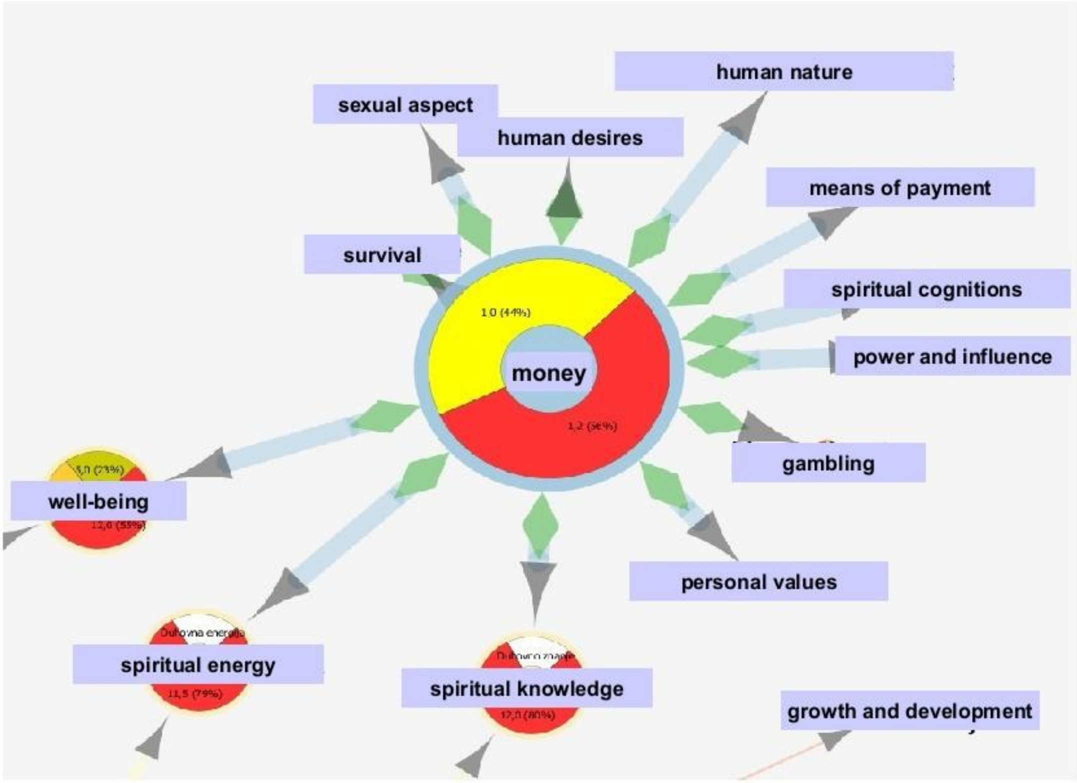
KE	KS	FKS	OKS	SV	OSV	SaV	OSaV	PV	OPV	DV	ODV
KE1	light (b)	4	4	life	5	cognition and perception	3	desire for knowledge	3	Divinity	5
KE1	light (b)	4	4	health	5	hope, new beginning	4	clarity, positive development	5	spiritual knowledge	4
KE1	light (b)	4	4	good mood	5	secure future, luck	5	erotic desires	3	Enlightenment	5



2.6.1.2 Figure 34: The complete network of classified groups of collective symbols and their aspects

Table 68 presents only a small portion of the prepared data used for visualizing the conceptual network with the software tool Cytoscape 3.5.1, while Figure 34 displays the fully visualized network. The conceptual network was created using a model of sources, targets, and their attributes. Collective symbols (KS) were defined as the source of the conceptual network, while their aspects —categorized into general (SV), dream-related (SaV), psychological (PV), and spiritual (DV) aspects—were designated as the target. The frequency of occurrence of a given concept (FKS) and its rating (OKS) were used as measurements for collective symbols. Other attributes for the listed aspects were expressed in the form of ratings (OSV, OSaV, OPV, and ODV).

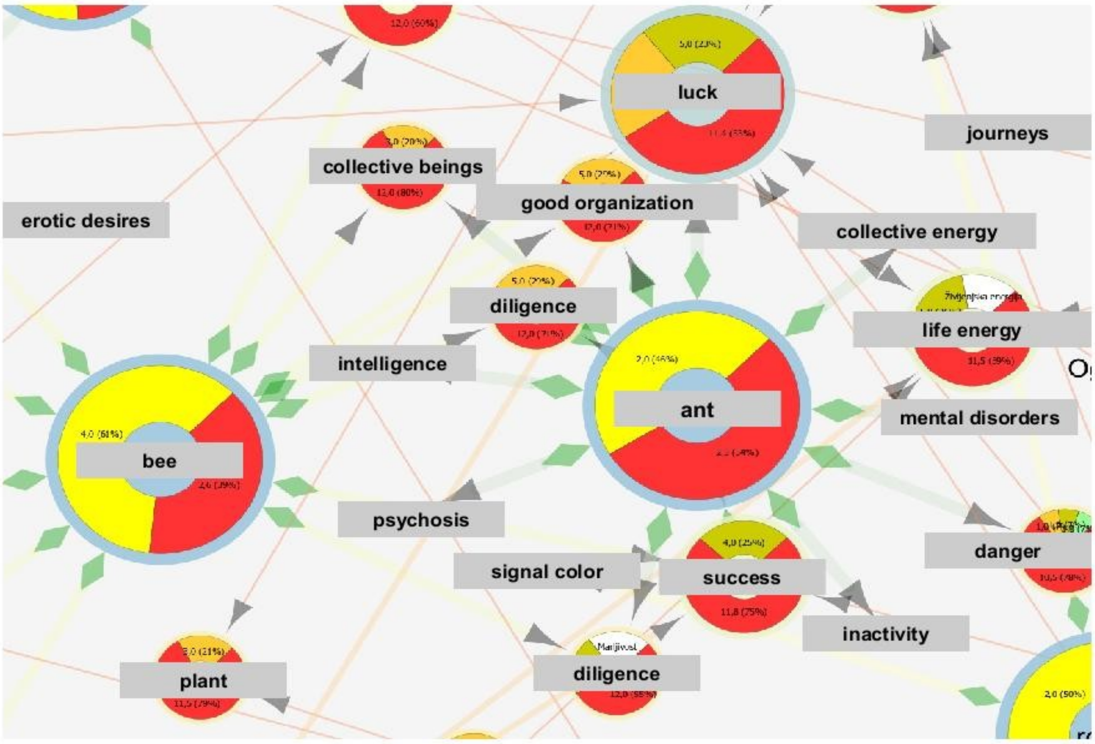
The analysis was conducted using the Network Analyzer plugin. Additionally, the connection styles were determined, as some connections were stronger than others. The nodes also vary in size, both for collective symbols and their aspects. The complete network contains nodes positioned both in the center and on the periphery. For better clarity, it is useful to examine two examples of nodes from the entire conceptual network.



2.6.1.3 Figure 35: Example of a segment from the conceptual network for the collective symbol "Money"

Figure 35 presents a segment of the conceptual network for the collective symbol money. The size of the source nodes was determined based on frequency, which was the highest for this symbol (17 occurrences).

Within the circular node for money, a yellow field displays the value 1.0 (44.0%), representing the average rating for this collective symbol, which is quite low. In the red field, we can observe the value 1.2 (56.0%), derived from an analysis of connected neighbors (neighborhood connectivity). This analysis is a metric based on the degree centrality algorithm, which measures the number of direct neighbors connected to the money node. This value is also very low. As a result, this part of the conceptual network is positioned more toward the periphery of the overall network. This example was chosen because it represents the largest node, illustrating that node size does not necessarily correlate with a high degree of influence.



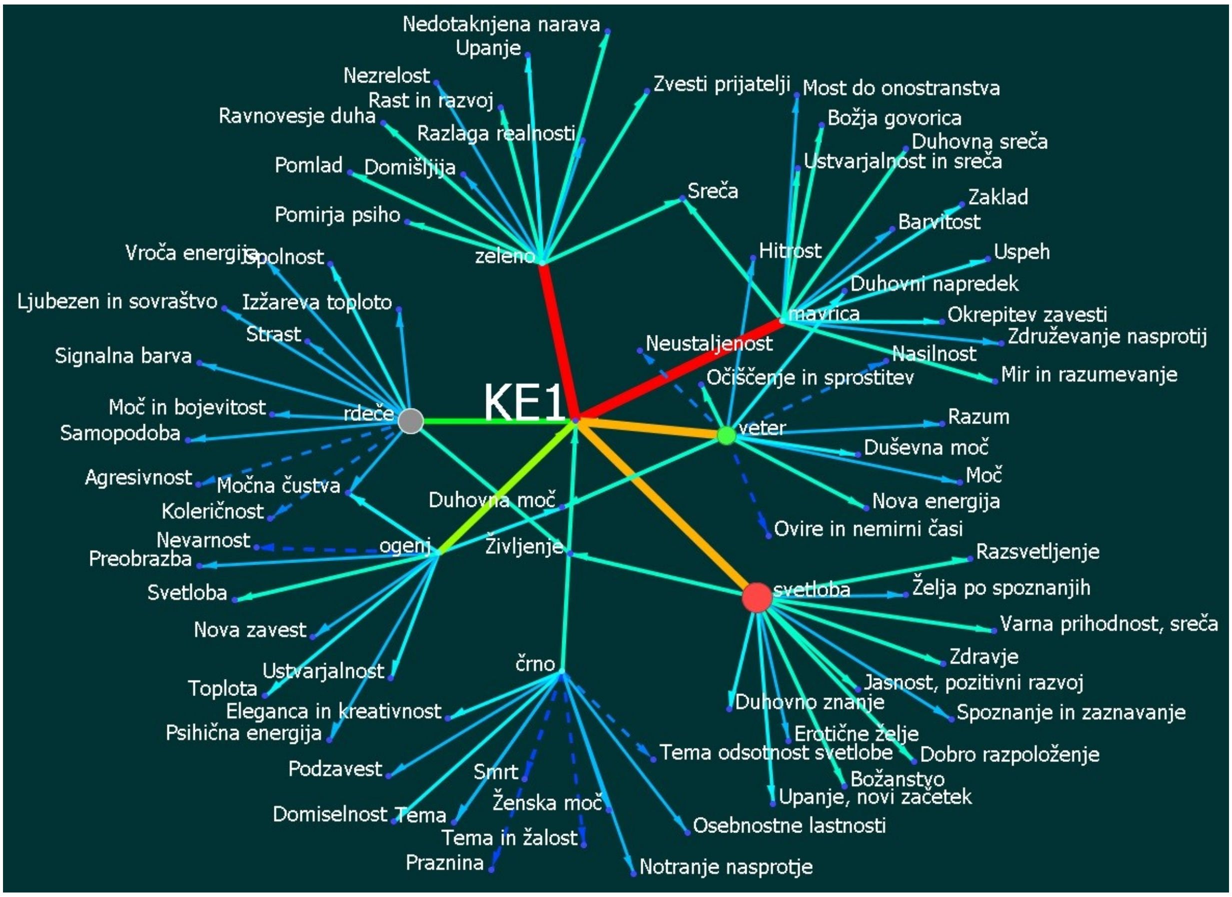
2.6.1.4 Figure 36: Example of a segment from the conceptual network for the collective symbol "Ant"

Figure 36 illustrates a segment of the conceptual network for the collective symbol ant. This node is the second-largest in size, as this collective symbol appeared frequently in respondents' answers (9 occurrences). The average rating is relatively low, at 2.0 (46.0%). Similarly, the value derived from the analysis of connected neighbors is also quite low, at 2.3 (54.0%).

Unlike the previously analyzed node (money), this node is positioned more toward the center of the conceptual network. The same applies to the bee node, which has a significantly higher average rating (4.0 or 61.0%) compared to ant.

Further analysis will be conducted using the Ora Casos software tool (older version 2.0.5), with a focus on classified groups. An important observation from the network study is that modern collective symbols (e.g., computer, phone) are generally located on the periphery of the conceptual network. In contrast, older collective symbols—especially those with natural themes (e.g., ant, bee, spring, flower)—are more centrally positioned. This suggests that older collective symbols, which have existed for centuries or even millennia, carry a richer semantic diversity and a deeper historical significance!

2.6.2 Classification group KE1

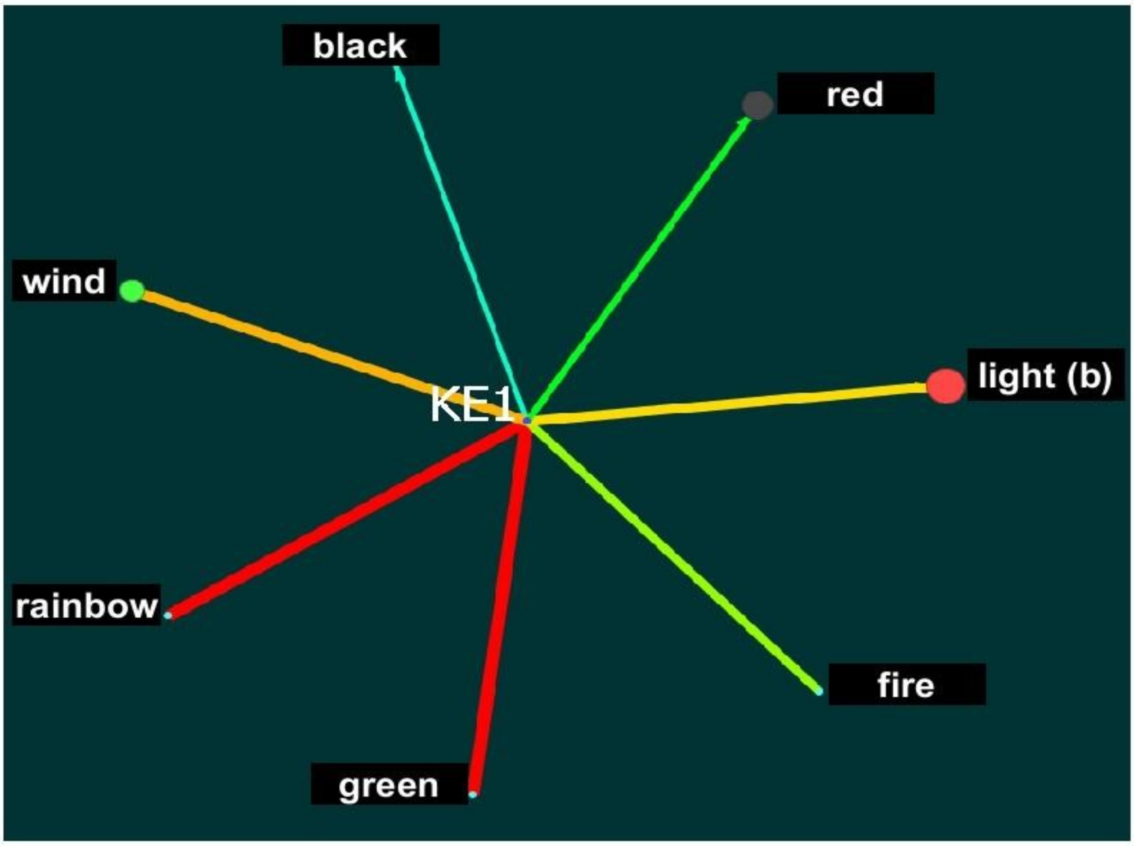


2.6.2.1 Figure 37: Conceptual network for collective symbols from Group KE1

Figure 37 illustrates the conceptual network for collective symbols from group KE1 (collective symbols emphasizing perceptual physical properties). Similar to the Cytoscape 3.5.1 software tool, Ora Casos 2.0.5 also used a model based on source, target, connection strength (ratings of collective symbols and their aspects), and attributes in the form of collective symbol frequency. The same dataset was used (see Table 68). The preparation process is quite extensive, so this description has been omitted as it does not contribute to a better understanding of the network analysis and is more technically oriented. Looking at Figure 37, we can observe both stronger (red for the strongest) and weaker (thinner and dashed) connections, as well as larger nodes (e.g., light) and smaller nodes (e.g., green).

The strength of the connections is determined based on the ratings of both collective symbols and their aspects, while node size is based on the frequency of a given collective symbol.

A particularly interesting aspect is the latent semantic analysis of this network, which identifies concepts that are closely related in meaning across the entire dataset. The results of the latent semantic analysis for the KE1 conceptual network are shown in the following figure.



2.6.2.2 Figure 38: Latent semantic analysis of the network of collective symbols from group KE1

Figure 38 presents a visualization based on the latent semantic analysis of the conceptual network of collective symbols from group KE1. This analysis identifies concepts or collective symbols that are exceptionally closely related in meaning. It is important to highlight that the Latent Semantic Analysis plugin considered both node size and connection strength. The strongest connections are represented by thick red arrows (rainbow, green), followed by orange (wind), yellow (light), light green (fire), green (red), and light blue (black or black color) arrow lines.[24] We can observe that the extracted concepts primarily describe colors (rainbow, green, red) and light (light, fire). However, in terms of meaning, wind and black stand out slightly. The largest node in the network is the collective symbol light, followed by red, wind, rainbow, green, fire, and finally black.

The key representatives of this group express highly significant concepts within the information hierarchy. These concepts greatly influence our lives and, consequently, our thoughts and decisions. In summary, they relate to energy, emotions (e.g., love), perception, cognition, and happiness. While this may seem self-evident, science always demands evidence for claims, whether through descriptive, measurement-based, illustrative, or hybrid (e.g., descriptions, measurements, and visualizations) methods.

24 According to scientists in the fields of optics and physics, black is technically not a color.

In social sciences and humanities (especially law), descriptive methods are most common. In natural and applied sciences, measurements and visualizations (e.g., graphs, network diagrams, and modeling for environmental scenarios) are preferred. However, today, interdisciplinary approaches are increasingly common. Social scientists are incorporating natural and applied science methods, while natural scientists are exploring social phenomena (e.g., crime prediction, stress-measuring devices).

Given the vast amount of content ahead, we will use a descriptive approach to prove that collective symbols represent crucial informational hierarchy concepts that ultimately guide or compel us toward decisions and actions. We will illustrate this with the largest node in this network: light.

Light (brightness) is a verbal code that evokes many related concepts, including other collective symbols. When we think of light, we might associate it with a lamp, the sun, fire, or a specific color. Under normal circumstances, light seems self-evident, but in special situations, it triggers a deep conceptual network, revealing previously unnoticed connections between different concepts.

These special situations can be everyday, scientific, imaginative, erotic, etc. However, they all share one thing: they demand a decision, often leading to an action or measure as a result. Scenarios vary in complexity, time, and space, sometimes leading to highly negative outcomes. To illustrate this, let’s consider a simple scenario.

The room is dark, and we can’t see anything. We need light. In this context, there are several possible solutions: we can turn on a lamp, light a candle, use a flashlight, raise the blinds, or leave the room and enter a brighter one. Another option is a passive solution—simply staying in the dark, lying down, and going to sleep. Regardless, we must make a decision and take action.

With light, we can work, enjoy leisure activities, conduct research, repair a car, sew a button, and even influence happiness hormones through specialized lighting. Light plays a role in complex surgical procedures, forensic investigations, and many other essential tasks.

At this point, it becomes clear that collective symbols are not only linked to numerous other concepts but also to activities, events, phenomena, and rules. Light helps us track sequences of time, establish correlations between events, trace causal chains, observe daily life episodes, create behavioral principles and generalizations, compile word lists, determine facts, and much more.

In short, in dynamic and complex situations, light becomes a concept encompassing all building blocks of information introduced in the previous chapter. This demonstrates that collective symbols are deeply intricate and historically rich elements within the information hierarchy.

In a relatively static situation, light may simply be a neutral piece of data with no additional significance at a given moment. However, incorporating other collective symbols from latent semantic analysis would significantly expand the scope, leading to more decisions and actions.

A thesaurus for "light" could be constructed and visualized as a conceptual network, further proving that the symbolic background of light is vast and highly interconnected, containing hierarchical, relational, and associative links.

Moving on to the Next Group: KE5 (NNL – Inanimate Natural Properties)

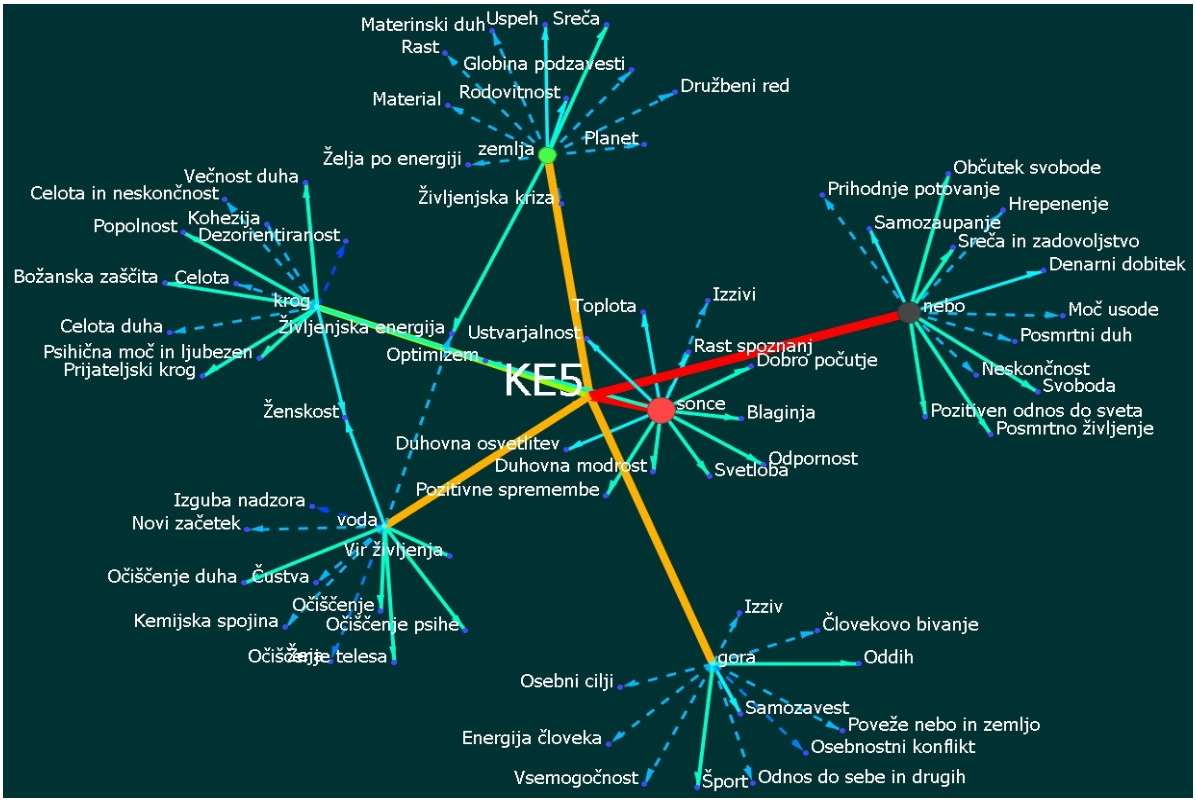
The collective symbols in this category are typically ancient and hold deep-rooted traditions across many cultures. They appear in both science and the arts. Many are mythological symbols, dating back to prehistoric communities and surviving to this day. Examples include the circle, square, cross, and crescent moon, which will endure as long as humankind exists. It is evident that collective symbols are interconnected, particularly across KE1, KE6, KE8, KE9, and KE10. The largest number of mythological symbols is found in KE1 and KE5.

These symbols form both hierarchical and associative connections within conceptual frameworks. This highlights the crucial role of collective symbols as building blocks of conceptual, hierarchical, and associative systems.

These systems emerged from human interaction with nature, shaped by needs, desires, fears, and inventions (such as tools, shelters, and food practices). However, decision-making has not always led to positive outcomes—historical examples include the invention of the atomic bomb.

The conceptual network displayed on the following page was created using the same principles as the network of collective symbols and aspects from group KE1. This visualization technique will also be applied to other groups of collective symbols and aspects. Additionally, latent semantic analysis will be performed for all groups that have sufficient representatives of both collective symbols and aspects. It should also be noted that the conceptual network for group KE8 had to be reduced using filters or conditions because it was too extensive for a clear presentation (as respondents, as mentioned on previous pages, provided a large number of associations from this group).

2.6.3 Classification group KE5

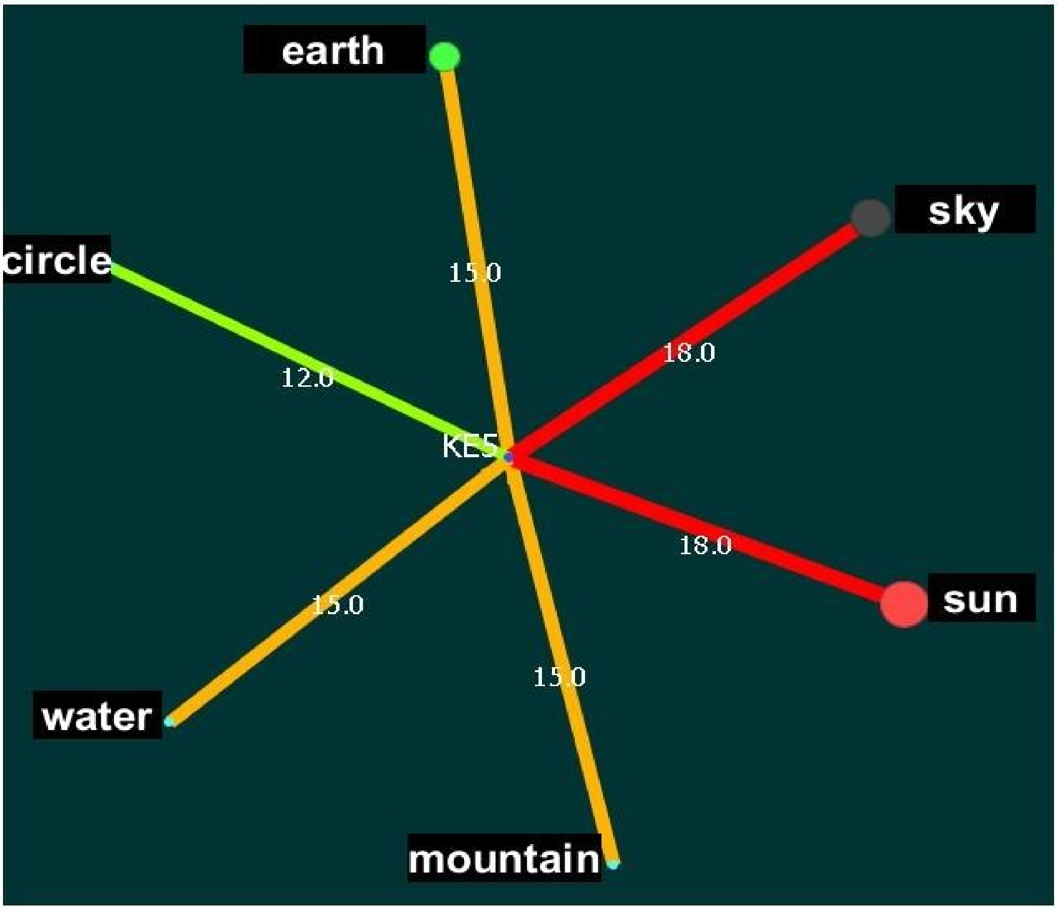


2.3.6.1 Figure 39: Conceptual network for collective symbols from group KE5

Figure 39 illustrates the conceptual network for collective symbols, including aspects, from group KE5. Upon examining Figure 39, one can observe both stronger connections (the strongest ones are red) and weaker connections (thinner and dashed lines), as well as larger nodes (e.g., "sun," "sky") and smaller nodes (e.g., "green"). The largest node within this conceptual network represents the collective symbol "sun," followed by "sky," "earth," "circle," "water," and "mountain."

An analysis of the aspects reveals that "earth" and "water" are connected through the aspect of life energy, while "circle" and "water" are linked via the aspect of femininity. Overall, it becomes evident that energy and life play a central role in this conceptual network. The collective symbols "sun" and "light" are closely interconnected, as the sun is a celestial body that serves as the primary and largest source of light on Earth. Consequently, it is no coincidence that light is one of the aspects derived from the collective symbol "sun."

Other notable aspects include spiritual wisdom, growth of knowledge, happiness, self-confidence, and self-trust. It can be concluded that most of these aspects are positively oriented, while negative aspects are rare within this conceptual network (e.g., disorientation, life crisis, and loss of control). In contrast, the conceptual network for group KE1 (which was somewhat larger) contained a greater number of negative aspects, such as death, darkness and sadness, hatred, inner conflict, emptiness, danger, obstacles, and turbulent times. A latent semantic analysis of this conceptual network will follow.



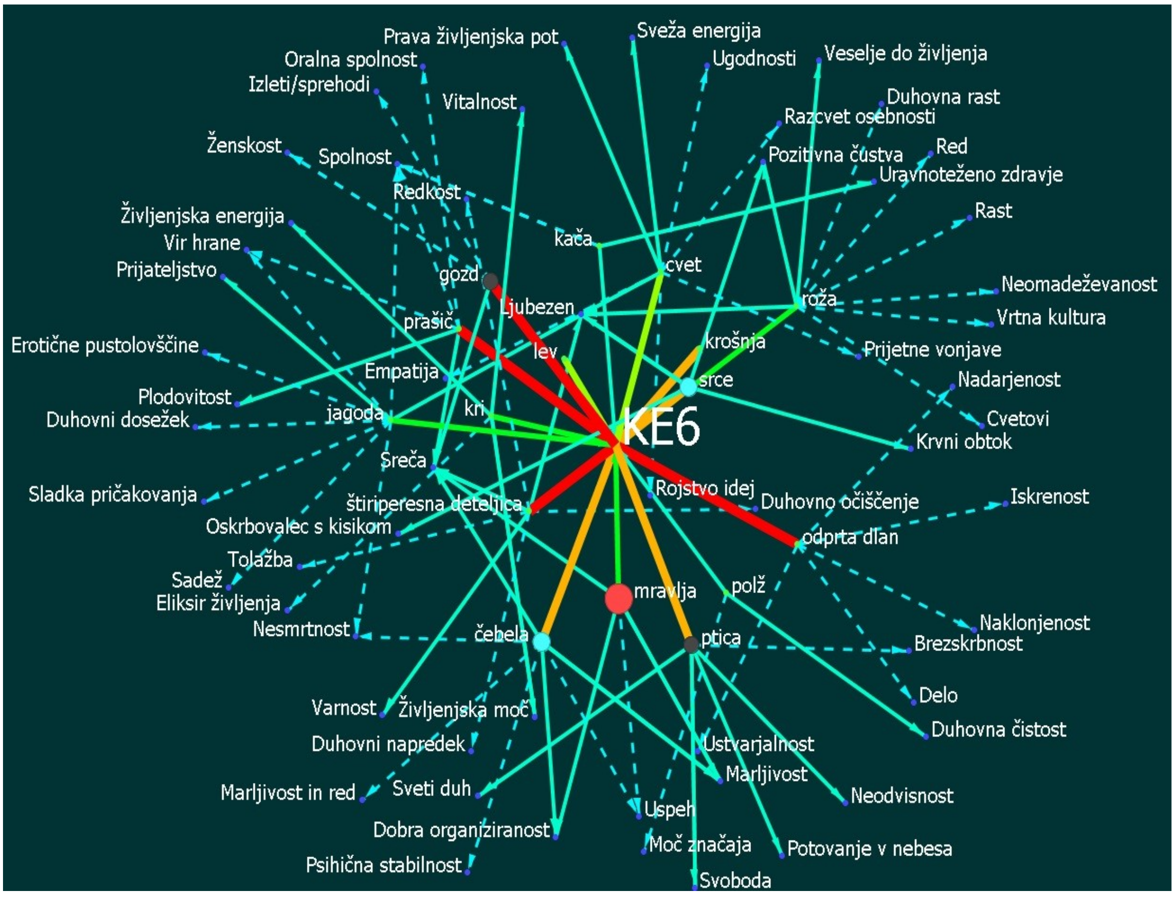
2.3.6.2 Figure 40: Latent semantic analysis of the collective symbols network from group KE5

Figure 40 visualizes the latent semantic analysis of the conceptual network of collective symbols from group KE5. As before (see Figure 38), selected concepts or collective symbols are shown with exceptionally close semantic connections, marked by numerical weights. All classes can be thematically linked to form the statement: In a circle, the Earth—comprising land, water, and mountains—rotates around the Sun, which we see in the sky. The largest node in these classes is the collective symbol "Sun."

To demonstrate that the collective symbol "Sun" is a genuine concept within the information hierarchy, consider an example from agriculture. A farmer preparing to mow grass for livestock feed must account for various factors. For the farmer, the Sun is not merely a source of pleasant weather but a critical determinant of agricultural decisions. The collective symbol "Sun" helps the farmer decide when to mow, as haymaking requires at least three consecutive days of clear weather to dry the grass sufficiently for storage (enough to feed 15 livestock heads).

The haymaking process involves mowing grass with a tractor, removing weeds that could harm livestock, and arranging cuttings into piles to dry under intense sunlight. If weather conditions remain favorable, the hay is collected with specialized machinery (historically, using wagons) and stored in a barn for further drying. The collective symbol "Sun" here transcends weather—it connects to drought, growth, seasons, and disciplines like astronomy, physics, biology, meteorology, geography, psychology, medicine, and others.
This brief illustrative proof allows us to transition to group KE6.

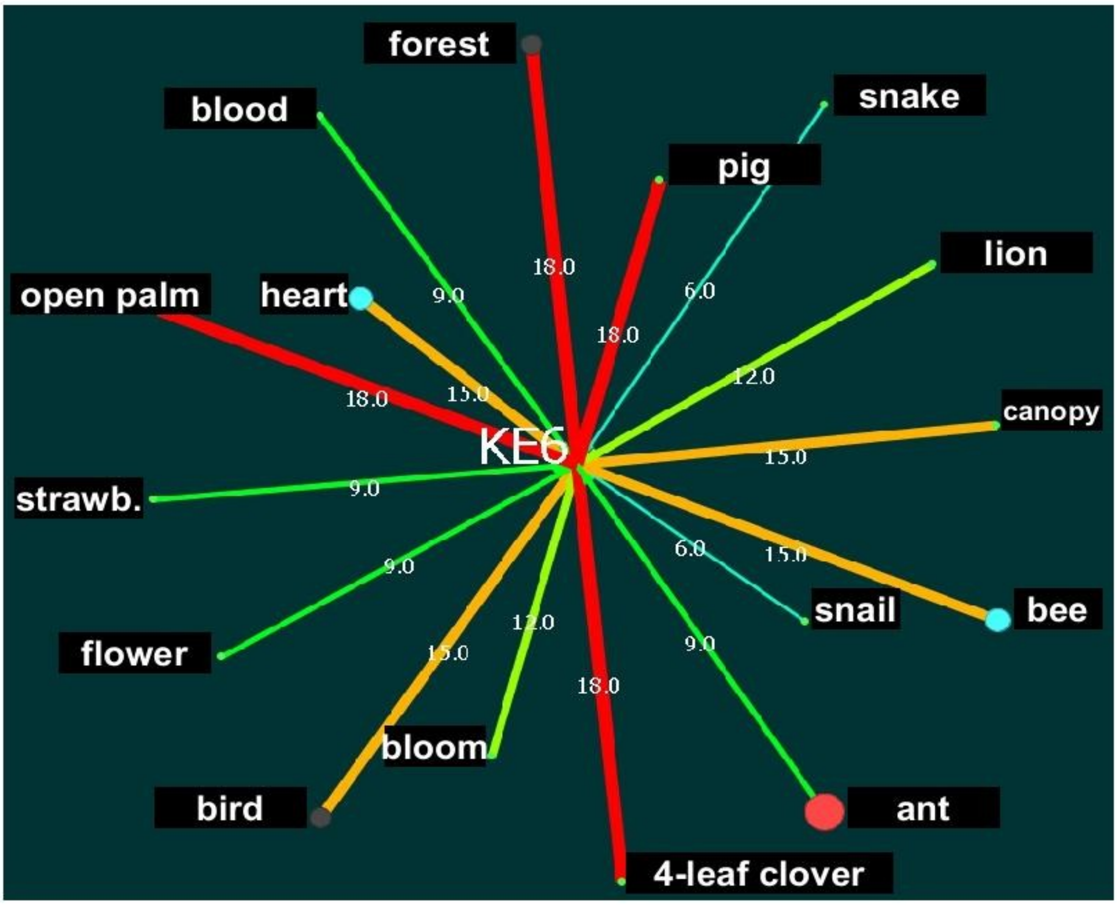
2.3.7 Classification group KE6



2.3.7.1 Figure 41: Conceptual network for collective symbols from group KE6

Figure 41 illustrates the conceptual network of collective symbols, including aspects, from group KE6. Initially, it is observable that this network includes a larger number of main nodes. The largest node represents the collective symbol "ant," followed by "bee," "bird," "forest," "rose," and others. Upon analyzing this network, another distinct feature becomes apparent, which was not as pronounced in the previous two networks. This network also includes a larger number of intermediate nodes. Notably, the collective symbol "pig" is connected to aspects that are also linked to other collective symbols (e.g., a source of food is found in strawberries, luck in four-leaf clovers and ants, and sexuality in snakes). There are other intermediate nodes, such as "love," which is connected to flowers, strawberries, hearts, four-leaf clovers, and roses. Additionally, we have the aspect of "immortality," which is linked to both strawberries and bees. We also observe the aspect of "diligence," which is connected to bees and ants. Furthermore, we can highlight the aspects of "good organization" and "success."

In general, it can be stated that the collective symbols in this network primarily represent flora and fauna. This network contains only positive aspects. The main thematic background of these aspects can be summarized as positive emotions and diligence. A latent semantic analysis will follow.



2.3.7.2 Figure 42: Latent semantic analysis of the collective symbols network from group KE6

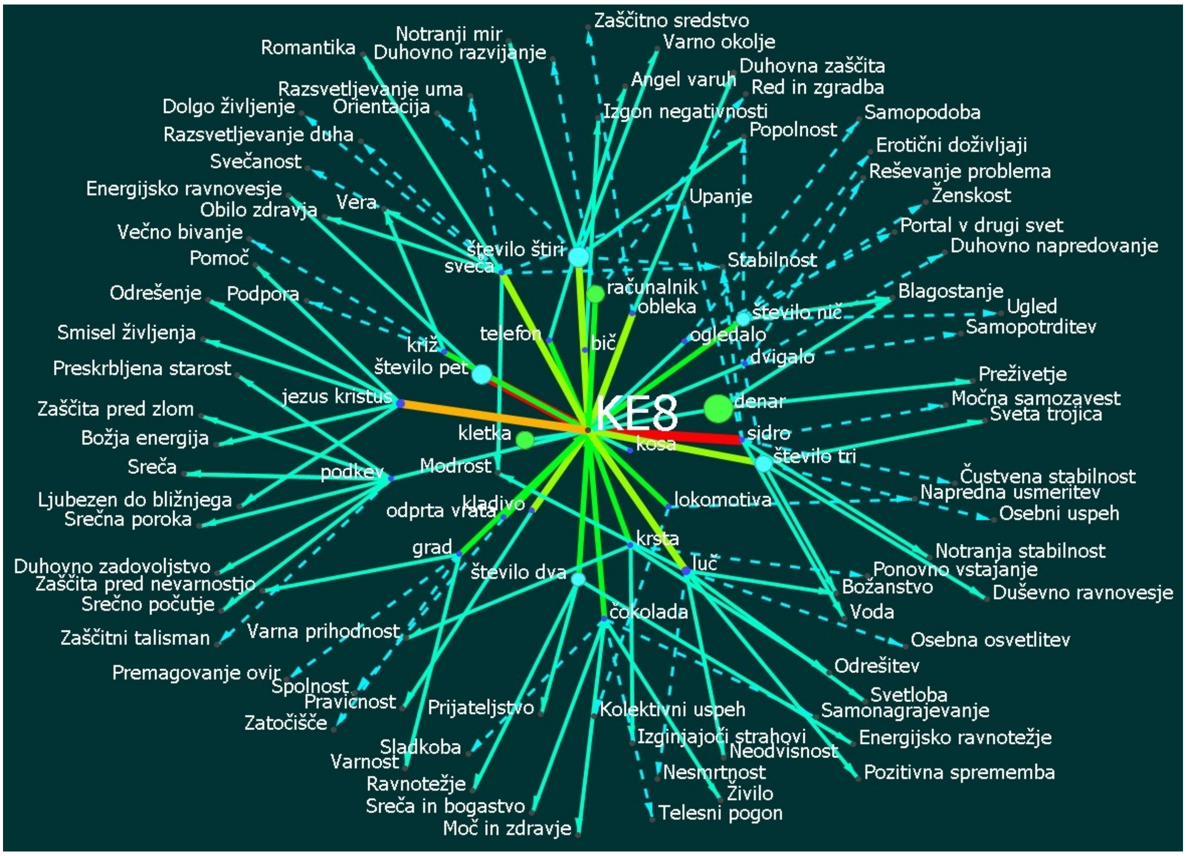
Figure 42 visualizes the latent semantic analysis of the collective symbols network from group KE6. All classes can be thematically linked, allowing the formation of at least two key statements: "fauna and flora" and "the heart pumps blood through the body and the palm opens." From these classes, we select the largest node, which represents the collective symbol "ant."

To demonstrate that the collective symbol "ant" is a genuine concept within the information hierarchy, we present an example from management or organizational science. The ant does not merely symbolize diligence but also represents an active member of the animal kingdom that typically contributes to the balance of the ecosystem. Additionally, ants are subjects of research not only in biology but also in management and organizational science. For researchers in these fields, ants offer models and best practices for managing and organizing communities, especially companies and institutions.

In this context, the ant is a profound concept for optimal decision-making. Its behavior and organization are studied both in laboratories and in natural environments within ant colonies. Based on observations of its behavior and organizational structure, researchers attempt to develop effective decision-making models that are then applied in certain organized communities.

In this case as well, the collective symbol "ant" does not represent just a concept but a significant and rich concept within the information hierarchy. We proceed with the discussion of the most extensive conceptual network of group KE8.

2.3.8 Classification group KE8



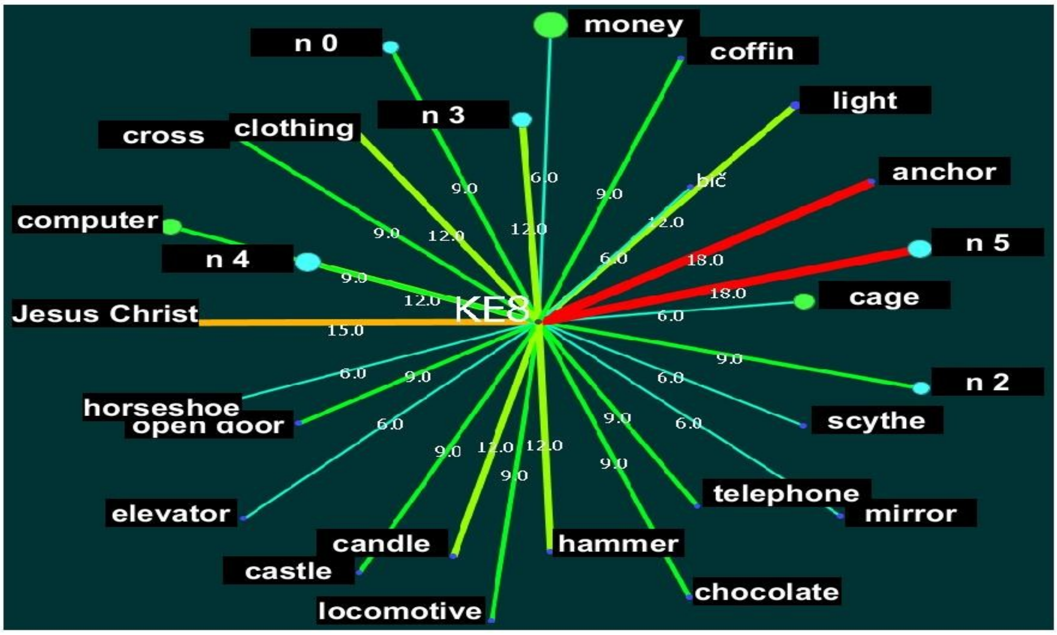
2.3.8.1 Figure 43: Reduced conceptual network of collective symbols from group KE8

Figure 43 displays a reduced conceptual network of collective symbols, including their aspects, for group KE8. This extensive network does not feature natural collective symbols; instead, it primarily includes human-made objects (e.g., money, computer, phone) and significant personalities (e.g., Jesus Christ). This network could also be referred to as a sociological conceptual network.

We can observe a large number of modern collective symbols (e.g., computer, phone, locomotive, elevator). The collective symbol "cross" is a notable exception, as it is classified among mythological symbols. Generally, this network is distinctly marked by religious content, including collective symbols (e.g., "Jesus Christ," "cross") and, to some extent, aspects (e.g., Guardian Angel, Faith, Divinity).

Similar to previous conceptual networks, this one also exhibits both strong connections (e.g., red) and weak connections (e.g., light blue dashed lines), as well as larger nodes (e.g., "money") and smaller nodes (e.g., "cradle"). The largest node in this network represents the collective symbol "money," followed by "number four," "number five," "number three," "cage," "number zero," "number two," etc. We also observe a larger number of intermediate nodes. These nodes are aspects that connect various collective symbols.

Firstly, we can highlight the aspect of stability, which connects collective symbols such as "anchor," "number three," "number four," and "candle." Faith is another aspect that connects the collective symbols "cross" and "candle." In this network, we also discover the aspect of completeness, which connects the collective symbols "number zero" and "number four." Furthermore, we can identify the aspect of prosperity, which connects the collective symbols "money" and "number zero." Additionally, we observe the aspect of divinity (connecting the collective symbols "number three" and "light") and the aspect of wisdom (connecting the collective symbols "light" and "candle"). Even in this reduced conceptual network, no negative aspects are discernible.



2.3.8.2 Figure 44: Latent semantic analysis of the collective symbols network from group KE8

Figure 44 illustrates the visual result of the latent semantic analysis of the conceptual network of collective symbols from group KE8. Until now, we have been accustomed to seeing the contents of collective symbols directly related to each other. However, in this case, the obtained collective symbols can only be connected indirectly.

Semantically, the content is very complex, making it impossible to form a simple statement. The collective symbols are highly heterogeneous, including numerical, religious, tool, architectural, consumer, and technological symbols. Among these symbols, we select the largest node, which represents the collective symbol "money."

To illustrate this, a fictional example from the field of pension fund financing will be presented. The meaning of money is relatively well-known to us all. Money fundamentally serves as a medium of exchange that has replaced collecting and hunting. With money, we primarily acquire food and provide shelter. Money has a certain value, which is usually earned through work.

The pension system is based on the principle that working individuals contribute a small portion of their personal income to the pension fund each month. This amount is typically listed on the pay stub as a deduction, expressed in currency or monetary value. This represents the primary source of funding for the pension fund. Working individuals, aged 18 to 60, contribute with their taxes so that older individuals, retirees, can receive pensions as compensation for their past work in the form of money. This is a recurring social cycle where younger generations work for older ones. Money is presented here as a payment and exchange medium.

However, the collective symbol "money" has a much deeper semantic dimension, as it is heavily dependent on the demographic pyramid of the population. If the age structure of the population is unfavorably distributed, it can be very harmful to pension recipients. Such a situation also negatively affects working individuals who will depend on the number of younger able-bodied people during their retirement. This means that fewer financial resources will flow into the pension fund.

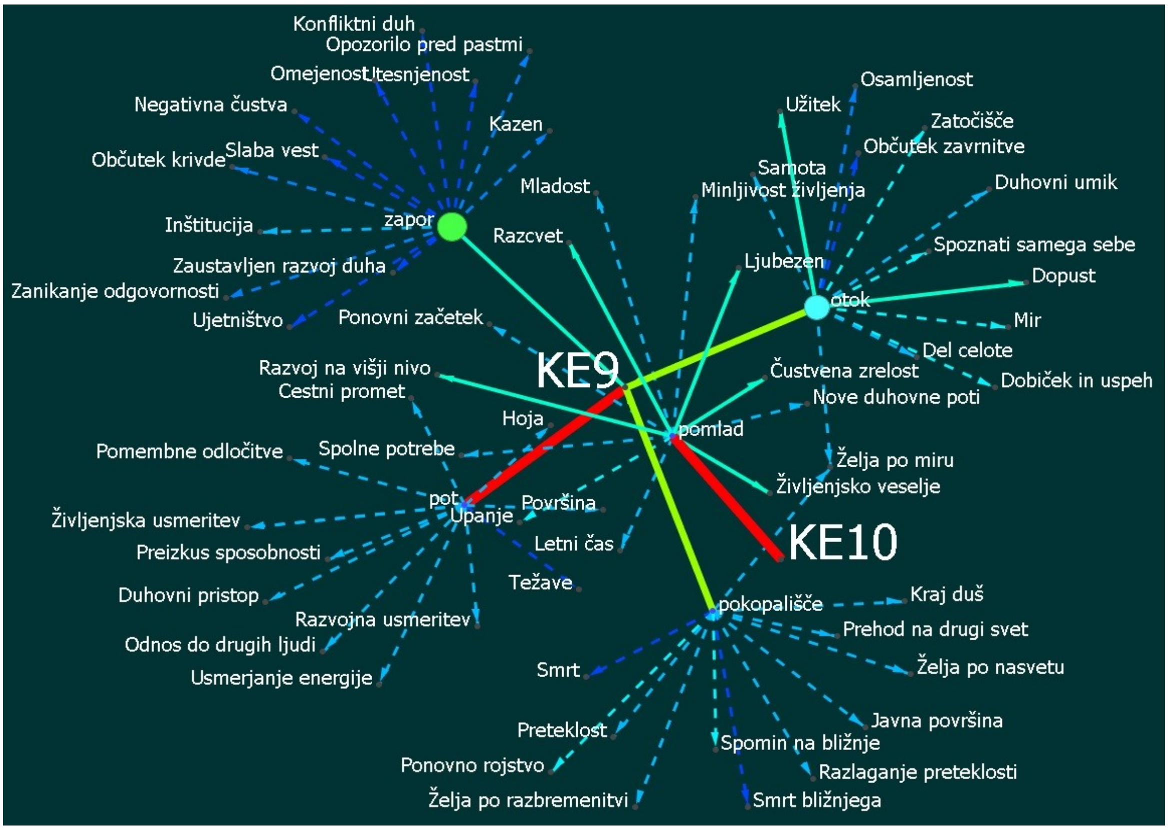
How can this problem be solved? In this case, money is not just a payment and exchange medium but also one of the tools for filling the pension fund, enabling a dignified life for retirees in the future. Primarily economists, financiers, politicians, and lawyers will need to find solutions for reforming the existing pension system, which will require decisions on additional financial sources for the pension fund.

Acquiring additional resources (e.g., sponsorship funds from companies, private individuals, or a share from games of chance) is not the biggest problem in itself. The greater challenge is aligning these resources with existing legislation, which stipulates that pension funds are financed based on deductions from personal income.

Thus, the collective symbol "money" is no longer just a concept or symbol of wealth and prosperity but represents a profound concept within the information hierarchy. This concept indicates the need for changes in pension legislation to allow pension fund financing from various sources. This will require agreement and subsequent action to prepare new pension legislation.

Theoretically, the proposal seems reasonable, but its implementation is extremely challenging, as it requires broad social consensus.

2.3.9 Classification group KE9 and KE10



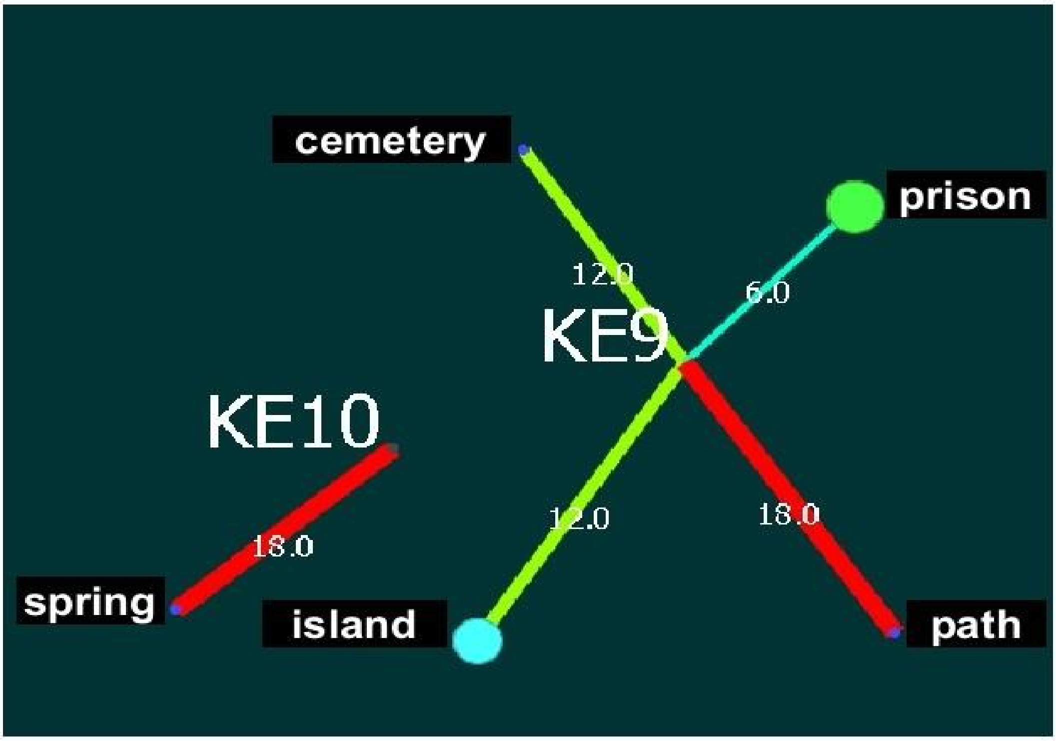
2.3.9.1 Figure 45: Conceptual network of collective symbols from groups KE9 and KE10

Figure 45 displays the conceptual network of collective symbols and their aspects from groups KE9 and KE10. Due to the small number of representatives of collective symbols, especially from group KE10, both groups were combined into a single visualization. The conceptual networks are not thematically connected through aspects.

Group KE9 includes collective symbols that represent a social aspect, while the sole representative of group KE10 symbolizes a natural aspect. The largest node in these two networks represents the collective symbol "prison," followed by "island," "path," "cemetery," and "spring."

Within the conceptual network, it is possible to discover the aspect of a desire for peace, which connects the collective symbols "island" and "cemetery." Additionally, the network includes some negatively oriented aspects, such as: the death of a loved one, loneliness, conflicting spirit, confinement, claustrophobia, stalled spiritual development, captivity, punishment, feelings of guilt, and death. In general, it can be stated that the conceptual network under discussion is the most negatively oriented compared to others. Within the KE9 conceptual network, we find representatives of various social contexts: the institution of a prison, part of a village (path), part of a church institution (cemetery), and part of a state or even a state itself (island). In the KE10 conceptual network, the sole and main representative of a season is spring.

Next follows the visual presentation of the latent semantic analysis of both conceptual networks.



2.3.9.2 Figure 46: Latent semantic analysis of the network of collective symbols from groups KE9 and KE10

Figure 46 presents a visualization of the latent semantic analysis conducted on the conceptual network of collective symbols from groups KE9 and KE10. Based on representatives from these groups, in connection with previous aspects, at least one statement could be formulated:

"Spring signifies blossoming and life; a person within it is neither an isolated island nor a prisoner in a jail, yet the path ultimately leads to the cemetery."

This statement is imbued with pessimism, a consequence of certain collective symbols with a distinctly negative connotation (e.g., prison, cemetery). At the same time, the symbol of "spring" carries a distinctly positive meaning, while the symbol of "path" can have a positive, negative, or neutral connotation. The pessimistic statement was primarily formed based on some negative aspects within the conceptual network of collective symbols from group KE9.

As a result, the latent semantic analysis identified representatives with a natural motif related to the time period from group KE10 ("spring") and representatives from group KE9, whose semantic connotation is of a social nature (path, cemetery, island, prison). To demonstrate that collective symbols represent significant conceptual elements within the informational hierarchy, the largest node will be selected—namely, the collective symbol "prison."

An example from the field of penology will be provided. Prisons are not only a concern for architects but also for experts in penology, which deals with the execution of sentences, prisons, prisoners, and the serving of sentences. Penology is closely linked to criminal law and criminology. The collective symbol "prison" does not only represent a spatial restriction but also an institution where the legal system places individuals who have violated the law(s). These range from perpetrators of serious crimes such as murder and grievous bodily harm to robbers, fraudsters, drug dealers, and terrorists.

Criminal offenders differ in their level of threat to society, making it reasonable to separate them accordingly. The most dangerous offenders should face additional restrictions even while serving their prison sentences, as experience, particularly in American and Turkish prisons, has shown that such criminals remain dangerous even within the prison environment.

Prison institutions frequently struggle with spatial constraints due to overcrowding and must also meet various standards, including spatial requirements. As a result, the collective symbol "prison" transcends mere terminology or signs and becomes a broad conceptual entity within the informational hierarchy. Addressing these issues requires an interdisciplinary approach, incorporating psychosocial, medical, criminological, legal, political, and economic perspectives. One potential solution is crime prediction, which could prevent numerous offenses and, consequently, reduce the number of prisoners. In this case, criminal law would also need to adapt, ensuring that penalties for offenders who have not successfully committed crimes differ from standard prison sentences. Additionally, the level of danger posed by an individual offender must be considered.

Implementing this proposal requires societal agreements that involve politics, criminal law, the economy, finance, and law enforcement. State institutions must take action, as prison overcrowding remains a serious issue.

This concludes the discussion on conceptual networks of collective symbols, as provided by respondents through an online survey. Based on the findings and evidence presented, it can be determined that collective symbols are intriguing hierarchical associative conceptual or semiotic systems, which have evolved over a long historical period through social induction (similar to economic propaganda). These systems often emerged without clear or deliberate development, yet they continued to expand and ultimately had a significant impact on social communication.

A relevant analogy is the process by which a path forms in a grassy area without prior planning—people repeatedly take a shortcut to reach their goal, eventually creating a visible trail. This principle mirrors the development of collective symbols.

It is well known that the meaning of collective symbols can vary significantly across different continents, largely depending on experiences, events, rules within existing communities, social hierarchies, and, especially, religion. In the predominantly Christian and Protestant European

Union, the meaning of collective symbols is relatively uniform and consistent, as a result of shared cultural values.

Both nature and society contain numerous hierarchical and associative systems, such as food chains in nature, patterns of thought, or the movement of planets. One of the most significant among them is the hierarchical associative system of collective symbols, which will continue to evolve as long as humanity exists. Collective symbols are crucial concepts within the informational hierarchy, as they drive human decision-making and actions. Based on this, we can conclude that collective symbols are, in fact, the fundamental building blocks of conceptual and semiotic hierarchical associative informational systems.

Some may argue that this discussion has focused excessively on symbols. However, it is important to emphasize that symbols—especially collective ones—are, in many aspects, extremely important. Without them, the human species would lack true cognitive concentration, which would, in turn, hinder the development of various forms of art (e.g., emotional expression) and science (e.g., logic, physical laws).

In the following section, a study will be explored that somewhat resembles movement analysis using specialized hardware, software, and telecommunication equipment (Bewegungsanalyse – gait or motion analysis, developed around 2002–2007). A similar method was developed around 1989–1990 by the author of this work and was further refined between 1991 and 1995. However, at that time, specialized technical (software) tools were not yet available. As a result, various events, movements, facial expressions, gestures, and other observations had to be manually recorded. This required an enormous amount of work, far exceeding the efforts of a single individual.

For the classification of different events and phenomena, the research relied on the inductive approach developed by Francis Bacon (a 17th-century English philosopher) and the work of Ludwig Klages (a German philosopher and the father of graphology).[25]

2.4 Introspective method of classified expressions and impressions

The introspective method of classified expressions and impressions will be presented in a condensed form. This method encourages individuals to engage in active and in-depth self-observation, as well as analysis of their own personality and environment. However, its main drawback is its inherent subjectivity, making it advisable to use the extrospective method of classified expressions and impressions in parallel. This complementary approach can incorporate technical tools such as digital cameras, digital photography, software for data collection, processing,

25 Bacon, F. (1986). Novi organon. 2. izd. Zagreb: Naprijed.
Klages, L. (1936). Grundlegung der Wissenschaft vom Ausdruck. 5. Aufl. Leipzig: A. Barth.
Klages, L. (1976 – 1979). Charakterkunde. Bonn: Bouvier.

and analysis, as well as GIS and GPS for tracking the movement of test subjects in space. Additionally, the execution of this method requires experts such as psychologists and sociologists. The core principle of this method is based on classifying expressions (internal and external) and impressions (internal and external) into appropriate categories, which are then subjected to data analysis and synthesis. By using well-prepared scenarios, it is possible to apply methods for identifying patterns in the data and extracting new insights and knowledge. The ultimate goal of these efforts is to develop a hierarchical associative system of an individual's thoughts.

First, a condensed definition of expressions and impressions will be provided, followed by relevant examples.

External Expressions

These include non-verbal, verbal, and combined communication units:

- Non-verbal (e.g., gestures, facial expressions)
- Verbal (e.g., speech)
- Combined (e.g., an involuntary reaction of both body and speech due to a medical condition)

External expressions result from two fields of consciousness:

1. Ordinary or everyday field of consciousness – Governs intentional external expressions whose origins are consciously recognized (e.g., writing a notice, playing the guitar, lifting weights, greeting people).
2. Subliminal field of consciousness – Governs external expressions whose origins are not consciously recognized (e.g., bodily automatisms, slips of the tongue).

It is common for the everyday field of consciousness to temporarily shift beyond its normal framework and transition into the subliminal field of consciousness. After this shift, consciousness usually returns to its previous state, which may be noticeably altered or remain seemingly unchanged. Regardless of the extent of these changes, the origin of such transitions from the everyday field of consciousness remains unknown. Similarly, societal functioning may also include subliminal fields of collective and individual consciousness, which generate sociological movements or automatisms whose origins cannot be clearly determined.

Internal Expressions

Internal expressions are thoughts that emerge with specific content and structure. They are not immediately perceivable during casual observation of another person, as they often later manifest as external expressions. For instance, the birth of an innovative idea is an internal expression, whereas writing about that idea is an external expression.

External Impressions

External impressions include all information perceived through the five senses: hearing, sight, touch, taste, and smell. These impressions encompass experiences such as the sensation of an object's heat, adverse weather conditions, melodies, feelings of antipathy or affection toward others, as well as emotions like joy or sadness. External impressions represent expressions of nature (e.g., weather), society, or other individuals, which are interpreted based on existing rules and frameworks.

Internal Impressions

Internal impressions are pieces of information received within the body in a form akin to a "telegraphic language." These impressions may arise either directly or indirectly from external impressions and are more deeply re-experienced rather than merely perceived. They often relate to one's internal state or emotions, which result from intense environmental stimuli (e.g., the internal impression: “I feel old”). A less experienced observer or self-observer may find it difficult to identify and classify internal impressions.

Observing and Measuring Expressions and Impressions

The observation and measurement of expressions and impressions—along with the partially hierarchical associative system of an individual’s thoughts—depend largely on specific situations. These situations can be highly diverse and difficult to manage without appropriate classification. Situations can generally be defined as temporal, spatial, contextual, communicative, or combined changes that signify a transition from one state to another.

In measuring situations (e.g., tracking spatial changes using GPS or manually mapping movements on a city grid labeled from A1 to J10 to follow an individual’s physical path), the following examples may be useful:

- Isolated cases – Instances that cannot be easily categorized and require further study. These may be connected to other expressions or impressions (e.g., a specific expression or impression that occurs very rarely or only once in a session).
- Cases of creativity or thought formation – Expressions or impressions linked to experiences, polarity, or associations (e.g., an innovative idea).
- Migration cases – Referring to spatial movements of individuals, other people, objects, events, or phenomena (e.g., a thought or event that recurs while moving from one location to another).
- Hostile or opposing cases – Instances where a conflict arises between an individual and their surroundings (e.g., a particular expression or impression triggers a sense of threat or discomfort).
- Dose of nature – The impact of natural forces on an individual (e.g., rain prompting an external expression such as opening an umbrella).

- Error cases – Mistakes or slips, such as forgetting something or making a verbal slip (e.g., unintentionally leaving an item behind or misspeaking).

Types of cases in expressions and impressions

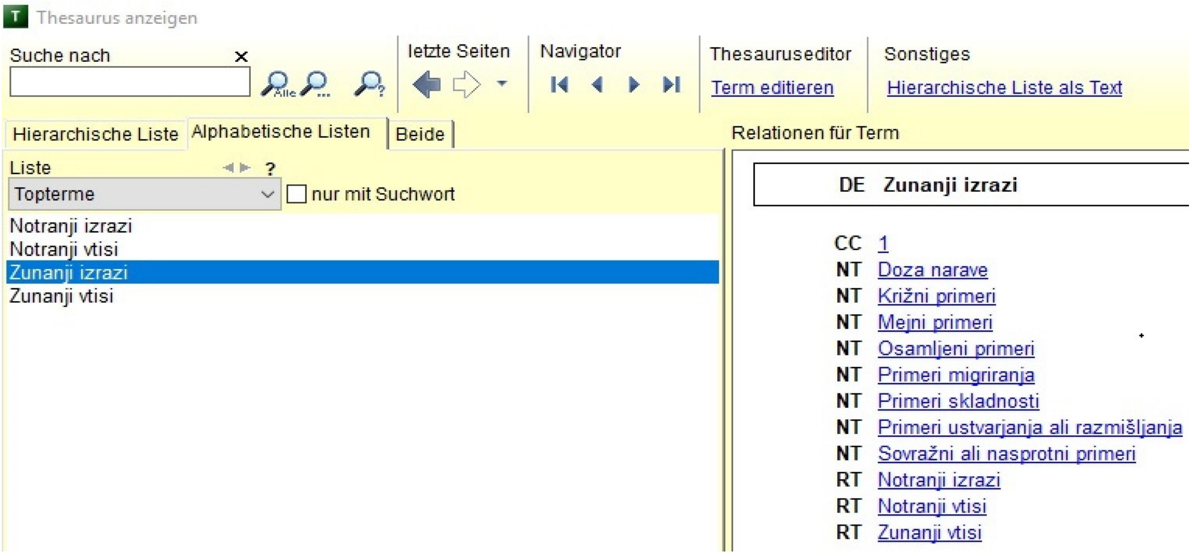
- Cases of consistency – Expressions and impressions in certain situations align and repeat (e.g., two different situations exhibit a similar pattern).
- Borderline cases – Expressions and impressions may appear consistent, but due to specific causal backgrounds, they ultimately result in an error case (e.g., paying for a service but forgetting to take the receipt because of being engaged in a conversation with an acquaintance).
- Cross cases – Two events are diametrically opposed but structurally very similar.

To facilitate case identification, preliminary observations—such as monitoring gestures, movements, and states of stillness—can be introduced.

Research process on classified expressions and impressions

The research follows a structured process:

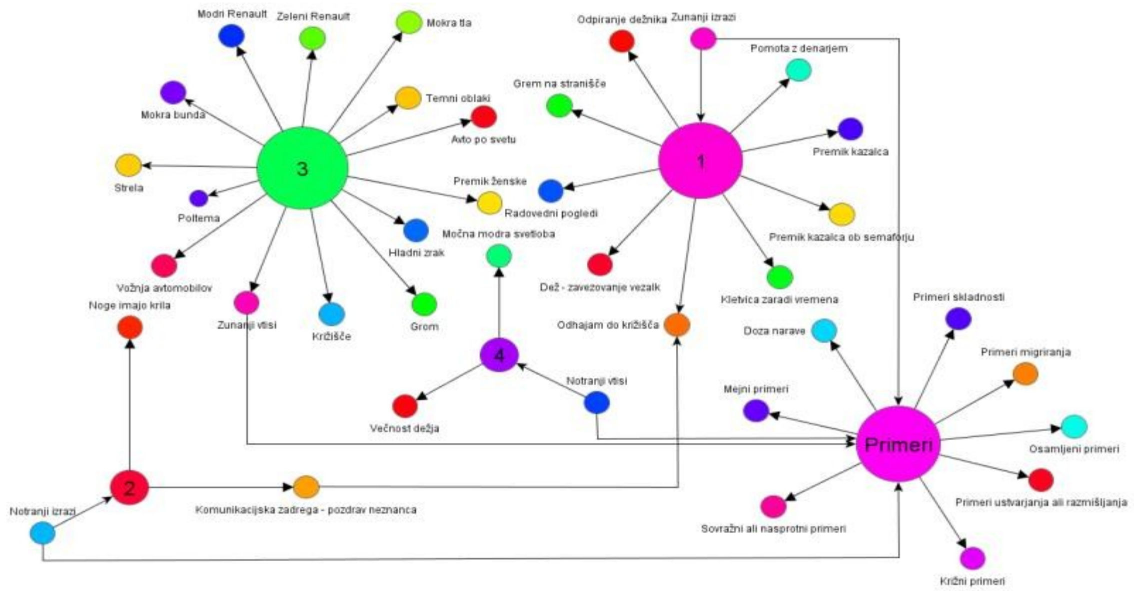
1. Data collection – Recording various expressions and impressions.
2. Categorization – Sorting the collected data into the previously mentioned case types within the categories of expressions and impressions.
3. Development of a customized micro-thesaurus – Constructing a specialized vocabulary of classified expressions and impressions for further analysis.



2.4.1 Figure 47: Excerpt from the adapted micro-thesaurus of classified expressions and impressions

Figure 47 presents an excerpt from the adapted micro-thesaurus of classified expressions and impressions. Expressions and impressions are defined as top-level categories (Eng. TT – top term) and are organized into four numerical groups (1 to 4). Cases are defined as subordinate units of expressions and impressions, which, in turn, are superior to specific events.

Concrete expressions and impressions (e.g., opening an umbrella, a money-related mistake, a blue Renault) are represented as descriptors, which are subordinate to the relevant case (e.g., dose of nature → opening an umbrella).



2.4.2 Figure 48: Visualization of the adapted micro-thesaurus of classified expressions and impressions

Figure 48 presents the result of visualizing the adapted micro-thesaurus of classified expressions and impressions. This thesaurus is particularly useful for preparing complex data, as it not only includes hierarchical relationships (superior-subordinate), associations, and relational links but also classification units.

Expressions and impressions are divided into four categories:

- External expressions (Class 1)
- Internal expressions (Class 2)
- External impressions (Class 3)
- Internal impressions (Class 4)

In this case, the adapted micro-thesaurus must be exported to an Excel file, which is then converted into a .txt file for processing in various data and text analysis software. .txt files are compatible with most analytical tools, whereas .xls files are often not supported.

Rich visualizations of relationships between classification units and cases are highly valuable, as they provide insights into cognitive structures and mental hierarchies of individuals. These relationships also form hierarchies, which dynamically interact based on situational changes, leading to the emergence of numerous associative connections. Changes in a given situation are influenced by spatial and/or temporal variations, which depend on individual decisions and actions.

Expressions and impressions are also part of a hierarchical associative system, where associative structures emerge based on specific cases and situational changes. A similar process can be observed in writing a prose work—where an initial draft exists, but individual elements are not yet interconnected. Gradually, sentences, objects, phenomena, events, and characters form structured hierarchical and associative relationships. The final product is a story that provides new insights and can influence future perspectives.

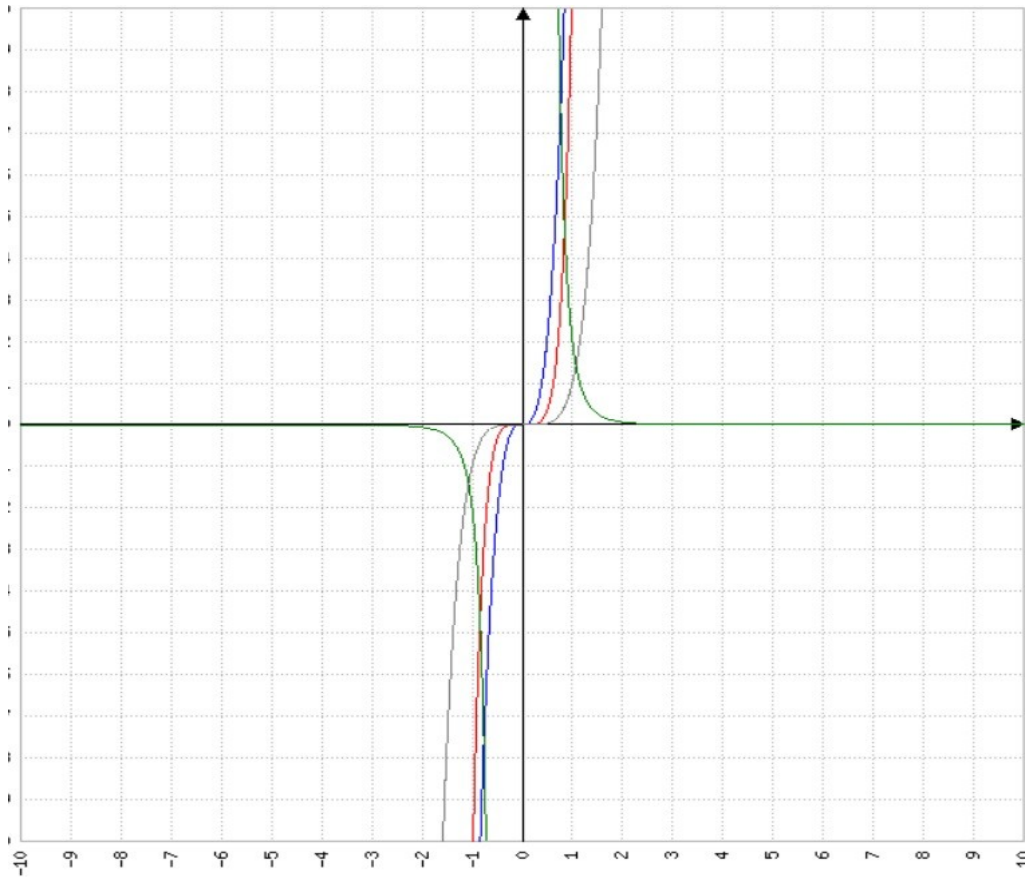
Collective symbols play a crucial role in both expressions and impressions as well as in storytelling, as they shape the interpretation of events, people, and objects. They can even affect data analysis and synthesis. Ultimately, scientific methods themselves function as hierarchical associative systems, which have existed since the era of early human communities.

From this perspective, historical science plays a vital role, as it records and interprets past events.

Hierarchical associative systems tend to expand into large networks. However, this does not mean they merely accumulate information—certain elements and even smaller sub-networks within the system can be discarded under the influence of hierarchical structures.

Just like all networks, hierarchical associative systems have a certain critical mass, beyond which further expansion is neither practical nor possible. When this threshold is reached, these systems may partially or entirely disintegrate, potentially giving rise to new systems.

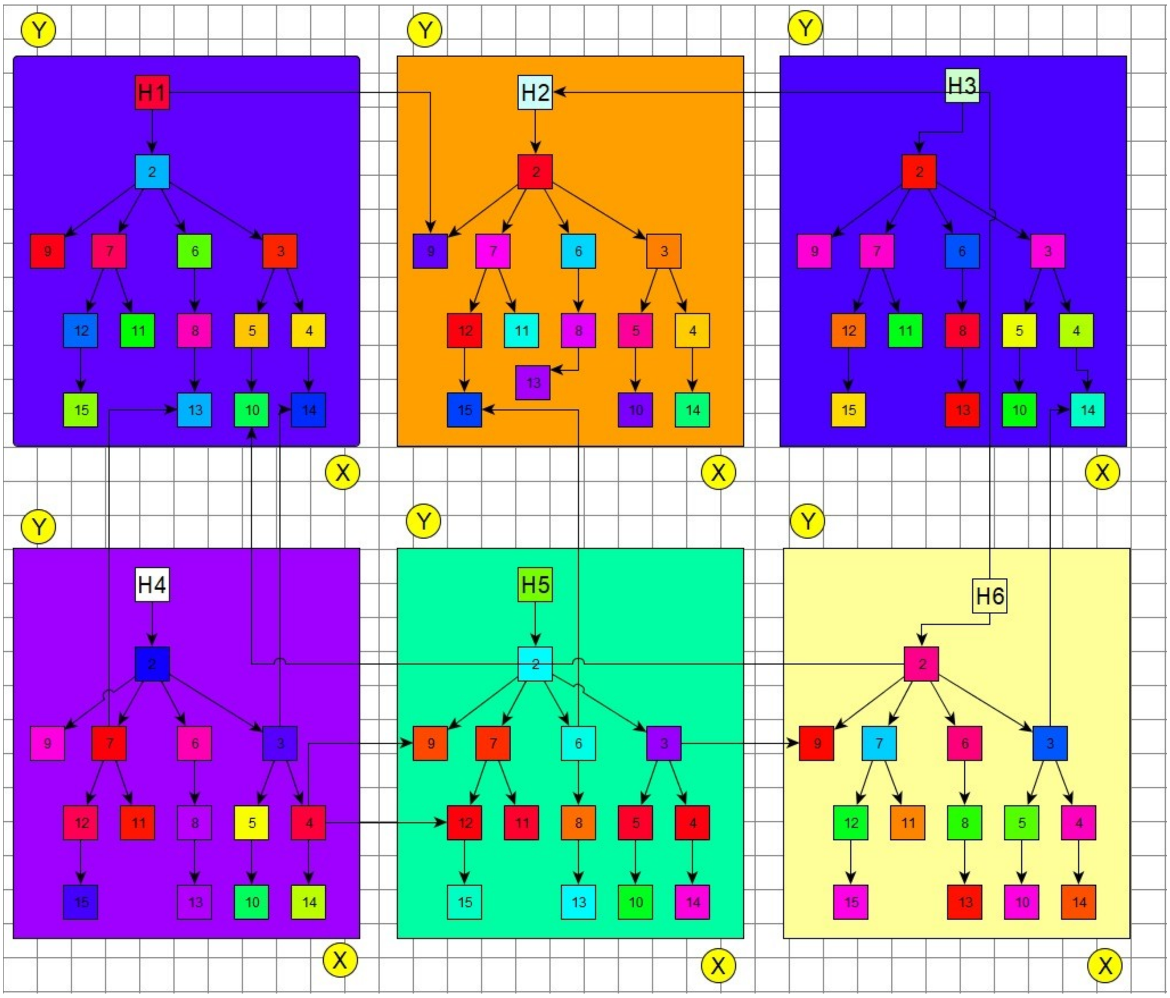
A good example of this phenomenon is the hierarchical associative system of individual thought. Any network that emerges is based on various hierarchies and/or hierarchical systems, which are interconnected through relational and/or associative links with other hierarchies and systems.
When examining visual representations of large networks, it is crucial to recognize that we are essentially looking at different hierarchies, which may be strongly, moderately, weakly, or not at all connected. These network visualizations are also referred to as graphs, which are based on graph theory. Originating from mathematics and computer science, graph theory represents networks as nodes (vertices) that may or may not be connected. Large networks can be seen as complex graphs with intricate functions.
In the case of large networks, we do not deal with linear or quadratic functions, but rather polynomial functions, whose fundamental components still include linear and quadratic elements. Mathematical functions always involve dependent (Y) and independent (X) variables. The goal here is not to analyze mathematical functions in detail but to illustrate the potential use of mathematical language or models through polynomial functions. Within a large network, there exists a multitude of coordinate systems, which may or may not be interconnected. Such a network graph can contain linear, quadratic, and polynomial curves. When interpreting symbols or collective symbols, we could apply a polynomial function model, where symbolic categories serve as dependent variables (Y) and associative concepts as independent variables (X).
Thus, we define:
- X = Symbolic Categories (SC)
- Y = Associative Concepts (AC)
Additionally, the frequencies of associative words (fa) were measured and can be represented as a multiplicative factor applied to X^n. Both symbolic categories and associative concepts were evaluated on a scale from -5 to 0 to 5, with ratings expressed as exponents.
For illustrative purposes, consider the following polynomial function:
$SC(AC) = faAC_1{}^n + faAC_2{}^n + faAC_3{}^n - faAC_4{}^{-n} \ldots faAC_{18}{}^n!!$
To clarify, inserting numerical values results in:
$SC(AP) = 17\,AC_1{}^3 + 11\,AC_2{}^5 - 2AC_4{}^{-5} + AC_{18}{}^5$



2.4.3 Figure 49: Examples of polynomial graphs

Figure 49 illustrates the graphs of the previously mentioned polynomial function. Multiple points can be observed where the curves intersect or touch each other.

Moving forward, these curves could be transformed into a network graph. Additionally, the figure presents a larger number of coordinate systems or two-dimensional planes representing different hierarchies. These hierarchies may be interconnected either directly or indirectly through a subordinate node within a given hierarchy.



2.4.3.1 Figure 50: Hierarchies within the entire network

Figure 50 illustrates the hierarchies within the entire (fictional) network, which can be interconnected. It represents the entire network using multiple coordinate systems, each with two variables (Y, X). Each hierarchy has its own coordinate system, while the connections between nodes from different coordinate systems actually link these systems together. By breaking down the hierarchies into separate planes (with the condition that each hierarchy has its own plane), it becomes easier to analyze the structure of a given network. This approach helps identify weaknesses earlier, which can then be addressed.

2.5 Personality theories – an attempt at modeling

We are still in the chapter focused on the individual. A general overview of various personality theories has already been provided. The following section presents several personality typologies, which—along with the previously introduced theories—will be used to construct a new model of personality typology. This model will be adapted for representation in the form of a network, where the main nodes will include orientations, functions, dimensions, and so on. Using such indicators, it becomes possible to describe a specific personality and/or a group of personalities. The main goal of these efforts is to portray personality as a hierarchical associative system or network. For greater clarity, some additional personality typology theories will also be briefly introduced.

2.5.1 Personality typology according to Hippocrates and Galen

A personality typology was developed based on human temperaments, which were believed to depend on bodily fluids such as blood, phlegm, black bile, and yellow bile. When these bodily fluids are in a certain balanced ratio, a person's behavior is also considered to be balanced. From this theory, four temperaments were derived:

- Sanguine (cheerful, sociable, pleasant, adaptable, full of positive energy, optimistic, etc.),

- Choleric (irritable, impulsive, restless, but also stable, loyal, reliable, etc.),

- Phlegmatic (inactive, passive, calm, unaffected, etc.), and

- Melancholic (sad, depressive, reserved, unsociable, pessimistic, etc.).

Despite the relative simplicity or naivety of this typology, it still holds a significant degree of truth. Bodily fluids, as well as physical organs and body constitution, do indeed influence personality formation. They contribute to the development of internal rules that a person tends to follow in order to keep their personality balanced and well-organized. Essentially, this typology describes certain innate orientations of an individual, believed to be determined by bodily fluids.

2.5.2 Personality typology according to Carl Gustav Jung

The Swiss psychologist developed a model based on two aspects of an individual's functioning: the direction of psychic energy and the functions of psychological experience. Depending on the direction in which this energy flows within consciousness, he distinguished between two personality types:

- Extraverted (oriented toward the external world, open personalities) and

- Introverted (oriented inward, reserved personalities).

In this typology as well, we can observe that an individual's orientation is influenced by both innate factors (biological predispositions) and acquired factors (environment, time).

2.5.3 Personality typology according to Ernst Kretschmer

This personality typology primarily focuses on an individual's physical build. Kretschmer observed people and examined the relationship between their body type and psychological disorders. He believed that certain mental illnesses were more likely to occur in individuals with specific body types. He identified three main body types:

- Pyknic (round face, stocky build, practical, extraverted, schizoid tendencies, sometimes emotionally unstable),

- Asthenic (thin, tall, idealistic, introverted, with a strong association with schizophrenia),

- Athletic (taller build, strong, resilient, sometimes aggressive, authoritative, prone to paranoia and epilepsy).

A fourth type was later added, called Dysplastic, characterized by mixed features.

This typology once again points toward a link between physical constitution and susceptibility to mental disorders.

2.5.4 Myers–Briggs personality typology

The two researchers continued the work of Carl Jung and developed four core life functions that guide an individual's behavior. These functions are:

- Orientation of attention (How does an individual connect with others?),

- Information gathering (How are situations perceived?),

- Information processing (How are decisions made and information processed for life choices?), and

- Life orientation (What is the person’s overall direction in life—toward goals or visions?).

Jung’s typology of extraversion and introversion served as the foundation for this model.

This typology also explores key orientations such as attention (sociability), analytical thinking, data synthesis, and goal-, idea-, vision-, or thought-oriented behavior.

Later, other researchers concluded that typological personality theories were too imprecise and too general to adequately describe personality. For example, they developed various dimensions to determine the degree or strength of certain orientations. Personality theory has become an extremely broad field, one that an individual alone cannot fully grasp—it would require an excellent, heterogeneous scientific team with a strong emphasis on psychologists.

Therefore, our efforts will focus primarily on representing the complexity of the individual in the form of a hierarchical associative network. How can this be visualized? To do this, a customized thesaurus will first be created, containing terms from various personality theories as well as orientations, dimensions, evaluations, etc. A fictional individual will be modeled.

Subsequently, the data will be exported to Excel and then processed using the tool Ora Casos to construct the network. To build this hierarchical associative network, the following personality theories were included and classified into eight numbered groups:

a. Psychodynamic personality theory (abbreviated PD) is assigned to group 1,

b. Typological and dimensional personality theory (TD) to group 2,

c. Biological personality theory (BT) to group 3,

d. Behavioral personality theory (VT) to group 4,

e. Social personality theory (ST) to group 5,

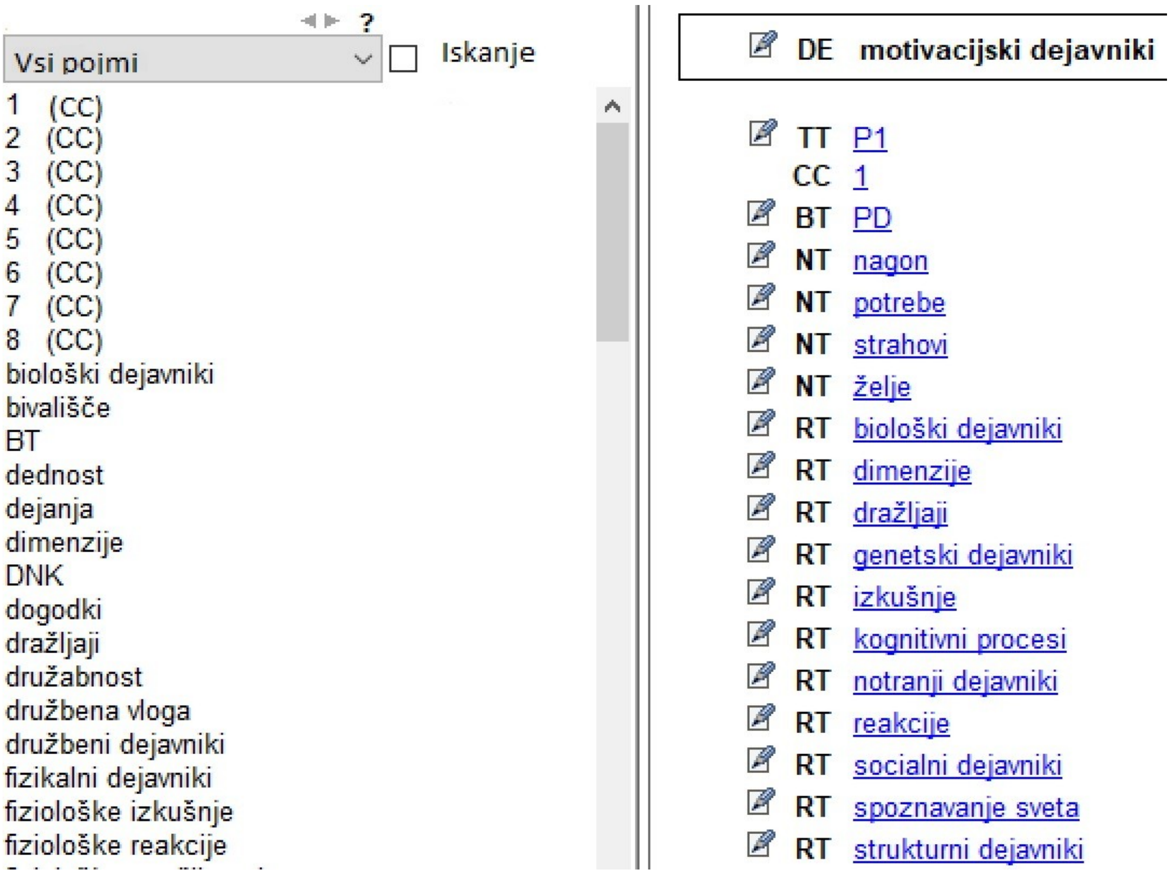
f. Subjectivist personality theory (SO) to group 6,

g. Cognitive personality theory (KT) to group 7,

h. Integral personality theory (IT) to group 8.

The individual being studied (referred to as P1) is marked in the thesaurus as TT (Top Term), which means P1 occupies the highest level in this hierarchical associative system. The personality theories are designated as BT (Broader Terms) and DE (Descriptors), placing them at the second level of the hierarchy—superordinate to the dimensions, traits, and characteristics, which are marked as NT (Narrower Terms), indicating they are subordinate to the theories.

Finally, there are also RT (Related Terms), which represent associative relationships between different personality theories. For greater clarity, a portion of the customized thesaurus will be presented.



2.5.5 Figure 51: Part of the customized thesaurus with corresponding relationships

Figure 51 shows a section of the customized thesaurus along with the appropriate relationships. Displayed is Group 1 (see the right side of Figure 51), which includes the Psychodynamic Theory (PD). This theory particularly emphasizes and examines the influence of motivational factors on P1. The narrower terms (NT) shown include factors such as drives, needs, desires, and fears. These factors can be associated (RT – Related Terms) with biological factors, dimensions, stimuli, experiences, and so on.

On the left side of Figure 51, the eight classification groups are visible, along with part of an alphabetical list of other terms. Figure 51 is significant because it provides the framework for exporting the data into Excel. A section of the Excel data will then be presented in tabular form.

2.5.5.1 Table 69: Part of the exported thesaurus data and added ratings

DE	*TT*	*VV*	*Wcc*	*CC*	*BT*	*NT*	*RT*
BT	P1	1	3		P1	biological ...	IT|KT ...
heredity	P1	1	3		biological ...		
actions	P1	5	5		free		
dimensions	P1	3	3		TD	sociability	biological ...
DNA	P1	1	3		genetic ...		

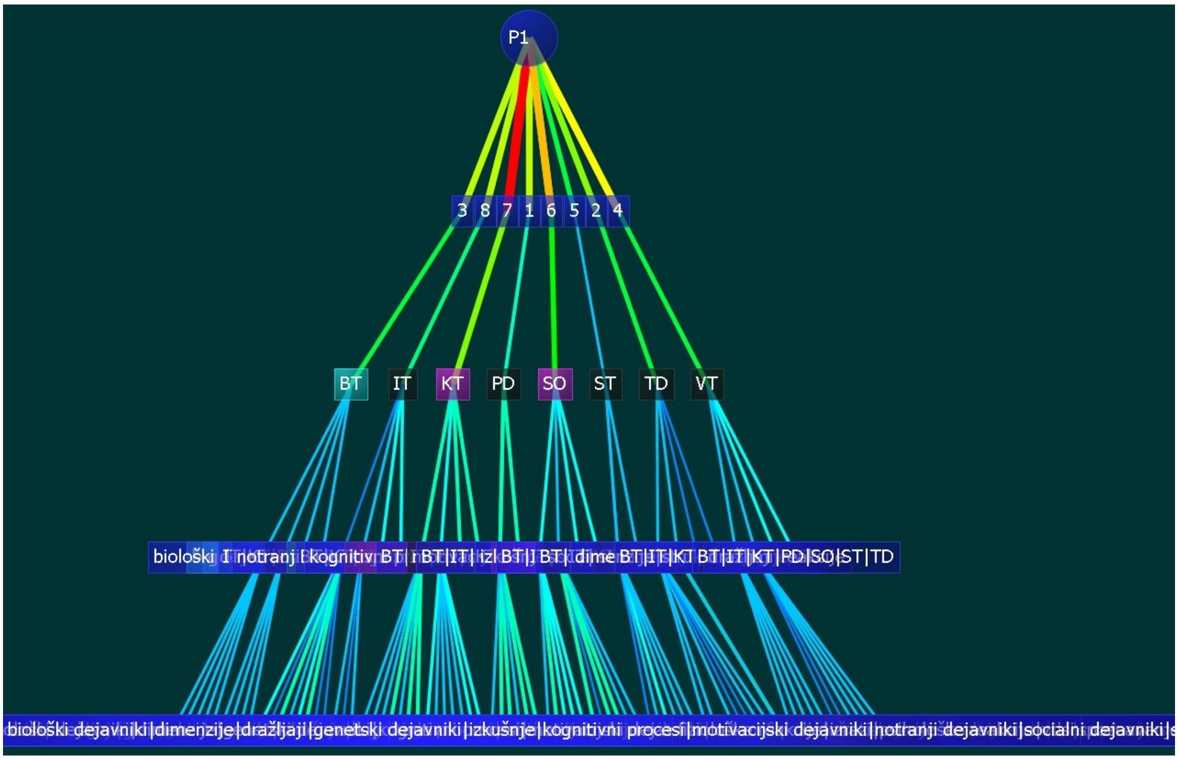
Table 69 shows a portion of the data exported from the thesaurus into Excel, along with added ratings. The meaning of most abbreviations has already been introduced, with the exception of Wcc and VV, which represent evaluation scores.

- Wcc refers to weights or importance scores (on a scale from 1 to 5, where 1 means least important and 5 means most important), assigned to DE (Descriptors) and CC (Concept Clusters) based on the relevance of specific theories, dimensions, traits, etc., in describing P1.
- VV represents the ratings of the influence of willpower (also on a scale from 1 to 5; a score of 1 means willpower has little influence, while a score of 5 means it has very strong influence). This rating indicates the extent to which P1’s willpower affects various factors, dimensions, traits, and so on.

It is well understood that P1’s will has no influence over genetic factors, even if the will is exceptionally strong. However, willpower can significantly affect actions, decisions, and to some extent, the satisfaction of biological needs such as food and drink intake.

The data in the format shown in Table 69 were then imported into the Ora Casos software tool for network visualization and analysis. The technical preparation process for this data—similar to that used in the representation of collective symbols—is quite complex and lies outside the scope of this text.

In this context, it should be noted that Wcc values represent connection strength (strong, medium, or weak links), while VV scores indicate the size of nodes (defined as an attribute for DE and CC nodes). We will begin with a hierarchical view of this conceptual and symbolic network.



2.5.5.2 Figure 52: Hierarchical view of a section of the conceptual and symbolic network

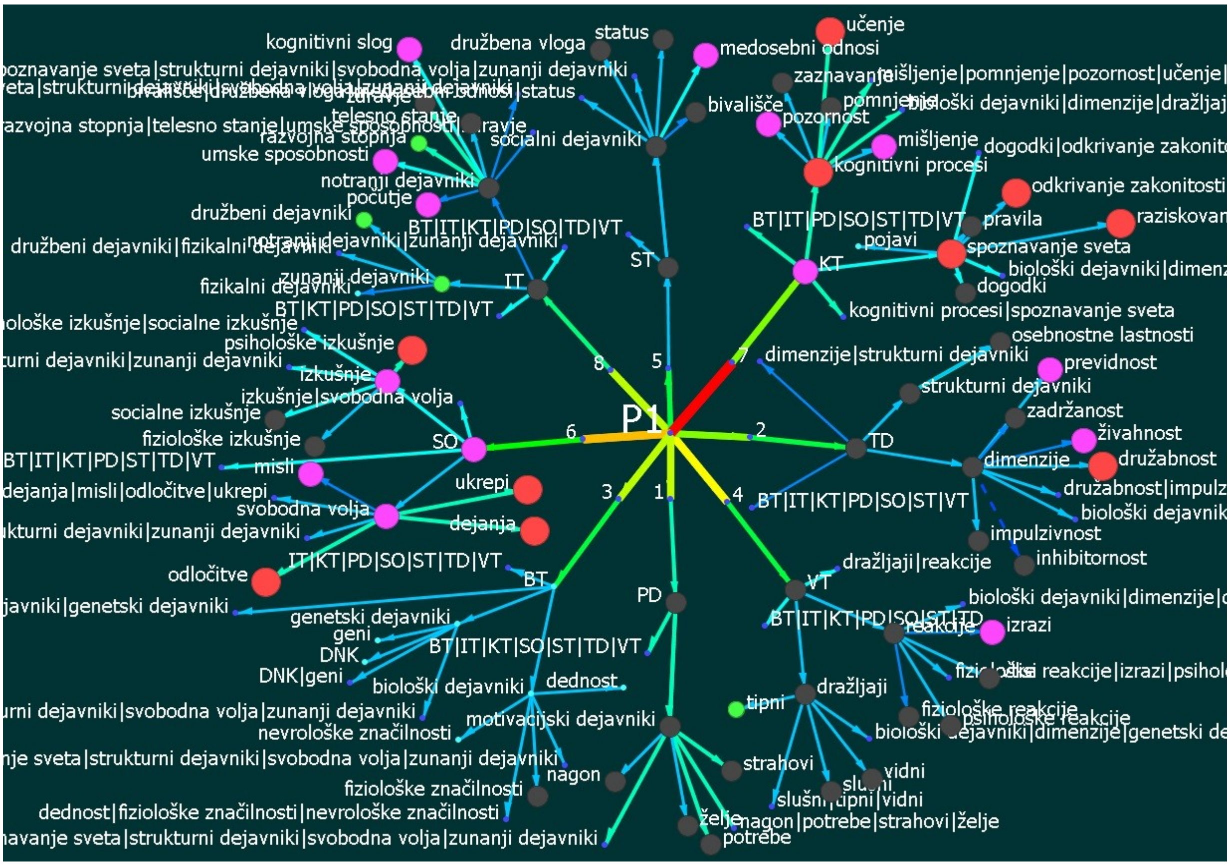
Figure 52 illustrates a hierarchical view of a portion of the conceptual and symbolic network of personality theories from the perspective of P1. One can immediately notice a strong red connection directed toward Group 7, which represents the Cognitive Theory (KT). This group also includes other theories such as Biological Theory (BT), Integral Theory (IT), and others.

The relationships then extend to narrower terms (NT) such as genetic factors and experiences.

Based on the strength or weight of the connections from P1's perspective, the order of relevance continues as follows: Subjectivist Theory (SO), Behavioral Theory (VT), Psychodynamic Theory (PD), Integral Theory (IT), Biological Theory (BT), Typological/Dimensional Theory (TD), and finally Social Theory (ST).

In summary, based on P1's evaluation scores, KT is shown to be the most suitable for describing personality, while ST is the least suitable.

This hierarchical view provides a clear structure of the network, but it does not display the size of the individual nodes. This limitation will be addressed in the following section, which presents an organic view of the network.



2.5.5.3 Figure 53: An organic view of the conceptual and symbolic network

Figure 53 presents an organic view of the conceptual and symbolic network, providing insight into both hierarchies and associative connections. Additionally, it allows us to discern the size of individual nodes, which reflect the impact of P1's will on factors, properties, characteristics, dimensions, etc. The largest nodes, shown in red, indicate that P1's will has the most pronounced influence on specific factors, dimensions, properties, characteristics, etc. P1 may exert significant influence on personal decisions, actions, measures, psychological experiences (based on Group 6 or SO theory), certain cognitive processes (e.g., learning), understanding the world and exploring its principles (based on Group 7 or KT theory), and internal tendencies such as sociability or unsociability (based on Group 2 or TD theory). Theories SO, KT, and TD are central in understanding the influence of P1’s will on these factors.

Nodes depicted in purple represent areas where P1's will has a slightly smaller yet still considerable influence. These include personal thinking and attention (Group 7 or KT theory), broader experiences, free will, thoughts (Group 6 or SO theory), interpersonal relationships (Group 5 or ST theory), cognitive style, mood, mental abilities (Group 8 or IT theory), tendencies toward liveliness or caution (Group 2 or TD theory), and expressions such as gestures and facial expressions (Group

4 or VT theory). These nodes involve a larger number of foundational theories such as KT, SO, ST, IT, TD, and VT.

Nodes with a moderate influence of P1’s will are gray-colored. Examples include perception, memory, rules, events (Group 7 or KT theory), social and physiological experiences (Group 6 or SO theory), status, social factors, residence, societal roles (Group 5 or ST theory), internal factors like physical condition and health (Group 8 or IT theory), structural factors such as personality traits and dimensions like introversion/extroversion (Group 2 or TD theory), physiological characteristics (Group 3 or BT theory), stimuli and reactions (Group 4 or VT theory), and motivational factors like fear, instincts, desires (Group 1 or PD theory). This group incorporates elements from all the discussed personality theories.

Nodes with a smaller influence of P1’s will are light green and significantly smaller than the previous ones. These include external factors such as social influences and developmental stages (Group 8 or IT theory) and tactile stimuli (Group 4 or VT theory). These nodes are associated with only two theories.

Finally, there are factors where P1’s will has minimal to no influence. These include physical factors (Group 8 or IT theory) and biological/genetic factors such as genes, DNA structure, heredity, and neurological characteristics (Group 3 or BT theory). It becomes evident that P1’s influence diminishes significantly when moving away from their psychological basis toward physical/social factors or biological/genetic domains.

In conclusion, when describing an individual or personality through psychological theories, it is crucial to acknowledge that many factors—dimensions, properties—are beyond the individual’s control. For instance, individuals cannot influence genetic factors like DNA structure or external conditions like weather. However, all these elements contribute to a better understanding of an individual’s personality. This raises an intriguing question: "Should we study an individual as P1 to uncover their personality?" Or "Should we define P1 as a personality first and then assign them to a specific personality group?" The assumption is that P1 is already a developing personality with all necessary traits.

A personality can be well- or poorly-organized concerning itself and its environment. It may have stronger/weaker willpower; be introverted/extroverted; possess exceptional mental abilities—or lack them. Ultimately, personality is a core aspect of an individual (e.g., P1) encompassing mental, behavioral, and physical characteristics. It is shaped by mental processes (cognition/emotion/motivation), traits (character/temperament/abilities/physical attributes), and various mental states resulting from psychological phenomena and behavior.

Personality is thus relatively complete, unique to varying degrees, and relatively enduring. When individuals suffer from severe mental illnesses like schizophrenia, psychiatrists often claim either that their personality disintegrates (neglecting ethics/memory markers/appearance) or multiplies into several personalities influencing thought/behavior. In both cases, individuals lose self-control and become poorly organized personalities.

Many aspects of personality are predetermined; however, individuals can significantly influence others. This dynamic allows for more vibrant development of meaningful positive/negative changes over time.

The influence of an individual's will on the meaning of collective symbols (see the study on symbols) is not particularly significant, although the meaning of a specific collective symbol can be individually nuanced (e.g., a happy or traumatic event). Despite these individual variations in meaning, the collective meaning remains primary (e.g., a white dove is collectively recognized as a symbol of peace, even if someone has had negative personal experiences associated with it).

Regarding expressions and impressions (see the brief presentation on expressions and impressions), it has been observed that an individual's will has a relatively significant influence on these. However, this does not hold true over time for physical or mental automatisms. An individual can freely decide when to perform a movement or what topic to think about. Similarly, individuals can influence their impressions and, if necessary, adapt or completely change them. For instance, we are all familiar with the effect of first impressions, where someone initially appears very likable or unlikable. An individual's will has the power to alter this first impression, especially through analysis of the subject, which can confirm or refute their emotional inclination toward that person.

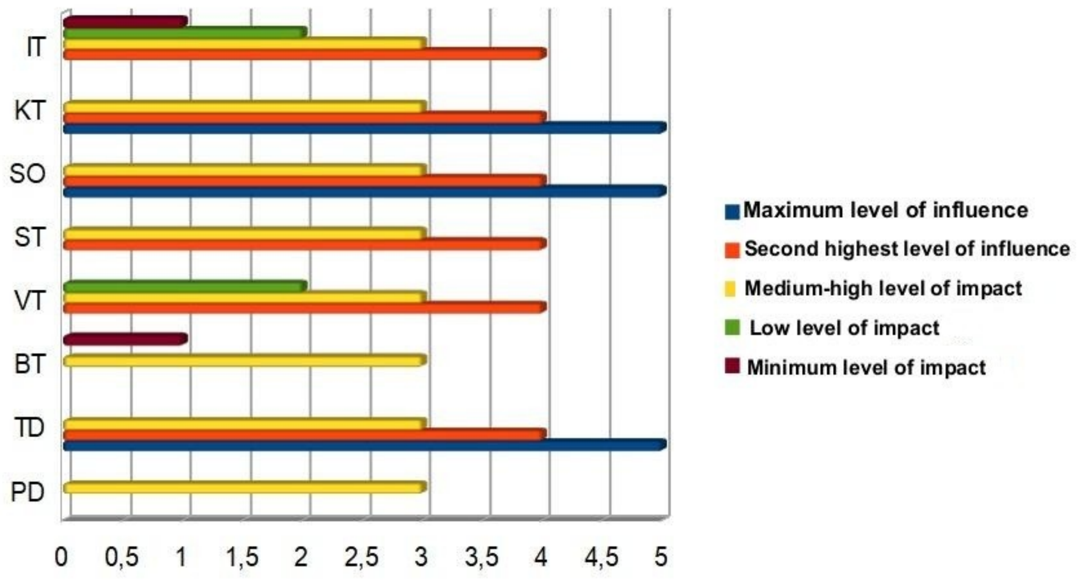
When it comes to polarized phenomena of human existence, the influence of an individual's will can range from very significant to negligible or even nonexistent. An individual's will can choose between love, a relatively neutral emotional state, or hatred. However, numerous factors influence the outcome of this choice, reducing the likelihood of achieving the intended goal. While individuals can decide on different types of love and hatred, they cannot always control the final outcome. Similarly, an individual's will can determine whether they spend their days working or not. Nevertheless, it is important to highlight coercion, which often does not result from an individual's will—especially in cases involving societal pressure. An individual's will also has some influence on their social role in terms of dominance or submission, but willpower alone does not guarantee full control over processes and outcomes.

In the polarized phenomenon of play versus non-play, an individual's will has considerable influence since they can usually decide whether to engage in play or not. Here, the mechanism of control is relatively strong. Finally, there is the polarized phenomenon of life versus death. An individual’s will has some influence over whether they live or die; however, this control mechanism weakens exponentially as one moves into social and natural spheres.

Based on an analysis of the conceptual and symbolic network presented, we can identify dominant representations of an individual’s will (in this case referring to P1).

2.5.5.4 Table 70: Influence of an individual's will on factors, derived from psychological personality theories

Personality theories	Maximum level of influence	Second highest level of influence	Medium-high level of impact	Low level of impact	Minimum level of impact
PD	0	0	3	0	*0*
TD	5	4	3	0	*0*
BT	0	0	3	0	*1*
VT	0	4	3	2	*0*
ST	0	4	3	0	*0*
SO	5	4	3	0	*0*
KT	5	4	3	0	*0*
IT	0	4	3	2	1



2.5.5.5 Figure 54: Influence of an individual's will on factors, etc.

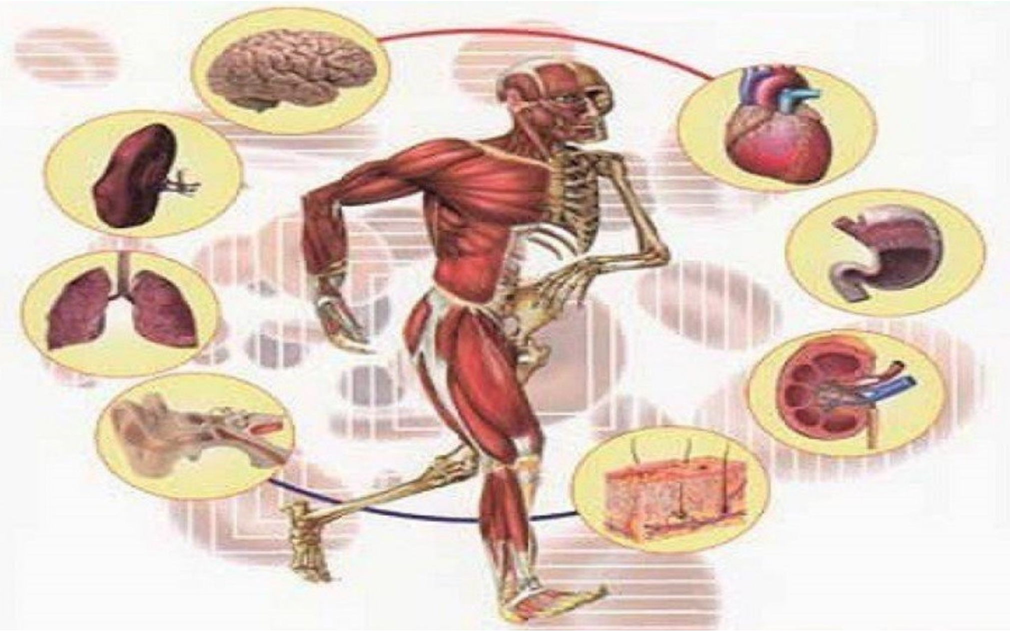
Table 70 and Figure 54 illustrate the influence of an individual's (P1) will on factors, dimensions, properties, etc., derived from psychological personality theories. We can observe that the greatest degree of influence of P1's will is found in KT (learning, understanding the world, etc.), SO (experiences, thoughts, etc.), and TD (e.g., sociability). The least influence of P1's will is observed in BT (e.g., DNA, genetic factors) and IT (e.g., physical factors). The distribution shown applies only to P1 and similar individuals, not to other groups of people.

It is known that willpower, on one hand, fills individuals with bioenergy, and on the other hand, it can also deplete it. For a well-organized personality, we would assume that energy utilization is very efficient, meaning that the individual does not waste unnecessary energy due to negative stress, unattainable desires, or excessive fears, and they have their psychophysiological needs under optimal control. Positive or creative willpower typically strives toward a meaningful goal. As an individual approaches the realization of a specific goal, they are filled with energy or bioenergy. However, as often happens in life, achieving the set goal is not straightforward, requiring significant effort or energy. The path to achieving the goal is often steep and filled with mistakes. Mistakes people make should not be crucial or negatively decisive. We can make numerous minor mistakes, but one correct key decision can lead to achieving the set goal. Mistakes, whether small or large, always deplete an individual's bioenergy. An individual's will has a certain influence on correcting mistakes, which can sometimes be exceptionally significant. However, the influence of an individual's will on collective mistakes or even collective idiocies is quite small and often negligible.

We must not forget that collective idiocies can drain individuals of a large amount of bioenergy. This can mean that the hierarchical associative system of an individual's thought and action is optimally organized, but collective idiocies hinder their path to a positively set goal. Collective idiocies will be discussed extensively in the chapter on "Social Nature," as they reduce the energy efficiency of social hierarchical associative systems. Broader circumstances can contribute to the unfortunate fact that individuals can lose a significant amount of vital bioenergy. An example of energy loss at the micro level can also be seen in the use of language, through which we communicate with the rest of the world, express thoughts and emotions, learn new facts, and acquire new knowledge, etc. Essentially, we can question the rationality or efficiency of a particular language used for oral and written communication with friends, professors during demanding exams, or colleagues at work. How much energy do we actually need to expend to construct and utter a simple sentence? In this context, a comparison between different languages, such as Slovenian, German, and English, would be extremely interesting. We might assume that the energy consumption when using Slovenian oral or written sentences is much higher than in English. This would mean that the energy consumption (given the same content) in oral and written communications is significantly greater in Slovenian than in English. Now, the key question is how to measure and calculate this? There are already attempts in the world to measure energy consumption during speech. For example, they measure the amplitude and frequency of speech. The higher the amplitude and frequency, the greater the energy consumption during speech. It is quite obvious that these measurements represent only approximations. There are other methods of measurement, such as assessing the speaker's energy consumption using glucose sensors. In this experiment, a glucose sensor is attached to the body of the test subject, who is asked to rest for a few minutes without doing anything. Then, the test subject is asked to utter selected sentences, first short ones and then longer ones. The human body consumes some energy in the form of glucose calories during any activity (including mental ones), which can be measured with an appropriate sensor. The question of measuring energy consumption will also be the subject of a future subchapter on positive and distressing factors. Overall, energy consumption in various hierarchical associative systems will be one of the key themes of this entire work, as societies and different natural systems also do not optimally utilize all the energy available to them. While humans may not have a significant impact on natural systems in many cases, this should not apply to social hierarchical associative systems.

2.6 A Brief overview of human anatomy and an attempt at a visual representation of the hierarchical associative system of the human body

In this subchapter, we will first briefly present human anatomy. The chapter on the individual has so far dealt with a kind of biological software. Now, we will introduce the solid platform of the individual, which is analogous to hardware. Without this platform, we would not be able to feel, perceive, sense, think, walk, act, etc. This platform represents the foundation for the existence of every individual.



2.6.1 Figure 55: The human body and its organs

Figure 55 depicts the human body and its organs, including the brain, heart, skin, lungs, etc. The human body is highly complex and composed of various systems, which are as follows:

1. Nervous system: This system consists of nerve and glial cells, whose primary function is to transmit signals about changes in the internal and external environment. The senses (eyes, ears, nose, etc.) are a subsystem of the nervous system and receive various stimuli (e.g., light, sound, temperature, smell).
2. Endocrine system: This system influences conditions within the body's internal environment. Key components of the endocrine system are endocrine glands, which release hormones into the bloodstream. Hormones maintain a stable internal environment and positively affect the functioning of other tissues.
3. Cardiovascular system: Comprising the heart, arteries, veins, and blood capillaries, this system supplies the body with oxygen and nutrients and regulates body temperature. The circulating blood acts as the "fuel" for the dynamic functioning of the individual.
4. Respiratory System: This includes the respiratory pathways and lungs. It consists of the upper respiratory tract (e.g., oral and nasal cavities) and the lower respiratory tract (e.g., trachea, bronchi, alveoli).
5. Digestive system: This system includes organs that enable the ingestion, digestion, and absorption of nutrients. The digestive tract consists of the oral cavity, pharynx, esophagus, stomach, and intestines. The liver, gallbladder, and pancreas also contribute to digestion. The basic function of the digestive system is the absorption of water and the elimination of undigested substances.

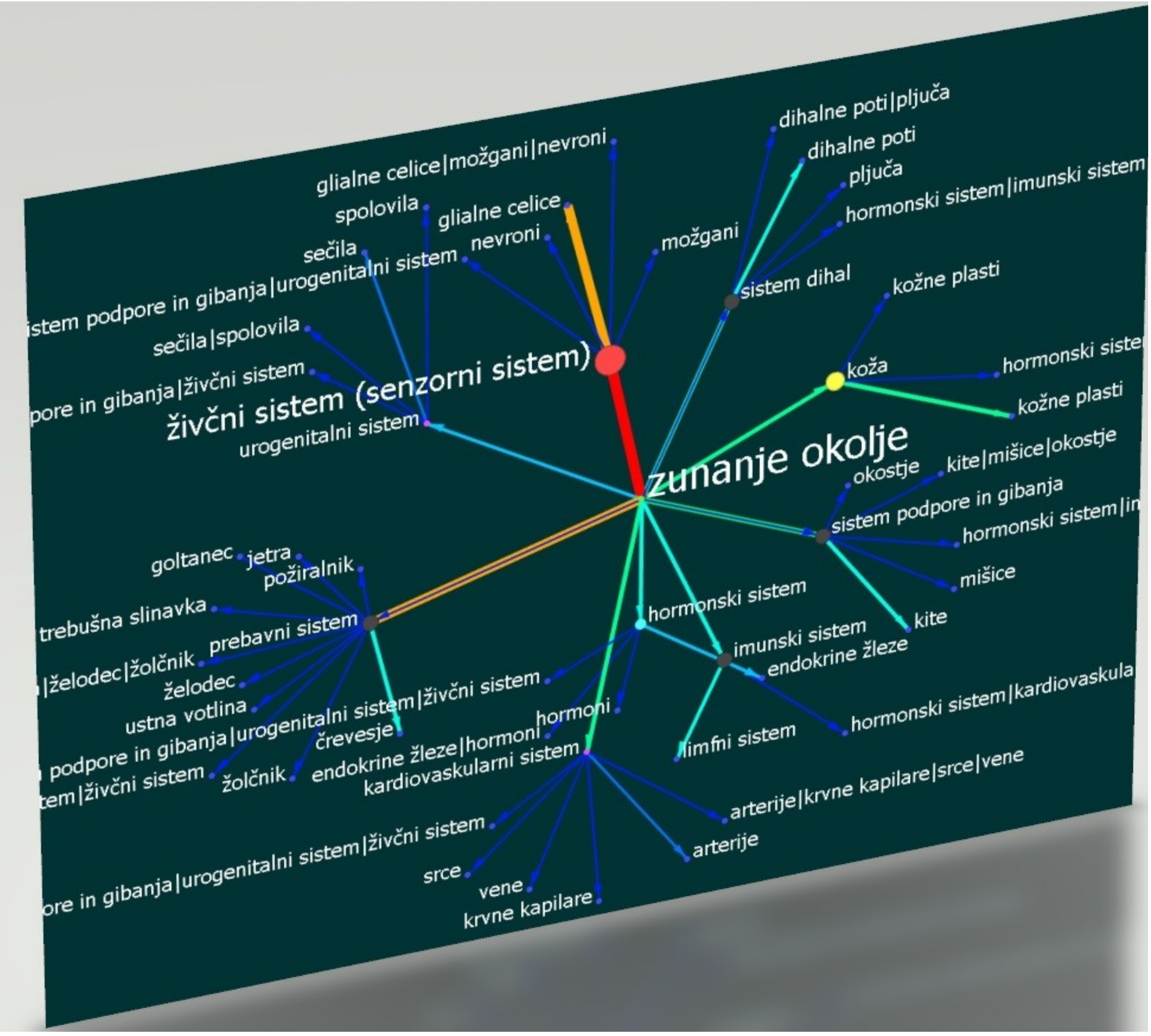
6. Urinary and reproductive system: This system includes the excretory and reproductive organs. The excretory organs eliminate urine, with the kidneys playing a crucial role. The reproductive organs facilitate reproduction. Urine elimination is mostly under conscious control, except when the bladder is full. Similarly, the decision to reproduce is largely dependent on the individual, but if no one ensured reproduction, the human species would become extinct.
7. Support and movement system: This system consists of the skeleton and muscles, which provide stability and the ability to move.
8. Skin: The skin is the largest and most versatile organ of the body. It acts as a protective covering that shields against external influences, maintains internal balance, and supports the immune system.
9. Immune system (Lymphatic System): This system protects the body from infections. The lymphatic system is a crucial part of the immune system and plays a key role in genetic transmission through mate selection.

From this brief overview of human anatomy, it is evident that the body is composed of nine major systems. These systems are interconnected and often collaborate. Although some systems are hierarchically organized, all function autonomously and often in associative relationships. Their collaboration enables individuals to perform life functions such as excretion, environmental perception, defense against pathogens, and idea development.

Under favorable conditions (adequate food, water, sleep), the systems function harmoniously, like a democracy. However, in cases of food scarcity, the brain, which requires the most energy, begins to function egoistically and absorbs most of the available glucose, leading to weight loss in other organs (e.g., stomach, liver).

Among all the systems, the nervous system is the most connected to the external environment, primarily through its sensory subsystem, which receives stimuli from the environment (e.g., light, sound, temperature). The skin also detects changes, mainly through nerve endings. Other systems are generally oriented inward, although, for example, the immune system protects against external enemies, the respiratory system brings oxygen into the body, and the digestive system brings in food and water.

The sensory system enables the interpretation of the external and internal world and the creation of data, information, knowledge, and wisdom, which positively affect the individual and society. This aspect is crucial for understanding human existence. Speculations about the higher meaning of our existence lead us beyond scientific frameworks, but they are still interesting and sometimes even reveal a fragment of truth.



2.6.2 Figure 56: Importance of individual systems of the human body in communicating with the external environment

Figure 56 illustrates the importance of individual systems of the human body in communicating with the external environment, which was previously described somewhat loosely. The strongest connection (see the thick red connection) exists between the external environment and the nervous system, specifically the sensory system. This connection leads to the largest node in this network (see the large red circle). The nervous system, especially its sensory part, acts as a recorder of external stimuli (sensory, visual, auditory, olfactory, etc.), which are then processed and converted into data in the brain. These data are classified and categorized to form information. This information guides individuals in decision-making processes regarding certain actions or behaviors. Based on the results of these decisions, individuals acquire experiential knowledge. Factual knowledge is primarily acquired through learning from the collective repository of knowledge. From the perspective of acquiring information, it is easier to determine the importance of individual systems of the human body and consequently establish relationships of superiority, subordination, and association among them. Despite this, all these systems are autonomous and primarily collaborative, allowing the body and soul to come alive together.

The basic conditions for acquiring information and knowledge are as follows:

- Food and water travel from the external environment through the oral cavity to other body organs, where they are processed so that the body can obtain as many nutrients as possible.
- Through inhalation and exhalation of air, an individual acquires oxygen, which is crucial for blood circulation and thus for brain function.
- The immune system continuously protects the human body from threats such as bacteria and viruses, allowing individuals to maintain health.
- The endocrine system takes care of strengthening the will to live and alleviating pain (both physical and mental).
- The skin acts as a protective layer between the external environment and the individual's interior.
- The cardiovascular system transports blood to various body organs, which is especially important for brain function.
- Without a skeleton and muscles, an individual would be difficult to move. Although there are living beings in nature with different body structures, even they cannot be said to have a truly mobile existence without a framework. Humans have a unique body structure that brings many advantages in certain respects.
- The body would "explode" if it were constantly just filling up. Therefore, there is a system in the human body that allows for the elimination of excess and useless substances.
- An individual needs mental functions that can accept and process challenges from the external environment.

It is no coincidence that humans have historically created machines that are more or less exact replicas of the human body. Good examples of this assertion can be found in steam engines, trains, cars, manufacturing processes, and computers. Especially remarkable is humanity's desire to create intelligent machines that are similar to humans and even surpass them in some respects. In this context, we can talk about android, humanoid intelligent robots that may one day be so advanced that we will no longer perceive them as machines.

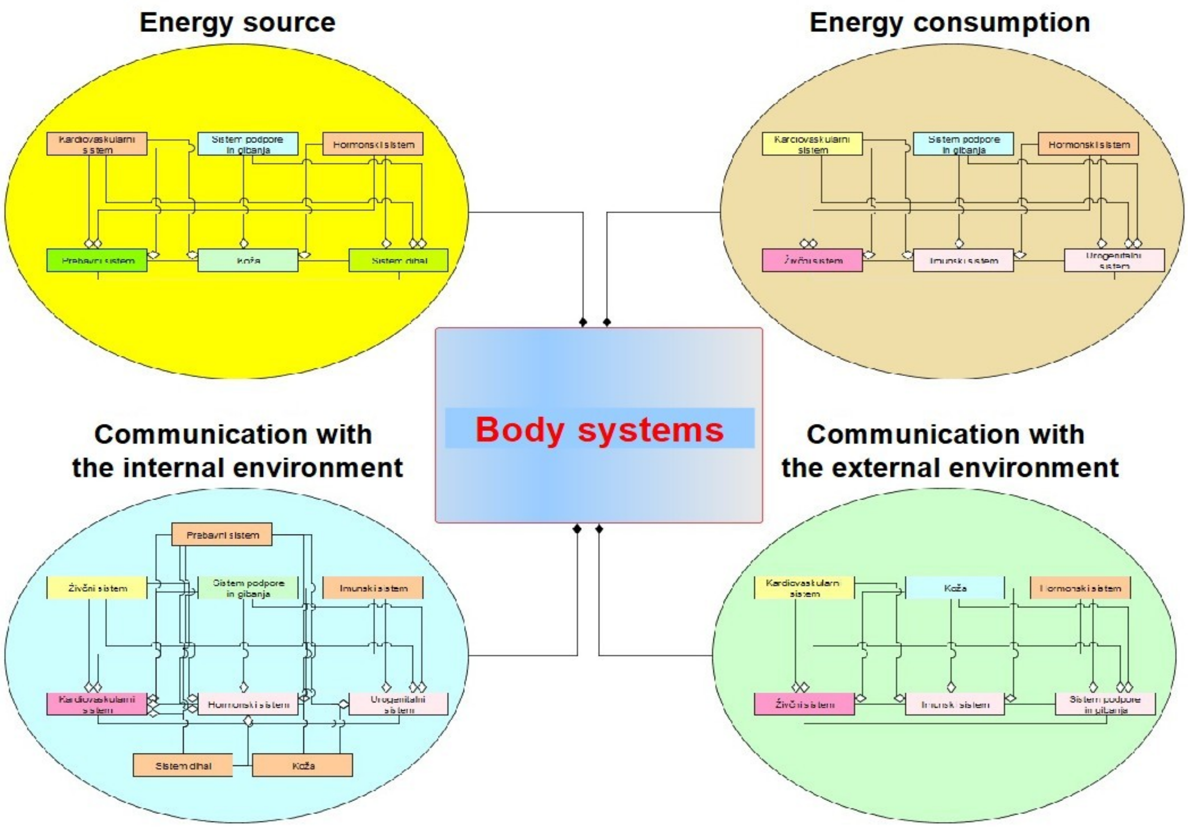
Machines have the function of simplifying numerous unpleasant activities that humans would otherwise have to perform. The idea for a machine originates with humans, who then prepare a plan, acquire suitable materials and parts, and gradually build the machine, which they operate and control.

Humans have the ability to perceive events, phenomena, and other stimuli from both the internal and, especially, external environment. The brain processes these stimuli and converts them into information. Humans are naturally open to the world, so their sensory system primarily perceives the external environment. The internal functioning of the body is largely automated (e.g., maintaining body temperature, heartbeats) and has not significantly changed through human evolution. Physiologically, we have not changed much. We can assume that because of this, the sensory system is more oriented toward the external world. Over the long historical development of humans, the methods of nutrition (energy source), movement (long distances are typically overcome with cars, airplanes, etc.), and thinking (the "soft part" or software) have changed significantly. By observing other animal species (e.g., various reptiles, insects), we can see that changes in them are almost negligible and are essentially conditioned by climate changes and the movement of tectonic plates. These animal species have proven extremely successful in the struggle for survival, so changes were not necessary for them.

The anatomy of reptiles or insects differs significantly from human anatomy. For survival in nature, there are numerous and diverse body structures that successfully overcome various obstacles and challenges. This raises a justified question: "Why did humans have to change so much mentally or programmatically in their evolution?" There are many animal species that are larger and physically more capable than humans, as well as many species that are smaller and less physically capable. Human mental development did not change due to deficiencies in their physical structure, which is not the most efficient in many respects but also not the worst. Perhaps a special magnetic field caused changes in the (mental) programming of humans? Answers to this question are purely speculative. From a strictly technological perspective, humans are actually mobile information systems connected to the external environment through sensors. In their bodies, especially in their brains, a vast amount of data and information is stored, the quantity of which cannot be counted. Additionally, humans are social beings that connect in large communities, such as cities.

Who or what actually controls and supervises humans? The sun, Earth, air, water? The answer to this question remains in the domain of speculation, as it cannot be scientifically proven. We can choose to believe, doubt, or not believe in a particular answer at all. All of nature, including humans, is subordinate to a higher level of existence. Many human behaviors and actions are thus the result of a distorted reflection of this higher level. This leads to the assumption that humans have a dual function in nature: on one hand, they act as mentors and destroyers of nature, and on the other hand, their fundamental function is recording and processing data for a higher level of existence. The entire universe records data and information, with our species contributing through powerful computers, which are likely just a distorted reflection of information storage from a higher level. With this hypothesis, we will now depart from speculative paths and return to exploring the hierarchical and associative system of the human body.

In doing so, we continually encounter the concept of hierarchies. In this case, it refers to an organizational chart that illustrates the hierarchy of a particular organized group or a specific mental model. We always seek the unit that is most important and superior to all others. This approach to illustrating the hierarchy and associativity of the human body is not satisfactory, as it involves autonomous systems that collaborate with each other and are extremely dynamic.
All these autonomous systems contain subsystems that are very complex and often incomprehensible even to experts in human anatomy. Therefore, linear organizational charts are not suitable. It is more appropriate to speak of networks that include polyhierarchical and polyassociative connections. The importance of a particular system in the human body depends on the perspective. We can view importance from the standpoint of the external environment, energy source and consumption, internal environment, movement, mental activities, etc.
In the continuation, a possible model of a hierarchical and associative network of bodily systems will be presented.



2.6.3 Figure 57: Hierarchical associative system of the human body from the perspective of energy and communication

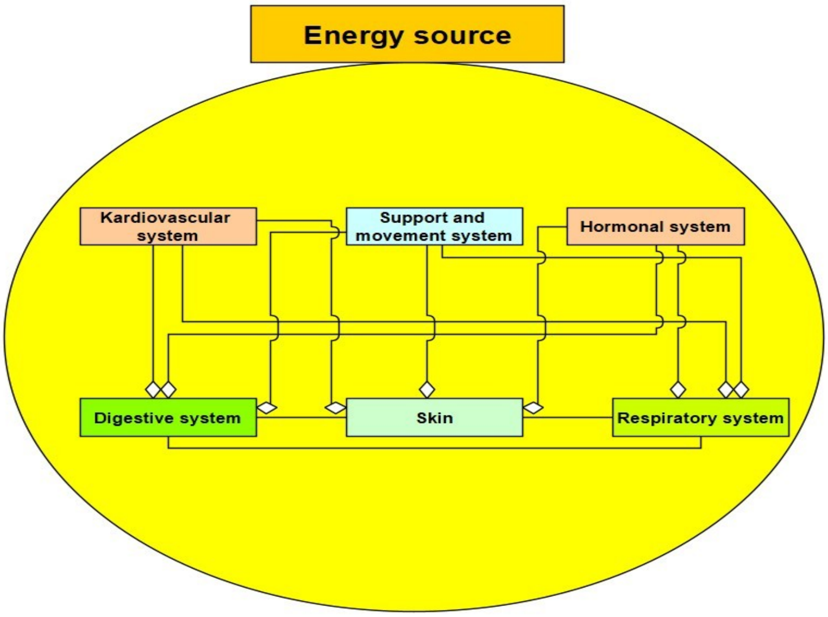
Figure 57 illustrates the hierarchical associative system of the human body in terms of energy sources and consumption, as well as the communication between these systems and both the internal and external environments. It represents a hierarchical associative network in the form of interconnected nests, all linked through a global hub (see bodily systems). A connection marked with a black diamond represents a primary superior position, while a connection with a white diamond indicates a superior position within individual nests. Dashed lines within visible nests signify equal-level positions.

The figure displays four nests, each depicting hierarchical and associative connections. These nests are categorized according to the following aspects:

- Energy sources (e.g., solid and liquid food, air, sunlight),
- Energy consumption (e.g., physical movement, mental processes),
- Communication with the internal environment (methods of receiving signals within the human body),
- Communication with the external environment (e.g., monitoring changes in the environment, data processing, transforming data into information and knowledge, decision-making processes, and bodily responses to external changes).

Although the network is simplified in the illustration, it remains quite complex and will require a more detailed explanation of each individual nest. The hierarchical associative system of the human body can be conditionally compared to manufacturing processes, which are essentially simplified and distorted representations of the functioning of the bodily system, comprising nine systems in total.

2.6.4 Nest of energy source



2.6.4.1 Figure 58: Network of bodily systems within the nest from the perspective of energy source

Figure 58 shows the network of bodily systems essential for acquiring the energy necessary for human functioning. The image highlights three main bodily systems that act as primary energy providers. From a broader perspective, all bodily systems are autonomous and equally important, as no system can function optimally without the others. However, in the context of energy acquisition or sources of energy, some systems hold a relatively superior position compared to the rest.

Humans primarily obtain energy from solid and liquid food, which enters the digestive system through the mouth. The food is broken down by the teeth, travels down the esophagus into the stomach, then moves through the gallbladder and into the intestines, where waste and harmful substances are filtered out. The remaining substances are converted into energy. This simplified description of the digestion and energy acquisition process refers to the digestive system (see Figure 58, bottom left). From the standpoint of energy acquisition, the digestive system holds a relatively higher position (see connections marked with a white diamond) compared to the cardiovascular system, the support and movement system, and the hormonal system.

It’s important to note that these three systems are not merely energy consumers—they also play a role in energy production. For example:

- Muscles generate energy in addition to enabling movement,

- The heart acts as a "motor," pumping blood throughout the body,

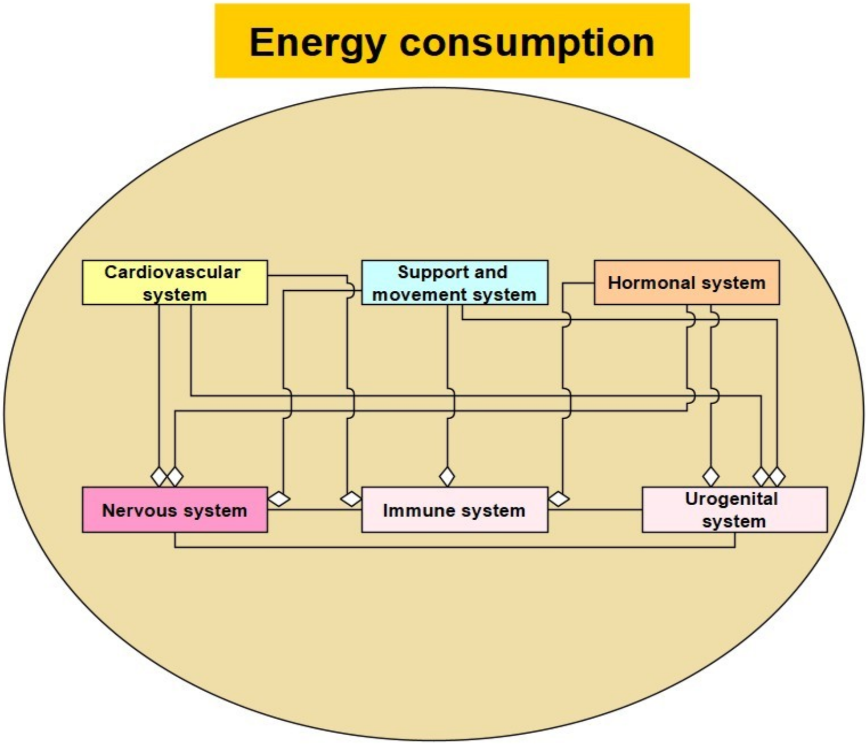
- "Happiness hormones" provide individuals with energy in the form of well-being.

In a relatively equal position to the digestive system are the skin and the respiratory system (see connections shown as straight lines).

The skin, as a bodily system, absorbs vitamin D from sunlight—an essential factor for skeletal health and overall mental and physical well-being. A deficiency in vitamin D can lead to depression and a weakened immune system.

The respiratory system facilitates gas exchange in the body—oxygen enters the bloodstream, which then circulates throughout the body, including to the brain. Without this vital gas, the brain cannot function properly.

2.6.5 Nest of energy consupmtion



2.6.5.1 Figure 59: Network of bodily systems within the nest from the perspective of energy consumption

Figure 59 illustrates the network of bodily systems within the nest from the viewpoint of energy consumption. The largest energy consumer in the human body is the nervous system (see Figure 59, pink-colored rectangle at the bottom left). Other major energy consumers include the immune system and the urogenital system. Therefore, connections to these systems are marked with a white diamond, indicating that they hold a relatively superior position within this nest.

It is important to emphasize that the nervous system is not solely a consumer of energy, but it consumes significantly more energy than it can generate. The human body, in general, is characterized by energy loss—bodily systems never produce as much energy as they consume. This imbalance may be one reason for human mortality: while cells regenerate effectively in youth, this ability diminishes significantly with age.

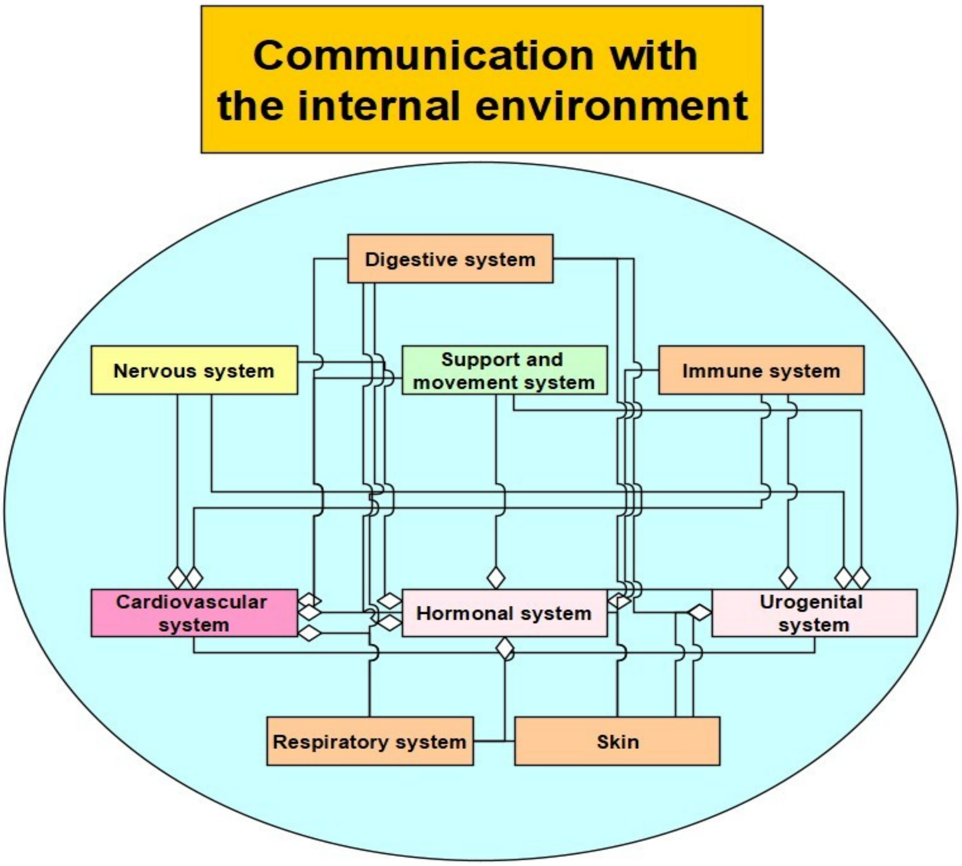
Nevertheless, under optimal conditions (e.g., adequate food supply, healthy genetic makeup, favorable living environment), human bodily systems—including the nervous system—operate with remarkable energy efficiency. There are differing opinions on this topic. Some argue that the human body's systems, including DNA, have changed very little since early human societies. Parts of our bodies still exist whose function is questionable or even unnecessary (e.g., the appendix, wisdom teeth, certain segments of immune system DNA).

In contrast, scientists have observed that in other animal species, bodily systems have improved over the course of evolution. For instance, chimpanzees have shown advancements in immune system efficiency. Some scientists, therefore, claim that human evolution, from a genetic standpoint, may be a dead end. According to this view, human DNA will remain unchanged and won't adapt, even in the face of drastic environmental changes. However, it's important to note that with the advancement of technology and knowledge, humans may eventually be able to modify and enhance certain elements within their DNA chain.

What remains clear is that human bodily systems always consume more energy than they produce, primarily due to the continuous release of heat into the environment. Human body temperature is typically higher than the ambient temperature, meaning the body’s temperature regulation system must expend significant energy to maintain a core temperature of approximately 37°C. A rise above 40.5°C or a drop below 34°C can be fatal.

Throughout history and into the present, scientists and engineers have sought ways to harness the energy released by the human body, including from movement. During the time of James Watt, an English prison experimented with generating energy through prisoners walking inside a giant wheel, which powered a mechanical device. In modern times, there are examples like a dance club where dancers' movements on the dance floor generate electricity. While the energy yield is small, the concept is intriguing. There is also research into harvesting energy from urban soundscapes—such as highways, restaurants, and city traffic—by capturing the collective effect of various sound sources (e.g., machines and people). The 21st century is not only an era of brain development but also a continuation of the quest for maximizing (electric) energy utilization!

2.6.6 Nest of communication with the internal environment

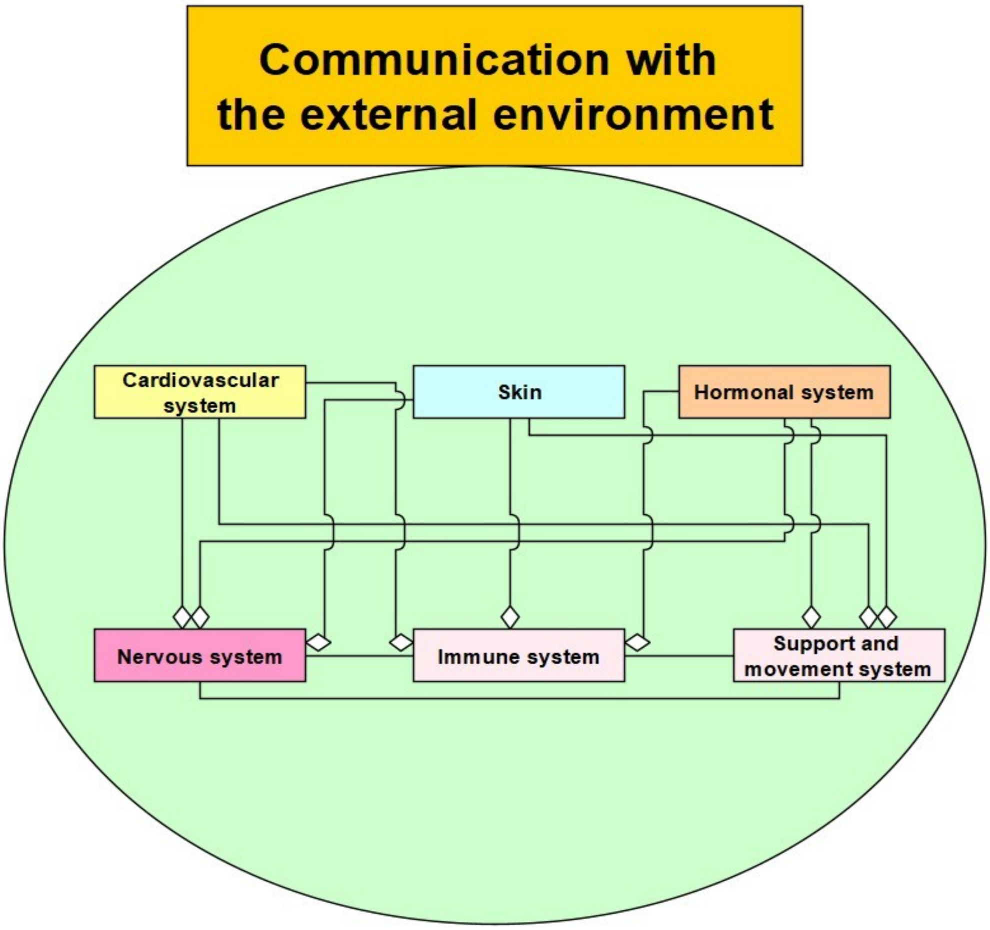


2.6.6.1 Figure 60: Network of bodily systems within the nest from the perspective of communication with the internal environment

Figure 60 shows the network of bodily systems within the third nest, viewed from the perspective of communication with the internal environment. This nest includes all human body systems, as they all interact and communicate with each other within the organism.

Based on the explanation of Figure 60, it becomes evident that the cardiovascular, hormonal, and urogenital systems are the most actively involved in internal communication. Systems such as the digestive system, respiratory system, and skin, which primarily serve as energy donors or sources, engage in less intense communication with the internal environment. Their main function is to provide raw materials that are later converted into energy. As a result, the cardiovascular, hormonal, and urogenital systems are shown in a relatively superior position compared to other systems (e.g., the digestive and nervous systems), which is indicated in the diagram by connections marked with a white diamond. A particularly important role of the nervous system is to monitor and process signals and data received from the external environment, converting them into information and knowledge. This general observation might differ slightly in cases such as autism, although such a claim is difficult to prove, as it involves a certain degree of speculation.

2.6.7 Nest of communication with the external environment



2.6.7.1 Figure 61: Network of bodily systems within the nest from the perspective of communication with the external environment

Figure 61 illustrates the network of bodily systems within the nest from the perspective of communication with the external environment. In this nest, the nervous system holds a relatively superior position compared to the cardiovascular system, skin, and hormonal system (as indicated by the white diamond connection).

When considering communication with the external environment, it's important to highlight the concept of receiving signals and data and processing them into information and knowledge. In this context, sources of energy—such as food, oxygen, and sunlight—are not considered informational units, even though in other models with different emphases, they might be. Here, they are simply raw materials that are later processed into information.

In an alternative model with different conceptual priorities, one might argue that the digestive and respiratory systems engage in intensive communication with the external environment. The functioning of the human body in terms of internal communication appears highly automated (e.g., heartbeat, temperature regulation) and more predictable, whereas communication with the external environment seems less automated and less predictable. This is likely due to the vast number of variables, combinations, and variations offered by the external world. We perceive the external environment far more intensively through the senses than we do the internal one (for example, we need tools like microscopes to observe internal processes).

This nest is built around the idea that most external signals and data are received through the sensory system, which is part of the brain and thus the nervous system. Human efforts to monitor the external environment often go beyond our natural perception of phenomena, events, and laws. To enhance our ability to perceive the vastness of the universe, humans have developed various technologies and devices (e.g., radars, telescopes, satellites, spacecraft), driven by a sense of connection to the vast cosmos.

We've created astonishing theories and models about the distances between stars—so vast in space and time that we now perceive them only as points of light in the sky, even though many of them no longer exist in that form. In essence, we are observing events from the distant past. To observe something closer to the present state of these distant constellations, we would have to travel to them at the speed of light.

The rapid and seemingly unstoppable development of human technology has surprised us many times before, making it seem possible that one day we might overcome even those cosmic distances.

Until now, this chapter on the individual has explored mental concentration, including its building blocks—stimuli, psychological drives, mental tools, symbols (with special attention to collective symbols as powerful concepts within the information hierarchy), expressions, and impressions (especially outward expressions that make concentration a visible phenomenon). We've also examined the bodily systems without which human concentration would not be possible.

In the continuation of this chapter on the individual, we will now turn to the topics of truth and reality, which are expressions of both individual and especially collective dynamics. Over the course of human development, we have constructed a collective reality—one that individuals generally adopt and live by from birth onward.

2.7 Truth and reality as the foundation of mental concentration

It is entirely natural that every individual begins to accept truth and reality from an early age. Truths are usually more individually shaped, yet they are also interwoven with the given reality. Truths are primarily the result of a person's unique experiences. They begin to form through the accumulation and processing of both real-life and fictional experiences. While they may often align with the given reality, significant discrepancies between the two are also common.

An individual forms various impressions and expresses views about specific objects, living beings, events, phenomena, rules, relationships, quantities, and so on. In the formation of truths, all of these elements are already present and pre-existing—meaning the individual has no influence at this stage. In early stages of life, a person perceives a unity of space and time. Truths can be very dynamic and prone to fluctuation, as many truths later turn out to be falsehoods. From an almost infinite number of individual truths, one or even several realities may emerge.

Reality is much less dynamic and significantly more stable, as its emergence is the result of long-term semantic development. Reality is a collective agreement, shaped primarily by the influence of the most dominant individuals. It is a product of social induction, which spreads through a hierarchical associative system, typically from the top down. Reality is, in essence, pseudo-homogeneous and pseudo-heterogeneous at the same time.

Both truths and realities are always the result of cognition, which is only possible if we are convinced of our own existence. Through the sensory system and the brain, humans recognize fragments of actual events, primarily through observation. In fact, we draw direct experience from the functioning of the sensory system, the brain, and the thinking process. Our consciousness is located in the cerebrum, while unconscious processes take place in the cerebellum.

Our brains have developed powerful concepts such as ontological realism, agnosticism, and idealism. These concepts are essential components of reality, and knowledge is gained under their influence, both theoretically and empirically. Based on various debates about the interpretation of reality, some scientists believe that it is primarily the natural sciences that are capable of perceiving at least an approximate version of reality. However, this truth likely only partially covers reality, which—like all truths and realities—can be understood as a construct.

Why do our brains strive so strongly to uncover truth and reality? Some neurobiologists suggest that this is the brain’s way of performing self-monitoring or self-examination.[26] In this context, there are various theoretical constructs that attempt to explain why the brain so intensely absorbs knowledge and, as a result, forms truths—and especially reality. One particularly influential construct, known as the evolutionary theory of knowledge, suggests that the brain not only monitors changes in its environment but also adapts to them when necessary. Another construct, the theory of hypothetical

26 „Das Gehirn muss sich selber untersuchen!“ Roth, G. (2021). *Aus Sicht des Gehirns*. Suhrkamp.

realism, emphasizes that the brain—and therefore the individual—continuously builds and maintains reality. Many other similar constructs about the nature of reality also exist.

It is a fact that humans share a common evolutionary path with other beings on Earth, all of which have also faced selective pressures, catastrophic events, and changes at both the physiological and mental levels. Some animal species have significantly enhanced their physical and cognitive abilities, including changes to their DNA. Looking at the phylogenetic tree of living organisms reveals that some beings are less, and others more, complex. Throughout evolution, many organisms have remained at a relatively low level of complexity and have survived on Earth for millions or even billions of years. They have proven their success in reproduction and survival.

A good example of a successful survival model is found in bacteria and viruses. In the case of viruses, scientists still do not entirely agree on whether they should be classified as living organisms. Some virologists argue that we still lack a satisfactory definition of life or what constitutes a living being, and instead only have a list of characteristics and traits that loosely describe life. Nonetheless, viruses have an extremely successful survival strategy—even though they cannot exist without a host or cell.

It's important to point out that humans and other more complex organisms are also unable to exist independently without their host—Earth. Independence itself is a construct that depends on one's chosen perspective. These perspectives are often referred to as the microcosm, mesocosm, and macrocosm. The mesocosm—the level of space and time familiar to human sensory and cognitive experience—is closest to us, as it is where we are most able to perceive reality through our senses and brains.

But how do we even comprehend the macrocosm (as in the theory of relativity) and the microcosm (as in quantum physics)? Our ability to explain these realms depends on trust in our own cognitive capabilities. The outcomes of that trust—our beliefs and perspectives—are various constructs created by individuals or their brains. These constructs are thought to contribute to the successful survival of the human species.

Within this framework, we focus on so-called universal truths. These are the fundamental building blocks or foundations of certain realities. Human civilization—both Western and Eastern—rests on these universal truths. They are extremely powerful arguments that the natural sciences have succeeded in proving both theoretically and empirically through measurement. Such truths endure across long historical periods and may even be seen, from our perspective, as eternal and immutable. They are often referred to as evergreen truths.

A good example of a universal truth is the claim that energy cannot be destroyed—it can only be transformed from one form to another. A similar idea appears already in the Bible, and much later, physicists scientifically confirmed it and expanded on it with the discovery of the relationship between mass and energy: the greater the mass, the greater the corresponding energy.

Philosophers have long grappled with the question of the relationship between matter and spirit. There is a connection here as well: spirit could be defined as a specific form of energy related to the environment of the human body. Between spirit and body, there is another layer of meaningful energy, often referred to as the soul.

For decades, the natural sciences avoided the term "soul," as it was considered insufficiently scientific and more suited to popular or philosophical discussions. However, in the last decade, some natural scientists have begun to accept it as a scientific concept. A new theory has even emerged—biocentrism—which challenges the materialistic paradigm of explaining reality.

Many people believe in life after death. While there are various interpretations (e.g., the deceased returning in the form of a human, animal, etc.), the vast majority of believers share a common construct: that some form of existence continues after death. The differences between spiritual and material models of reality are mostly conceptual in nature, especially since even quantum physicists are exploring ideas that sometimes appear close to spiritualism.

In other words, we can sense similarities, but we struggle to communicate because the conceptual frameworks and terminologies differ. What's needed is a shared vocabulary that could help bridge these seemingly different perspectives. In this context, universal truths—such as "energy is indestructible"—could serve as common ground.

Life after death most likely exists, but we do not know its form, content, function, or levels. These remain in the realm of speculation. There are many different paths that can lead to different truths or insights. An example of such a path is presented below for greater clarity.

2.7.1 The Paracelsus example

This example originates from real life, specifically from the experience of an individual referred to as K. The process will be described in the form of a narrative and a timeline of events.
January 24, 1992 – Reading the book Das Weltbild des Parazelsus, page 92:[27] The microcosm (including man) is an image of the macrocosm! June 1985 – Location: City park in Žalec

27 Spunda, F. (1941). *Das Weltbild des Paracelsus*. Wilhelm Andermann Verlag.

I conceived the idea that microorganisms, animals, and humans are a reflection of the infinite universe!

At that moment, I stared at the sky for a long time. Due to the sensory strain, I began to see bubble-like shapes before my eyes that reminded me of microorganisms traveling toward the heavens. On my way home, I recalled my third-grade teacher from elementary school.

1973 – Location: Wesseling, Classroom of the Schillerschule

During biology class, our teacher used a microscope, a drop of water, and a projector to display microorganisms onto a white screen. The micro – the tiny world within a single drop – became clearly visible!

When I got home, I made myself a potato salad and, during the meal, a clearly formed thought occurred to me:

"The microcosm – man – is an image of the macrocosm!"

Final thought:

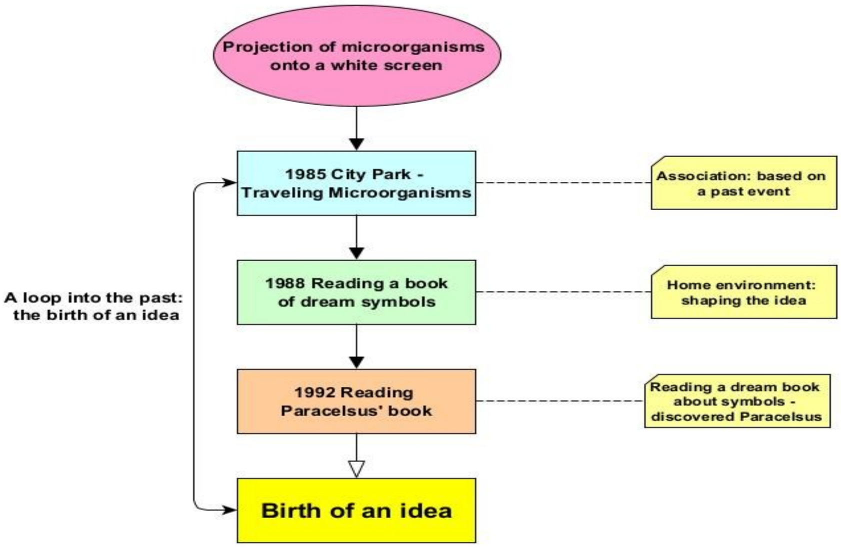
The Swiss physician and alchemist Paracelsus understood this truth over 400 years ago. However, even Paracelsus did not discover anything entirely new, as the ancient Greeks had already explored this idea around 300 BC!

Paracelsus lived in entirely different surroundings and circumstances than both myself and the ancient Greeks. He was engaged in different tasks and concerns. Yet despite that, he developed or realized the same idea (unaware, of course, of the Greeks or of me). We each arrived at the same truth via different paths and modes of understanding.

There are certain similarities in human thought, as we often use the same cognitive approaches to a greater or lesser extent. In this case, it is the method of analogy — comparing similarities and differences. The concept of mental approaches is relatively broad and less dependent on variables such as events, phenomena, historical periods, geographical location, weather, status, language, motivation, or even rules or paradigms.

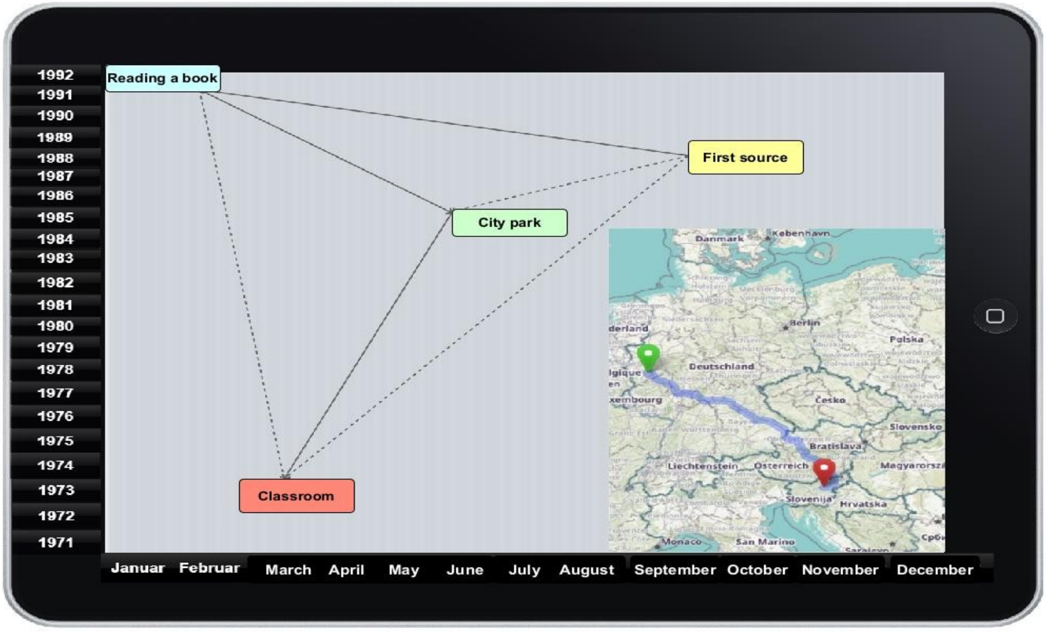
In short, we might say there are many entrances that lead to the same exit — or truth. We can arrive at insights, and thus truths, through actions, events, phenomena, rules, objective and subjective circumstances, and spatial or temporal dynamics. These primary factors can give rise to ideas, realizations, or even truths — and thereby shape part of reality.

Secondary factors also play a role, although they are only indirectly connected to the main ones. (For example, I discovered Paracelsus through reading The Dream Book in 1988, and four years later I borrowed the aforementioned biography.) These secondary factors often have a lesser influence on later primary decisions. (For example, I didn't read Paracelsus's biography because of The Dream Book, but rather due to the influence of a philosophical lexicon where I read summaries of various philosophical theories. Based on those summaries, I chose authors I found interesting and comprehensible.). Secondary factors can still serve as additional inspiration for certain decisions.



2.7.1.1 Figure 62: The process of idea formation

Figure 62 illustrates, using a modified flowchart (see also the written description on the previous page), the birth of the idea of a universal truth — that the microcosm (including humans) is a reflection of the macrocosm. In the following section, we will attempt to represent this process using a coordinate system. The dependent variable (y-axis) will be defined as time in years, and the independent variable as time in months.



2.7.1.2 Figure 63: The pyramid of understanding/cognition

Figure 63 shows a pyramid of understanding/cognition, constructed based on key events and their temporal and geographical dynamics. The pyramid emerged as a result of connections between pivotal events that enabled the individual (the "actor") to rediscover the universal truth:

"The microcosm (including human beings) is a reflection of the macrocosm!"

We can observe that the actor overcame significant spans of time and relatively large spatial distances in order to arrive at this realization, and many years later, rediscovered this universal truth.

The pyramid primarily serves as a model for calculating the inclination and surface areas of its planes. Regarding its stability, it could be described as relatively unstable due to weak internal connections within its planes (see dashed lines). This suggests that the involved events only indirectly influenced the rediscovery of the universal truth. The smaller the surfaces of the pyramid, the sooner the actor might have realized that his idea aligns with the insights of Paracelsus.

This implies that the actor could have discovered this alignment much earlier, or alternatively, he might have only come to this realization while reading Paracelsus’s biography. Naturally, this would have required the actor to engage in a broader and more intense range of interests (such as reading, philosophical inquiry), which would have also impacted the strength of his mental focus. In that case, the trajectory of his personal development could have been significantly different, though the end result may not necessarily have changed.

The specific formulation of the sentence – the universal truth – emerged from the intertwining of two events: one relatively recent (1985), and one more distant (1973). The first involved a sensory experience – prolonged gazing at the night sky – which led to a fictional visual of floating bubbles. The actor associated these with microorganisms, triggering a memory from his elementary school days, where in third grade he observed a biology lesson demonstrating microorganisms. At that moment, he realized that ordinary water contains a vast array of living beings invisible to the naked eye.

The night sky thus symbolizes the macrocosm, while the imagined microorganisms are a reflection of sensory strain. That experience was less pleasant, whereas the school-day memory (observing life in a drop of water) sparked excitement and wonder at such biological diversity, evoking a sense of discovery.

Clearly, the brain tends to categorize events based on their significance, pleasantness, unpleasantness, beauty, speed, or duration. In this case, one could say the brain prioritized the more pleasant event (observation of the microcosm) over the less pleasant one (contemplation of the macrocosm). The actor—equated here with a human being—thus found himself in an intermediate position between the micro- and macrocosm: the imagined microorganisms, the memory of actual microorganisms, and the celestial sky together formed an interwoven reflection of both worlds.

Interestingly, such truths endure over long historical periods and are accepted by a majority of people. The question of why this is so is difficult to answer, but two hypotheses can be proposed:

1. The first suggests that there are multiple paths (or entrances) that can lead to the same destination (or exit). Universal truths are so vast in their content that they are not limited to a single or narrow set of access points.

2. The second hypothesis is that such truths arise from the cooperation of physical and psychological dynamics — a constant interaction between the human internal and external environment.

Humans are generally less aware of their inner world, while more actively observing and analyzing the external one. Thus, the individual occupies a middle ground between the microcosm and macrocosm. On the level of the *mesocosm* (the intermediate world), they monitor and process various signals, data, and information.

Humans often adopt a superior attitude toward the microcosm, reflecting a superiority complex. Conversely, the attitude toward the macrocosm tends to reflect an inferiority complex, due to the overwhelming power and vastness of the cosmos. The combination of these two perspectives results in a "centrality complex" — a state in which humans mostly reside.

The centrality complex and the anthropocentric model

The centrality complex has led humans to develop an anthropocentric model for interpreting the world. These models vary in their rigidity: from strict (e.g., "humans are the center of the universe and the most important beings on Earth") to more flexible interpretations (e.g., "humans differ from other living beings only in nuances").

Anthropocentric models are deeply embedded in science, art, religion, and everyday life. It's difficult for us to imagine the brain as a living being in itself, since we perceive it merely as a part of the human body. Likewise, we tend to view neurons more as specialized cells or particles that enable the processing and connection of data and information, rather than as independent living beings.

It is known that neurons move and communicate with each other, yet we still prefer to define them as essential building blocks. Similarly, science doesn’t treat sperm—or “tadpole-like sperm cells”—as living beings, even though they can move, carry DNA, have scent receptors, and even exhibit memory. As of now, science has not discovered that these “seeds” (though the term may be misleading, as it evokes plant seeds) possess brains of their own.

What’s astonishing, however, is that we attribute a lifespan to these “seeds,” a trait we also casually assign to cars and machines in everyday language. Sperm cells are, in fact, classified as living cells and therefore as living organisms. One might speculate that the story of the relationship between sperm and egg cells predates humanity itself.

Humans are essentially a composition of various material parts, "semi-living" and fully living organisms. It is possible that sperm were penetrating egg cells billions of years ago, but with entirely different functions and modes of existence. Only through a long process of evolutionary development did conditions emerge that altered their nature and contributed to the rise of mammals and other animal species.

The same might apply to other cells, such as red and white blood cells. From the perspective of a human being—both as an individual and as a species—this anthropocentric viewpoint is quite understandable. It’s hard to accept the idea that we are not whole, but rather made up of countless other living beings. So where, then, is the human as such? Where is our wholeness, our personality, our soul and spirit?

If we were to accept that humans are merely a mosaic of many other beings and various chemical compounds, we might conclude, for example, that a person's violent behavior is simply the result of elevated testosterone levels. This hormone is believed to increase the number of "sperm tadpoles" and, consequently, the potential for species survival.

While scientists have established a strong correlation between elevated testosterone and aggressive behavior, this does not necessarily mean such behavior will always manifest.[28] It is a well-known fact of everyday life that women tend to be somewhat more attracted to men who display a certain level of decisiveness, strength, and even overt aggression. This behavioral pattern is believed to signal that such men are fertile and better equipped to care for their offspring. Some women follow this pattern so consistently that they repeatedly choose violent partners, regardless of previous negative experiences. Time and again, this cognitive error leads them into cycles of unhappiness and suffering.

One theory suggests that such women subconsciously choose partners based on the violent role their fathers played during their development. Another theory proposes that women are drawn to aggressive men because of weak, indecisive, and emotionally distant fathers who played a highly passive role in their upbringing. In short, there is strong potential for chemical compounds to influence human behavior, thoughts, and emotions. In other living beings—particularly mammals—this influence may be even more pronounced.

There is also a theory that violent behavior is not solely dependent on chemical compounds or hormones, but is also influenced by a range of other factors such as environment, temporal dynamics, and content-related aspects (ethics, morality, values, etc.), as well as various higher-level influences that extend beyond the mesocosmic realm toward the macrocosmic—such as magnetic fields, electric fields, gravitational forces, climate, atmosphere, and celestial bodies.

In broad terms, we have outlined two models of understanding the human being:

- The "anthropocentric model", in which the human is viewed as a complete whole, and individual cells—such as neurons, sperm cells, and blood cells—are living organisms, but not living beings in themselves; they are merely parts of a person.

- The "mosaic model", which is not widely accepted, suggests that a human is composed of numerous living beings and chemical compounds, and therefore not a whole in and of themselves.

28 Batrinos, M. L. (2012). Testosterone and aggressive behavior in man. *International Journal of Endocrinology & Metabolism*, 10(3), 563–568. https://doi.org/10.5812/ijem.3661.

In essence, the first model represents a „mesocosmic" perspective, while the second reflects a „microcosmic" view. A "macrocosmic" perspective could be illustrated by the model of particles and/or waves, which posits that a human being is merely a particle and/or wave in the vast universe.

These different perspectives can lead us to entirely different insights—and thus, to different truths and even different realities. Despite these possibilities, it is important to maintain an anthropocentric platform that provides both individuals and various ways of interpreting reality—through science, religion, art, and everyday thinking—a stable cognitive framework.

Based on this stable mental framework, ethics is also preserved, as it, along with morality and values, serves as a valuable compass throughout an individual's and society's life. In any case, it is necessary to believe in something positive—whether it be faith in God, trust in the positive direction of science, the creative freedom of art, or the power of positive ethics across all levels of social life.

The essential difference between science and religion has been (and still is) defined by the claim that science seeks evidence, while religion does not; instead, it treats the existence of God as an indisputable fact for which no proof is required. Yet even in science, we must believe in various collective agreements (e.g., measurement units, standards, axioms) for which no proof is needed—especially in the case of axioms, such as the number system and arithmetic. In other words, scientists believe in pre-established symbolic systems because they use them as tools (e.g., the language of mathematics, natural language) to solve problems and interpret the environment.

Science, art, religion, and everyday life are all filled with numerous symbols. In this regard, science is not fundamentally different from religion—the only real difference lies in how they model and view the world. The religious model is more emotionally charged and organically inclined, while science seeks to distance itself from emotions, leading to a more mechanistic orientation. However, it would be wrong to claim that science has no room for emotion.

In popular discourse, one often hears the claim that scientists doubt the existence of God or attribute to God a non-scientific meaning. In the extreme atheist model, God does not exist. But doubt in God—or assertions of His nonexistence—cannot be entirely correct, because a vast number of people believe in God, which means God exists within the mental frameworks of both believers and skeptics. The concept of God is a human invention. Through this concept, we personify a great cosmic energy that is indestructible and, by our standards, capable of an infinite number of transformations and forms. The anthropocentric view of God is essentially a simplified view of the energy of the entire universe. A less anthropocentric view would suggest that God is not merely a kind, bearded figure, but rather encompasses all living beings and all chemical elements and compounds, including their various dynamics and governing laws.

In short, those who do not believe in God are, in essence, also doubting energy—one of the most important quantities in the scientific world. We have full freedom to doubt God's existence, but in the end, that doubt seems almost meaningless, as we are continuously subject to natural processes that surpass us both in space and in time. God, or "Omne," is simply a different perspective on energy. This model simplifies the origins of the universe, the world, and life, and is conditionally comparable to an axiom—something we accept without seeking or needing proof of its existence.

Alongside this energetic view, it is essential to emphasize that every form of positive faith contains positive energies that, in the form of ethics and morality, guide human behavior and decision-making on a large scale. Faith essentially steers the positive organization of individuals and communities. Faith itself does not dictate how people must live—that role is often taken over by extremely egocentric individuals who pursue material wealth and dominance over others. Similarly, science also guides people in how they interpret the world, though scientific endeavors are often driven by the egocentric interests of certain individuals or groups. Because of this, scientific knowledge and applications are frequently misused for unethical and immoral purposes.

All the good and bad things that happen on Earth are, to some extent, the result of our collective and subjective interpretation. We cannot fully grasp higher dimensions and cosmological processes because our minds are confined within a cage of familiar methodologies, theories, models, rules, laws, fears, desires, hopes, and so on. Through science, we attempt to understand higher processes and dimensions—which is mostly in contrast with art, which we try to feel. Humanity is a reflection of a higher energy. We also imitate higher processes, knowledge, and existences; we emulate energy flows, for example, in computing, where we collect information, simulate events, and develop new knowledge that we then seek to store in memory devices.

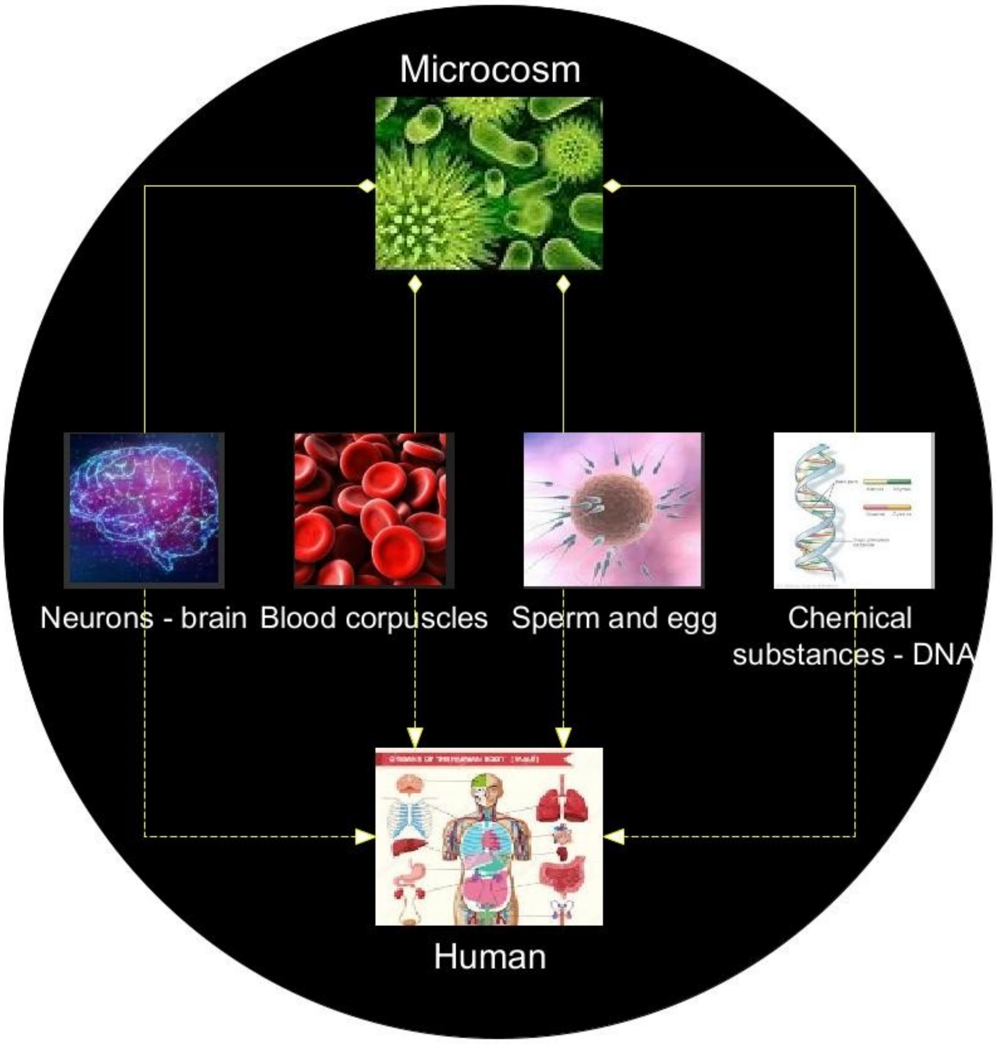
Similarly, the universe contains various forms of information and energy, waiting to be transformed into different shapes and meanings. Often, it is the combination of different energies that gives rise to new life.

The debate about the existence of God is not particularly meaningful, as God represents a significant element of thought across different human civilizations. Similarly, while it is within every individual’s right and freedom to question the legitimacy of the arts and sciences, such skepticism does not appear entirely reasonable.

It is conceivable that in parallel worlds, forms of religion, science, and art also exist. Rather than rejecting positive forms of religion, science, or art outright, it is more constructive to integrate and apply insights from these domains—particularly in efforts to enhance psychological, social, and scientific development.

Each person has a relatively free choice when it comes to participating in science, the arts, or religion. These fields offer a rich repository of diverse symbols developed over centuries and millennia. It is important to emphasize that science, art, and religion all share a common foundation: energy. Each constitutes an essential part of human reality and forms a key basis for cognitive focus and understanding.

In technologically advanced societies, individuals are constantly exposed to the outputs of artistic expression, scientific achievement, and religious manifestation. The frameworks of hierarchology and hierarchography attempt to describe and visually represent these relationships, based on different perspectives on the world—namely, the microcosmic, mesocosmic, and macrocosmic views of the human being.



2.7.2 Figure 64: The puzzle model or microcosmic view of the human being

Figure 64 illustrates the puzzle model, or the microcosmic view of the human being. This model is based on the assumption that the human—both as a living organism and as a personality—is not a complete entity, but rather a composition of numerous other living organisms or beings (e.g., neurons, blood cells, sperm, bacteria) and chemical compounds (e.g., DNA). These components are hierarchically and associatively interconnected, and through their dynamic interactions—expressed in various forms of energy—they collectively form what we refer to as "a human." According to this model, the term "human" is merely a label for this assembled whole.

In short, without microorganisms and chemical substances, neither humans nor other higher organisms (e.g., insects, reptiles, birds, rodents) would exist. The same applies to plant life. The human being is essentially the result of interactions and relationships among many lower hierarchical levels, which in turn influence individual behavioral patterns (e.g., bacteria influencing what a person craves to eat) and social structures (e.g., the clustering of people into urban communities mirrors the behavior of microorganisms).

Imagine applying this model as a psychological or sociological framework for understanding individuals. In that case, one would likely not search for a "soul" or "spirit" within a person, nor for a unified personality. Instead, attention would be directed toward behavioral and social manifestations arising from the dynamics of microorganisms and chemical compounds. In this framework, every known microorganism, in conjunction with chemical substances, would represent a specific psychological and/or social behavior pattern.

In recent years, scientists have indeed begun to uncover the significant influence of bacteria within the human body—organisms that, interestingly, behave in ways similar to social networks.[29] Upon this realization, it is necessary to note that specific software tools (e.g., Cytoscape, Pajek) and algorithms (e.g., Fruchterman-Reingold) are used for network analysis, which are relatively constrained to produce similar (formatted) outcomes. Science strives to better understand the worlds within and outside of humans through various tools, devices, and methods.

An individual, who is a composite of diverse microorganisms and chemical compounds, behaves somewhat distortedly yet similarly under the influence of these components. A single bacterium likely does not significantly impact an individual's behavioral patterns, but entire networks might dictate dynamics such as bioenergy strength, consciousness states, or certain physiological abilities. The puzzle model thus highlights the importance of all microorganisms living within the framework we call a human. Astonishing, isn’t it? The content of the presented model indeed moves towards devaluing humanity and thereby the individual and society! Despite the unfavorable message of this model, we can confidently conclude that it does not belong to current scientific reality. On the other hand, the puzzle model is very intriguing because it opens up a new perspective on humans and society.

This perspective on humans and individuals excludes anthropocentrism. Imagine applying a similar model to explain the origin, structure, and dynamics of language. Indirectly, this would mean that linguistic communication would fundamentally be under the influence of microorganisms and chemical compounds. How would such a model affect thoughts about God? In any case, one could argue that God should not only be sought at the macrocosmic level but is also present at the micro- and mesocosmic levels. Following this is a presentation of an anthropocentric model or a mesocosmic view of humanity.

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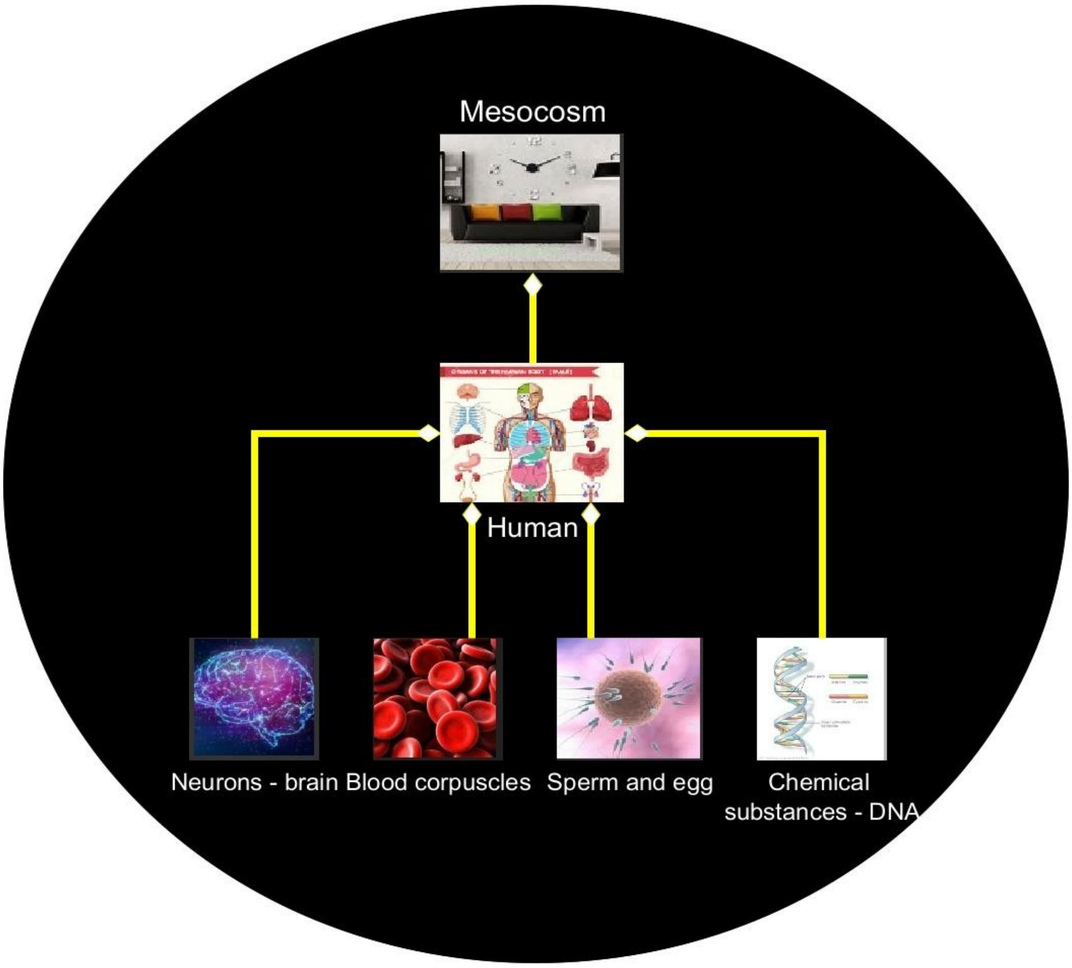
29 Fernandez, M., Riveros, J. D., Campos, M., Mathee, K., & Narasimhan, G. (2015). Microbial “social networks.” *BMC Genomics*, 16(S11). https://doi.org/10.1186/1471-2164-16-s11-s6.

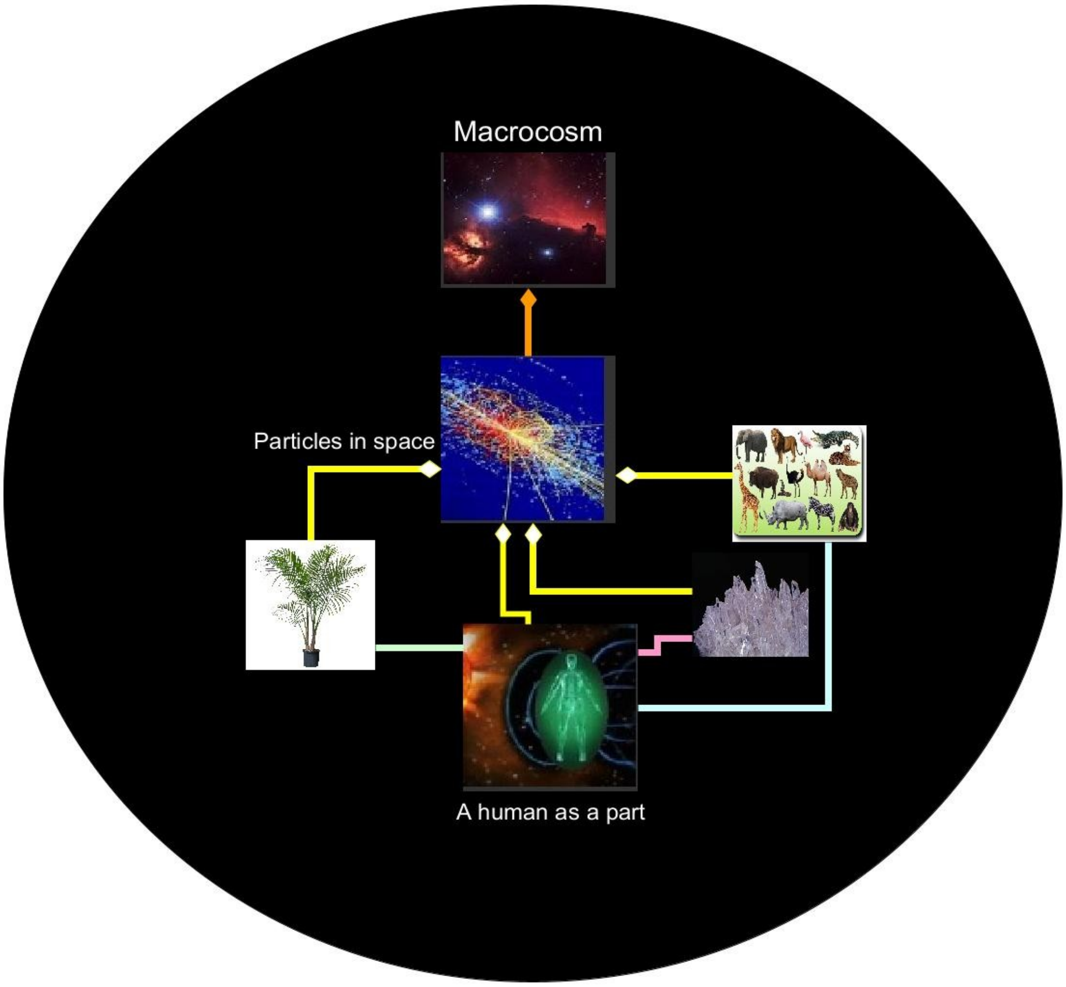


2.7.3 Figure 65: The anthropocentric model or mesocosmic perspective on humanity

Figure 65 illustrates the anthropocentric or mesocosmic perspective on humanity, which defines humans as beings existing within the dimensions of space and time, representing a unified whole. All other living organisms and chemical compounds within the human body are considered merely part of its dynamics and are not classified as independent living entities (except for bacteria). The depicted organisms, such as neurons and blood cells, are referred to as living cells, which lack all the essential characteristics of independent living beings and rely on their host—humans—for survival.

The mesocosmos represents the reality closest and most comprehensible to humans. Within this realm, two systems are categorized: the ecosystem and the cognitive system. The ecosystem encompasses our environment, including the atmosphere, climate, heat, animals, plants, stones, crystals, water, and more. The cognitive system pertains to the human method of understanding and interpreting the world. It occupies a central dimension and represents only a small segment of actual reality. Everything perceptible through our sensory system and processed meaningfully by our brain constitutes both the mesocosmos and anthropocentrism. In summary, everything comprehensible to humans forms a dimension that most closely aligns with reality from an anthropocentric viewpoint.

This model is widely recognized across various fields of science, art, and religion. Disciplines closely connected to this worldview include psychology, social sciences, humanities, environmental sciences, natural sciences (e.g., biology, anthropology, oceanography, meteorology, chemistry), and applied sciences (e.g., medicine, engineering disciplines, much of computer science and informatics, mechanical physics).



2.7.4 Figure 66: The particle/wave model or the macrocosmic perspective on humanity

Figure 66 presents the particle/wave model or the macrocosmic perspective on humanity, which defines humans as merely a small, insignificant particle or a minor wave within the vast universe. Many religious, philosophical, and scientific theories have expressed the belief that the microcosm is a reflection of the macrocosm (e.g., Paracelsus's worldview). Essentially, the macrocosm repeats itself in the microcosm in a cyclical manner. This model is largely in contrast to the anthropocentric view of humanity, as higher levels of the universe guide humans and other living beings throughout their lives.

We have previously noted that the micro-world, especially in the mesocosmic view of humanity, could be a guiding force. However, in the macrocosmic perspective, this assumption does not hold, as larger cosmic forces have a greater impact on human existence. If humans are seen as tiny particles from a macrocosmic perspective, microorganisms are even smaller particles, with both the micro- and mesocosmos having little influence. Based on this model, both the micro- and mesocosmos are under the strong influence of the macrocosm.

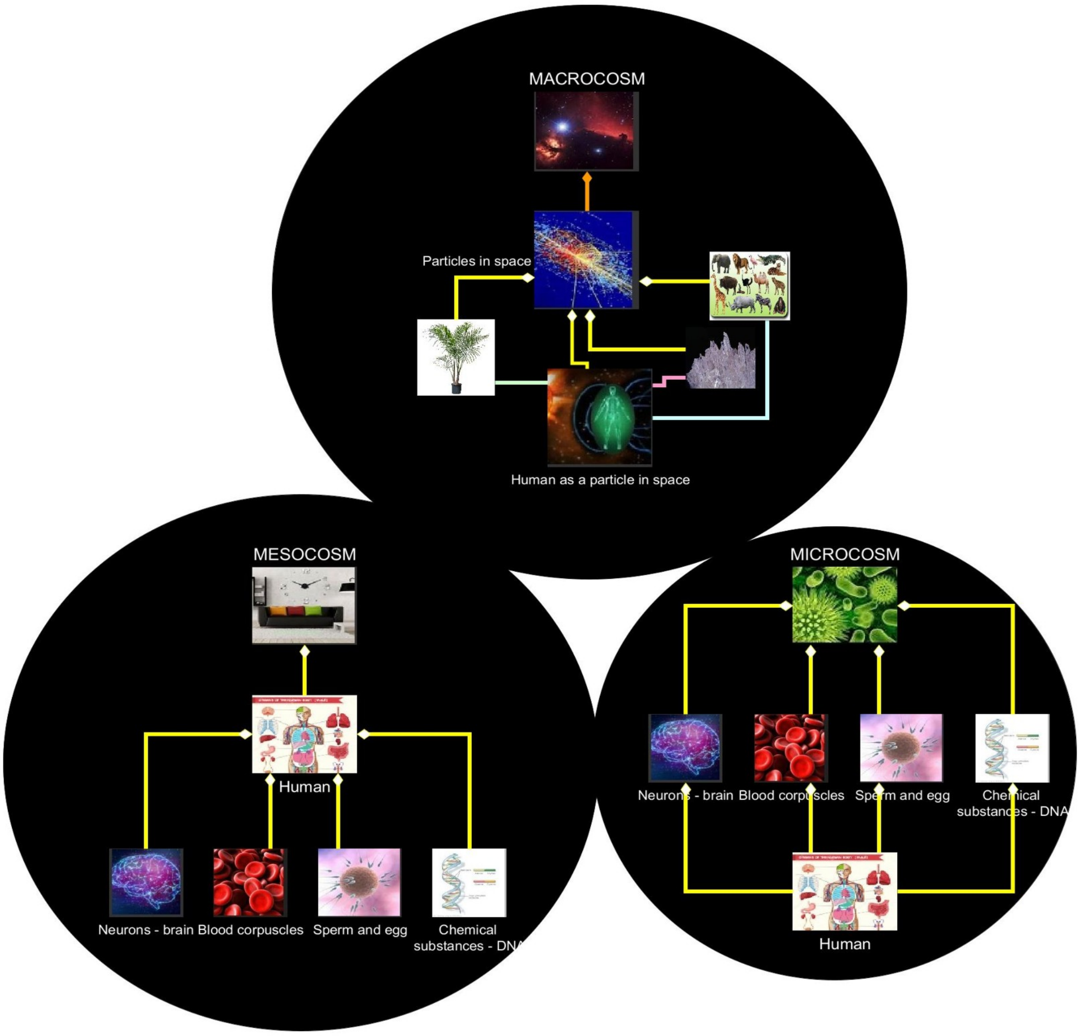
Relativity theory attempts to describe the operation of a part of the macrocosm by assuming that the movement of a particle with a certain mass and light speed produces a large amount of energy. The greater the mass of the particle traveling at light speed, the greater the energy, which can be converted into different types of energy or even mass. It is intriguing to consider whether the output mass can be greater than the input mass of the particle. If the output mass resulting from the particle's movement at light speed is greater than the input mass, this would essentially invalidate the law of mass conservation, which explains the beginning and end of chemical reactions. According to this law, the mass at the start of a chemical reaction cannot be exceeded at the end of the reaction; what you put in is what you get out.

In contrast, relativity theory shows that space and time are constantly changing, with time flowing faster or slower, which is in stark contrast to the uniform and constant time experienced at the mesocosmic level. From this brief description, it is clear that while we want to establish similarities between the micro-, meso-, and macrocosmos, theories have developed that highlight the distinct differences between these worlds.

The realization that data and information are stored at both the micro- (neurons or brains) and mesocosmic levels (e.g., computers) leads us to speculate, through speculative reasoning, that there might also be memory media at the macrocosmic level that record events, phenomena, and laws from all three worlds, or at least some connection exists. The problem is that we do not know of any memory medium at the macrocosmic level, while memory media for data and information from the other two worlds are more familiar.

Imagine using the particle/wave model in psychology and sociology; this would be almost a mission impossible, as the view of humanity would be devalued in an anthropocentric sense, and measurements in psychological and sociological terms would be incomprehensible. However, hierarchology with hierarchography might be able to use this model of viewing humanity and society, as its content and methodological scope are much broader, allowing for more research approaches. Hierarchology with hierarchography could potentially combine with astrophysics and astronomy to study hierarchical and associative entities and connections within the macrocosmic perspective on humanity.

It is also difficult to imagine using this model to study language, as language research seems possible only with the mesocosmic perspective on humanity, which is widely accepted in the humanities. An anthropocentric view is necessary, as we must not forget our identity. On the other hand, an anthropocentric view acts as a kind of mental cage, especially when it is very radical! Other perspectives on humanity are interesting and could be used as additional approaches to studying personality and society, with the goal of revealing something new.



2.7.5 Figure 67: All three worldviews on humanity

Figure 67 presents three comprehensive worldviews on humanity, highlighting the following key points:

- All perspectives consider energy as the crucial driving force of reality.

- Humanity is present in all views, though not always in a primary role.

- Science attributes certain similarities to these worlds but also highlights significant differences.

- From an anthropocentric standpoint, humans occupy a central position, acting as a kind of mediator between the micro- and macrocosmos.

- Based on the macrocosmic view of humanity, one could conclude that humans represent just a small particle within a larger whole, whose function is unknown.

- With the microcosmic view, humans are seen as components that do not form a whole on their own but do so through the method of induction (hierarchically from bottom to top), for example, by combining living cells, bacteria, and chemical compounds to form a whole.

- The mesocosmic view of humanity is anthropocentrically oriented, where humans represent the whole, using a deductive method (hierarchically from top to bottom).

- We can assert that data and information are recorded at both the micro- and mesocosmic levels, but we cannot confidently claim this for the macrocosmic level. However, based on the principle of similarity with the other two worlds, we can speculate about it.

- The macrocosmos holds the greatest power and influence among all worlds, dictating the dynamics of both microorganisms and higher living organisms, such as mammals (e.g., primates, dolphins, whales), birds, fish, reptiles, insects, etc. These organisms represent a median position between the micro- and macrocosmos. On the other hand, the macrocosmos is composed of the micro- and mesocosmos and essentially serves as the framework for both worlds. The boundaries between these worlds can be quite fluid. Due to this, some have believed that the end of the macrocosmos lies within the microcosmos. The truth is likely difficult to determine, as there are various models for viewing these worlds. In summary, we can report on a relative reality that helps humans orient themselves, which also forms the basis of an individual's mental concentration. Humans can approach truths using various tools, such as mental techniques, psychological stimuli, senses (the connection between the sensory system and the brain), devices (measuring instruments, recorders, etc.), and collective agreements (e.g., laws, symbols, language). The guiding force in gathering truths for a particular individual is precisely mental concentration. Reality is the outcome of numerous contributions from many individuals who are more or less connected in social communities, so that the accepted and agreed-upon reality is essentially the mental concentration of society. In the continuation, we will focus somewhat on sexual identity and sexual orientation of the individual, which could have been discussed under the subheading on love. However, it is necessary to emphasize that sexual orientation is not necessarily a component of love. Sexual identity and sexual orientation are powerful components of an individual's mental concentration and thus significantly contribute to the acquisition of truths and reality.

2.8 Gender identity and sexual orientation of an individual

This is an important part of an individual's personality and the starting point for autobiographical memory, where a person begins to store personal data, experiences with various people throughout life, events and phenomena, and their role in them, different laws or rules they have learned, and finally information about who they were, who they are now, and who they would like to be in the future. Each person creates their own autobiography within their brain. Relatively few individuals write it down later in life. Gender identity within autobiographical memory confirms an individual's gender affiliation. In most societies, there are two genders, divided into male and female. In rare societies, a third gender is added (e.g., transsexuals, hermaphrodites). An individual begins to be aware of their gender around the age of three. Both biological and later social factors influence gender identity. Essentially, social factors (family, society) further refine an individual's gender identity. In societies, strong stereotypes regarding gender often emerge, which rigidly define the roles and behaviors of males and females. These clear distinctions between male and female genders are less pronounced today, after about twenty years, so much so that it is claimed that the differences between genders are exponentially decreasing. This statement is hard to dispute, as if we follow the historical development of both genders in technologically advanced societies, we can easily see that many relationships, relationships, rights, etc., between both genders have changed significantly. We can go back to a time when women did not have the right to vote, could not hold leadership positions in organized associations, were established as housewives who were typically not employed in a company, it was not considered proper for a woman to wear pants, key decisions were usually left to men, etc. With the increasing role of women, especially in technologically advanced societies, the style of governance has also changed, becoming softer due to increased female influence, which has contributed to the advancement of such societies, as they have enabled peaceful agreements and various collaborations in problem-solving and decision-making. In every respect, an individual's gender identity means an important part of our mesocosmic reality. What the actual biological differences between genders are is a question that would be wise to answer. Biological differences create a certain tendency that is expressed in behavioral patterns of both genders, both from a psychological and sociological perspective. In this regard, an interesting question arises about the mental distance and mental proximity or equivalence between both genders. How could this be computationally determined using a complex evaluation matrix and then visually represented? Biological differences between both genders are important because they shape the cognitive and social dynamics of human societies and consequently also the quality of life. Organizational scientists have long ago found that the best and most effective collectives are those that can combine the mental abilities of both genders, thereby achieving even greater business effects. It is necessary to emphasize that the differences in the brain between both genders cause different mental and emotional worlds that affect collaboration, decision-making, agreements, crisis management, innovation, scientific products, politics, etc. Physiological differences between both genders are somewhat better known and are determined based on values such as body height, muscle mass, sexual organs, etc. There are also certain differences between both genders in brain structure. Let's mention some of these differences in the continuation (Annis, B. & Nesbitt, R., 2017).[30]

a. Women have a larger hippocampus, which means better memory for specific details, especially for words exchanged between two or more people.

b. Women interpret the world more emotionally, while men more often use logic.

c. Problem-solving occurs differently in men than in women. Men more often decide on action, while women look at the problem more broadly and often require a more in-depth discussion.

d. Men are more inclined towards conflict situations, while women want to reach an agreement.

e. Women's brains are more active than men's during rest.

f. Women have a larger prefrontal cortex and a larger amygdala than men. Because of this, women are more sensitive to threats and have a better memory for details.

g. Women's behavior in meetings differs from men's behavior. Women tend to express themselves, are more sensitive to the emotional climate in the room or to the people around them.

h. The female corpus callosum is 25% larger than in men, which consequently leads to a different way of thinking, as men prefer to think linearly step-by-step, while women more often think in a network and connect different ideas.

i. Men produce 20 to 30 times more testosterone than women. The consequence of this is evident in the experience of success and the way of dealing with negative stress. Men need a larger amount of testosterone than women, which can make them somewhat more violent.

30 Van Edwards, V. (2018). 6 Fascinating Gender Differences Between Men and Women in the Workplace. Science of People“ je na osnovi knjige: Annis, B., & Nesbitt, R. (2017). *Results at the top: Using gender intelligence to create breakthrough growth.* Wiley.

j. Men and women need oxytocin. In women, oxytocin increases even during normal relaxed conversation. Men need oxytocin to cope more easily with negative stress, but too much oxytocin reduces testosterone levels, which consequently causes negative stress.

k. Research has shown that cortisol levels are higher in women than in men. This hormone is crucial in coping with negative stress. Because women are somewhat more emotional and sensitive than men, nature has ensured that their cortisol levels are higher.

l. In the case of conflict situations, women experience a significant decrease in oxytocin levels more than men, which makes it difficult to cope with negative social stressors. Therefore, women often want to reach agreement, cooperation, and a pleasant social climate.

The selection of these differences (of which there are likely more) essentially reflects gender identity. The ways in which genders (including the middle gender) realize their gender identity are sexual orientations. Based on available sources, there are 17 different types of sexual orientations, which greatly exceeds the number of sexual orientations of all other living beings on Earth. In this regard, humans are champions of nature.[31]

1. Homosexuality: This refers to a sexual orientation where an individual is sexually attracted to members of the same sex. In this sense, these individuals can be both men and women. This sexual orientation is likely as old as the human species. In the past, homosexuality was probably less common because the number of people was smaller, and there was a greater emphasis on the continuation of the species. Homosexuality was often present in ancient Greece and Rome, especially in wealthy circles, where dignitaries had a wife and a male lover. History reports less about female homosexuality (lesbianism). The most famous representative of these times was Sappho from the island of Lesbos. Homosexuality also occurs in the animal world, although less frequently. It is more common in other primates, such as bonobos. In human communities, homosexuality is most common where there is a high population density per square kilometer and in prisons, while in rural areas, we assume that homosexuality occurs less frequently.

2. Demisexuality: This is a sexual orientation where individuals cannot have sexual relations with people with whom they are in a romantic relationship. A prerequisite for sexual relations with these individuals is the termination of the romantic relationship.

3. Heterosexuality: This is the most common sexual orientation in both human and other animal species. This orientation refers to individuals who are attracted to members of the opposite sex.

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31 Taken from an online source: 17 different types of sexual orientation. (2016). URL https://allwomenstalk.com/sl/56e0705a0c4fe713328b4686 (2018-12-29).

Heterosexual orientation is the most important of all orientations, as it enables the reliable continuation of the human species. We can assume that heterosexual orientation is the most common in terms of percentage in locations where population density is extremely low. As we have already learned, this form of sexual orientation is also not entirely pure, as there are cases where heterosexual individuals enter into sexual relations with members of the same sex. The same applies to many homosexual individuals who occasionally do not refuse sexual relations with the opposite sex. Regarding sexual orientations, we should not expect clear boundaries between them. In fact, the number of individuals who are 100% heterosexual or homosexual is relatively small. In short, we can only speak of relatively pure forms of sexual orientations.

4. Bisexuality: This is a sexual orientation where individuals are sexually attracted to both sexes. This is a very variable orientation, as there are different scenarios within bisexuality (e.g., a man slightly prefers men but also has very frequent intercourse with women; a man has sexual relations with a man only when a woman is also present; many transsexuals are bisexual).

5. Biromantic: This refers to individuals who feel romantic love for members of the same and opposite sex. This sexual orientation is no guarantee that sexual relations will actually occur with individuals of both sexes.

6. Pansexuality: Also known as polysexuality, this is a sexual, romantic, and emotional attraction to all people regardless of their gender. Pansexuals often do not specify their gender identity, which is why they are also called gender-blind.

7. Demiromantic: This is a sexual orientation where individuals can only feel romantic attachment to another person if they have known them for a long time. Romantic attachment may fade over time.

8. Lesbianism: See homosexuality.

9. Asexuality: This refers to a sexual orientation where individuals do not feel desire or need for sexual relations. They do not feel significant attraction to members of the same or opposite sex. A larger proportion of women are in this group.

10. Queer: Representatives of this orientation are very diverse and can be found in communities of homosexuals, bisexuals, transsexuals, etc.

11. Autosexuality: This refers to a sexual orientation where individuals experience satisfaction with themselves. Many see autosexuality as a subcategory of asexuality.

12. Aromantic: In this sexual orientation, individuals do not feel romantic connection to members of the opposite or same sex, although they may have sexual relations.

13. Gyneromantic: This means a sexual orientation towards members of the female sex, whereby the individual does not specify their gender identity.

14. Gynecophilia: This is similar to lesbian sexual orientation, but with the emphasis that neither partner assumes a male role.

15. Omnisexual: See pansexuality.

16. Skoliksexual: People with this sexual orientation have sexual attraction to people who do not identify with a specific gender.

17. Spectrasexual: This refers to a sexual orientation where individuals are attracted to all people, regardless of their sexual orientation or gender identity.

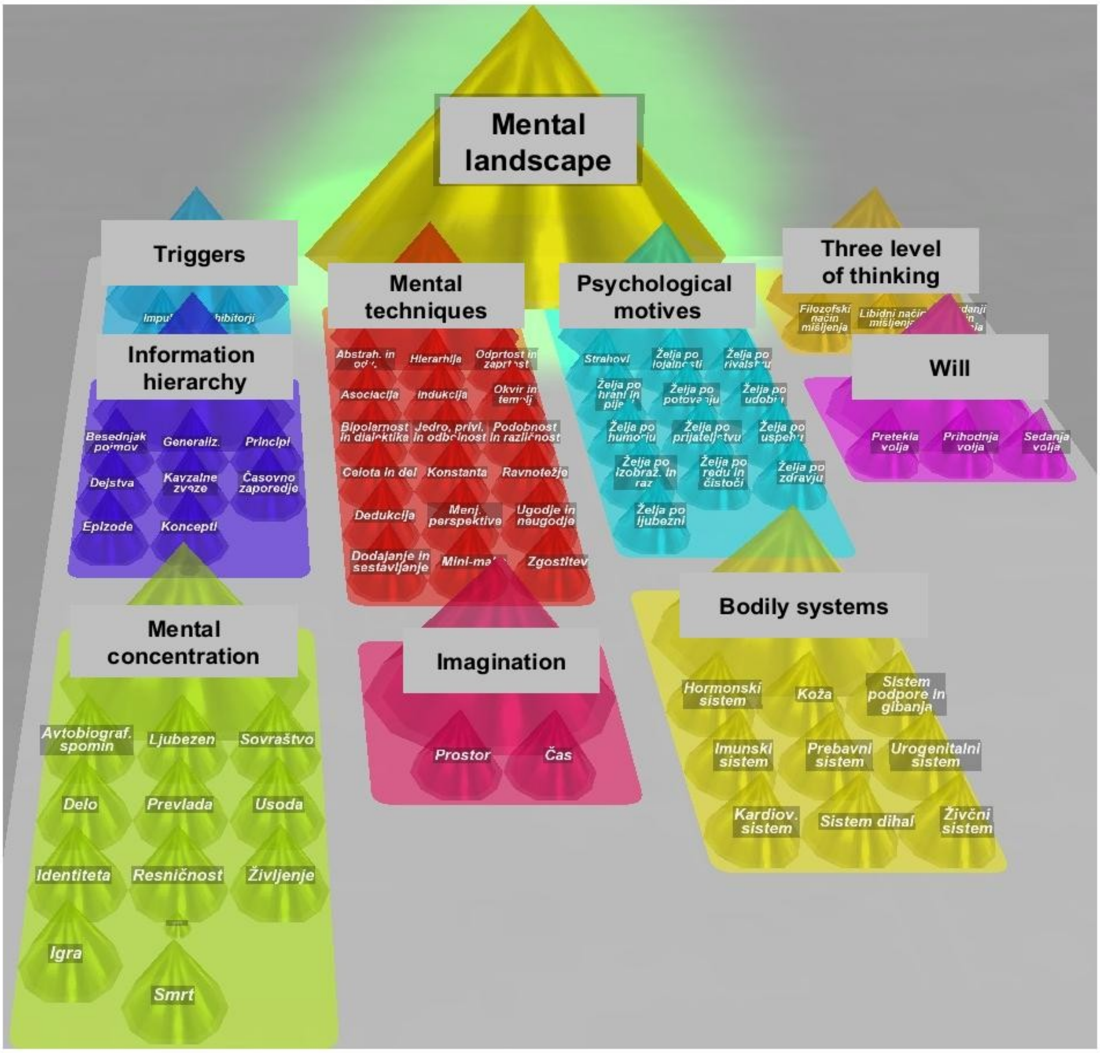
It is noticeable that there are many similar sexual orientations, where it is difficult to discern the essential differences. The listed forms of sexual orientation are considered socially accepted and normal. However, there is also a range of deviant forms of sexual orientation (e.g., masochism, sadism, pedophilia, gerontophilia, exhibitionism, voyeurism). Some of these will be discussed in more detail in the chapter on social nature or in the subsection on criminality. An individual's sexual orientation can more precisely define their gender identity, but this is not necessary if we consider the brief descriptions of sexual orientations, where certain individuals do not explicitly define their gender identity. In this regard, social and psychological factors are not decisive for gender affiliation, but we must not overlook biological factors, which quite clearly determine sex.

The chapter on the individual is nearing its end, so a review of the discussed material will be conducted in the form of a verbal description and a mental landscape of the individual.

2.9 Conclusion of the chapter on the individual

2.9.1 Figure 68: Conceptual cross-section of the content of the chapter on the individual

Figure 68 shows a conceptual cross-section of the content of the chapter on the individual. We dealt with the information hierarchy, which contains building blocks (e.g., facts, concepts) that the individual uses in collecting, selecting, and processing data. Within this content connection, we established that symbols represent extremely important concepts for both the individual and society (e.g., collective symbols). These types of concepts can have a significant impact on strengthening the imagination, will, and identity of a particular individual. Collective symbols, in particular, can strongly influence the strengthening of a nation's identity. Symbols as important concepts within the information hierarchy can also express certain values that originate from symbolic categories (e.g., love, freedom). The three basic modes of thinking were also described and illustrated, divided into philosophical, everyday, and libidinal levels of thinking, which was termed the three-level mode of thinking. Twelve of the most well-known psychological motives were presented, which represent an additional driving force for thinking in connection with stimuli. It is precisely stimuli (e.g., impulses, inhibitors) and psychological motives (e.g., desire/need for food and drink, desire/need for competition, desire/need for love and loyalty, desire/need for humor, fears of the future, animals, death, desire/need for friendship) that can establish cultural responses in the form of mental techniques (e.g., deduction, induction, bipolarity, dialectics, similarity, difference, condensation, abstraction, derivation, addition, composition, mini-max, whole and part, constant), which were listed and briefly described. These mental techniques can direct an individual towards focusing on a specific topic. We termed this type of focus mental concentration. This was defined as an individual's focus on more complex content and is a product of existing rules (e.g., ethical code, laws, values), strong representations (e.g., time, space), and will (e.g., past will, present will, future and/or preventive will). The definition and description were followed by visual representations in the form of a metamodel and a package diagram. Later, the dynamics of expressions and impressions, which are the outcome of the thinking and motor dynamics of a particular individual, were described and illustrated. In this connection, various personality theories used to describe an individual were presented. It was established that one personality theory is not sufficient for a quality description of an individual; rather, a hierarchical associative network of different personality theories is needed. This was followed by a description of bodily systems (e.g., cardiovascular system, hormonal system, immune system, skin, respiratory system, sensory system, urogenital system, digestive system, support and movement system) with organs (e.g., heart, stomach, brain, liver, intestines, senses, muscles). Bodily systems were defined as hierarchical associative network systems. At the end of this chapter, reality was discussed, along with truths that are the basic orientational platform for both the individual and society. Reality is also the basis for the mental concentration of the individual and society. In this regard, reflection on sexual identity and sexual orientations followed, which represent strong building blocks of mental concentration and significantly influence the acquisition of truths and, in long historical development, also the establishment of reality. Reality was defined as a construct that can be modeled from a microcosmic (not anthropocentrically oriented and assumes that humans are not a whole but a composition of microorganisms and living cells), mesocosmic (anthropocentrically oriented, which posits that humans are a whole), and macrocosmic (not anthropocentrically oriented and humans represent only a particle or wave) perspective on the world. It was established that the mesocosm is closest and most understandable to us, which is indeed only a small segment of reality but still the most reliable reflection of the actuality that we observe with our senses and brain. When observing the micro- and macrocosm, we need additional aids such as microscopes, sensitive measuring devices, telescopes, radars, etc., and a considerable portion of imaginative abilities. We primarily interpret both worlds based on the mental technique of similarity and difference. What follows is the mental landscape.



2.9.2 Figure 69: Mental landscape of the individual

Figure 69 illustrates the mental landscape of the individual, where we encounter the building blocks that were loosely described on the previous page.[32] Based on this hierarchical model, we can state that an individual's mental world contains a specific mental platform (the three-level mode of thinking, which includes philosophical, everyday, and libidinal modes of thinking), an information hierarchy (data building blocks such as principles, facts, concepts, especially symbols), susceptibility or insusceptibility to stimuli, psychological motives (desires, needs, fears that can trigger active or passive responses to stimuli), the use of mental tools in the form of mental techniques (e.g., deduction, induction, bipolarity, frame and foundation), which occurs based on strong representation and will (identity, autobiographical memory), enabling strong mental concentration. This means focusing on more or less complex content, without which stimuli, psychological motives, and mental techniques would not have their proper function and content!

32 Made with help from: Topicscape is an amazing visual information organizer. Topicscape (no longer available?) http://www.informationtamers.com/topicscape/.

Bodily systems represent a certain hard platform (conditionally comparable to the analogy of hardware in a computer), without which the previously described soft platform (conditionally comparable to the analogy of software in a computer) would not function.

Of course, in this chapter on the individual, it should not be expected that all key elements of an individual's personality have been described, as only those factors that, from the perspective of the hierarchical associative concept, are believed to most influence an individual's mental world to create a certain new view of personality have been summarized.

In the next chapter, from the perspective of the hierarchical associative view, the family will be discussed, which, as the smallest unit of society, will serve as a springboard for the upcoming chapter on social nature (society).

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3 Family

In a broader sense, the family is the fundamental and most important existential unit that enables the preservation and development of various animal species, including humans. In nature, we can observe different natural family models, especially among insects and mammals, which have successfully survived the struggle for existence over long evolutionary periods through these models. From a strictly anthropocentric and sociological perspective, the term “family” should not be used to describe communities of different animal species. However, from the perspective of hierarchology and hierarhography, the term “family” — in its broader sense — also includes various animal communities.

An interesting example is the ant family model, where an entire colony, both large and small, represents a large eusocial family, with all individuals genetically related (ants will be discussed in more detail in Chapter 5 on natural nature, as hierarchical associative systems of different ant species will be examined). After mating, males typically die within a few weeks, while the queen ant can live up to 30 years. The ant family model is distinctly organized into hierarchies, with the queen ant occupying the highest position. All other individuals are subordinate, including workers (young, mature, old), foragers, soldiers, and so on. In essence, the queen ant ensures reproduction and, therefore, the continuation of the species. This family model is highly hierarchically structured.

A similar model is found in eusocial bee colonies, where the queen bee holds the highest hierarchical position. Within large bee colonies, there is also a form of "bee police" that monitors and maintains the established hierarchy.

Among mammals and birds, many species rely on a core family model as an existential foundation for species preservation (e.g., foxes, eagles). In the animal world, single-parent family models have also developed, where females care for the offspring while males do not participate after fertilization (e.g., leopards, domestic cats). Additionally, there are so-called extended family models in nature, where offspring are cared for by elders, parents, and relatives (e.g., elephants). It seems that many different family models in the broader sense could be found in the natural world.

The human species is also undoubtedly a champion when it comes to the diversity of family models. The following section will focus on the family in the narrower sense. This is defined as an important social unit within human communities. In this context, we recognize families where blood relations are a primary condition, as well as families where people unite based on shared interests, with blood ties not being essential (e.g., criminal organizations, communes, social networks).

3.1 Historical development of the family

In prehistoric communities, tribes were the dominant form of social organization. Within these tribes, men typically provided shelter, food, and protection, while women were responsible for raising and safeguarding the offspring. These tribal communities were likely quite small, which may have led to women occupying the highest positions in the social hierarchy. Historians refer to this period as the matriarchate. In a later period, the matriarchate was replaced by the patriarchate, as the strongest and most experienced male usually assumed leadership of the now larger tribal group. This family structure resembled an extended family, often including tribe members who were not related by blood.

In Greek and Roman antiquity, the concept of the family as we understand it today did not yet exist. Back then, the family was understood in much broader terms, and blood relations were not a prerequisite. The term "family" referred to a social unit in which the male head of household was the owner of his wife, children, slaves, employees, and property. The family was essentially seen as a strict hierarchical unit, with the male owner reigning over people and possessions.

Similarly, during the Middle Ages, it is difficult to speak of families in the modern sense. However, especially among the nobility, such social units were referred to as noble households. As in antiquity, the man was the master and claimed ownership over his wife (sometimes multiple wives), children, slaves, servants, and property.

It was not until the rise of the bourgeoisie—especially after the French Revolution—that the concept of the bourgeois family emerged, based on parents, children, and blood relations. This nuclear family model proved to be highly efficient and successful in technologically and socially advanced countries. Despite its success, many new family models have emerged within these developed countries over a relatively short period of time—some of which differ significantly from the nuclear model.

The main reason behind the emergence of new family models often lies at the individual level. Some people simply consider the nuclear family model inadequate for a healthy partnership and the development of children. From the perspective of the state and its key institutions, opinions on the recognition of new family models are divided, as the state sees the family as the foundational unit of society or the nation. Consequently, the following criteria are considered important:

a. Demographic criteria – The family is a means of producing offspring, who become citizens that will be educated, work, pay taxes (e.g., land tax), and contribute financially (e.g., to healthcare or pension systems). Without new generations, a society or nation will eventually die out, which would ultimately result in the extinction of the state itself.

b. Legal criteria – The nuclear family is legally formalized. Law regulates various relationships between partners, between parents and children, mandates compulsory basic education (regulating the relationship between parents, children, and the state), as well as matters of property ownership and other legal affairs.

c. Economic and financial criteria – Parents are expected to contribute to economic productivity, educate their children in the same direction, and fulfill various financial obligations to the state (e.g., taxes, contributions, paying rent, saving money in banks, spending money on raw materials for heating, transportation, food—whether in rural environments like large farms with livestock or urban settings like small and large industries).

d. Defense and security criteria – Every state expects its citizens to fulfill their civic duty and defend national borders in the event of war. In this regard, children are seen as potential future soldiers, making their existence particularly significant.

e. Child development criteria – Every state has a vested interest in ensuring that children are well educated and positively developed, so that as adults they can contribute to more effective economic outcomes, enhance the country's reputation, and eventually start families of their own, raising children who are well-mannered and socially responsible (a society made up of honest and content individuals faces fewer problems and incurs lower costs).

There may be other important criteria not listed here (such as the preservation of language and, consequently, national identity), but the above criteria clearly illustrate the effectiveness of the nuclear family model, which has proven highly successful based on these standards.

The following sections will present some recognizable family models, followed by hypothetical models that could potentially become reality one day.

3.2 Types of family models based on shared household and blood relations

This subsection will present the most and least recognizable family models found around the world.[33]

33 Hareven, T. (1985). *Historical Changes in the Family and the Life Course: Implications for Child Development*. Monographs of the Society for Research in Child Development, 50(4/5), 8–23. https://doi.org/10.2307/3333860. Furstenberg, F. F. (2019). Family change in Global Perspective: How and Why Family Systems Change. *Family Relations*, 68(3), 326–341. https://doi.org/10.1111/fare.12361.

a. Tribal family model

This is likely the oldest family model, which still exists in technologically undeveloped and remote parts of the world. It typically consists of a tribal chief, women, children, relatives, and other community members (e.g., in Papua New Guinea). A more modern version of this model appears in communes, which are usually religiously motivated. The main characteristic of these communities is that they are generally not permanent and often dissolve over time.

b. Nuclear family model

This model is most commonly found in technologically and socially developed countries, where it has proven to be the most successful from the state's perspective. It typically consists of two heterosexual parents (a man and a woman) and at least one child. Less than fifty years ago, the male held the top position in the family hierarchy, while the woman was subordinate and lacked significant decision-making power. Since the mid-1970s, relationships in developed countries have changed significantly, with women gaining equality and the ability to influence key decisions. Parenting styles have also shifted—becoming softer, less strict, and more focused on freedom (e.g., the use of gentler guidance methods).

c. Single-parent family model

This type of family is becoming increasingly common. A single mother or single father raises and cares for the children. Single-parent families can arise for various reasons, such as divorce (e.g., the woman seeks independence, or the man is unfaithful, or vice versa) or the death of one partner. The most common form is where a single mother raises the children on her own.

d. Reconstructed or blended family model

In this model, one of the parents remarries, creating new family relationships in which the children gain a stepparent (stepfather or stepmother).

e. Mosaic or mixed family model

This model is similar to the previous one. It arises from parental separation due to legal reasons (divorce) or biological reasons (death of a spouse). Later, a man and a woman who both already have children marry each other. This family model is becoming increasingly common in Europe.

f. Extended family model

Multiple generations (e.g., grandparents, parents, children) and other relatives (e.g., uncles, aunts, cousins) live together and share household responsibilities and child-rearing duties. This form of family was very common in the past, especially in rural areas.

g. Family model with adopted children

Partners who cannot have biological children choose to adopt. This family model can consist of a man and a woman, two men, or two women raising one or more adopted children. Partners may also choose a surrogate mother, who is artificially inseminated and, through a legal agreement and financial compensation, gives the child to the couple after birth.

h. Extended youth family model

In this model, adult children choose not to start their own families for personal, emotional, biological, or sociological reasons. Instead, they focus on personal development (e.g., education and finding a well-paying job) and continue living with their parents into adulthood. This lifestyle is sometimes referred to as "living in a parental hotel," while others label these individuals as "eternal children."

i. Dispersed extended family model

In this model, family members either live together in the same location or in different places but provide each other with mutual support—materially, in work, and emotionally.

j. Cohabitation or non-marital partnership family model

This model involves two partners living together by mutual agreement without entering into a formal marriage. They may share or keep separate ownership of property and may have biological or adopted children. In some cases, each partner brings children from previous marriages, and they might also have adopted or mutual children. This model is quite similar to the mosaic family model.

k. Same-sex partnership family model (Rainbow family model)

This is one of the most modern family models and appears primarily in technologically and socially developed countries. Discussions about this type of family are highly polarized.

l. Bigamous family model

This model is relatively rare in Europe. It may involve three parental figures (e.g., a woman with two men, or a man with two women) and children. For example, the children may have the same mother but two different fathers, or the same father but two different mothers.

m. Polygamous family model

Also rare in Europe, this model usually consists of one man—typically acting as the head of the household—and at least three or more women. The children have one father but multiple mothers. From a legal standpoint, both this and the bigamous model are impermissible and even punishable in technologically and socially developed societies. If a man legally marries one woman but, by mutual agreement, lives with additional women in the same household, legal regulation becomes ineffective. In short, both models may exist in practice, but the man cannot legally marry all the women involved.

n. Pedophile ring family model

This model is completely unacceptable and punishable both legally and ethically, yet unfortunately, it still exists. It is mainly driven by sexual and exploitative motives. Various versions may include:

- A pedophile couple has a biological child and kidnaps another.

- A pedophile couple adopts a child and kidnaps additional ones.

- A pedophile couple adopts children and connects with other pedophile couples through pedophile rings or networks.

o. Espionage family model

This model is secretive and difficult to detect. The partners, who may live as a married couple, operate in strategic symbiosis as part of the secret service of a particular country. They adopt or abduct several children, usually from impoverished regions, provide for their development, and then steer them toward secret service activities. These adopted children effectively become covert instruments of state intelligence operations and secret spies.

p. Organ trafficking family model

This model is extremely criminal and wholly unacceptable both legally and ethically. A married couple with their own children may adopt additional children from poor regions of the world. They then connect with criminal organizations and arrange for these adopted children to be abducted. Sometimes, they even report the abductions to the police after a delay to pose as victims. The criminal group murders the children, sells their organs, and shares a portion of the profits with the criminal stepfather and stepmother.

There are certainly other family models that are entirely criminal in nature or exist on the edge of what is socially acceptable. We will examine such forms in more detail in the next chapter on social dynamics, where we will also explore various types of criminal behavior.

In the following section, we will attempt to present fictional family models that could potentially better meet both individual criteria (e.g., greater comfort, positive emotional well-being, reduced negative stress) and collective criteria (e.g., improved economic performance, increased security, legal transparency, higher birth rates). In doing so, it will not be enough to simply design new hierarchical or associative family models—existing and newly proposed models will need to be assessed and evaluated based on both individual and collective standards.

3.3 Fictional family models

We will attempt to present fictional family models both descriptively and visually so that we can later evaluate and compare them using a complex matrix against the most successful family models found in technologically and socially advanced societies. Given the wide range of socially recognized sexual orientations, we can already assume that it is nearly impossible to list all potential fictional family models. Therefore, we will limit ourselves to a selection of the most interesting and potentially applicable ones.

We have come to understand that the concept of family is not only sociological in nature but also involves numerous individual, cognitive, and psychological dimensions. The family is of crucial importance not only for the survival of the human species but also for the maintenance and development of ethics and morality in a broader sense. Without positive ethics and morality, the human species would likely have gone extinct long ago. And even if it hadn't, it certainly would not have spread to the extent that it has. In this context, decadent anthropologists might describe ethics and morality as a “toxic seed.”

The human species has made numerous and serious mistakes over a relatively short historical period, but it would also be unfair to deny its many positive achievements. Therefore, it makes little sense to view humanity solely from a negative perspective. It is important that, despite our loyalty to our kind, we remain sufficiently critical—both in a positive and negative sense of the word.

Fictional family models are theoretical constructs without direct practical application. They represent a kind of formation or synthesis of various existing models that may, at first glance, seem more suitable, more rational, safer, or capable of producing a greater number of offspring. Until we have empirical data, the success of these fictional models can only be estimated, and it should be emphasized that such evaluations are purely theoretical and not grounded in reality.

The broader significance of the family lies in ensuring the survival of the human species, which appears to be a more compelling goal than many individual considerations. Recently, there has been considerable public debate surrounding same-sex families and their right to adopt children. Opinions on this issue have been highly polarized.

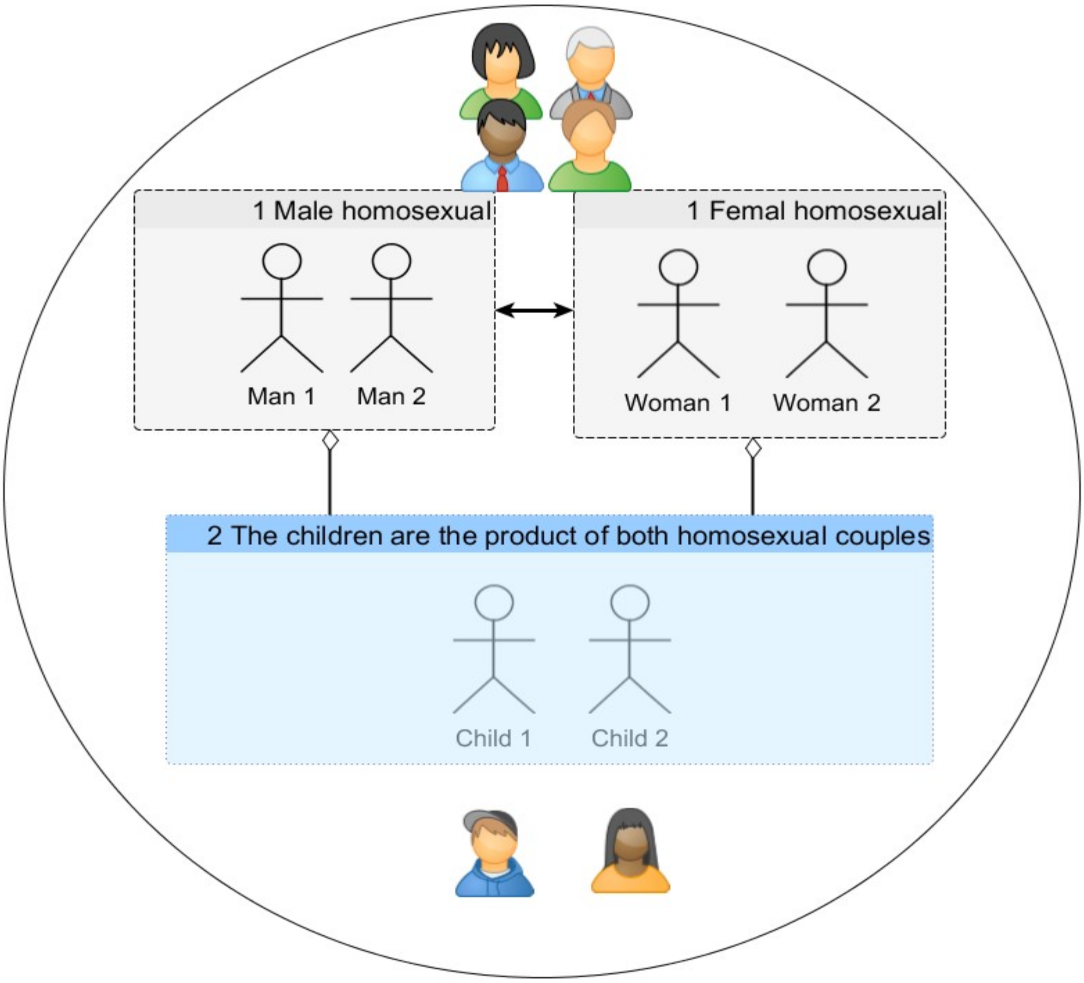
One perspective supports the nuclear family model as the most natural form, arguing that a child needs both a mother and a father for healthy development. Proponents of this model often refer to its historical success. The other perspective emphasizes human rights, asserting that same-sex individuals also have the right to marry and establish a family. The means of achieving this goal can vary (e.g., surrogacy, family units composed of two lesbians and two gay men living together), and are not necessarily dependent on legal recognition.

In essence, the law cannot prevent informal arrangements, such as a gay man and a lesbian woman living together and raising a child. Such a union can be seen as a non-marital partnership, which is legal and increasingly common. In short, the law cannot fully prevent the emergence of new family forms, meaning that same-sex couples do not necessarily need legal marriage to establish a family.

The key question is whether same-sex family models could be, in a broader context, equally or even more successful than the traditional nuclear family. An interesting trend in technologically and socially developed societies shows that many heterosexual couples choose not to marry formally and instead prefer to live in non-marital partnerships. Conversely, in many countries, same-sex couples are demanding the right to formal marriage, and the number of such marriages is steadily increasing.

Demands for family creation with children are also growing louder. In Slovenia, these demands have not yet been fulfilled, but this does not prevent same-sex couples from forming bonds and families. It seems that the development of a wide variety of family models is unstoppable and, from a broader social and natural perspective, may even be necessary for the survival of the human species.

3.3.1 Dual homosexual family model



3.3.1.1 Figure 70: Dual homosexual family model

Figure 70 illustrates a dual homosexual family model in which two gay men and two lesbian women live together with two children. The children are the result of a loving relationship between Gay Man 1 and Lesbian Woman 1, and Gay Man 2 and Lesbian Woman 2. At first glance, this model may seem quite complex or contradictory, but that is not the case—it is, in fact, a possible family structure. This model emerged out of the individual needs of those involved to have a family of their own.

When describing the advantages of this family model, we will consider the following assumptions:

a. Gay Man 1 and Lesbian Woman 1 are in a formal marriage. Likewise, Gay Man 2 and Lesbian Woman 2 are also formally married. Each couple has one child, and all live together in the same household—such as a large residential home.

b. All married couples are highly educated, adhere to strong ethical standards, and hold well-paying jobs, for example in public administration.

c. Each child has both a biological father and a biological mother.

d. The children are provided with favorable conditions, both materially and in terms of quality of life.

e. The children are always under supervision and are never left alone.

f. They receive high-quality upbringing with appropriate ethical and moral values.

g. The children are offered every opportunity for positive development, such as access to quality education.

h. All legal and formal matters are appropriately regulated.

i. The children experience a high level of safety and security.

Based on these assumptions, we can argue that such a family model could be superior to the nuclear family model, as the children benefit from favorable conditions that support their development into well-adjusted members of society and provide an excellent foundation for eventually building families of their own.

This raises questions such as: would the children choose a similar family model in the future? Or, could certain homosexual behavioral patterns be passed on to the children? It is difficult to provide definitive answers to these questions due to a lack of empirical data. However, based on the outlined assumptions and conditions, no serious concerns are apparent.

That said, under different circumstances, this same family model could present itself in a much more negative light. A possible negative scenario might include:

a. All parents are unemployed.

b. The parents have very low levels of education.

c. They lack strong ethical standards.

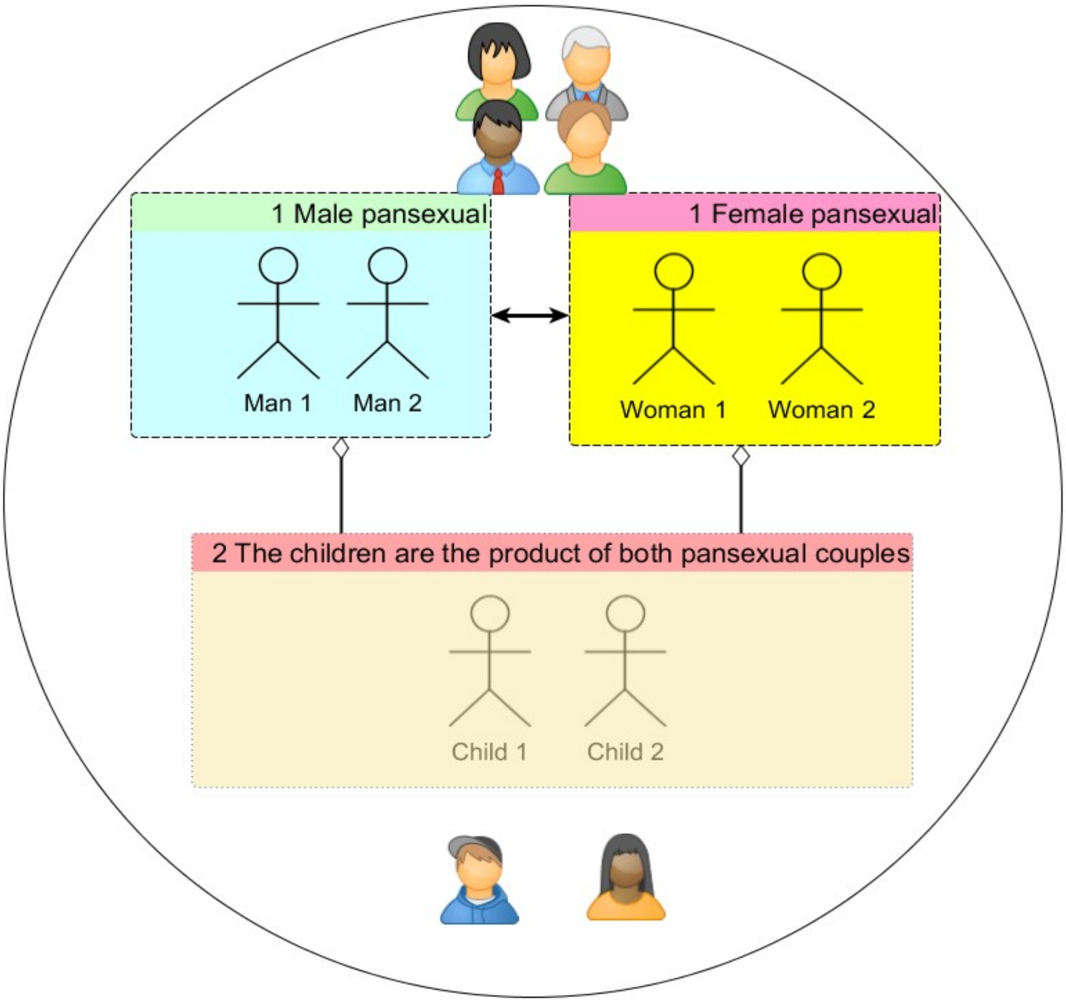
d. The children face stigma and social bullying at school due to having homosexual parents.

e. The parents neglect the children and focus primarily on changing sexual partners.

In such a negative scenario, this family model would be catastrophic and destructive for the children. It’s important to acknowledge that similar negative outcomes can also occur within the nuclear family model, for which there are statistical records (e.g., domestic violence or child sexual abuse).

In conclusion, this model merely presents a particular form or structure of family-based hierarchical and associative relationships. For this reason, we will evaluate the model based on the positive scenario described above. A similar approach will be used to assess the nuclear family model and other family types.

3.3.2 Pansexual model of family



3.3.2.1 Figure 71: Pansexual model of family

Figure 71 depicts the pansexual model of family. Pansexually oriented people are defined as individuals who cultivate romantic and emotional attachments to all people, regardless of gender identity. Because of this, they are often described as "gender-blind." These are people who are mostly open, warm, well-meaning, and sincere. Their outward appearance can vary greatly, as both male and female pansexuals express their unique style of clothing and makeup. It is sometimes difficult to determine which gender they belong to.

Given their openness and kindness, we could assume that a pansexual family network is quite extensive. The probability of it being composed of only a few actors, as shown in Figure 70, is lower. In this case as well, we will define some assumptions based on a positive scenario:

a. Male pansexual 1 and female pansexual 1 are in a non-marital relationship. Similarly, male pansexual 2 and female pansexual 2 are in a non-marital relationship. Both couples have one child each and do not live in the same household but are neighbors, for example, in an apartment building.

b. All couples have a high level of education, high ethical standards, and lucrative employment, for example, in a museum or schools.

c. The children have a biological father and a biological mother.

d. The children enjoy favorable living conditions from both a material and qualitative standpoint.

e. Someone is always watching both children, so they are never left to fend for themselves.

f. The children receive a quality upbringing with appropriate ethical and moral values.

g. The children have every opportunity for positive development, such as quality education.

h. Relationships within the family are not entirely formally legally regulated, but family members have no difficulty communicating and cooperating, especially when it comes to the well-being of the children.

i. The children are not raised in the spirit of strict gender identity, which could cause a certain degree of gender insensitivity. Their way of dressing is not entirely adapted to the surroundings.

j. The children enjoy a high level of security.

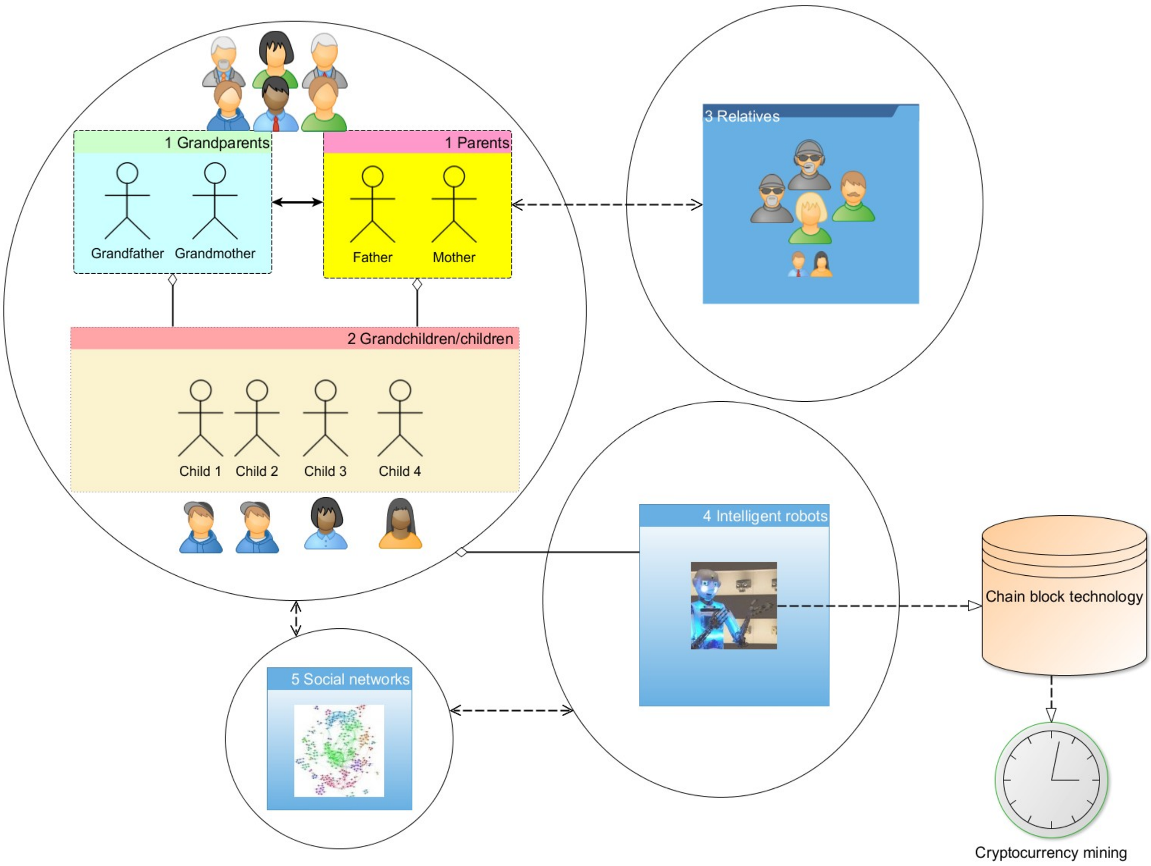
This family model seems strong. The only possible problem is that the children could be stigmatized, and not only because of their way of dressing but primarily because of the unclear expression of their gender identity. We know that children in kindergartens and elementary schools often have strongly divided gender roles – boys express themselves through playing with cars, strength, and skill, while girls mostly wear colorful skirts and play with dolls.

Nevertheless, in the last 45 years, we have observed a trend of decreasing distance between genders. Despite the supposedly weak point of this family model, we can argue that the pansexual model of family may have a bright future. Such a family model could become strongly established, especially if it meets individual and collective criteria and contributes to the emotional, social, and economic well-being of many pansexual families. This is essentially one of the fundamental missions of every family!

In the following section, we will focus on a family model that combines elements of the extended family model, artificial intelligence, and social networks. The question arises as to what the role of financial resources will be in the future. Much has already been written about e-money, including Bitcoin. Large farms for Bitcoin mining, supported by powerful information technology, are being built. Economists and sociologists predict that cash will gradually disappear and be replaced by other payment alternatives.

It is precisely the future of money that could be linked to the formation of a new family model, with which sociologists, politicians, lawyers, and economists have no experience yet. A completely new quality could develop, which would be subject to new monetary policies and legal regulations.

3.3.3 Extended family model with intelligent robots and social networks



3.3.3.1 Figure 72: Extended family model supported by social networks and intelligent robots

Figure 72 depicts the extended family model supported by social networks and intelligent robots that mine for e-money or Bitcoins using blockchain technology. At first glance, this family model seems extremely strong, as in addition to strong membership support (e.g., relatives and social networks), it should also provide a financial background for the family's existence (intelligent robots that mine for e-money). In the past, we have already experienced technological inventions helping to change the nature of the family (see the first industrial revolution and the rise of the bourgeois form of the nuclear family, especially after the French Revolution). Intelligent robots will in any case be an important factor both for mining e-money and for supporting the upbringing and education of children. Quality social networks are known for containing much useful knowledge and can be extremely beneficial to someone. Unfortunately, dangers also lurk behind social networks, most notably in the form of social mobbing, identity theft, and the destruction of informational privacy. Similar to the two previous fictional family models, we will define some assumptions in this case as well, leaning towards a positive scenario:

a. Grandparents and parents care for the offspring. Other relatives such as aunts, uncles, cousins, etc., are also available as additional support.

b. All adult family members/couples have a high level of education, high ethical standards, and lucrative employment, e.g., in public administration, self-employment, and pensions.

c. The children have a biological father and a biological mother.

d. The children essentially have a favorable starting point from both a material and qualitative level.

e. Someone can always watch all the children, so they are never left to fend for themselves.

f. The children can receive a solid upbringing with appropriate ethics and morals.

g. The children will have every opportunity for positive development, e.g., education.

h. Relationships are entirely formally legally regulated, and family members have no difficulty communicating and cooperating, especially when it comes to the well-being of all children.

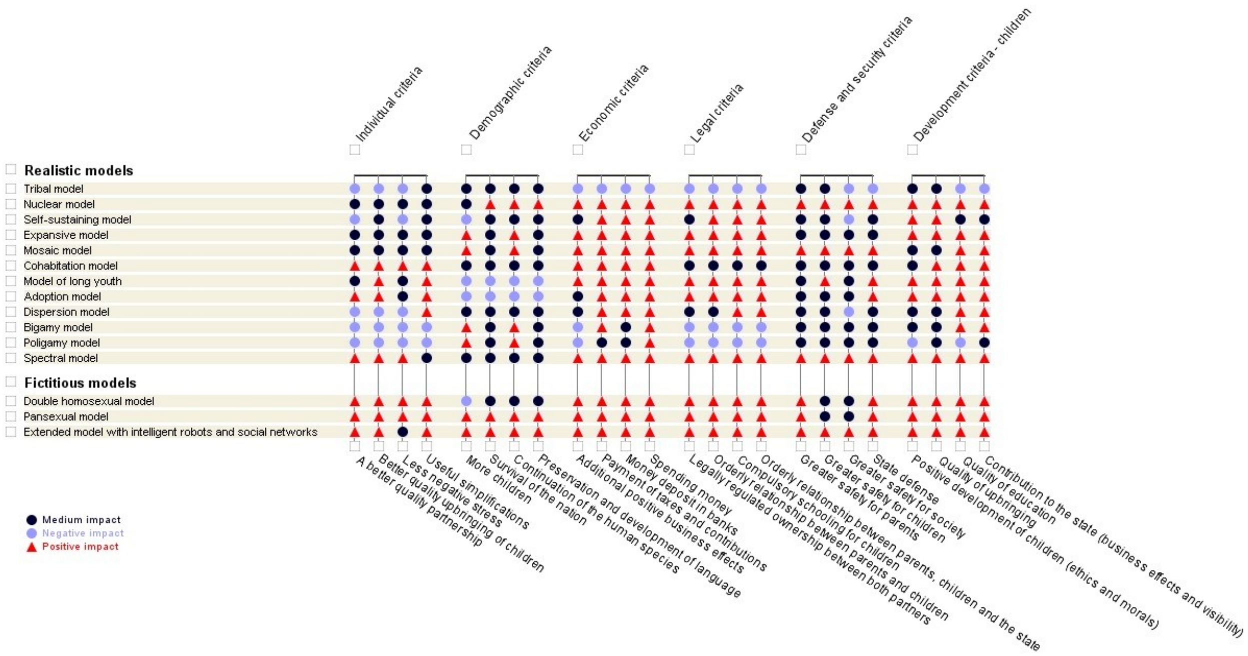
i. The children also receive additional support in upbringing and further education (e.g., social networks, intelligent humanoid robots).

j. The children enjoy a high level of security.

Could the family model under consideration be the family of the future? Nevertheless, it is necessary to highlight the weak point of this model, which is that it involves a large number of family and other members, which can break down quite quickly (e.g., internal disputes, death of grandparents, greed, envy).

Undoubtedly, many other fictional family models could be formed that might leave a strong mark on social realities in the future. In this section, we will be satisfied with the three described, so that we can proceed to evaluate known and fictional family models using a complex matrix. The shortlist for evaluating family models will include:

tribal family model, nuclear family model, single-parent family model, extended family model, mosaic family model, cohabitation family model, model of the family of prolonged youth, family model with adopted children, dispersed family model, bigamy family model, polygamy family model, rainbow family model, dual homosexual family model, pansexual family model, and extended family model supported by social networks and intelligent robots. We will evaluate the 15 selected family models based on individual (e.g., quality partnership, better development for the child), demographic, economic-financial, legal, defense-security, and developmental criteria (with an emphasis on the positive development of children). The evaluation will also need to consider various developmental social trends, from socialization and technology to democratization, potential changes in pension reforms, etc.



3.3.4 Figure 73: Evaluation of 15 family models

Figure 73 shows a complex matrix for the evaluation of 15 family models, which are divided into two groups: real or existing models (tribal model, nuclear model, single-parent model, expansive or extended model, mosaic model, cohabitation model, prolonged youth model, child adoption model, dispersed model, bigamy, polygamy, spectral or rainbow model) and fictional models (dual homosexual model, pansexual model, extended family model with intelligent robots and social networks). Family models are evaluated based on criteria (individual, demographic, economic, legal, defense-security, and developmental criteria with an emphasis on child development) and characteristics (for example, higher quality partner relationships, a larger number of children, additional business effects, regulated ownership relations, defense of the state, positive child development in terms of ethics and morals). The evaluation is based on three categories of impact: positive (marked with a red triangle, worth five points), medium (marked with a black circle, worth three points), and negative (marked with a purple circle, worth zero points).

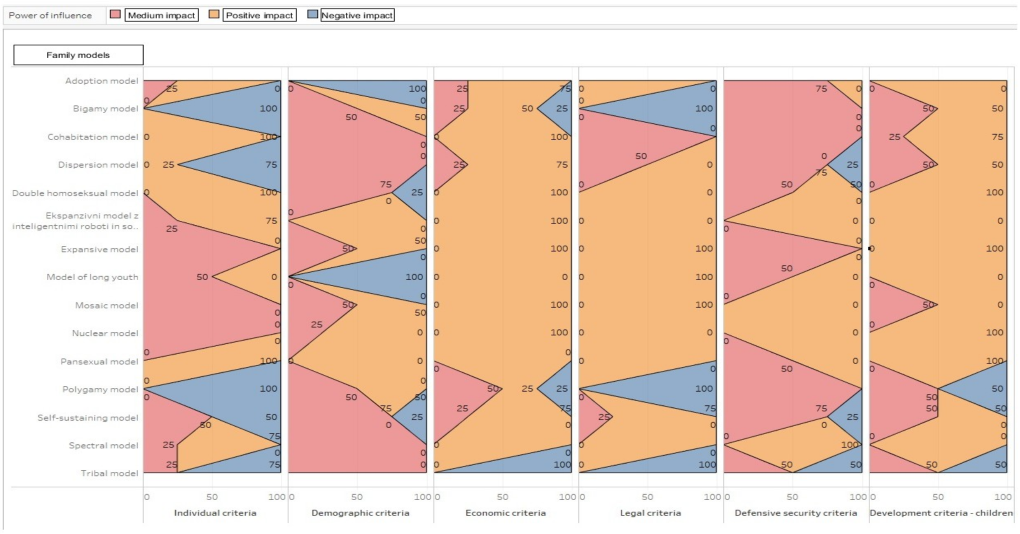
The matrix shows that the models from the fictional group, in particular, are rated very positively (for example, the extended family model with intelligent robots and social networks). The lowest rated is the tribal family model, which has almost disappeared in technologically and socially more developed countries, while it still appears in more remote parts of the world.

The successful nuclear family model achieved somewhat lower scores in individual criteria, as certain groups of people (e.g., same-sex oriented individuals or partners who do not want to enter into a formal marriage) believe that the nuclear model is too exclusive of certain social groups. In addition, relationships within this model can be more complex.

The data from the matrix were then exported to Excel and analyzed with Tableau software. A small portion of the prepared data is presented in the following table.

3.3.5 Table 71: Part of the data on evaluated family models in percentages

Family models	*Impact*	*Individual criteria*	*Demographic criteria*	*Economic criteria*	*Legal Criteria*	*Defense-security criteria*	*Developmental criteria - children*
Tribal	Medium	25	100	0	0	50	50
Tribal	Negative	75	0	100	100	50	50
Tribal	Pozitive	0	0	0	0	0	0
Nuclear	Medium	100	25	0	0	0	0



3.3.5.1 Figure 74: Surface diagram of the evaluated family models

Table 71 presents part of the data on the evaluation of family models in percentages, while Figure 74 illustrates a surface diagram comparing family models based on individual, demographic, economic, legal, defense-security, and developmental criteria.

Negative impacts of family models are marked in blue, moderate impacts in red, and positive impacts in yellow.

Figure 74 clearly shows that fictional family models do not exhibit negative effects on the criteria mentioned—individual, demographic, economic, legal, defense-security, and developmental. The nuclear family model, which is also highly rated, stands out particularly in the economic, legal, defense-security, and developmental criteria. However, its ratings are somewhat lower in the individual and demographic areas, as in more technologically and socially developed countries, partners often choose to have fewer children, which affects the demographic aspect.

The question of which family model will dominate in the future remains complex. The answer is closely tied to various social and natural factors such as policy (monetary, family, labor, healthcare), reforms (pension, social, healthcare, employment), technology (development of cryptocurrencies, legal regulation of intelligent robots, energy acquisition, communication), climate change, tectonic shifts, and natural disasters.

Certain family models will continue to play a role in the future. The nuclear family model, cohabiting unions, blended family model, and rainbow families are likely to remain present. The dominance of a particular model in technologically and socially advanced societies will depend on key criteria: economic, financial, legal, defense-security, demographic, developmental (with emphasis on children), and individual aspects.

For a family model to become dominant, it will need to ensure conditions such as having a sufficient number of children, legally regulated relationships, financial stability, contribution to national defense, and optimal child development—ethically, morally, and educationally. Additionally, the model must provide comfort and meet the individual needs of family members. Few would choose a family model that is legally complicated, financially unsustainable, and causes negative stress.

Future generations will make their decisions based on these factors, while governments will examine whether a given model meets criteria such as profitability and legal simplicity (e.g., in terms of inheritance and property relations). Analyses show that a fictional extended family model incorporating intelligent robots and social networks currently receives the highest ratings. However, the adoption of this model depends on numerous conditions and circumstances that have yet to be met.

1. Politics in the future

The role of politics will be crucial in shaping future family models. This includes the development of monetary policy, employment strategies, pension reform, the education system, legislation (including international law), and the provision of free healthcare.

The pension system will require reform, as the current system—based on employer and employee contributions—will become unsustainable due to the growing number of retirees and the shrinking workforce. Potential additional sources of funding may include contributions from gambling revenues or sponsorship investments. There is also ongoing discussion about introducing a universal basic income, which would ensure basic financial security for everyone.

The rapid development of humanoid robots will also impact employment, as robots will be able to perform many routine tasks more efficiently than humans. This will lead to shifts in the labor market and increase the importance of free healthcare as a basic right of citizens.

Future policies will need to adequately respond to these challenges while avoiding the risks associated with the misuse of advanced technologies, such as mass surveillance and authoritarian systems. Acquiring new energy sources will also be crucial for continued technological and social development.

a. Cash in the future

Economists predict that cash transactions will become increasingly rare. In Sweden, the use of banknotes and coins has already been heavily restricted, with consumers relying primarily on mobile and electronic payment methods. Some large-denomination banknotes, such as the 500 and 200 euro notes, have already been removed from circulation.

Some monetary policy experts believe that cryptocurrencies could become a standard method of payment in the future, but only if legal and banking regulations support this—which is not yet the case. Much attention is given to Bitcoin, which has been around since 2009, but its highly volatile value presents a significant risk, especially for serious investors. While some economists believe that cash will never disappear entirely, it is unlikely to remain the primary medium of exchange.

If cryptocurrencies—led by Bitcoin—become the main means of payment for goods and services, the extended family model involving intelligent robots and social networks could emerge as a key family structure of the future. Humanoid intelligent robots, as part of the family, could mine cryptocurrencies and thereby provide for the household. However, this raises the question of how to treat intelligent robots from both legal and ethical perspectives. Although robots are machines, technological advancements may make them similar to or even cognitively superior to humans, potentially elevating their status to that of family members in such a model.

b. The status and role of intelligent and humanoid robots in the future

If future legislation grants intelligent robots the status of family members, they could gain not only responsibilities but also rights. They might assist in the upbringing and education of children, and enable family survival through cryptocurrency mining, possibly becoming the main earners in the household.

This raises concerns about the quality and performance of humanoid robots. Will all families adopting this model receive robots of the same standard, or will some families be privileged? Such disparities could significantly impact social and economic equality.

c. Food consumption in the future

The issue of food consumption, especially in technologically and socially advanced societies, is crucial. It is anticipated that insects may become a primary food source. If so, the market would shift significantly—slaughterhouses would be replaced by farms for the mass production of various insect species.

d. Human migration in the future

Massive migration waves are expected in the future, particularly from the African continent. These movements will present major challenges in economic, legal, and social areas. Addressing them will require comprehensive and sustainable measures.

2. Natural trends in the future

a. Climate change

Continued ozone layer depletion is expected in the future, which will lead to higher temperatures on Earth. This will affect humans, animals, and plant life, potentially resulting in the extinction of many species. Climate change is also likely to trigger migrations of both people and animals from less favorable regions.

b. Tectonic plate shifts

Future tectonic movements will be difficult to predict, but the natural disasters they may cause represent a serious threat. Large-scale migration from affected areas could lead to overpopulation in safer regions, resulting in further societal challenges.

These scenarios cover only a few potential aspects of the future (e.g., they do not address asteroids or armed conflicts that could arise under adverse conditions). The structure of the family will be crucial for the survival of the human species and society as a whole. The nuclear family model is unlikely to be sufficient for humanity's long-term survival.

The extended family model, incorporating intelligent robots and social networks, could play a key role in ensuring the sustainability and survival of humanity in the future.

Without ethics, morality, and values, socially advanced societies cannot exist or function effectively. This raises the question: what defines a positively oriented family? An evaluation of the positive characteristics of a family will be conducted later—similar to how individuals are evaluated—based on its contribution to the well-being of its own members, fellow humans, society, and the natural environment.

3.4 Brief Overview of ethics and morality

Ethics is a branch of philosophy that deals with questions of good and evil and examines positive decision-making. It focuses on the study of human behavior—both positive and negative. In more contemporary philosophical views, morality is considered a subordinate category of ethics and represents a specific normative system, primarily concerned with correct and reasonable conduct. Essentially, it provides practical guidelines for behavior.

Ethics is divided into three main branches:

- Metaethics, which examines the status and meaning of moral expressions and judgments;

- Normative ethics, which explores what kinds of moral systems people *ought* to adopt; and

- Descriptive ethics, which studies the moral systems people *actually* follow.

Ethics also has an interdisciplinary character, appearing across various sciences (e.g., theology, research ethics, sociology, psychology, medicine) and professional fields (e.g., medical ethics, police ethics, managerial ethics, commercial ethics).

Ethics, morality, and values are essentially constructs that have proven useful and successful in human development. They act as frameworks for thinking and behavior, forming the foundation for social cohesion and cooperation. These are collective guidelines that direct individuals and families. However, despite their collective nature, families often differ in how they understand and represent normative systems. These differences are not primarily due to ethics or morality themselves, but rather to the values that parents emphasize and prioritize.[34] Some of these values were already introduced in the chapter on symbols, where we discussed symbolic categories such as freedom, wealth, life, happiness, love, power, hope, peace, technology, eroticism, diligence, health, and beauty. There are many more values, and different parents assign different levels of importance to them, which is why child-rearing practices can vary significantly. When parents place the highest importance on values like power and wealth, this is reflected in the mindset of their children. The strength of such influence is difficult to override later through schooling or collective upbringing, especially because it is well known that children, particularly in their early developmental stages, tend to adopt the thinking patterns and behaviors of their parents.

34 Liste aller Werte dostopno na URL: https://www.wertesysteme.de/alle-werte-definitionen/ (2019-02-23).

These value-based emphases are numerous and diverse. Parents assign different weights to various values—for example, love may be considered less important than wealth. From a hierarchical associative perspective, this means that one could construct many different parental models or value networks, each with different major, moderate, or minor emphases. The Ten Commandments, for instance, can also be viewed as ethical or moral norms, as they represent a set of organized guidelines that individuals within structured communities are expected to follow.

1. Believe in one God!

Many people do not believe in God, but instead believe in something else (e.g., an ideology) or in nothing at all. This commandment directs believers toward monotheism. However, it is known that other belief systems exist (e.g., polytheism). From an ethical or moral standpoint, believing in God is a matter of free choice. What's important is that belief—whatever form it takes—is directed toward something positive for the individual, the family, society, and the natural world.

2. Do not take the name of God in vain!

From an ethical or moral point of view, especially for believers, this commandment is an obligation. Dishonoring one's own faith also diminishes one's self-worth. Even for non-believers, this commandment holds value—if something represents a positive idea, it is wrong not to respect it, even if one does not believe in God.

3. Keep the Lord's day holy!

This commandment is particularly relevant to those who are religious. For non-believers, it is a matter of personal choice, but even so, they can maintain a respectful attitude toward the day.

4. Honor your father and mother!

This commandment can be considered inherently right, since disrespecting one's roots can weaken one's sense of identity, which in turn harms the self.

5. Do not kill!

The commandment "Do not kill" is among the most important, as taking another's life is neither meaningful nor positive. It leads to personal and societal tragedies.

6. Do not commit adultery!

This commandment provides a sense of direction, helping individuals maintain inner balance and integrity.

7. Do not steal!

Stealing harms others, undermines trust, and damages positive social connections.

8. Do not bear false witness!

Honesty is a sign of inner strength and uprightness. Trust is vital to healthy relationships, and false testimony weakens trust and destroys social harmony.

9. Do not covet your neighbor's wife!

This commandment is crucial for the stability of social communities. Emotional and existential bonds between two people must be respected, as doing so makes life simpler and more fulfilling.

10. Do not covet your neighbor's goods!

Desiring someone else's possessions leads to dissatisfaction, which negatively affects relationships between people.

How closely people adhere to these commandments largely depends on their mental health and the values they prioritize—whether those values are given high, moderate, or low importance. For example, in cases where there is an excessive desire for wealth, there is a high probability that individuals—or parents—may break some of these commandments, potentially leading to negative and complex consequences. The next section will provide an analysis of values from the parental perspective.

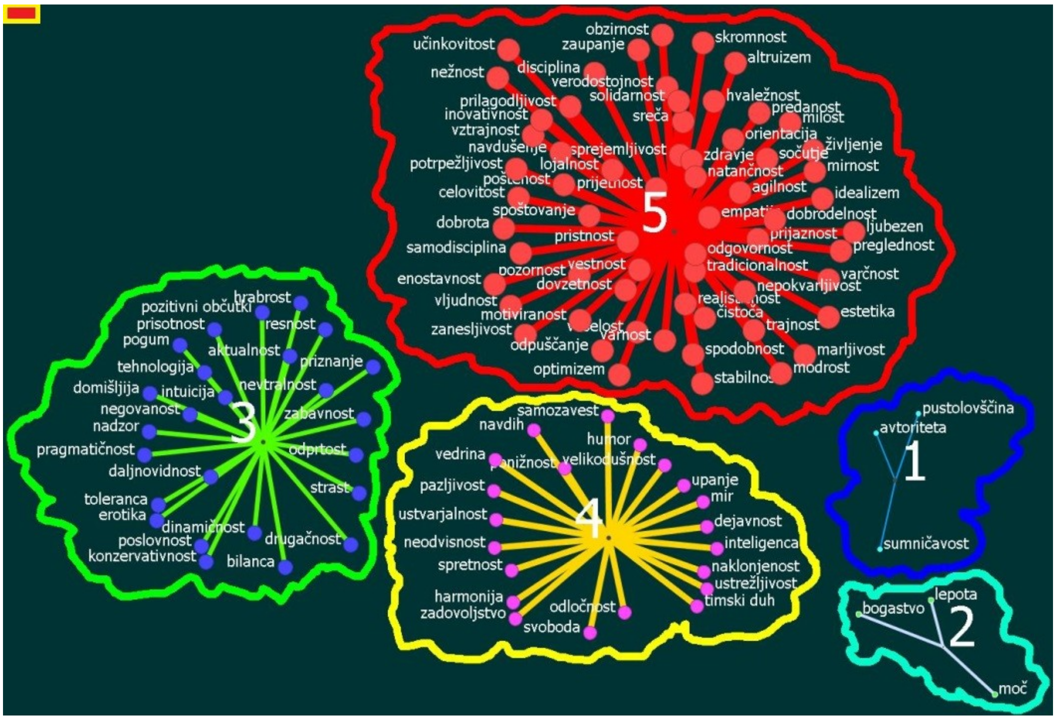
3.4.1 Table 72: A small part of the data regarding the assessment of values from the perspective of parents

Values	S1	S2	S3	S4	S5
life	5	5	5	5	4
luck	5	4	3	4	4
love	5	5	2	3	3
adventure	1	5	4	3	2
wealth	2	5	3	1	5
power	2	3	3	2	5
attention	5	4	5	5	2

Table 72 presents a small portion of the data on the evaluation of 115 values from the perspective of five parental couples. For greater clarity, network visualizations of the ratings—from one (lowest rating) to five (highest rating)—will be shown in the following sections.

3.4.1.1 Parental couple 1

A network visualization of values will be presented based on the ratings given by the first parental couple, who evaluated the importance of 115 values using a scale from one to five.



3.4.1.2 Figure 75: Network visualization of ratings by parental couple 1 based on 115 values

Figure 75 presents a network visualization of the ratings given by the first parental couple with respect to 115 values.[35] The two individuals rated values such as love, dedication, forgiveness, responsibility, consideration, trust, patience, and politeness with the highest score (see the red cloud). With a score of four, they rated values such as cheerfulness, attentiveness, creativity, affection, harmony, generosity, and contentment (see the yellow cloud). A score of three was given to values like imagination, grooming, pragmatism, courage, playfulness, professionalism, eroticism, and control (see the green cloud). The two individuals rated three values—wealth, beauty, and power—with a score of two (see the turquoise-green cloud). Finally, the lowest rating of one was given to authority, adventure, and suspicion (see the blue cloud).

In summary, the couple clearly prioritizes internalized and non-materialistic values. This emphasis can be a strong influence in raising children, who would likely be educated according to such principles. The next section presents the ratings of the second parental couple.

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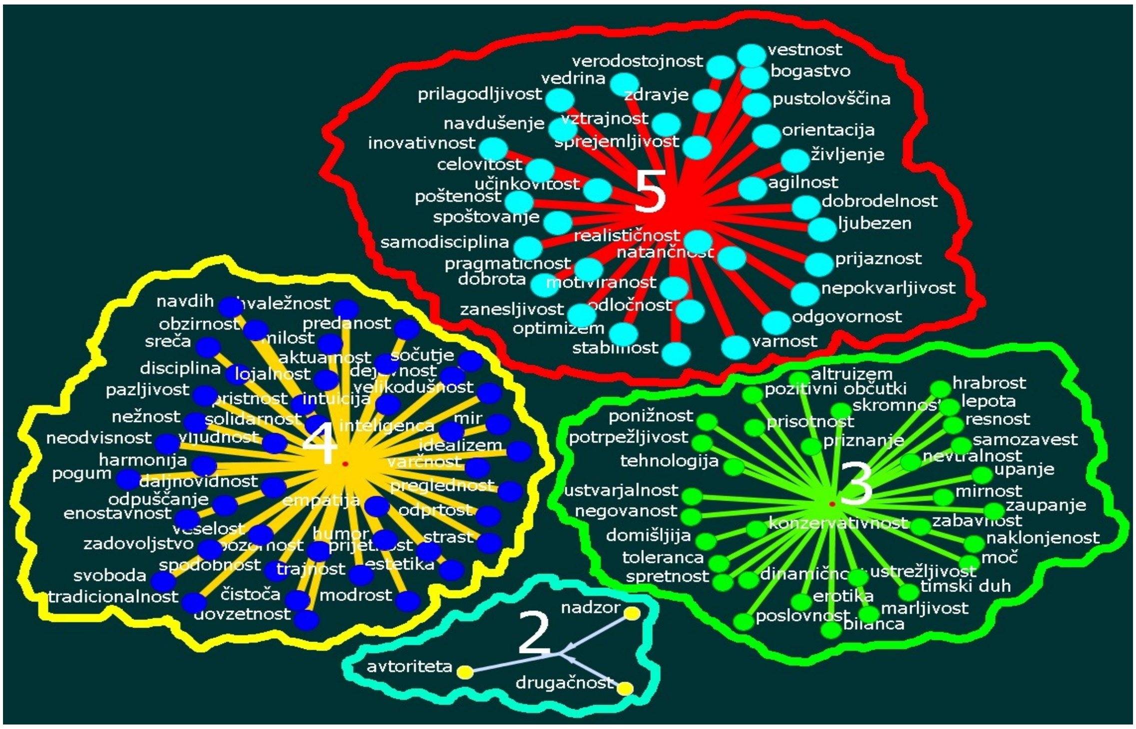
35 Network visualization: the assessment was carried out with the ORA Casos software tool

3.4.1.3 Parental couple 2

In this case as well, a network visualization of values will be presented based on the ratings given by the second parental couple, who evaluated the importance of 115 values using a scale from one to five. The same rating scale applies, with one being the lowest score and five the highest.



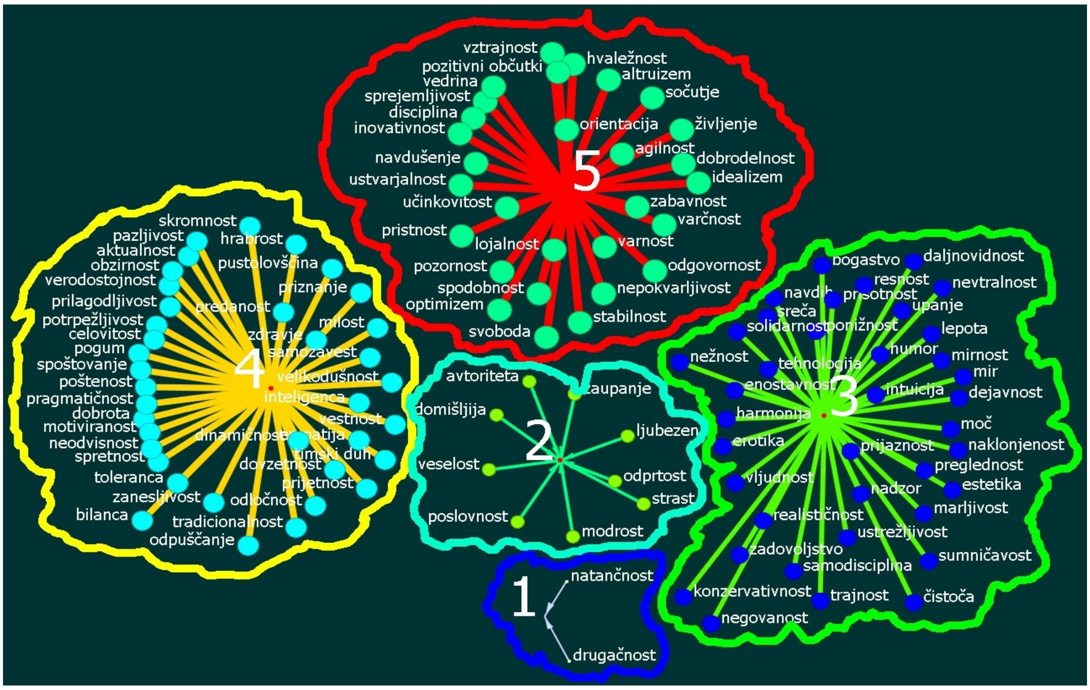
3.4.1.4 Figure 76: Network visualization of parental couple 2 ratings based on 115 values

Figure 76 illustrates the network visualization of the ratings given by parental couple 2 concerning 115 values. It can be observed that there are notable differences compared to the previous parental couple. The analyzed pair rated values such as wealth and adventure with the highest possible score. Additionally, they included values like love, kindness, integrity, goodness, life, agility, stability, responsibility, security, and innovation among others in their top-rated category (see the red cloud).

Values such as gratitude, consideration, courage, intelligence, generosity, wisdom, compassion, humor, cleanliness, politeness, gentleness, and solidarity were rated with a score of four (see the yellow cloud). Following this, values rated with a score of three include self-confidence, seriousness, creativity, neatness, imagination, trust, and altruism (see the green cloud). With a score of two, the pair evaluated three values: authority, control, and uniqueness (see the turquoise-green cloud). Notably, no value was assigned the lowest possible score of one.

3.4.1.5 Parental couple 3

The following are the results of parental couple 3, who evaluated the corpus of 115 values using the same rating scale.



3.4.1.6 Figure 77: Network visualization of parental couple 3 ratings based on 115 values

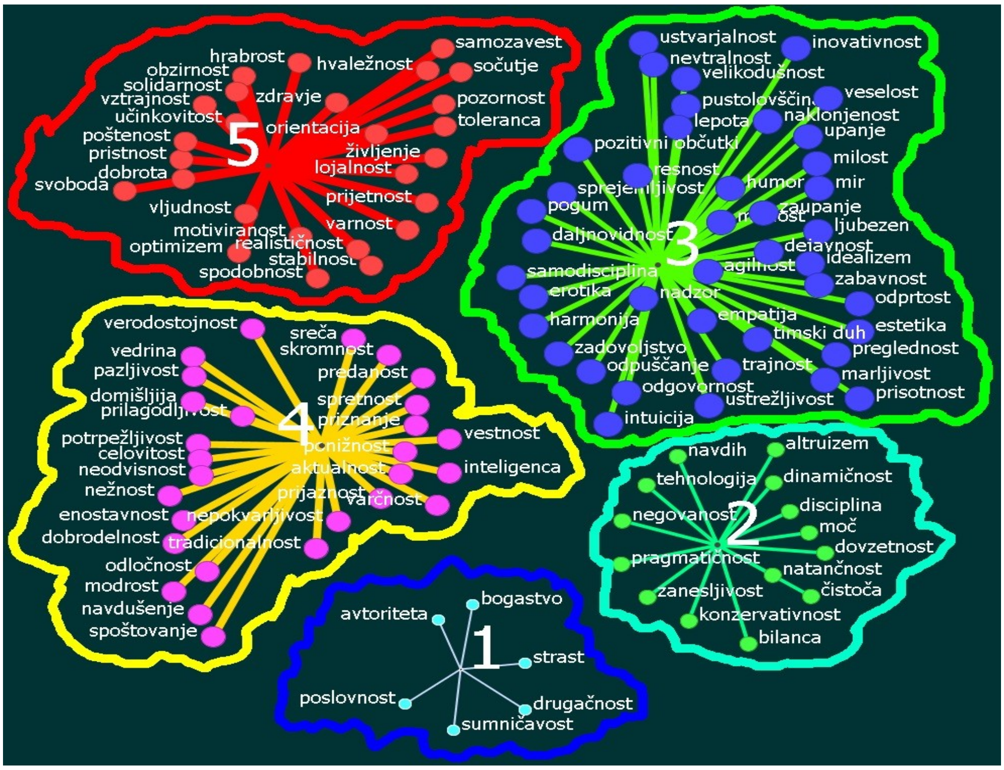
Figure 77 presents the network visualization of parental couple 3's ratings based on 115 values. Upon reviewing the results, it is immediately noticeable that the value love did not receive the highest possible rating. The top score of five was assigned to values such as discipline, fun, frugality, responsibility, attentiveness, loyalty, optimism, decency, freedom, integrity, and others (see the red cloud).

Values rated with a score of four include dedication, team spirit, pleasantness, determination, dynamism, reliability, traditionalism, tolerance, forgiveness, and more (see the yellow cloud). A score of three was given to values such as humility, solidarity, kindness, eroticism, helpfulness, suspicion, aesthetics, strength, beauty, calmness, politeness, control, conservatism, sustainability, harmony, transparency, neatness, and others (see the green cloud).

Values rated with a score of two include authority, imagination, trust, love, openness, passion, business-mindedness, wisdom, and cheerfulness (see the turquoise-green cloud). The lowest score of one was assigned to values such as precision and uniqueness (see the blue cloud). For parental couple 3, it is evident that they rated a larger number of values with lower scores, such as two and one.

3.4.1.7 Parental couple 4

We continue with parental couple 4, emphasizing that they evaluated the 115 values based on the same rating scale (from 1 to 5).



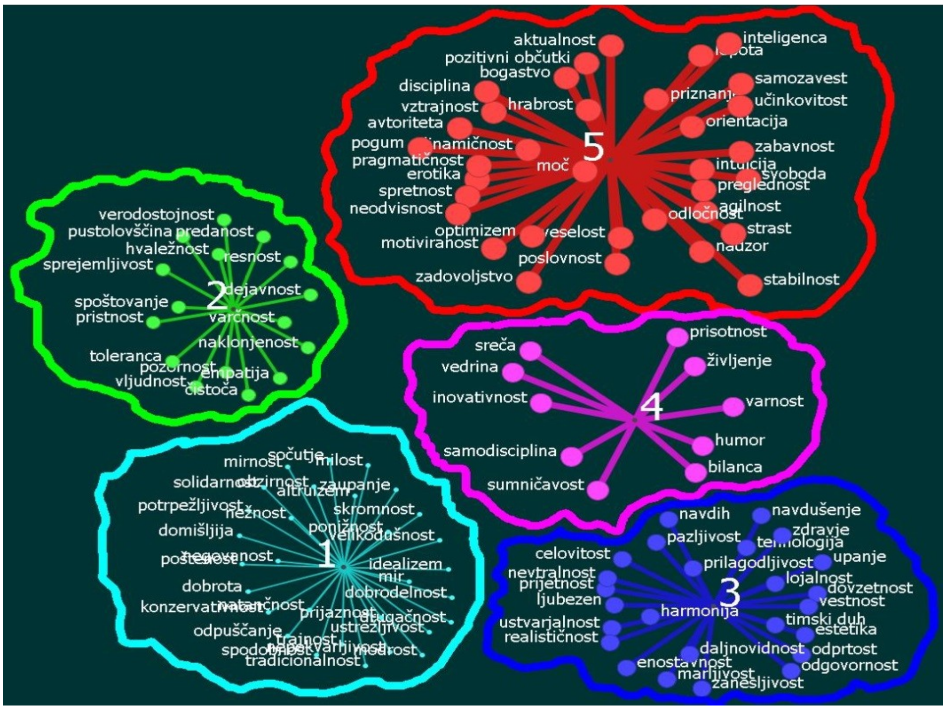
3.4.1.8 Figure 78: Network visualization of parental couple 4 ratings based on 115 values

Figure 78 shows the network visualization of parental couple 4's ratings based on 115 values. The highest possible score was given to values such as optimism, motivation, decency, goodness, stability, realism, honesty, compassion, attentiveness, self-confidence, orientation, consideration, and solidarity (see the red cloud).

Values rated with a score of four include cheerfulness, cautiousness, imagination, traditionalism, humility, determination, wisdom, enthusiasm, respect, wholeness, independence, intelligence, frugality, and conscientiousness, among others (see the yellow cloud). Values rated with a score of three include intuition, harmony, empathy, control, satisfaction, aesthetics, love, fun, diligence, team spirit, idealism, and trust, among others (see the green cloud). A large number of values were rated with a low score of two, including altruism, inspiration, technology, neatness, discipline, pragmatism, and precision, among others (see the turquoise-green cloud). The lowest possible score was assigned to values such as wealth, authority, passion, business-mindedness, suspicion, and uniqueness (see the blue cloud). It is noticeable that this parental couple also assigned a larger number of low scores to certain values.

3.4.1.9 Parental couple 5

Finally, we have the results of parental couple 5, who also used the same rating scale (from 1 to 5).



3.4.1.9.1 Figure 79: Network visualization of parental couple 5 ratings based on 115 values

Figure 79 presents the network visualization of parental couple 5's ratings based on 115 values. It is immediately apparent that the assigned ratings for values differ most significantly from all previously discussed couples. Prominent values include cheerfulness, satisfaction, motivation, business-mindedness, determination, eroticism, courage, stability, transparency, authority, wealth, and positive feelings, among others (see the red cloud).

Values rated with a score of four include innovation, security, self-discipline, suspicion, humor, balance, cheerfulness, happiness, presence, and life (see the purple cloud). A score of three was given to values such as inspiration, team spirit, foresight, harmony, creativity, and diligence, among others (see the blue cloud).

The largest number of values from all previously discussed parental couples were rated with a score of two (see the green cloud). Similarly, this also applies to values rated with a score of one (see the light blue cloud). If parental couple 1 was found to prioritize values that are intrinsic and non-materialistic, parental couple 5 can be said to prioritize materialistic and hedonistic values. Essentially, parental couple 5 can be considered the diametric opposite of parental couple 1. The subsequent section will present an experiential study on family and values, focusing particularly on the interpretation of family and values.

3.5 Study on family and values

This study addresses a theme already encountered in previous subchapters. On one hand, it will present the significance and future development of the family, and on the other hand, the values that, according to 428 survey respondents, are most closely associated with the family.[36]

3.5.1 Objective of the study

The study aims to examine the hierarchical and associative connections between family and values, particularly by demonstrating that the family, together with values, forms hierarchical associative networks that possess significant informational power in various decision-making processes. Within this framework, the values will be precisely defined, with some representing symbolic categories. Values are classified in the informational hierarchy, similar to symbolic categories and consequently symbols, as concepts. There are both strong and weaker connections between values and symbolic categories. We also know that certain symbols can represent values. At the conclusion of the study, the perspectives of 428 survey respondents on the future development of the family will also be analyzed.

3.5.1.2 Research hypotheses

1. The priority list of values important for the family varies significantly or very significantly based on gender, age groups, education, and marital status.

2. The priority list of values important for the family is relatively or very similar based on gender, age groups, education, and marital status.

3. The future development of the family will proceed in a distinctly negative direction.

4. The future development of the family will proceed in a distinctly positive direction.

5. The future development of the family will not differ significantly from the current state.

6. The family and values together form hierarchical associative networks.

3.5.1.3 Research questions

1. What significance does the family hold according to the respondents?

2. Are respondents familiar with different family models?

3. Why, in the respondents' opinion, can child-rearing vary significantly?

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36 Petrič, K. (2023). Hierarchical associative networks of family and values. *European Review Of Applied Sociology*, 16(27), 1–16. https://doi.org/10.2478/eras-2023-0006.

4. Which values did respondents rate with the highest and lowest scores?

5. Which values do respondents consider most important for the family?

6. How do respondents predict the future development of the family?

7. Do the priority lists of values important for the family differ by demographic groups (e.g., gender, age, marital status, education)?

8. Are the priority lists of values important for the family similar by demographic groups (e.g., gender, age, marital status, education)?

9. Can the family, in connection with values, form a hierarchical associative network?

3.5.2 Methodology

The research sample included public servants and scientists from various ministries, faculties, schools, libraries, institutes, and scientific social networks (sample size is 428 obtained and usable respondents).

3.5.2.1 Tools

To test the appropriateness of the hypotheses, an online survey questionnaire was used.[37] Various software tools for pattern discovery were used in the data analysis.

3.5.2.2 Procedure

An email notification about the survey questionnaire was sent to various ministries, faculties, schools, institutes, and other institutions, resulting in 929 responses. Of these respondents, 664 started the questionnaire, but 236 completed only part of it. The final analysis included data from 428 public employees and scientists whose responses were considered complete and usable.

The survey was administered using the online survey tool Enklik. The study primarily involved educated participants (ranging from university graduates to individuals with master's degrees and doctorates) from the regions of Ljubljana, Maribor, Koper, and Celje.

Data collection proceeded as follows:

a. Data were collected on gender, age, partnership status, education level, and current status.

b. Respondents' opinions on the importance of family were gathered.

37 1KA (Verzija 17.05.02) [Software]. (2017). Ljubljana: Fakulteta za družbene vede. Available online: https://www.1ka.si (2020-10-03).

c. Data on familiarity with different family models were collected.

d. Opinions were gathered on why child-rearing practices often differ.

e. Data were collected on how respondents rate values such as peace, love, and courage.

f. Opinions were gathered on values considered important for the family.

g. Respondents' perspectives on the future development of the family were collected.

Data concerning values important for the family were classified using the same scheme as the symbols [Note: The meaning of "symbols" depends on context not provided here]. Sentiment analysis was employed to analyze the perspectives on the future development of the family.

3.6 Statistical data analysis and interpretation

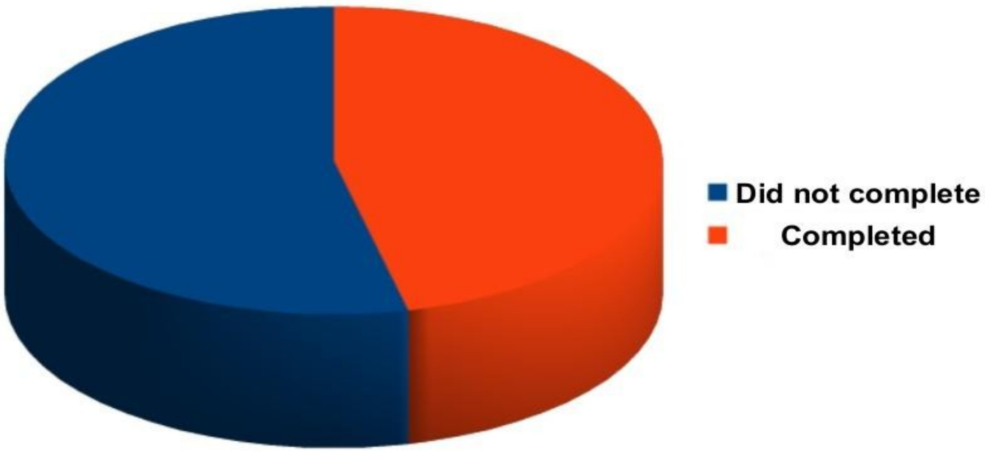
In addition to respondents' demographic data, the online survey tool also made it possible to collect data on their technological equipment; this information will be presented among the introductory findings [or introductory highlights].

3.6.1 Introductory highlights

Most respondents accessed the online survey questionnaire using a computer (604 accesses), followed by a mobile phone (56 accesses) and a tablet (4 accesses). All respondents, except for two, had JavaScript enabled. The most commonly used browser was Google Chrome (285 accesses), followed by Firefox (158), Internet Explorer (100), Edge (52), Safari (35), Android WebView (2), and others (31). Among operating systems, Windows 10 was the most frequently used (372 accesses), followed by Windows 7 (128), Windows 8 (35), macOS (30), iOS (24), Android (24), Linux (15), Windows 32 (3), Windows Vista (1), and others (32). Technologically speaking, the respondents use modern equipment.

3.6.1.1 Table 73: Number and percentage of visitors/respondents

	Number of visitors	Percentage (%)
Did not complete	501	53,93
Completed	428	46,07
Total	929	100

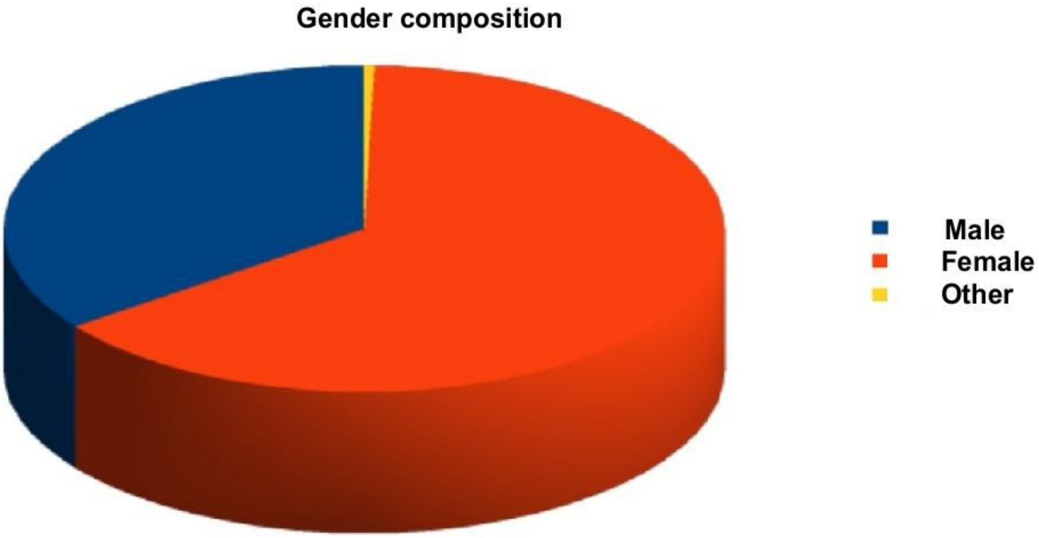


3.6.1.2 Figure 80: Number of visitors/respondents to the online survey questionnaire

Table 73 and Figure 80 show the number of visitors or respondents to the online survey questionnaire. Out of a total of 929 visitors to the online survey on family and values, 428 or 46.07% (data as of April 14, 2019) completed the questionnaire in full. The average time taken to complete the survey was four minutes and 43 seconds. The highest number of completed questionnaires (144) was recorded on March 12, 2019.

3.6.1.3 Table 74: Gender composition

Responses	Frequency	Percentage
1 (Male)	149	34,81
2 (Female)	277	64,72
3 (Other)	2	0,47
Total	428	100

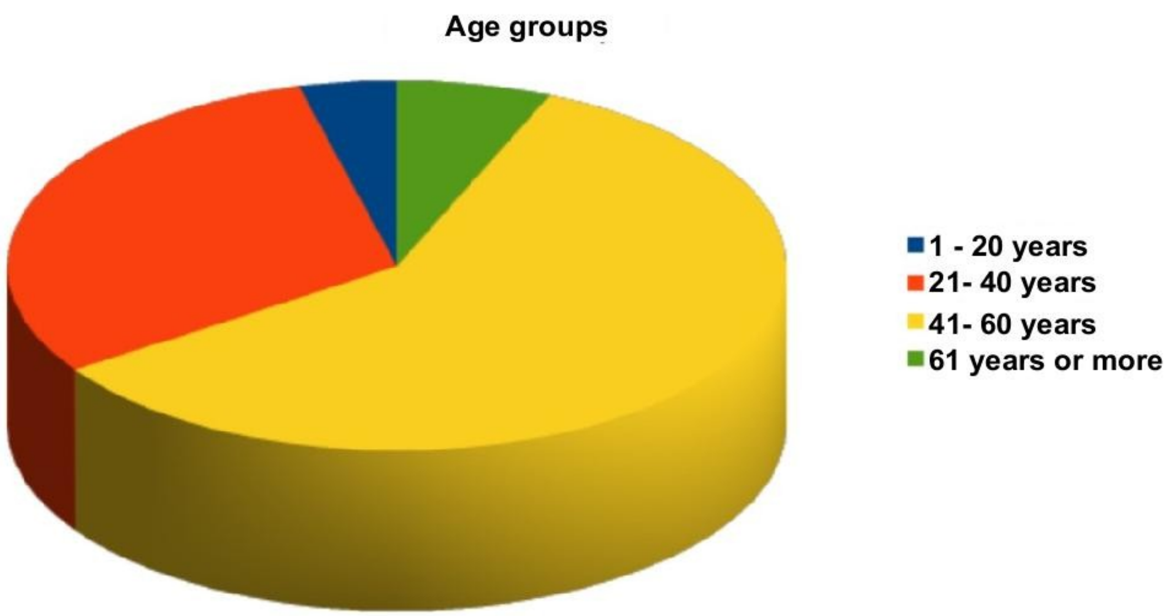


3.6.1.4 Figure 81: Gender Composition

Table 74 presents data on the gender of respondents who fully completed the survey questionnaire, while Figure 81 displays the same data in the form of a pie chart for 428 respondents. As expected, the majority of responses came from female participants (277; 64.72%). There were significantly fewer male respondents (149; 34.81%). The “other” category included one agender and one non-binary individual. The results are not surprising, as most of the respondents who fully completed the online questionnaire were employed in schools, universities, libraries, institutes, and ministries—sectors where women are predominantly employed.

3.6.1.5 Table 75: Age groups

Responses	Frequency	Percentage
– 20 years	17	3.98
21-40 years	130	30.37
41-60 years	253	59.11
61 years or older	28	6.54
Total	428	100

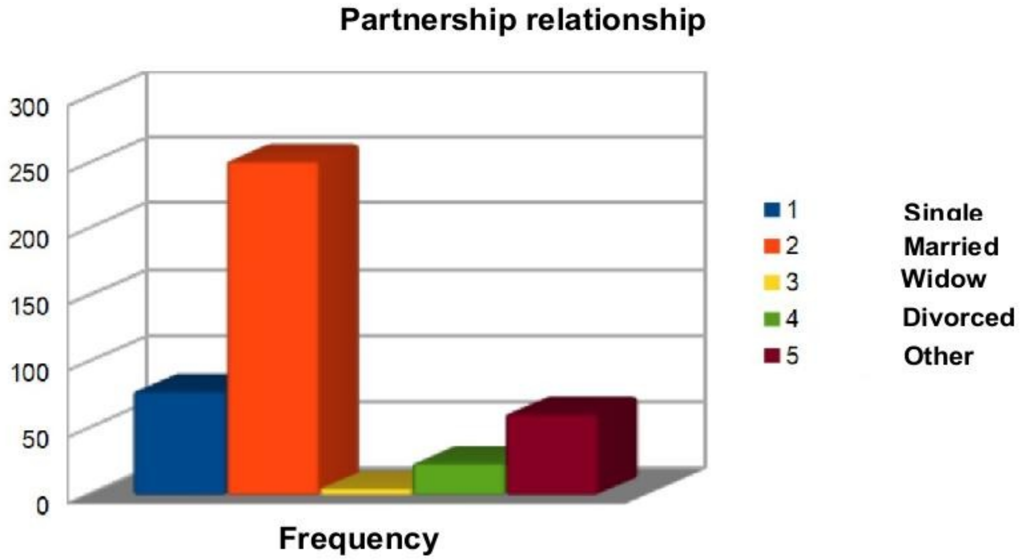


3.6.1.6 Figure 82: Age groups

Table 75 and Figure 82 show the distribution of age groups: up to 20 years old (17; 3.98%), 21 to 40 years (130; 30.37%), 41 to 60 years (253; 59.11%), and 61 years or older (28; 6.54%). As we can see, the age structure of the respondents is relatively high. The majority of respondents fall within the second and especially the third age group. Based on this observation, one could conclude that the age structure of those employed in public administration is already quite high. This trend is likely to continue and even intensify in the future, assuming that current retirement conditions remain unchanged.

3.6.1.7 Table 77: Partnership relationship

Responses	Frequency	Percentage
Single	79	18.46
Married	257	60.05
Widow	5	1.17
Divorced	25	5.84
Other	62	14.49
Total	428	100

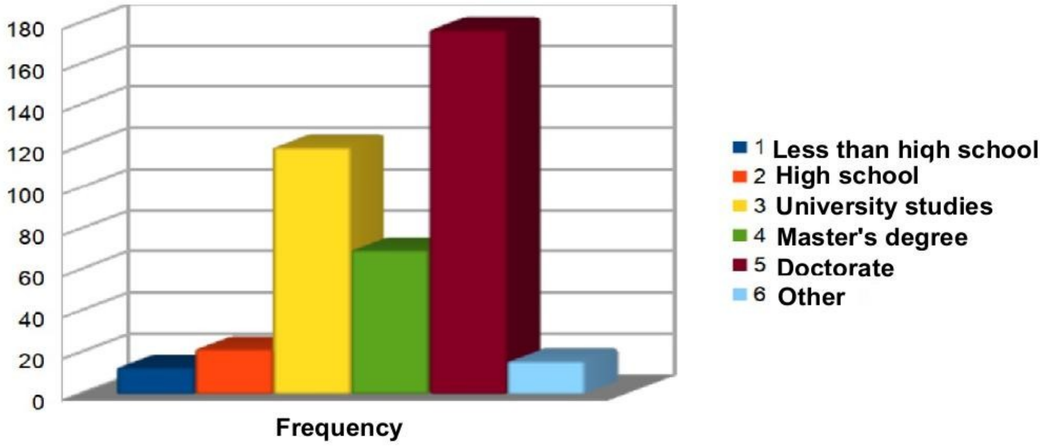


3.6.1.8 Figure 83: Composition of relationship status

Table 77 and Figure 83 show the composition of relationship statuses, which are as follows: single (79; 18.46%), married (257; 60.05%), widowed (5; 1.17%), divorced (25; 5.84%), and other (62; 14.49%). The "other" category includes a variety of relationship types, such as cohabiting partnerships (the most common), engaged, in a relationship but never married, living with a girlfriend, divorced and remarried.

3.6.1.9 Table 78: Composition by education

Responses	Frequency	Percentage
Less than high school	13	3.04
High school	22	5.14
University studies	124	28.97
Master's degree	72	16.82
Doctorate	179	41.82
Other	16	3.73
Total	428	100



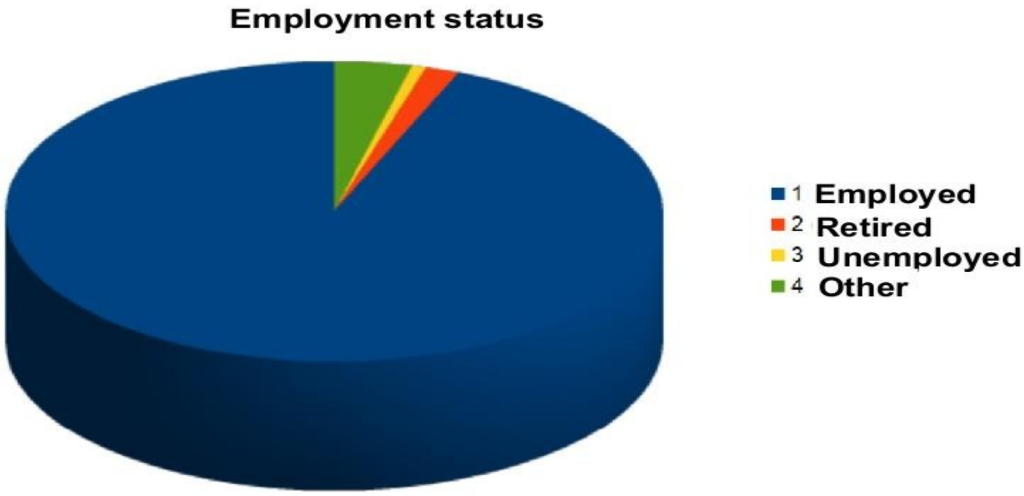
3.6.1.9.1 Figure 84: Educational background

Table 78 and Figure 84 present the educational background of the respondents, as follows: less than secondary school (13; 3.04%), secondary school (22; 5.14%), university degree (124; 28.97%), master’s degree (72; 16.82%), doctorate (179; 41.82%), and other (16; 3.73%).

The "other" category includes various additional levels of education, such as higher vocational school, professional college, higher education programs, higher education – Level VII, scientific master’s degree (pre-Bologna system), advanced diploma candidates, professional master’s degree, post-university specialization, and first-cycle undergraduate studies.

3.6.1.9.2 Table 79: Composition by current status

Responses	Frequency	Percentage
Employed	402	93.92
Retired	7	1.64
Unemployed	3	0.7
Other	16	3.74
Total	428	100



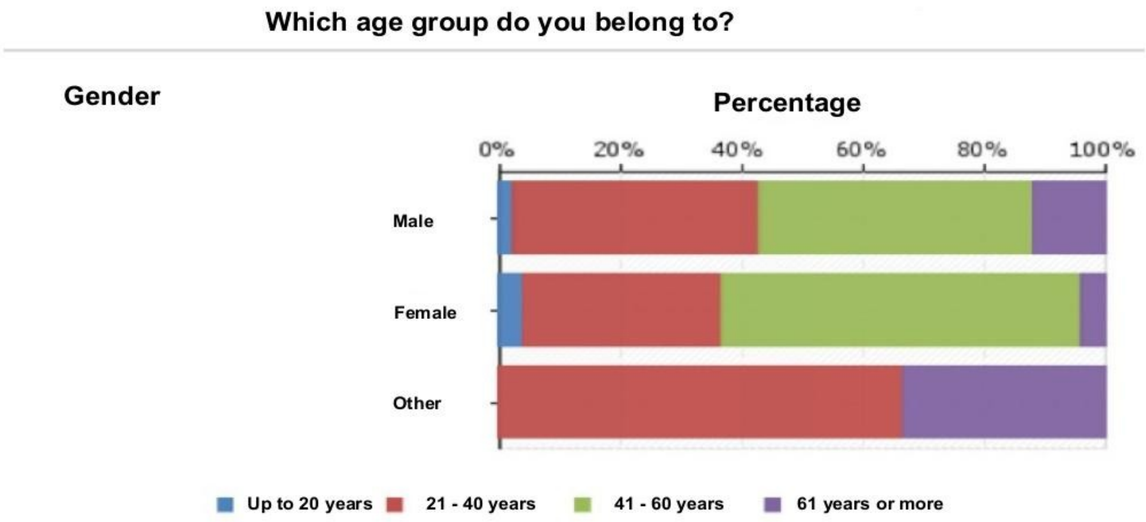
3.6.1.9.3 Figure 85: Composition by current status

Table 79 and Figure 85 show the composition of respondents by their current status. The majority of respondents are employed (402; 93.92%). There is also a smaller number of retirees (7; 1.64%) and unemployed individuals (3; 0.7%). The "other" category (16; 3.74%) includes statuses such as student, in education, high school student, self-employed, currently studying, and attending secondary school. In the following sections, we will continue exploring demographic data through composite visual representations.

3.6.2 Composite demographic data in charts

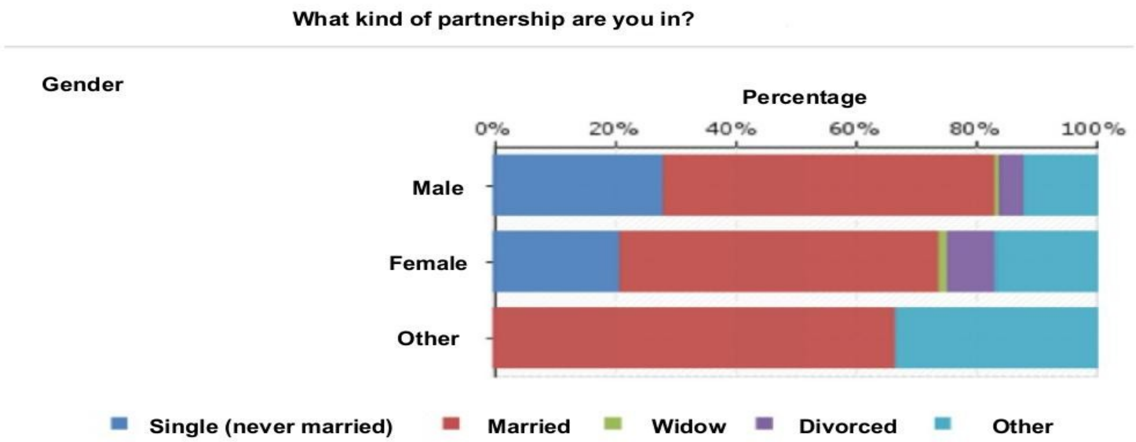
The following section presents charts of composite demographic data, focusing on the relationships between gender and age, gender and relationship status, gender and level of formal education, as well as gender and current status. Alongside the bar charts, some observations regarding the gender composition in relation to other demographic indicators will also be provided. The bar charts were generated using the online survey tool Enklik, which, among other features, allows users to create custom tables and visualize them graphically.

It will become apparent that some of the results are quite surprising.



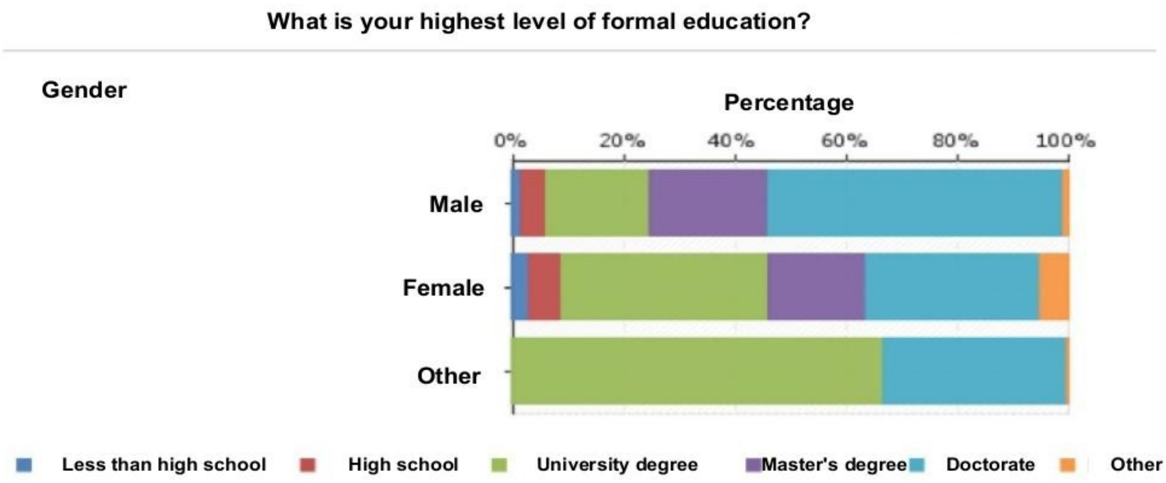
3.6.2.1 Figure 86: Relationship between gender and age

Figure 86 shows the relationship between gender and age. Notably, in the age group up to 20 years, there are more women (14; 5%) than men (3; 2%). In the age group from 21 to 40 years, there are more men (53; 36%) than women (76; 27%). In the age group from 41 to 60 years, women are the majority (178; 64%) compared to men (75; 50%). Finally, in the age group of 61 years and older, men significantly outnumber women (18; 12% / women: 9; 3%).



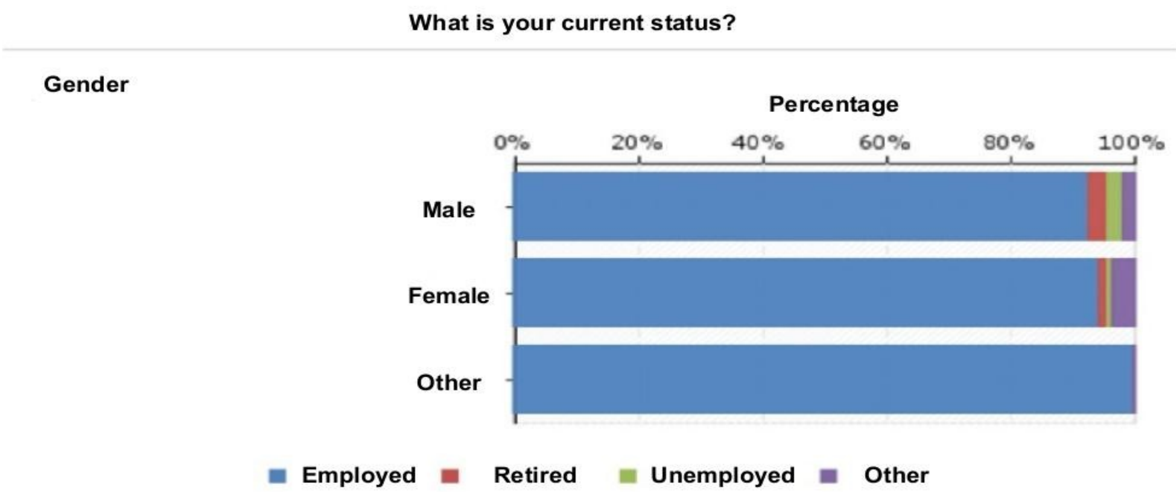
3.6.2.2 Figure 87: Relationship between gender and partnership status

Figure 87 shows the relationship between gender and partnership status. As expected, a higher percentage of men are single (32; 21%) compared to women (47; 17%). When it comes to marital status, there are no significant differences between genders (men: 32; 21% / women: 47; 17%). Furthermore, we observe that the percentage of divorced women is higher (21; 8%) than that of men (4; 3%). The percentage of widowed individuals is the same for both genders (men: 2; 1% / women: 3; 1%). A surprising result appears in the group of cohabiting (non-marital) partnerships. One might expect more men in this group (16; 11%), but this is not the case, as women are also predominant here (45; 16%).



3.6.2.3 Figure 88: Relationship between gender and education

Figure 88 illustrates the relationship between gender and education. Based on the results, it can be said that men are more highly educated than women, as the percentage of those with master's degrees (men: 28; 19% / women: 44; 16%) and doctoral degrees (men: 86; 58% / women: 92; 33%) is significantly higher among men. However, within the female population, there is a greater share of individuals with a university degree (women: 99; 36% / men: 24; 16%).



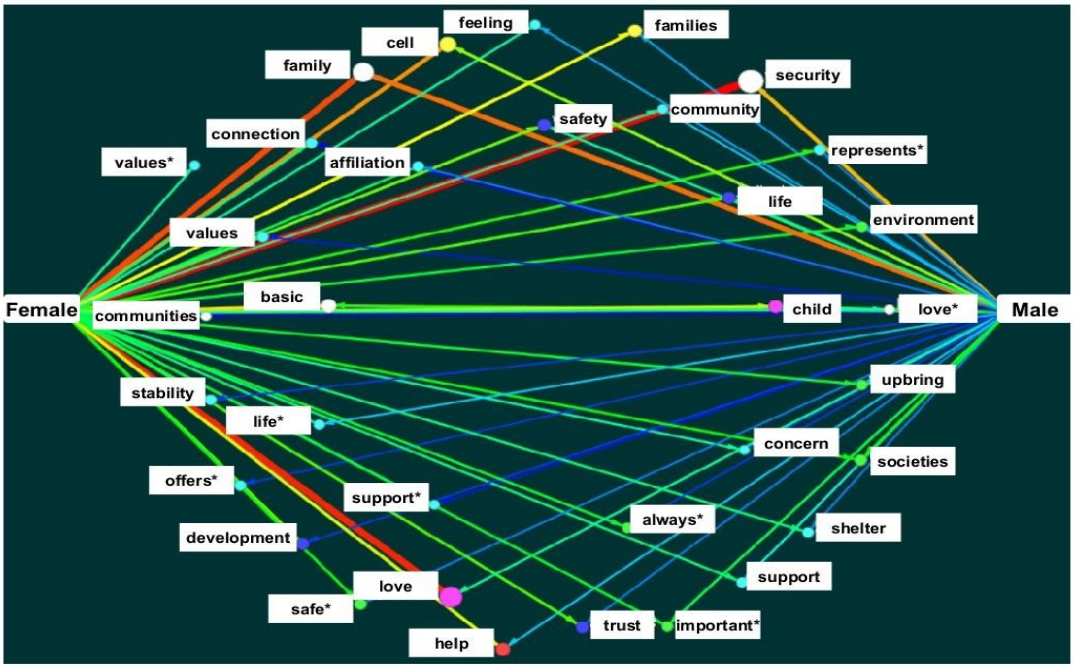
3.6.2.4 Figure 89: Relationship between gender and current status

Figure 89 shows the relationship between gender and current status. Based on a sample of 428 respondents, the percentage of employed women (261; 94%) is slightly higher than that of employed men (139; 93%).

Let us move on to the results of the question, "Why do respondents consider family important?" It is important to note that these are unstructured textual responses, which need to be converted into structured data.

3.6.3 The importance of family

Using the custom reporting features of the online survey tool Enklik, a table was created to show the relationship between gender and the responses provided. Interestingly, the female participants contributed a total of 3,657 words (13.20 words per respondent) across 405 lines (1.46 lines per respondent), while the male participants contributed 1,876 words (12.59 words per respondent) across 205 lines (1.38 lines per respondent). This indicates that, on average, women contributed slightly more words about the importance of family than men, although the difference is relatively small. The following section presents a conceptual network analysis based on responses categorized by male and female gender. A third gender category, which included only two respondents, will be excluded from the analysis due to the low number of participants.



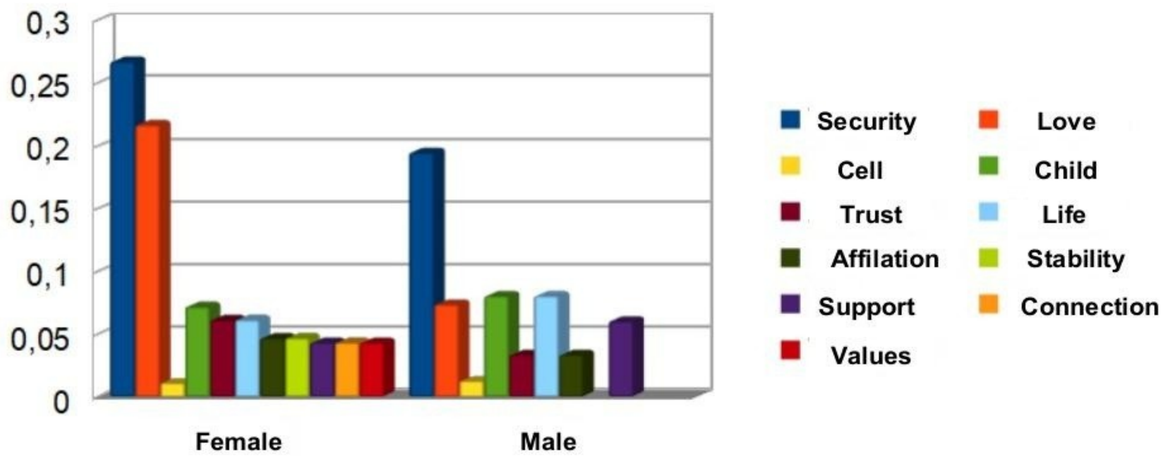
3.6.3.1 Figure 90: Simplified conceptual network of the most frequent words in responses by gender

Figure 90 presents a simplified conceptual network of the most frequently used words in the responses, categorized by male and female gender. A threshold was applied to exclude all terms with a frequency lower than nine. Prominent concepts quickly become visible, such as security, love, help, belonging, life, environment, trust, society, shelter, child, family, unit, support, community, care, development, values, upbringing, and connection.

Some terms were used more frequently by women than men—for example, the concept of security (see the white node with a strong red connection). A similar pattern can be seen with the pink node representing love. Based on this brief qualitative analysis, the following section will show the distribution of eleven key concepts in relation to the number of respondents by gender.

3.6.3.2 Table 80: Relationship between the number of concepts and respondents by gender

Concepts/words	Frequency M	Ratio M/R	Frequency F	Ratio F/R
Security	29	0.19	74	0.27
Love	11	0.07	60	0.22
Cell	19	0.01	31	0,01
Child	12	0.08	20	0.07
Trust	5	0.03	17	0.06
Life	12	0.08	17	0.06
Stability	0	0	13	0.05
Support	9	0.06	12	0.04
affilation	5	0.03	13	0.05
Connection	0	0	12	0.04
Values	0	0	12	0.04



3.6.3.3 Figure 91: Relationship between the number of concepts and respondents by gender

Table 80 presents the numbers and ratios between the number of concepts and respondents (277 women, 149 men), while Figure 91 illustrates only the ratios. In describing the importance of family, some respondents used key words, while others formed more or less complex sentence structures. I processed the texts using the software tool AntConc, which allowed me to extract the scope and number of included concepts.[38] In Figure 91, we can immediately see that the concept of "security" was the most frequently used term by both women (74 times; a ratio of 0.27 based on 277 female respondents) and men (29 times; a ratio of 0.19 based on 149 male respondents). In short, women placed greater emphasis on the concept of security when describing the importance of family compared to men. This difference is even more pronounced with the concept of "love",

38 Anthony, L. 2019. *AntConc* (Version 3.5.8) [Computer Software]. Tokyo, Japan: Waseda University. Available online: from https://www.laurenceanthony.net/software (2020-10-03).

which women used significantly more often (60 times; ratio of 0.22) than men (11 times; ratio of 0.07).

The term “unit” (or “cell”) is particularly interesting, as it was used equally often by both men and women relative to their group sizes (0.01 for both 277 female and 149 male respondents).

When it comes to the term “child”, there is a slight difference in ratio, favoring men (men: 0.08; women: 0.07).

The concept of “trust” shows a ratio in favor of women (women: 0.06; men: 0.03), while “stability” was notably more emphasized by women (ratio among women: 0.05; among men: 0.00).

A particularly interesting result appears with the concept of “support”, where the ratio favors men (men: 0.06; women: 0.04).

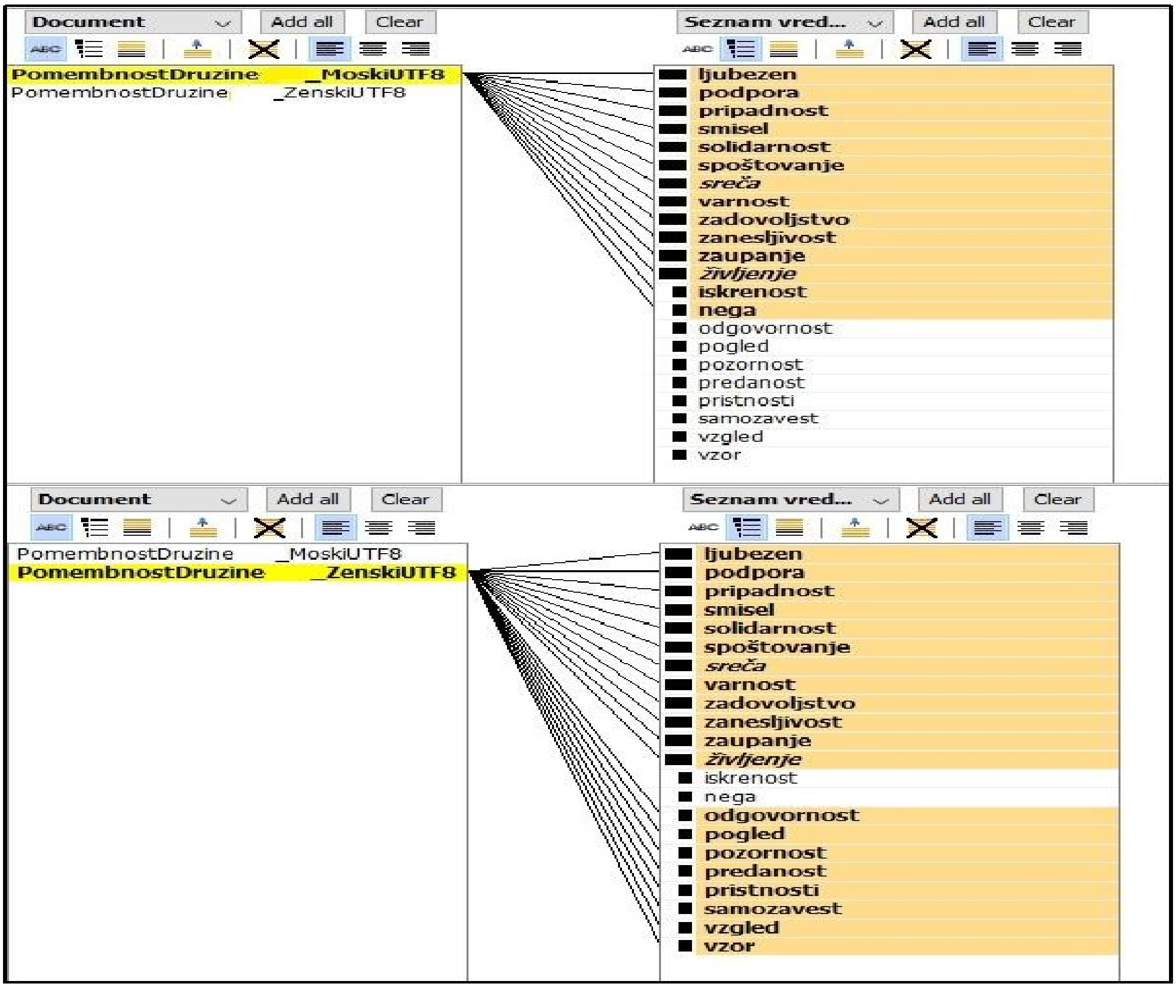
The term “belonging” was again used more frequently by women (women: ratio 0.05; men: ratio 0.03). Finally, we have the terms “connection” and “values”, where the ratios strongly favor women once again (women: 0.04 for both; men: 0.00 for both).

In the next section, a word analysis of male and female responses on the importance of family was conducted using the software tool JigSaw.

3.6.3.4 Figure 92: Classification of concepts and phrases and their labeling

Figure 92 illustrates the classification of concepts and phrases, as well as their labeling, derived from two imported textual files that were divided into male and female opinions on the importance of family. It can be observed that there are 11 available groups.

The most commonly used concepts and phrases by men and women when describing the importance of family were categorized into groups representing activities (61 different ones), processes (42 different ones), values (25 different ones), states (32 different ones), persons (21 different ones), psychological states/traits (87 different ones), and social groups/traits (51 different ones). Certain concepts and phrases were also classified into less represented groups, such as shapes, objects, time, and humanity, which can be disregarded in further analysis.



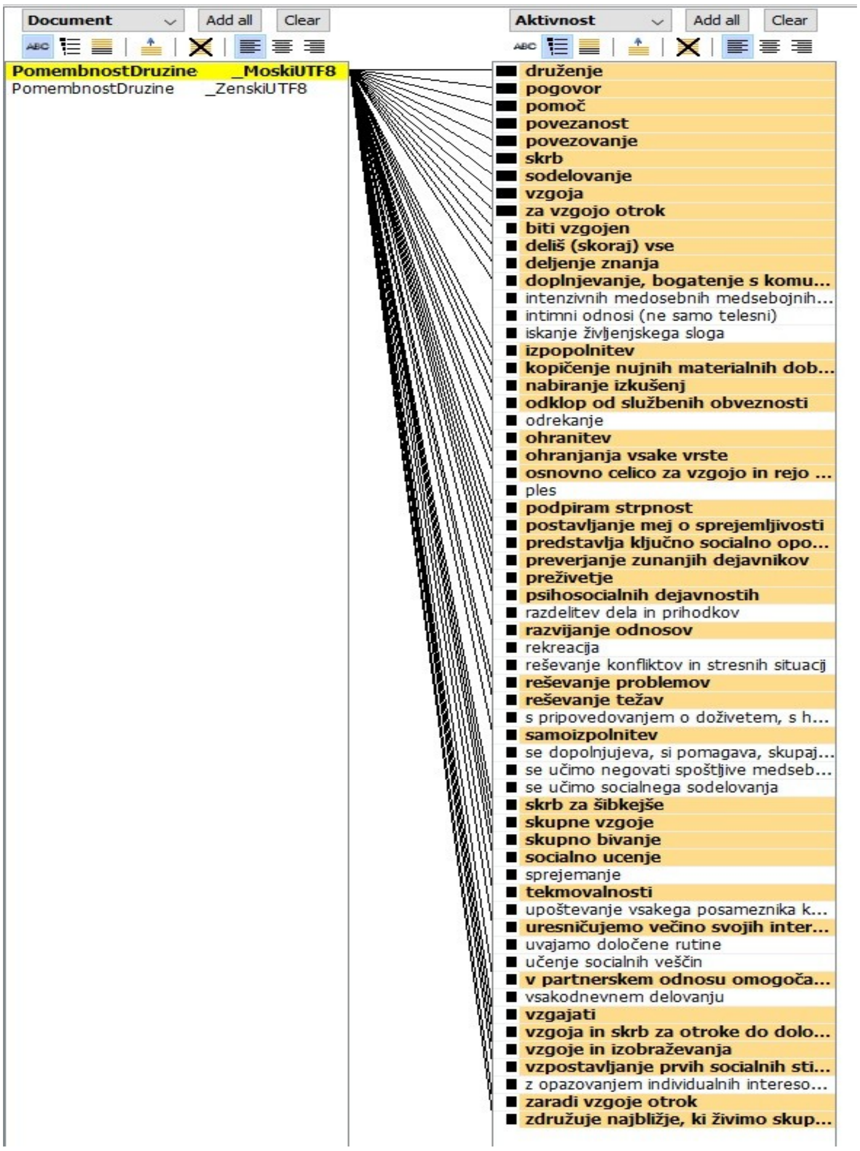
3.6.3.5 Figure 93: Visual bar lists of values for men and women

Figure 93 presents visual bar lists of values that men and women used when describing the importance of family. It can be observed that women employed a greater number of distinct values (20; ratio per 277 female respondents is 13.85) compared to men (14; ratio per 149 male respondents is 10.64) (see the lower part of Figure 93).

Both women and men frequently used values such as love, support, belonging, meaning, solidarity, respect, happiness, security, satisfaction, trust, and life when describing family. However, men also referred to values like honesty and care, which were not mentioned by women.

A significant difference between genders emerges in the use of values such as responsibility, perspective, attention, dedication, competence, self-confidence, role model, and example—values exclusively used by women. Based on the results, it can be concluded that the 12 most common values (love, support, belonging, meaning, solidarity, respect, happiness, security, satisfaction, reliability, trust, and life) are shared by both genders.

Interestingly, men more frequently referred to honesty and care—qualities typically associated with women. On the other hand, men did not use values such as responsibility, attention, and dedication when describing the importance of family. This is noteworthy since it is often emphasized that men in relationships are perceived to lack these qualities.



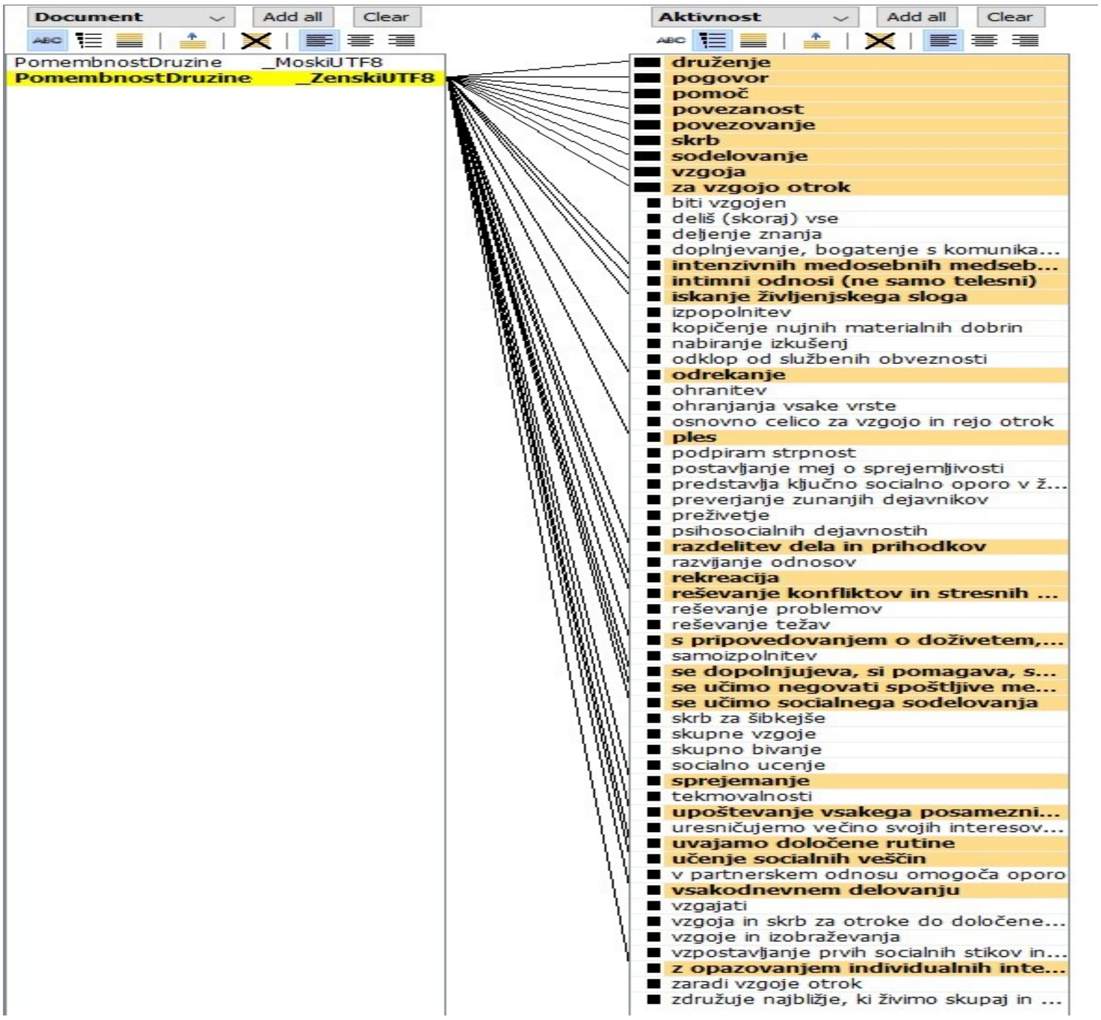
3.6.3.6 Figure 94: Visual bar list of concepts and phrases about activities by male representatives

Figure 94 presents a visual bar list of concepts and phrases related to activities that men used when describing the importance of family. In their descriptions, men highlighted 44 different activities, including:

- Socializing
- Conversation
- Helping
- Connection or bonding

- Caring
- Cooperation
- Parenting or raising children
- Being well-raised
- Sharing (almost) everything
- Sharing knowledge
- Complementing and enriching through communication
- Self-improvement
- Accumulating essential material goods
- Gaining experience
- Disconnecting from work obligations
- Preserving all kinds of life forms
- Serving as the basic unit for raising children
- Supporting tolerance
- Setting boundaries regarding acceptability
- Providing key social support in life
- Assessing external factors
- Survival
- Psychosocial activities
- Developing relationships
- Solving problems and difficulties
- Self-development
- Caring for the weaker members of the family
- Joint parenting
- Living together as a family unit
- Social learning
- Competitiveness
- Fulfilling most personal interests and needs
- Support in a partnership relationship
- Parenting and caring for children up to a certain age
- Education and upbringing
- Establishing initial social connections
- Raising children, and bringing together close family members who respect and love each other.

This comprehensive list reflects the diverse range of activities men associate with the importance of family.

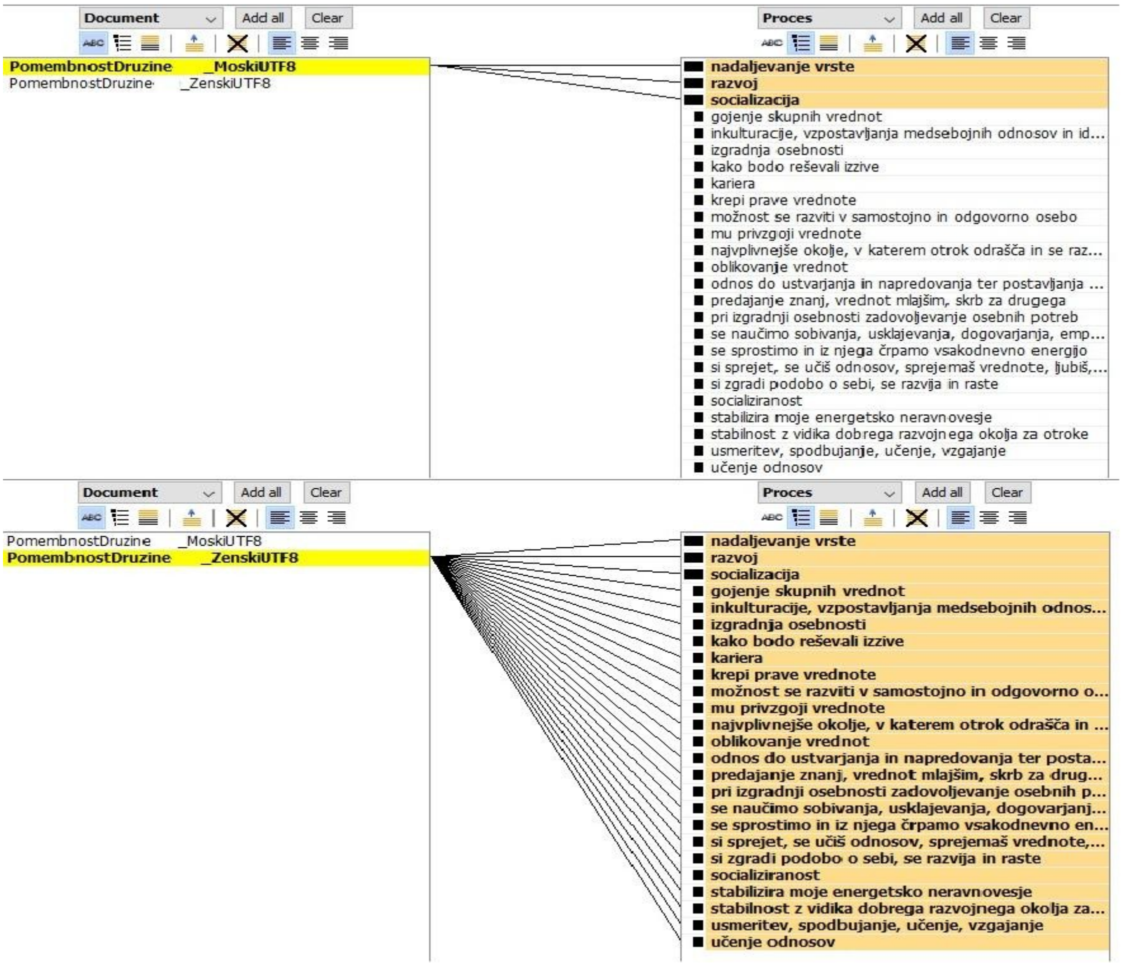


3.6.3.7 Figure 95: Visual column list of terms and phrases about activities mentioned by female respondents

Figure 95 presents a visual list of terms and phrases referring to 27 different activities that women used to emphasize the importance of family. Women particularly prioritized the following activities: socializing, conversation, helping, connection or bonding, care, cooperation, raising or raising children, intense interpersonal relationships and mutual help, intimate relationships, finding a lifestyle, self-sacrifice, dancing, distribution of work and income, recreation, resolving conflicts and stressful situations, sharing experiences with humor, discussions and consultations, complementing one another, mutual assistance, doing sports together, teaching respectful interpersonal relationships, social participation, accepting and respecting each individual as a unique person, establishing routines, teaching social skills, daily functioning, and observing children’s individual interests.

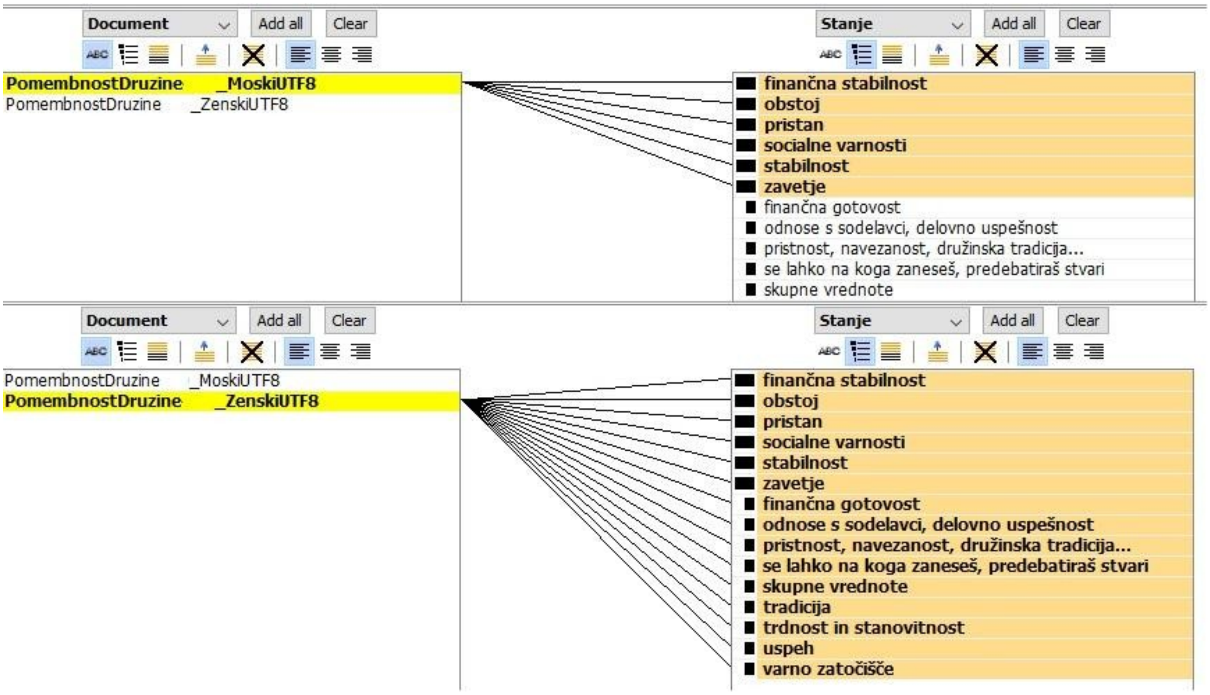
It can be observed that men, when describing the importance of family, used terms and phrases from the category of activities more frequently than women. Interestingly, men highlighted activities such as problem-solving and caring for the vulnerable, while women focused on other activities such as conflict resolution and managing stressful situations, complementing one another, teaching respectful interpersonal relationships, and social cooperation.

From the perspective of activities, both genders see the importance of family primarily in mutual assistance, child-rearing, complementing each other, learning, and in social and emotional connection.



3.6.3.8 Figure 96: Visual column lists of terms and phrases related to processes by both genders

Figure 96 shows visual column lists of terms and phrases related to processes used by both genders when describing the importance of family. Male respondents used only three different processes to describe the family (procreation, development, and socialization), whereas female respondents used significantly more terms and phrases (42 in total) from the "process" category. In addition to the ones already mentioned, women also highlighted processes such as cultivating shared values, strengthening true values, social integration, building self-image, stability from a developmental environment perspective, shaping values, learning relationships, learning coexistence, attitudes toward creativity and progress, and the opportunity to develop into an independent and responsible individual. In short, female respondents placed much greater emphasis on the developmental aspect of both family and personal growth when discussing the importance of family.



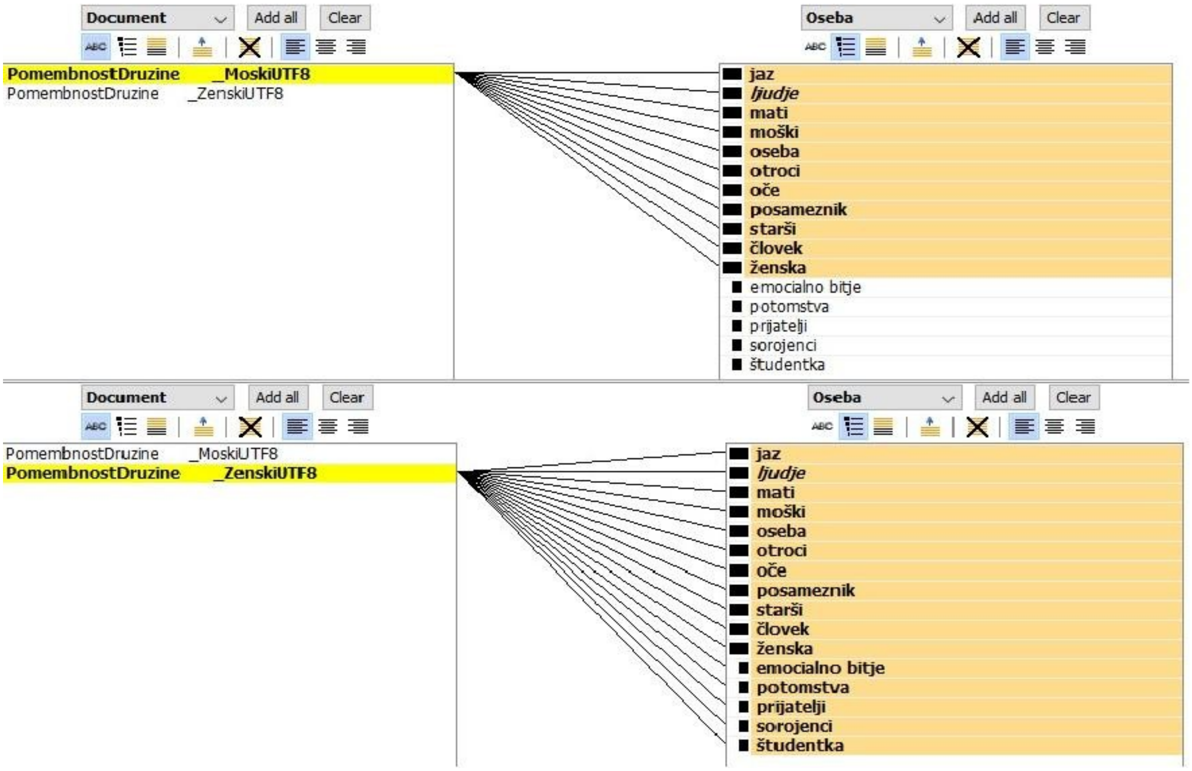
3.6.3.9 Figure 97: Visual column lists of terms and phrases related to states by both genders

Figure 97 presents visual column lists of terms and phrases related to states, as used by both genders. Both men and women emphasized states such as financial stability, existence, acceptance, social security, stability, and shelter when discussing the importance of family.

As with the category of processes, female respondents used a greater number of different phrases (15) from the "state" category compared to male respondents (6). In addition to those already mentioned, women also used phrases such as financial certainty, relationships with colleagues and work performance, authenticity, emotional attachment, family tradition, having someone to rely on, shared values, tradition, resilience and consistency, success, and safe haven.

Female respondents thus placed greater emphasis on tradition, values, financial security, and the idea of family as a safe haven. Descriptions of family importance from the "state" perspective, as given by women, could be broadly summarized under the concept of "security," whereas male respondents tended to describe family more in terms of a stable framework for survival or existence.

In the following section, we will explore the category of "person."

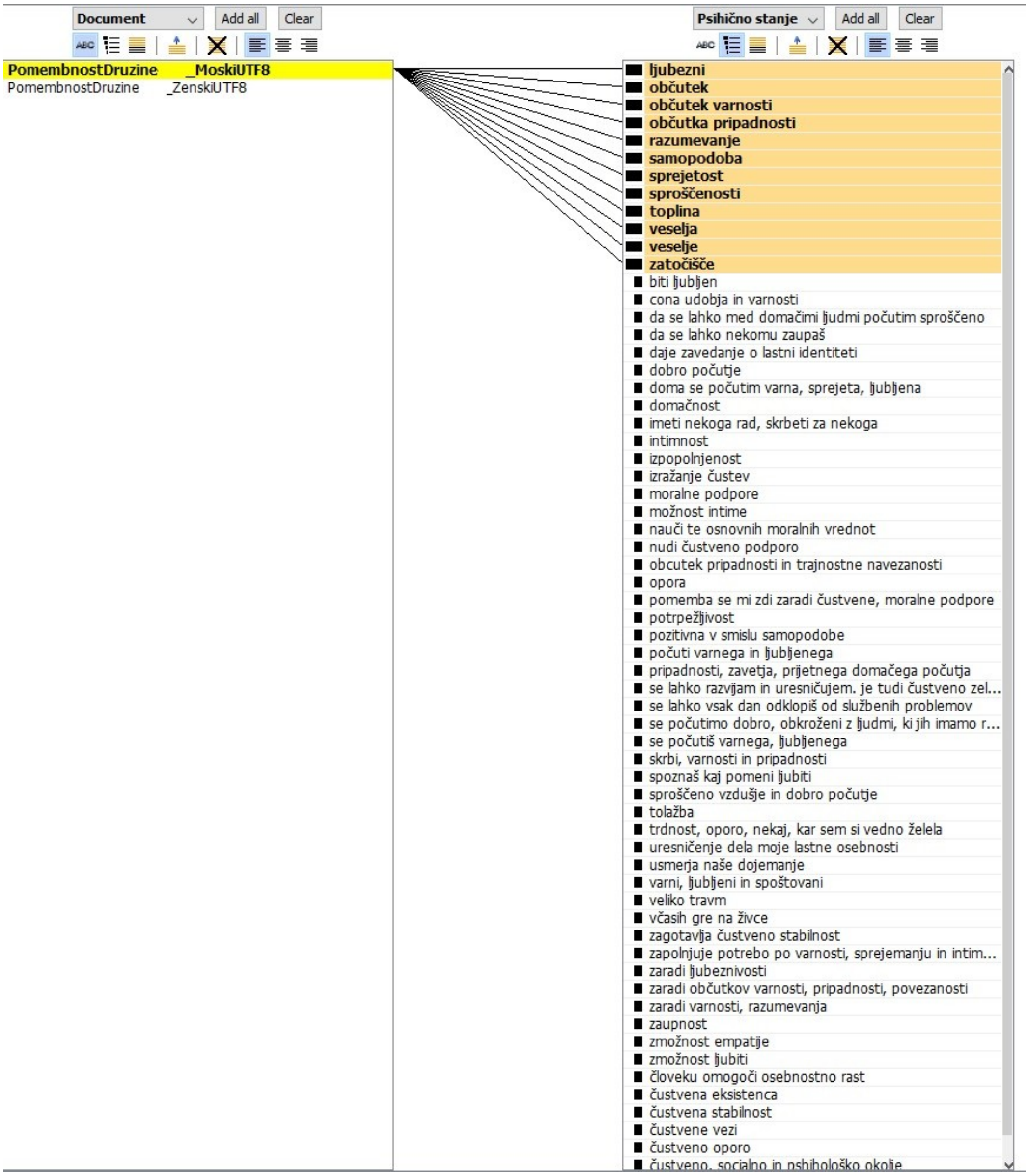


3.6.4 Figure 98: Visual column lists of terms and phrases related to people by both genders

Figure 98 presents visual column lists of terms and phrases related to people, as used by both genders.

Male respondents, when describing the importance of family, mentioned individuals such as myself, people, mother, man, person, children, father, individual, parents, human, and woman. Female respondents, on the other hand, included additional references such as emotional being, offspring, friends, siblings, and female student.

The individuals who clearly represent a key foundation of the family—parents and children—were emphasized by both genders. The next two categories—mental state/trait and social group/trait—are particularly interesting, as they contain the largest number of phrases related to the description of the importance of family.

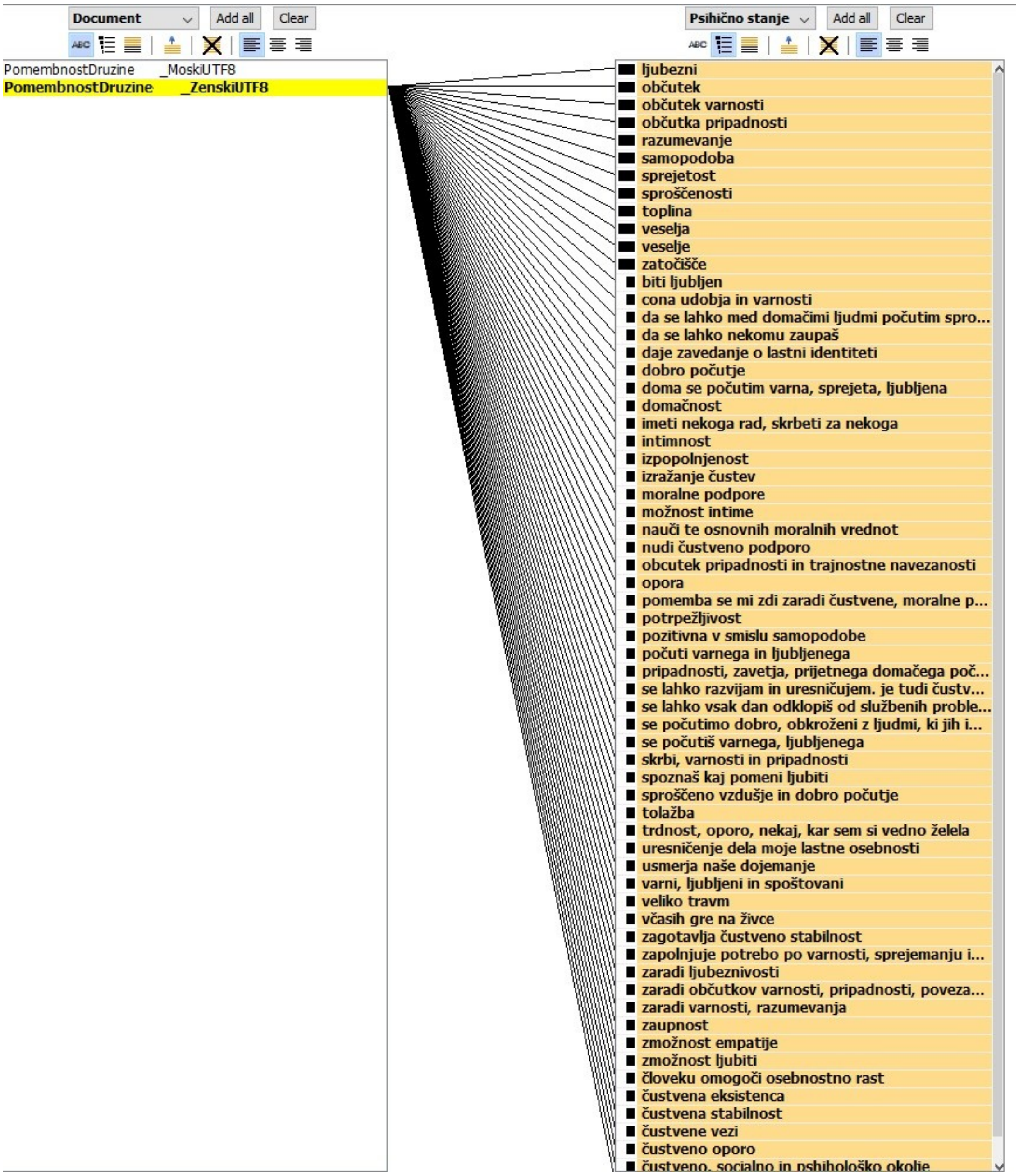


3.6.4.1 Figure 99: Visual column list of terms and phrases related to mental states/traits by male respondents

Figure 99 displays a visual column list of terms and phrases (12 different terms → ratio = 12.42) related to mental states or traits used by male respondents.

In describing the importance of family, men emphasized the following mental states or traits: love, feeling, sense of security, sense of belonging, understanding, self-image, acceptance, relaxation, warmth, joy, happiness, and a sense of refuge. Apart from love and joy, men mostly emphasized various feelings rather than a wide range of emotions.

As we will see in the next section, female respondents relied more heavily—numerically—on mental states and traits when describing the importance of family, although the ratio in relation to the number of female participants will be noticeably lower.



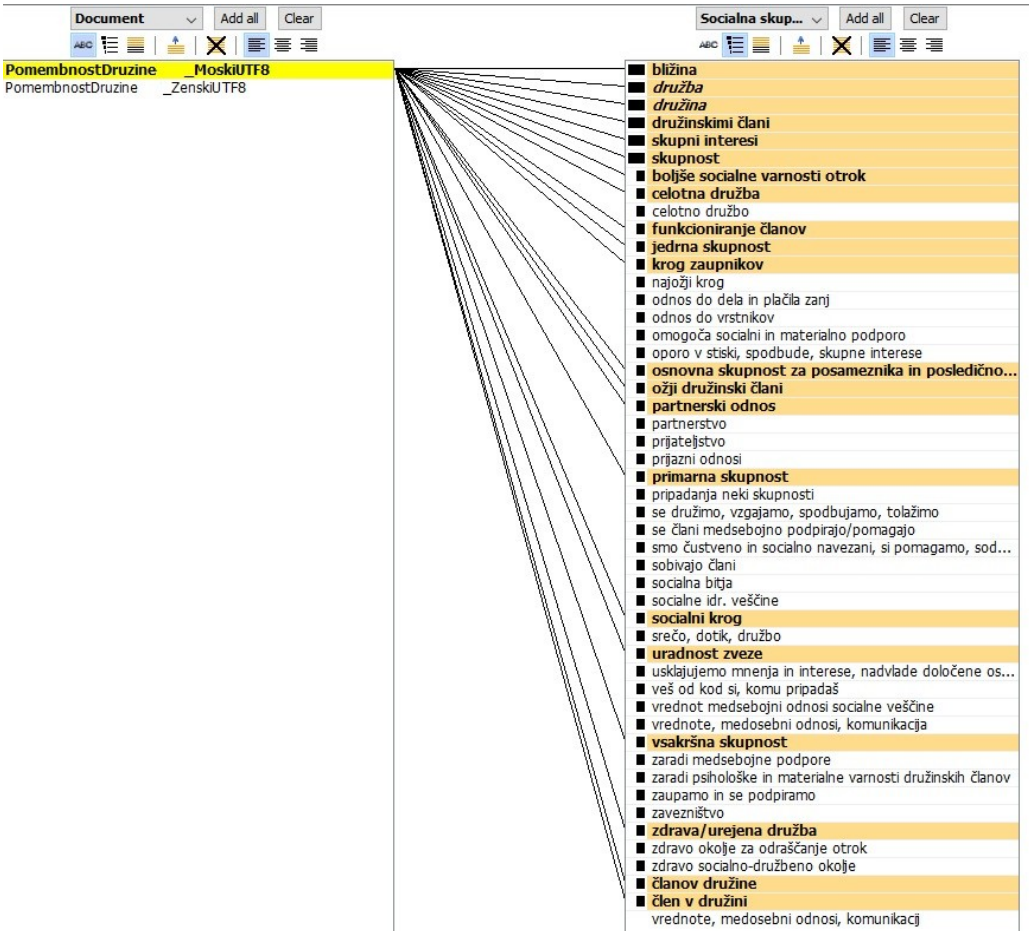
3.6.4.2 Figure 100: Visual column list of terms and phrases related to mental states/traits by female respondents

Figure 100 presents a visual column list of terms and phrases related to mental states or traits as used by female respondents. In addition to the mental states/traits already emphasized by male respondents, women described the importance of family using a much broader range—64 different terms (ratio = 4.33).

Female respondents highlighted the following mental states and traits: being loved, a zone of comfort and safety, feeling relaxed, awareness of one's own identity, support, refuge, feeling safe and loved at home, understanding what it means to love, a relaxed atmosphere and well-being, comfort, confidentiality, belonging, shelter, loving and caring for someone, emotional existence, viewing it positively due to emotional and moral support, intimacy, learning core moral values, fulfillment, patience, a positive impact on self-image, realizing part of one's personality, guiding our perceptions, providing emotional stability, capacity for empathy, emotional bonds, emotional, psychological, and social environment, emotions and warm personal relationships, being able to disconnect from work-related problems every day, enabling personal growth, and providing security and understanding.

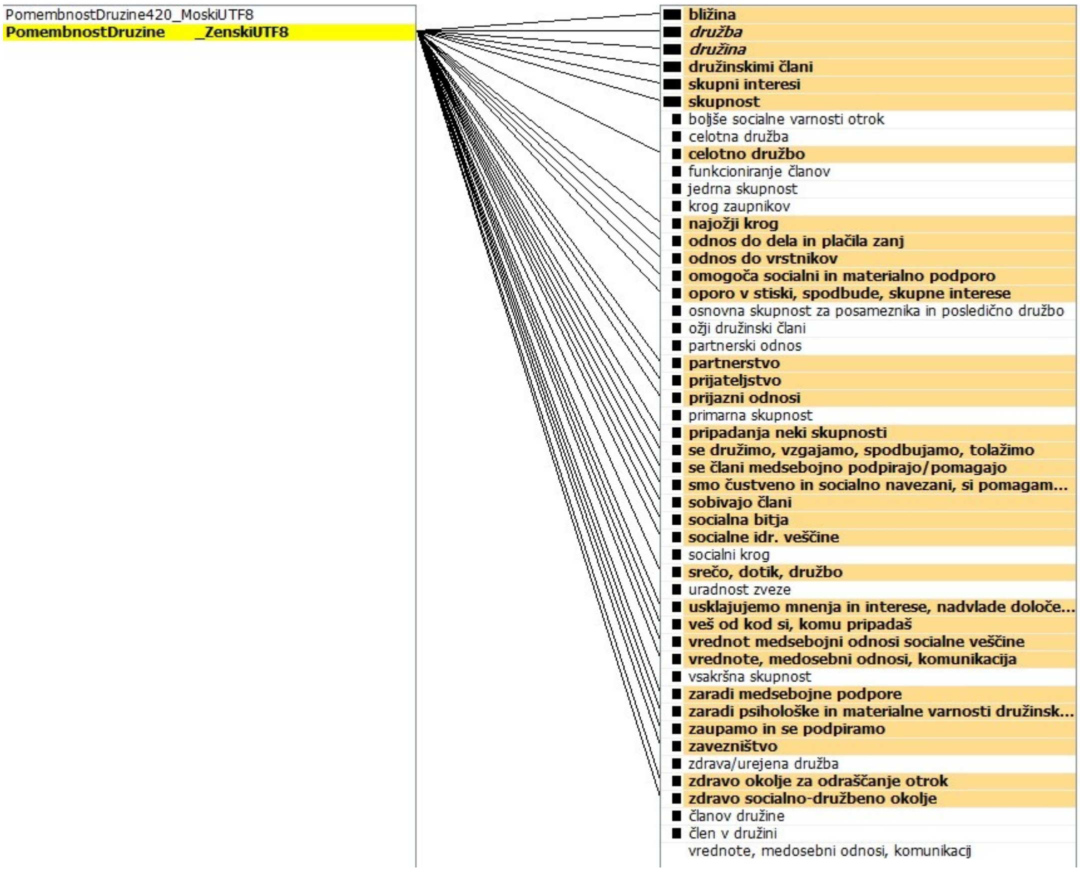
Compared to men, female respondents placed significantly greater emphasis on the security, emotional, and developmental aspects of personality.

Within the category of Mental State/Trait, we can conclude that there is a fundamental difference between the genders in how they perceive the importance of family.



3.6.4.3 Figure 101: Visual column list of terms and phrases related to social groups/traits by male respondents

Figure 101 shows a column list of terms and phrases related to social groups or traits, as used by male respondents. In describing the importance of family, male participants used 21 different phrases (a ratio of 7.1 per 149 respondents) that were categorized under the group “Social Group/Trait.” They emphasized terms such as: closeness, society, family as a family, family members, shared interests, community, improved social security for children, functioning of members, core community, circle of trusted people, basic community for the individual, immediate family members, partnership, primary community, social circle, formality and relationships, any kind of community, a healthy and organized society, family members, and a member of the family.



3.6.4.4 Figure 102: Visual column list of terms and phrases related to social groups/traits by female respondents

Figure 102 presents a visual column list of terms and phrases related to social groups or traits as used by female respondents (33 different terms; a ratio of 8.39 per 277 respondents).

Statistically speaking, there are no significant gender differences in the overall frequency of using social group/trait-related phrases when describing the importance of family. However, while both genders emphasized aspects like closeness, society, and family members, female respondents particularly highlighted the following social building blocks as essential to the concept of family:

- The inner circle,
- Attitudes toward work and compensation,
- Friendship,
- Kind relationships,
- Partnership,
- Belonging to a community,
- Spending time together, raising, encouraging, and comforting each other,

- Mutual support and assistance among members,
- Emotional and social bonds,
- Social skills,
- Harmonizing opinions and interests,
- Dominance of certain individuals,
- Knowing where you come from and whom you belong to,
- Values and mutual relationships,
- Communication,
- Mutual support,
- Psychological and material security of family members,
- Trust and support,
- Alliance,
- Providing a healthy environment for raising children, and
- Supporting a healthy social setting, among others.

The core of the social emphasis from female respondents regarding the importance of family can be summarized through key elements such as social identity, social skills, and emotional and social connectedness. By contrast, male respondents' descriptions from a social perspective tended to focus more heavily on family members and social communities.

Other notable social-related phrases—though not part of a detailed category analysis—include expressions like:

family is a unit, the center of life – a social starting point, represents an intimate social structure, a traditional value, a safety net, basic social unit, home, a space, a lifelong classroom, a safe environment, favorite social corner, basic nucleus, future, time management ability, foundation of human development, birthrate, modern civilizations, and more.

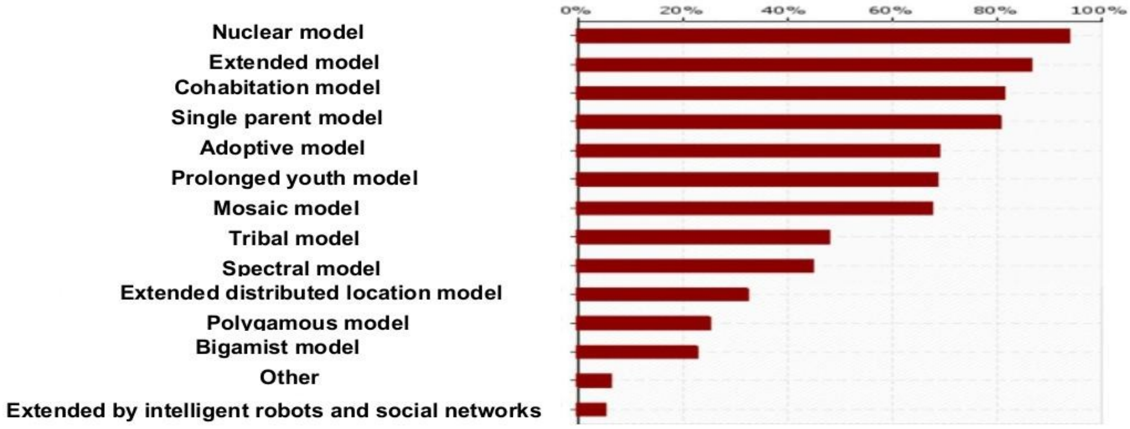
3.6.5 Knowledge of family models

The question regarding knowledge of family models was intentionally phrased in a somewhat ambiguous and provocative manner. Only a few respondents (seven out of 428) pointed out the ambiguity of the question. Under the "Other" option, they noted observations or concerns such as: the question was unclear, whether it was asking if they personally had experience with these family models, or if they simply knew people living in such types of partnerships, etc.

These comments were welcome and, in their own way, valid. However, the concerns raised did not pose a threat to the main purpose of the question. On one hand, the question served as a test of whether respondents would answer sincerely, since the sub-questions included clearly defined family models. Based on the results, we can conclude that respondents answered honestly despite the definitions provided, as they selected only those family models they were truly familiar with. This allowed for the creation of an accurate ranking list. In this sense, the question served as a kind of test of the respondents' honesty. On the other hand, the main purpose of the question was to act as a guiding transition. It was intended to lead respondents toward the final question about their vision of the family in the future. In fact, as we will see later, many respondents answered the final question of the survey in the spirit of the development and future existence of different family models.

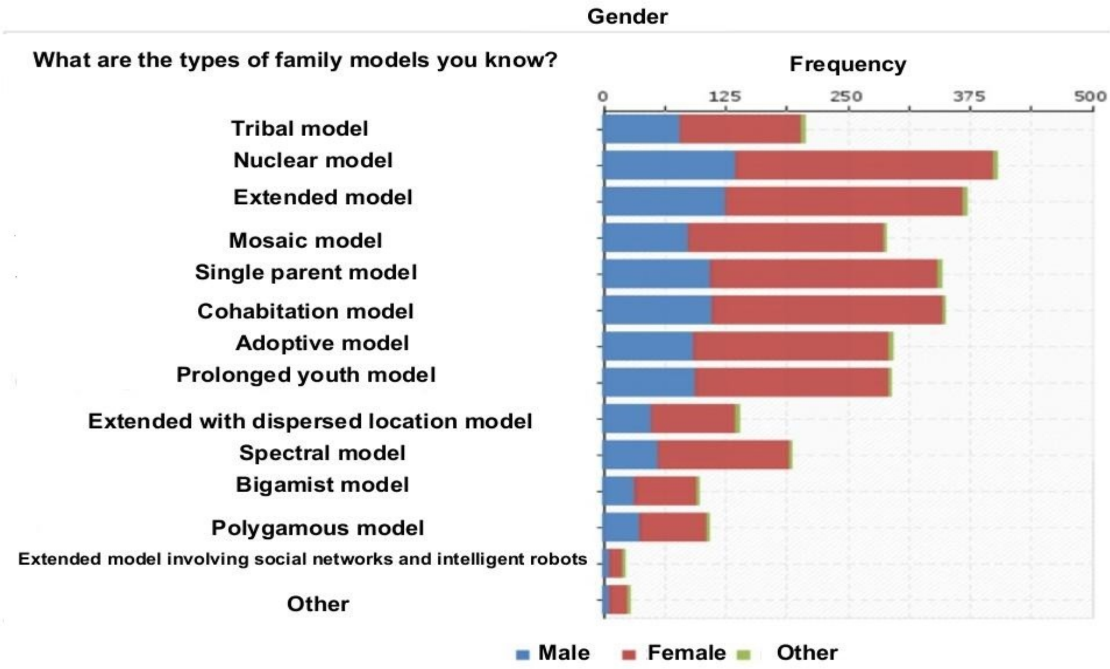
3.6.5.1 Table 81: Knowledge of family models

Family models	Frequencies	Valid	% - Valid	Appropriate	% - Appropriate	Frequencies	%
Tribal	205	428	48%	428	48%	205	7%
nuclear	402	428	94%	428	94%	402	13%
Extended	371	428	87%	428	87%	371	12%
Mosaic	289	428	68%	428	68%	289	9%
Single parent	345	428	81%	428	81%	345	11%
Cohabitation	349	428	82%	428	82%	349	11%
Adoptive	295	428	69%	428	69%	295	9%
Prolonged youth	294	428	69%	428	69%	294	9%
Extended distributed location	138	428	32%	428	32%	138	4%
Spectral	192	428	45%	428	45%	192	6%
Bigamists	97	428	23%	428	23%	97	3%
Polygamous	107	428	25%	428	25%	107	3%
Augmented by intelligent robots	22	428	5%	428	5%	22	1%
Other:	27	428	6%	428	6%	27	1%
TOTAL		428		428		3133	100%



3.6.5.2 Figure 103: Bar chart of knowledge of family models

Table 81 presents the results regarding the familiarity with family models among 428 respondents, while Figure 103 illustrates these results in the form of a slanted bar chart, showing percentages. The findings show that respondents were most familiar with the nuclear family model (402 respondents or 94%), followed by the extended family model (371 or 87%), cohabitation family model (349 or 82%), single-parent family model (345 or 81%), adoptive family model (295 or 69%), and the delayed adulthood family model (294 or 69%). Also well known were the blended family model (289 or 68%) and the tribal family model (205 or 48%). Less familiar to respondents were the rainbow family model (192 or 45%), extended family with dispersed location (138 or 32%), polygamous family model (107 or 25%), and bigamous family model (97 or 23%). Under the "Other" category (27 or 6%), respondents mentioned specific or alternative family models such as: nuclear family with a sister, a woman living with multiple men, a woman as head of household, a blended family model (e.g., living with a partner who brought a child from a previous relationship and having a child together without being married), "his, hers, and ours" children, polyamory, parents living separately with children alternating between homes, or parents rotating living in a home that remains the children's fixed residence. Other examples included the NEET model (parents unable to raise children, with another caregiver taking over), extended family without marriage, where partners raise both shared and non-shared children, and so on. Interestingly, the least known model was a fictional extended family model involving social networks and intelligent robots, which was recognized by 22 respondents (5%).



3.6.5.2.1 Figure 104: Awareness of family models by gender

Figure 104 shows the awareness of different family models by gender. It can be said that female respondents were significantly more familiar with various family models than male respondents.

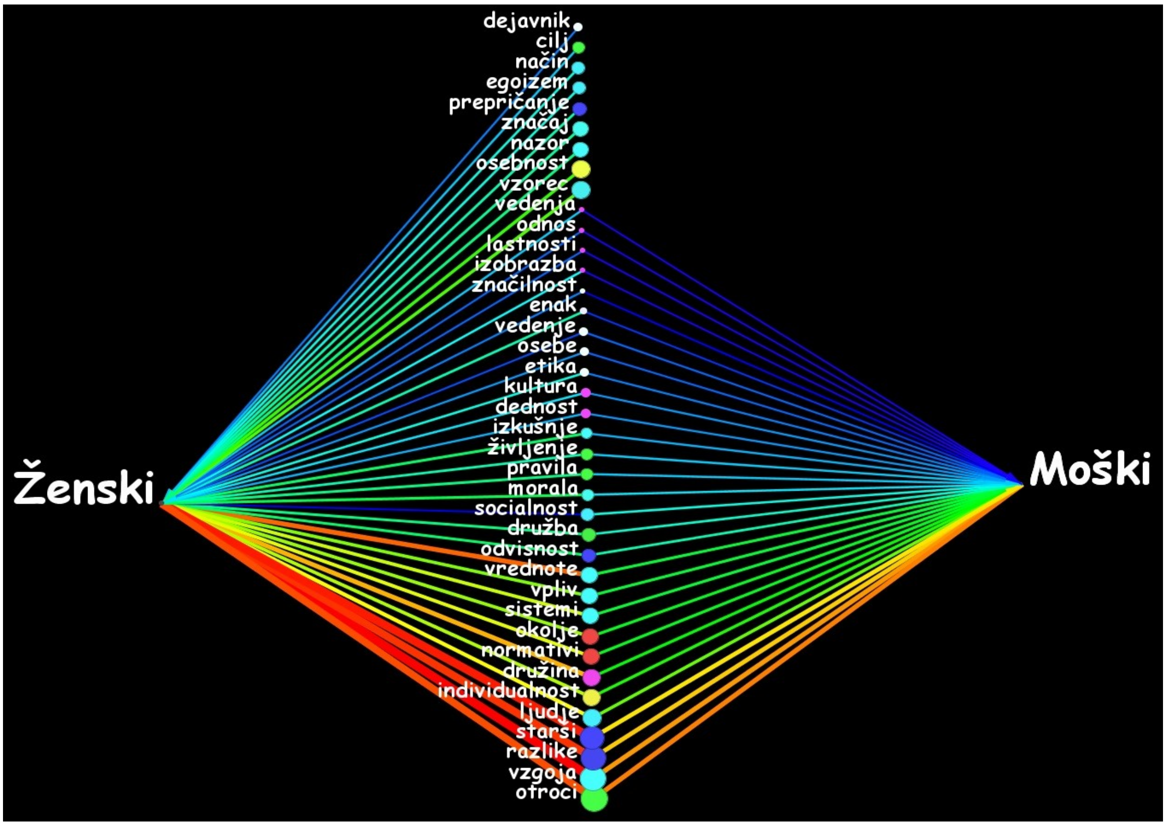
3.6.6 Reasons or causes for differences in child-rearing

We have reached the eighth question in the survey on family and values. The aim of this question was to identify the reasons or causes behind differences in child-rearing, based on the opinions of 428 respondents. Given that we are once again dealing with textual data, it made sense to convert this data into a structured format (similar to the approach used for the question on the importance of family). The respondents' answers were first separated by gender, and then the texts were imported into the AntConc software tool. Before the import, a list of unnecessary words (e.g., conjunctions) and a lemma list (a list of different word forms) were prepared and included in AntConc during the analysis. After running the appropriate commands, the output consisted of two structured lists containing range, frequencies, and keywords. These structured lists were then exported as two .txt files. It is also worth noting that keywords with frequencies of one or two were excluded from both structured lists.

3.6.6.1 Table 82: A small portion of the exported and processed data

Frequency (f)	Keywords (K)	Gender
68	children	Male
67	upbringing	Male
59	differences	Male
58	parents	Male
34	people	Male
150	upbringing	Female
139	parents	Female
127	differences	Female
118	children	Female
69	values	Female

Table 82 shows a small portion of the exported and processed data from the AntConc software tool. Using the two previously mentioned lists, the software filtered out unnecessary words and various word forms, grouping them under umbrella terms (e.g., upbringing → upbrings, parenting, upbring, upbringer; children → child, childish, childs, kids). Even from this shortened list, it is easy to observe differing emphases in the opinions of both genders regarding differences in child-rearing. A more detailed visual representation of these differences will follow in the form of a double dendrogram, which will clearly illustrate the distinct opinion patterns between genders. The complete dataset was imported into the Ora Casos software tool, though we will once again omit a detailed technical description of working with this program. It is worth mentioning, however, that keywords were defined as the data source, and gender as the data target. The frequency of each keyword's appearance was used both as a weight for the strength of the connection and as a numerical attribute.



3.6.6.2 Figure 105: Double hierarchogram of the most common keywords regarding perceptions of differences in child-rearing between genders

Figure 105 displays a double hierarchogram of the most frequently mentioned keywords (including various word forms, as previously noted) relating to perceptions of differences in child-rearing between genders. The extracted keywords represent focal points concerning these differences. The main highlights were as follows:

1. Child-Rearing (including different word forms): This was the most frequently mentioned keyword by both women and men (women and men: large light blue node with a connection strength of 151.0; men: connection strength 68.0).

2. Children (including different word forms): This was also frequently mentioned by both genders (women and men: large yellow node with a strength of 119.0; men: 69.0).

3. Differences (including different word forms): Commonly mentioned (women and men: blue node with a strength of 128.0; men: 60.0).

4. Parents (including different word forms): Frequently referenced (women and men: blue node with a strength of 140.0; men: 59.0).

5. People (including different word forms): Mentioned relatively often (women and men: light blue node with a strength of 50.0; men: 35.0).

6. Individuality (including different word forms): Moderately frequent (women and men: yellow node with a strength of 41.0; men: 31.0).
7. Family (including different word forms): Moderately frequent (women and men: pink node with a strength of 66.0; men: 30.0).
8. Norms (including different word forms): Moderately mentioned (women and men: red node with a strength of 43.0; men: 28.0).
9. Environment (including different word forms): Moderately frequent (women and men: red node with a strength of 40.0; men: 28.0).
10. Systems (including different word forms): Moderately mentioned (women and men: light blue node with a strength of 42.0; men: 27.0).
11. Influence (including different word forms): Moderately mentioned (women and men: light blue node with a strength of 38.0; men: 27.0).
12. Values (including different word forms): Moderately frequent (women and men: light blue node with a strength of 70.0; men: 27.0).

The most frequently used key concepts have already been discussed in detail, so we will omit a more thorough description of the remaining keywords from Figure 105, which will only be briefly mentioned. Male and female respondents used certain keywords and their various word forms less frequently, such as: dependence, society, sociability, morality, rules, life, experiences, heredity, culture, ethics, individuals, behavior, equality, traits, education, characteristics, and behaviors. Only female respondents used key terms such as pattern, personality, worldview, character, belief, egotism, method, goal, and factor.

In the following section, we will review some of the main opinions expressed by female and male respondents and then summarize the core thematic emphasis of both genders.

Women expressed the following opinions (this is primarily a summary of various responses):

- Parents do not necessarily follow normative systems, but rather base child-rearing on their own beliefs and principles.
- Parents place varying levels of importance on different values and apply different learned patterns in raising children.
- Parents themselves are products of different upbringing styles, and how they pass this on to the next generation varies accordingly.
- The foundation for raising children is not a system of norms, but the behavioral patterns adopted by the parents.
- Main issues include:
  1. Disagreements between partners

2. Inconsistency in child-rearing
3. Influence of the surrounding environment

- Causes include:
  1. Different family models
  2. Religion
  3. Values instilled by parents
  4. State priorities
- Society and peers also play a significant role in a child's development. Children imitate not only family upbringing patterns but also the behavior of their peers. It also depends on individual personalities and, naturally, the development of the world around them.
- The way children are raised varies from family to family because people themselves are different. There is no need for it to be identical.
- Raising children is demanding; it requires consistency and perseverance, which many people find too exhausting, resulting in less effort than is truly needed.
- Just as people (parents) differ, so too can their approach to raising children. Normative systems can be interpreted in hundreds of ways or followed only partially, if at all.
- Differences in how the parents themselves were raised and differences in temperament also play a role.
- One female respondent identified the character of parents and children, differing upbringing patterns, and the intelligence of the individuals involved as the main reasons for variations in child-rearing.

Different Parenting Styles, Values, Culture…

Child-rearing varies due to several factors: heredity, environment, and individual agency. The maturity level of parents, their youth, living conditions, self-confidence, level of education, and the amount of time they have available to spend with their children all influence the way children are raised. Each person is an individual with their own history, upbringing, values, and moral framework. Differences also stem from the way both parents were raised in their primary families and from their differing personality structures. Materialism and greed have eroded values that once held firm in the past, significantly affecting society and, consequently, the upbringing of children.

1) Different religious beliefs result in varying views on how children should be raised.
2) There are differing approaches to parenting—permissive versus restrictive.
3) There are varied understandings of what constitutes parental authority or authoritarianism.
4) Parenting differs based on whether the environment is urban or rural, the type of employment, and other factors.

Cultural background, religion, customs, parenting style, current life situation, surroundings, differences in temperament and personality—all these contribute to variations in upbringing. Different personality traits of the individuals raising children (who are not necessarily the parents themselves) also play a role.
A normative system based on moral principles can break down if basic needs—such as food, water, shelter, heating, etc.—are not met, which undermines basic human dignity. If a family cannot sustain a decent standard of living (which includes child-rearing), moral standards tend to diminish. On the other hand, differences can also arise from excess (overabundance), which leads to a loss of moral sensibility.
Male respondents expressed the following views in relation to the keyword "child-rearing" (again, this is a summary):
- Rules of behavior, morality, and ethics are often defined in vague and broad terms. They serve merely as guidelines for child-rearing and allow a high degree of freedom.
- Children and parents are unique individuals, and it is impossible to predict the outcome of upbringing.
- Parenting styles vary due to factors like the parents themselves, lack of education, indecisiveness, inconsistency, and a lack of understanding of the importance of family and the child's role within it.
- First, different societies (even historically) have different needs, which shape their moral frameworks and values.
- Second, every individual has their own specific set of values.
- Third, parenting is also influenced by current external factors—including negative ones, such as alcoholism.
Cultural (and/or geographical) differences, personality differences, differences in how parents were raised as children, and economic disparities all contribute to variation in parenting.
People differ, and without a foundation of shared values, mutual respect, and trust, effective parenting is not possible. Parenting is primarily based on imitation. Words and yelling carry little weight. Early phases of child-rearing often involve modeling behavior, followed by gentle, non-coercive guidance. It is important to allow the development of individuality rather than suppress the ego. Attitudes toward and understanding of normative models vary greatly among individuals, influenced by cultural background, upbringing, religion, and environment.
Parental values and social models, along with strong environmental influences, play a major role in the upbringing and information processing of adolescents.

Global individualism leads to everyone doing things "their own way," making each person unique with their own perspective on parenting. However, it remains uncertain to what extent child-rearing practices truly differ.

Rules, moral, and ethical principles are learned through upbringing and further shaped by interaction with the surrounding environment. Different environments create different foundations for child-rearing. The diversity of the human brain—largely influenced by genetics—adds further nuances. A lack of empathy or poor social skills, whether due to upbringing or genetics, can significantly alter parenting styles. Parenting is also heavily influenced by lived experiences; childhood or adult trauma can surface in parenting behaviors, just as a conflict-free youth may result in later difficulties managing conflicts with teenage children.

Human beings have two opposing drives: the need to belong and the need to stand out. The first enhances group and individual safety, while the second supports personal advancement in society. Normative systems foster group and individual safety. Heredity influences whether a person is more inclined to conform to norms or to deviate from them. Thus, parenting requires adaptation to the individual child.

Differences in parenting also arise from secondary socialization factors, genetics—which cannot be fully shaped by upbringing—and subjective interpretations of what constitutes a "norm" (by parents). In general, children are raised in a similar Western framework, with only minor deviations. Most of the child-rearing is effectively carried out by society. Different parental definitions regarding the importance of values lead to different parenting styles, while individual goals of parents influence the amount of time and attention they devote to their children. The foundations of parenting lie in moral values, support in socializing within society, and the ability to cope in difficult situations—something that can be provided by a single parent, a lesbian couple, or a monogamous family, among others. These differences arise from varying cultural and sociological environments. Even within the same cultural system, divergences occur due to differing worldviews, beliefs about humanity, and perceptions of God. Not everyone shares the same moral-ethical outlooks—not even within the same town or family. Parenting approaches are shaped by one's belief system. In summary, based on the opinions presented, male respondents tended to place greater emphasis on differences in child-rearing, especially due to the presence of normative systems (e.g., ethics, morality, values, behavioral rules), as well as the influence of genetics and culture. In contrast, female respondents focused more on individuals, their personality traits or structures, learned behavior patterns, and the consistency or inconsistency of parents in raising children. There were no significant differences between the genders regarding opinions on the influence of environment and time on child-rearing practices.

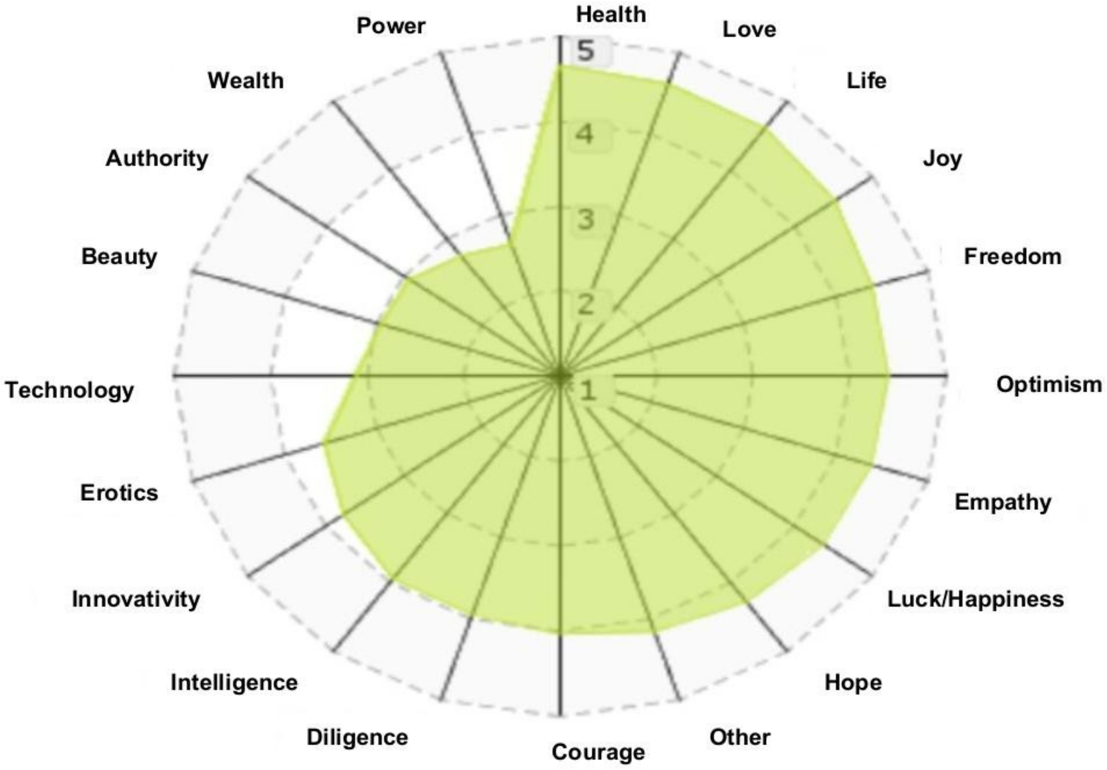
3.6.7 Evaluating values

In the ninth question, respondents were asked to rate various values on a scale from 1 (lowest rating) to 5 (highest rating). These values included: health, love, life, joy, freedom, optimism, empathy, happiness, hope, courage, diligence, intelligence, innovation, eroticism, technology, beauty, authority, wealth, and power. Under the "other" option, respondents could add and rate additional values or simply express their opinions.

3.6.7.1 Table 83: Statistical data on estimated values

Sub-questions	Responses						Valid	N. units	Average	Std. deviation
	1	2	3	4	5	Total				
Love	9 (2%)	2 (0%)	19 (4%)	83 (19%)	315 (74%)	428 (100%)	428	428	4.6	0.8
Freedom	7 (2%)	6 (1%)	39 (9%)	133 (31%)	243 (57%)	428 (100%)	428	428	4.4	0.8
Luck/happiness	8 (2%)	9 (2%)	49 (11%)	113 (26%)	249 (58%)	428 (100%)	428	428	4.4	0.9
Wealth	37 (9%)	113 (26%)	210 (49%)	54 (13%)	14 (3%)	428 (100%)	428	428	2.8	0.9
Power	67 (16%)	106 (25%)	187 (44%)	53 (12%)	15 (4%)	428 (100%)	428	428	2.6	1.0
Authority	33 (8%)	98 (23%)	187 (44%)	87 (20%)	23 (5%)	428 (100%)	428	428	2.9	1.0
Courage	9 (2%)	13 (3%)	85 (20%)	170 (40%)	151 (35%)	428 (100%)	428	428	4.0	0.9
Joy	7 (2%)	4 (1%)	20 (5%)	126 (29%)	271 (63%)	428 (100%)	428	428	4.5	0.8
Intelligence	8 (2%)	16 (4%)	106 (25%)	159 (37%)	139 (32%)	428 (100%)	428	428	3.9	0.9
Empathy	14 (3%)	8 (2%)	38 (9%)	105 (25%)	263 (61%)	428 (100%)	428	428	4.4	1.0
Life	10 (2%)	4 (1%)	29 (7%)	56 (13%)	329 (77%)	428 (100%)	428	428	4.6	0.8
Diligence	7 (2%)	12 (3%)	100 (23%)	184 (43%)	125 (29%)	428 (100%)	428	428	4.0	0.9
Innovation	11 (3%)	23 (5%)	118 (28%)	176 (41%)	100 (23%)	428 (100%)	428	428	3.8	1.0
Optimism	6 (1%)	5 (1%)	40 (9%)	138 (32%)	239 (56%)	428 (100%)	428	428	4.4	0.8
Erotica	17 (4%)	33 (8%)	145 (34%)	158 (37%)	75 (18%)	428 (100%)	428	428	3.6	1.0
Technology	30 (7%)	75 (18%)	176 (41%)	113 (26%)	34 (8%)	428 (100%)	428	428	3.1	1.0
Health	9 (2%)	4 (1%)	21 (5%)	57 (13%)	337 (79%)	428 (100%)	428	428	4.7	0.8
Beauty	36 (8%)	85 (20%)	193 (45%)	92 (21%)	22 (5%)	428 (100%)	428	428	3.0	1.0
Hope	9 (2%)	9 (2%)	55 (13%)	134 (31%)	221 (52%)	428 (100%)	428	428	4.3	0.9
Other:	9 (12%)	0 (0%)	10 (13%)	8 (11%)	49 (64%)	76 (100%)	76	428	4.2	1.4

Table 83 presents statistical data on rated values using a scale from 1 to 5. The data includes information on values, numerical data regarding the number and percentages of each rating based on the evaluation scale, the number of respondents who rated the given values, the average ratings for each value, and the standard deviations of the ratings for each value, listed in the last column. A polar diagram, which will follow, will display the results of the rated values from the aforementioned table.



3.6.7.2 Figure 106: Polar diagram of assessed values

Figure 106 displays a polar diagram of assessed values on a rating scale from 1 to 5. It can be observed that the value "Health" received the highest ratings (average score of 4.7 with a standard deviation of 0.8) from 428 respondents. This is followed by values such as:

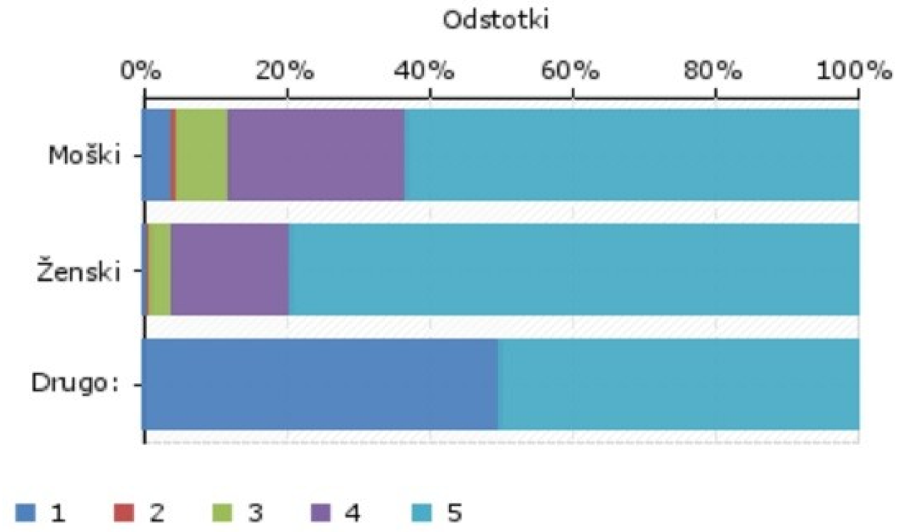
- "Love" (average score: 4.6, standard deviation: 0.8)
- "Life" (average score: 4.6, standard deviation: 0.8)
- "Joy" (average score: 4.5, standard deviation: 0.8)
- "Freedom" (average score: 4.4, standard deviation: 0.8)
- "Optimism" (average score: 4.4, standard deviation: 0.8)
- "Empathy" (average score: 4.4, standard deviation: 1.0)
- "Luck/Happiness" (average score: 4.4, standard deviation: 0.9)
- "Hope" (average score: 4.3, standard deviation: 0.8)
- "Courage" (average score: 4.0, standard deviation: 0.9)
- "Diligence" (average score: 4.0, standard deviation: 0.9)
- "Intelligence" (average score: 3.9, standard deviation: 0.9)
- "Innovation" (average score: 3.8, standard deviation: 1.0)
- "Eroticism" (average score: 3.6, standard deviation: 1.0)

- "Technology" (average score: 3.1, standard deviation: 1.0)
- "Beauty" (average score: 3.0, standard deviation: 1.0)
- "Authority" (average score: 2.9, standard deviation: 1.0)
- "Wealth" (average score: 2.8, standard deviation: 0.9)
- "Power" (average score: 2.6, standard deviation: 1.0).

Under the option “Other” (average score of 4.2 with a standard deviation of 1.4), some respondents listed and rated additional values such as respect, trust, faith, honesty, acceptance, truth, kindness, reliability, selflessness, communication, cooperation, responsibility, education, independence, attentiveness, willpower, self-confidence, support, justice, security, solidarity, personal growth, alliance-building, acceptance, creativity, knowledge acquisition, money management, reasoning skills, listening skills, passion for life or work adaptability to circumstances. One respondent listed Bosnia and Slovenia as values while another found the question meaningless and unclear. Two respondents mentioned that values such as technology, eroticism, and love are not true values—an interesting perspective that could spark broader discussions on defining values in general terms. Values can be categorized into absolute and relative ones; for instance, technology and eroticism would fall under relative values in this classification system.

3.6.7.3 Table 84: Ratings for the value of Love by gender based on frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	6 (4%)	1 (1%)	11 (7%)	37 (25%)	94 (63%)	149 (100%)
Female (Ženski)	2 (1%)	1 (0%)	8 (3%)	46 (17%)	220 (79%)	277 (100%)
Other (Drugo)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	2 (100%)
Total	9 (2%)	2 (0%)	19 (4%)	83 (19%)	315 (74%)	428 (100%)



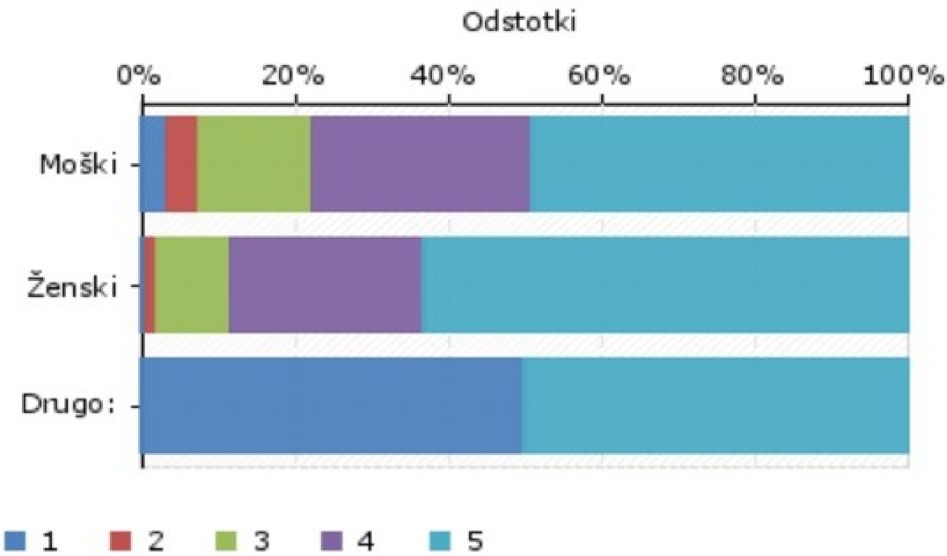
3.6.7.4 Figure 107: Ratings for the value of love by gender in percentages

Figure 107 illustrates the ratings for the value of love by gender in percentages (the table provides statistical data in numbers and percentages). The figure shows the distribution of ratings on the evaluation scale between genders. Due to low frequency, the third gender or "Other" category is excluded from the description, which also applies to subsequent examples.

In general, it can be concluded that both genders gave high ratings to the value of love, as lower ratings (1 to 3) were relatively rare. Women (220; 79%) assigned a higher number of top ratings compared to men (94; 63%). For other ratings (1 to 4), men slightly outnumbered women (e.g., rating 4: men—37 or 25%; women—46 or 17%).

3.6.7.5 Table 85: Ratings for the value of luck/happiness by gender based on frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	5 (3%)	6 (4%)	22 (15%)	43 (29%)	73 (49%)	149 (100%)
Female (Ženski)	2 (1%)	4 (3%)	27 (10%)	70 (25%)	175 (63%)	277 (100%)
Other (Drugo)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	2 (100%)
Total	8 (2%)	9 (2%)	49 (11%)	113 (26%)	249 (58%)	428 (100%)

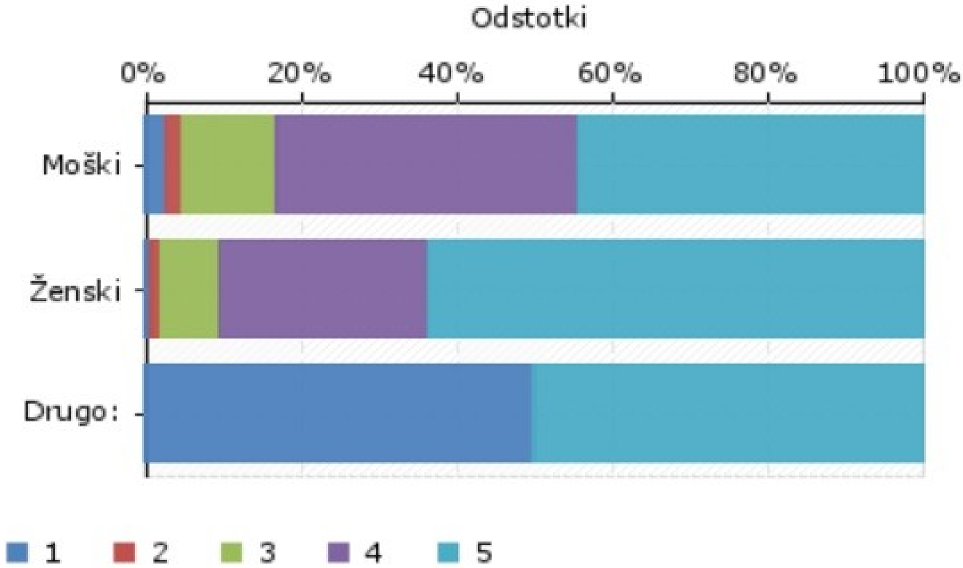


3.6.7.6 Figure 108: Ratings for the value of luck/happiness in percentages

Figure 108 illustrates the ratings for the value of happiness by gender in percentages (the table provides statistical data in numbers and percentages). The figure shows the distribution of ratings on the evaluation scale between genders. In general, it can be observed that both genders gave high ratings to the value of happiness, as lower ratings (1 to 2) were relatively rare. The rating of 3 was more frequently represented in both genders compared to the value of love (women: 27 or 10%; men: 22 or 15%). Overall, women (175; 63%) assigned a higher number of top ratings compared to men (73; 49%). For other ratings (1 to 4), men had a slight advantage (e.g., rating 4: men—43 or 29%; women—70 or 25%). We will proceed with the value of freedom next.

3.6.7.7 Table 86: Ratings for the value of freedom by gender based on frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	4 (3%)	3 (2%)	18 (12%)	58 (39%)	66 (44%)	149 (100%)
Female (Ženski)	2 (1%)	3 (1%)	21 (8%)	75 (27%)	176 (64%)	277 (100%)
Other (Drugo)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	2 (100%)
Total	7 (2%)	6 (1%)	39 (9%)	133 (31%)	243 (57%)	428 (100%)



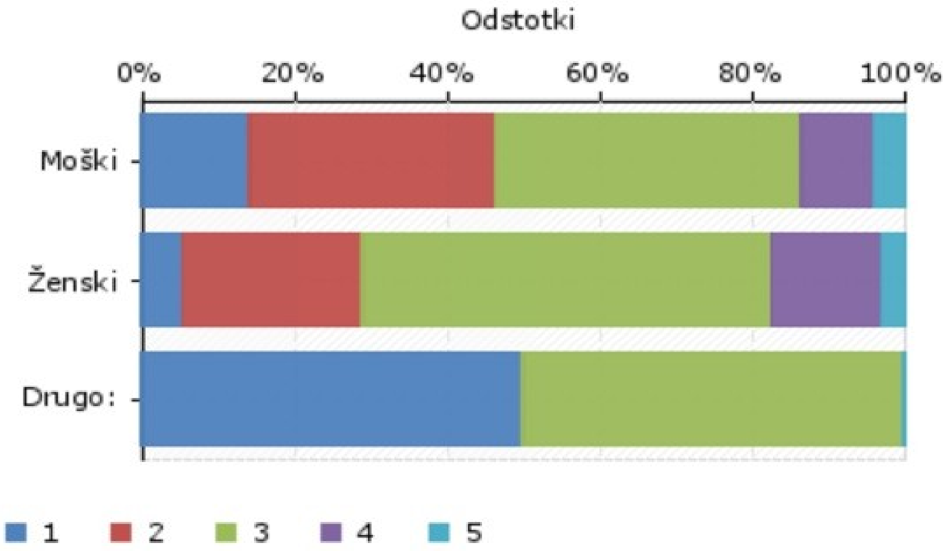
3.6.7.8 Figure 109: Ratings for the value of freedom in percentages

Figure 109 illustrates the ratings for the value of freedom by gender, expressed in percentages (the table provides statistical data in numbers and percentages). It shows the distribution of ratings on the evaluation scale between genders. In general, it can be observed that both genders gave high ratings to the value of freedom, as lower ratings (1–2) were relatively rare. For the rating of 3, both genders showed a similar pattern to that observed for the value of happiness (women: 21 or 8%; men: 28 or 12%).

Overall, women (176 or 64%) assigned a higher number of the highest possible ratings to this value compared to men (66 or 44%). For other ratings (1–4), men again had a slight advantage (e.g., rating 4: men—58 or 39%; women—75 or 27%).

3.6.7.9 Table 87: Ratings for the value 'wealth' by gender, according to frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	21 (14%)	48 (32%)	60 (40%)	14 (9%)	6 (4%)	149 (100%)
Female (Ženski)	15 (5%)	65 (23%)	149 (54%)	40 (14%)	8 (3%)	277 (100%)
Other (Drugo)	1 (50%)	0 (0%)	1 (50%)	0 (0%)	0 (0%)	2 (100%)
Total	37 (9%)	113 (26%)	210 (49%)	54 (13%)	14 (3%)	428 (100%)



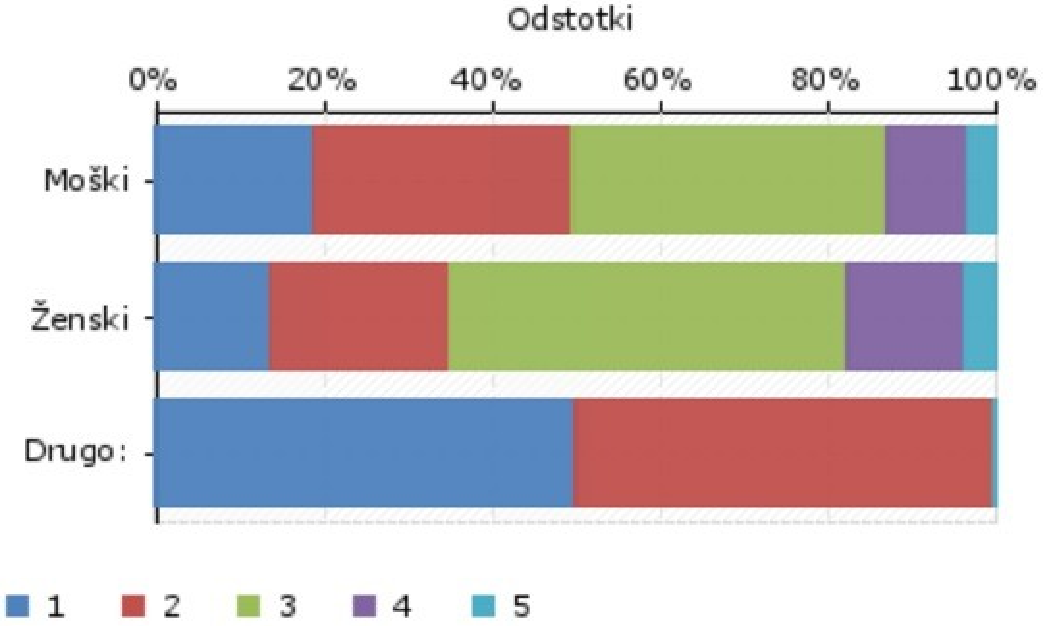
3.6.8 Figure 110: Ratings for the value 'wealth' in percentages

Figure 110 shows the ratings for the value wealth by gender, expressed in percentages (the table presents statistical data in both numbers and percentages). It reveals the distribution of ratings on the evaluation scale between genders. Overall, we can conclude that both genders assigned lower ratings to the value wealth, as higher ratings (4–5) are relatively rare. Members of both genders most frequently rated wealth with a score of 3 (women: 149 or 54%; men: 60 or 40%).

In general, female respondents rated wealth higher than male respondents (see values in Table 87). With regard to the highest possible rating (5), it can be observed that male respondents are slightly ahead (6 or 4%; women: 8 or 3%). The reason why female respondents assigned greater importance to wealth than male respondents likely lies in the assumption that women more closely associate this value with security or with ensuring a stable and secure family life.

3.6.8.1 Table 88: Ratings for the value of power by gender based on frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	28 (19%)	46 (31%)	56 (38%)	14 (9%)	5 (3%)	149 (100%)
Female (Ženski)	38 (14%)	59 (21%)	131 (47%)	39 (14%)	10 (4%)	277 (100%)
Other (Drugo)	1 (50%)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	2 (100%)
Total	67 (16%)	106 (25%)	187 (44%)	53 (12%)	15 (4%)	428 (100%)

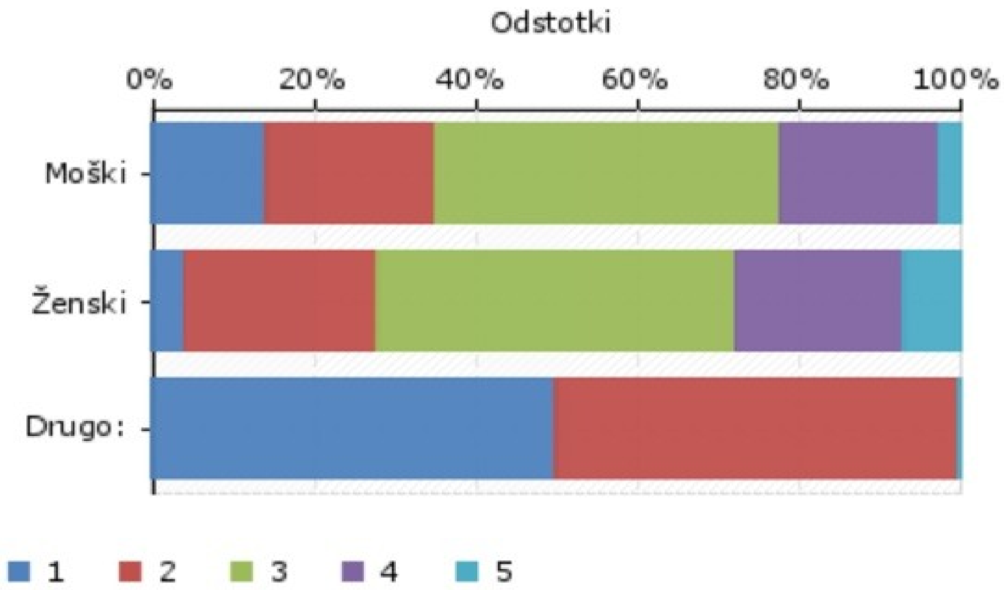


3.6.8.2 Figure 111: Ratings for the value 'power' in percentages

Figure 111 presents the ratings for the value power by gender, expressed in percentages (the table displays statistical data in both numbers and percentages). It shows how the ratings are distributed across the evaluation scale between genders. Overall, we can conclude that both genders assigned lower ratings to the value power, as higher ratings (4–5) are relatively few. Members of both genders most frequently rated power with a score of 3 (women: 131 or 47%; men: 56 or 38%). Similar to the value wealth, we can observe that female respondents rated the value power higher than male respondents (see values in Table 88). Regarding the highest possible rating (5), female respondents are slightly ahead (10 or 4%; men: 5 or 3%). In this case as well, a similar assumption could be made as in the previous example.

3.6.8.3 Table 89: Ratings for the value of authority by gender based on frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	21 (14%)	31 (21%)	64 (43%)	29 (19%)	4 (3%)	149 (100%)
Female (Ženski)	11 (4%)	66 (24%)	123 (44%)	58 (21%)	19 (7%)	277 (100%)
Other (Drugo)	1 (50%)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	2 (100%)
Total	33 (8%)	98 (23%)	187 (44%)	87 (20%)	23 (5%)	428 (100%)



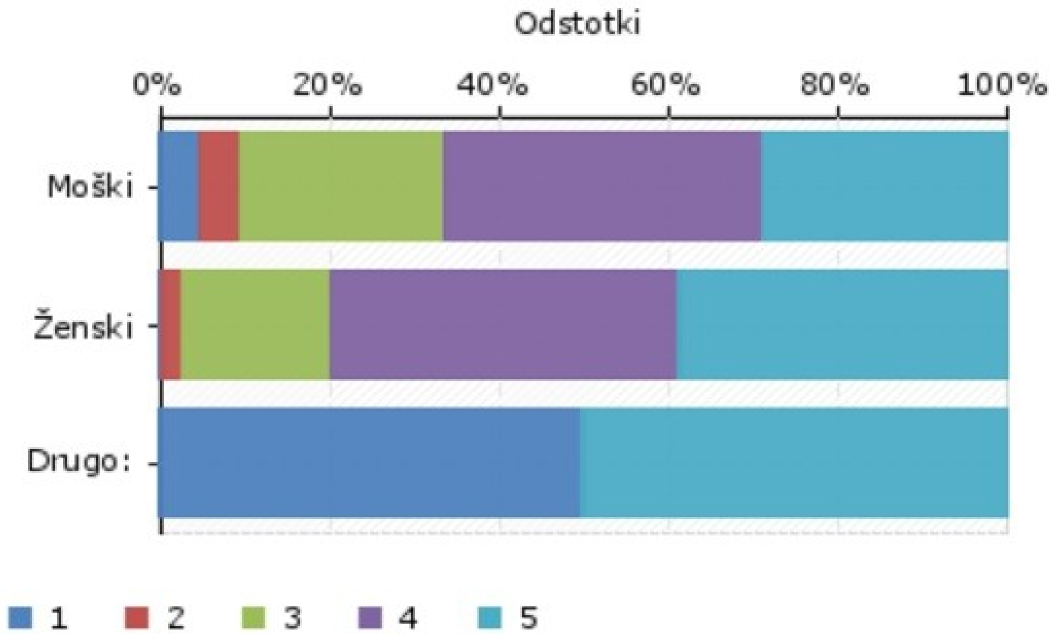
3.6.8.4 Figure 112: Ratings for the value 'authority' in percentages

Figure 112 presents the ratings for the value authority by gender, expressed in percentages (the table displays statistical data in both numbers and percentages). It shows the distribution of ratings on the evaluation scale between genders. Overall, we can conclude that both genders assigned lower ratings to the value authority, although a rating of 4 was relatively frequently given by both genders (men: 29 or 19%; women: 58 or 21%). Members of both genders most commonly rated authority with a score of 3 (women: 123 or 44%; men: 64 or 43%).

Similar to the value power, we can observe that female respondents rated the value authority higher than male respondents (see values in Table 89). Regarding the highest possible rating (5), female respondents are ahead (19 or 7%; men: 4 or 3%). In this case as well, a similar assumption can be made as in the two previous examples.

3.6.8.5 Table 90: Ratings for the value of courage by gender based on frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	7 (5%)	7 (5%)	36 (24%)	56 (38%)	43 (29%)	149 (100%)
Female (Ženski)	11 (4%)	6 (2%)	6 (2%)	114 (41%)	107 (39%)	277 (100%)
Other (Drugo)	1 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	2 (100%)
Total	9 (2%)	13 (3%)	85 (20%)	170 (40%)	151 (35%)	428 (100%)



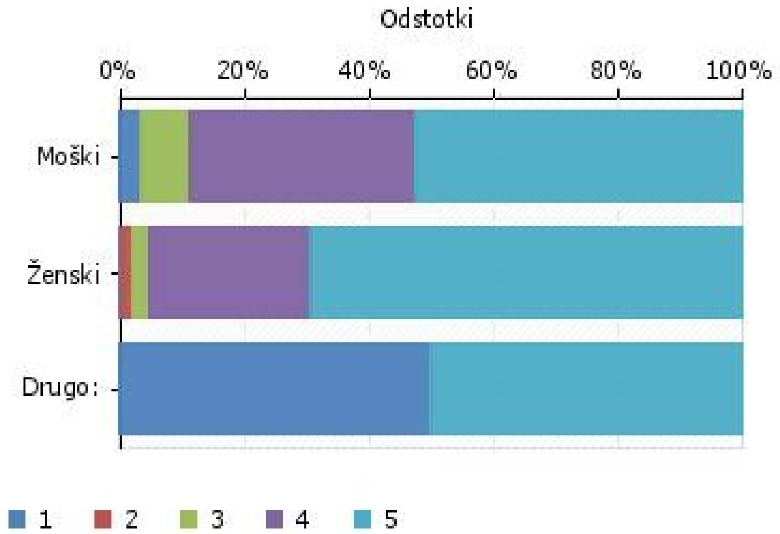
3.6.8.6 Figure 113: Ratings for the value 'courage' in percentages

Figure 113 presents the ratings for the value courage by gender, expressed in percentages (the table displays statistical data in both numbers and percentages). It shows the distribution of ratings on the evaluation scale between genders. Overall, we can conclude that both genders assigned high ratings to the value courage, as lower ratings (1–2) were relatively rare. Notably, a rating of 4 was very frequently given by both women (114 or 41%) and men (56 or 38%).

Female respondents (107 or 39%) assigned the highest possible rating more often than male respondents (43 or 29%). For ratings 1–2, male respondents had a slight lead (e.g., rating 1: men 7 or 5%; women 11 or 4%). Male respondents also gave the rating of 3 (36 or 24%) much more frequently than female respondents (6 or 2%) when evaluating the value courage.

3.6.8.7 Table 91: Ratings for the value of joy by gender based on frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	5 (3%)	0 (0%)	12 (8%)	54 (36%)	78 (52%)	149 (100%)
Female (Ženski)	1 (0%)	4 (1%)	8 (3%)	72 (26%)	192 (69%)	277 (100%)
Other (Drugo)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	2 (100%)
Total	7 (2%)	4 (1%)	20 (5%)	126 (29%)	271 (63%)	428 (100%)



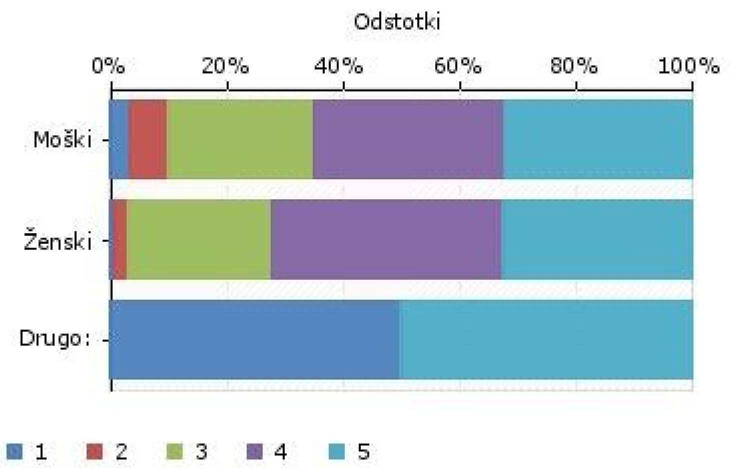
3.6.8.8 Figure 114: Ratings for the value 'joy' in percentages

Figure 114 presents the ratings for the value joy by gender, expressed in percentages (the table displays statistical data in both numbers and percentages). It shows the distribution of ratings on the evaluation scale between genders. Overall, we can conclude that both genders assigned high ratings to the value joy, as lower ratings (1–3) were relatively rare. A rating of 3 was more frequently given by male respondents (12 or 8%) compared to female respondents (8 or 3%).

In general, female respondents (192 or 69%) assigned the highest possible rating to this value more often than male respondents (78 or 52%). Regarding the other ratings (1–4), male respondents were slightly ahead (e.g., rating 4: 54 or 36%; women: 72 or 26%).

3.6.8.9 Table 92: Ratings for the value of intelligence by gender based on frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	5 (3%)	10 (7%)	37 (25%)	49 (33%)	48 (32%)	149 (100%)
Female (Ženski)	2 (1%)	6 (2%)	69 (25%)	110 (40%)	90 (32%)	277 (100%)
Other (Drugo)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	2 (100%)
Total	8 (2%)	16 (4%)	106 (25%)	159 (37%)	139 (32%)	428 (100%)

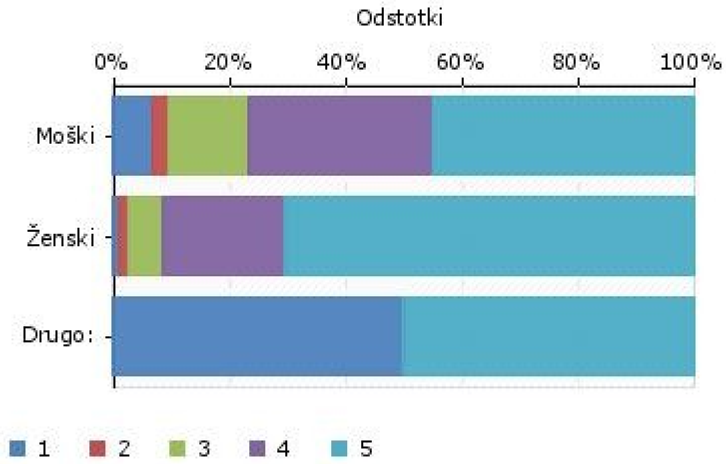


3.6.9 Figure 115: Ratings for the value 'intelligence' in percentages

Figure 115 presents the ratings for the value intelligence by gender, expressed in percentages (the table displays statistical data in both numbers and percentages). It shows the distribution of ratings on the evaluation scale between genders. Overall, we can conclude that both genders assigned high ratings to the value intelligence, as lower ratings (1–2) were relatively rare. A rating of 3 was more frequently given by both male and female respondents (men: 37 or 25%; women: 69 or 25%).
A rating of 5 was also very frequently assigned by both genders (women: 90 or 32%; men: 48 or 32%). However, the most commonly given rating was 4 (men: 49 or 33%; women: 110 or 40%).

3.6.9.1 Table 93: Ratings for the value of empathy by gender based on frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	10 (7%)	4 (3%)	21 (14%)	47 (32%)	67 (45%)	149 (100%)
Female (Ženski)	3 (1%)	4 (1%)	17 (6%)	58 (21%)	195 (70%)	277 (100%)
Other (Drugo)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	2 (100%)
Total	14 (3%)	8 (2%)	38 (9%)	105 (25%)	263 (61%)	428 (100%)



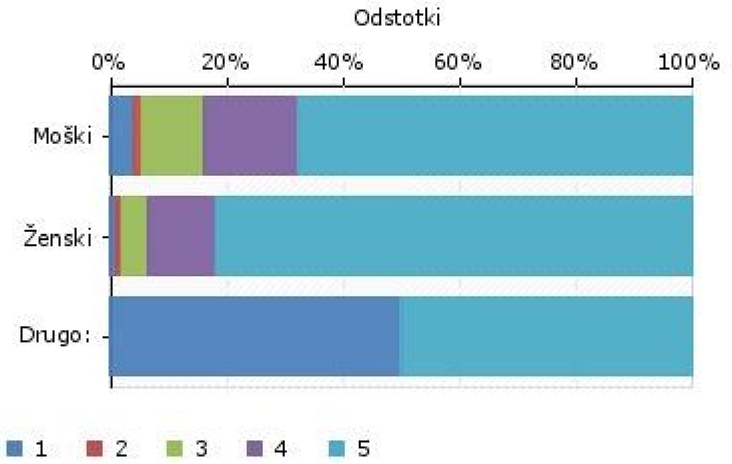
3.6.9.2 Figure 116: Ratings for the value 'empathy' by gender in percentages

Figure 116 presents the ratings for the value empathy by gender, expressed in percentages (the table displays statistical data in both numbers and percentages). It shows the distribution of ratings on the evaluation scale between genders. Overall, we can conclude that both genders assigned high ratings to the value empathy, as lower ratings (1–2) were relatively rare. A rating of 3 was more frequently given by male respondents (men: 21 or 14%) compared to female respondents (17 or 6%).

A rating of 5 was very frequently assigned by both genders (women: 195 or 70%; men: 67 or 45%). The same applies to rating 4 (men: 47 or 32%; women: 58 or 21%).

3.6.9.3 Table 94: Ratings for the value of life by gender based on frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	6 (4%)	2 (1%)	16 (11%)	24 (16%)	101 (68%)	149 (100%)
Female (Ženski)	3 (1%)	2 (1%)	13 (5%)	32 (12%)	227 (82%)	277 (100%)
Other (Drugo)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	2 (100%)
Total	10 (2%)	4 (1%)	29 (7%)	56 (13%)	329 (77%)	428 (100%)



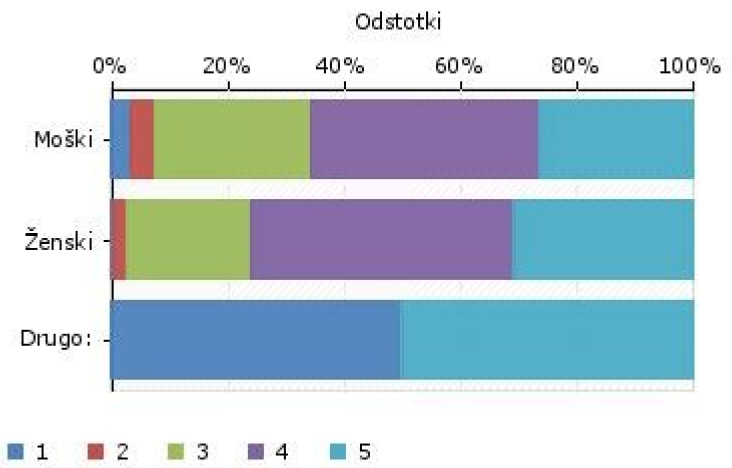
3.6.9.4 Figure 117: Ratings for the value 'life' by gender in percentages

Figure 117 presents the ratings for the value life by gender, expressed in percentages (the table displays statistical data in both numbers and percentages). It shows the distribution of ratings on the evaluation scale between genders. Overall, we can conclude that both genders assigned high ratings to the value life, as lower ratings (1–3) were relatively rare. A rating of 3 was more frequently given by male respondents (16 or 11%) than by female respondents (13 or 5%).

In general, female respondents (227 or 82%) assigned the highest possible rating to this value more often than male respondents (101 or 68%). Regarding the other ratings (1–4), male respondents were slightly ahead (e.g., rating 4: 24 or 16%; women: 32 or 12%).

3.6.9.5 Table 95: Ratings for the value of diligence by gender based on frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	5 (3%)	6 (4%)	40 (27%)	59 (40%)	39 (26%)	149 (100%)
Female (Ženski)	1 (0%)	6 (2%)	60 (22%)	125 (45%)	85 (31%)	277 (100%)
Other (Drugo)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	2 (100%)
Total	7 (2%)	12 (3%)	100 (23%)	184 (43%)	125 (29%)	428 (100%)



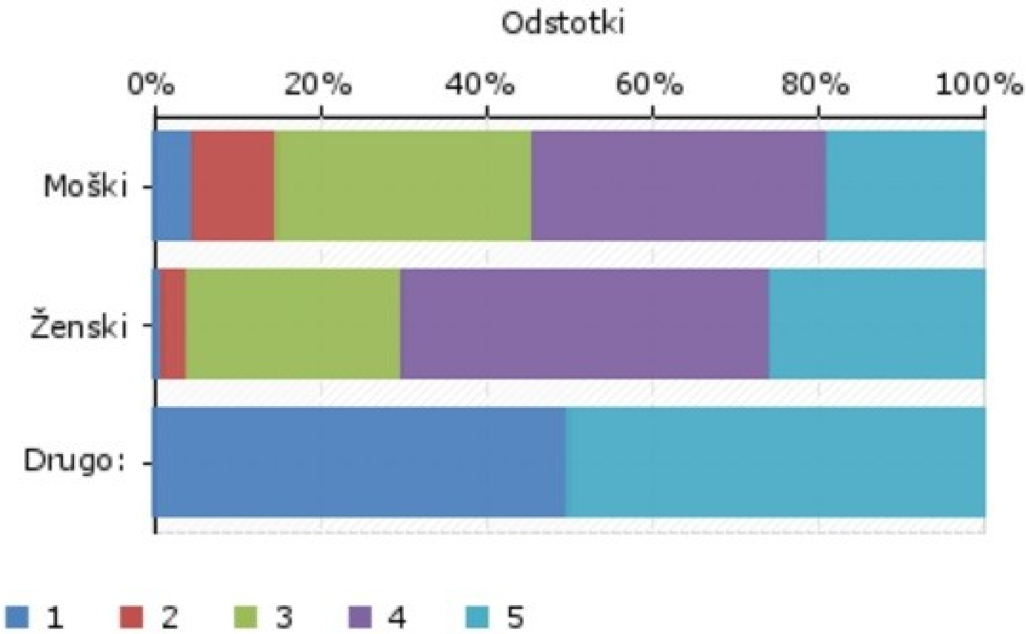
3.6.9.6 Figure 118: Ratings for the value 'diligence' by gender in percentages

Figure 118 presents the ratings for the value diligence by gender, expressed in percentages (the table displays statistical data in both numbers and percentages). It shows the distribution of ratings on the evaluation scale between genders. Overall, we can conclude that both genders assigned high ratings to the value diligence, as lower ratings (1–2) were relatively rare. A rating of 3 was more frequently given by male respondents (40 or 27%) compared to female respondents (60 or 22%).

In general, female respondents (85 or 31%) assigned the highest possible rating to this value more often than male respondents (29 or 26%). For ratings 1–3, male respondents were slightly ahead (e.g., rating 2: 6 or 4%; women: 6 or 2%). For rating 4, female respondents had a slight lead (women: 85 or 31%; men: 39 or 26%).

3.6.9.7 Table 96: Ratings for the value of innovativeness by gender by frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	7 (5%)	15 (10%)	46 (31%)	53 (36%)	28 (19%)	149 (100%)
Female (Ženski)	3 (1%)	8 (3%)	72 (26%)	123 (44%)	71 (26%)	277 (100%)
Other (Drugo)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	2 (100%)
Total	11 (3%)	23 (5%)	118 (28%)	176 (41%)	100 (22%)	428 (100%)

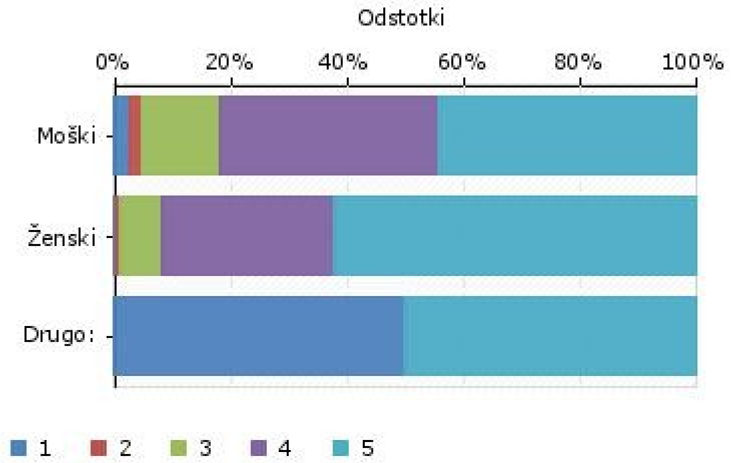


3.6.9.8 Figure 119: Ratings for the value of innovativeness by gender (in percentages)

Figure 119 shows the ratings for the value of innovativeness based on gender, expressed in percentages (the table presents statistical data in both numbers and percentages). It illustrates how ratings were distributed across genders according to the evaluation scale. Overall, it can be observed that both genders gave relatively high ratings to the value of innovativeness, as there were relatively few low ratings (1–2). Rating 3 was more frequently given by male respondents (46 or 31%; females: 72 or 26%). In general, female respondents (71 or 26%) assigned the highest possible rating to this value more often than male respondents (28 or 19%). When considering ratings from 1 to 3, male respondents were more represented (e.g., rating 2: 15 or 10%; females: 8 or 3%). For rating 4, female respondents had a notable lead (females: 123 or 44%; males: 53 or 36%).

3.6.9.9 Table 97: Ratings for the value of optimism by gender by frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	4 (3%)	3 (2%)	20 (13%)	56 (38%)	66 (44%)	149 (100%)
Female (Ženski)	1 (0%)	2 (1%)	20 (7%)	82 (30%)	172 (62%)	277 (100%)
Other (Drugo)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	2 (100%)
Total	6 (1%)	5 (1%)	40 (9%)	138 (32%)	239 (56%)	428 (100%)



3.6.9.9.1 Figure 120: Ratings for the value of optimism by gender (in percentages)

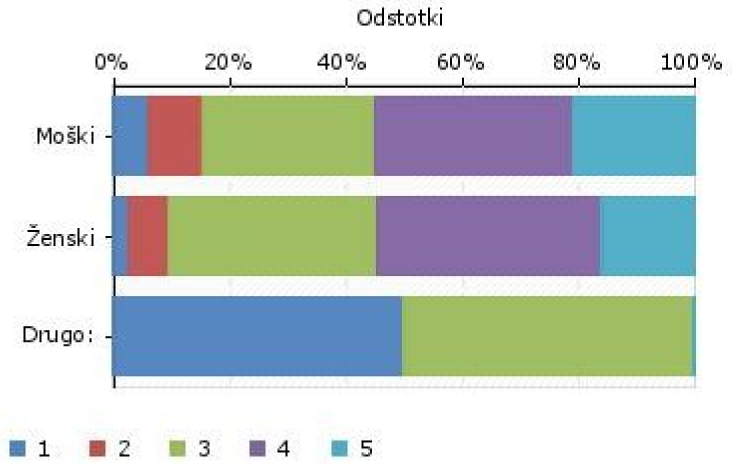
Figure 120 presents the ratings for the value of optimism by gender, expressed in percentages (the table includes statistical data in both numbers and percentages). It shows how ratings were distributed between genders according to the evaluation scale.

In general, it can be concluded that both genders gave high ratings to the value of optimism, as there were relatively few low ratings (1–3). Rating 3 was more frequently given by male respondents (20 or 13%; females: 20 or 7%).

Overall, female respondents (172 or 62%) gave the highest possible rating to this value more often than male respondents (66 or 44%). Regarding the other ratings (1–4), male respondents had a slight advantage (e.g., rating 4: 56 or 38%; females: 82 or 30%).

3.6.9.9.2 Table 98: Ratings for the value of eroticism by gender by frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	9 (6%)	14 (9%)	44 (30%)	51 (34%)	31 (21%)	149 (100%)
Female (Ženski)	7 (3%)	19 (7%)	100 (36%)	107 (39%)	44 (16%)	277 (100%)
Other (Drugo)	1 (50%)	0 (0%)	1 (50%)	0 (0%)	0 (0%)	2 (100%)
Total	17 (4%)	33 (8%)	145 (34%)	158 (37%)	75 (18%)	428 (100%)



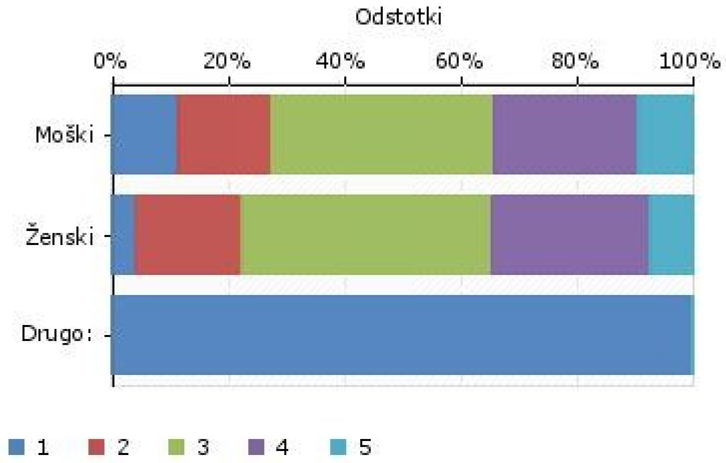
3.6.9.9.3 Figure 121: Ratings for the value of eroticism by gender (in percentages)

Figure 121 shows the ratings for the value of eroticism by gender, expressed in percentages (the table presents statistical data in both numbers and percentages). It illustrates how ratings were distributed across genders according to the evaluation scale. Overall, it can be observed that both genders gave slightly higher ratings to the value of eroticism, as the highest possible rating was fairly often assigned by both men and women (men: 31 or 21%; women: 44 or 16%).Respondents of both genders most frequently gave a rating of 3, which was more often assigned by female respondents (women: 100 or 36%; men: 44 or 30%).

Regarding the other ratings (1–4), female respondents had a slight advantage (e.g., rating 4: women: 107 or 39%; men: 51 or 34%). It can be said that, as expected, men rated the value of eroticism slightly higher than women.

3.6.9.9.4 Table 99: Ratings for the value of technology by gender by frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	17 (11%)	24 (16%)	57 (38%)	37 (25%)	14 (9%)	149 (100%)
Female (Ženski)	11 (4%)	51 (18%)	119 (43%)	76 (27%)	20 (7%)	277 (100%)
Other (Drugo)	2 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (100%)
Total	30 (7%)	75 (18%)	176 (41%)	113 (26%)	34 (8%)	428 (100%)

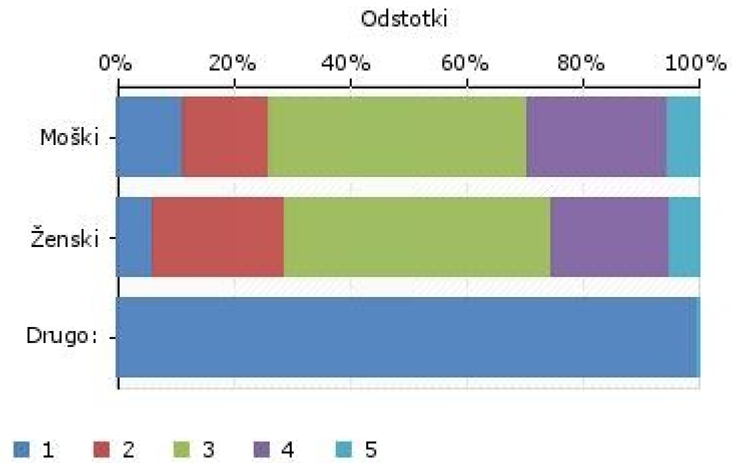


3.6.9.9.5 Figure 122: Ratings for the value of technology by gender (in percentages)

Figure 122 presents the ratings for the value of technology by gender, expressed in percentages (the table includes statistical data in both numbers and percentages). It shows how the ratings were distributed between genders according to the evaluation scale. Overall, it can be observed that both genders gave somewhat lower ratings to the value of technology, as the highest possible rating was less frequently assigned by either gender (men: 14 or 9%; women: 20 or 7%). Respondents of both genders most frequently gave a rating of 3, which was more commonly assigned by female respondents (women: 119 or 43%; men: 57 or 38%). It can be concluded that there are no statistically significant differences between genders in how they rated the value of technology, which is somewhat surprising. One might have expected slightly higher ratings from male respondents, who are generally believed to identify more closely with technology than female respondents. In short, the results indicate that this commonly held stereotype does not hold true.

3.6.9.9.6 Table 100: Ratings for the value of beauty by gender by frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	17 (11%)	22 (15%)	66 (44%)	36 (24%)	8 (5%)	149 (100%)
Female (Ženski)	17 (6%)	63 (23%)	127 (46%)	56 (20%)	14 (5%)	277 (100%)
Other (Drugo)	2 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (100%)
Total	36 (8%)	85 (20%)	193 (45%)	92 (21%)	22 (5%)	428 (100%)



3.6.9.9.7 Figure 123: Ratings for the value of beauty by gender (in percentages)

Figure 123 presents the ratings for the value of beauty by gender, expressed in percentages (the table includes statistical data in both numbers and percentages). It shows how the ratings were distributed between genders according to the evaluation scale.

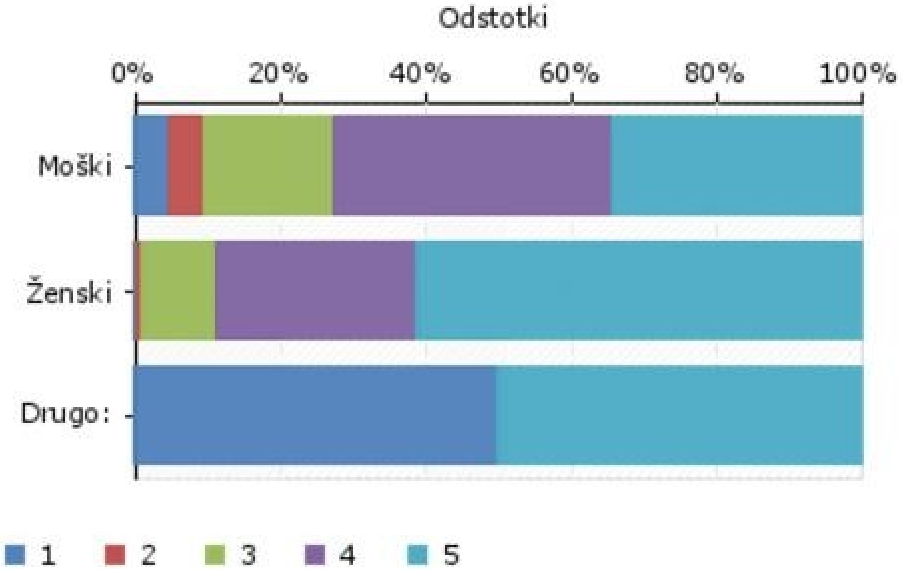
Overall, it can be observed that both genders gave lower ratings to the value of beauty, as the highest possible rating was assigned relatively infrequently by both men and women (men: 8 or 5%; women: 14 or 5%).

Respondents of both genders most frequently gave a rating of 3, which was more often assigned by female respondents (women: 127 or 46%; men: 66 or 44%).

It can be concluded that there are no significant statistical differences between genders in how they rated the value of beauty.

3.6.9.9.8 Table 101: Ratings for the value of hope by gender by frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	7 (5%)	7 (5%)	27 (18%)	57 (38%)	51 (34%)	149 (100%)
Female (Ženski)	1 (0%)	2 (1%)	28 (10%)	77 (28%)	169 (61%)	277 (100%)
Other (Drugo)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	2 (100%)
Total	9 (2%)	9 (2%)	55 (13%)	134 (31%)	221 (52%)	428 (100%)



3.6.9.9.9 Figure 124: Ratings for the value of hope by gender (in percentages)

Figure 124 presents the ratings for the value of hope by gender, expressed in percentages (the table includes statistical data in both numbers and percentages). It shows how the ratings were distributed between genders according to the evaluation scale.

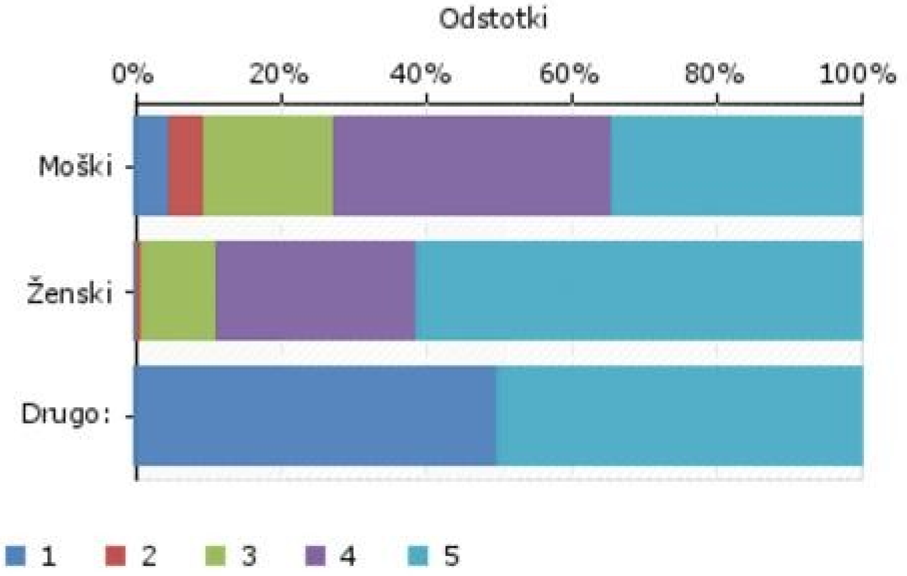
Overall, it can be concluded that both genders gave high ratings to the value of hope, as lower ratings (from 1 to 3) were relatively rare. Rating 3 was more frequently assigned by male respondents (27 or 18%; females: 28 or 10%).

In general, female respondents (169 or 61%) gave a greater number of the highest possible ratings than male respondents (51 or 34%).

For the other ratings (from 1 to 4), it can be said that male respondents were somewhat more represented (e.g., rating 4: men: 57 or 38%; women: 77 or 28%).

3.6.9.9.9.1 Table 102: Ratings for the value of health by gender by frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	4 (3%)	1 (1%)	11 (7%)	27 (18%)	106 (71%)	149 (100%)
Female (Ženski)	4 (1%)	3 (1%)	10 (4%)	30 (11%)	230 (83%)	277 (100%)
Other (Drugo)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	2 (100%)
Total	9 (2%)	4 (1%)	21 (5%)	57 (13%)	337 (79%)	428 (100%)

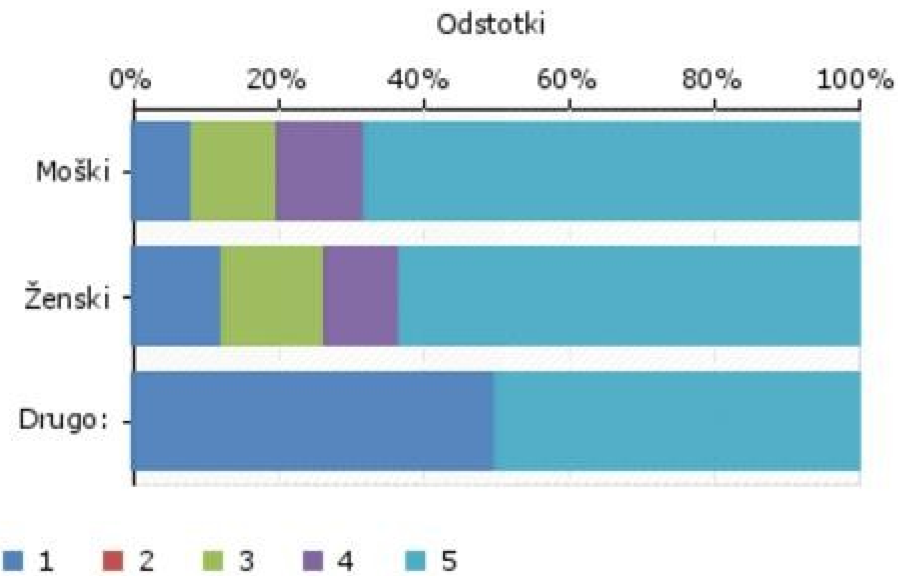


3.6.9.9.9.2 Figure 125: Ratings for the value of health by gender (in percentages)

Figure 125 presents the ratings for the value of health by gender, expressed in percentages (the table includes statistical data in both numbers and percentages). It shows how the ratings were distributed between genders according to the evaluation scale. Overall, it can be observed that both genders gave high ratings to the value of health, as lower ratings (from 1 to 3) were relatively rare. Rating 3 was more frequently assigned by male respondents (11 or 7%; females: 10 or 4%). In general, female respondents (230 or 83%) gave a greater number of the highest possible ratings to this value than male respondents (106 or 71%). For the other ratings (from 1 to 4), male respondents were slightly more represented (e.g., rating 4: men: 27 or 18%; women: 30 or 11%). It can be concluded that women attributed slightly more importance to the value of health than men.

3.6.9.9.9.3 Table 103: Ratings for the option "Other" by gender by frequencies and percentages

Gender	1	2	3	4	5	Total
Male (Moški)	2 (8%)	0 (0%)	3 (12%)	3(12%)	17 (68%)	25 (100%)
Female (Ženski)	6 (12%)	0 (0%)	7 (14%)	5 (10%)	31 (63%)	49 (100%)
Other (Drugo)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	2 (100%)
Total	9 (12%)	0 (0%)	10 (13%)	8 11%)	49 (64%)	76 (100%)



3.6.9.9.9.4 Figure 126: Ratings for the “Other” option by gender (in percentages)

Figure 126 presents the ratings for the “Other” option by gender, expressed in percentages (the table includes statistical data in both numbers and percentages). It shows how the ratings were distributed between genders according to the evaluation scale. Overall, it can be observed that male respondents (e.g., rating 5: 17 or 68%) selected this option slightly more frequently than female respondents (e.g., rating 5: 31 or 63%).

3.6.9.9.9.5 Final Conclusion

It can be concluded that female respondents were generally more generous in assigning the highest rating (5), especially when it came to more positive values (e.g., love, health). In contrast, some male respondents tended to assign lower ratings even to positive values. Regarding less positive values (e.g., wealth, power, authority), women rated these values slightly higher than men, likely because they associated them with security in family life. As seen in the previous analysis of responses to the question about differences in child-rearing, it was clearly shown that women placed significantly more importance on the concept of security than men.

3.7 Most important values for the family

In the tenth question of the online survey questionnaire, respondents were asked to list, using sentence formulations or keywords, the values they believe are most important for a family.

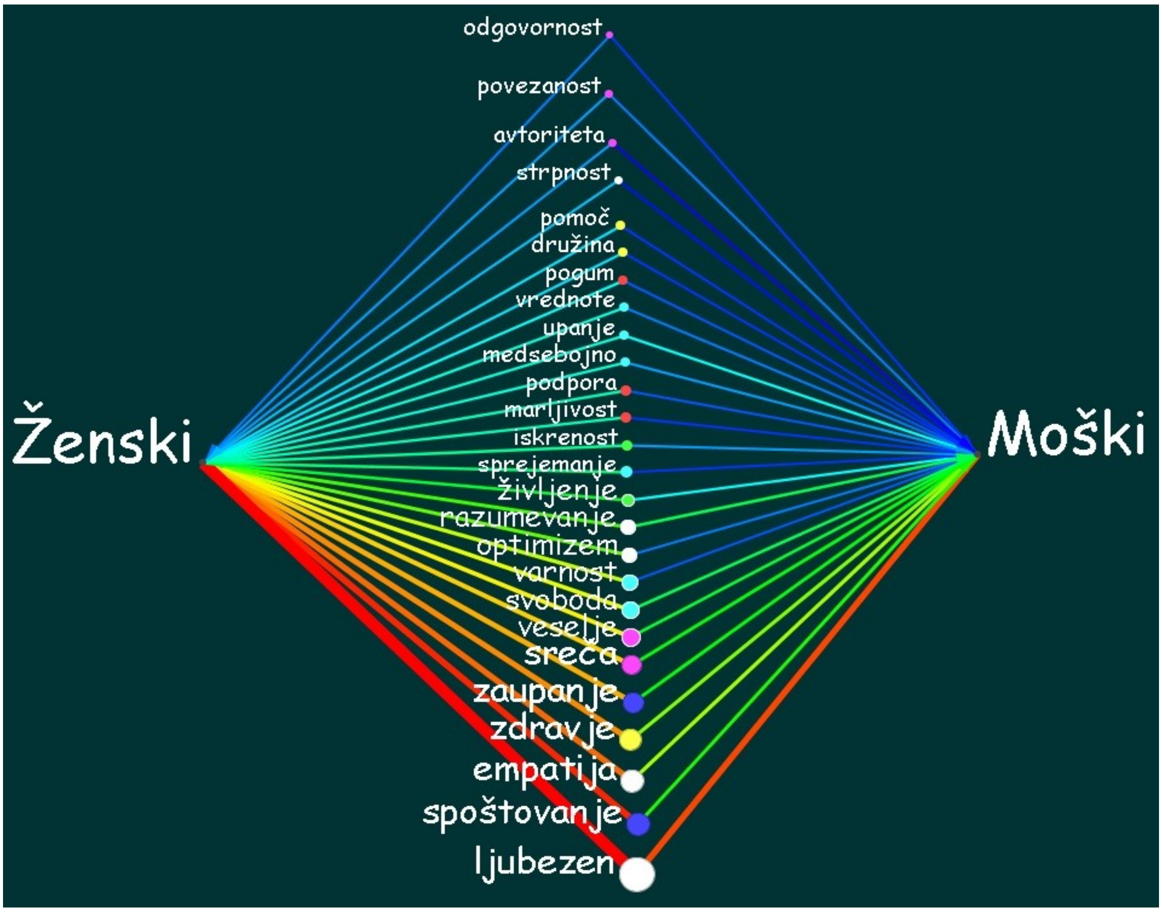
3.7.1 Table 104: Part of the data regarding the most important values for the family

Responses	Frequencies
love, connection	1
love, respect, empathy	2
love, respect, tolerance, attention, compassion, responsibility	1
love, respect, support, happiness/luck	1
trust, love	1
x	1
health, family, love	1
optimism, diligence, joy,	1
love, health, empatihy	1
love, trust, help, empathy, dedication	1
Love, happiness/luck, courage, innovativeness	1
trust and respect	1
love, security, solidarity	1
love, empathy, joy	1
respect, love, freedom, acceptance of diversity, similar values and outlook on life.	1
Love, stability, security	1

Table 104 shows only a small portion of the data on the most important values for families. The complete dataset (excluding frequencies) was imported into the software tool AntConc, which was used to perform a textual analysis of opinions for both female and male representatives (lists of unnecessary words and various word forms were also considered). As a result, structured data were obtained in the form of two tables containing information on ranks, frequency of word occurrences, and keywords. Subsequently, the data were categorized by gender (male/female), and a merging process of both tables was conducted. The outcome of these efforts was a table containing data on the frequency of certain keywords, keywords themselves, and gender (the data preparation process was similar to that used in Question 10). The resulting dataset was then imported into the Ora Casos software tool. It is worth noting that a detailed technical description of the work will be omitted.

3.7.2 Table 105: Partial data for import into the Ora Casos software tool

Frequency	Keyword	Gender
181	Love (Ljubezen)	Female (Ženski)
77	Respect (Spoštovanje)	Female (Ženski)
71	Empathy (Empatija)	Female (Ženski)
66	Health (Zdravje)	Female (Ženski)
76	Love (Ljubezen)	Male (Moški)
31	Empathy (Empatija)	Male (Moški)
28	Health (Zdravje)	Male (Moški)
23	Happiness/luck (Sreča)	Male (Moški)



3.7.3 Figure 127: Key values from the perspective of male and female representatives

Figure 127 illustrates a dual hierarchogram of the most frequent keywords (including various word forms, as previously mentioned) related to the most important values from the perspective of both genders. The identified keywords highlight the most significant family values (keywords with a frequency lower than 6.1 were excluded). The key findings are as follows:

1. Love (word forms: love, loving, to love, etc.): Both male and female representatives most frequently identified this value (see females and males: large white node with a connection strength

of 182.0; males: connection strength of 77.0). A total of 65.70% of women (277) and 51.68% of men (149) rated this value as the most important. This result is unsurprising.

2. Respect (word forms: respect, respecting, etc.): This value was also frequently mentioned by both genders (see females and males: dark blue node with a connection strength of 81.0; males: connection strength of 25.0). Among women, 29.24% considered it the second most important value, while 16.78% of men ranked it fourth.

3. Empathy (word forms: empathy, empathic, etc.): Empathy was another frequently mentioned value (see females and males: white node with a connection strength of 72.0; males: connection strength of 32.0). It was ranked third by 25.29% of women and second by 21.48% of men.

4. Health (word forms: health, healthy, etc.): Health was also commonly mentioned (see females and males: yellow node with a connection strength of 72.0; males: connection strength of 29.0). It was ranked third by both 25.29% of women and 19.46% of men.

5. Trust (word forms: trust, trusting, etc.): Trust was relatively frequently cited (see females and males: dark blue node with a connection strength of 59.0; males: connection strength of 24.0). It was ranked fifth by 21.30% of women and by 16.11% of men.

6. Happiness (word forms: happiness, happy, etc.): Happiness was moderately mentioned (see females and males: pink node with a connection strength of 49.0; males: connection strength of 24.0). It was ranked sixth by 17.69% of women and fifth by 16.11% of men.

7. Joy (word forms: joy, joyful, etc.): Joy was also moderately mentioned (see females and males: pink node with a connection strength of 43.0; males: connection strength of 18.0). It was ranked seventh by both 15.52% of women and 12.08% of men.

8. Freedom (word forms: freedom, free, etc.): Freedom was moderately mentioned as well (see females and males: light blue node with a connection strength of 39.0; males: connection strength of 17.0). It was ranked eighth by both 14.10% of women and 11.40% of men.

9. Safety (word forms: safety, safe, etc.): Safety was moderately cited (see females and males: light blue node with a connection strength of 34.0; males: connection strength of 6.0). It was ranked ninth by 12.27% of women but twelfth by only 4.03% of men.

10. Optimism (word forms: optimism, optimistic, etc.): Optimism appeared moderately often (see females and males: light blue node with a connection strength of 28.0; males: connection strength of 7.0). It was ranked tenth by 10.11% of women but eleventh by only 4.70% of men.

11. Understanding (word forms: understanding, to understand, etc.): Understanding was moderately cited as well (see females and males: white node with a connection strength of 27.0; males: connection strength of 17.0). It was ranked eleventh by only 9.75% of women but eighth by 11.40% of men.

12. Life (word forms: life, living, etc.): Life appeared less frequently but still made the list (see females and males: green node with a connection strength of 18.0; males: connection strength of 11.0). It was ranked twelfth by only 6.50% of women but tenth by only 7.38% of men.

Other terms such as acceptance, honesty, diligence, support, mutuality, hope, values, courage, family, help, tolerance, authority, connectedness, and responsibility were mentioned but not elaborated upon in detail.

Future Analysis

The next section will analyze important values based on age groups, formal education levels, and relationship status using an approach similar to the gender-based analysis described above.

Methodology

The process involves converting unstructured data into structured data using the AntConc software tool (including two lists for unnecessary words and various word forms), exporting word frequency lists into .txt files, and analyzing data across age groups using the Ora Casos software tool for further insights into family values across different demographics.

3.7.4 Important family values by age groups

This section focuses on analyzing family values across different age groups. Specifically, the age groups of 21–40 years and 41–60 years will be examined in detail, while the groups under 20 years and over 61 years will be analyzed only qualitatively due to the limited amount of data.

1. Age Group: Under 20 Years

Only 17 respondents from this age group shared their opinions. Within this group, two values were highlighted as important for families: love and trust. As mentioned earlier, the sample size is too small for quantitative analysis.

2. Age Group: 61 Years or Older

Only 28 respondents from this age group contributed their views. The values identified as important for families include love, respect, empathy, understanding, freedom, health, and happiness. Similar to the under-20 age group, the sample size is insufficient for quantitative analysis.

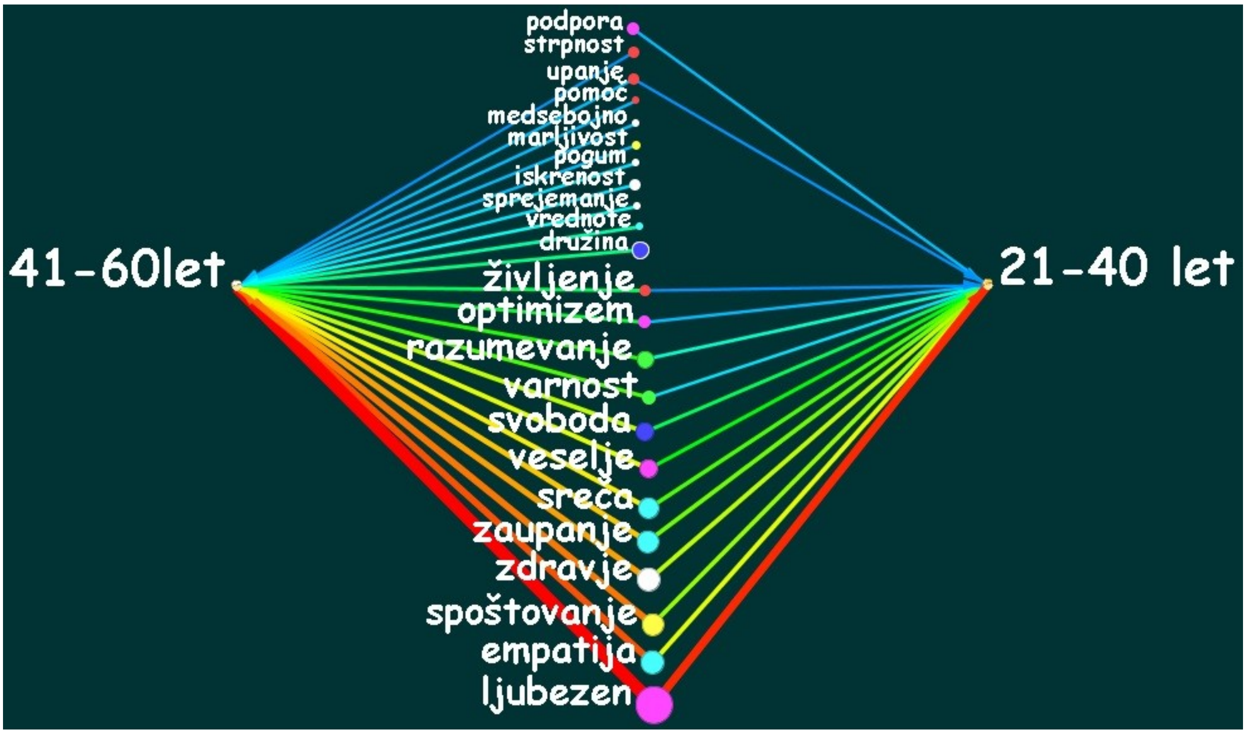
3. Age Groups: 21–40 Years and 41–60 Years

A total of 130 respondents from the 21–40-year age group and 253 respondents from the 41–60-year age group provided their opinions. These sample sizes are large enough to enable quantitative text analysis of family values within these groups.

3.7.4.1 Table 106: Partial data for import into the Ora Casos software tool 2

Frequency	Keyword	Age group
87	Love (Ljubezen)	21-40 years
34	Empathy (Empatija)	21-40 years
32	Health (Zdravje)	21-40 years
30	Respect (Spoštovanje)	21-40 years
150	Love (Ljubezen)	41-60 years
65	Empathy (Empatija)	41-60 years
63	Respect (Spoštovanje)	41-60 years
52	Health (Zdravje)	41-60 years

Table 106 shows a truncated portion of the data for import into the Ora Casos software tool. The indicators include the number or frequency of occurrence of a specific keyword, the keyword itself, and the age group (which includes two categories: 21 to 40 years and 41 to 60 years). This data (in its complete form) was imported into the Ora Casos software tool. It should also be noted here that the technical description of the process within the Ora Casos software tool will be omitted. An important piece of information concerns the exclusion filter setting, which was set to 8.1.



3.7.4.2 Figure 128: Selection of the most important values from the perspective of members of two age groups

Figure 128 presents a selection of the most important values according to members of two age groups (21 to 40 years and 41 to 60 years). Let's examine the key points regarding values for each age group:

1. Love: 67.69% of the younger age group members (130) and 59.68% of the older age group members (253) attributed the greatest importance to this value. Based on these percentages, it can be stated that the family value of love is more important for the younger members than for the older ones.
2. Empathy: 26.92% of the younger age group members (130) and 26.09% of the older age group members (253) attributed the second highest importance to this value. The difference between the two age groups is not statistically significant.
3. Respect: The older age group rated this value as the third most important, while the younger group rated it as fourth. 25.30% of the older age group members (253) and 23.85% of the younger age group members (130) attributed considerable importance to this value. Respect holds slightly greater importance for the older members.
4. Health: The younger age group rated health as the third most important value, while the older group rated it as fourth. 20.95% of the older age group members (253) and 25.38% of the younger age group members (130) attributed considerable importance to this value. Health holds slightly greater importance for the younger members.
5. Trust: 17.39% of the older age group members (253) and 23.08% of the younger age group members (130) attributed the fifth highest importance to this value. Trust holds greater importance for the younger members.
6. Happiness: 15.02% of the older age group members (253) and 20.00% of the younger age group members (130) attributed the sixth highest importance to this value. Happiness holds greater importance for the younger members.
7. Joy: 13.83% of the older age group members (253) and 16.15% of the younger age group members (130) attributed the seventh highest importance to this value. Joy holds greater importance for the younger members.
8. Freedom: 13.04% of the older age group members (253) and 14.61% of the younger age group members (130) attributed the eighth highest importance to this value. Freedom holds slightly greater importance for the younger members.
9. Security: 10.28% of the older age group members (253) and 9.23% of the younger age group members (130) attributed the ninth or tenth highest importance to this value, respectively. Security holds slightly greater importance for the older members.
10. Understanding: 8.70% of the older age group members (253) and 12.31% of the younger age group members (130) attributed the tenth or ninth highest importance to this value, respectively. Understanding holds greater importance for the younger members.

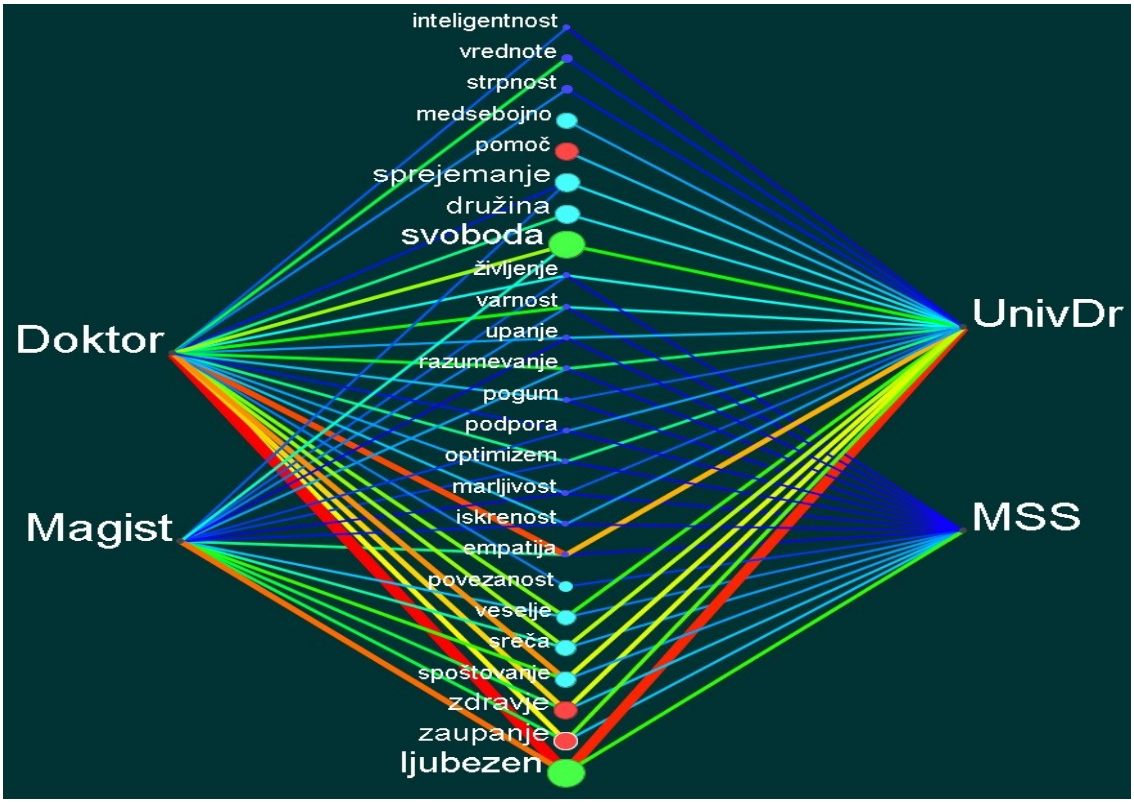
11. Optimism: 7.90% of the older age group members (253) and 8.46% of the younger age group members (130) attributed the eleventh highest importance to this value. Optimism holds slightly greater importance for the older members.
12. Life: 7.51% of the older age group members (253) and 6.92% of the younger age group members (130) attributed the twelfth highest importance to this value. Life holds slightly greater importance for the older members.
Less frequently mentioned values, such as hope, appear in both age groups. Other values, such as family, diligence, courage, honesty, acceptance, tolerance, and helpfulness, are present only within the older age group, while the value of support is noted only within the younger age group.
Based on the results obtained, we can conclude that the members of the 21 to 40 age group attributed greater importance to certain values, such as love, health, trust, happiness, joy, freedom, and understanding, than the older members. Values such as respect, security, optimism, and life were slightly more important for the older members. Regarding the value of empathy, there were no marked differences between the two age groups.

3.7.5 Important values for family by formal education

Regarding formal education, we are dealing with six groups. Given that respondents from certain educational structures were less frequently represented, it became necessary to combine some groups based on formal education. Thus, four groups were formed:

1. Group – Less than secondary school / secondary school (MSS: 35 respondents)
2. Group – University degree / other (e.g., includes higher vocational college; UnivDr: 140 respondents)
3. Group – Master's degree (Magist: 72 respondents)
4. Group – Doctorate (Doktor: 179 respondents)

The principle of analysis is otherwise very similar to that of gender and age groups. For this reason, the table on the truncated part of the prepared data, which includes indicators such as the number of occurrences of a specific keyword, the keyword, and formal education, will be omitted.



3.7.5.1 Figure 129: A selection of the most important values according to formal education level

Figure 129 presents a selection of the most important family values as perceived by respondents, categorized by their level of formal education. The following values were identified as the most important by respondents from different educational backgrounds:

1. Love (see large green node)

Representatives from all four educational groups expressed the opinion that love is the most important family value (connection strength: MSS = 21.0; UnivDr. = 91.0; Magist = 46.0; Doctor = 106.0). Based on the frequency and number of respondents, we can calculate the percentage of participants in each group.

- 65% of respondents with a university degree (UnivDr.) considered love the most important value for family life.
- Followed by 63.89% with a Master's degree (Magist),
- 60% with a secondary school degree (MSS),
- and 59.22% with a doctoral degree (Doctor).

2. Trust (see red node)

All four groups agreed that trust is an important family value (connection strength: MSS = 9.0; UnivDr. = 23.0; Magist = 17.0; Doctor = 36.0).

- 25.71% of respondents with MSS education consider trust important,

- followed by 23.61% (Magist),
- 20.11% (Doctor),
- and 16.43% (UnivDr.).

3. Health (see red node)

All groups identified health as an important family value (connection strength: MSS = 9.0; UnivDr. = 32.0; Magist = 17.0; Doctor = 38.0).

- 25.71% MSS,
- 23.61% Magist,
- 22.86% UnivDr.,
- and 21.23% Doctor.

4. Respect (see light blue node)

Respect was also seen as an important family value across all educational groups (connection strength: MSS = 8.0; UnivDr. = 32.0; Magist = 21.0; Doctor = 41.0).

- The highest percentage was among those with a Master’s degree (29.17%),
- followed by those with a Doctorate (22.90%),
- and both MSS and UnivDr. groups with an equal share (22.86%).

5. Happiness (see light blue node)

Happiness was identified as an important value by all groups (connection strength: MSS = 8.0; UnivDr. = 27.0; Magist = 13.0; Doctor = 25.0).

- 22.86% MSS,
- 19.29% UnivDr.,
- 18.06% Magist,
- and 13.97% Doctor.

6. Joy (see light blue node)

Joy was also recognized as an important value (connection strength: MSS = 7.0; UnivDr. = 21.0; Magist = 9.0; Doctor = 24.0).

- Highest among MSS (20.00%),
- followed by UnivDr. (15.00%),
- Magist (12.50%),
- and Doctor (13.41%).

7. Empathy (see small dark blue node)

Empathy was rated as a relatively important family value (connection strength: MSS = 3.0; UnivDr. = 40.0; Magist = 14.0; Doctor = 51.0).

- Highest percentage among UnivDr. (28.57%),

- followed closely by Doctor (28.49%),
- then Magist (19.44%),
- and finally MSS (8.57%).

Less frequently mentioned values

Among the family values considered to be of lesser importance, the following were mentioned: honesty, diligence, optimism, support, courage, understanding, hope, safety, and life. Among these, certain values—like support—were only mentioned by some of the educational groups, highlighting group-specific differences.

1. Freedom (see large green node)

Representatives from three groups stated that freedom is an extremely important value for family life (connection strength: UnivDr. = 20.0; Magist = 6.0; Doctor = 25.0). However, when calculating the percentages based on respondent participation within each group, a slightly different picture emerges:

- 14.29% of respondents with a UnivDr. degree placed great importance on freedom,
- followed by 13.97% of those with a Doctorate,
- and 8.33% of those with a Master's degree (Magist).

2. Family (see larger light blue node)

Only two groups expressed that family itself is an important value in family life (connection strength: UnivDr. = 10.0; Doctor = 14.0).

- 7.82% of Doctorate holders and
- 7.14% of UnivDr. respondents considered it highly important.

3. Acceptance (see larger light blue node)

Three groups highlighted acceptance as a highly important value for family life (connection strength: UnivDr. = 10.0; Magist = 6.0; Doctor = 4.0).

- 8.33% of Magist respondents emphasized its importance,
- followed by 7.14% of UnivDr. respondents,
- and 2.23% of Doctorate holders.

4. Help (see larger red node)

Only respondents with a UnivDr. degree identified help (whether towards family members or others) as an important family value (connection strength: UnivDr. = 9.0).

- 6.43% of this group considered it significant.

The keyword mutual also appeared in this context and can be associated with the value of help. Lastly, values such as tolerance, intelligence, and connectedness were also mentioned.

Using the software tool AntConc (which filtered out irrelevant words and unified different word forms into a single concept), the frequency of keywords was analyzed and broken down by educational group.

In total, respondents from all four groups contributed 737 keywords.

- The highest number came from those with the highest level of formal education (Doctorate) with 381 keywords (51.70%),
- followed by UnivDr. respondents with 180 (24.42%),
- Magist with 103 (13.98%),
- and MSS with 73 (9.91%).

The analysis of important family values continues, with a focus on their role in partner relationships.

3.7.5.2 Important family values according to relationship status

There are five different types of relationship statuses represented in the data. Three of these groups consist of individuals who are not in a relationship (single, widowed, divorced), while two groups include those who are in a relationship (married and those in non-marital partnerships, such as couples dating or cohabiting).

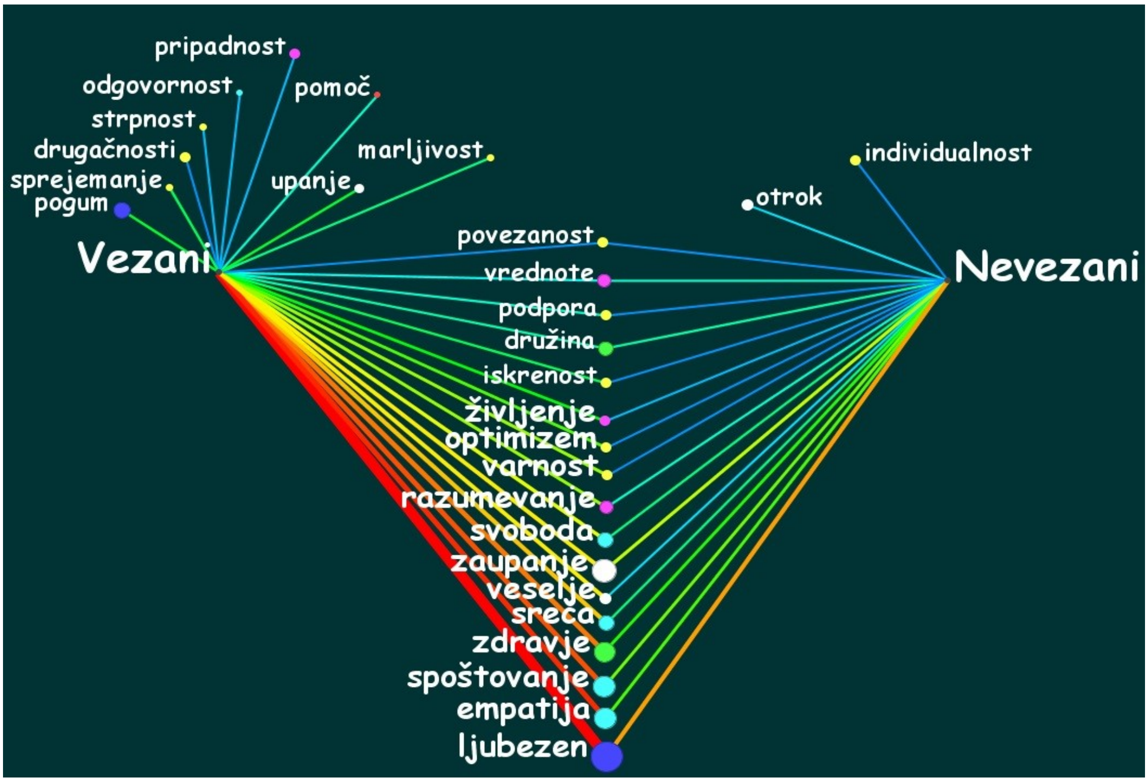
Given that the sample size for the widowed and divorced groups is relatively small, it makes sense to combine the single, widowed, and divorced respondents into one group. Similarly, individuals who are married and those in non-marital relationships can be grouped together.

For the purpose of this analysis, we therefore distinguish between two main groups: those in a relationship and those not in a relationship.

This results in:

- 321 individuals in a relationship (married = 257; non-marital/cohabiting relationships = 62), and
- 109 individuals not in a relationship (single = 79; widowed = 5; divorced = 25).

The following analysis uses the same method as in previous sections. It’s worth noting that, once again, the results will not be presented in tabular form, as the analytical approach is similar to that used in earlier parts of the study.



3.7.5.3 Figure 130: Key family values by relationship status (committed vs. non-committed)

Figure 130 presents a dual hierarchogram of important family values based on the perspectives of individuals in committed relationships (e.g., married, cohabiting) and those not in relationships (e.g., single, divorced). All keywords with a frequency lower than 6.1 were excluded (filtered out).

1. Love (word forms: love, to love, loved, etc.):

Both committed and non-committed individuals considered love the most important family value — see the large dark blue node (committed: connection strength 202.0; non-committed: 58.0).

62.93% of individuals in relationships and 53.21% of those not in relationships rated love as the most important value. This suggests that love is seen as more important by those in relationships than those who are not.

2. Empathy (word forms: empathy, empathic, etc.):

Both groups saw empathy as a very important family value — see the large light blue node (committed: 79.0; non-committed: 27.0).

24.61% of committed individuals and 24.77% of non-committed individuals rated it highly, indicating no statistically significant difference between the two groups.

3. Respect (word forms: respect, respecting, etc.):

Respect was also seen as a very important value — see the large light blue node (committed: 74.0; non-committed: 28.0).

23.05% of those in relationships and 25.69% of those not in relationships rated it as highly important, suggesting respect may be slightly more important for non-committed individuals.

4. Health (word forms: health, healthy, etc.):

Both groups viewed health as a very important family value — see the green node (committed: 72.0; non-committed: 26.0).

22.43% of committed and 23.85% of non-committed individuals gave it high importance, suggesting a slightly higher relevance for non-committed individuals.

5. Happiness (word forms: happiness, happy, etc.):

Seen as a fairly important family value — see the light blue node (committed: 57.0; non-committed: 13.0).

17.76% of committed individuals and 11.93% of non-committed individuals valued it highly, indicating that happiness is more important to those in relationships.

6. Joy (word forms: joy, joyful, etc.):

Considered a somewhat less important family value — see the white node (committed: 51.0; non-committed: 9.0).

15.89% of committed individuals and 8.26% of non-committed individuals valued it, showing it's more important to those in relationships.

7. Trust (word forms: trust, trusting, etc.):

Trust was seen as a fairly important value — see the large white node (committed: 51.0; non-committed: 33.0).

15.89% of committed and 30.28% of non-committed individuals valued it highly, indicating that trust is significantly more important for non-committed individuals.

8. Freedom (word forms: freedom, free, etc.):

Seen as a fairly important family value — see the large light blue node (committed: 43.0; non-committed: 13.0).

13.40% of committed and 11.93% of non-committed individuals rated it highly, suggesting it is slightly more important to those in relationships.

9. Understanding (word forms: understanding, to understand, etc.):

Viewed as moderately important — see the pink node (committed: 32.0; non-committed: 11.0).

9.97% of committed and 10.09% of non-committed individuals valued it, showing no statistically significant difference between the groups.

10. Security (word forms: safety, secure, etc.):

Seen as a moderately important family value — see the yellow node (committed: 32.0; non-committed: 7.0).

9.97% of committed and 6.42% of non-committed individuals valued it, indicating that it is more important to those in relationships.

11. Optimism (word forms: optimism, optimistic, etc.):

Also moderately important — see the yellow node (committed: 27.0; non-committed: 7.0).

8.41% of committed and 6.42% of non-committed individuals valued it, again suggesting slightly more importance among those in relationships.

12. Life (word forms: life, to live, living, etc.):

Seen as moderately important — see the pink node (committed: 23.0; non-committed: 8.0).

7.17% of committed and 7.34% of non-committed individuals valued it, with no significant difference between the two groups.

Values displayed in smaller text on the graph represent those considered somewhat less important from the perspective of both committed and non-committed individuals, though still relevant.

1. Honesty (word forms: honesty, honest, sincerely, etc.):

Both committed and non-committed individuals considered honesty to be a somewhat less important family value — see the yellow node (committed: connection strength 15.0; non-committed: 7.0).

4.67% of individuals in relationships and 6.42% of those not in relationships rated this value as relatively less important. Based on these percentages, we can conclude that honesty is considered more important by non-committed individuals than by those in relationships.

2. Family (word forms: family, families, etc.):

Surprisingly, both groups viewed the concept of “family” itself as a somewhat less important family value — see the green node (both committed and non-committed: connection strength 12.0).

3.74% of committed individuals and 11.01% of non-committed individuals valued this concept. Based on these results, we can conclude that the value of “family” is significantly more important to non-committed individuals than to those in relationships.

3. Support (word forms: support, supportive, etc.):

Support was also considered a somewhat less important value — see the yellow node (committed: 11.0; non-committed: 7.0).

3.43% of committed individuals and 6.42% of non-committed individuals valued it, suggesting that support is more important to non-committed individuals.

4. Values (word forms: value, values, etc.):

An interesting response: participants identified “values” themselves as a family value!

Both committed and non-committed individuals saw values as a somewhat less important family value — see the pink node (committed: 10.0; non-committed: 11.0).

3.12% of committed individuals and 10.09% of non-committed individuals rated it as important. Based on these results, the value of “values” is notably more important to non-committed individuals.

5. Connectedness (word forms: connection, connected, etc.):

Connectedness was also seen as somewhat less important — see the yellow node (both committed and non-committed: connection strength 7.0).

2.18% of committed individuals and 6.42% of non-committed individuals valued it, showing that connectedness is perceived as more important by non-committed individuals.

Finally, we can list a third group of values, each of which had only a single connection — either with committed individuals (e.g., courage, acceptance, belonging, tolerance, responsibility, help, diligence, hope, uniqueness) or with non-committed individuals (e.g., child, individuality).

These findings have revealed a number of insights that require further interpretation and reflection.

3.8 Future development of the family

In the final question of the online survey, respondents shared their opinions on the future development of the family. Once again, we are dealing with unstructured data — that is, free-form text — which needs to be converted into structured data.

Given that respondents expressed neutral, pessimistic (dark), and optimistic (bright) scenarios regarding the future of the family, a tailored sentiment analysis is an appropriate method for identifying positive and negative connotations.

Although there are many software tools that use specific algorithms to extract emotional, negative, neutral, and positive messages, most of these tools are designed for the English language. Even in English, these algorithms can be misleading, reducing the accuracy of sentiment analysis (for example, when dealing with ambiguous messages, irony, or sarcasm).

Because of these limitations, an intellectual/manual method was used to tag positive and negative words within the texts, with the help of the software tool JigSaw. Alongside the tagging process, the actual content of the submitted opinions was also analyzed, especially in terms of ambiguity, irony, and similar nuances.

It’s also important to highlight certain guidelines used in evaluating positive and negative opinions. In general, a positive outlook on the future development of the family assumes the continuation of the nuclear family model. However, this is not the case when a broader context suggests change (e.g., "The nuclear family will continue to exist, but conservative structures will be replaced by more diverse and flexible models" — in this context, the nuclear model is not considered positive).

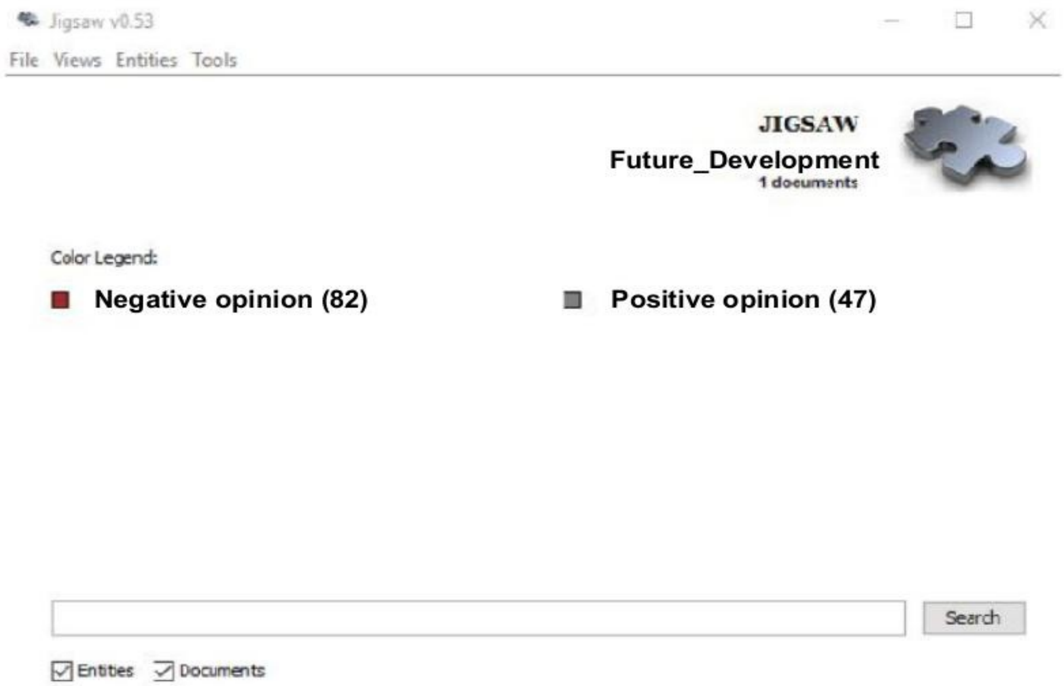
Individualism, while often seen as a positive concept, may carry a negative connotation in discussions about the family (e.g., smaller families, fewer children, less social interaction, and excessive individualism).

The same applies to technology — while it may indicate human progress, in certain family-related contexts it can be perceived negatively (e.g., "Technology is advancing rapidly, parents have less time to raise their children, and kids are left alone in front of screens").

These kinds of subtleties are often difficult for software algorithms to detect, which is why the use of a manual, intellectual evaluation method was deemed more appropriate. Such cases are not rare exceptions but relatively common in the data.

Finally, it should be noted that only opinions with clearly positive or negative sentiment were evaluated (e.g., “I am optimistic” or “I am pessimistic”), while neutral opinions (e.g., “I don’t know,” “I have no opinion,” “It’s hard to predict,” or “The family will need to adapt to societal changes”) were not included in the analysis.

3.8.1 Customized sentiment analysis for the male gender



3.8.1.1 Figure 131: Analysis of positive and negative ppinions from male respondents

Figure 131 presents the positive and negative opinions expressed by male respondents. Based on the previously mentioned classification criteria, positive and negative sentiments were identified within the texts submitted by male participants. As a result, 47 positive and 82 negative opinions were extracted (the remaining content was considered neutral and was not included in the analysis). In total, men contributed 36.43% positive and 63.57% negative opinions out of 129 analyzed entries. A more detailed examination of these opinions will follow.

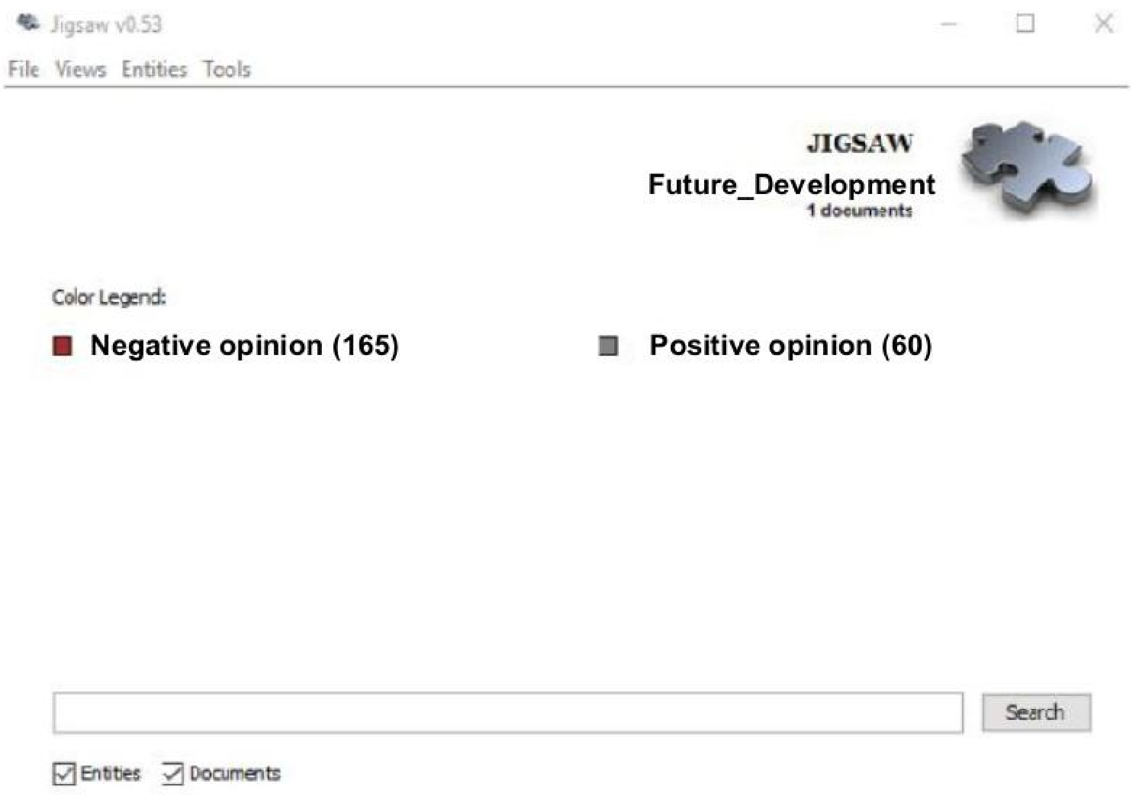
3.8.1.2 Figure 132: Visual bar charts of negative and positive opinions from male respondents

Figure 132 displays visual bar charts representing the negative and positive opinions expressed by male respondents. The men described the future development of the family in terms of decline, disintegration, and a loss of values or meaning. They also warned about the growing prevalence of single-parent families.

Respondents highlighted the increasing influence of society (e.g., major dictatorships) and modern technology on family life, and even predicted a rise in individualistic tendencies—which they viewed as unfavorable for families (e.g., loneliness, alienation). Many believed that the nuclear family model would gradually fade and be replaced by tribal or other unusual family structures (e.g., polygamy, bigamy). They also emphasized the strong influence of migration from other continents and the resulting imposition of foreign values.

On the positive side, some opinions suggested that the family—as a source of joy, empathy, and hope—would endure and continue to evolve. The family was still expected to serve as a haven of support and warmth. Some positive views leaned toward preserving and even strengthening the nuclear family model, while others anticipated society becoming more open to alternative family forms. A few respondents believed that the family's current role would remain largely unchanged.

3.8.2 Customized sentiment analysis for the female gender



3.8.2.1 Figure 133: Analysis of positive and negative opinions from female respondents

Figure 133 shows the analysis of positive and negative opinions from female respondents. Based on the previously mentioned classification criteria, positive and negative opinions of female respondents were marked within the text (just as with male respondents). As a result, we obtained 60 positive and 165 negative opinions (the remaining part of the text was considered neutral and was not included in the analysis). In summary, out of a total of 225 opinions, women contributed 26.67% positive and 73.33% negative opinions. It appears that female respondents saw a somewhat more negative scenario regarding the future development of the family. We will further examine these opinions in detail below.

3.8.2.2 Figure 134: Visual bar chart of negative and positive opinions from female respondents

Figure 134 shows the visual bar chart of negative and positive opinions from female respondents. Women similarly described the future development of the family as heading toward decline, disintegration, and loss of value or significance. They also warned about the possibility of a significant decrease in fertility rates in the future. They expressed concern that parents would have less and less influence in raising children and that society would not oppose this. Due to a lack of time, there was also a belief that emotional communication, especially with children, would decline in quality. In this context, they mentioned the negative impact of modern technology on child-rearing and the fact that social systems fail to provide the right example. Like men, they viewed the increased power of individualistic orientations negatively, which is not seen as favorable for family life (e.g., loneliness, alienation). Women highlighted various family models much more than men, although they believed these models do not contribute to strengthening quality family life. They also placed emphasis on the strong influence of migration, though less frequently than men. Interest in family life is expected to decline in the future. As positive opinions, they suggested that the family would remain the basic unit in its current form and that its significance would even increase. They believed that the family would continue to develop positively and become more open and flexible. In their view, the family remains the beginning of life and will always serve as a primary institution.

We have already established that women described the future development of the family in a somewhat more negative light. The next question is whether this difference between the sexes is statistically significant. For this purpose, a chi-square test was performed.

3.8.2.3 Table 107: Chi-Square test for negative and positive opinions on the future development of the family between genders

	Female	Male	Total	χ^2
Pozitive	60	47	107	
Negative	165	82	247	
Total	225	129	354	3.2603

Chi-Square Test (χ^2-test) is calculated using the following formula:

$\chi^2 = \Sigma (f - f^*)^2 / N$

The theoretical frequency (f*) is determined as 50% positive and 50% negative opinions (i.e., no difference between positive and negative opinions).

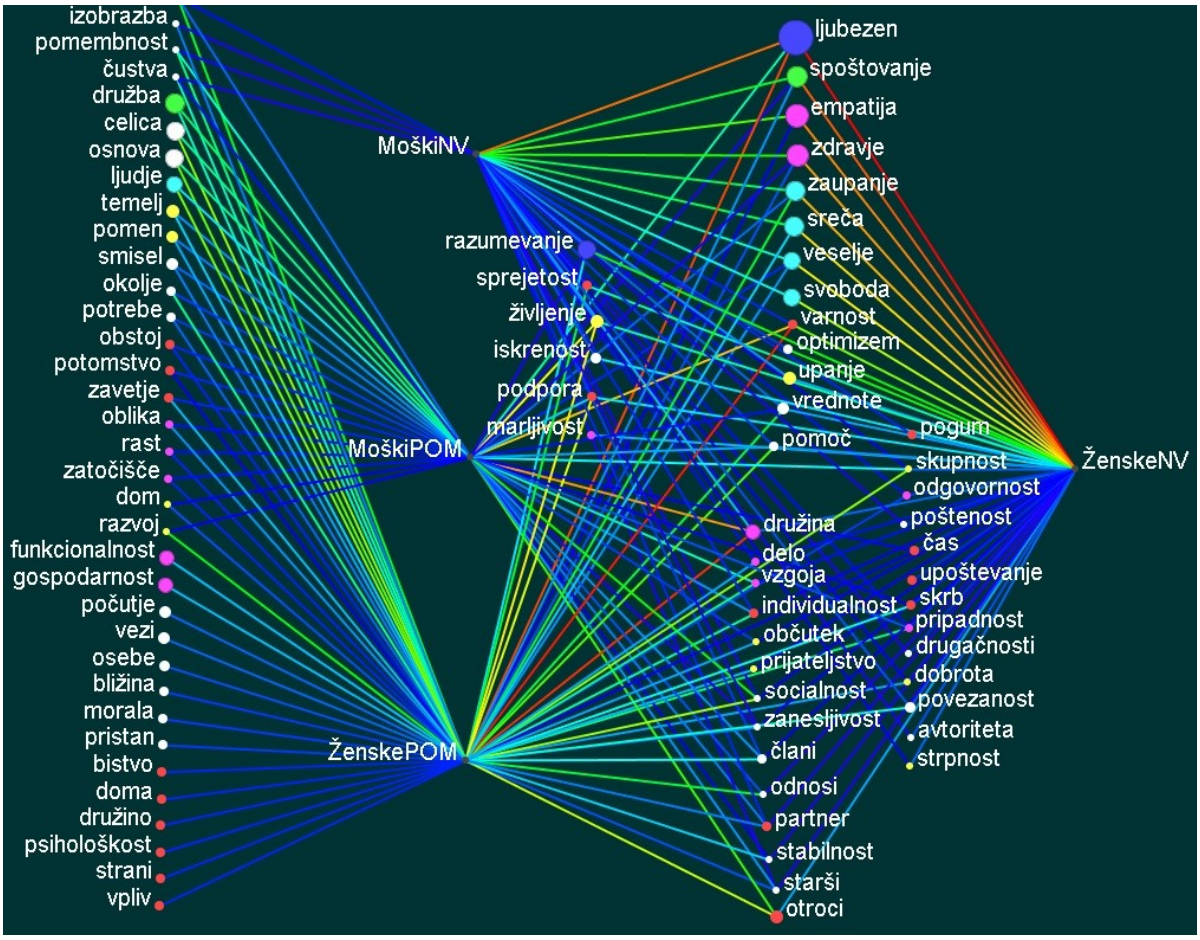
$X^2 = 3.2603$ (considering a 5% risk, Yates' correction of 0.5, and one degree of freedom).

The χ^2 test tells us whether there is a statistically significant difference between the values of categories. If the obtained value is higher than 3.841, which represents the threshold value at a 5% risk and one degree of freedom, we can conclude that the differences are statistically significant.

The given χ^2 test in the comparison between positive and negative opinions did not show statistical significance, as the obtained value of 3.2603 is below the threshold value, which is set at 3.841.

Conclusion:

At one degree of freedom and a 5% risk, there are no statistically significant differences between the opinions of men and women on the future development of the family! Now, it will be necessary to demonstrate or prove that the family and values form a hierarchically associative network, which reveals both hierarchies and associative connections. Data preparation was done similarly to previous cases (e.g., important values for the family). Two .txt files (importance of family and the most important family values) with frequencies, keywords, and categories by gender were imported into the Ora Casos software.



3.8.3 Figure 135: A section of the hierarchical associative network related to the importance of family and the most important family values

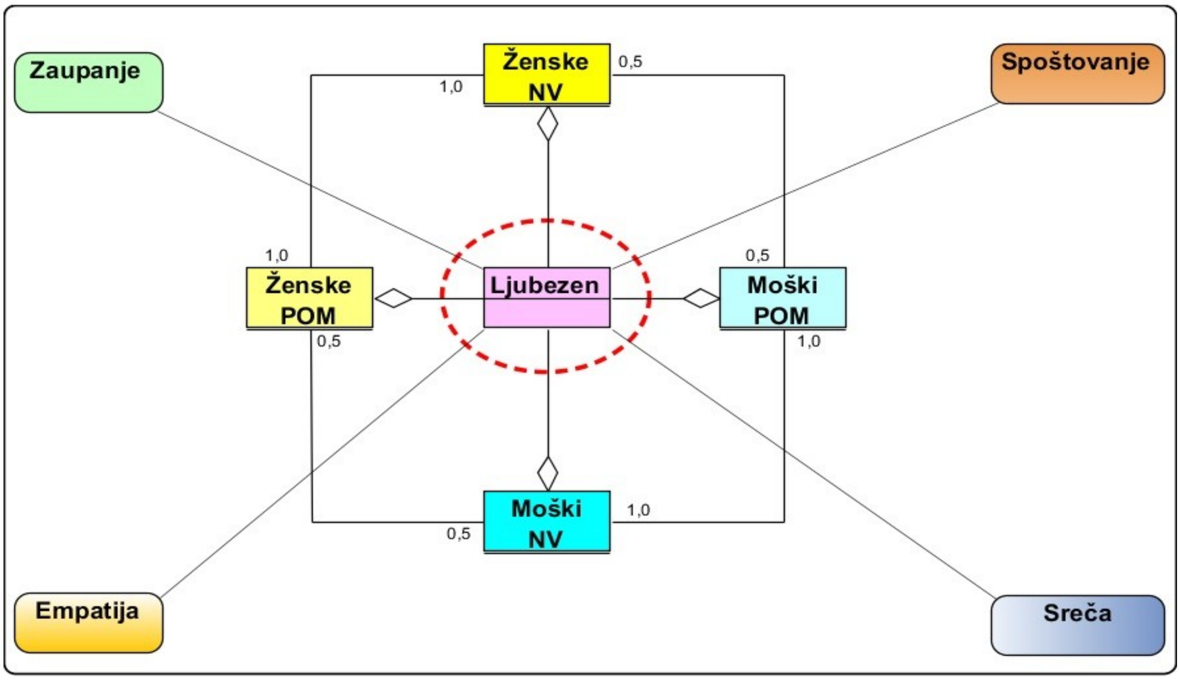
Figure 135 shows a part of the hierarchical associative network related to the importance of family and the most important family values. A filter value of 5.1 was used, meaning that keywords with a lower frequency were removed. The data is categorized by gender, with separate associative networks for women (female POM) and men (male POM), which represent the perceived importance of family by gender. Additionally, the labels female NV and male NV indicate the most important family values according to women and men, respectively.

In describing the importance of family, both genders (female and male POM) mentioned numerous values, which are also visible in the network graph (see the top right of Figure 135), such as love, respect, empathy, health, trust, happiness, freedom, and hope. These values were mentioned even more frequently when respondents were asked specifically about the most important family values (female and male NV).

In essence, this suggests that these values are an integral part of the family or can be seen as a sort of "family program." There are also other connections to individuals (e.g., partner), relationships (e.g., friendship), traits (e.g., stability), and even dimensions (e.g., time), which help define the family as a whole more clearly.

Figure 135 presents a simplified portion of the hierarchical associative network of family and values, based on responses from 428 participants. This can be considered a fairly representative result.

In summary, families and values—together with individuals, relationships, traits, dimensions, and more—form a hierarchical associative network. These hierarchies and associations can vary in emphasis (e.g., on love) when analyzing smaller subgroups within the sample, or if respondents from different social backgrounds were included (e.g., doctors, soldiers, workers, artisans, unemployed people, homeless individuals). To enhance clarity, part of the studied network is also presented using a UML (*Unified Modeling Language*) diagram.



3.8.3.1 Figure 136: A segment of the hierarchical associative network using a modified UML notation

Figure 136 shows a segment of the hierarchical associative network represented using a modified UML notation. Different types of connections can be observed, illustrating hierarchical (superordinate and subordinate) and associative relationships. A connection with a white diamond indicates a superordinate relationship, while a plain line represents an associative relationship. The modified UML diagram also indicates the strength of associative connections between entities—for example, a notation of 1.0 signifies a stronger associative link, whereas 0.5 indicates a weaker one. Connections without a numerical value represent even weaker associative links.[39] At the center lies

39 Programsko orodje: Tsang, C. H. K., Lau, C. S. W., & Leung, Y. K. (2010). Object-oriented technology: From diagram to code with visual paradigm for UML. computer software, Singapore; McGraw-Hill.

the concept of love (ljubezen), which is subordinated to the perspectives of male and female respondents (Female POM, Female NV, Male POM, Male NV). These entities, shown in parentheses, are interconnected through stronger or weaker associative relationships. The concept of love can be associated with empathy (empatija), happiness (sreča), respect (spoštovanje), and trust (zaupanje).

There could also be superordinate links between the central concept and the other concepts. This would apply, for example, if we considered both the strength of the connections across the entire network and the key semantic emphasis given by respondents (e.g., if a particular person attributes such strong significance to the concept of love that it becomes dominant over all other concepts).

With this representation, we have essentially answered the final research question and confirmed the sixth research hypothesis. Based on the main objective of this study, the next step is to define values and shed light on the contradictions between theoretical frameworks and people's lived experiences.

Values can be defined as generally desirable, morally or ethically grounded specific characteristics of a person living within a particular value-based community. Values typically give rise to thought patterns, beliefs, attitudes, behavioral tendencies, and aspects of individual character. The effects or outcomes may manifest, for example, as results, experiences, or achievements that already embody or aim to align with the desired values.

Values are usually expressed as nouns that embody certain positive moral qualities. They represent important mental (conceptual) constructs related to morality.[40] A related or even slightly similar term to "value" is the result of a specific measurement or evaluation, which is usually expressed in the form of numbers or other symbols (e.g., units of measurement). From this, we can infer that values are linked to value-based concepts or value systems.

Value systems are the sum of all constructive value-based concepts and virtues that hold significant meaning for a given individual and/or smaller or larger communities. Through an individual social inductive process, a particular value order or norm emerges.

As we have seen in the case of parental couples, values can carry different weights for different individuals, and these can be visually represented in hierarchical associative connections. Values may be motivated, for example, by individual, family, social, ideological, interest-based (e.g., business), or religious considerations.

In essence, values emerge based on shared denominators such as a common language, common terminology (e.g., measurement systems), shared culture, joint projects or missions, and a shared

40 The definition was modified from a German online resource on values, available at the URL: http://www.wertesysteme.de/was-sind-werte/ (2019-06-16).

worldview. In all respects, values tend to act as a sort of personal integrity program for an individual and become deeply embedded in autobiographical memory.

What applies to an individual is often equally relevant to their family members or the family as a whole. This empirical study on family and values clearly showed that there is a gap between established theory and people's perceptions. Many respondents considered concepts like family, satisfaction, and happiness to be values. However, some value theory experts (as cited in a previously referenced online source) disagree, arguing that terms such as happiness, family, behavior, curiosity, success, humanity, self-confidence, satisfaction, well-being, work-life balance, and value judgment—although closely related to values—are not values themselves.

Other scholars, such as Janek Musek, interpret some of these so-called "non-values" as actual values.[41] In the case of happiness (see Figure 136, where happiness is listed as a value), it is noted that although happiness is extremely precious, it does not represent a specific value-based concept. According to the presented theory of values, happiness is a relatively abstract notion that arises when an individual experiences something and perceives that state. In short, opinions on what constitutes a value—and what does not—are fairly divided.

In this section, we will define values as broadly as possible and apply the same classification system that was used for symbols. Values are ethical or moral representations of entities that hold significant importance for individuals and/or smaller or larger communities, and they guide the behavior of individuals, families, and society as a whole.

In the informational hierarchy, values can be placed among the most important concepts, ultimately exerting a profound influence on personal, familial, and societal decisions. Values function as nodes in the hierarchical associative network for decision-making (e.g., political decisions, parenting strategies, citations in publications, or choices in surgical procedures). In this context, many of the previously mentioned "non-values" (e.g., family, happiness, well-being) will now be included under the category of values.

Here follows a modified classification of values, which mirrors the classification previously used for symbols:

1. Values expressing physical attentional qualities: e.g., warmth, light, fire, silence, rain (e.g., in agriculture).
2. Values expressing performance-related qualities: e.g., investment, service, work, education, sports.
3. Values expressing psychological qualities: e.g., joy, love, satisfaction, emotionality, dignity.

41 See the classification of values according to Musek, J. http://www.ipsos.si/VodenjeVIZ_VI_vrste_vražod.html (2019-06-21).

4. Values expressing social qualities: e.g., family, cooperation, socializing, friendship, popularity.
5. Values expressing non-living natural qualities: e.g., rock (as a cultural landmark), gold (as a rare metal), crystal (e.g., for healing), water, the Sun.
6. Values expressing living natural qualities: e.g., heart (as a bodily organ—engine of life), flower (as a local symbol), human (as a convergence of multiple values), tree (as a geographical landmark), animal (as a geographical feature).
7. Values expressing health and biological qualities: e.g., health, life, illness (in the context of healing).
8. Values expressing human-made products and important personalities: e.g., book, innovation, building (as a landmark), statue.
9. Values expressing institutions and their parts: e.g., country, sports club, island.
10. Values expressing seasons and important historical events: e.g., spring, Independence Day.
11. Undefined values – open category.

The same classification system used for symbols is deliberately applied to values here, to help us explore the relationship between the two. To begin, two adapted microthesauri were prepared: one for symbolic categories and one for values (see both studies).

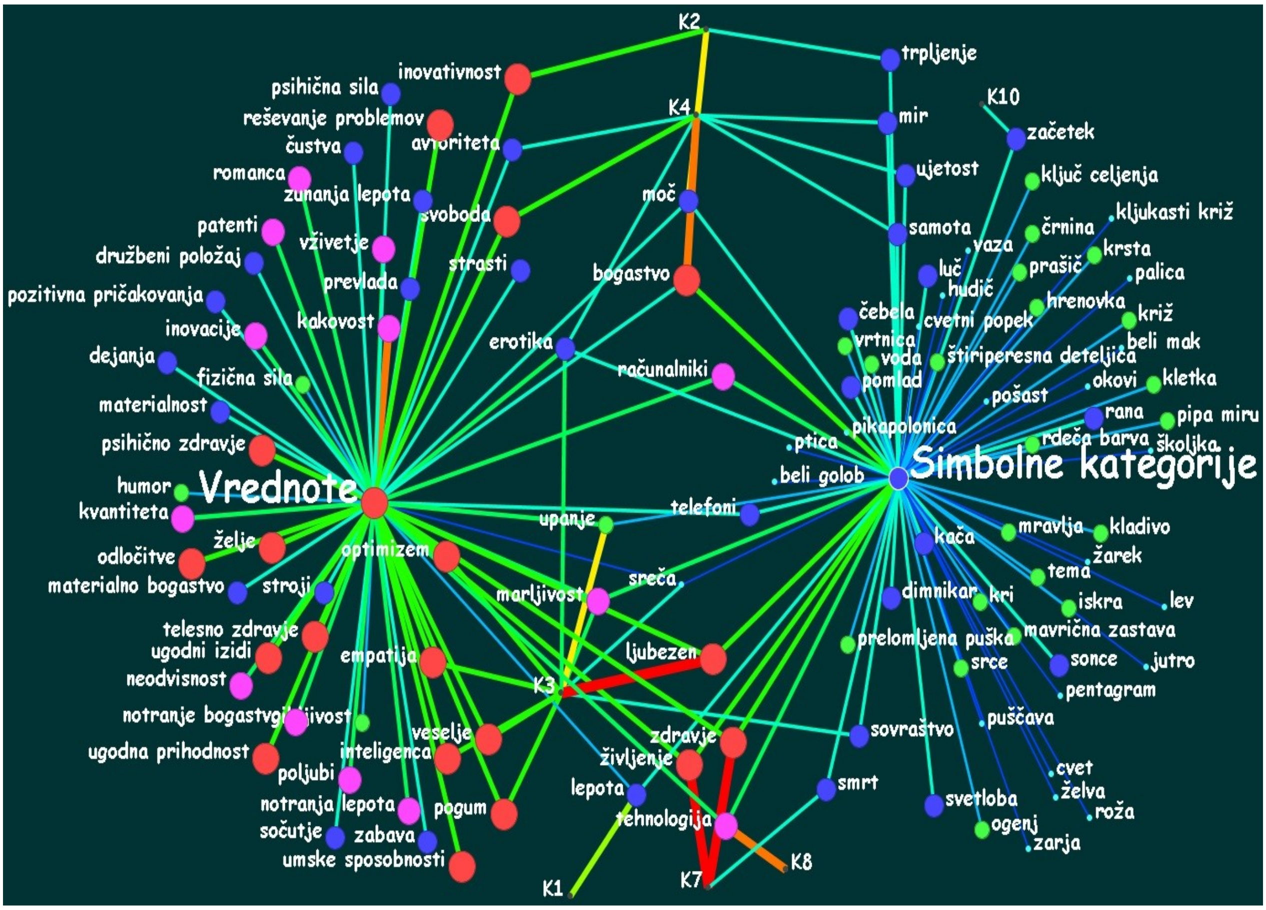
Next, the data was exported to a .txt file and then into Excel. Within Excel, an evaluation was conducted based on decision-making strength, using a scale from one to five (one being the lowest and five the highest level of aggregation). Ratings were assigned to descriptors in both the symbolic categories and the values group. These scores were based on the presumed influence of each concept on decision-making.

After the evaluation, the merged file with the scores was imported into the software tool Ora Casos. Preparation then began for the construction of the conceptual network of symbolic categories and values. Once again, we will omit the detailed technical description and simply mention that all concepts with a frequency below 5.1 were excluded from the visualization. To improve clarity, a portion of the prepared data used for the visualization of the hierarchical associative network of symbolic categories and values is presented.

3.8.4 Table 108: A small portion of the data exported from both adapted microthesauri

De	MO	TT	CC	BT	NT	RT
love (ljubezen)	5	Symbolic categories	K3	Symbolic categories	red (rdeče), heart (srce)	wealth (bogastvo), erotika (erotica) ....
Diligence (marljivost)	4	Symbolic categories	K3	Symbolic categories	bee (čebela), ant (mravlja)	wealth (bogastvo), erotika (erotica) ...
Peace (mir)	3	Symbolic categories	K4	Symbolic categories	white dove (beli golob), white poppy (beli mak)	wealth (bogastvo), erotika (erotica) ...
Power (moč)	2	Symbolic categories	K2	Symbolic categories	Lion (lev), fire (ogenj)	wealth (bogastvo), erotika (erotica) ...
Solitude (samota)	3	Symbolic categories	K4	Symbolic categories	Desert (puščava), darkness (tema)	authority (avtoriteta), wealth (bogastvo)
Symbolic categories	3	Symbolic categories				wealth (bogastvo), erotika (erotica) ...
death (smrt)	3	Symbolic categories	K7	Symbolic categories	Blackness (črnina), križ (cross), krsta (coffin)	wealth (bogastvo), erotika (erotica) ...
hate (sovraštvo)	3	Symbolic categories	K3	Symbolic categories	pentagram, monster (pošast)	wealth (bogastvo), erotika (erotica) ...
Values	5	Values				avtoriteta, bogastvo ...
love (ljubezen)	5	Values	K3	Values	kisses (poljubi), romance (romanca)	authority (avtoriteta), wealth (bogastvo)
diligence (marljivost)	4	Values	K3	Values		authority (avtoriteta), wealth (bogastvo)
life (življenje)	5	Values	K7	Values	quality (kakovost), material	authority (avtoriteta), wealth (bogastvo)
health (zdravje)	5	Values	K7	Values	psychologic. (psihično), physical, (telesno)	authority (avtoriteta), wealth (bogastvo)
technology (tehnologija)	4	Values	K8	Values	computer (računalnik), telephones, (telefoni)	authority (avtoriteta), wealth (bogastvo)

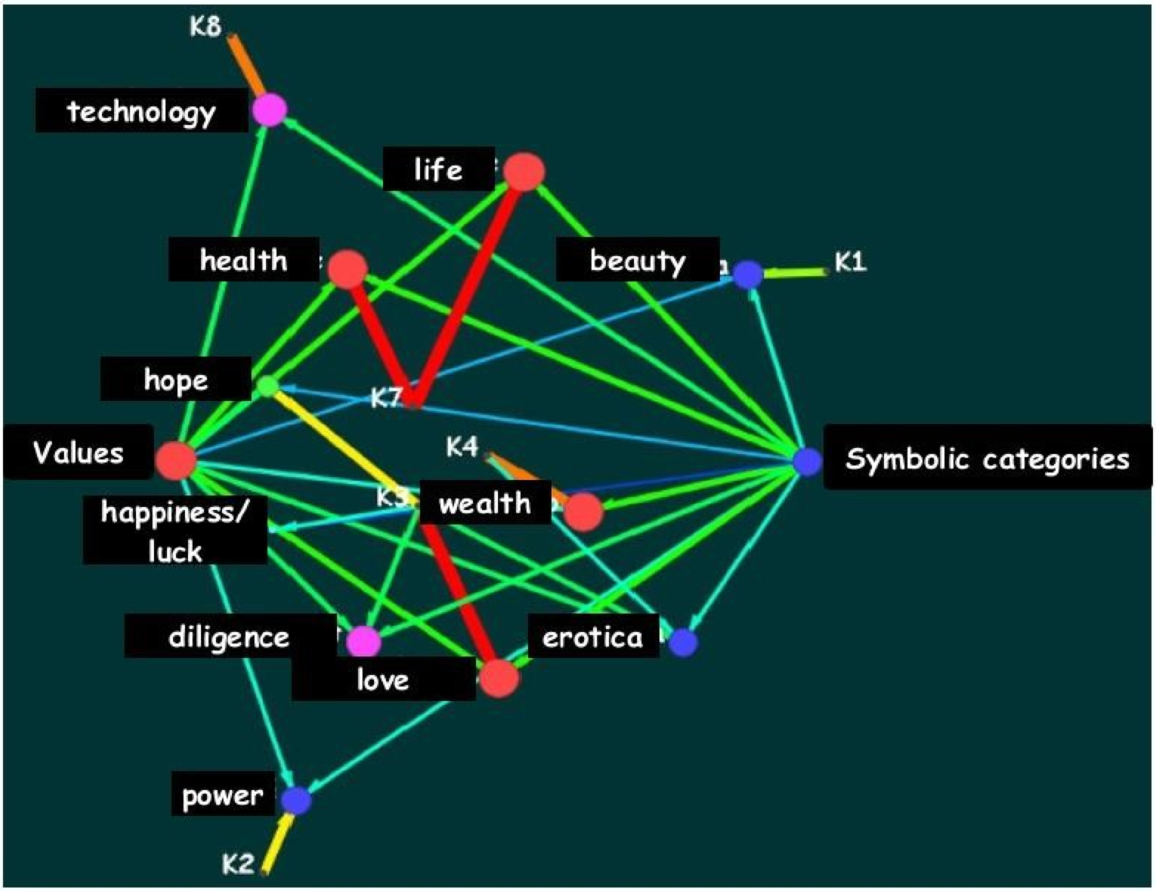
Table 108 presents only a small portion of the data exported from the two adapted microthesauri. The entities symbolic category and value serve as superordinate concepts (TT) and descriptors (DE). Concepts such as love, diligence, and hatred were also designated as descriptors (DE) and evaluated on a rating scale from one to five (MO). The descriptors were categorized into the already known classification groups K1 to K11 (CC). The next column lists subordinate concepts (NT) associated with the descriptors, while the final column shows concepts that are relationally linked to the descriptors (RT). Based on the data preparation shown in the table, a visualization of the hierarchical associative network was created.



3.8.4.1 Figure 137: Visualization of the hierarchical associative network of values and symbolic categories, including selected symbols

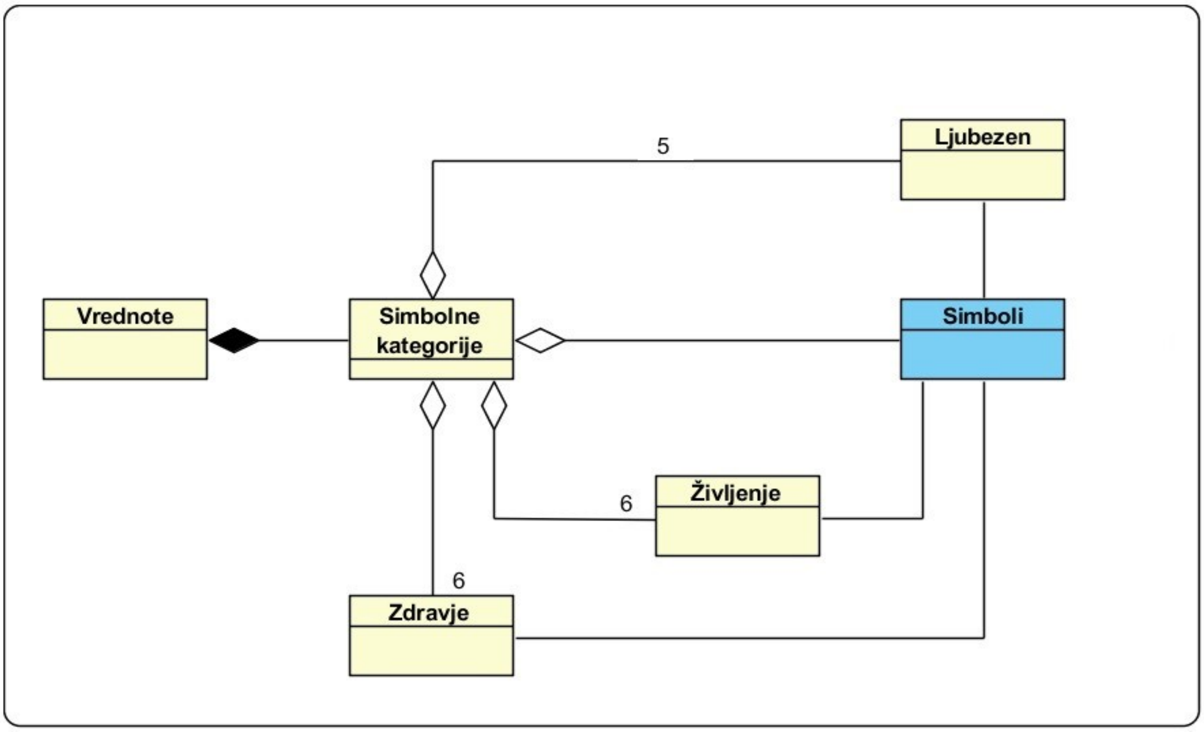
Figure 137 shows a visualization of the hierarchical associative network of values and symbolic categories, including some symbols (a filter of 5.1 was applied). Based on the decision-making strength ratings (MO), we can observe that values carry more weight than symbolic categories (see the large red node representing values and the smaller blue node for symbolic categories).

The figure also reveals that 11 symbolic categories simultaneously represent values—namely: love, wealth, beauty, diligence, technology, life, health, hope, happiness, power, and eroticism. From this, we can conclude that there are stronger or weaker connections between certain symbolic categories and values, which will be illustrated in more detail in the next figure.



3.8.4.2 Figure 138: Extraction of the hierarchical associative network

Figure 138 presents an extraction of the hierarchical associative network shown on the previous page. This visualization highlights 11 values that simultaneously function as symbolic categories. It can be asserted that values such as love, health, and life, which also serve as symbolic categories, have the greatest influence on decision-making. They are followed by wealth, diligence, and technology. Eroticism, beauty, hope, and happiness have the least influence on decision-making.
The connections between values and symbolic categories vary in strength depending on the direction of decision-making, with values generally representing stronger concepts than symbolic categories within the information hierarchy. It is worth emphasizing that, in the context of professional decision-making, symbolic categories are usually subordinate to values. Nevertheless, symbolic categories—and by extension, symbols—can complement or strengthen values.
Based on Figure 138, we can illustrate one of the many possible hierarchies in which values, in conjunction with symbolic categories (and thus symbols), exert a stronger influence on decisions and even on the behavior of individuals, families, and society as a whole. It is important to note the broad range of research opportunities this field offers. Research of this kind could greatly enhance our understanding of different decision-making models—and even help improve them!



3.8.4.3 Figure 139 Possible adapted UML model of values/symbolic categories determining decision-making

Figure 139 illustrates a possible adapted UML model of values and symbolic categories that influence decision-making. The model represents an abstraction of a comprehensive hierarchical associative network, where values occupy a superior position (see the connection with the black diamond). Symbolic categories, which simultaneously represent values, are subordinate to values (see the connection with the white diamond). Symbolic categories (which are superior to symbols), such as health (zdravje) (weight 6), life (življenje) (weight 6), and love (ljubezen) (weight 5), have associative connections (see the straight line) with symbols, which ultimately also affect decision-making.

In summary, values and symbolic categories can be treated separately, but in more complex decisions involving individuals, families, or societies, separate treatment is no longer meaningful. Values, symbolic categories, and symbols are the result of broader and narrower agreements as well as the outcome of long historical development and diverse experiences. These factors impact various areas such as child-rearing, significant political decisions, individual lifestyle choices, and even partner selection.

Values possess significant informational power that can lead to new insights and even wisdom. On the other hand, they can guide us or sometimes even constrain us within certain mental frameworks. Nevertheless, they provide orientation and direction that are more or less aligned with higher value systems.

3.8.5 Findings and insights

This subsection presents findings and insights based on the analysis of 11 questions from an online survey questionnaire.

A. Findings and insights based on demographic data

1. Gender composition

Among respondents who completed the online survey questionnaire targeted at employees in schools, universities, libraries, institutes, and ministries, the majority were women (277; 64.72%). Male respondents were significantly fewer (149; 34.81%). Additionally, one respondent identified as gender-neutral and another as non-binary under the "other" option.

Insight: Public administration, including schools, universities, libraries, institutes, and ministries (excluding the military, police, and healthcare), is characterized by roles associated with safety, social responsibility, and fairness—qualities often linked to the female population. Furthermore, women's physiological structure frequently leads them to avoid physically demanding jobs, which are rare in these institutions.

2. Age groups

The age structure of respondents is relatively high. The largest groups fall into the second age category (130; 30.37%) and particularly the third age category (253; 59.11%).

Insight: The age structure of employees in public administration (excluding the military, police, and healthcare) is already quite high and will likely increase further under current retirement conditions. This trend may make it more difficult for young people to secure permanent employment. Considering advancements in robotics and artificial intelligence, opportunities for regular employment may decrease even further.

3. Relationship status

The majority of respondents were married (257; 60.5%), followed by single individuals (79; 18.46%), those living in common-law partnerships (62; 14.49%), divorced individuals (25; 5.84%), and widowed individuals (5; 1.17%). Among men, there were more singles, while among women there were more divorced and widowed individuals. Interestingly, women also dominated the group of respondents in common-law partnerships.

Insight: Since gaining equal rights after 1977, women have acquired greater decision-making power and become less dependent on men. Today, they can choose various forms of shared living arrangements, including common-law partnerships, which are becoming a viable alternative to traditional marriage. Additionally, the female population is numerically larger than the male population.

4. Educational composition

Most respondents held the highest level of education—doctorates (179; 41.82%), followed by university degrees (124; 28.97%), master's degrees (72; 16.82%), high school diplomas (22; 5.14%), higher education diplomas (16; 3.73%), and respondents without completed high school education (13; 3.04%).

Insight: Men tend to be more educated than women, as they represent a higher proportion of master's degree holders and PhDs. Women often face barriers to further education due to their physiological and social roles—particularly motherhood—which can result in at least two years of interruption per child. Additionally, women often devote themselves more intensively to raising children.

5. Current employment status

The majority of respondents were employed (402; 93.92%), followed by retirees (7; 1.64%), unemployed individuals (3; 0.7%), and those with other statuses (16; 3.74%). Among employed individuals, women had a slightly higher percentage.

Insight: After completing their education, women are generally quicker to secure suitable employment and start families compared to men. On average, men take longer to decide on family life.

This analysis provides valuable insights into demographic trends among public administration employees and highlights broader societal patterns affecting employment, education, and personal relationships within this sector.

B. Findings based on thematic questions

1. Importance of family

The term "security" was the most frequently used by both women (74 times; ratio relative to 277 female respondents is 0.27) and men (29 times; ratio relative to 149 male respondents is 0.19). The second most common term was "love," which women used more often (60 times; ratio 0.22) compared to men (11 times; ratio 0.07).

Interestingly, the term "cell" was used with equal frequency by men and women (ratio 0.01 relative to 277 female and 149 male respondents). For the term "child," a slight difference was observed in favor of men (men: 0.08; women: 0.07). Conversely, the ratio for the term "trust" favored women (women: 0.06; men: 0.03).

When describing the importance of family using the term "stability," women emphasized this significantly more often (ratio for women: 0.05; for men: 0.00). Particularly interesting is the term "support," where the ratio favored men (men: 0.06; women: 0.04).

The term "belonging" was again used more frequently by women than men (women: ratio 0.05; men: ratio 0.03). Lastly, the terms "connection" and "values" were predominantly used by women (women: ratio for both terms is 0.04; men: ratio for both terms is 0.00).

This addresses the first research question.

Insight:

Female respondents particularly emphasized security, love, values, connection, and trust when discussing the importance of family. Male respondents also highlighted security and love (though less than women), but they placed greater emphasis on children and support compared to women.

Overall, it can be concluded that people view the importance of family in providing security, giving and receiving love, living according to positive values, fostering connections among family members, building mutual trust, caring for children's development, and offering support to partners and children. All these aspects define the family as an essential foundational unit of humanity.

Analysis of texts on family importance using Jigsaw software

Based on an analysis of texts using word-group classification methods in categories such as activities, processes, values, states, individuals, psychological states/traits, and social groups/traits, it was found that both men and women most frequently used phrases categorized as follows: activities (61 different), processes (42 different), values (25 different), states (32 different), individuals (21 different), psychological states/traits (87 different), and social groups/traits (51 different).

a. Activities

It was found that men more frequently used terms and phrases from the "activities" category compared to women when describing family importance. Interestingly, men emphasized activities such as problem-solving, resolving issues, and caring for weaker members. Women focused on activities such as conflict resolution, handling stressful situations, teaching respectful interpersonal relationships, and fostering social cooperation.

From the perspective of activities, both genders see family importance primarily in mutual assistance, child-rearing, complementing one another, learning together, and fostering social and emotional connections.

Insight:

The lower levels of testosterone in women result in less capacity or interest in physical activities compared to men, who have higher testosterone levels driving their inclination toward physical activity and action-oriented tasks. Men are more prone to immediate action, while women tend to analyze situations and relationships more thoroughly. This difference can partly be attributed to historical cultural contexts where men performed physically demanding tasks and played roles as hunters.

b. Processes

Men mentioned only three processes when describing family—continuation of lineage, development, and socialization—while women used significantly more phrases from the "processes" category (42 different). Women strongly emphasized developmental aspects of family life and personal growth.

Insight:

Women are generally more process-oriented than men as they focus on relationship development and nurturing offspring. The developmental aspect of children is particularly important for women—they emphasize gradual preparation for life and personality formation—whereas men tend to think more in terms of goals or end results (e.g., "my son will become a successful athlete"). These findings highlight gendered differences in perceptions of family importance while underscoring shared values such as mutual support and emotional connection within families.

c. Values

Both genders used the 12 most common values: love, support, belonging, meaning, solidarity, respect, happiness, security, satisfaction, reliability, trust, and life. Men surprisingly emphasized sincerity and care more, which are typically associated with women.

Women added values such as responsibility, attention, dedication, self-confidence, role model, and exemplarity when describing the importance of family. Men did not highlight these values.

Insight:

Women are more sensitive to negative stress factors, particularly psychological and social ones. Values like responsibility, dedication, and self-confidence play a crucial role in reducing stress and strengthening emotional stability.

d. States

Women used the overarching term "security" when describing the importance of family, while men described a stable framework for survival (e.g., money, job, a roof over one's head).

Insight:

Men are more defined and focused on material stability when discussing family importance, whereas women think more broadly about various aspects of security, such as financial, traffic, biological, health, and other areas.

e. Individuals

Both genders emphasized that parents and children are key components of the family.

Insight:

Parents and children together represent, in the opinion of both genders, the fundamental core of the family.

f. Psychological states/traits

Men highlighted the following psychological states and traits: love, sense of belonging, understanding, self-image, relaxation, warmth, joy, and refuge. Except for love and joy, they focused more on feelings rather than emotions.

Women significantly emphasized the safety, emotional, and developmental aspects of personality.

Insight:

The family contributes to harmonizing the emotional world, especially for women. It provides love, a sense of security, belonging, strengthens self-image, and encourages the development of offspring.

g. Social groups/traits

Women emphasized social identity, social skills, and emotional and social connection when discussing family importance. Men placed greater emphasis on family members and social communities.

Insight:

Men are more focused on individuals, while women emphasize broader social belonging and communication, leading to greater connectivity. Men's view of family importance is more hierarchical, while women's is associative and aimed at reducing stress and improving interpersonal relationships.

These findings and insights provide additional answers to the first research question.

2. Understanding family models

It can be asserted that female representatives are much more familiar with various family models than male representatives. This addresses the second research question.

Insight:

Women identify more strongly with family life than men, as they see themselves intensely in the maternal role, selflessly loving and caring for offspring. Women strive to build a safe haven, loving relationships, and educational morals. It seems that family-related content and everything associated with it interests them more. Women also think more intensely and deeply about different alternatives to family models that could improve the quality of life for children, partners, and themselves.

The findings do not imply that men are uninterested in family topics; rather, their focus is on content indirectly related to family (e.g., politics, income, activities, home planning, vacations). Men often see themselves as heads of the family (although this stereotype is less pronounced in modern times), which leads them to be less interested in other family models. The results are clear, as women demonstrated significantly greater knowledge of various family models.

3. Reasons for differences in child-rearing

Representatives of both genders rarely used key terms such as dependence, society, sociality, morality, rules, life, experiences, heredity, culture, ethics, individuals, behavior, equality, characteristics, education, and behaviors.

Only female representatives used key terms like pattern, personality, view, character, belief, egoism, method, goal, and factor.

Male representatives attributed greater importance to differences in child-rearing due to normative systems (e.g., ethics, morality, values, behavioral rules), the influence of genetics or heredity, and cultural influence. In contrast, female representatives focused on individuals, personality traits, and structures, adopted behavioral patterns, and the consistency or inconsistency of parents in child-rearing.

No significant differences were observed regarding opinions on the impact of environment and time on differences in child-rearing between genders.

Insight:

Humans are products of nature, meaning they bring certain physiological and mental potentials. In life, they encounter various people, learn basic rules, observe or actively participate in events. This way, individuals acquire identical and different experiences, developing diverse skills and knowledge.

Different genetic combinations and diverse situations and norms in the environment cause differences in decision-making. Child-rearing depends on individual parents, their worldview (which can change), cultural perception, and social status.

Men emphasized aspects over which individuals have little control (genetics, normative systems, ethics, morality, values, behavioral rules, culture). On the other hand, women highlighted aspects related to personal traits and family environment (individuals, personality traits, adopted behavioral patterns, personality structure, consistency or inconsistency of parents in child-rearing).

Men's perspective on differences in child-rearing is more global, while women's emphasis is specifically tied to the family. Based on the findings and insights, the third research question was addressed.

4. Evaluation of values

It is observed that the value "Health" received the highest ratings from 428 respondents (average rating of 4.7). Following closely are values like "Love" (average rating of 4.6), "Life" (average rating of 4.6), "Joy" (average rating of 4.5), "Freedom" (average rating of 4.4), "Optimism" (average rating of 4.4), "Empathy" (average rating of 4.4), "Happiness" (average rating of 4.4), "Hope" (average rating of 4.3), "Courage" (average rating of 4.0 with a standard deviation of 0.9), "Diligence" (average rating of 4.0), "Intelligence" (average rating of 3.9), "Innovation" (average rating of 3.8), "Eroticism" (average rating of 3.6), "Technology" (average rating of 3.1), "Beauty" (average rating of 3.0 with a standard deviation of 1.0), "Authority" (average rating of 2.9), "Wealth" (average rating of 2.8 with a standard deviation), and "Power" (average rating of 2.6). The option "Other" has an average rating of 4.2.

Insight:

Without health, it is impossible to achieve true love and true life. Consequently, there can be no true joy, freedom, optimism, empathy, happiness, hope, and other positive values. Based on the ratings from 428 respondents, the importance of the "triangle of values" – Life, Health, and Love – can be emphasized, to which all other values can be connected. Based on the findings and insights, the fourth research question was addressed.

5. The most important values for the family

A. Based on a textual analysis using the software tool AntConc and a network visualization created with the Ora Casos tool, the key findings regarding the most important family values by gender are as follows:

1. Love: This value was considered the most important by 65.70% of female respondents (277) and 51.68% of male respondents (149). In short, this result is not surprising.
2. Respect: 29.24% of women ranked this as the second most important value, while 16.78% of men ranked it as the fourth most important.
3. Empathy: 25.29% of women considered empathy the third most important value, while 21.48% of men ranked it second.
4. Health: This was ranked third in importance by 25.29% of women and 19.46% of men.
5. Trust: 21.30% of women and 16.11% of men gave this value fifth place in importance.
6. Happiness: 17.69% of women considered this the sixth most important value, while 16.11% of men ranked it fifth.
7. Joy: 15.52% of women and 12.08% of men ranked this value seventh.
8. Freedom: 14.10% of women and 11.4% of men assigned this value the eighth position.
9. Security: 12.27% of women ranked this ninth, while only 4.03% of men placed it twelfth.
10. Optimism: This value was ranked tenth by 10.11% of women and eleventh by 4.70% of men.
11. Understanding: 9.75% of women ranked it eleventh, while 11.40% of men ranked it eighth.
12. Life: This was ranked twelfth by 6.50% of women and tenth by 7.38% of men.

Conclusion:

The prioritized list of family values differs significantly by gender. Out of the 12 values, only four were ranked the same by both men and women, indicating 41.66% alignment and 58.34% divergence. This confirms the first research hypothesis and provides insight into the fifth and seventh research questions.

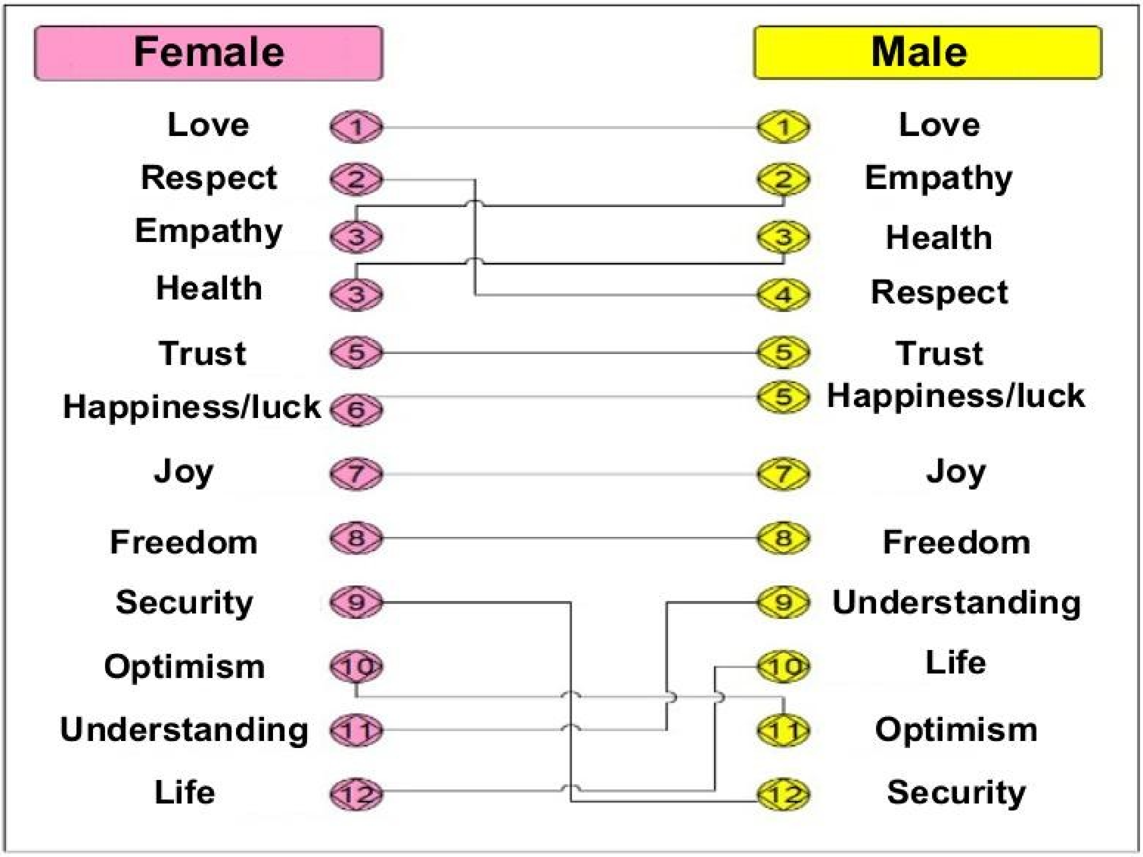
Key insight:

The prioritized list of values important in a general sense differs somewhat from the list of values deemed important specifically for family life (based on responses to open-ended questions). However, many values from the previous (semi-open) question appear here as well. The shared value across both measurements is love, while health and life lost some of their previous importance.

There is alignment between genders on the values of love, trust, joy, health, and freedom. Divergence appears in values such as respect, empathy, happiness, understanding, optimism, security, and life.

This hierarchy of values influences decision-making for both men and women—first in terms of entering a partnership (marriage or cohabitation), and later in child-rearing and broader family life. Although the value rankings differ by 58.34%, they are not so different as to prevent men and women from forming successful, loving partnerships. These differences are not as visible in simple decisions but tend to become more apparent in complex situations requiring deeper decision-making.

For better clarity, the following diagram illustrates these findings.



3.8.5.1 Figure 140: Prioritized list of family life values by gender

Figure 140 presents the prioritized list of values regarding family life by gender. As previously noted, there are distinct differences in the emphasis placed on specific values between men and women. Values, as powerful concepts within the information hierarchy, can significantly influence various decisions. For example, even when choosing a partner, there needs to be sufficient alignment in the perception of values to support the formation of a shared family life. On the other hand, if these emphases are too identical, it could suppress the emotional and sexual dynamic of the relationship.

In essence, the most important value in family life is love—both between partners and toward children. From experience, we know that love between partners is not always equally reciprocated and can vary significantly in intensity and strength. Nonetheless, despite any doubts, love remains the common denominator.

Another aspect involves the broader intention of starting a family, which includes factors such as financial stability, health, a safe and supportive environment, employment, and so on. Next comes the consideration of children, who need to be raised and supported in their development for the future.

In this context, two distinct hierarchies of values emerge between the genders, which in turn generate hierarchical and associative relationships between them. For example, if the man believes it is most important to first develop empathy in children, while the woman believes that teaching respect for parents and others should come first, they must find the best possible decision and compromise.

Should a child first be taught to respect parents and others, or should empathy toward people, animals, and other beings be the starting point? It's clear that teaching a child to respect living beings might be somewhat easier, and this can be done alongside the introduction of content from various normative systems (e.g., behavioral rules, ethics, morality). Respect for other living beings is closely linked to empathy toward them, meaning that empathetic feelings must be gradually instilled into the child's thinking. For example: "Son, don't hurt animals—they feel pain just like you would if someone did the same to you."

Findings from neuroscience have shown that some individuals lack the necessary neural connections to experience empathy. In this regard, respect is more strongly tied to learning processes rather than to the physiological and/or mental traits of an individual. Learning empathy is more complex, as it is closely related to these neural connections; without them, learning empathy may not be possible.

To sum up, we are once again dealing with hierarchical associative networks when it comes to the value hierarchy between genders. The results obtained from the online survey clearly indicate that men and women place different emphases on what values are most important in family life. However, these differences and similarities are balanced enough to support healthy partnerships. As a result, both men and women can relatively easily find common ground when it comes to decision-making and various actions.

In conclusion, it is evident that nature itself has ensured a certain level of heterogeneity and diversity in thinking between men and women—something that can be attributed to the historical cultural evolution of the human species, the physiology of both sexes, and genetic factors.

B. Based on a verbal analysis using the software tool AntConc and network visualization through the Ora Cases software, the key values deemed most important for family life, categorized by age groups, are as follows:

In the age group up to 20 years, 17 respondents participated. They highlighted love and trust as key values.

In the age group of 60 years and older, 28 respondents contributed their opinions. The most emphasized values were love, respect, empathy, understanding, freedom, health, and happiness.

In the age group of 21 to 40 years, 130 respondents gave their input, while in the 41 to 60 age group, 253 respondents participated. These sample sizes were large enough to allow for quantitative text analysis.

1. Love:
   - 67.69% of the younger group (130 respondents)
   - 59.68% of the older group (253 respondents)
   → Conclusion: Love is a more significant family value among the younger respondents than among the older ones.
2. Empathy:
   - 26.92% (younger group)
   - 26.09% (older group)
   → Conclusion: The difference between the age groups is not statistically significant.
3. Respect:
   - Third most important value for the older group (41–60 years)
   - Fourth for the younger group (21–40 years)
   - 25.30% (older) vs. 23.85% (younger)
   → Conclusion: Respect holds slightly more importance among older respondents.
4. Health:
   - Fourth most important for the older group
   - Third for the younger group
   - 20.95% (older) vs. 25.38% (younger)
   → Conclusion: Health is slightly more important to younger respondents.
5. Trust:
   - 17.39% (older) vs. 23.08% (younger)
   → Conclusion: Trust holds more value among younger respondents.
6. Happiness:
   - 15.02% (older) vs. 20.00% (younger)
   → Conclusion: Happiness is more important to the younger group.
7. Joy:
   - 13.83% (older) vs. 16.15% (younger)
   → Conclusion: Joy is more valued among younger respondents.
8. Freedom:
   - 13.04% (older) vs. 14.61% (younger)
   → Conclusion: Freedom is slightly more important to younger respondents.

9. Safety:
- 10.28% (older) ranked it ninth
- 9.23% (younger) ranked it tenth

→ Conclusion: Safety is slightly more important to older respondents.

10. Understanding:
- 8.70% (older) ranked it tenth
- 12.31% (younger) ranked it ninth

→ Conclusion: Understanding is more important to younger respondents.

11. Optimism:
- 7.90% (older) vs. 8.46% (younger)

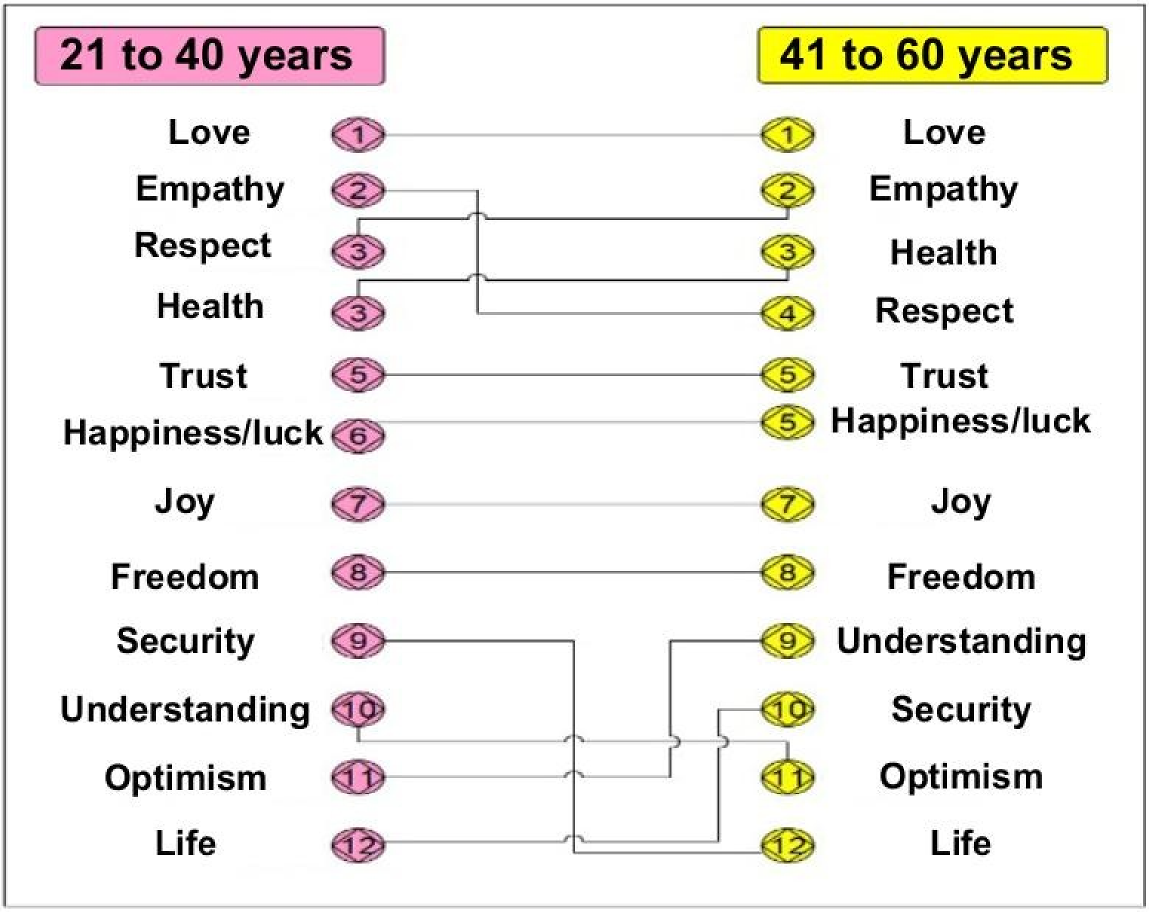
→ Conclusion: Optimism is slightly more valued among older respondents.

12. Life:
- 7.51% (older) vs. 6.92% (younger)

→ Conclusion: Life holds slightly more importance for older respondents.

Less frequently mentioned values, such as hope, appeared in both age groups. Meanwhile, values such as family, diligence, courage, honesty, acceptance, tolerance, and help were only recorded in the older age group. The value of support was mentioned exclusively in the younger age group. Based on the presented data, we can conclude that respondents in the 21 to 40 age group attributed greater importance to certain values—such as love, health, trust, happiness, joy, freedom, and understanding—compared to their older counterparts. On the other hand, older respondents placed slightly more emphasis on values such as respect, safety, optimism, and life. There was no significant difference between the two age groups regarding the value of empathy. When comparing the ranked list of values important for family life between the two age groups, it can be observed that the lists are relatively identical. Out of the 12 prioritized values, eight hold the same rank in both groups, which equates to 66.67% similarity and 33.33% difference. This confirms the second research hypothesis and provides answers to the fifth and eighth research questions from the perspective of age groups.

Insight: Overall, there is a higher percentage of female respondents in both age groups (91% in the younger group; 86% in the older group), which does not represent a major difference. While there were some differences in emphasis between age groups, the overall ranking of the discussed values showed substantial similarity, which will be illustrated in the next figure.



3.8.5.2 Figure 141: Priority list of values by both age groups

Figure 141 presents the priority list of values across both age groups. It can be observed that the rankings differ between the groups in values such as health, respect, safety, and understanding. On a qualitative level, we can infer that there is no significant gap between the age groups in how they perceive the discussed values. The distribution of emphasis on particular values appears to be fairly homogeneous.

Older respondents tended to place slightly more importance on values such as respect, safety, optimism, and life, while other values (with the exception of empathy) were more strongly preferred by younger respondents.

Once again, this brings us to the concept of informational hierarchy and decision-making, raising the question: does this relatively identical priority list of key family life values indicate that decision-making—such as in child-rearing—can be the same for both age groups?

From a global perspective, decision-making among members of both age groups, in the context of less complex situations, can be quite similar or even identical. However, in more complex scenarios or when local content-specific focus is required from individuals of both age groups, similar or identical decisions may still occur—but the likelihood is significantly lower.

This opens up an interesting area for further research into decision-making in relation to hierarchical associative value networks among individuals from different age groups.

C. Based on the textual analysis using the AntConc software and the network visualization using the Ora Casos tool, the emphasis on the most important family values by formal education level is as follows:

The analysis identified four groups:

1. Group 1 – Less than secondary school / Secondary school (MSS: 35 respondents)
2. Group 2 – University degree / Other (e.g., includes higher education; UnivDr: 140 respondents)
3. Group 3 – Master’s degree (Magist: 72 respondents)
4. Group 4 – Doctorate (Doctor: 179 respondents)

Respondents across all four groups contributed a total of 737 keywords. The highest number of keywords (interpreted by respondents as family values) came from those with the highest level of education—381 or 51.70%. In second place were those with a university degree—180 or 24.42%, followed by master's degree holders—103 or 13.98%, and finally those with secondary education or less—73 or 9.91%.

Key Family Values (Top 7):

1. Love

All four groups agreed that love is the most important family value.

- 65% of UnivDr respondents
- 63.89% of Master's degree holders
- 60% of MSS respondents
- 59.22% of Doctorate holders

2. Trust

All groups recognized trust as an important family value.

- 25.71% MSS
- 23.61% Master's
- 20.11% Doctor
- 16.43% UnivDr

3. Health

All groups viewed health as a significant family value.

- 25.71% MSS
- 23.61% Master's
- 22.86% UnivDr
- 21.23% Doctor

4. Respect

All four groups considered respect important.

- 29.17% Master's
- 22.90% Doctor
- 22.86% UnivDr and MSS

5. Happiness

All four groups included happiness as an important value.

- 22.86% MSS
- 19.29% UnivDr
- 18.06% Master's
- 13.97% Doctor

6. Joy

All four groups acknowledged joy as a family value.

- 20.00% MSS
- 15.00% UnivDr
- 12.50% Master's
- 13.41% Doctor

7. Empathy

Empathy was seen as relatively important by all groups.

- 28.57% UnivDr
- 28.49% Doctor
- 19.44% Master's
- 8.57% MSS

Other Family Values (Given slightly less importance across groups):

These include honesty, diligence, optimism, support, courage, understanding, hope, security, and life.

Values Recognized by Fewer Groups:

1. Freedom

Only three groups highlighted freedom as a highly important family value:

- 14.29% UnivDr
- 13.97% Doctor
- 8.33% Master's

2. Family

Only two groups recognized family itself as a family value:

- 7.82% Doctor
- 7.14% UnivDr

3. Acceptance

Three groups emphasized acceptance as very important:

- 8.33% Master's
- 7.14% UnivDr
- 2.23% Doctor

4. Help

Only UnivDr respondents highlighted help (supporting family or others) as a family value:

- 6.43% of UnivDr respondents

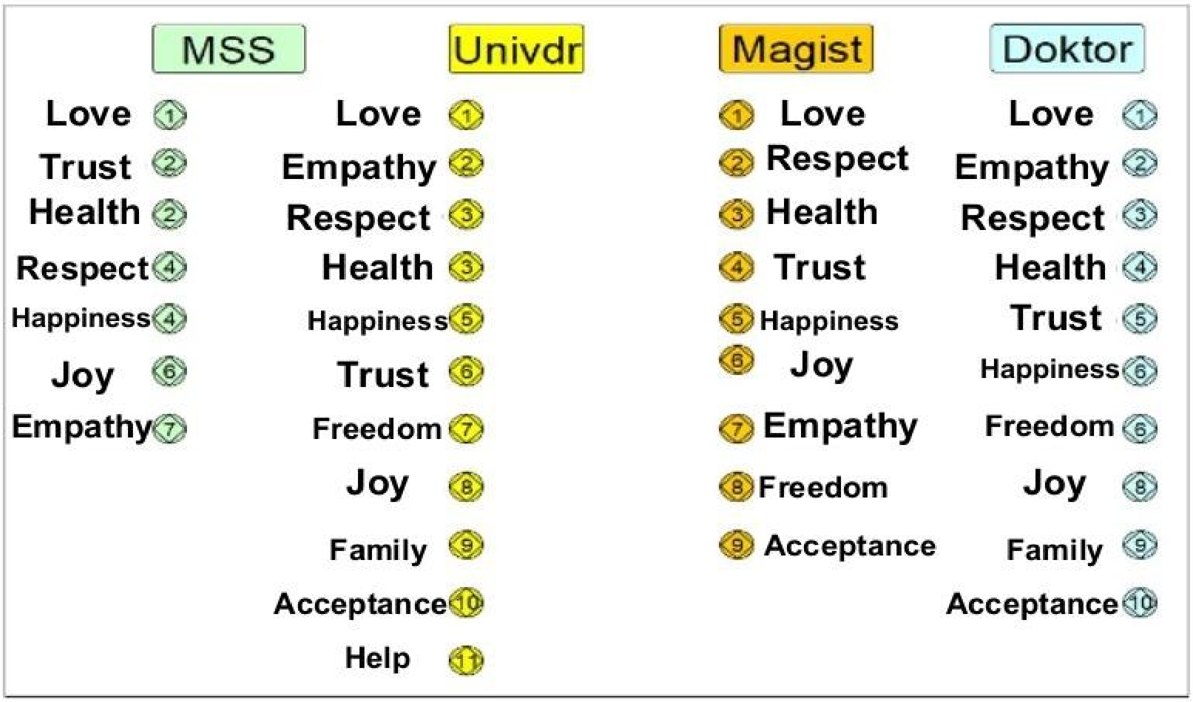
The keyword "mutual" also appeared and can be associated with help.

Conclusion on value priority lists by education:

The priority list of values varies significantly across education levels. Among the top 11 values, only one value holds the same rank across groups, representing just 9.09% similarity and 90.91% difference. This confirms the first research hypothesis and answers the fifth and seventh research questions from the perspective of formal education.

Key insight:

Compared to previous analyses based on gender and age, the priority list by education level shows the greatest variation. Earlier analyses involved only two groups each, while this one involves four categories—resulting in four separate text samples. Moreover, sample sizes varied significantly both in the number of respondents and the length of textual contributions.



3.8.5.3 Figure 142: Priority list of important family life values by level of formal education

Figure 142 presents the priority list of important values for family life based on levels of formal education. As a result, some values emerged that had not previously been emphasized, such as family, acceptance, and help. Meanwhile, values like security, optimism, and life dropped from the top of the list.

The most similar value priority lists were found between respondents with a university degree (Univ. Dr.) and those with a doctorate, while the lists for MSS (less than/secondary education) and Master's degree holders were quite different from each other.

If we again consider the informational hierarchy and the conceptually significant values within it, we can conclude—based on this sample—that individuals with a university degree or doctorate are highly likely to make similar decisions in family life.

In any case, the topic is interesting and would merit a more in-depth analysis, which, however, will not be carried out here.

D. Based on a word analysis using the AntConc software and network visualization using the Ora Casos software, the key findings regarding the most important family values by relationship status are as follows:

Participants were divided into two groups based on relationship status: those in a relationship (321 individuals) and those not in a relationship (109 individuals). The priority list of values important for family life according to relationship status is as follows:

1. Love: Both individuals in relationships and those not in relationships considered love the most important family value. 62.93% of those in relationships and 53.21% of those not in relationships assigned the highest importance to this value. Based on these percentages, we can conclude that love is more important to those in relationships than to those not in relationships.
2. Empathy: Both groups considered empathy a very important value for family life. 24.61% of individuals in relationships and 24.77% of those not in relationships valued empathy highly. The minimal difference suggests no statistically significant variation between the two groups.
3. Respect: Both groups agreed that respect is a very important family value. 23.05% of those in relationships and 25.69% of those not in relationships considered it important. Respect appears slightly more important to those not in relationships.
4. Health: Both groups regarded health as a very important value for family life. 22.43% of those in relationships and 23.85% of those not in relationships assigned it high importance. Thus, health holds slightly more value for those not in relationships.
5. Happiness: Both groups saw happiness as a fairly important value. 17.76% of those in relationships and 11.93% of those not in relationships valued it significantly. This suggests that happiness is more important to people in relationships.
6. Joy: Joy was considered a somewhat less important value by both groups. 15.89% of those in relationships and 8.26% of those not in relationships gave it moderate importance. Therefore, joy is considerably more valued by individuals in relationships.
7. Trust: Both groups viewed trust as a relatively important value. 15.89% of those in relationships and 30.28% of those not in relationships gave it high importance. This shows that trust is significantly more important to individuals not in relationships.
8. Freedom: Freedom was regarded as a fairly important value for family life. 13.40% of those in relationships and 11.93% of those not in relationships valued it. This implies that freedom is slightly more important to individuals in relationships.
9. Understanding: Both groups saw understanding as a reasonably important value. 9.97% of those in relationships and 10.09% of those not in relationships gave it importance. No statistically significant difference was observed.
10. Security: Security was seen as moderately important. 9.97% of those in relationships and 6.42% of those not in relationships gave it value. Therefore, security is more important to those in relationships.
11. Optimism: Optimism was also considered fairly important. 8.41% of those in relationships and 6.42% of those not in relationships valued it. Thus, optimism holds more weight for those in relationships.

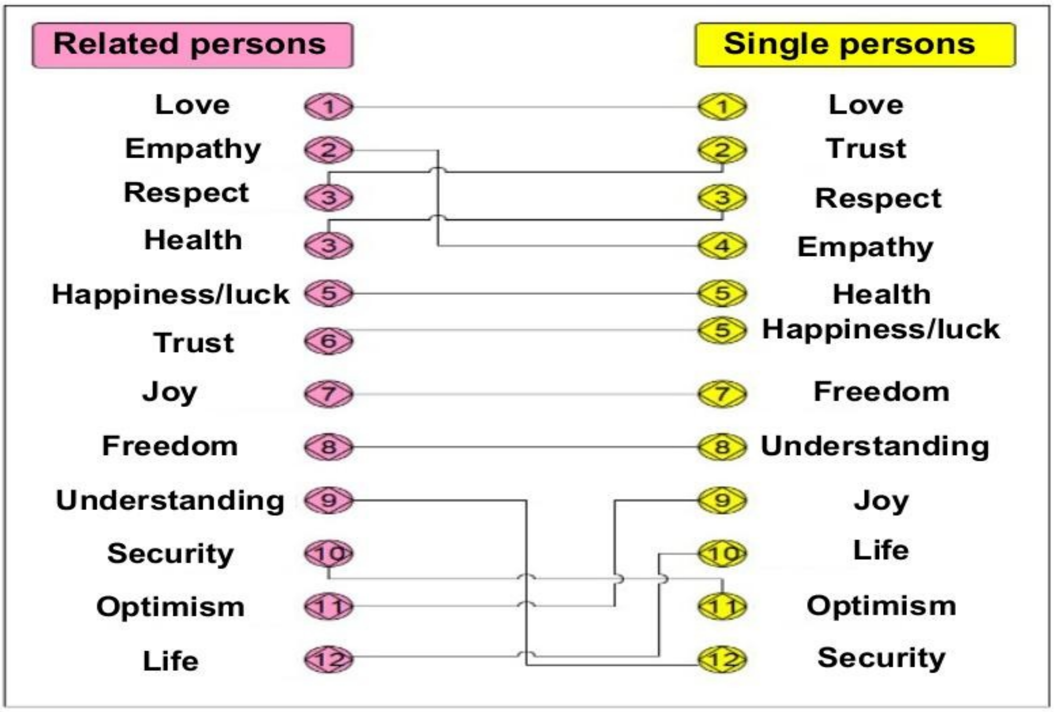
12. Life: Both groups considered life moderately important. 7.17% of those in relationships and 7.34% of those not in relationships valued it. The difference is negligible, with no statistically relevant variation.

Conclusion:

The priority list of values important for family life differs considerably between those in relationships and those who are single. Among the 12 values, only three shared the same ranking in both groups—representing 25% similarity and 75% difference. This confirms the first research hypothesis and answers the fifth and seventh research questions from the perspective of relationship status.

Insight:

There are certain differences in how values are perceived in family life depending on relationship status. This somewhat correlates with the fact that a higher percentage of individuals not in relationships are male. The results are not surprising, as the lifestyle of single individuals often differs significantly from those in relationships. Single people tend to focus more on themselves, while those in relationships typically also engage with their partner and children.



3.8.5.4 Figure 143: Priority list of important values for family life according to people in relationships and single people

Figure 143 presents the priority list of important values for family life, categorized by individuals in relationships and those who are single. A key difference in this list is the value of trust, which single individuals rank more highly than those in relationships. Generally speaking, we can conclude that single individuals tend to be less trusting and more hesitant when it comes to establishing romantic relationships. Because of this, they may require a higher level of motivation in order to develop greater trust in others.

Another contributing factor is that single individuals are often more inhibited in their interactions with the opposite sex and need stronger signs of affection from the other side. The reasons for this kind of emotional reservation can vary—they may stem from past disappointments, the loss of a loved one, or simply a personal belief that they can better realize their potential while remaining single.

Typically, single individuals have a slightly lower capacity for empathy. However, this does not mean they are significantly behind those in relationships. Single people often lean more toward individualism, which is generally considered less favorable for the concept of family life. On the other hand, single individuals may be more engaged with values related to social development, helping others, and actively seeking practical solutions for everyday problems—areas in which individuals in relationships may, on average, have less time to dedicate.

It is important to emphasize that this does not imply people in relationships are any less capable or committed to personal development and social contribution. The statement only suggests a certain tendency or potential that single individuals may possess to a greater extent than those in relationships.

From the perspective of decision-making based on a value hierarchy, we can conclude that the decisions of single individuals in certain complex situations may be more prone to fluctuation, which can manifest either as excessive emotional restraint or as openness.

6. Future development of the family

A customized sentiment analysis of the texts was conducted using the Jigsaw software tool. Out of a total of 129 opinions submitted by men, 36.43% were positive and 63.57% were negative. Women contributed a total of 225 opinions, of which 26.67% were positive and 73.33% negative.

Men described the future development of the family in terms of decline, disintegration, and the loss of value or meaning. They also highlighted the possibility of an increase in single-parent families. Additionally, they pointed to the growing influence of society (e.g., authoritarian regimes) and modern technology on family life, and even predicted a rise in individualistic tendencies—which they see as unfavorable for families (e.g., loneliness, alienation). According to them, the traditional nuclear family model will gradually fade and be replaced by tribal or other unconventional family models (e.g., polygamy, bigamy). They also emphasized the strong influence of migration from other continents, which could result in the imposition of foreign values.

On the positive side, some believed that the family, in its current form as a source of joy, empathy, and hope, would be preserved and continue to evolve. The family would remain a place of refuge, support, and warmth. Positive views included hopes for the preservation or even strengthening of the nuclear family model, while also recognizing a potential openness to other family structures. Some felt the status of the family, as it is today, would not significantly change.

Women also described the future development of the family in terms of decline, disintegration, and loss of value. They expressed concern that fertility rates would significantly drop in the future. They feared that parents would have less and less influence over raising their children, and that society would not oppose this trend. Due to a lack of time, they expected fewer high-quality emotional interactions, especially with children. They noted the negative influence of modern technology on parenting and criticized societal systems for failing to provide appropriate role models.

Similar to men, they were critical of the growing individualism, which they saw as detrimental to families (e.g., isolation, estrangement). Women more frequently highlighted various alternative family models, which they believed did not contribute to a better quality of family life. Although they mentioned migration as an influencing factor less often than men, it still featured in their responses. They also expected that interest in family life would gradually diminish.

On a positive note, women expressed the belief that the family, in its current form, would remain the fundamental unit of society and that its importance might even increase. They envisioned the family continuing to develop in a positive direction, becoming more open and adaptable. In their view, the family would remain the foundation of life and continue to serve as the primary institution.

These findings confirm the third, fourth, and fifth research hypotheses and provide an answer to the sixth research question.

Women described the future of the family somewhat more negatively than men, but a chi-square test (with 1 degree of freedom and a 5% significance level) showed that there were no statistically significant differences between men's and women's opinions on the future of the family. The test result of 3.2603 was below the critical value of 3.841.

Families and values together form hierarchical associative networks made up of elements such as individuals (e.g., partner), relationships (e.g., friendship), attributes (e.g., stability), and even dimensions (e.g., time).

Insight: Values are an integral part—or in a way, the "software"—of the family. The links between values and symbolic categories are more or less actively present in decision-making processes, meaning that values tend to be stronger concepts than symbolic categories within the informational hierarchy. Symbolic categories, and consequently symbols, complement and strengthen values.

In summary, while values and symbolic categories can be considered separately, when it comes to more complex decisions by individuals, families, or society, separating them is no longer possible. Both are the result of broader and narrower agreements as well as long historical development and diverse experiences. These factors influence child-rearing, important political decisions, individual lifestyles, and even partner selection. Values have substantial informational power, which can lead us to new knowledge and even wisdom.

In this hierarchical associative framework, women's greater concern about the negative future development of the family appears logical, as women are generally more affected by stress factors and tend to have more difficulty processing them—as has been repeatedly noted.

Based on the collected findings and insights, the sixth research hypothesis has been confirmed and the ninth research question has been answered.

3.9 Conclusion

Based on a flexible and broadly defined understanding of values, the family can also be considered a value—even though some authors disagree with this notion. In the broader context of this research, the family served as an overarching value encompassing the various values expressed by the respondents.

The family, together with values (regardless of whether one defines the family itself as a value), forms hierarchical associative networks. These networks can be extensive and significantly influence various decisions, especially those related to child-rearing. The hierarchical associative networks of family and values are also critically important in other interdisciplinary decision-making areas such as politics, business, law (legislation), medicine (patient care), science (use of test animals), chemistry (inventions), the military, policing, everyday thinking, and management (e.g., recruitment decisions).

If the most positive values—such as love, health, and life—are represented within these networks as smaller nodes with weak and limited connections, there is a high likelihood that the decisions made will be less positive or less favorable for individuals, families, and society at large.

This research has essentially opened up a new and interesting field of study related to hierarchical associative networks (or systems), which form the structure of all social phenomena and can have both positive and negative effects on our human nature. Studying these networks—whether in the context of individuals, families, or societies—could help improve various decision-making models. Another perspective points to artificial intelligence, which already plays a significant role in daily life and is expected to have even greater influence in the future. For example, programming humanoid intelligent robots with positive and realistic hierarchical associative value networks could help them make or suggest the best decisions in social contexts. These networks of values will continue to play an important role in decision-making, which in turn will influence the future development of the family.

Among the 428 respondents, the majority expressed the belief that the future of the family will be less positive. This is somewhat alarming, especially considering that most respondents were public sector employees—people who typically have stable family lives, secure social status, and relatively sufficient financial resources.

This may indicate that more scientific research efforts will need to be invested in ensuring that positive values are realized within societal hierarchical associative systems (such as families, individuals, communities, organizations, and institutions). Furthermore, those in positions of political power must ensure that these values have a stronger and more active influence within such systems. If positive values diminish in everyday life, the result will likely be a loss of energy within social hierarchical systems, which will negatively affect both families and individuals.

On the other hand, implementing positive values across all areas of social life generates positive energy, making life more meaningful, less complicated, and less financially burdensome.

4 Society or social nature

When it comes to experiencing life within hierarchical associative systems of a social nature, we encounter a range of perspectives. This social reality can be interpreted in a very positive way, relatively neutrally, or very negatively. Of course, there are also intermediate states, which tend to be more variable and less stable, as such fluctuations can be influenced by the current mood of the system's members or the broader social climate (e.g., an economic crisis).

A common desire among most members of the system is to perceive the past, present, and future in a positive light. Education—both within families and institutions (such as schools, kindergartens, and universities)—strives to teach and promote positive values, as confirmed by research on family and values. One way of systematically implementing positive values within social hierarchical associative systems is through various legislative frameworks. However, as experience shows, these laws are often not sufficiently practical or aligned with real life, which is why amendments and revisions are fairly common.

People, especially those in socially and technologically advanced societies, live in and depend on the system. This system functions as a living and breathing mechanism, where laws serve as navigational tools that individuals may choose to follow—or not. Poor understanding of the law often leads to ignorance, making such individuals more easily influenced by those who have a better grasp of legal mechanisms. In this context, it's important to note that individuals with limited legal knowledge are often placed at a disadvantage.

This observation provides a useful starting point for classifying people in socially and technologically advanced societies into four groups. Those who are particularly aware of the power of money, influence, and legal knowledge can be described as "individuals with an extreme hierarchy complex." The other three groups—progressive individuals, the majority group, and the anomaly group—are generally less focused on the power of money, influence, and law.

The thoughts and interests of these groups can differ significantly, meaning that specific events and phenomena may affect each of them differently. In the following sections, we will attempt to profile these groups based on general characteristics, aiming to highlight the hierarchical potential of the social system.

4.1 Structure of the social hierarchical associative system

Members of the social hierarchical associative system can be classified into four groups: the majority group, the anomaly group, the group with an extreme hierarchy complex, and the progressive group.

4.1.1 The majority group

On average, members of this group are more easily influenced, which means their behavior and thinking are more predictable. They largely operate within the framework of social programming, leading to the assumption that they are more susceptible to both moral and immoral forms of programming compared to the other groups. They tend to follow collective guidelines more closely, which is favorable for establishing hierarchical structures.

When society becomes less stable or secure, this group struggles more with orientation and adaptation, which can lead to chaos and, in extreme cases, even mass psychosis. Their capacity for functioning independently as individuals is weaker, making them more reliant on collective mechanisms and leaders. Their behavior often mirrors herd instincts, suggesting a more instinct-driven orientation. Their personal instincts are somewhat weaker and may even be overridden by what's referred to as “de-instinct.”

Their reasoning tends to be shaped by contributions from standout individuals and is adapted to the societal mode of organization. However, when this reasoning disrupts entrenched social structures, it may be suppressed through ideological or religious dogmas, leading to a regression into collective instincts or even the de-instincting of certain individuals or groups. A clear example of this is seen in the influence of strong religious dogmas in India.

Instinct tells a person to preserve their species and care for offspring, where sexuality plays a key role. Some religions teach that believers should be as fertile as possible and have many children. In India, members of the majority group are often devout believers who, despite poor living conditions, have ten or more children—whom they often cannot adequately support. As a result, half of these children do not survive past the age of four, primarily due to hunger and disease.

In some parts of India, religious dogma dictates that cows are sacred and must not be eaten. The same goes for rats, which also must not be killed. As a result, these animals multiply freely and spread dangerous diseases.

The caste system in India significantly hinders change, as the upper classes suppress development. In this way, religious ideology—which is supposed to transcend instinctive and rational thinking—becomes a tool for reinforcing extreme hierarchical relationships and encouraging de-instinctive behavior. This leads to conditions of severe poverty, overpopulation, hunger, and disease, which are clearly irrational. In the long term, such extreme poverty poses a serious problem for humanity as a whole.

In socially and technologically advanced societies, the prevailing dogmas are those of wealth, influence, and profit. These societies, too, display many examples of irrational behavior, including collective irrationalities such as environmental pollution. Although this may result in short-term economic gain, it is ultimately counterproductive and can be classified as an anomaly or collective idiocy.

In such a system, all social groups participate and help sustain it, as they are dependent on it (e.g., car usage or harmful detergents). Even in socially and technologically advanced societies, there are favorable conditions for hierarchical relationships—but these also include more intense forms of cooperation.

The human relationship with nature, compared to the instinctual thinking and behavior of other living beings, is more polarized. The counter-instinct in humans is extremely strong and often irrational, positioning humans as both mentors and parasites of nature. On one hand, they maintain balance; on the other, they disrupt it.

The majority group, like other social groups, is highly dependent on the socially hierarchical associative system and provides it with the largest numerical support. They live within a system of collective instinct, which is reflected in the high population density per square kilometer, especially in socially and technologically advanced societies. This concentration triggers collective instinctive processes, which often manifest in undesirable forms such as prostitution, crime, war, mental illness, alcoholism, addiction, and traffic accidents.

These processes often remove individuals from the reproductive cycle. Prostitution, for example, suggests that many sex workers will not have children. Similarly, psychopathic killers often spend most of their lives in prison, which prevents them from reproducing.

In the long term, such collective instinctive mechanisms impact the whole society, which continues to sustain them due to its dependence on the system. Even in socially and technologically advanced societies, we encounter undesirable phenomena resulting from instinctive and irrational behavior, highlighting the paradox of the human relationship with both nature and society.

For example, many homosexuals do not have biological children, as their sexual orientation typically excludes reproduction. We can also mention individuals who are severely physically or mentally disabled, severely psychotic patients, drug addicts, alcoholics, and, as history has shown, even some artists. This group also includes Catholic priests and members of various monastic orders.

From this, we can conclude that the collective instinctive mechanism, in addition to genetic potential, both creates and eliminates these groups of people.

The more dangerously high the population density per square kilometer becomes, the more prominently this collective instinctive mechanism appears. It acts as a kind of filter, maintaining a relatively balanced level of population density. If individuals from the groups mentioned were to each have two children, the already high population density could quickly spiral into catastrophe. In short, the hierarchical associative social system, through various individuals, ensures that extreme overpopulation does not occur.

This collective instinctive mechanism does not target only certain types of people—it fulfills its purpose regardless of gender, age, poverty, or wealth. Anyone can become its target. The mechanism is blind to pleas and gratitude, as well as to commands and criticism. It is a consequence of human behavior in nature and the result of our biological foundation.

Especially in socially and technologically advanced societies, systems are constantly changing, and rules are adapted, because no system can provide an optimal hierarchical associative organization. Despite these efforts, there is always an ongoing struggle between the law of unity—within which opposites intertwine (e.g., activity/passivity, unification/separation, individual/collective, etc.).

"No thing or phenomenon can be fully understood until we see its connection with other things and phenomena, as one thing indirectly or directly influences another."[42] Every part is a component of a larger system, within which it both receives and transmits certain activities. Therefore, the power of mental self-initiative is a key factor that determines an individual's position within the social structure. In the majority group, this mental self-initiative is, on average, less developed, which makes it easier to establish hierarchies and promotes predominantly subordinate participation.

The majority group can be characterized by the fact that, both in thought and behavior, its members generally do not stand out and tend to adhere to tradition and established rules. People in this group often belong to the working class, private sector (e.g., tradespeople), or middle class (public employees who do not hold high-ranking positions and therefore have less influence). Their thinking is typically focused on everyday matters, such as home renovations, shopping, socializing with friends, stable and secure employment, and conversations about politics or children.

It is less likely to find individuals in this group who are highly innovative, exceptionally educated, or extremely ambitious in terms of wealth and influence. People in the majority group are heavily influenced by individuals from the group with an extreme hierarchical complex. As a result, they often adopt their (hierarchical) behavioral patterns. The well-known chain reaction, where a superior reprimands a subordinate, who then does the same to those beneath them, illustrates this dynamic.

All of these characteristics contribute to the fact that people in the majority group are, on average, loyal to the state, good consumers, regular taxpayers, reliable, sociable, relatively physically and mentally healthy, kind, etc., and are less frequently involved in improper behavior such as criminal activity, fraud, stalking, or workplace harassment.

42 Stiehler, G. (1960). *Hegel und der Marxismus über den Widerspruch*. Berlin: Dietz – Verlag.

4.1.2 The anomaly group

This group includes individuals whose mental and behavioral patterns are highly unpredictable. In many respects, they represent the direct opposite of the majority group. Typically, this group includes people suffering from severe forms of psychosis, such as advanced schizophrenia, violent psychopaths and sociopaths, extreme addicts (to drugs, alcohol, sex, gambling, video games), as well as asocial individuals (e.g., many homeless people, certain artists, and individuals with lower intelligence).

From a statistical perspective, this group may appear marginal and small in number. However, a more detailed analysis—one that takes into account the sum of all such individuals—reveals a significantly larger figure.

According to statistical data from 2015, the number of registered individuals with mental impairments in the United States indicates a large population. Out of a total of 319,929,162 inhabitants, approximately 6,700,000 were recorded as mentally impaired, suffering from various severe forms of psychosis, bipolar disorders, and other conditions. In Slovenia, during the same period, around 21,154 such individuals were registered.[43] If we were to add up the number of people in this group across all countries, one might sarcastically conclude that we are looking at a massive army of anomalous human specimens. Statistically, these individuals appear almost insignificant, but this global statistical perspective can be misleading. People in the anomaly group are likely the least socially connected structure among all groups. However, in terms of costs and energy, they are extremely demanding, while the positive return from them is nearly nonexistent.

These individuals have rights, and rightly so, although those rights are often neglected or misunderstood. From the perspective of hierarchology and hierarchography, it would be wise to invest significant research effort and develop practical solutions that would allow society to gain more positive feedback from this group. In technologically and socially developed societies, the anomaly group somewhat resembles the “untouchables” in the Indian caste system.

It is appropriate to attempt to profile this heterogeneous group, which—due to its characteristics—is more difficult to unify than members of the majority group. People from the anomaly group are generally less suited for forming hierarchically associative organization. They tend to be less structured personalities who often lack positive motivation and emotional depth. They are frequently in a state of emotional numbness. Many are guided by ideology to which they are consciously attached, but real-life situations often transform this attachment into chaotic susceptibility. This chaos frequently results in a sense of alienation from the ideology (a similar effect can be seen with religion), triggering a strong sense of guilt.

43 Statistical data can be found at https://www.who.int/mental_health/evidence/atlas/profiles-2017/en/ (2019-08-6).

This sense of guilt weakens their real ego system and strengthens the imaginative ego system. A suppressed self-critical nature leads them to focus on their own weaknesses, which can give rise to delusional feelings of being watched, psychologically inferior, or that others are hostile toward them. As a result, such individuals often drift away from normative social thinking, which is a key requirement for forming hierarchical and associative social communities.

These characteristics point to general tendencies, but the anomaly group is extremely diverse. For example, there are major differences even between schizophrenic individuals and classic paranoiacs. People with borderline personality disorder may function quite acceptably until they enter a particular emotional state. Even specific categories of mental illness are highly varied and can only be unified in terms of personality traits.

Because of these traits, people in the anomaly group form an unstable foundation for hierarchical associative relationships. They frequently fall into states of excessive anxiety, which may lead them into a momentary superiority complex that quickly shifts into an inferiority complex. This creates a constant struggle between positive and negative energy, draining much of their bioenergy. The ongoing internal conflict affects their state of consciousness, which may become either excessively narrow or completely dispersed.

Under the influence of medication, such individuals are generally more manageable, but this does not reflect life without medication. The pharmaceutical industry profits greatly from their treatment, as there are medications available for nearly every psychological issue. These treatments are often presented as successful research projects, but they can also be misused within the scientific field.

Many individuals from the anomaly group create their own reality and escape from the real one, while simultaneously struggling with the desire to live in an agreed-upon reality. In most cases, the counter-energy is stronger, leading them to direct their inner energy toward their own constructs of reality. Science has not yet done enough to extract useful information from these individuals that could contribute to the development of innovative ideas.

Our collective instinctual mechanism in society is based on a polarity between truth and falsehood. The balance within this polarity can tip in favor of mass untruths, which may trigger uncontrollable chain reactions within society. These processes threaten any form of social order, as even individuals from the majority group become less manageable and more unpredictable under such conditions.

It would be reasonable to critically reflect on the strategies and tactics of public psychiatric treatment. Currently, this treatment does not sufficiently encourage methods of self-observation in people from the anomaly group. For example, in a psychiatric session where a psychotic individual speaks about their worldview, the psychiatrist may interrupt and redirect them toward the agreed-upon reality. This means the psychotic individual is expected to immediately shift to the psychiatrist's framework of thinking, which is practically impossible. As a result, these individuals are pushed into a state of passivity.

Subsection 2.4 described in relative detail the introspective method of classified expressions and impressions, which could contribute added value to understanding the causes of various thought anomalies while also enabling the emergence of innovative ideas. Excessive mental anomalies—particularly those related to psychotic disorders (including bipolar disorder, borderline personality disorder, psychopathy, addictions, and others)—arise primarily from genetic predispositions and the agreed-upon social reality, that is, from events, phenomena, and even rules within a given socially hierarchical associative system. The larger the group of anomalies within a particular social hierarchical associative system, the closer we approach the assumption that effective positive solutions are needed in the form of technological, legal, organizational, informational-communicative, semantic, ethical, moral, and other improvements, patents, or innovations. It is crucial to recognize that as the anomaly group grows, social hierarchical associative systems lose various types of energy (e.g., kinetic energy, bioenergy).

This raises a key question: Should we view anomaly groups as a civilizational pinnacle – a logical consequence of collective preservation mechanisms that instinctually isolate them from communities – or as potential indicators that could improve social hierarchical associative systems? These perspectives conflict, much like opposing human structures where unrest perpetually fluctuates. Such unrest creates confusion, affecting the system and potentially fostering psychotic tendencies and psychoses, which in turn generate more anomalies.

The dilemma emerges: maintain the status quo or pursue improvement? This question reveals opposing human tendencies – some strive to preserve existing social realities, while others push for change. These conflicting forces trigger cascading contradictions that overwhelm social networks. An overwhelmed social network becomes increasingly aware of differences between societal segments, leading to greater diversity of desires.

The highest form of diversity manifests as dissent, which possesses collective and individual histories akin to language – our communication tool. Even within language, interpersonal differences emerge. While people may evaluate many phenomena and rules similarly, they simultaneously assess them differently. Situations and associated positions vary significantly: even identical social network positions between individuals lead to divergent valuations of words and even vowels.

Despite varied internal responses to language (including vocal elements), words remain collective and individual orientation tools for expressing fears, desires, needs, experiences, and knowledge.

Language establishes a dynamic, evolving infrastructure for internal and external world perception. This analysis reveals a relationship between _emanation_ and _parvamagnation_ – dynamically intertwined and mutually dependent concepts.[44] In certain aspects, the principle of emanation is superior to the principle of parvamagnation, but there are also many perspectives in which emanation takes a subordinate position. To shed light on the interplay between these two principles in our social nature, let's consider an example: a baby who has not yet acquired linguistic knowledge. From this initial position, we can argue that the baby begins learning language rules through a higher level—namely, the parents, who already have a more or less established grasp of these rules. In this sense, the higher level influences the lower one, which reflects the principle of emanation.

However, if we focus on how the baby learns language, the principle of emanation becomes subordinate. The baby learns word by word and gradually builds simple sentences as they develop. Here, everything from the lower level flows toward the higher level, embodying the principle of parvamagnation in our social nature. The interplay between these two principles reveals and illustrates both differences and similarities within human structures.

Individuals belonging to the group of anomalies tend to lean toward the parvamagnation principle in their thinking and experience-gathering processes, making them less receptive to the broader social picture. Within these personalities, various internal objections often arise, which can be extremely challenging. The negative consequence of internal objections is internal conflict, while the positive outcome is problem-solving. However, people from this group frequently fail to recognize the core issue at hand, which puts them at a disadvantage when addressing their internal struggles. Their internal objections are often disjunctive in nature, whereas those of other groups tend to be more conjunctive.

This brings us back to a critical question with two opposing tendencies: should we leave things as they are or improve social hierarchical associative systems to reduce the number of individuals within the anomaly group and prevent new members from joining? The answer is clear: we should aim for improvement. But when? What moment is most suitable and least risky for such interventions? When should we decide and act?

When improving any system, it is crucial to thoroughly understand its mechanisms. Without sufficient knowledge, well-intentioned efforts can lead to negative consequences—even catastrophic ones—that may affect other members of the system. To mitigate risks, it is essential to have a precise understanding of individual system segments—their properties, functioning, and

44 Emanation means that everything comes from some highest level, that all lower forms arise from higher forms. The concept of parvamagnancy means the opposite, as it states that higher forms arise from lower forms. This concept is new and has no scientific tradition.

connections with other segments. Are these connections hierarchical or associative? It's also helpful to know the history of each segment within the system.

It would be wise to determine whether a specific segment in the system is more aligned with emanation or parvamagnation principles. This could be achieved through an analysis of causality and conditionality.[45]

As a result, we could obtain various relationships that demonstrate either emanation or parvamagnation alignment. A segment within a system can be viewed from three perspectives:

1. The segment is sui generis – we see it as a standalone entity.
2. The segment is a conglomerate – we view it as part of a larger whole.
3. The segment is a medium – we perceive it as something intermediate between a part and a whole, serving in a mediating role.

It would also be sensible to introduce an observational system after analyzing causality and conditionality, allowing us to track changes.

Insight into the relationship between totality or the overall structure and immanence or independence can provide additional understanding regarding the functioning and interconnectedness of system segments. The whole is composed of things, and the relationships within it maintain or change it. If the relationships within the whole change, we speak of a process that gradually alters the constituent parts and, consequently, the members within the system who are co-creators of the whole. In social hierarchical associative systems, the whole is relatively maintained through laws. As long as laws are appropriate, there is no formation of a changed whole. The mental relationship, especially among the majority group, tends to favor totality or structure over immanence or independence. In contrast, the mental relationship of the anomaly group is extremely dynamic, sometimes aligning with totality or structure during certain episodes and then shifting to a level of mental immanence or independence. These struggles or forces are dependent on the polysum and monosum of an individual's laws (collective and individual laws of the individual).

The way of perceiving the broader community and, consequently, the laws in relation to one's own world tends more toward isolated individuality among representatives of the anomaly group. This means that the anomaly group is a relatively amorphous formation, and its representatives are somewhat floating correlates within the social hierarchical associative system.

45 The term etial system (German: Ethiale système) was used by Menges, G. (1969). *Beiträge zur Unternehmungswissenschaft*. Würzburg : Wien. [s. n]. This term was never accepted. The aforementioned edition of this scientific monograph is also no longer available. The author Karl Petrič renamed the etial system to the conditional system (see subsection 2.2).

4.1.3 Group with an extreme hierarchical complex[46]

In subsection 2.3.6, we already addressed the theme of dominance, which has both genetic and psychosocial origins. Figure 11 depicted the demonstration of dominance through handshaking, a behavior particularly characteristic of political figures. Moving forward, it will be necessary to profile this group of people based on certain characteristics.

Representatives who can be identified as individuals with a strong desire to dominate others can come from the working class, middle class, upper-middle class, upper class, and highest class. The largest number of these individuals actually comes from the highest class, where they are particularly active in exercising authority, distributing financial resources among members of the social hierarchical associative system, and shaping, adopting, and implementing legislation.

Within this group, we also find so-called "invisible people," who represent invisible power at both local and national levels. These include intelligence agents who spread and monitor information and disinformation in various ways and at different levels (e.g., lobbyists, spies, informants). Their influence is very significant, which is why it is appropriate that they were mentioned, as we will return to such individuals later.

People from the group with an extreme hierarchical complex are most frequently found where there is significant decision-making influence, inductive influence (e.g., spreading rumors, economic propaganda, shaping opinions), decision-making and executive power, and influential wealth in various material or exchangeable forms.

The first key finding is that individuals from this group represent an exceptionally favorable platform for establishing hierarchical relationships. Regarding collaborative relationships, they are distinctly interest-oriented. Representatives of this group are the main drivers of the social hierarchical associative system. Without them, social nature would be relatively amorphous, less stratified, and perhaps even anarchic. These individuals are crucial for establishing and operating such a system.

Despite this finding, it will also be necessary to critically evaluate these representatives, as their decisions often result in unnecessary energy loss and social costs. The purpose of this critique is to improve the system so that energy losses are minimized and costs and decisions are as optimal as possible.

Representatives of this group do not merely harbor a strong desire to dominate others; they also have a strong need for it. Their genetic makeup is such that they are somehow compelled to fulfill

46 The term "Group with an extreme hierarchical complex" is due to their extreme innate need to dominate other members of the social hierarchical associative system. In subsection 2.3.6, their above-average need to extract happiness hormones was already mentioned, which is fulfilled by continuously proving superiority over other people. We have also caricatured them as addicts of biological drugs.

this need. Social and natural circumstances further encourage it. They are often persuasive, charismatic, and highly adaptable, which allows them to attract a large number of members from other groups.

People from the group with an extreme hierarchical complex often (consciously or unconsciously) use methods from the field of reverse psychology. Due to their persuasiveness, they can directly or indirectly influence others, as they are able to project their life vision onto numerous individuals. They intensely use psychological triggers to evoke desires, fears, and needs in others, as they quickly identify the weak and strong points of other people. It should be noted that they are not necessarily knowledgeable about psychological theories, methods, or practices; these abilities and potentials are innate.

Globally, representatives of this group cannot be labeled as immoral, as they are often advocates of morality and values. However, many values are overshadowed by their excessive need for dominance, which they wish to demonstrate or achieve at every opportunity. In this interplay between ethics, morality, values, and the need for dominance, numerous effects arise that can have profoundly negative or even catastrophic consequences on the social hierarchical associative system.

In this context, they are often prone to tunnel vision, as the need for dominance is often stronger than positive values. The problem is that they often do not realize or refuse to acknowledge that their impulsive decisions violate key values (e.g., establishing a casino in the city center has good business effects but also brings negative social phenomena such as drug addiction among youth, uncontrolled prostitution, alcoholism, traffic accidents, violence, and suicides). They always manage to justify their decisions with familiar phrases, such as: "We developed the city's infrastructure," "We created new jobs." Their arguments are not incorrect or false, but this calculation did not take into account the numerous misfortunes that befell individuals who succumbed to drugs, injuries, death, etc. Representatives of the group with an extreme hierarchical complex typically defend themselves with the argument that they did not plan this and that it could have happened even if the casino were built on the outskirts of the city or not built at all. This argument is initially difficult to refute, but through research on the environment, people, their habits, etc., it could be proven that the establishment of a casino in the city center actually posed an exceptionally high safety risk for certain groups of people. Another problem can be seen in the area of environmental pollution, which is highly lucrative in terms of profit (e.g., the sale of cars, fuels, detergents, pesticides, etc.), but ultimately causes intense environmental pollution and increasingly severe ecological problems. Even when faced with criticism about this, they typically defend themselves with the argument that environmental pollution has little impact and is not critical.

However, time will show that they lived in a grave misconception. They generally do not acknowledge their own mistakes, but their adaptability is evident in how quickly they change their stance. If they previously downplayed the importance of environmental pollution, they suddenly become fervent advocates for environmental protection. They adopt new legislation and implement corrective measures.
It is almost necessary to say that their key personality trait – "an extreme and strong need to dominate other people" – is exceptionally beneficial for establishing organized social hierarchical associative systems, but in another light, it poses a danger for short-sighted decisions. Their mental immanence or independence strongly prevails over mental totality or structure in the sense of egocentricity of their own personality. Due to their extremely strong need to dominate others, they must become leaders to have a certain level of authority. In every case, authority means something that must be maintained, defended, and preserved. In doing so, they use various methods and means that can lead to extremely negative consequences, such as exploiting fellow humans, severe conflicts, crime, plots, and even wars. Because of this strong need for dominance, they can become extremely ruthless and, in an ethical sense, even irrational.
Regarding positive and key improvements in social hierarchical associative systems, we must emphasize a crucial condition: representatives from the group with an extreme hierarchical complex must be aware not only of their power but also of the weaknesses hidden behind it. It would be advisable for them to weigh every important decision not just from the perspective of authority, influence, and wealth, but also to actively consider proposals from people, especially from the scientific community.
For the political sphere, this could mean that alongside the parliament and the president of the country, there should exist a kind of wise social network that includes scientific institutions, various scientists, economic sections, private individuals, and other individuals. This wise social network should also have interactive and real-time influence on parliamentary debates.
Many have witnessed lengthy discussions in the national assembly where no agreement was reached because two subjective viewpoints were stubbornly maintained. With the direct involvement of representatives from the wise social network, many unproductive discussions could be turned into a more constructive direction much faster. People from the group with an extreme hierarchical complex bear significant responsibility for future existential decisions that will be crucial for the survival of the human species.

4.1.4 Group of progress

People in the group of progress are broadly inclined toward seeking and implementing ideas that aim to improve the world or social hierarchical associative systems. They generally favor egalitarian relationships, which can also include collaborative interactions. Rigid hierarchical relationships often limit their ability to develop new ideas. It is difficult to definitively state whether they provide a favorable or unfavorable platform for hierarchical relationships, as they are relatively strong individualists at heart. If individuals from the group with an extreme hierarchical complex allow for flexible hierarchical associative organization, such relationships are most suitable for members of the group of progress, enabling them to develop their own individual potential and foster collaborative relationships with others.

Representatives from the group of progress can be found across all social strata and are not necessarily confined to scientific institutions, although a significant number originate from them. There are individuals without formal education who can still be highly innovative and knowledgeable (e.g., amateur researchers, collectors, inventors, certain artists). Many people in this group are not necessarily scientists but may be experts with remarkable kinesthetic abilities capable of improving parts of the system. Their mental immanence or independence typically prevails over mental totality or structure.

People in the group of progress usually possess strong ideas and unwavering determination to improve the world or social hierarchical associative systems. They tend to gravitate toward visions that are often unacceptable or incomprehensible to the broader community. Similar to how individuals from the group with an extreme hierarchical complex can be seen as "addicts" of dominance over others, people in the group of progress can be considered "addicts" of new ideas aimed at improving the world. Essentially, they are compelled to face challenging intellectual tasks daily and prove their intellectual capabilities. Their intellectual strength can sometimes be disruptive to their broader environment.

It is important for members of this group to be mindful of such disruptions, as presenting complex ideas to other groups can lead to discomfort or even psychological stress among those groups. Developing and managing complex ideas is always the result of rigorous mental training—training that other groups typically have not undergone. Representatives from the group of progress should avoid falling into egocentric states that may arise if they become overly fixated on their vision, as this vision is often incomprehensible to others and may even distance them from the real world.

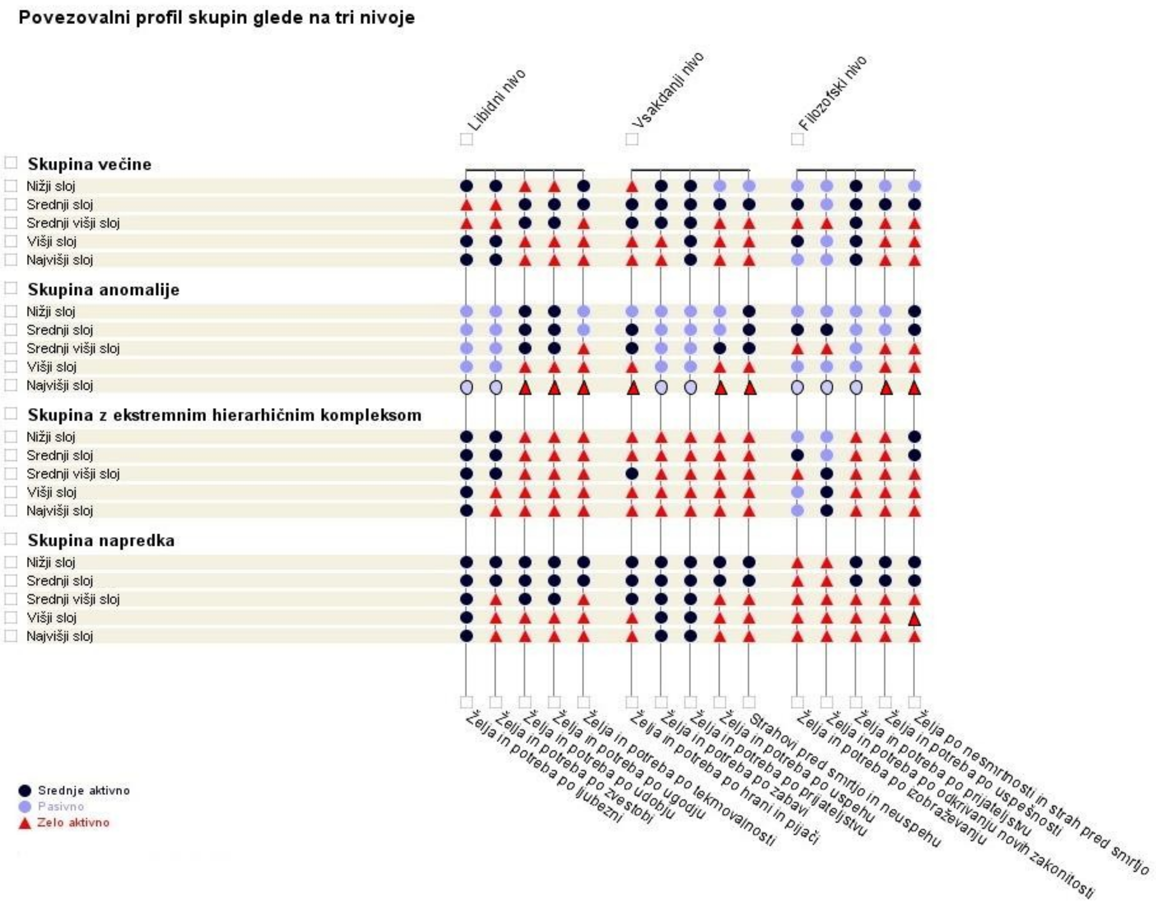
4.1.5 Connecting profile of groups of people

All representatives from various groups within the social hierarchical associative system adapt more or less successfully to given situations and positions. They all orient themselves according to collective and individual values and laws. They all act with the desire to leave their mark, but the way they intend to achieve this is partly dependent on themselves and largely dependent on the opportunities provided by social and natural circumstances. From a functional perspective, we have implementers (people from the majority group), dictators or managers (people from the group with an extreme hierarchical complex), developers (people from the group of progress), and the afflicted (people from the group of anomalies).

The greatest energy of mental immanence or independence can be found within the group of people with an extreme hierarchical complex and the group of progress. The strongest energy of mental totality or structure is present among people from the majority group, while individuals from the group of anomalies are extremely fluctuating and experience significant bioenergy loss. For successful technological, ethical, and socially developmental-oriented functioning of the social hierarchical associative system, it is crucial to have the right ratio of representatives from all groups. If there are too many implementers, managers, developers, or even afflicted individuals within the system, it may happen that the system does not function optimally.

Would a formula for the ratio of groups, such as a quarter of dictators or managers, a quarter of developers, half implementers, and no afflicted individuals, be a good guide for the successful and humane functioning of the social hierarchical associative system? This question is extremely interesting, but there is no practical answer to it. Perhaps it would be possible to study the proportion of people from these groups within individual successful and less successful technologically and socially developed countries. However, despite positive intentions, this would overlook a large amount of data, such as about amateur researchers or mentally ill individuals, as global statistics cannot fully capture the real picture. Despite this limitation, such a study might be interesting and could provide useful feedback on the percentage composition of people from individual groups in successful social hierarchical associative systems.

Based on three-dimensional thinking (libidinal level, everyday level, philosophical level) and information hierarchy, it is possible to create a connecting profile of all four groups of people to determine the framework of their thinking or which data building blocks they predominantly use. What data or information can we therefore expect from representatives of all four groups?

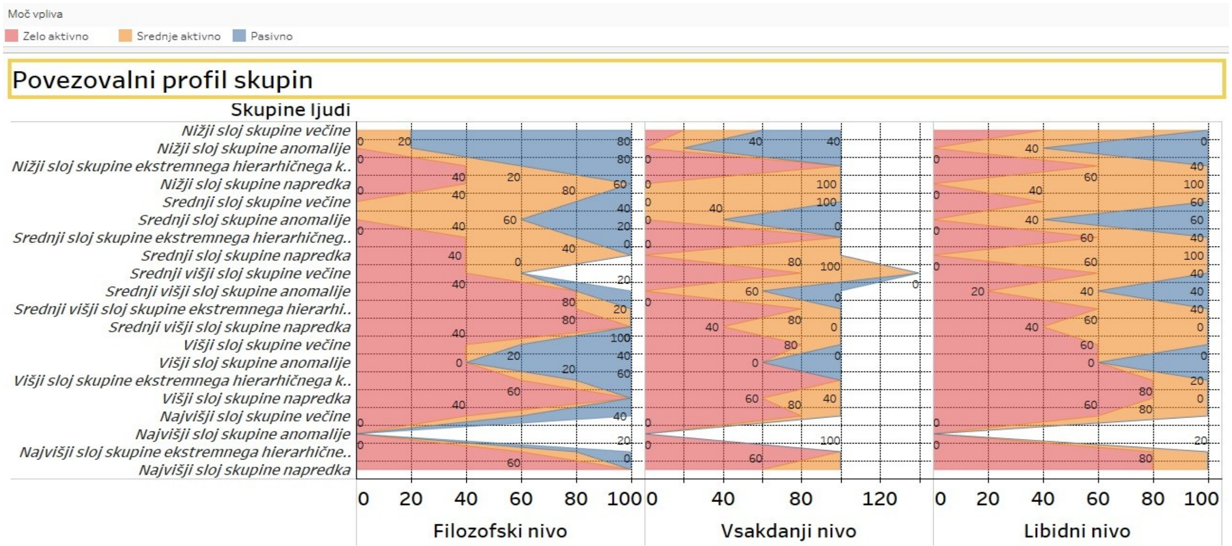


4.1.5.1 Figure 144: Profile of group representatives based on a three-level thinking method

Figure 144 displays the profile of group representatives based on a three-dimensional thinking method using a complex matrix. All groups of people are divided into subgroups such as the lower class (e.g., workers, unemployed, homeless), middle class (e.g., administrators, artisans, teachers, high school professors), upper-middle class (e.g., university professors, art academicians, doctors), upper class (e.g., bank managers, stock market lobbyists, political lobbyists, business directors), and the highest class (e.g., state politicians, president of the country, ministers, high-ranking officials in intelligence services).

The groups of people from the four main groups discussed (majority group, etc.) were evaluated based on libidinal (e.g., desire and need for love, desire and need for loyalty, desire and need for comfort, desire and need for indulgence, desire and need for competitiveness), everyday (desire and need for food and drink, desire and need for entertainment, desire and need for friendship, desire and need for success, fears of death and failure), and philosophical thinking (desire and need for education, desire and need for discovering new laws, desire and need for friendship, desire and need for success, desire for immortality and fear of death). The characteristics or evaluated psychological stimuli for each level of thinking are listed in parentheses.

The evaluation was conducted using an assessment scale: very active (highest rating: assigned value is three), moderately active (medium rating: assigned value is two), and passive (lowest rating: assigned value is one). The purpose of the measurement was to determine the strength of active needs, desires, and fears in individual groups of people distributed across the mentioned classes. The collected data were exported to Excel, followed by visualization using Tableau Software. An analysis of the profiles of people by group follows. It is also sensible to emphasize that this is a simulation of determining profiles, as such an empirical study has not yet been conducted. Due to this fact, the analysis of profiles will be less accurate and will highlight only the outstanding characteristics.



4.1.5.2 Figure 145: Surface diagram of the power of needs, desires, and fears by stratified groups

Figure 145 displays a surface diagram showing the power of needs, desires, and fears by stratified groups. The power of needs, desires, and fears is represented by red (very active), yellow (moderately active), and blue (passive) colors. The numerous values within the surface diagram represent percentages. The surface diagram clearly illustrates the highest, medium, and lowest power of activity across groups or subgroups according to levels of thinking. In short, which groups or subgroups can we expect to have the highest, medium, and lowest power of activity across levels of thinking regarding the fulfillment of given psychological stimuli? Essentially, we obtained a kind of "hotspots" and "cold spots" of activity across individual groups.

An excessive power of passive response or engagement across various levels of thinking indicates an unfavorable platform for hierarchical associative relationships, socialization, societal development, information exchange, and communication (see blue surfaces). Red surfaces indicate the opposite and suggest dominance and self-initiative. Medium values (see yellow surfaces) represent a favorable platform for hierarchical associative relationships, but predominantly in a subordinate position and often lacking self-initiative.

a. Lower class and the power of philosophical thinking

In the majority group, anomaly group, and extreme hierarchical complex group, there is a lower level of activity and a more passive response to certain psychological stimuli (e.g., desire and need for education, desire and need for discovering new principles). Among lower-class representatives from the progress group, the power of desire and need for education and discovering new principles is greater, meaning these individuals place much more emphasis on education and exploration. The likelihood that they actively pursue this emphasis through educational and scientific activities is significantly higher compared to representatives from other groups. In summary, at the philosophical level, representatives from the progress group exhibit greater activity in fulfilling psychological stimuli than those from other groups.

b. Lower class and the power of everyday thinking

In the lower class of the majority group, increased activities related to desires and needs for food and drink are reported. Regarding other characteristics, moderate activity levels are observed for desires and needs for entertainment and friendship, while desires for success and fears of death or failure tend to be more passive. A much greater passive response to these psychological stimuli is found among representatives of the anomaly group's lower class. Representatives of the extreme hierarchical complex group's lower class show exceptionally high activity levels across all psychological stimuli. They are much more likely to actively seek social connections at gatherings. On the other hand, they also exhibit very high levels of fear regarding death and failure. Representatives from the progress group's lower class are rated as having moderate responsiveness to fulfilling activities based on psychological stimuli. Based on evaluations at the everyday thinking level, representatives from the extreme hierarchical complex group show higher activity levels than those from other groups.

c. Lower class and the power of libidinal thinking

Among lower-class representatives, those from the extreme hierarchical complex group stand out in terms of their ability to fulfill activities related to psychological stimuli (e.g., desire and need for comfort, indulgence, competitiveness). They are followed by representatives from the majority group's lower class (desire and need for comfort and indulgence). Representatives from the progress group's lower class achieve moderate activity levels, while those from the anomaly group's lower class exhibit low fulfillment power or predominantly passive responses to psychological stimuli.

d. Middle class and the power of philosophical thinking

In the middle class of the anomaly group, philosophical thinking shows the least inclination toward active engagement. Next are representatives from the majority group, who achieve average values regarding desires and needs based on psychological stimuli. Third place goes to representatives from the extreme hierarchical complex group, who demonstrate strong tendencies toward fulfilling two psychological stimuli (desire and need for friendship and success). In the middle class of the progress group, there is a strong inclination toward two activities (desire and need for education and discovering new principles), while other psychological stimuli at this level show moderate values.

e. Middle class and the power of everyday thinking

The anomaly group again stands out with minimal power in fulfilling activities due to given psychological stimuli. The middle class of both the majority group and progress group achieves moderate values. The highest values or greatest power in fulfilling activities due to given psychological stimuli are observed in the extreme hierarchical complex group.

f. Middle class and the power of libidinal thinking

Once again, representatives from the anomaly group show highly passive power levels, while individuals from the progress group achieve moderate values at this level. The middle class of the majority group emphasizes desires and needs for love and loyalty strongly, whereas individuals from the extreme hierarchical complex group achieve high results in fulfilling activities related to three psychological stimuli (desire and need for comfort, indulgence, competitiveness).

g. Upper-middle class and the power of philosophical thinking

At the upper-middle class level, representatives from the group of progress stand out as achieving the highest values regarding philosophical thinking and given psychological stimuli. In contrast, representatives from the anomaly group show the lowest values. Upper-middle class representatives from the majority group demonstrate significant power in fulfilling activities due to four psychological stimuli (desire and need for education, discovering new principles, success, immortality, and fear of failure). Similarly, representatives from the extreme hierarchical complex group also achieve high values, but with less emphasis on fulfilling desires and needs related to discovering new principles.

h. Upper-middle class and the power of everyday thinking

Representatives from the extreme hierarchical complex group are most prominent, achieving the highest possible ratings in fulfilling four psychological stimuli (desire and need for entertainment, friendship, success, and fears of death and failure). As a counterbalance, representatives from the anomaly group generally achieve lower and medium values. Similar results are observed for representatives from the majority and progress groups, as they achieve medium ratings for the first three psychological stimuli and the highest possible ratings for the last two (desire and need for success, fears of death and failure).

i. Upper-middle class and the power of libidinal thinking

Representatives from the anomaly group stand out for their passive power, having been rated with the highest possible score only for the last psychological stimulus on the libidinal level (desire and need for competitiveness). Again, representatives from the extreme hierarchical complex group achieve the highest possible ratings for three psychological stimuli (desire and need for comfort, indulgence, and competitiveness). Similarly, representatives from the majority group achieve the highest ratings for the first two psychological stimuli (desire and need for love and loyalty) and high ratings for the last stimulus (desire and need for competitiveness). Upper-middle class representatives from the progress group were rated with the highest possible score for two psychological stimuli (desire and need for loyalty and competitiveness), while other ratings were in the medium range.

j. Upper class and the power of philosophical thinking

Representatives from the upper class of the progress group strongly stand out, as all psychological stimuli were rated with the highest possible score. They are followed by representatives from the extreme hierarchical complex group, who show a tendency toward strong activities in fulfilling the last three psychological stimuli (desire and need for friendship, success, immortality, and fear of death). However, their activity level is lower and medium regarding the desire and need for education and discovering new principles. Even upper-class representatives from the anomaly group achieve high ratings for the last two psychological stimuli (desire and need for success, immortality, and fear of death), while showing high passivity regarding the desire and need for education and discovering new principles. Upper-class representatives from the majority group show identical results for the last two psychological stimuli but are somewhat more inclined to pursue education and form friendships.

k. Upper class and the power of everyday thinking

Representatives from the upper class of the extreme hierarchical complex group are particularly prominent, achieving the highest possible ratings for all psychological stimuli. This indicates exceptionally strong tendencies toward active engagement at all levels of everyday life. They are followed by upper-class representatives from the majority group, who have a slightly lesser inclination toward fulfilling social connections, especially in the direction of friendship. Upper-class representatives from the anomaly group achieve high ratings for three psychological stimuli (desire and need for food and drink, success, and fears of death and failure). Similar to representatives from the anomaly group, they achieve high ratings for these psychological stimuli but are somewhat more prepared to participate in social gatherings and form friendships.

l. Upper class and the power of libidinal thinking

Regarding the power of activity in fulfilling psychological stimuli, representatives from the progress group and the extreme hierarchical complex group stand out, as only the first psychological stimulus (desire and need for love) resulted in a medium value. Upper-class representatives from the anomaly group show greater passivity in fulfilling the first two psychological stimuli (desire and need for love and loyalty), while achieving the highest possible ratings for other stimuli (desire and need for comfort, indulgence, and competitiveness). Upper-class representatives from the majority group achieve medium values for the first two stimuli and the highest possible ratings for the last three stimuli.

m. Highest class and the power of philosophical thinking

At this level of thinking, representatives from the highest class of the progress group clearly stand out, achieving the highest possible ratings for all characteristics. They are followed by representatives from the highest class of the extreme hierarchical complex group, who express a tendency toward passivity regarding education and a moderately active tendency toward discovering new principles, but show very active inclinations toward establishing social connections, which can be key to success. They also have a strong desire for immortality and fear of death. Third place goes to representatives from the highest class of the majority group, who express passivity regarding education and discovering new principles. They achieve a medium value in establishing social connections and have a strong desire and need for success and immortality, along with significant fears of death. Representatives from the highest class of the anomaly group express the highest level of passivity regarding education and discovering new principles and are largely socially isolated. However, they have a strong desire and need for success and immortality and express stronger fears of death.

n. Highest class and the power of everyday thinking

At this level, representatives from the highest class of the extreme hierarchical complex group again stand out, achieving the highest possible ratings for all psychological stimuli. They are closely followed by representatives from the majority group. On the everyday thinking level, representatives from the highest class of the progress group show less power of activity, especially in the area of desire and need for entertainment and friendship. Representatives from the highest class of the anomaly group can be placed last, achieving the lowest values regarding desire and need for entertainment and friendship, while achieving the highest possible ratings for the other three stimuli.

o. Highest class and the power of libidinal thinking

At this level, the groups of the extreme hierarchical complex and progress stand out, expressing medium power of activity only regarding the desire and need for love, while achieving the highest possible ratings for the other four psychological stimuli. They are followed by representatives from the highest class of the majority group, who express medium power of activity regarding the desire and need for love and loyalty. Once again, representatives from the highest class of the anomaly group achieve the lowest possible ratings regarding the desire and need for love and loyalty.

Based on profiling groups or subgroups across different classes, we obtained "hotspots" and "cold spots" of potential activity in the mental space or mental cones. This simultaneously means that we determined from which group of people we can expect the greatest, medium, and least energy inputs.

4.1.5.3 Concluding insights on group profiles based on levels of thinking

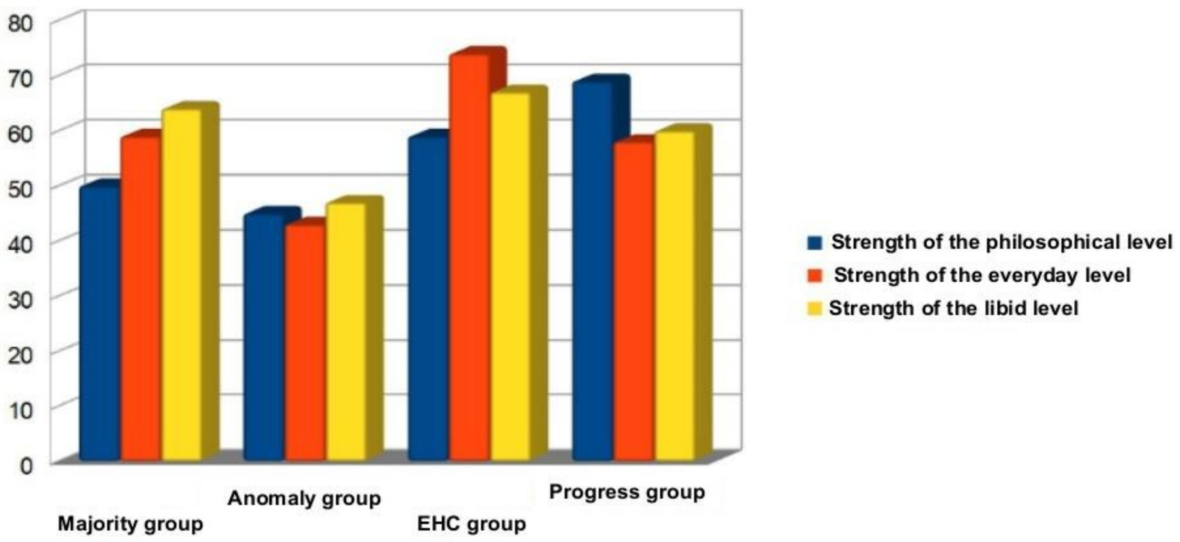
Upon examining groups or subgroups, we found that representatives from the group with an extreme hierarchical complex exhibit the strongest tendency toward activities at the libidinal and everyday levels of thinking. This means they are prepared or have a stronger need to invest a lot of energy into activities such as socializing with people and establishing social connections, primarily in the form of interest-based friendships. They are generally very active at the libidinal level of thinking, which is associated with establishing social connections that are not necessarily of an emotional nature. At the philosophical level of thinking, their tendency toward activity is somewhat lower but still higher than that of representatives from the majority group and the anomaly group.

Representatives from the majority group show a greater tendency toward activities at the everyday and libidinal levels of thinking compared to representatives from the progress group. At the philosophical level of thinking, they express a lesser tendency toward activities than representatives from the extreme hierarchical complex group and the progress group. The obtained values for the majority group indicate expected averageness. Representatives from the progress group strongly expressed the greatest tendency toward activities at the philosophical level of thinking, while lagging behind representatives from the majority group and the extreme hierarchical complex group at the everyday and libidinal levels of thinking. Representatives from the anomaly group expressed the least tendency toward activities at all levels of thinking.

In all groups, there were differences within subgroups or classes, which allowed us to conclude that the higher we ascend the hierarchical ladder, the stronger the tendency toward increased activities at all levels of thinking. This likely aligns with the motivation and increased opportunities typically available to representatives of higher classes. The simulation in the form of analysis essentially showed the energy dynamics across different groups or subgroups, primarily expressing the distribution in terms of tendencies toward activities or energy inputs. For greater clarity, the full results should be presented in the form of a table and a bar chart.

4.1.5.3.1 Table 109: Statistical data on values at the three levels of thinking by groups

Groups	*Philosophical level*	*Everyday level*	*Libid level*	*Total by groups*
Majority group	50	59	64	173
Anomaly group	45	43	47	135
EHC group	59	74	67	200
Progress group	69	58	60	187
Total by levels	223	234	238	695



4.1.5.3.2 Figure 146: Distribution of the power of three-Level thinking by group

Table 109 presents statistical data on values across the three levels of thinking by group, while Figure 146 uses a bar chart to illustrate the distribution of the power of three-level thinking across these groups.

The highest value is observed in the domain of everyday thinking (everyday level: 74, libidinal level: 67, philosophical level: 59) within the group labeled Extreme Hierarchical Complex (EHC group). In contrast, the lowest value (43) appears in the Anomaly group at the everyday level. The thinking level values within the Anomaly group are relatively balanced (philosophical level: 45, everyday level: 43, libidinal level: 47).

In the Majority group, we see a nearly linear increase across the thinking levels (philosophical: 50, everyday: 59, libidinal: 64). The Progress group stands out at the philosophical level (philosophical: 69, everyday: 58, libidinal: 60).

Taking an overall view, the libidinal level dominates (238), followed by the everyday level (234), with the philosophical level coming in last (223). The philosophical level is most characteristic of the Progress group.

Looking at overall values by group, the EHC group has the highest total (200), followed by the Progress group (187), the Majority group (173), and finally, the Anomaly group (135).

In terms of energy investment toward activities across all levels of thinking (or mental zones) on a global scale, the EHC group clearly takes the lead. Members of this group are the most dynamic in both action and content, strongly driven by an excessive desire and need to dominate others.

In contrast, members of the Progress group place significant emphasis on the philosophical level of thinking, while remaining more or less average at the other two levels. Their focus lies in improving the social hierarchical-associative system. However, a weakness of this group is their relatively low engagement at the everyday level, which hinders their ability to implement innovative solutions effectively.

The excessive desire and need for dominance observed in the EHC group is also a weakness, as it often prevents the realization of many potentially positive solutions. This leads to suboptimal social and intellectual collaboration between members of the EHC and Progress groups, which ultimately benefits neither the system nor the broader population.

At the everyday thinking level, the Majority and EHC groups are relatively more aligned, which provides a favorable foundation for subordinated functioning. However, this tends to maintain the current status quo rather than foster meaningful change.

Such self-regulation can be seen as beneficial to a certain extent, as it contributes to the relative stability of the social hierarchical-associative system, ensuring that everyday life isn't overwhelmed by a flood of changes or novelties. Nevertheless, a significant portion of the population does not utilize their full potential, which results in less effective and constructive energy direction.

This portion of the population is reflected in the Anomaly group, which is the least active emotionally, intellectually, and socially. The analysis provided here serves as a solid starting point for the promised upcoming exploration of information hierarchy across different human groups.

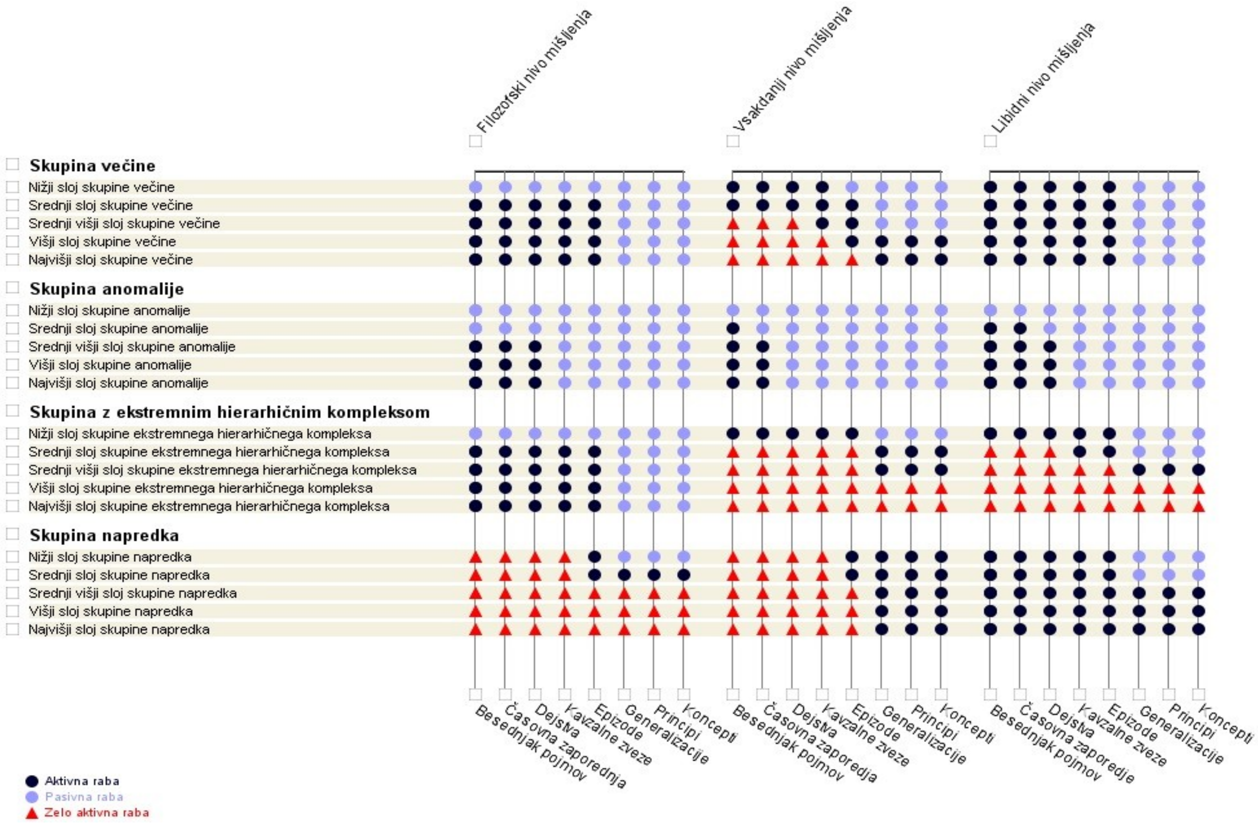
4.1.6 Information hierarchy and human groups

This subsection presents a simulation in the form of an analysis of how different groups of people actively use data elements within the information hierarchy. The focus is on determining the frequency and complexity of using vocabulary related to concepts, temporal sequences, facts, causal relationships, episodes, generalizations, principles, and concepts.

It is clear that all people, to varying degrees, use these data elements at the libidinal, everyday, and especially the philosophical levels of thinking. However, the frequency and complexity of their use are not equivalent across groups.

As discussed earlier in subsection 1.3, these data elements are particularly relevant in scientific analysis and data synthesis. Still, analysis and synthesis are not limited to scientific research—they also occur at the libidinal and everyday levels of thinking.

In essence, people process data—consciously or unconsciously—on a daily basis, in the form of events, individuals, objects, rules, phenomena, historical developments, and so on. Through this process, we evaluate our experiences, knowledge, current and desired states, often assigning them a specific and even measurable value (e.g., in the form of symbols, quantities, strength, magnitude, or color).



4.1.6.1 Figure 147: Use of data elements by human groups according to three-level thinking

Figure 147 illustrates how various human groups use data elements in relation to the three levels of thinking. These groups are further divided into subgroups based on social strata, such as:

- Lower class (e.g., workers, unemployed individuals, homeless people)

- Middle class (e.g., administrators, craftsmen, teachers, high school educators)

- Upper middle class (e.g., university professors, fine arts academics, doctors)
- Upper class (e.g., banking managers, stock market lobbyists, political lobbyists, corporate executives)
- Highest class (e.g., state politicians, the president, ministers, high-ranking intelligence officials)

The main four population groups (e.g., the Majority group, etc.) were assessed based on their use of data elements (such as conceptual vocabulary, facts, temporal sequences, causal links, episodes, generalizations, principles, and concepts) in connection with the libidinal, everyday, and philosophical levels of thinking.

The assessment was conducted using a rating scale:

- Very active use (highest score: value of 3),
- Active use (moderate score: value of 2),
- Passive use (lowest score: value of 1).

The Majority group scored:

- 60 at the philosophical level,
- 82 at the everyday level,
- 65 at the libidinal level.

The Anomaly group showed the lowest scores across all levels:

- 49 (philosophical),
- 47 (everyday),
- 51 (libidinal).

The Extreme Hierarchical Complex (EHC) group scored particularly high at the everyday level:

- 60 (philosophical),
- 103 (everyday),
- 98 (libidinal).

The Progress group achieved the highest score at the philosophical level:

- 109 (philosophical),
- 103 (everyday),
- 74 (libidinal).

The aim of this measurement was to determine the active and passive use of data elements across different human groups. These values will later be used in a visualization of the network linking human groups, levels of thinking, and their active or passive use of data elements.

Using a customized thesaurus method, terms were categorized as:

- TT or BT (broader terms: human groups, information hierarchy),
- CC (classification by thinking levels),

- NT (narrower terms, based on specific data elements).

Data from the customized thesaurus were exported into Excel, including TT, CC, BT, and NT categories. Next to the column for broader concepts, a new column titled “Active Use” was added, into which the previously mentioned values were entered row by row.

For the broader concept “Information Hierarchy”, values were calculated by summing the scores across human groups and levels of thinking. Both the human groups and the information hierarchy were broken down by thinking level (e.g., Majority Group – Philosophical, Majority – Everyday, Majority – Libidinal; Information Hierarchy – Philosophical, Everyday, Libidinal).

The data were then processed and visualized using the previously mentioned Ora Casos software tool.

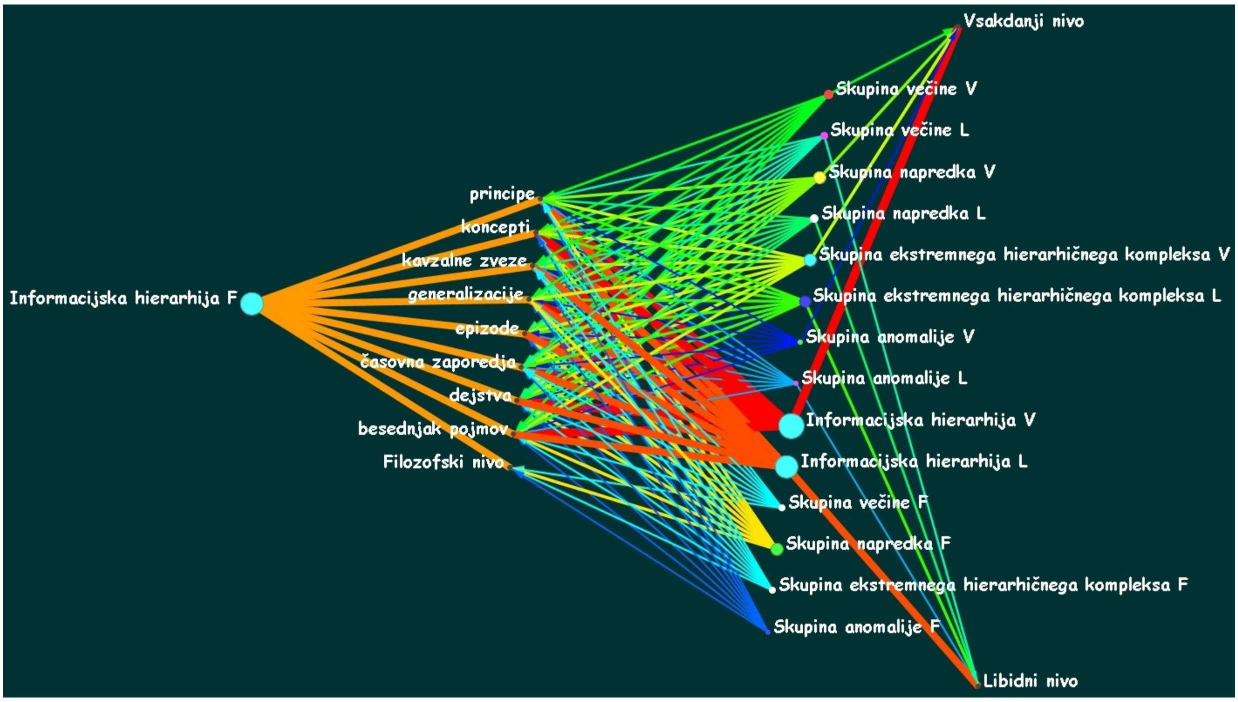
What follows is an analysis of the active use of data elements (i.e., types of data within the information hierarchy) by level of thinking and by human group. This represents a simulated analysis, as no empirical study of this kind has yet been conducted. As a result, the findings should be considered less representative.

For clarity, a partial dataset from the customized thesaurus is also presented. However, some data columns are still missing—particularly those for:

- NT5: Generalizations
- NT6: Causal relationships
- NT7: Principles
- NT8: Concepts

4.1.6.2 Table 110: Part of the data from the adapted microthesaurus

BT	Usage	CC	NT1	NT2	NT3	NT4
Majority group F	60	Philosophic. level	Glossary of terms	Facts	Time sequences	Episodes
Majority group V	82	Everyday level	Glossary of terms	Facts	Time sequences	Episodes
Majority group L	65	Libid level	Glossary of terms	Facts	Time sequences	Episodes
Anomaly group F	49	Philosophic. level	Glossary of terms	Facts	Time sequences	Episodes
Anomaly group V	47	Everyday level	Glossary of terms	Facts	Time sequences	Episodes
Information hierarchy F	278	Philosophic. level	Glossary of terms	Facts	Time sequences	Episodes
Information hierarchy V	335	Everyday level	Glossary of terms	Facts	Time sequences	Episodes
Information hierarchy L	288	Libid level	Glossary of terms	Facts	Time sequences	Episodes



4.1.6.3 Figure 148: Network visualization of active use of data Elements

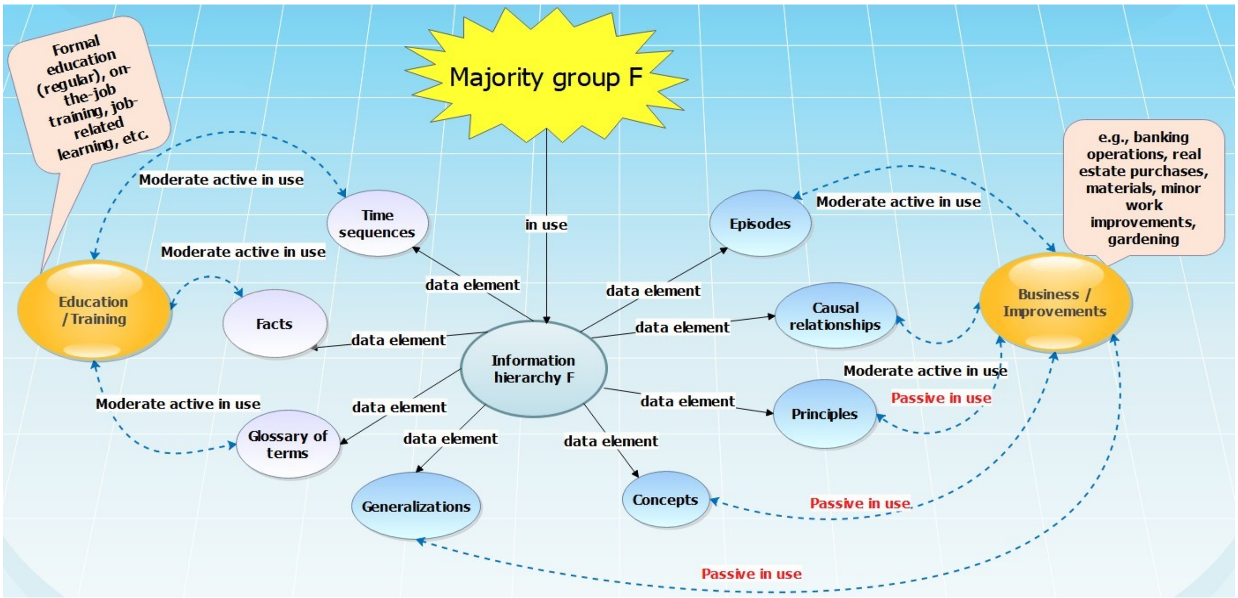
Table 110 presents a portion of the exported and supplemented data from the customized micro-thesaurus, while Figure 148 shows a network visualization of the active use of data elements (information hierarchy F – Philosophical, V – Everyday, L – Libidinal) across levels of thinking and human groups. There are many possibilities for analyzing this network, but examining every aspect would be unnecessarily time-consuming. The following section will focus on analyzing the use of data elements by different human groups in order to identify their main thematic focus. What kinds of activities and global content can be expected from the representatives of these various groups?

4.1.6.3.1 The Majority Group's use of data elements at the philosophical level of thinking

At the philosophical level of thinking, the Majority group utilizes all of the listed data elements (see also the matrix: out of a possible 120 points, this group scored 60, representing 50% usage), although this usage is mostly not for the purpose of scientific research.

In the network graph (see Figure 148), we can observe that the larger node labeled "Information Hierarchy F" (highlighted in light blue) is connected to data elements such as conceptual vocabulary, facts, temporal sequences, episodes, causal relationships, principles, generalizations, and concepts, with a connection strength (indicated by orange) of 279.0.

The Majority group (represented by a small white node) uses these data elements at the philosophical level with moderate to passive intensity (as shown by the weaker light blue links, with a connection strength of 61.0). To determine the practical level of active or passive use of data elements and the group's overall thematic focus, a conceptual diagram was created.[47]



4.1.6.3.1.1 Figure 149: Conceptual diagram of the Majority group at the philosophical level of thinking – use of Data elements and global thematic focus

Figure 149 presents a conceptual diagram of the Majority group at the philosophical level of thinking, illustrating their use of data elements and overall thematic focus.

Generally, members of the Majority group use less complex data elements at this level, such as glossary of terms, facts, and temporal sequences, with a moderate level of activity and intensity. Examples of this type of usage include regular or occasional education alongside work and training for specific job tasks.

47 Luo, X. (2020). Design of full-link digital marketing in business intelligence era with computer software Edraw Max. *2020 Management Science Informatization and Economic Innovation Development Conference (MSIEID)*, 364–367. https://doi.org/10.1109/msieid52046.2020.00077.

More complex data elements, such as episodes and causal relationships, are used moderately actively, while the most complex elements—principles, generalizations, and concepts—are used only passively.

Examples of the use of these more complex data elements by the Majority group at the philosophical level include fields like business operations and implementing small-scale improvements (e.g., banking operations, real estate purchases, materials acquisition, sales, and minor improvements at work or in the garden).

In summary, representatives of the Majority group at the philosophical level of thinking typically do not demonstrate high energy investment or strong emphasis on complex content. These individuals are not focused on driving significant societal change, but rather tend to favor moderate adaptation and subordination within the existing social structure.

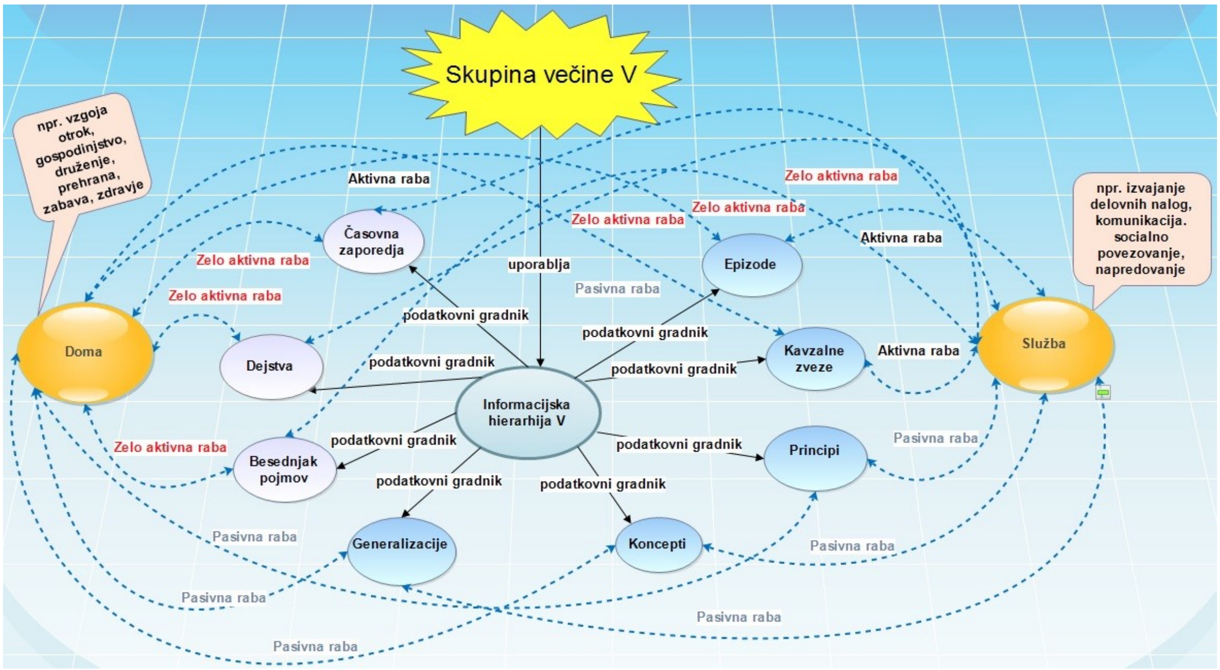
4.1.6.3.2 The Majority group's use of data elements at the everyday level of thinking

At the everyday level of thinking, the Majority group utilizes all of the listed data elements (out of a possible 120 points, the group achieved 82 points, representing 68.33% usage).

In the network graph (see Figure 148), we can observe that the largest node, "Information Hierarchy E" (see the light blue node), with a connection strength of 336.0 (indicated by the red color), is linked to data elements such as conceptual vocabulary, facts, temporal sequences, episodes, causal relationships, principles, generalizations, and concepts.

The Majority group (represented by the red node) uses these data elements at the everyday level of thinking with varying intensity—ranging from very active, to moderately active, to passive (see green links with a strength of 83.0).

This is followed by an analysis of the practical active or passive use of data elements and the global thematic focus, using a conceptual diagram.



4.1.6.3.2.1 Figure 150: Conceptual diagram of the Majority group at the everyday level of thinking regarding the use of data elements and global thematic focus

Figure 150 shows the conceptual diagram of the Majority group at the everyday level of thinking in relation to their use of data elements and the global thematic focus.

Representatives of the Majority group at this level of thinking use certain data elements very actively (such as glossary of terms, facts, temporal sequences, and episodes), others moderately actively (like causal relationships), and some passively (generalizations, principles, and concepts).

The number of instances in which the Majority group uses data elements at the everyday level is significantly greater than at the philosophical level of thinking. These uses can broadly be divided into the domestic and work environments.

Examples of using data elements in the home environment include child-rearing, household management, food, health, socializing, entertainment, recreation, play, sports, politics (e.g., elections), vacations, home renovation, and shopping (e.g., buying a car). These represent the many daily activities that define the global thematic focus of the Majority group at the everyday level.

The same applies to the work environment, where members of the Majority group may deal with tasks such as performing job duties, communicating with superiors, subordinates, and colleagues, forming social connections (both formal and informal), career advancement, increasing income, dealing with stressors, and facing workplace bullying (mobility-related stress).

At this level of thinking, representatives of the Majority group are generally expected to adapt and faithfully fulfill their civic duties (e.g., paying taxes, ensuring the proper upbringing and education of children). Their mental world revolves around a secure home, a stable and reasonably rewarding job, good health, a simple daily routine, friendly relationships, and a moderate or even high level of respect for certain social authorities (e.g., leaders, politicians, actors, singers), entertainment, and relatively superficial engagement with politics.

Their energy investment is generally average and less directed toward prominent or standout activities (e.g., complex economic decisions, criminal activities, public exposure, lobbying, or exerting influence on social events). More often, they are in the role of active information recipients rather than creators (e.g., opinion-makers).

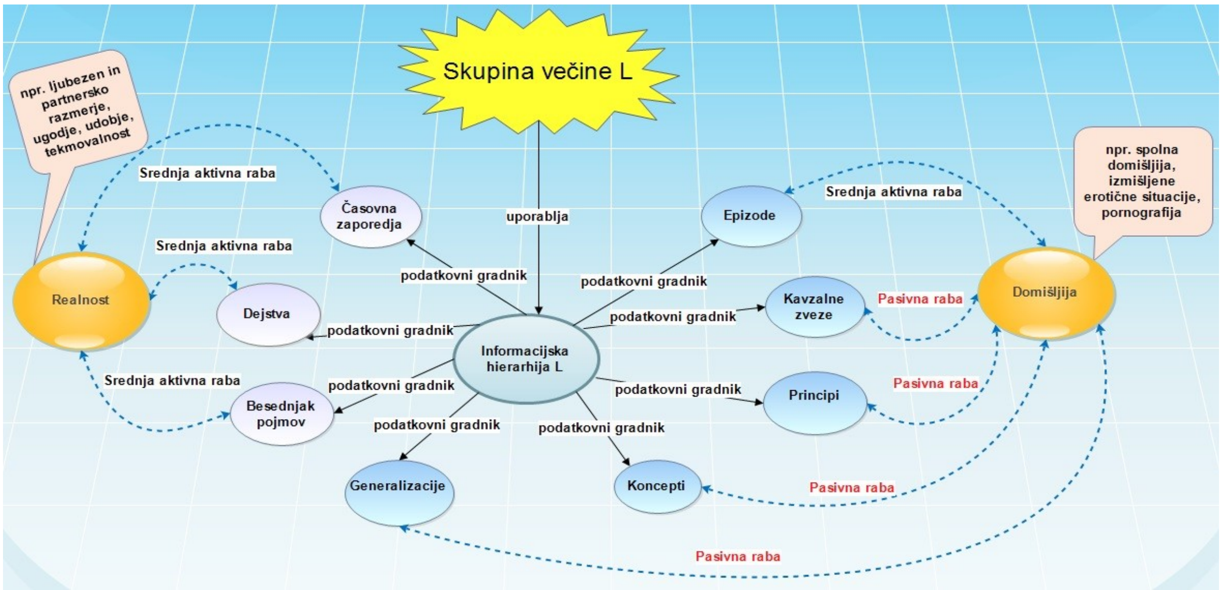
4.1.6.3.3 The Majority group regarding the use of data elements at the libidinal level of thinking

At the libidinal level of thinking, the Majority group uses all listed data elements (out of 120 possible points, the group scored 65 points, representing 54.17% usage). On the network graph (see Figure 148), the largest node, "Information Hierarchy L" (see the light blue node), with a connection strength (see the dark orange color) of 289.0, is linked to data elements such as conceptual vocabulary, facts, temporal sequences, episodes, causal relationships, principles, generalizations, and concepts.

The Majority group (see the pink node) uses the mentioned data elements at the libidinal level of thinking with moderate to passive intensity (see the turquoise green connections with a strength of 66.0). Within this group, we can expect active use of less complex data elements and highly passive use of more complex ones.

Once again, a conceptual diagram is used to determine the nature of active or passive use of data elements and the global thematic focus. However, this diagram will be simpler, with fewer connections and a more limited thematic range than at the philosophical and everyday levels of thinking.

Nevertheless, certain aspects—especially from the everyday level—are also reflected at the libidinal level (e.g., role-playing in erotic contexts such as “master and maid”).



4.1.6.3.3.1 Figure 151: Conceptual diagram of the Majority group at the libidinal level of thinking regarding the use of data elements and global thematic focus

Figure 151 shows the conceptual diagram of the Majority group at the libidinal level of thinking regarding the use of data elements and global thematic focus. Representatives of the Majority group at the libidinal level of thinking use certain data elements with moderate activity (glossary of terms, facts, temporal sequences, and episodes) and others passively (causal relationships, generalizations, principles, and concepts). The number of instances in which data elements are used at the libidinal level of thinking by the Majority group is significantly limited and focused on inherited designs, instinct, and social circumstances.

Libido is an important source of life energy, which is not only limited to the desire for sexuality but also helps reduce negative stress factors. A suitable libido can transform bad moods into satisfaction, while a low libido can lead to dissatisfaction, especially in a partnership. Essentially, "Information Hierarchy L" can be divided into the real environment and ego, as well as the imaginative environment and ego.

Eroticism is an extremely popular topic in friendly circles. However, it should be emphasized that those who talk and think a lot about this subject often show signs of dissatisfaction. Examples of the use of data elements in the real environment may include adjusting a partnership toward equal relationships with as few unnecessary power struggles as possible, developing a favorable and comfortable living situation, cultivating positive emotions, and so on.

Regarding the development of a positive or favorable imaginative environment, it is important that sexual imagination does not burden the individual, but rather transforms negative life energy into positive. In this regard, various erotic situations that actively unfold in an individual's imaginative world are very important (e.g., excessive viewing of pornography can lead an individual to passivity and discomfort).

In any case, desires for sexuality are often greater than the actual need for it. Sexual reality within the Majority group is often less romantic, accompanied by a corresponding emotional numbness. In erotic imagination, it can shift into excessive passivity, which certainly does not contribute to greater pleasure. In summary, at the libidinal level of thinking, the Majority group displays relatively traditional relationships, a certain passivity, and mostly a life realism that is fundamentally removed from romantic emotions.

This does not mean that romantic or love emotions do not exist, but they are excessively connected to sexual energy. The energy investments from the Majority group at the libidinal level of thinking are generally average and are not primarily directed toward various interest-based activities (e.g., using sexuality to gain a better position or to acquire financial resources). Regarding the creation of libidinal information, the Majority group members are more passive elements in social reality, thus showing a greater tendency to accept libidinal information.

4.1.6.3.4 Group of Anomalies in terms of using information components at the philosophical level of thinking

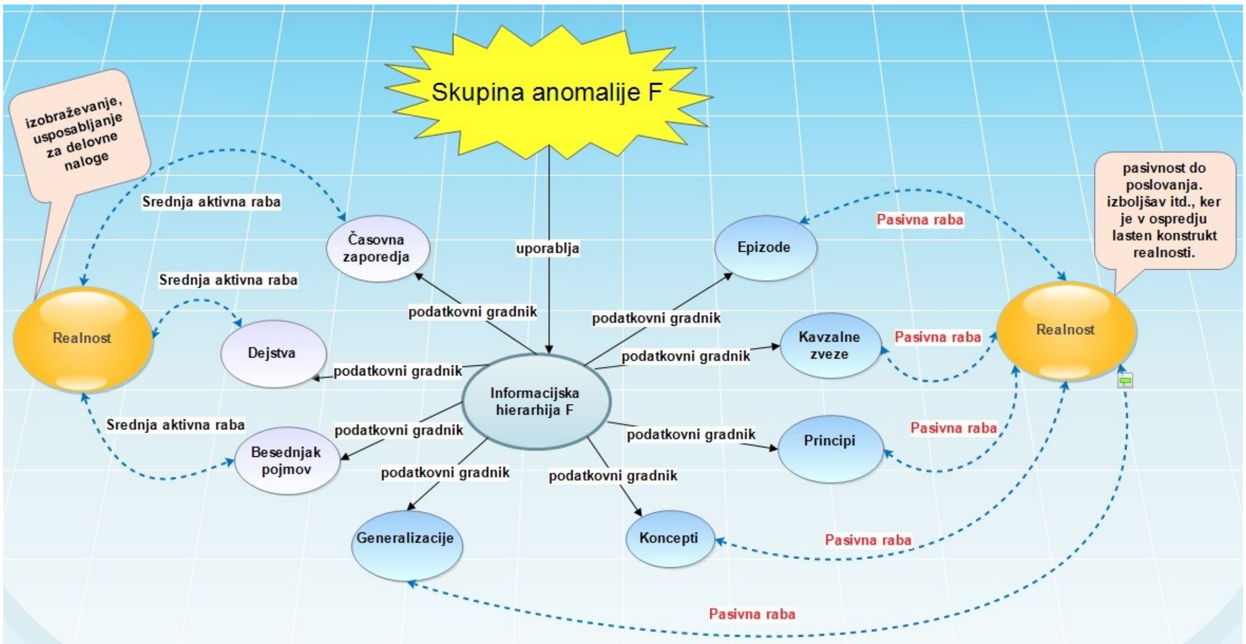
At the philosophical level of thinking, the group labeled as "anomalies" uses most of the identified information components, although only partially (scoring 49 out of a possible 120 points, which amounts to 40.83% usage). In the network diagram (see Figure 148), a large node labeled “Information Hierarchy F” (marked in light blue) stands out, with a strong connection strength of 279.0 (shown in orange). This node is linked to components such as vocabulary of terms, factual information, chronological sequences, events, cause-and-effect relationships, principles, generalizations, and abstract ideas.

The anomaly group (represented by a small black node) uses these components in a more passive way (indicated by blue lines with a connection strength of 50.0). This suggests that, at the philosophical level, this group tends to engage more actively with simpler informational components and uses more complex ones only to a very limited extent.

As previously mentioned, this group is highly diverse. It includes individuals with severe mental disorders, often with antisocial, sociopathic, or psychopathic traits. However, there are exceptions—especially in fields like science and art—where such individuals have made significant contributions to society. These exceptions make it difficult to strictly classify all such individuals within the “anomalies” group. Generally, this group deviates from socially accepted ways of thinking, which can stem from genetic factors or psychosocial circumstances. What they have in common is a tendency to reject external reality to some degree and instead rely heavily on their own internally constructed reality.

From a broader informational perspective, this group could be seen as producing "information noise" within the structured, socially shared system of thinking. So far, science has not been able to fully understand or translate this kind of information processing into something beneficial. In most systems, such information noise acts as a disruptive factor, indicating system malfunction or even energy loss.

This analysis once again emphasizes evaluating whether the use of information components is active or passive, and identifying the main content focus using a conceptual diagram.



4.1.6.3.4.1 Figure 152: Concept diagram of the Anomaly group at the philosophical level of thinking – use of information components and overall thematic focus

Figure 152 presents a concept diagram showing how the anomaly group uses information components at the philosophical level of thinking and highlights their overall thematic focus.

At this level, members of the anomaly group engage moderately with certain types of information (such as vocabulary, facts, and chronological sequences), while using others more passively (like cause-and-effect relationships, generalizations, principles, and abstract concepts). Overall, their use of these components is quite limited in content and mainly directed toward constructing their own version of reality.

In this context, the group's approach to the "Information Hierarchy F" can be divided into two categories: the parts of reality they still accept, and the parts they reject. Examples of their use of information components in the real world might include education, training, or contributions to science—usually in the role of a patient. They show very little engagement in practical matters like improving systems or organizational functioning, because they are primarily focused on their own internal version of reality, which is often hard for others to understand or apply.

In short, this group tends to show non-traditional patterns of thinking. They are extremely passive when it comes to shared, socially agreed-upon reality, and overly active in developing their personal version of it. Their energy and effort usually diverge from the norm, tending toward below-average participation in society's structured way of thinking. As a result, they often act as sources of "information noise"—their internal information structure tends to follow imaginative or fictional patterns more than real-world logic.

A similar pattern can be seen in how they think on a everyday level (where they scored 47 out of 120 points, or 39.17% usage) and on an emotional or instinctual level (scoring 51 out of 120 points, or 42.50% usage).

The analysis continues next with a simulation focused on the group labeled as the "extreme hierarchical complex."

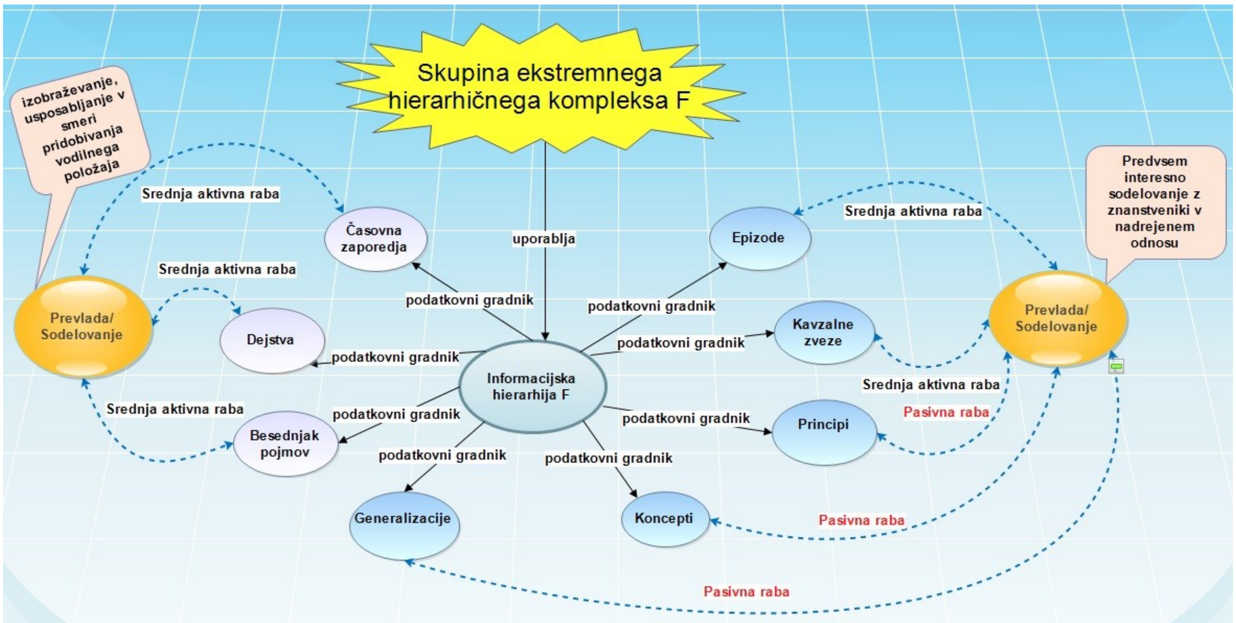
4.1.6.3.5 The Extreme Hierarchical Complex group – use of information components at the philosophical level of thinking

At the philosophical level of thinking, the group identified as the "Extreme Hierarchical Complex" uses most of the listed information components. Out of a possible 120 points, the group scored 60, which represents a 50.00% usage rate.

In the network diagram (see Figure 148), the larger node labeled "Information Hierarchy F" (shown in light blue) has a strong connection strength of 279.0 (indicated in orange) and is linked to various information components such as vocabulary, facts, chronological sequences, episodes, cause-and-effect relationships, principles, generalizations, and abstract concepts.

The Extreme Hierarchical Complex group (represented by a small white node) uses these components at a range between moderately active and passive levels (blue connections with a strength of 61.0).

For this group, we can generally expect active use of simpler information components and more passive use of the more complex ones at the philosophical level of thinking.



4.1.6.3.5.1 Figure 153: Concept diagram of the Extreme Hierarchical Complex group at the philosophical level of thinking – use of information components and overall thematic focus

Figure 153 presents a concept diagram for the Extreme Hierarchical Complex group, showing how they use information components at the philosophical level of thinking and what their overall thematic focus is.

Generally, members of this group primarily use simpler information components—such as vocabulary, facts, and chronological sequences—with a moderate level of activity and intensity. Examples of such usage include formal or on-the-job education and training for specific tasks aimed at gaining leadership positions.

They use more complex components—like episodes and cause-and-effect relationships—at a moderately active level, while other advanced components—such as principles, generalizations, and abstract concepts—are used only passively. Their use of these more complex elements typically appears in contexts where they exert significant influence over business operations, participate in legislative processes, shape public opinion, or implement organizational improvements. In such cases, they are willing to collaborate with scientists and experts, but usually from a position of authority.

In summary, we should not expect significant intellectual effort or deep philosophical engagement from this group. Their behavior often reflects an excessive, even pathological, need to dominate others. Rather than seeking meaningful social change, they tend to focus on asserting their influence, accumulating wealth, and maintaining a superior position over others. They support changes to the social order only when these offer positional or financial advantages, or when problems become so serious that innovative solutions are unavoidable.

The outcomes for this group are nearly identical to those of the majority group, indicating a strong alignment and mutually beneficial relationship between the two, particularly in terms of power dynamics and hierarchical roles.

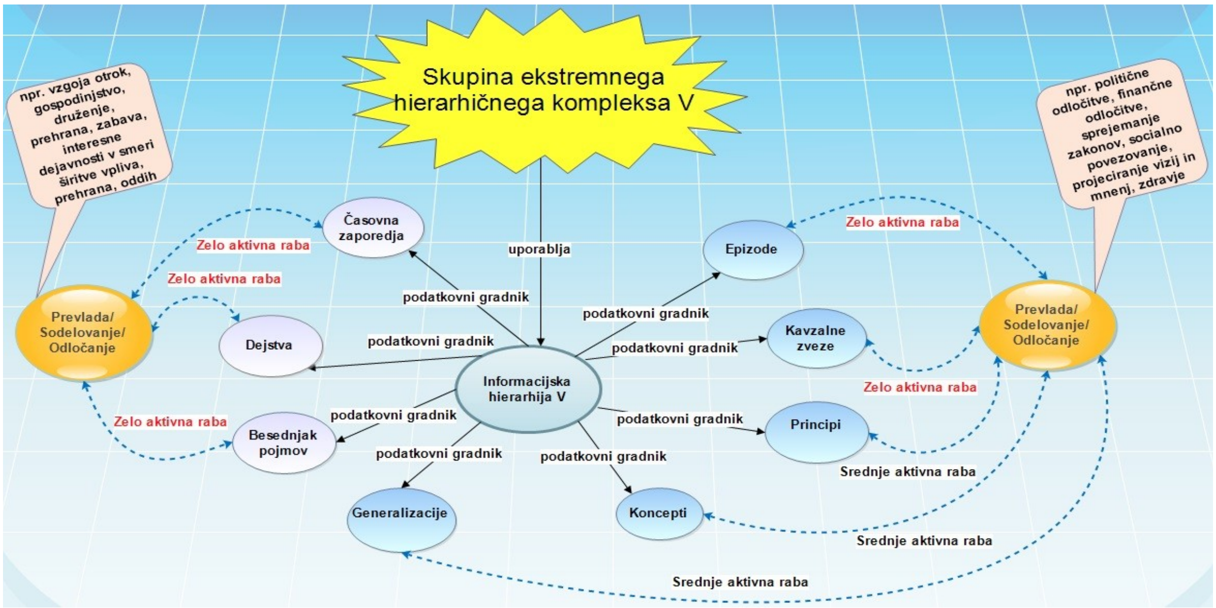
4.1.6.3.5.2 The Extreme Hierarchical Complex group – use of information components at the everyday level of thinking

At the everyday level of thinking, the Extreme Hierarchical Complex group uses most of the listed information components. Out of a possible 120 points, the group scored 103, which corresponds to 85.83% usage.

In the network diagram (see Figure 148), the largest node—labeled "Information Hierarchy V" (shown in light blue)—has a very strong connection strength of 336.0 (indicated in red). This node is linked to various components, including vocabulary, facts, chronological sequences, episodes, cause-and-effect relationships, principles, generalizations, and abstract concepts.

The Extreme Hierarchical Complex group (represented by a light blue node) uses these components very actively to moderately actively at the everyday level of thinking (shown by light green connections with a strength of 104.0). This indicates a high level of engagement with both simpler and more complex types of information in their day-to-day thinking.

A concept diagram will be created to illustrate the group's life focus, which centers primarily on exercising dominance over others.



4.1.6.3.5.3 Figure 154: Concept diagram of the Extreme Hierarchical Complex group at the everyday level of thinking – use of information components and overall thematic focus

Figure 154 presents a concept diagram for the Extreme Hierarchical Complex group, showing their use of information components at the everyday level of thinking and their overall thematic focus.

Typically, members of this group use simpler information components—such as vocabulary, facts, and chronological sequences—with very high intensity and frequency. Examples of this include parenting, household decision-making, socializing, participating in interest-based activities aimed at expanding influence, entertainment, nutrition, leisure, and similar everyday activities.

They also use more complex components—like episodes and cause-and-effect relationships—very actively, while components such as principles, generalizations, and abstract concepts are used at a moderately active level. These more advanced components are seen in contexts such as political decisions, legislation, projecting visions and opinions, financial choices, health, social matters, and various types of interest-based collaboration.

Overall, the thematic focus of this group at the everyday level doesn't differ much from their philosophical-level thinking. However, the intensity and effort they invest in asserting dominance and expanding their influence is significantly greater. Their aim is to gain positional and material advantage and maintain decision-making power.

Members of this group are highly focused on their own social status and that of others. They strategically monitor and mark tactical points within the social landscape. If they are satisfied with their current level of influence and wealth, they tend not to seek major societal changes. If not, their excessive, often pathological, need for dominance drives them to pursue and implement changes.

At the everyday level, this group differs significantly from the majority group, which is expected given their underlying psychological motivations. Despite this difference, the hierarchical relationship between the two groups remains intact and is even reinforced—creating a symbiotic dynamic of dominance and subordination.

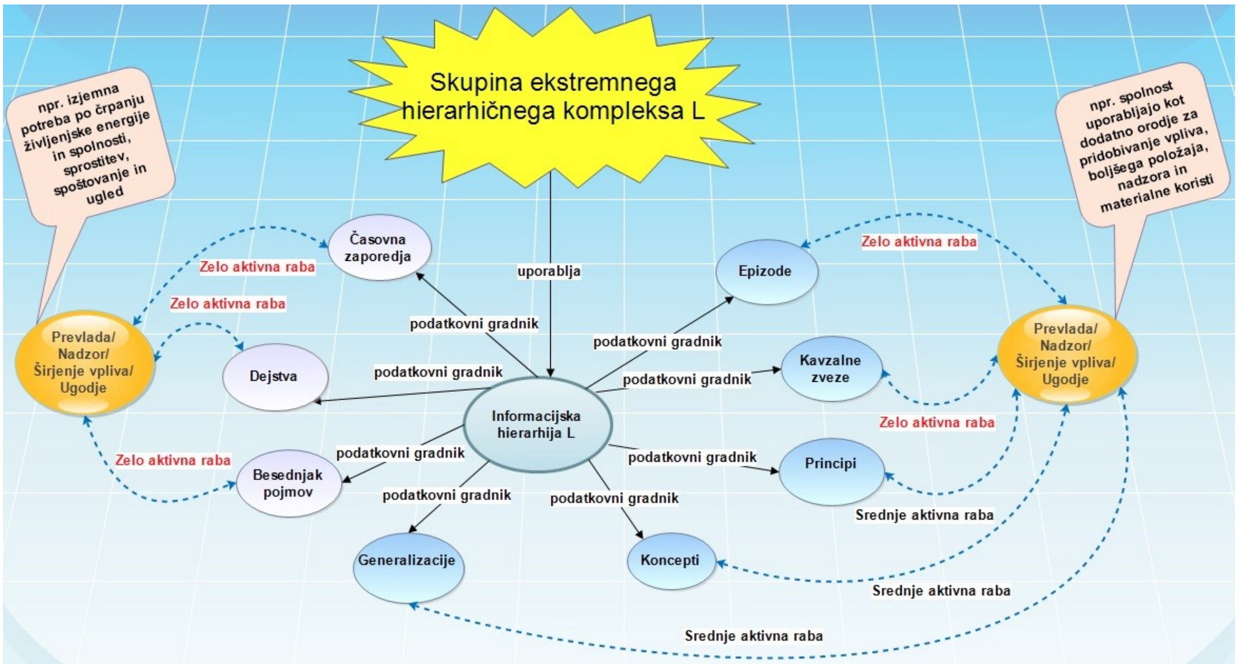
In short, we can expect this group to invest substantial energy in spreading information designed to influence other groups—encouraging consumerism, idolization, compliance, civic duties, values, and aspirations toward seemingly unattainable goals. These goals may be theoretically achievable, but only with extremely low probability—such as winning the lottery.

4.1.6.3.5.4 The Extreme Hierarchical Complex group in relation to the use of information components at the libidinal level of thinking

At the libidinal level of thinking, the Extreme Hierarchical Complex group utilizes most of the identified information components. Out of a possible 120 points, the group scored 98 points, representing 81.67% usage. In the network graph (see Figure 148), the larger node labeled "Information Hierarchy L" (light blue node) with a connection strength of 289.0 (dark orange color) is linked to information components such as vocabulary, facts, chronological sequences, episodes, causal relationships, principles, generalizations, and concepts. The group (light blue node) uses these components at a very active to moderately active level (light green connections with a strength of 99.0).

At the libidinal level of thinking, this group shows high activity in both the use of simpler and more complex information components. Sexuality and the extraction of life energy play a particularly significant role for this group, driven by an intense pathological need. Based on this, it can be concluded that the content and intensity of libido in this group differ substantially from that in other groups. For example, something that represents mere relaxation for a member of the majority or progress group is, for someone from this group, also an opportunity for lobbying, gaining higher status, exercising control, increasing influence, or achieving material benefits.

Members of the Extreme Hierarchical Complex group are extremely active at the libidinal level of thinking and tend to be more aggressive and competitive. Their sexual relationships are often less guided by deep emotional connection and more by a compulsive pathological need for dominance. A concept diagram will be created next, focusing on the life orientation of this group—particularly emphasizing social engagement, pursuit of pleasure, and above all, the drive for dominance over others.



4.1.6.3.5.5 Figure 155: Conceptual diagram of the Extreme Hierarchical Complex group at the libidinal level of thinking in relation to the use of information components and global content emphasis

Figure 155 shows the conceptual diagram of the Extreme Hierarchical Complex group at the libidinal level of thinking, focusing on the use of information components and the global content emphasis. Typically, members of this group use less complex information components—such as vocabulary, facts, and chronological sequences—with very high intensity and activity. Examples of this include drawing life energy through sexuality, achieving respect and prestige, and relaxation from daily activities.

More complex information components—such as episodes and causal relationships—are also used very actively, while the most complex components—principles, generalizations, and concepts—are used at a moderately active level. In this group, complex data components are often applied in the context of interest-driven sexuality, which is not limited to relaxation but is used as a strategic tool for gaining influence, control, higher status, and material benefits.

Members of this group must remain highly active in the realm of sexuality—both in terms of messaging and behavior—because they struggle to maintain a stable sense of pleasure. Their need for pleasure is strongly guided by a global content focus that is centered on dominance. The classic metaphor of “the glass is half full or half empty” does not satisfy them—explaining their intense dynamism.

At this level of thinking as well, it is evident that the group's global content focus does not significantly differ from that observed at the philosophical or everyday levels of thinking. As with the everyday level, they are willing to invest tremendous energy in pursuing dominance over others, expanding influence, gaining positional and material advantages, and increasing decision-making power.

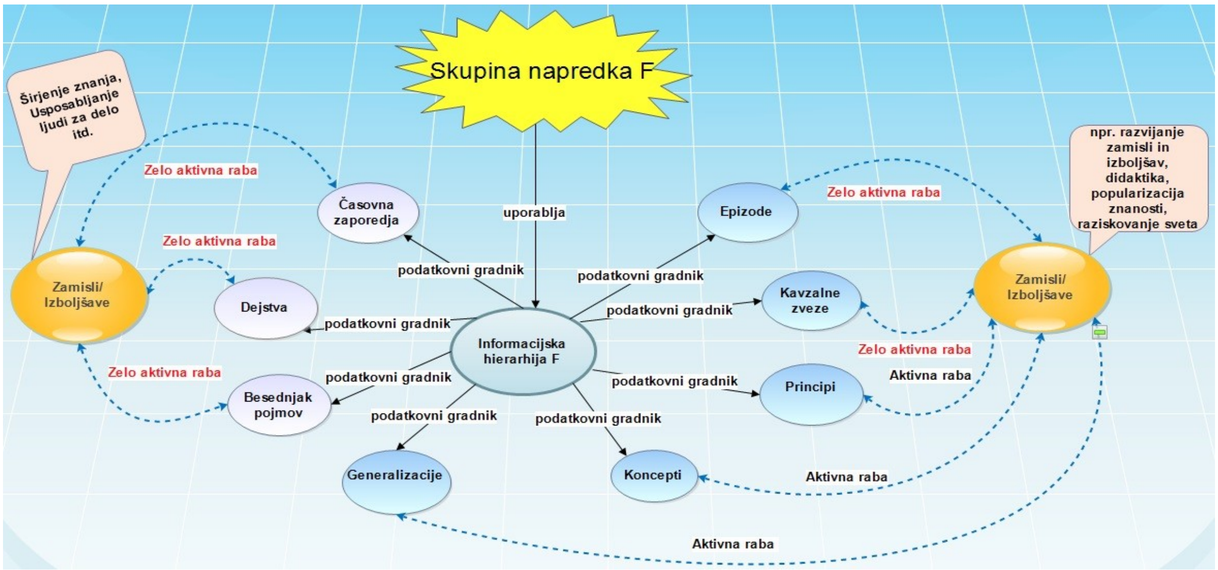
In short, we can expect high energy investment and complex content emphases from members of the Extreme Hierarchical Complex group even at the libidinal level of thinking. These emphases often involve intense and strategic information-communication activities, such as economic propaganda that stimulates sexual desire. In a world saturated with sexuality, these individuals adapt well and successfully manipulate it to their own advantage. In this regard, they differ significantly from other human groups—a difference rooted both in genetic and psychosocial factors.

4.1.6.3.5.6 The Progress group in relation to the use of information components at the philosophical level of thinking

At the philosophical level of thinking, the Progress Group utilizes all of the listed information components (see also the matrix: out of a possible 120 points, this group achieved 109 points, representing 90.83% usage), primarily for the purposes of scientific and research work.

In the network graph (see Figure 148), it is evident that the larger node "Information Hierarchy F" (see light blue node) with a connection strength of 279.0 (see orange color) is linked to information components such as conceptual vocabulary, facts, chronological sequences, episodes, causal relationships, principles, generalizations, and concepts.

The Progress group (see green node) uses the listed information components at the philosophical level of thinking with levels ranging from highly active to moderately active usage (see yellow connections with a strength of 110.0). A conceptual diagram will be developed in the following section.



4.1.6.3.5.7 Figure 156: Conceptual diagram of the Progress group at the philosophical level of thinking regarding the use of data constructs and global content emphasis

Figure 156 illustrates a conceptual diagram of the Progress group at the philosophical level of thinking, focusing on the use of data constructs and global content emphases. Generally, representatives of this Progress group at the philosophical level of thinking utilize less complex data constructs, such as vocabulary of concepts, facts, and chronological sequences, with highly active power and intensity. Examples of using less complex data constructs include disseminating or transmitting knowledge, training individuals for work, organizing informational workshops, etc. More complex data constructs, such as episodes and causal relationships, are used very actively, while other complex constructs like principles, generalizations, and concepts are used with moderate activity. Examples of employing more complex constructs by this group include developing ideas and improvements, didactics, popularizing science, environmental research, and scientific collaboration. The progress group has achieved the highest number of points at the philosophical level of thinking.

Some representatives from this group use all data constructs with very active power and intensity; however, this is not depicted in the conceptual diagram since the group was evaluated layer by layer, resulting in slightly lower scores. In summary, representatives of the progress group at the philosophical level of thinking are expected to invest significant energy and focus on more complex content emphases.

Similar to representatives from the extreme hierarchical complexity group, members of the progress group actively monitor themselves and their environment, recognize distinctive patterns, forms, structures, and outstanding values. They develop ideas, insights, knowledge, and applications with the primary goal of improving or contributing to the enhancement of societal hierarchical associative systems.

Representatives of this group are constant seekers and developers of ideas, often driven by a strong pathological need to prove their intellectual capabilities. Their motivation is less about dominance over others but rather about intellectual challenges aimed at addressing deficiencies in various systems (e.g., social, natural, or artificial systems created by humans). These individuals actively seek changes in social conditions and partially in natural contexts.

In summary, the Progress group is expected to invest significant energy into disseminating information and knowledge that stimulates other groups to desire improvements and necessary changes for a higher-quality and less wasteful societal condition.

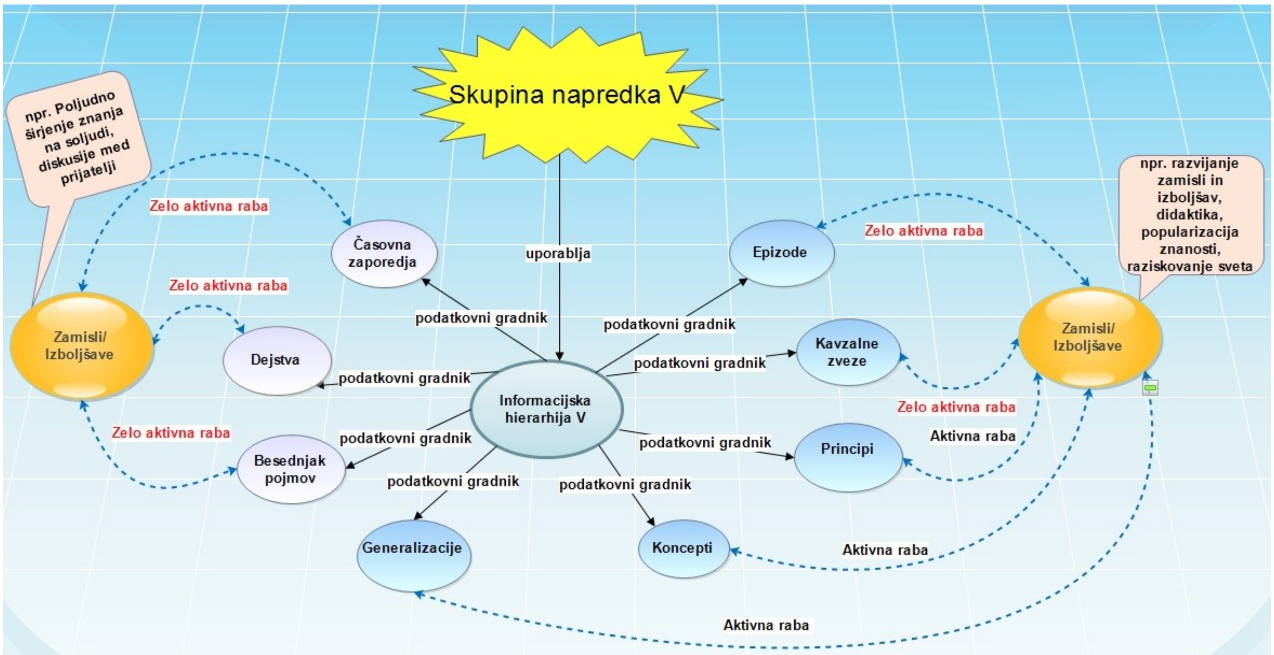
Regarding hierarchical system organization, these representatives are more effective in environments without rigid hierarchical structures that enable equal collaboration and fruitful exchange of opinions leading to diverse improvements. In this context, it is worth noting the relationships between representatives of the Extreme Hierarchical Complexity group and those in the progress group, where productive communication is often ineffective.

Representatives of the Progress group generate the largest amount of information within societal hierarchical associative systems and are carriers of the richest biological archives of knowledge. However, due to the vast amount of information and knowledge they produce, these data are often difficult to access and comprehend by the general public—resulting in many useful insights remaining confined within closed circles.

4.1.6.3.5.8 Progress group regarding the use of data constructs at the everyday level of thinking

At the everyday level of thinking, the Progress group utilizes all listed data constructs (see also the matrix: out of a possible 120 points, this group achieved 103 points, which represents 85.83% usage). On the network graph (see Figure 148), it is evident that the largest node, "Information Hierarchy V" (see the light blue node), with a connection strength (see orange color) of 336.0, is linked to data constructs such as vocabulary of concepts, facts, chronological sequences, episodes, causal relationships, principles, generalizations, and concepts.

The Progress group (see green node) at the everyday level of thinking uses these data constructs with activity levels ranging from very active to moderately active (see green connections with a strength of 104.0). The creation of a conceptual diagram follows this analysis.



4.1.6.3.5.9 Figure 157: Conceptual diagram of the Progress group at the everyday level of thinking regarding the use of data constructs and global content emphasis

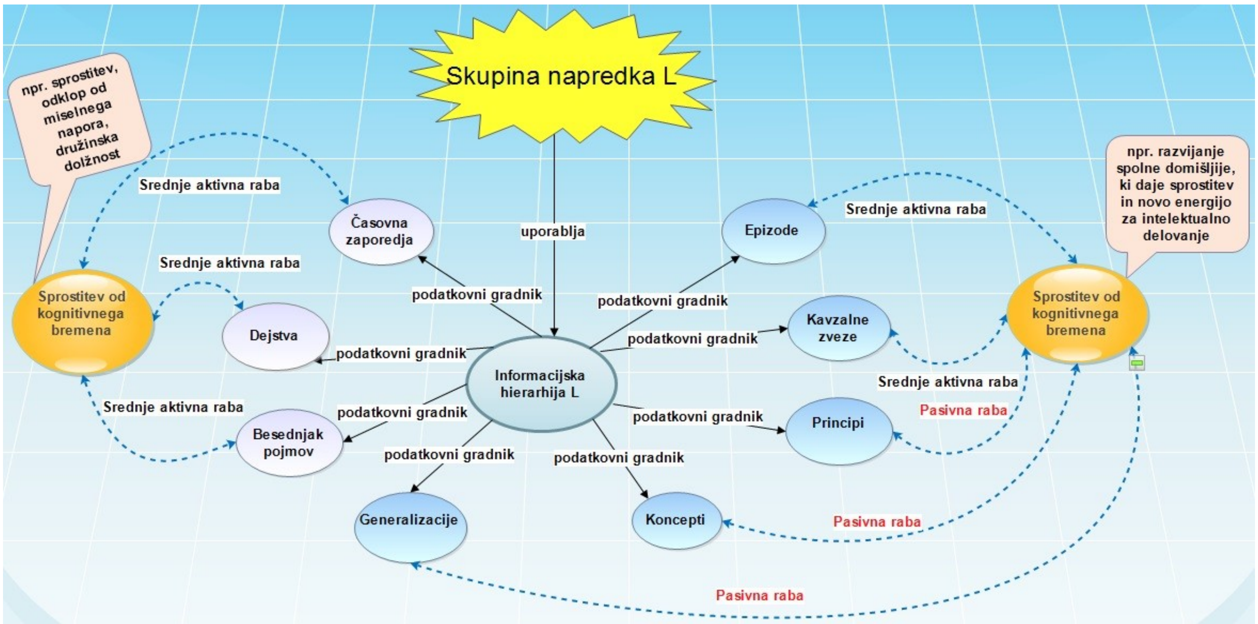
Figure 157 presents a conceptual diagram of the Progress group at the everyday level of thinking regarding the use of data constructs and global content emphasis, which closely resembles the conceptual diagram at the philosophical level of thinking. The primary reason for this similarity is that representatives of the Progress group, even at the everyday level of thinking, struggle to disconnect (similar to individuals from the extreme hierarchical complexity group with a pathological focus on dominance over others) from their tendency to prove their intellect and improve the world.

Typically, representatives of the Progress group at this level use less complex data constructs, such as vocabulary of concepts, facts, and chronological sequences, with highly active power and intensity. Examples of using these less complex data constructs include popular dissemination or sharing of knowledge among people and frequent discussions with friends on scientific topics. More complex data constructs, such as episodes and causal relationships, are used very actively, while other complex constructs like principles, generalizations, and concepts are used moderately actively. Examples of employing these more complex data constructs by this group include developing ideas and improvements, didactics, popularizing science, environmental research, scientific collaboration, and household improvements.

The Progress group achieved the same score at the everyday level of thinking as the Extreme Hierarchical Complex group—103 points—indicating some similarities between representatives of both groups. However, their global content emphasis is quite different yet still interconnected.
In summary, representatives of the Progress group at this level are expected to invest significant energy into using data constructs with more complex content emphases. Similar to individuals from the Extreme Hierarchical Complex group, they actively monitor themselves and their environment, identify distinctive patterns, forms, structures, and outstanding values, and develop ideas, insights, knowledge, and applications with the primary goal of improving or contributing to improvements in societal hierarchical associative systems.
From a social perspective, representatives from this group are less flexible and dynamic since they primarily operate within closed circles or social connections. While they seek changes in societal conditions and partially in natural contexts, they are somewhat less capable when it comes to implementation.
In conclusion, even at this level of thinking, the Progress group is expected to make significant energetic contributions toward developing ideas for system improvements and consequently creating solutions to pressing problems in societal conditions.

4.1.6.3.6 Progress group regarding the use of data constructs at the libidinal level of thinking

At the libidinal level of thinking, the Progress group uses all listed data constructs (see also the matrix: out of a possible 120 points, this group achieved 74 points, which represents 61.67% usage). On the network graph (see Figure 148), it can be observed that the larger node, "Information Hierarchy L" (see the light blue node), with a connection strength (see orange color) of 289.0, is linked to data constructs such as vocabulary of concepts, facts, chronological sequences, episodes, causal relationships, principles, generalizations, and concepts.
The Progress group (see white node) at the libidinal level of thinking uses these data constructs with activity levels ranging from moderately active to passive (see green connections with a strength of 75.0). It appears that representatives from this group place less emphasis on deriving life energy through sexual motivation compared to individuals from the Extreme Hierarchical Complex group, which may indicate a lower libido. It is likely that a higher libido among these representatives would result in a decline in their intellectual capabilities, without which they would not be who they are—“incessant seekers and developers of ideas and solutions.” Whether an excessively increased libido negatively affects an individual's innovative power is an intriguing question. The creation of a conceptual diagram follows this analysis.



4.1.6.3.6.1 Figure 158: Conceptual diagram of the Progress Group at the libidinal level of thinking regarding the use of data constructs and global content emphasis

Figure 158 presents a conceptual diagram of the pProgress group at the libidinal level of thinking regarding the use of data constructs and global content emphasis. Typically, representatives of the progress group at this level use less complex data constructs, such as vocabulary of concepts, facts, and chronological sequences, with moderately active power and intensity. Examples of using these less complex data constructs include fulfilling family duties, relaxation, or disengaging from cognitive overload, etc.

More complex data constructs, such as episodes and causal relationships, are used moderately actively, while other complex constructs like principles, generalizations, and concepts are used more passively than actively. Examples of employing more complex data constructs by this group include developing sexual imagination, which provides relief and thus new energy for intense intellectual activity, seeking relaxation through play, etc.

Similar to the Extreme Hierarchical Complex group at the libidinal level of thinking, who use sexuality (albeit as an extended means of dominance over others) as a tool to reduce cognitive overload, which is particularly a result of intense and powerful thinking about less and more complex problems and solutions, the progress group also utilizes sexuality to achieve this goal.

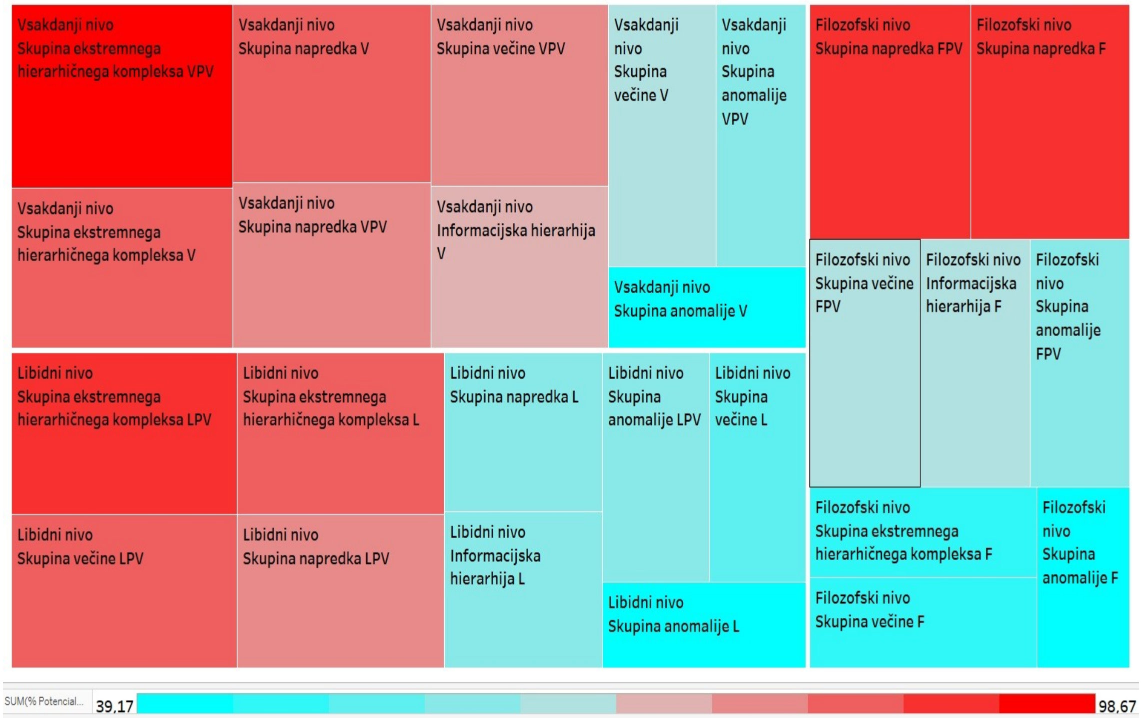
In summary, representatives of the Progress group at the libidinal level of thinking can be expected to invest moderate energy into using data constructs with somewhat less complex content emphases. At this level of thinking, they are similar to representatives from the Majority group, with the difference that individuals from the Progress group are much more cognitively burdened, especially in the area of complex problems. Appropriate and not excessively frequent derivation of life energy from sexuality, including positive sexual imagination, provides these representatives with relief and further motivates them for intellectual and innovative work.

4.1.7 Integration of data regarding levels of thinking, psychological motivations, groups of people, and information hierarchy

In the following section, we will convert the values at the levels of thinking based on given psychological motivations and information hierarchy into percentages for groups of people (values are derived from both complex matrices), and then a synthesis of the data will be performed. The synthesis of a small portion of the data is presented in the following table.

4.1.7.1 Table 111: Part of the aggregated data

BT	EV %	CC	NT1	NT2	NT3	NT4
Majority group F	50	Philosophic. level	Glossary of terms	Facts	Temporal sequences	Episodes
Majority group V	68.33	Everyday level	Glossary of terms	Facts	Temporal sequences	Episodes
Majority group L	54.17	Libid level	Glossary of terms	Facts	Temporal sequences	Episodes
Majority group FPV	66.67	Philosophic. level	Glossary of terms	Facts	Temporal sequences	Episodes
Majority group VPV	78.67	Everyday level	Glossary of terms	Facts	Temporal sequences	Episodes
Information hierarchy F	66.19	Philosophic. level	Glossary of terms	Facts	Temporal sequences	Episodes



4.1.7.2 Figure 159: Tree map of cold and hot spots egarding potential energy investments by groups of people, levels of thinking, psychological motivations, and information hierarchy

Table 111 displays part of the integrated statistical data by groups of people based on given psychological motivations, levels of thinking, and information hierarchy from the perspective of potential energy investments in percentages. Figure 159, in the form of a tree map, illustrates the cool and hot spots of the mentioned statistical data. The color scale has ten color levels, shown in a range of values from 39.17% (light blue color or the coolest spot) to 98.67% (red color or the hottest spot). The results are as follows:

A. Hot zone

1. First Place: Everyday level of thinking of the extreme hierarchical complexity group regarding given psychological motivations (VPV: 98.67%).
2. Second Place: Philosophical level of thinking of the progress group regarding given psychological motivations (FPV: 92.00%).
3. Third Place: Philosophical level of thinking of the progress group regarding the use of data constructs (information hierarchy F: 90.83%).
4. Fourth Place: Libidinal level of thinking of the extreme hierarchical complexity group regarding given psychological motivations (LPV: 89.33%).
5. Fifth Place: Everyday level of thinking of the extreme hierarchical complexity group regarding the use of data constructs (information hierarchy V: 85.83%).

6. Sixth Place: Everyday level of thinking of the progress group regarding the use of data constructs (information hierarchy V: 85.83%).
7. Seventh Place: Libidinal level of thinking of the majority group regarding given psychological motivations (LPV: 84.00%).
8. Eighth Place: Libidinal level of thinking of the extreme hierarchical complexity group regarding the use of data constructs (information hierarchy L: 81.67%).
9. Ninth Place: Everyday level of thinking of the progress group regarding given psychological motivations (VPV: 80.00%).
10. Tenth Place: Everyday level of thinking of the majority group regarding given psychological motivations (VPV: 78.67%).
11. Eleventh Place: Libidinal level of thinking of the progress group regarding given psychological motivations (LPV: 77.33%).
12. Twelfth Place: Everyday level of thinking of information hierarchy V (69.79%).

B. Moderately hot zone

13. Thirteenth Place: Everyday level of thinking of the majority group regarding the use of data constructs (information hierarchy V: 68.33%).
14. Fourteenth Place: Philosophical level of thinking of the majority group regarding given psychological motivations (FPV: 66.67%).
15. Fifteenth Place: Philosophical level of thinking of information hierarchy F (66.19%).

C. Cold zone

16. Sixteenth Place: Libidinal level of thinking of the progress group regarding the use of data constructs (information hierarchy L: 61.67%).
17. Seventeenth Place: Philosophical level of thinking of the anomaly group regarding given psychological motivations (FPV: 60.00%).
18. Eighteenth Place: Libidinal level of thinking of information hierarchy L (60.00%).
19. Nineteenth Place: Libidinal level of thinking of the anomaly group regarding given psychological motivations (LPV: 60.00%).
20. Twentieth Place: Everyday level of thinking of the anomaly group regarding given psychological motivations (VPV: 57.33%).
21. Twenty-First Place: Libidinal level of thinking of the majority group regarding the use of data constructs (information hierarchy L: 54.17%).

D. Very cold zone

22. Twenty-Second Place: Philosophical level of thinking of the extreme hierarchical complexity group regarding the use of data constructs (information level F: 50.00%).

23. Twenty-Third Place: Philosophical level of thinking of the majority group regarding the use of data constructs (information hierarchy F: 50.00%).

24. Twenty-Fourth Place: Libidinal level of thinking of the anomaly group regarding the use of data constructs (information hierarchy L: 42.50%).

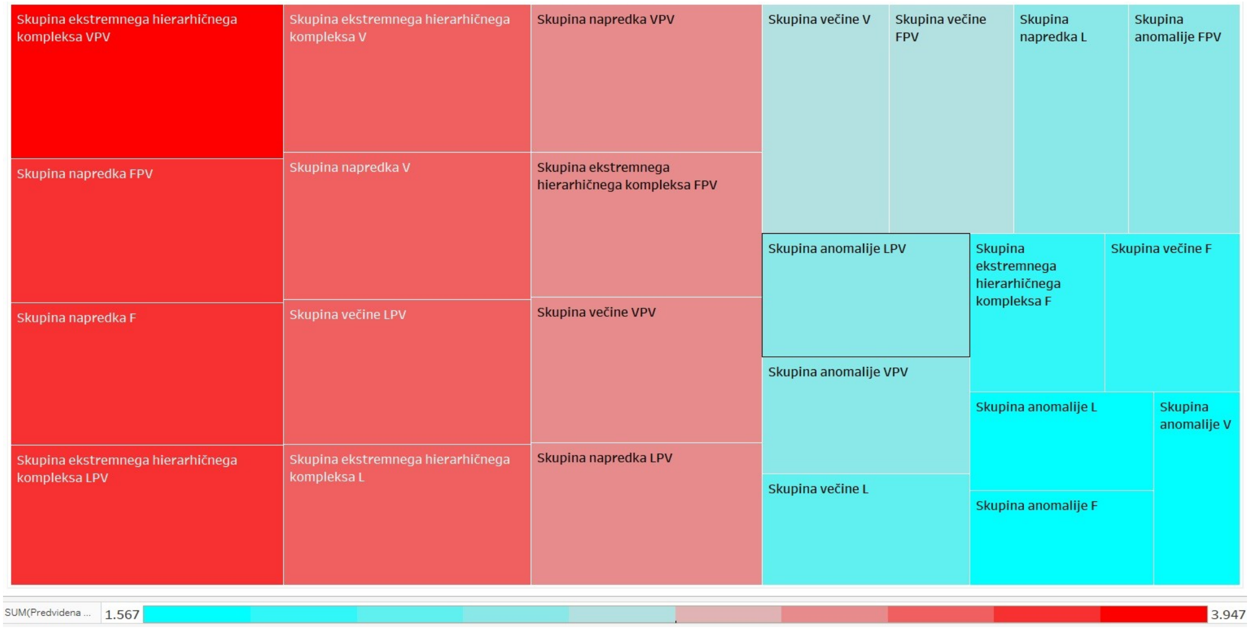
25. Twenty-Fifth Place: Philosophical level of thinking of the anomaly group regarding the use of data constructs (information hierarchy F: 40.83%).

26. Twenty-Sixth Place: Everyday level of thinking of the anomaly group regarding the use of data constructs (information hierarchy V: 39.17%).

In the following section, the obtained percentages will be recalculated into kilocalories (Kcal) to gain a clearer understanding of the potential or predicted energy investments by the given groups of people in connection with levels of thinking and the use of data constructs. It should be emphasized again that this is a simulation, as such an empirical study has not yet been conducted.

4.1.7.2 Table 112: Part of the statistical data on the estimated energy inputs by groups of people

Groups of people	PEV %	Levels of thinking	Estimated maximum energy input in Kcal	Estimated minimum energy input in Kcal
Anomaly group F	40.83	Philosophic. level	1633.2	816.6
Anomaly group FPV	60	Philosophic. level	2400	1200
Anomaly group L	42.5	Libido level	1700	850
Anomaly group LPV	60	Libido level	2400	1200
Anomaly group V	39.17	Everday level	1566.8	783.4
Anomaly group VPV	66.19	Everday level	2293.2	1146.6



4.1.7.3 Figure 160: Tree map of hot and cold spots by groups of people regarding predicted energy investments at different levels of thinking

Table 112 shows a part of the statistical data on predicted energy investments by groups of people in Kcal, while Figure 160 illustrates a tree map of hot and cold spots by groups of people regarding predicted energy investments at different levels of thinking in interdependence with given psychological motivations and the use of data constructs. The following values apply: a person in a resting state consumes approximately 2318.26 Kcal, in a state of average activity 3146.98 Kcal, and in a state of severe physical exertion around 3642.98 Kcal. Based on these values, a maximum value (4000 Kcal) and a minimum value (2000 Kcal) were determined for easier calculation. The calculation is simple: the percentage of potential energy investment (see Table 110: PEV) is multiplied by the predicted energy investment, and then the product is divided by 100. The abbreviations within the tree map mean the following: F (philosophical level of thinking regarding the use of data constructs), V (everyday level of thinking regarding the use of data constructs), L (libidinal level of thinking regarding the use of data constructs), FPV (philosophical level of thinking regarding given psychological motivations), VPV (everyday level of thinking regarding given psychological motivations), and LPV (libidinal level of thinking regarding given psychological motivations). The results by groups of people and levels of thinking were as follows (the results will be presented according to the display of the tree map or the maximum value of energy investments of 4000 Kcal). First, the results of the hot and moderately hot zones will be presented:

1st place: The extreme hierarchical complex group VPV, whose representatives are expected to be willing to invest 3947 Kcal at the everyday level of thinking and given psychological motivations (see the tree map and the red field at the top left), which already represents a very severe effort or very strong energy activity (minimum 1973.4 Kcal). The average based on the maximum and minimum energy values indicates a predicted energy investment of 2960.25 Kcal by representatives of this group, which is approximately equal to average energy activity. The high value obtained does not mean that representatives from the extreme hierarchical complex group will invest such a large amount of physical and mental energy every day, but there is a certain probability that in the case of great existential importance or necessity, they will invest a large amount of energy in the direction of social networking, lobbying (business or political), organization of people, material goods, positional benefits, etc., as they want to be particularly successful and are afraid of failure. In addition, the achievement must meet their very high expectations, which means that they are difficult to satisfy. To extract happiness hormones, they must carry out numerous strategic and tactical activities that can lead them to dominance over other people. Psychological motivations for these representatives act as a mechanism that increases susceptibility to stimuli within themselves and from the environment. These stimuli trigger their increased fear of failure, financial collapse, and loss of influence over other people.

2nd place: The progress group FPV, whose representatives are expected to be willing to invest 3680 Kcal at the philosophical level of thinking and given psychological motivations (see the tree map and the red field below the one described above), which also represents a very severe effort or very strong energy activity. Similar to the previous example, these representatives are not so active every day, as they also need a break from particularly severe mental effort. In representatives from this group, the given psychological motivations act as a mechanism that increases susceptibility to stimuli that trigger the desire for new knowledge, discovering new laws, success, scientific social connections, immortality, and fear of death. Representatives of this group must train and prove their own mental capacities and abilities, especially with activities that develop new ideas, theories, models, and applications.

3rd place: The progress group F, whose representatives are expected to be willing to invest 3633 Kcal at the philosophical level of thinking with the help of the use of various data constructs (information hierarchy F) (see the tree map and the red field below the one described above), which also represents an exceptional energy investment. In the world of science and innovation, the use of more complex data constructs, such as episodes, causal relationships, generalizations, principles, and concepts, is essential, so that representatives from this group face tasks that even exceed the energy investments of professional chess players.

4th place: The extreme hierarchical complex group, whose representatives are expected to be willing to invest 3573 Kcal at the libidinal level of thinking and given psychological motivations (see the tree map and the red field below the one described above), which represents an above-average severe effort or very strong energy activity. Drawing life energy, especially in the field of sexuality, means an important tool for these representatives to create social connections, business interests, influence over other people, etc. In technologically developed societies, sexuality is present in almost all structures of people, as it is not only a physical activity (e.g. sexual act), but also in the cognitive field (e.g. economic propaganda encourages the desire for sexuality, everyday communication is often directly or indirectly intertwined with sexual jokes).

5th place: The extreme hierarchical complex group, whose representatives are expected to be willing to invest 3433 Kcal at the everyday level of thinking with the help of the use of various data constructs (information hierarchy V) (see the tree map and the pale red field in the second column at the top left), which also represents an exceptional energy investment. Representatives from this group use different combinations of complex data constructs to achieve dominance over other people. Although they are not as active as representatives from the progress group at the philosophical level of thinking, the energy investments are respectable, as they include a combination of cognitive and physical activities. The philosophical level of thinking is crucial for creating complex information and knowledge, while the everyday level of thinking represents the most suitable platform for establishing and realizing hierarchical associative relationships. In this mental and social space, we are once again faced with exerting influence over other people. This space is also home to the majority group, which is the most numerous human structure. At the everyday level of thinking, they are willing to actively participate in the establishment, maintenance, and development of hierarchical associative relationships with an emphasis on subordinate organization....

6th place: The progress group, whose representatives are expected to be willing to invest 3433 Kcal at the everyday level of thinking with the help of the use of various data constructs (information hierarchy V) (see the tree map and the pale red field below the one described above), which can again be considered an extremely high energy investment. The values for the extreme hierarchical complex and progress groups are the same. This does not mean that representatives from the progress group would act similarly to representatives from the extreme hierarchical complex group, but the reason lies in the fact that people from the progress group find it difficult to disconnect from the philosophical level of thinking, so that they are often at the philosophical level even at the everyday level. It is mainly about searching for and realizing ideas that lead to positive changes within social and even natural hierarchical associative systems. It has already been mentioned that people from the progress group mainly do not have more intensive contacts with people from the majority group, and at the same time it is a fact that communication between people from the extreme hierarchical complex group is less effective. The main reason for this less effective communication lies in the basic mental front between the vision of world pain and more or less crude interests.

7th place: The majority group, whose representatives are expected to be willing to invest 3360 Kcal at the libidinal level of thinking and given psychological motivations (see the tree map and the pale red field below the one described above), which represents approximately average effort or moderately strong energy activity (the average value is around 3146.21 Kcal). The desire and need for sexuality are also actively present in this group of people, especially in the direction of relaxation, preservation of the species, and thinking about imaginary possibilities. They often respond to given and thoughtful stimuli from the environment (e.g. economic propaganda) and are relatively reflective in this regard, which is a favorable basis for subordinate organization. In addition to monetary or material resources, sexuality also means a basic common language between representatives from the majority and extreme hierarchical complex groups. In these relationships, representatives from the extreme hierarchical complex group are often transmitters of sexual stimuli, while representatives from the majority group are more often in the role of receivers. It is the distribution of intense and strong sexual stimuli that encourages consumer tendencies and consumerism itself. It is difficult to imagine the functioning of the social hierarchical associative system in today's sense of the word without consumerism.

8th place: The extreme hierarchical complex group, whose representatives are expected to be willing to invest 3267 Kcal at the libidinal level of thinking with the help of the use of various data constructs (information hierarchy L) (see the tree map and the pale red field below the one described above), which can again be considered an average or slightly above average high energy investment. The use of data constructs is less variable and complex, but nevertheless relatively intense in the direction of spreading influence and dominance over other people.

9th place: The progress group, whose representatives are expected to invest 3200 Kcal on a daily level of thinking and given psychological impulses (see the tree map and the pink field in the third column above), which can be considered an average high energy input. The calculated energy input seems very ready for activities that go in the direction of social assimilation, responding to psychosocial inductions and reflections, and hierarchical associative cooperation with representatives from the extreme hierarchical complex group.

10th place: The extreme hierarchical complex group, whose representatives are expected to invest 3147 Kcal on a philosophical level of thinking and given psychological impulses (see the tree map and the pink field in the fourth column above), which can be considered an average high energy input, which goes in the direction of performing activities with medium power. The predicted

energy input from representatives of this group seems appropriate for monitoring and accepting certain achievements from the world of science and innovation, which help representatives from this group to gain material and positional benefits and, consequently, dominance over other people.
11th place: The majority group, whose representatives are expected to invest 3147 Kcal on a daily level of thinking and given psychological impulses (see the tree map and the pink field in the fifth column above), which can be considered an average high energy input. The calculated energy input seems very ready for activities (taking into account the basic tendencies of people from this group) that go in the direction of social assimilation, responding to psychosocial inductions and reflections, and proportionate subordinate action with representatives from the extreme hierarchical complex group.
12th place: The progress group, whose representatives are expected to invest 3093 Kcal on a libidinal level of thinking and given psychological impulses (see the tree map and the pink field in the sixth column on the upper right), which, according to the previously presented values, can be considered a slightly below average to average high energy input. The emphasis on libidinal thinking among representatives of this group is satisfactory and should not interfere with demanding intellectual activity. In general, these types of people are less sexually active than people from the extreme hierarchical complex and majority groups, as they live mostly in monogamous partnerships (on average, they have had perhaps two to three partnerships in their entire lives since puberty) or live a single life.
In the following, groups of people in co-dependence with levels of thinking, psychological impulses, and the use of data building blocks, whose results were ranked within the cooler and cold zones, will be described.
13th place: The majority group, whose representatives are expected to invest 2733 Kcal on a daily level of thinking with the help of data building blocks (information hierarchy V) (see the tree map and the gray field in the third column and the second row), which, according to the previously presented values, can be considered a slightly below average high energy input. Representatives from this group are mostly in the role of performers and recipients of information, so they can contribute their significant share to the establishment of a hierarchical associative platform in the direction of predominantly subordinate action. Precisely because of this fact, the lower result of the predicted energy input is not surprising.
14th place: The majority group, whose representatives are expected to invest 2667 Kcal on a philosophical level of thinking and given psychological impulses (see the tree map and the gray field below the previously described one), which can be considered a slightly below average result. Representatives from this group usually acquire basic, secondary, higher, and university education,

create a home and family, and ensure secure employment, where they are most often in the role of performers. People from the majority group have a strong tendency to adapt and, moreover, do not have an excessive desire to stand out. This tendency represents a certain mental obstacle to further education and the discovery of new laws and knowledge, so this lower result is also not surprising.
15th place: The progress group, whose representatives are expected to invest 2467 Kcal on a libidinal level of thinking with the help of data building blocks (see the tree map and the gray-blue field in the third column and the fourth row), which, according to the previously presented values, can be considered a below-average high energy input. Representatives from this group are generally less sexually active, as too frequent and too intense sexual activity could weaken intellectual thinking and work, so the obtained result seems entirely appropriate.
16th place: The anomaly group, whose representatives are expected to invest 2400 Kcal on a philosophical level of thinking and given psychological impulses (see the tree map and the gray-blue field in the fourth column and the second row), which can be considered a below-average result. This lower result is also more than expected, as representatives from the anomaly group usually live in their own construct of reality and are more passive in relation to the agreed reality. However, there are also exceptions, which are overshadowed by the large statistical population.
17th place: The anomaly group, whose representatives are expected to invest 2400 Kcal on a libidinal level of thinking and given psychological impulses (see the tree map and the gray-blue field in the fifth column and the second row), which can be considered a below-average result. Representatives from the anomaly group, with some exceptions, have an extremely ambivalent, destructive, and passive attitude towards sexuality, so the low result is not surprising.
18th place: The anomaly group, whose representatives are expected to invest 2293 Kcal on a daily level of thinking and given psychological impulses (see the tree map and the gray-blue field in the sixth column and the second row), which can be considered a below-average result. Their way of thinking on a daily level is largely disturbed by excessive fears, internal conflicts, ambivalent desires, emotional numbness, etc., so they are unable to develop a real relationship with reality.
19th place: The majority group, whose representatives are expected to invest 2167 Kcal on a libidinal level of thinking with the help of various data building blocks (information hierarchy L) (see the tree map and the gray-blue field in the fourth column and the third row), which can be considered a below-average result. The use, especially of more complex data building blocks, is greatly impaired among representatives of the group, as they use libidinal energy primarily as a tool for relaxation and are predominantly in the role of recipients of such signals and information.... 20th place: The extreme hierarchical complex group, whose representatives are expected to invest 2000 Kcal on a philosophical level of thinking with the help of various data building blocks (information

hierarchy F) (see the tree map and the light blue field in the fourth column and the fourth row), which can be considered an extremely below-average result for this group. People from the extreme hierarchical complex group mainly have a relationship of acceptance to the world of science and innovation and are similar in this respect to people from the majority group.

21st place: The anomaly group, whose representatives are expected to invest 1700 Kcal on a libidinal level of thinking with the help of various data building blocks (information hierarchy L) (see the tree map and the light blue field in the sixth column and the third row), which can be considered a very below-average result.

22nd place: The anomaly group, whose representatives are expected to invest 1633 Kcal on a philosophical level of thinking with the help of various data building blocks (information hierarchy F) (see the tree map and the light blue field next to the one described above), which can be considered a very below-average result.

23rd place: The anomaly group, whose representatives are expected to invest 1567 Kcal on a daily level of thinking with the help of various data building blocks (information hierarchy V) (see the tree map and the light blue field in the lower right), which can be considered a very below-average result.

We have observed significant differences in the predicted energy inputs among various groups of people in terms of psychological impulses and the use of data constructs (information hierarchy). This raises the question of whether these differences are genetically and socially conditioned, or perhaps more genetically influenced in symbiosis with microorganisms and macrocosmic forces, with less emphasis on social factors—or whether the social influence is relatively minor. From a genetic perspective, all humans share 99% of the same genome; however, scientists in this field have discovered that extremely small genetic differences can be decisive in the development of diseases as well as potential physiological and intellectual abilities.[48] Regarding the definition of the genome, possible changes are already being considered. One of the currently valid definitions is that the genome represents the entire collection of DNA (including all genes within the DNA) in a particular living organism.[49] Then we also have forces or fields, as they are called, which can be an electric field, a magnetic field (both often appear together), a gravitational field, weak and strong

48 Regarding certain diseases (e.g. heart disease, mental illness), they have found a tremendous influence of genes and environmental factors: International HapMap Consortium (2003). "The International HapMap Project". Nature. 426 (6968): 789–796. It has also been found that certain bacteria influence human thinking and emotions: Kohn, D. (2015). When Gut bacteria change brain function. The Atlantic. Available at URL: https://www.theatlantic.com/health/archive/2015/06/gut-bacteria-on-the-braine/395918/ (2019-08-30). Let us also remember the already cited scientific article that reported on the influence of microorganisms on smoking habits!

49 Bielawski J.P. (2019) Introduction to Genome Biology and Diversity. In: Anisimova M. (eds) *Evolutionary Genomics. Methods in Molecular Biology*, vol 1910. Humana, New York, NY. Access URL: https://link.springer.com/content/pdf/10.1007%2F978-1-4939-9074-0.pdf (2019-08-30).

interactions (e.g., radioactivity in nature), which reliably contribute a significant share to the behavioral characteristics of all living beings on Earth. The influence of genes and microorganisms on human behavior can be classified as part of the microcosmic view, the influence of social circumstances within the mesocosmic view, while the aforementioned electromagnetic and gravitational fields or forces are classified as a macrocosmic view. We can assume that people from the majority group possess the most identical genome, an identical composition of microorganisms, are identically susceptible and reflective to macrocosmic forces and the influences of social circumstances. In this most numerous group, we have highlighted certain characteristics that contribute to the creation of a favorable platform for subordinate organization, that they are predominantly executor-oriented, and that they are predominantly in the role of information recipients. We got a different picture from people from the anomaly, extreme hierarchical complex, and progress groups, who represent a statistically strong minority of the human species. Their fundamental difference could be based on microcosmic (e.g., genes, viruses, bacteria), mesocosmic (social circumstances), and macrocosmic factors (e.g., gravitational fields, electromagnetic fields) simultaneously. Perhaps it does not make sense to ask which factors now most influence the difference between these three groups of people? We could assume that all factors participate and intertwine with each other in such a way that, from our point of view, these differences or otherness automatically occur, and consequently, the self-regulatory organization of the human species in socially technologically developed societies. People from the extreme hierarchical complex group are especially driven by the instinct to dominate other people, people from the anomaly group flee from the agreed reality and create their own construct of reality, while people from the progress group are dependent on developing new ideas and proving their own intellectual ability. All this identity and difference has self-regulated social hierarchical associative systems. Would science, such as psychology and/or psychiatry, even exist in today's sense if all human specimens behaved within the agreed limits of normality? People from the anomaly group are clearly in the role of constantly monitoring the human species internally, thus determining the norms of behavior, thought, and action. Man, therefore, performs not only the function of mentorship and parasitism in nature but also control over his own inner world, which should help to establish proportionate homeostasis. In any case, we must admit that we do not know the entire cosmic picture. The interpretation of the microcosm is based on our assumptions, theories, models, etc., and measuring or observational devices (e.g., microscope), the interpretation of the macrocosm is similar (e.g., telescope, radar), while the interpretation of the mesocosm (e.g., society), which is closest and most real to us, depends on human thought models, knowledge, attitudes, experiences, and senses, which does not guarantee that we see the world correctly, but we can agree and believe in it. A hierarchical associative model of these cosmic factors might contribute to a better understanding of the relationships between genes, microorganisms, social circumstances, and electromagnetic and gravitational fields in connection with the causes of differences between representatives of the groups of people under consideration.

Based on profiling and simulation in the form of analyzing different groups of people, we have created a certain idea of their basic tendencies and dynamics, which should contribute to a better understanding of the social hierarchical associative system. We continue with the simulation of a small part of society in the form of a modified urban community.

4.2 Simulation of the operation of a modified urban community

In simulating the operation of an adapted urban community, we will use the conditional system method. First, we will set the conditions (e.g., demographics, functions of individuals, status, partnerships, education, organization), and then we will examine the consequences from the perspective of statics and dynamics.

4.2.1 Static view

Determination of characteristics of an adapted urban community

A. General Information

1. Demographic Data

    a. Number of residents: 5000 people

    b. Age groups

        Up to 20 years: 2000 people

        From 21 to 40 years: 2000 people

        From 41 to 60 years: 800 people

        More than 60 years: 200 people

    c. Gender

        Male: 2500 people

        Female: 2500 people

    d. Status

        Employed: 2500 people

        Retirees: 300 people

        Unemployed: 200 people

        Children and students: 2000 people

    e. Education

        Higher or university education: 200 people

Post-secondary education: 300 people

Secondary school with a diploma: 500 people

Vocational school: 1000 people

With completed or incomplete primary school: 1000 people

f. Partnership status

Married/in a relationship: 1250 people

Unattached (widowed, single, divorced): 1750 people

B. More detailed description of general information

To make it easier to understand this smaller urban community, it is advisable to stop it for a while, thus removing movement and, consequently, time (mortality: 0, birth rate: 0, work: 0, traffic flow: 0, thoughts: 0, etc.). This gives us a static picture of the space in which people are placed like figures on a chessboard.

In this urban community:

Only 2500 people work,

2000 are under 18 years old,

300 people are pensioners,

200 people are unemployed.

There are three factories operating in the urban community:

1. Ironworks: 1000 employees,
2. Plastics industry: 500 employees,
3. Food industry: 500 employees.

The remaining 500 employees are divided as follows:

Municipality: 200 people,

Police: 50 people,

Defense sector: 2 people,

Cultural center: 2 people,

Post Office: 25 people,

Two banks: 25 people,

School: 50 people,

Health center: 20 people,

State catering (hotel: 40 people, restaurant: 10 people),

Private catering: 50 people,

Various craftsmen (40 people):

Electrical installations: 4,

Repair of household appliances: 3,

TV mechanic: 3,

Tourist agency: 3,

Carpentry: 3,

Flower shop: 2,

Blacksmith shop: 2,

Private gas station: 3,

Tailor shop: 3.

Assumptions for a simplified model:

A. All residents are employed in their home district, so there are no work-related migrations. There are 1250 women and 1250 men employed. Of the remaining 2500 people (including children and adolescents), 1250 are women and 1250 are men without employment.

B. 1000 people attend school, of which:

800 attend primary school,

200 attend secondary school in a larger town 15 km away:

Grammar school: 30 people,

Technical school: 70 people,

Vocational schools: 100 people.

200 people are older than 15 years,

1000 people are younger than 6 years (the kindergarten has just been built, the opening is scheduled for next week).

The age structure of the community is relatively young.

C. Of the 200 unemployed people, 100 are women and 100 are men.

D. Among the 300 retirees, 150 are women and 150 are men.

E. There are a total of 1250 attached people (married, in common-law marriage, etc.). Of these, only 100 attached couples are unemployed and receiving social assistance.

F. 1000 attached couples have two children (aged 0 to 18), and 250 attached couples are without children.

G. 200 people have higher or university education, 300 have post-secondary education, 500 have completed secondary school with a diploma, 1000 have vocational school, and finally, 1000 people have completed or incomplete primary school. From which fields have people obtained higher or university education, and where are they employed?

50 people are lawyers:

25 are employed at the municipality,

10 in the ironworks,

5 in the plastics industry,

5 in the food industry,

2 at bank A,

2 at bank B,

1 lawyer is employed at the post office.

50 people are graduate economists:

10 are employed at the municipality,

10 in the ironworks,

10 in the plastics industry,

10 in the food industry,

2 economists are employed at the post office,

3 in the tourist agency,

3 at bank A,

2 at bank B.

90 people are graduate engineers in the fields of chemical, metallurgical, mechanical, electrical, food, and other technical professions: all are employed in industry.

3 people are doctors: they are employed in healthcare.

2 people are agronomists: both are employed in the food industry.

1 criminologist: is employed at the police.

2 defense specialists: are employed in the military department.

1 slavist: is employed as the headmaster of the school.

1 clergyman: has completed his study of theology.

49 people have completed teacher training college and are employed in education.

In this small hierarchical urban community, key positions are primarily occupied by economists and lawyers. People with post-secondary education also hold important roles in the municipality, post office, industry, education, police, and banks.

Individuals with secondary education occupy only one-third of key positions. The remaining two-thirds do not perform leadership functions and work in other roles, such as:

- Administrative technicians,
- Surveying technicians,
- Economic technicians,
- Police officers,
- Medical technicians.

Others with secondary education are employed in industries, hospitality, or as craftsmen.
Regarding people without qualifications, it can be noted that they do not hold key positions. They are most commonly employed in industries, hospitality, or as craftsmen.

Conclusion:

Based on the provided data and assumptions, we will analyze the possible consequences of the operation of this adapted urban community.

Possible Consequences of Assumption A:

Since there are no work-related migrations, costs for companies are lower, and workers' physical commutes are more predictable. Half of the workforce consists of women and half of men. It is assumed that men perform heavier physical labor, while women are mostly employed in jobs with lighter physical demands. This could lead to an excess of administrative positions and a shortage of physical labor.

Possible Consequences of Assumption B:

The school employs 46 teachers (23 men and 23 women) who teach 800 children divided into 40 classes. If each class has 20 students (10 girls and 10 boys), this means each grade level consists of five classes, requiring at least 40 classrooms. The school is at the limit of its spatial capacity, which could necessitate relocating primary school students to larger towns or expanding the school building and hiring additional teachers.

A transitional solution would involve merging the 40 classes into 32 classes, which would worsen teaching conditions as working with more than 20 students per class is challenging. Overcrowded classrooms increase the risk of reduced concentration among both students and teachers.

200 high school students attend schools in a larger town. Of these, approximately 25 are expected to graduate, which may create a need for new job opportunities in the local area. If this does not happen, young people will have to seek employment elsewhere.

Additionally, there are 1000 children under six years old, which poses a sociological problem as they may often be left unattended while their parents are at work. Therefore, a kindergarten is urgently needed.

Possible Consequences of Assumption C:

Of the 200 unemployed people, most will likely seek employment in other towns, leading to work-related migrations.

Possible consequences of assumption D:

In the urban community, there are 1250 attached couples, which means 2500 people, or half of the total population. A high proportion of attached individuals could have a positive effect on reducing crime rates.

On the other hand, attached individuals, especially those with children, often lack time for activities such as sports, arts, science, and innovation, as they are preoccupied with daily existential concerns. This can lead to societal anemia, where people become predominantly execution-oriented and less intellectually active.

However, there is also the possibility that attached individuals may still contribute to advancements in science, sports, arts, and innovation, which would represent a positive scenario.

Possible consequences of assumption E:

Societal anemia could also affect younger generations, potentially leading to migrations in later stages of life. Among 150 attached retiree couples, there are no children. Among 50 young attached couples, about half are likely planning to have children. The already high child population will thus continue to grow, which could lead to overcrowding within the limited space of the urban community.

Possible consequences of assumption F:

The current situation is favorable for members of the extreme hierarchical complex group, who exert significant influence over others. Conversely, there is a lack of encouragement for innovative and scientific thinking, which hinders the development of the urban community and causes organizational and social challenges.

The lack of representatives from various scientific fields (e.g., PhDs and master's degree holders) means that there is no constructive confrontation between "old" and "new" ideas in the community. Instead, an apathetic symbiosis forms where outdated views dominate.

If more than 90% of urban communities follow a similar direction, this poses a serious threat to the entire country as promising potential and constructive energy are lost.

Members of the extreme hierarchical complex group have the greatest influence on people, finances, and culture. Their organization and interconnectedness will be studied using sociological maps and directed graphs (digraphs), as their agility—while admirable—poses a risk to society. They may channel too much energy into dominating others, which harms the overall hierarchical system.[50]

4.2.2 Key positions in the adapted urban community

Key positions in a specific urban community certainly represent important administrative facilities, which can be divided into two levels:

50 On the sociological map, we can plot the key positions within the adapted urban community and additionally mark the locations of their homes. For further reading on digraphs, you may refer to Günter Menges's work titled "*Beiträge zur Unternehmungswissenschaft*", though not the previously mentioned edition, which appears to no longer be available.

a. Primary administrative facilities

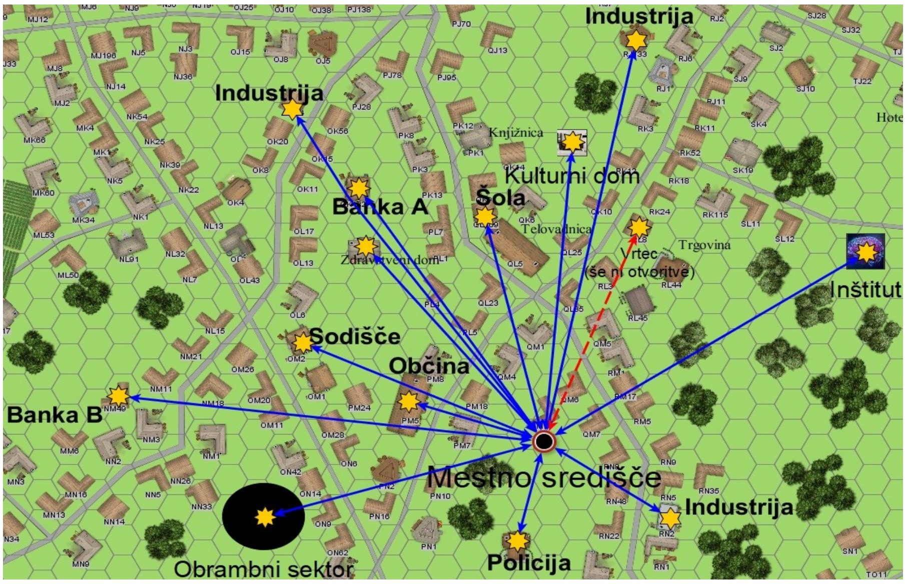
b. Secondary administrative facilities

4.2.2.1 Primary administrative facilities

Primary administrative facilities include the municipality, court, police, defense sector, administration of industrial facilities, institute, administration of school facilities, administration of the cultural center, administration of kindergartens, administration of the health center, and bank administration. These primary administrative facilities contain a wealth of data about the people living within a specific urban community (e.g., place of residence, criminal record, savings, number of children, employment, health status, education, profession, hobbies).

Through the positions within these primary administrative facilities held by individuals from a group with an extreme hierarchical complex, data on the past, present, and even future tendencies of the urban community's residents are available.

Before creating a concrete profile of the group of people with an extreme hierarchical complex, it is also necessary to present the spatial aspect of the aforementioned primary administrative facilities where the majority of these individuals are employed. They predominantly perform important and demanding decision-making functions related to financial transactions, law enforcement, educational programs, ensuring public order and peace, health programs, planning defense and security tasks, production programs, etc.



4.2.2.1.1 Figure 161: Spatial aspect of primary administrative facilities in relation to the city center

Figure 161 shows the spatial aspect of primary administrative facilities in relation to the city center. We can observe that the main primary administrative facilities, such as the defense sector, police, municipality, and court, are located near the city center. An exception is industry, which is situated in the southeast, while other primary administrative facilities (e.g., bank, school, health center, institute, cultural center, and the remaining two industries) are further away from the city center. This could reflect a universal pattern of distributing more important primary administrative facilities in relation to the city center, as these often represent the local authority or government. This question could only be answered by conducting empirical comparative research (e.g., among Slovenian cities).

For the adapted urban community, a network is formed as a result, where the city center acts as the main node. Additionally, content-related connections between the primary administrative facilities could be shown, which would create a complex network with numerous links. In connection with the spatial aspect, the historical dynamics of the city center could also be included, as the city center has likely shifted through long-term historical development. This question can also only be answered through empirical comparative research (e.g., tracking the movements of the city center over time in Slovenian cities).

The spatial aspect reveals a specific strategy and tactics of operation for primary administrative facilities, where key managers are mostly individuals from the group with an extreme hierarchical complex. Who are these people, and by what characteristics can we define them? As already mentioned, the boundaries between different groups of people are often unclear, and there is no distinct dividing line. For example, we can compare two lawyers: one belongs to the group of people with an extreme hierarchical complex, while the other would more likely be classified into the group of progress, despite the fact that his position in the social network is characteristic of the former group.

When classifying an individual into a specific social structure, we do not only assess their physical position (although this is a strong indicator), but we also consider their mindset and basic psychological inclination (e.g., an excessive need to dominate others, a desire to develop ideas for improving the system). Similarly, we can compare two workers performing physical labor, but their mindsets differ significantly. Membership in a particular group is dynamic, as people often change their mental positions. Someone who was still part of the group of progress yesterday may find themselves today in a group with a different basic inclination due to a change in mindset (e.g., due to self-interest or a desire to dominate others).

People from the group with an extreme hierarchical complex in smaller urban communities are often:

A. Lawyers

Lawyers have in-depth knowledge of legislation and therefore also of potential shortcomings in legal systems. They operate in the fields of criminal, traffic, industrial, trade union, land, copyright, political, banking, and police law, etc. Their wide-ranging subject matter reveals that lawyers are most active and numerous in the areas of financial, criminal, industrial, inheritance, land, and banking law. From this, we can conclude that there is a relatively strong symbiosis between the work of lawyers and economists.

B. Economists are well-versed in the flow of capital, investments, exchanges, ventures, etc. They are particularly useful for collaboration with lawyers.

C. Criminal investigation services and the Agency of the Republic of Slovenia for Payment Transactions, Supervision, and Information (the Social Accounting Service was abolished in 1994) often further strengthen cooperation between economists and lawyers, especially in the field of economic crime.

D. School administrations are heavily dependent on economists and lawyers, as they provide them with the legal basis for operation and the necessary financial resources. Economists and lawyers also have a similar strong influence on the administrations of cultural centers.

E. Bank administrations largely operate with the support of legal and economic services and the Agency for Payment Transactions, Supervision, and Information.

F. Administrations of smaller and larger industrial facilities operate in a similar way to bank administrations.

G. The defense sector is heavily dependent on lobbies that are willing to support high financial investments for defense and security tasks.

In short, economists and lawyers largely determine the criteria and rules, while repressive bodies ensure their enforcement, implementation, and protection. In addition, there are special services that create a kind of barrier, preventing most people from having a clear insight into these legal and financial structures. These services can be called the mobile part of the invisible government. This very part of the invisible government largely directs the mindset of the majority of people. The most well-known representatives of this mobile part of the invisible government are political and business lobbyists, organizers, and planners of economic and political propaganda, etc.

Now that we have briefly discussed these spheres, we will focus on where people from this group reside, in order to perhaps identify a certain universal pattern. As we have already established, the group of people with an extreme hierarchical complex is divided into different strata, which, however, have a distinct basic tendency to dominate other people. First, we will discuss secondary administrative facilities.

4.2.2.2 Secondary administrative facilities

Secondary administrative facilities can include bus stations, railway stations, tourist agencies, hotels, restaurants, other catering establishments, various craft activities, department stores, shops selling technical goods, etc. Secondary administrative facilities indirectly, and sometimes directly, provide additional information to primary administrative facilities about the residents of the urban community. This additional information is used for business and surveillance purposes, exploited by representatives of both the visible and invisible government. With the help of this additional information, they are primarily informed about the consumer and other behavioral patterns of individuals. Later, this information is used for economic and political propaganda purposes.

4.2.2.3 Dwellings of people from the Extreme Hierarchical Complex group

For people from the extreme hierarchical complex group, we could infer that they predominantly self-regulatively organize themselves to be present in all strategically and tactically important locations of the urban community. The main reason for this presumed self-regulatory organization stems from their basic tendency to dominate others, acquire material and positional benefits, and achieve success or reputation. In a way, these people consciously or unconsciously mark out spaces and strive to maintain a favorable state of influence and control.

People from this group often follow two extremes when choosing a home. The first extreme is choosing a location near the city center within the urban community, as the more important primary and secondary administrative facilities are located in this vicinity. The second extreme is having reserve residences that are quite far from the urban community.

The life of people from the extreme hierarchical complex group is usually extremely dynamic, full of conflict situations and negative stress, which is very demanding. Maintaining strong influence while acquiring material benefits is not an easy task. Fulfilling this self-regulatory mission requires strong internal motivation, which representatives of this group typically possess. Because of this, they need mental and physical detachment from the demanding everyday life. This may explain the reason for choosing a reserve residence that is relatively very far from the urban community.

From the above, we can extract a universal behavioral pattern regarding the choice of dwelling, which moves between two extremes: from extreme dynamism of mental and physical activity to the necessary mental and physical rest. The choice of home location often involves an interplay of planning and a self-regulation mechanism.

The group of people with an extreme hierarchical complex is, in a sociological sense, the most connected group. No other group of people achieves such a high level of organization. You probably

noticed the term "human species"? You noticed correctly, because people from this group differ in their actions from other groups.
We continue with the analogy of "human species." Other groups are much less connected, less organized, and predominantly operate under the influence of people from the extreme hierarchical complex group, who most strongly extend their influence. In nature, we know similar modifications among certain animal species, for example, among hornets, wasps, bees, and bumblebees. Although they have a similar genetic makeup, shape, and structure, they operate quite differently. Bees are considered very diligent and docile, bumblebees calm and less numerous, while hornets and wasps give the impression of aggressiveness and predation.
The idea of different human species within social hierarchical associative systems and the analogy used seems interesting. Nevertheless, we will no longer write about "human species" in the following, but will stick to the agreed-upon concept of people as one human species and will again use the term "different groups of people."
Through which criteria can we classify an individual into the extreme hierarchical complex group? Strong indicators are the individual's functional position in the social network and their assets in the form of money, real estate, and land. In addition, we must also consider their sociological and psychological influence on other people. The most prominent indicator is their basic psychological tendency to dominate others, which is evident even at the micro-level in numerous and diverse situations. Furthermore, we can mention the daily information and communication activity, which is most intensive and strong among people from the extreme hierarchical complex group. Another strong indicator is also the spatial aspect, which they actively and thoughtfully plan.

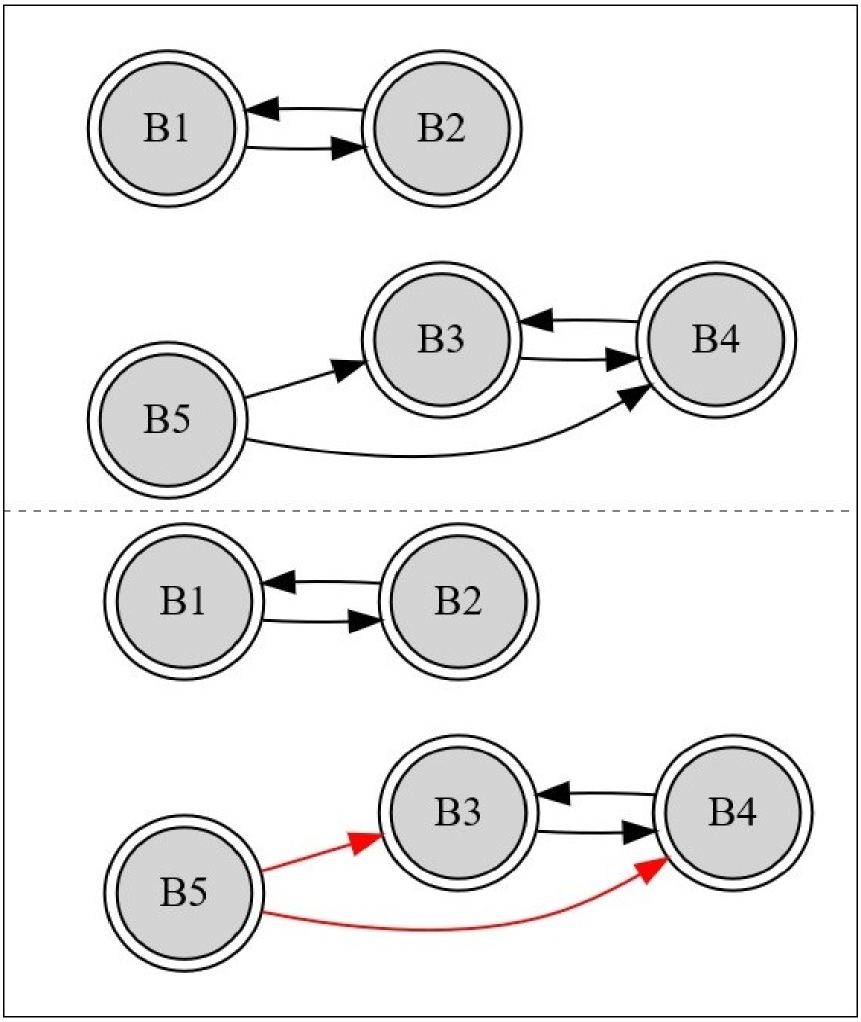
4.2.3 Dynamic view of the adapted urban community

For a basic understanding of how the adapted urban community functions, the static view served very well. In the following, we will also present a dynamic view of the functioning of the adapted urban community using digraphs. First, we will show two different social forces in which people from the extreme hierarchical complex group are in the forefront. The dynamics of the social hierarchical associative system are manifested in the emergence of numerous diverse situations that encourage people from the extreme hierarchical complex group to carry out various deliberate and less deliberate actions.
Apparently less connected representatives of people from both opposing forces of the extreme hierarchical complex strategically and tactically unite in two different organizations or networks due to given distinct situations, which have a similar tendency, for example, gaining positional advantage, material benefits, and greater influence. With the help of the dynamic view of the given

social hierarchical associative system, we can monitor the sociological movements of a certain collective mechanism. This is similar to watching the state and dynamics of the weather with a weather satellite for the purpose of predicting effects and consequences (or the analogy of a microscope, with the help of which we monitor the dynamics and patterns of behavior of living beings to discover certain laws and derive new insights and knowledge).

Researching sociological movements seems like a promising field, as with the help of the acquired insights and new knowledge, we could predict certain organizational awkwardness in urban communities in advance and prevent undesirable social phenomena, such as crime, increased negative stress that further creates mental patients, more efficient and rationally organized traffic connections, etc. Despite the positive aspects of such research, it is also necessary to point out the negative consequences of these ideas, as the possibilities of misuse of the acquired new insights and knowledge are likely. Misuses can even go so far as to destroy the privacy of a large number of people, which could lead to a sociological catastrophe (e.g., supertotalitarianism).

With the help of digraphs and other representations, we will determine the connections between different organized associations and people who perform important functions within them. We will especially highlight the connections with regard to active, moderately active, and less active or negligible sociological relationships both between organized associations and between people who we classify into the extreme hierarchical complex group. More specifically, we will examine administrative and decision-making activities also from the perspective of dynamic social networks, which, like individuals, are subject to certain laws. We will also present various variations regarding the emergence and operation of the invisible part of the government, which is particularly active during more important social events. We will also find that the highest governing function does not necessarily mean the greatest decision-making power, as the size and strength of a certain social network can, based solely on raw interests, overcome high governing functions at both the local and national levels.



4.2.3.1 Figure 162: Digraph for administrative activities and holders of main functions

Figure 162 shows a digraph for administrative activities and holders of main functions, where we have five different nodes (B1, B2, B3, B4, and B5) with connections that indicate active links between them. The nodes represent formal and informal (see invisible government) organized associations, including their main representatives.[51]

Legend:

B1 … Municipality – Mayor of the urban community

B2 … Police – Chief of Police

B3 … Bank – Bank Director

B4 … Industry – Factory Director

B5 … Invisible government

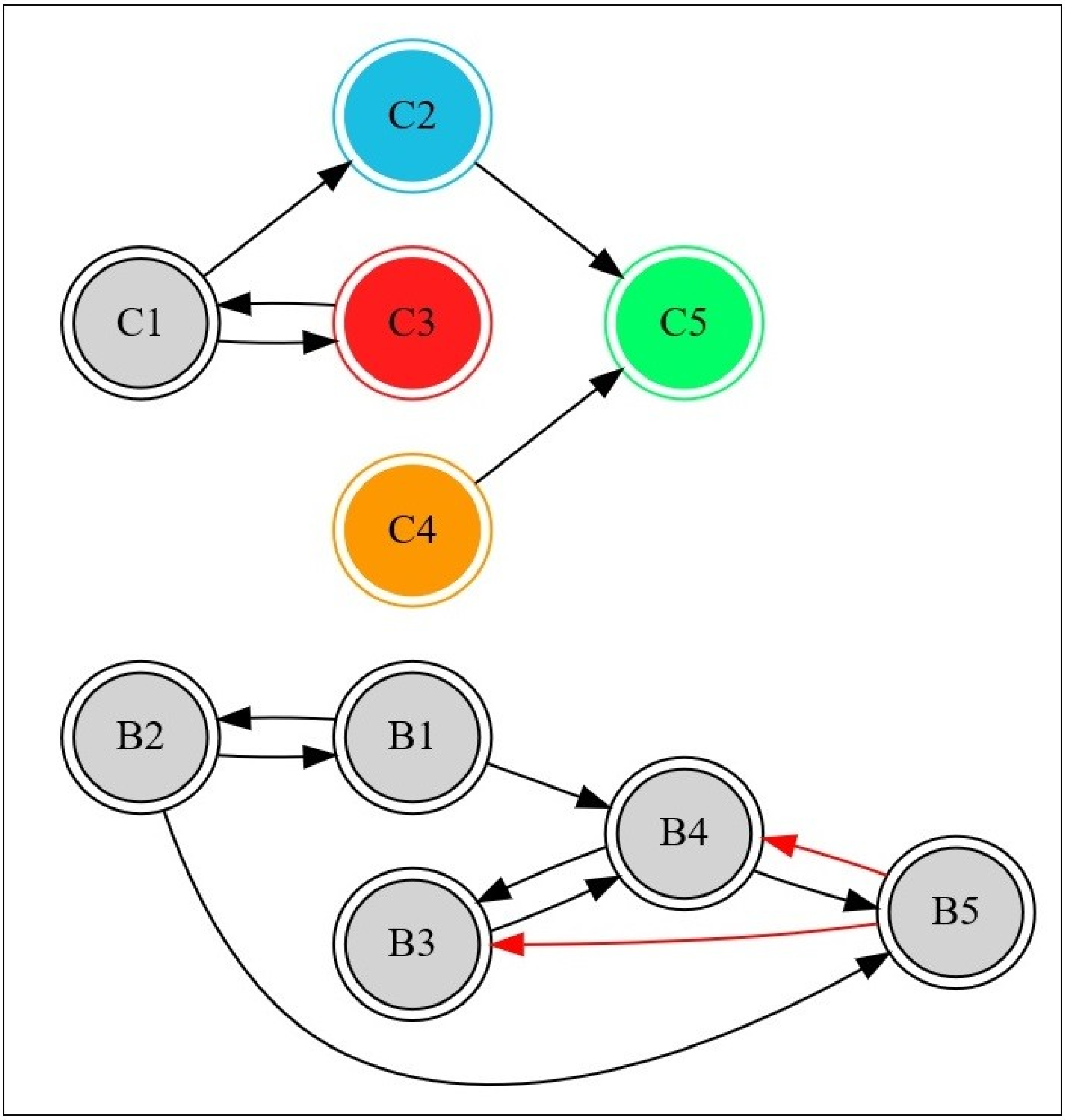
Shown are the collaborative relationships between B1 (municipality) and B2 (police). The municipality employs 200 people, of whom 160 employees support the mayor of the adapted urban community. These employees have a wide circle of acquaintances, which could mean that most of

51 The digraphs were created using the Graphviz software tool.

the people they have friendly contacts with also support the mayor and his city government. The police employ 50 people, of whom 40 support the chief of police. These people also have a wide circle of acquaintances, sometimes even identical to the circle of acquaintances of people employed at the municipality, and on top of that, they have their own circle of friends. The first digraph shown primarily represents active sociological relationships between people employed at the municipality and the police. From this digraph, we can conclude that the highest representatives of both organized associations also mutually support each other. The second digraph (B3, B4, and B5) represents active sociological relationships between the invisible government, the bank, and industry. The lower part of the image highlights the importance and strength of these relationships with the help of two connections marked in red. The explanation follows below.

The invisible government is essentially a relatively amorphous, very heterogeneous, and more or less informally organized association (it sounds similar to a Freemason lodge, the mafia, sectarianism, etc., but this organization is different, although connections between the mentioned and the invisible government may exist), which can be composed of some influential craftsmen, independent legal professionals (e.g., lawyers, notaries), a certain segment of the ("secret") police (e.g., informants, undercover police officers), defense experts from the defense sector, freelance artists, some journalists (e.g., local media), public officials at the municipality, etc. This mentioned invisible government can, based on a wide circle of acquaintances with strong vested interests, extend its influence to the local banking and industrial sectors. The second digraph shows an equal relationship between the local banking and industrial sectors, which, however, are subject to the influence of the invisible government (again, see the lower part of Figure 161: two directed red links from node B5 to B3 and B4).

In the following, we will use digraphs to present the dynamics of two different competing sociological formations that have become pronounced due to the arrival of an important social event, which is under the influence of a longer but already known established social process. From an organizational point of view, the competing sociological formations are not so different, because most representatives come from the same organized associations. Likewise, the basic interest of both formations is identical, as it goes in the direction of gaining influence over other people, material and positional benefits. We have already become acquainted with the first formation, and it wants to maintain or even increase its existing influence over other people, material and positional benefits, while the second formation wants to change the existing state in its favor. In short, a sociological movement is occurring that can cause proportionate or even large local social changes.



4.2.3.2 Figure 163: Sociological movement due to the arrival of a competitive sociological formation and an important social event

Figure 163 uses the visualization technique of a digraph to show the sociological movement due to the arrival of a competitive sociological formation and an important social event. The connections between the nodes are more or less present all the time, but not as intensely and strongly as Figure 163 shows. This essentially shows us how and when active sociological connectedness and the formation of more visible sociological formations occur in relation to the displayed segments. In fact, there has been a movement of collective masses in the adapted urban community. This kind of turning point of the unification of both forces is a sociological movement. This mechanism or organism (depending on the point of view) has moved and thereby changed, similar to how the weather changes due to the movement of air currents, whose changes we can observe via weather satellites, which clearly show us how these air masses overlap or separate from each other. In weather, we witness numerous repetitions, and it is no different in the sociological climate, where entities (organized associations and people) and their more or less strong connections are present. An important social event at both the national and local levels is elections, which essentially take place all the time, but are most intense and strong about a month before the actual voting. During this period, the political formations, which are basically composed of the ruling position and competitors, are also most clearly visible. The competitive political formation is shown in the upper part of Figure 163 (C1 – representatives from the municipality, C2 – police representatives, C3 – representatives from the bank, C4 – representatives from industry, and C5 – a more or less wide circle of acquaintances of the aforementioned representatives and others). With the help of the diagrammatic technique of a digraph, we very quickly notice the fundamental difference between formation C (C1, C2, C3, C4, C5) and B (B1, B2, B3, B4, B5). The digraph with nodes from formation B shows better organization than the digraph with nodes from formation C. This means that we can predict very quickly in advance that formation B will have a greater chance of maintaining power and winning the local elections. Despite the favorable finding for formation B, it is necessary to point out that the digraph of formation B shows a weak point among the sociological connections. This is certainly node B4, or industry, which has somehow strengthened its position among these segments. Node B5, or the invisible government, has slightly lost its priority role compared to the digraph in Figure 162, although this loss is only temporary but could be fatal, as important representatives from industry, including directors, may embark on paths of raw business interests where positional and material benefits count. Both of these are less connected to other content, such as ethics or ideology. The local industrial sector may represent a potential opportunity for political rivals. In the digraph of formation B, the banking sector maintains the same status compared to the industrial sector. Node B5 has a priority role over B3, while B5 and B4 are in an equivalent relationship. B1 and B2 are also in an equivalent relationship and extend their influence to B4 and B5. From this, we can conclude that B5 has a priority role over B4, B3, and even B1, which may mean that the informal supreme commander of the invisible government might be a higher police officer, the deputy chief of police, or the chief of police himself.

Examining such entities and connections based on positions and situations (e.g., important events) serves, on the one hand, primarily to predict the future of sociological movements with the aim of preventing minor or even catastrophic consequences (e.g., wars) in social hierarchical associative systems, and on the other hand, it serves to improve and save valuable energy in the functioning of the system. The research field seems interesting and useful, but it is not within the domain of certain individuals, but primarily requires the level of well-organized scientific groups. In this strategic and tactical space, the group of progress could win a certain preferential position, thereby strengthening its importance in everyday life and finding a connection in relation to the majority group. In this way, the group of progress would have more opportunities to influence important decisions and could thus further realize its important mission regarding the development of ideas and applications that would contribute to positive changes within social hierarchical associative systems. The basic purpose of positive changes lies in improving the quality of life for the majority of people (e.g., the lowest possible percentage of poverty, the lowest possible level of negative stress) and the optimal use of energy (the consequences of suboptimal energy consumption can be seen, for example, in unnecessary expenses, costs, collective idiocies, an increased percentage of crime).

A somewhat smaller adapted urban community was studied in more detail, which operates on the basic principle similarly to smaller and much larger urban communities (although the dynamics of sociological movements are much greater), which are connected within a specific country into an extensive substantive and interest network. At the local, regional, and national levels, representatives of different urban communities also cooperate with each other to a greater or lesser extent, which of course greatly depends on the spatial location, natural resources, internal interests, and the very infrastructure of a particular urban community (e.g., information communication infrastructure, transport infrastructure, political infrastructure, industrial infrastructure, tourism infrastructure, business infrastructure, organizational infrastructure, etc.). Especially urban communities with similarly developed infrastructure and relatively close spatial proximity can cooperate better or even very well with each other, while many urban communities do not have very close contacts with each other. The efficiency and success of cooperation between different urban communities can have extremely beneficial effects on the functioning of the entire country. A good example of cooperation between urban communities in a particular democratic, social, and legal state is elections, which are essentially accompanied by significant competition between different political parties.

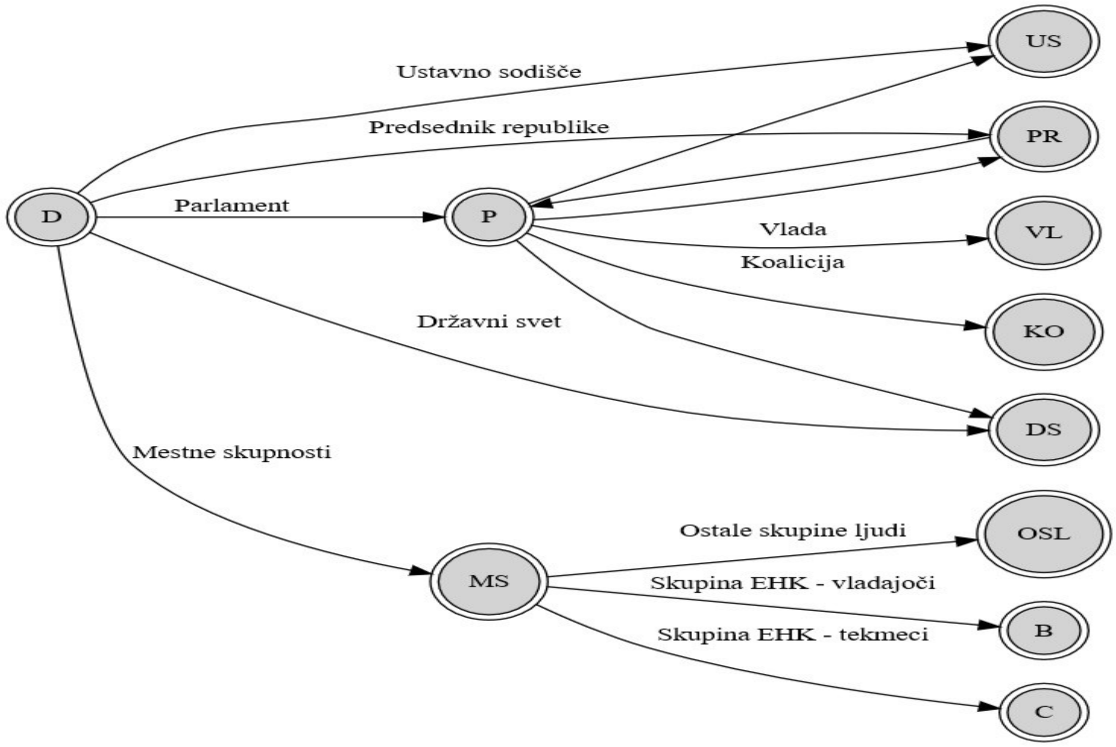
Before moving on to the next subsection on the state, we would first like to draw attention to research that could be carried out in numerous urban communities from the perspective of various sectors to determine which urban communities could successfully and effectively cooperate with each other at different levels of social life. This essentially involves determining the similarities between urban communities (e.g., local economy, local culture, local politics), strengths, and weaknesses. At which levels (e.g., local economy) could urban communities within the country complement each other and thus increase the efficiency and effectiveness of operation? The aforementioned research idea would require an excellently organized scientific group composed of various types of scientists (e.g., economists, lawyers, sociologists, psychologists, computer scientists, geographers, historians, natural scientists, linguists, representatives of the medical profession, criminologists). Much data on various urban communities within a specific country has long been available (e.g., demographic data, data on local political infrastructure), while much data is still hidden (e.g., crop yields, banking operations, more detailed data on performance in the industrial sector, the success of crime prevention). This insight would be an extremely large scientific project at the national level. The basic purpose of this project would be to determine certain laws governing the operation of urban communities and to identify opportunities for better cooperation between them. The goal, based on the findings and insights, would be to propose good solutions.

4.3 The State

The definition of the concept of the state can be very diverse, with many definitions being more complex. We will define the state as simply as possible. A state is a geographical area and a relatively independent political entity (independence is conditioned by international or world politics) with its own government and its own constitution (including laws, tax rules, etc.). It should also have a police force, defense forces, its own flag, anthem, and a relatively ethnically homogeneous population.

From a network perspective, the state represents a puzzle of various smaller and larger cells of human communities with similar and different substantive emphases (e.g., politics, economic activities, industrial sectors), which are unified with the help of laws, rules, values, and symbols (e.g., flags).

From a hierarhological and hierarhographical perspective, the state represents a larger and more complex socio-hierarchical associative system based on hierarchy, cooperation between people, planning, induction (including political propaganda, economic propaganda, informal social agreements, the transfer of psychological states to others without direct physical contact, etc.), and formal social agreements.



4.3.1 Figure 164: Digraph of a possible basic organizational network of the state

Figure 164 shows a digraph of a possible basic organizational network of the state, which in a very simplified form illustrates the main entities and the relationships between them.

The State (D) is the overarching entity for the Parliament (P), the National Council (DS), the President of the Republic (PR), and the Constitutional Court (US). This pattern at the national level is fundamentally very similar to the pattern at the regional or city level, as the state is also the overarching entity for urban communities (MS) and various groups of people (the majority group – SV, the progress group – SN, the anomaly group – SA, the extreme hierarchical complex group – EHK). The extreme hierarchical complex group (EHK) is divided at the city level into two sociological formations, B and C (we have already learned about both formations in detail in the dynamic view of the adapted urban community). Formation B represents the ruling structure, while formation C is in the role of competitors. At the national level, we are dealing with the government (VL) and the coalition (KO).

There are other possible models of state organization, but we will not deal with them in this section.

When studying the state, we will focus on determining success and efficiency based on already known indicators and the possibility of determining expenditure, especially lost energy.

Officially, data on the success or failure of a particular state are collected in the areas of gross domestic product (GDP) and national accounts, prices and inflation, labor and unemployment, economic relations with foreign countries, energy, construction, education, quality of life, agriculture, forestry and fisheries, culture, environment, wages and labor costs, entrepreneurship, population, development and technology, regional reviews, social protection, transport, trade and services, and tourism.[52] Gross Domestic Product (GDP) basically denotes a certain created market value, represented by the sum of products and services multiplied by their prices. The indicator thus obtained expresses the level of success and efficiency of the economic activity of a particular country. The higher a country's GDP, the richer or more successful it is supposed to be. However, this indicator offers a very narrow view of a country's performance.

If we compare GDP with the poverty rate indicator, we can get a quite different picture. In other words, the analysis of the distribution of the acquired wealth among all the inhabitants of the country can show that wealth is accumulating only among a small number of inhabitants, while many people are on the verge of poverty.

For a more comprehensive view of a country's success and efficiency, it would be sensible to try to unify all indicators to a common denominator in order to obtain a comprehensive and realistic picture. National statistics often show simplified data or indicators, which is not necessarily wrong, but it would be useful if more detailed and complex analyses were also available.

The market value of GDP can vary greatly between individual regions and urban communities. In more developed regions and urban communities, the results are higher, while in less developed regions and urban communities, the results are markedly low. Often, less developed regions numerically predominate, which means that the country has a larger number of less developed areas. This negatively affects the entire social hierarchical associative system that the state represents.

Based on existing data, it would be sensible to analyze the ratio between the GDP indicator (expressed in euros, US dollars, and/or percentages) and the at-risk-of-poverty rate (expressed in percentages). For 2018, the following data are available for Slovenia regarding GDP, economic growth, and the at-risk-of-poverty rate:

a. A 4.1% growth in GDP volume for 2018, which corresponds to a monetary value of 45.755 billion euros.

b. The at-risk-of-poverty rate for 2018 compared to 2017 was 13.3%, which is a relatively high value. In 2018, approximately 268,000 people lived below the poverty line (the total population of Slovenia is around 2,066,880).

c. Based on the values presented above, we can conclude that the wealth generated by the country in the economic field is unevenly distributed both among individual urban communities and among

52 An example of this type of data collection and presentation is the website of the Statistical Office of the Republic of Slovenia.

individual residents. If we divide the 4.1% growth in GDP volume by the 13.3% at-risk-of-poverty rate, we get a very low value of 0.31, assuming that a value of one would represent an optimal or desirable ratio.

Excessive uneven distribution of wealth, whether among urban communities or among residents, certainly implies a loss of productive potential and relative stagnation of individual building blocks of the state (urban communities, population, etc.). Taking into account the ratio between the number of the working-age population (854,391) and the non-working-age population (1,212,489, which includes children, pensioners, etc.), we get a picture of a large loss of productive energy in the social hierarchical associative system.

To illustrate the issue more clearly, we can present a simulation in the form of an analysis of energy inputs from different groups of people, expressed in kilocalories (kcal). These values represent a certain probabilistic energy potential that individuals can contribute to various activities at different levels of functioning. A high level of inactive population, in terms of both social hierarchy and structure, primarily signifies a significant loss of productive energy.

If we were to express this loss in kilocalories or any other unit of energy, the resulting value would be remarkably high—both at the level of urban communities and individual residents. Assuming that an individual uses about 3,000 kcal to produce a certain product or provide a service, we can simply multiply this value by the number of inactive individuals to arrive at a staggering figure of 3,637,467,000 kcal (approximately 3,637.467 Gcal). This result indicates a massive amount of lost energy, with no product created or useful service delivered. If this unused energy were accumulated annually, it could, based on an average annual heating consumption of 700 Gcal, heat an average-sized apartment block for about five years.

Given the high likelihood that the level of inactive population will not change significantly in the coming years, this energy loss will continue to increase. The same applies if we analyze energy losses from past periods.

It would be reasonable to include energy efficiency indicators—measuring energy utilization across urban communities and individuals—alongside traditional economic performance indicators. There should be an agreement at the scientific, professional, legal, and political levels on the methodology and calculations for energy use within the societal hierarchical associative system.

Another important indicator of a country’s performance and efficiency is inflation in relation to prices. From an economic perspective, inflation refers to the rise in the prices of goods and services over a certain period (e.g., monthly or annually). The negative consequences of excessively high inflation include a decrease in purchasing power, discouragement of investors from making useful and necessary investments, a drop in currency value, and an oversupply of money in circulation.

The main reasons for rising prices may include the following:

- Increased demand for certain products and services, especially when they are relatively scarce.
- Expensive investments in technology for use in industry and public administration (e.g., costs related to security applications and devices, which are often necessary due to external threats).
- Adverse weather conditions and natural disasters (e.g., crop destruction due to drought, excessive rainfall, pests, or hurricane-force winds).
- Environmental pollution, which requires significant financial resources to mitigate its negative effects, as excessive pollution harms the health of living beings.
- High levels of poverty and unemployment (e.g., low productivity among these groups, who also require financial support; at the same time, they are often exploited by businesses and market speculators).
- Economic monopolies, where companies with high-demand products or services freely raise prices, indirectly driving inflation.
- Excessive importation of foreign goods, where higher prices result from the costs of business intermediaries, managers, etc.
- High transportation costs for goods, raw materials, semi-finished products, and finished products.
- Rising fixed and variable operational costs.
- Business and stock market speculation carried out by influential individuals, organized groups, banks, or even states. Inadequate monetary policy enables price manipulation of raw materials and food products.
- Economic and financial crime, where large sums of money end up in the hands of a small group of people, causing harm to the state and its citizens. This often results in austerity measures, wage reductions, and price hikes.
- Excessive negative stress, which affects people's well-being, efficiency, and health—leading to increased sick leave and decreased productivity, indirectly contributing to price increases.

We’ve now outlined the primary causes of rising prices, which are a key factor behind inflation in the economy. It is important to emphasize that these causes are not limited to international or national financial markets—they also appear at the local level. Although local market speculators are less well known or operate differently, they should not be equated directly with broader-scale business speculations. One of the simplest methods for calculating inflation uses the following formula:

$$SI = \left(\frac{TC - PC}{PC}\right) \cdot 100$$

For example, if the current price of a product is €10.20 and its previous price was €10.00, the inflation rate is 2%, which is roughly in line with Slovenia's current inflation rate. Inflation is calculated monthly and annually for the prices of all known products and services, after which an average is determined.

If the price of a product or service increases by €0.20 in a single month, that is already a relatively high increase—especially if prices continue rising by similar or higher amounts in the following months. There are countries with higher inflation rates (e.g., Romania at around 5%) and countries with lower rates (e.g., Germany at around 1%).

Inflation and the Slovenian Economy

Slovenia imports a large volume of foreign products and uses various foreign services (e.g., IT consulting), while having relatively few domestic brands. Slovenian brands that are globally successful are negligible, and in comparison with more developed countries, almost nonexistent. A high level of innovation—including inventions, innovations, patents, etc.—can help a country succeed in financial markets, which indirectly contributes to lower prices.

In many cases, a country has limited influence over product and service prices, as they are often artificially inflated by powerful market speculators. Potential measures to reduce the harmful impact of these speculators on energy and food prices could include global monetary policy agreements banning such practices, supported by appropriate legal regulation. Additionally, the role of unnecessary or irrational intermediaries and managers—who are likely quite numerous—should be carefully examined.

Research into prices and inflation should include an analysis of the most realistic and optimal wealth distribution to preserve the population's purchasing power. The damage caused by market speculators can also be seen as a form of energy loss, affecting societal hierarchical systems such as states. If poverty levels and inactive populations were converted into energy units, the result would be a macro-level energy loss. This lost energy could theoretically power many thermal power plants.

Purchasing and hoarding large quantities of energy resources and food products for the purpose of inflating prices and selling them to poor countries could be considered a crime against 90% of the world's population. In a moderately developed country—socially, legally, and technologically—this crime might affect 10–20% of the population living in poverty. While these percentages may seem small, in absolute numbers they are significant (e.g., from 200,000 to 5 million people).

Given that the topic of work and unemployment has already been indirectly addressed in relation to the concept of energy loss, we would now like to highlight the important issue of introducing „new professional profiles“, along with „legal and political support“ for creating jobs in areas such as IT, environmental protection, traffic safety, entrepreneurship, and applied research connected to society, technology, and nature. These measures could help reduce unemployment and thus prevent the significant energy loss that occurs when large portions of the population remain inactive. Since this is a complex topic, it's useful to present some concrete examples of practical measures:

a. Example: Employment and social work agency measures to reduce unemployment

Using geographic information systems (GIS) and various analytical software tools to identify the (potential) skills of unemployed individuals. This would be based partly on data already held by employment agencies, and partly on additional qualitative and/or quantitative research. The collected data could be used to effectively organize unemployed individuals with different useful skills. These skills could then be applied in specific work groups or projects aimed at generating business results in the form of financial gain and/or social benefit. In this way, many people could find at least partial employment, while the state would benefit significantly—since it is a great loss to any society when the knowledge of its citizens goes unused.

b. New professional profiles in IT that include social sciences and humanities

University programs in computer science and IT are often too focused on transferring technological knowledge for use in industry and public administration. Less attention is given to skills that could be applied in fields such as environmental protection, crime prevention, quality-of-life management, psychological analysis of at-risk populations, educational methods, assessing children's abilities during preschool and school years, employment services, and social work. Although "knowledge management" is widely discussed, this area often receives insufficient attention in university curricula. Greater emphasis on knowledge management and the introduction of new professional roles—such as „information engineers“, „data analysts“, and „knowledge extractors“—could benefit both industry and public administration.

c. New professional profiles in identifying and preventing illegal dumping

Illegal waste dumping often surprises tourists and locals seeking relaxation in nature. A professional profile focused on detecting and preventing illegal dumping could offer a promising employment opportunity. Training for such work could be included in specific academic programs.

d. New professional profiles in traffic safety

These roles would focus on identifying hazardous locations in traffic infrastructure and proposing solutions in the form of patents, innovations, and advanced concepts to prevent accidents. Projects in this field could involve urban planners, specially trained police officers, and unemployed individuals with university degrees (e.g., psychologists, sociologists, anthropologists, environmental scientists, and logistics experts).

e. New professional profiles in the private sector

Self-employment offers many possibilities and should be supported legally by the state. The process of gaining self-employed status should be simple and financially accessible. For example, many older individuals over the age of 65 need assistance with daily tasks such as gardening. Private individuals could provide valuable support for elderly care in this way.

f. New professional profiles for reducing negative stress

Professionals specialized in stress reduction could be employed in both the public sector and industry. These experts could offer services such as massage and other unconventional relaxation techniques (e.g., gentle brush tickling). Such services would be especially beneficial for administrative staff, who often suffer from issues related to prolonged sitting—such as spinal, neck, and eye strain. Short daily relaxation sessions (e.g., 15 minutes) could improve employee well-being and productivity.

Proposal for further action

It would be worthwhile to conduct a survey using a targeted questionnaire asking people for **ideas about new, non-existent professional profiles** that could be useful in both public administration and industry. This approach could capture a much broader range of excellent ideas, as individuals tend to focus primarily on their own environments and often don't consider other possibilities. By engaging a large number of people, we could achieve better outcomes in the form of "practical and beneficial ideas" for new professions.

This topic has been highlighted because many countries are "not fully utilizing their potential", especially when it comes to people living on the edge of poverty who remain unemployed.

Regarding the import and export of goods, it has already been noted that some countries import large quantities of foreign products while being less active in exporting their own. On one hand, this concerns raw materials and food products that are either unavailable or only available in limited quantities on the domestic market. On the other hand, an excessive reliance on imported goods indicates a lack of domestic activity in fields such as science, innovation, patents, and so on.

This trend is evident in areas like the development of advanced technologies (e.g. information technology), the creation of unique culinary products with potential for success on global markets, tourism, and the use of energy resources. A lack of scientific and innovative awareness pushes these countries into a state of dependency. This dependency on more technologically, gastronomically, and energetically advanced countries appears to be an endless spiral.

As a result, these countries tend to repeat patterns of behavior typical of states with lower scientific and innovative capacity, facing year after year an uneven balance between imports and exports—always tipping in favor of imports. This means that these countries spend vast sums of money annually and face a negative trade balance in raw materials and food products. A similar pattern can be observed in their energy dependency, as they consistently struggle with imbalances in energy imports and supply.

Another highly important sector for a country's economy is construction, which not only provides jobs for large numbers of people but also creates wealth through the development of infrastructure—such as public buildings, industrial facilities, and private housing. Problems in this sector arise when planning and financial calculations are poorly executed, leading to either a shortage or an oversupply of different types of buildings, particularly private housing. It's often the case that housing prices reach astronomical levels, while the population's purchasing power remains too low. As a result, many apartments remain unsold and unused, representing a significant waste of energy and financial resources for the country.

Industry is also a key sector for any technologically, legally, and socially developed country. It can employ a large workforce and produce goods for both domestic and international markets. In this area, both the positive and negative effects of operations are clearly visible and often serve as indicators of a country's overall efficiency and success.

Here again, we encounter the question of energy efficiency—whether thermal, kinetic, electric, hydropower, light-based, or even human bioenergy. Industries that rely on outdated technology tend to have much lower energy efficiency and typically cause more environmental pollution, which can be viewed as a form of energy loss. Countries with poor energy efficiency are often also those with lower scientific and innovative awareness.

The development of every scientific or innovative idea must be placed in a broader context—something that individuals or small groups cannot achieve on their own. There is a need for intensive yet engaging societal encouragement of innovation and idea development, as this can lead to exceptionally positive outcomes.

Throughout human history, various inventions, patents, innovations, theories, models, and laws have emerged in different eras in response to the desire for greater, more efficient, and more economical use of energy. This drive has often benefited the profit, power, and influence of elites—such as nobility, capitalists, and others. Since the 18th century, we have witnessed the rise of industrialization, in which science has played a crucial role. Following the invention of the steam engine, the first law of thermodynamics was formulated, stating that energy is indestructible and that we cannot extract more energy than we put in. (Later, Einstein's theory of relativity introduced the equation that describes the relationship between mass and energy.) This perspective supported wealthy entrepreneurs' aspirations for ever-greater profits.

Alongside the focus on energy, human history and science have also seen a strong need for rapid, efficient, and high-quality communication—seen in inventions such as the telegraph, telephone, and email. These advancements further expanded the influence of elites. In the 21st century—the age of the brain and knowledge—the emphasis is once again on improving energy efficiency, but now with a focus on optimizing that efficiency. This is one reason why large virtual social networks have developed, enabling rapid exchange and enrichment of knowledge. In short, energy efficiency within society must be improved, and this cannot be achieved without further promotion of knowledge. It requires that world leadership actively supports the development of economic models that allow for a less asymmetrical distribution of capital. Within this strategic framework, industry also plays an important role, as it must align with the need for advancing knowledge and innovation in order to optimize the use of various forms of energy.

Education is also an extremely important cultural domain. Generally, educational programs and their implementation place a strong emphasis on promoting and transmitting knowledge from linguistic and mathematical perspectives. This primarily nurtures linguistic and mathematical intelligence, but this alone is insufficient. There are many other types of intelligence—such as social, kinesthetic, spiritual, and emotional—that receive far too little attention in current education systems. As a result, countries do not make full use of the energy embodied in the population's knowledge and intelligence, and many capabilities remain untapped. For hierarchical, associative social systems like states to function at maximum efficiency in terms of energy utilization, this critical shortcoming must be taken seriously. In the future, humanity will face challenges that cannot be solved by dominant linguistic and mathematical intelligence alone.

The topic of quality of life is closely linked to employment, the risk of poverty, health and social security, and the population’s purchasing power. In connection with social security, the indicator of social exclusion is frequently mentioned. A higher level of social exclusion indicates a lower quality of life. Quality of life also includes a variety of other indicators, such as access to technology, living conditions, time for socializing with friends, raising children, pursuing hobbies, and so on. In technologically, socially, and legally developed countries, the pursuit of profit—whether in the form of money or real estate—is so intense that employers often deprive people of the ability to realize these aspects of quality of life. Government policy could do more to help countries place greater emphasis on quality of life, for instance by mitigating the excessively asymmetric distribution of wealth within urban communities and among individuals.

Agriculture is also of exceptional importance, as it ensures the production of healthy food. A major value of agriculture lies in the sensible organization and use of agricultural land. Farmers often generate relatively small profits, largely due to commodity market policies that leave too much room for market intermediaries, who take a significant portion of the financial returns. These intermediaries also contribute to increased prices (including storage, maintenance, and other costs) in supermarkets. Young people often lack the desire to work in rural areas and prefer to move to larger cities. Encouraging more extensive, higher-quality, and more efficient use of agricultural land would only be possible by increasing farmers' earnings. As long as the market permits the existence of numerous unnecessary intermediaries, farmers' incomes will remain low. This diminishes motivation for agricultural work and leads to increased imports of food products or even the sale of domestic agricultural businesses to foreign investors. This results in inefficient use of domestic agricultural potential, causing substantial losses of financial resources and energy.

Government statistics typically monitor a country's cultural activity in a very narrow sense. They record the number of exhibitions in museums and galleries and highlight the number of public events. However, culture has a broad scope that goes beyond art and public events, encompassing science, sports, quality of life, and more. This narrow perspective on culture taken by official statistics does not offer a realistic view of the quality and effectiveness of a country's cultural landscape.

Environmental pollution indicators are also very important, as they provide data on waste generation, water pollution, and vehicle emissions. Higher values in these indicators lead to increased costs for waste removal and water purification. Polluted air also negatively affects the health of humans, animals, and plants. Although solutions such as electric vehicles, biodegradable packaging, and renewable energy sources have been known for a long time and have clear environmental benefits, they are still not sufficiently widespread. A future dominated by these technologies would allow a country to achieve long-term savings in both money and energy.

Wages and labor costs are also key indicators of a country's performance and efficiency. A more balanced distribution of capital within urban communities and among citizens could increase purchasing power, encourage domestic investment, and improve business performance. Through appropriate policies and legislation, the state could prevent the excessive enrichment of a relatively small group of individuals. Low wages and high labor costs result in the loss of financial resources and, more importantly, a significant loss of human potential, as much knowledge and skill remain untapped. These two indicators are closely linked to poverty risk levels and the proportion of the inactive population.

Business-related indicators show how many fast-growing and newly established companies are active in a given country. While many companies may exist, some fail to provide real value and merely "exist" in the market, which over time leads to financial losses and encourages criminal activities such as insurance and financial fraud. On the positive side, these companies often temporarily employ a large number of people.

When evaluating a country's success and efficiency, demographic indicators such as birth rate, mortality rate, population density per square kilometer, and natural and migratory population growth are also highly important. Successful countries typically have favorable birth rates and a positive balance between immigration and emigration, which increases population density. However, this growth can lead to organizational and social challenges, as these favorable indicators can also have unintended negative consequences.

Immigration of high-quality individuals—those who are educated, skilled, healthy, and ethical—can bring social prosperity and long-term benefits to a country. On the other hand, immigration of less socialized individuals often leads to issues such as violence, crime, and increased costs for social support. These immigrants may lack adequate education, be unwilling to work, and struggle to adapt to the host country's culture. This can result in additional social problems, especially if they have many children whom they are unable to support.

Some countries, like Switzerland, have already implemented selective immigration measures to limit the influx of less socialized or less capable individuals. While these measures can be logical and economically beneficial, they may also lead to injustice for high-potential individuals who, due to life circumstances, never had the opportunity to pursue education or training. Such individuals could represent significant potential for any country, but this potential often remains untapped.

In this context, it would make sense to develop a new professional role dedicated to assessing various types of immigrants, identifying their hidden abilities, and facilitating their integration into society. This role could combine the expertise of sociologists and psychologists, who would use their professional knowledge to improve immigrant integration and strengthen social potential.

In terms of development and technology, it would also be wise to further encourage various positive scientific research and innovative activities at all levels of social and natural domains. These efforts could be carried out within government and non-governmental organizations, as well as through civil society associations. As already mentioned, countries that are less scientifically and innovatively aware tend to be less developed and significantly more dependent on nations that actively cultivate scientific and innovative cultures.

The social protection indicator tells us how much financial support is allocated to people who are unemployed and living on the edge of survival. The higher this amount, the greater the unused energy and hidden potential of these individuals. It is clear that this indicator is closely linked to the risk of poverty and the level of inactive population in a given country. It would be reasonable to synthesize these two indicators in order to roughly calculate the efficiency and loss of the social hierarchical associative system, both as a percentage and in terms of energy units.

When it comes to the transportation of raw materials and energy resources, it has already been shown to incur high costs and create certain organizational challenges within traffic systems. Regarding the transportation of people, public transport is extremely beneficial as it reduces environmental pollution and alleviates traffic congestion. However, a common issue with public transportation is underdeveloped transport infrastructure. It would be useful to assess the functionality and efficiency of a country's entire transport infrastructure to identify weaknesses and implement necessary improvements. This area could also benefit from calculations of energy consumption and efficiency within specific transportation systems.

Retail and various services are crucial to the positive economic performance of any country and to consumers who purchase products and use services. It is often the case that too many similar stores and services are concentrated in one area, while other areas are underutilized. This can result in people having to travel relatively long distances to access a certain product or service, which may benefit fuel sales but harms the environment by increasing pollution. Moreover, it leads to a huge amount of energy consumption as people move from point A to point B. Additionally, traffic congestion can lead to more frequent accidents. In short, it would be wise to explore and find solutions for a more rationally organized commercial and service infrastructure within a country.

Tourism is an important sector through which any country can generate significant revenue. It is closely tied to retail, services, transportation, accommodation, information and communication infrastructure (e.g., marketing, internet access), and mobility networks. Tourists themselves—with their distinct personality profiles and preferences—also play a key role. Within the tourism industry, there is potential to develop new professional roles that address tourists' social, consumer, and psychological needs in a scientific and expert manner. A country's tourism success and efficiency could also be evaluated through the utilization rate of various forms of energy.

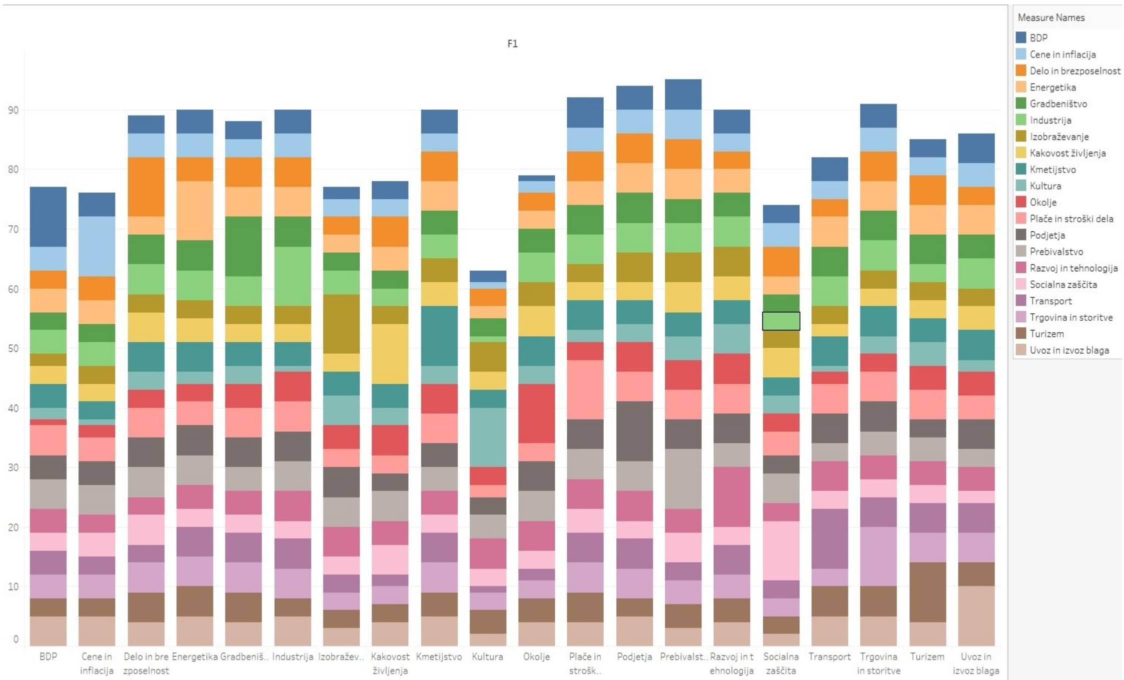
Based on the presentation of various indicators that reflect the success and efficiency of a given country, it was determined that all quantitatively measurable indicators could potentially be converted into energy units (e.g., kilocalories). This would allow for better comparison and correlation between different indicators, and at the same time provide a clearer picture of energy efficiency within all economic and other activities taking place in a country.

In this way, the indicator of financial profit would no longer hold a monopolistic role, but would instead become highly dependent on an overarching indicator of energy efficiency within that country. It is well known that a large amount of energy can be consumed to achieve high financial gains, but in the long term, it may turn out that these high energy investments result in additional costs (e.g., in the form of sick leave, fatalities, accidents, or the irrational distribution of profit among a relatively small group of people).

What follows is an overview of the stronger and weaker connections between the presented indicators. A contingency table was created, in which the indicators were compared using a rating scale from 1 to 5 (1 meaning the indicators are weakly related, and 5 indicating the strongest possible correlation between areas). The self-correlation strength of a given indicator was rated with a score of 10.

4.3.2 Table 113: Part of the data regarding the strength of the correlation between indicators

	GDP	Prices and inflation	Work and unemployment	Import/export of goods	Energy
GDP	10	4	3	5	4
Prices and inflation	4	10	4	5	4
Work and unemployment	3	4	10	4	3
Import/export of goods	5	4	3	10	5
Energy	4	4	4	5	10



4.3.2 Table 113: Part of the data regarding the strength of the correlation between indicators

Table 113 shows only a portion of the data on the strength of the connections between indicators, whereas Figure 165 uses bar charts to illustrate all the connection strengths among the indicators under consideration. Based on the height of a given bar, we can infer that a particular indicator has the highest number of strong connections with other indicators (e.g., the 'population' column has a total score value of 95, followed by the 'business' column with a value of 94, 'shops and services' are in third place with a value of 89, and the 'culture' indicator has the lowest value regarding connection strength, at 63). The colored rectangles within the bars illustrate the strength of a given indicator's connection to others (the largest rectangles within the bars have a value of 10, and the smallest have a value of 1).

Based on Figure 165, it is evident that certain indicators are more influential in representing the success and efficiency of a given country, while others have a lesser impact. This does not mean, however, that they are less important from a broader perspective (not just from an economic standpoint). Attention was previously drawn to the broad scope, complexity, and significant importance of culture in the broader sense, which achieved the lowest score from an economic perspective within the limited timeframe, yet can significantly influence the country's economic efficiency and success in the long run (e.g., the aforementioned innovations or major sporting achievements that increase the country's visibility).

The problem is that the indicators are primarily evaluated based on monetary flows, which prevents a comprehensive insight. From a monetary perspective, hidden influences and developmental processes—which can be decisive in the long term and contribute significantly to a country's success and efficiency—are not visible. For this reason, incorporating an additional energy perspective (energy efficiency) would contribute to a better insight into, or assessment of, the actual efficiency and success of a given country.

Societal hierarchical associative systems, such as countries, can achieve large monetary profits, which are often distributed asymmetrically among small groups of people. Consequently, the system's actual energy efficiency is lower, and the country as a whole loses energy. This leads to problems such as unemployment and poverty, while a large portion of capital is concentrated among a minority of the excessively wealthy, who are less engaged in the country's technological, legal, and social development. Furthermore, their resources are often spent on less essential items, such as collections of shoes, clothes, cars, or jewelry, which have no particular practical function and primarily serve vanity.

This leads to the consideration that it is not sufficient merely to define a minimum poverty or subsistence threshold; rather, it would be sensible to also introduce a maximum wealth threshold. This would enable a more optimal utilization of diverse resources, benefiting the country as a whole. Defining the minimum poverty threshold is relatively straightforward, as it is based on calculating an individual's purchasing power relative to the prices of basic necessities. Conversely, a maximum wealth threshold has not yet been defined, as it represents a new concept. This threshold could potentially be based on comparing an individual's surplus purchasing power against the minimum subsistence threshold, with the surplus amount being divided by a relevant subsistence index.

Establishing a maximum wealth threshold could reduce the excessive asymmetry in wealth distribution. The wealth threshold should be set in such a way that wealthy individuals remain motivated for business activities, while a portion of their surplus capital is directed towards the well-being of the country and its population. This could help reduce crime rates, improve the quality of life, and accelerate the development of less developed regions. Excess surplus capital could also be used to strengthen pension funds.

Countries, as societal hierarchical associative systems, should strive for a more optimal organization of collaboration among their entire populations. The loss of various forms of energy represents a significant deficit for any system. Similar to technical systems, societal systems should also aim for the highest possible energy efficiency. Excess surplus capital, concentrated among a minority of the population, reduces the system's energy efficiency, leading to inefficiency and ultimately harming the country's long-term development.

In this chapter, we have examined the approximate functioning of the state as a societal hierarchical associative system, focusing on its level of legal, social, and technological development. We concluded that this system does not operate optimally in terms of utilizing diverse energies (resources) and that, when facing future challenges (e.g., the greenhouse effect, mass migrations of impoverished populations from other continents, challenges and issues of intelligent robotization), improvements are necessary in the legal, social, and technological domains. If we were to compare the country to an electrical circuit with a light bulb, the bulb would likely glow very dimly and burn out quickly.

Before turning to the study of societal anomalies (e.g., crime, various addictions), which result from the irrational and suboptimal functioning of countries, we will first define concepts such as phenomenon, event, and rule, and illustrate the influence of other people on an individual's thinking. Building on this influence, we will explore mental and emotional inductions, through which data and information are transmitted via communication without direct physical contact, both in the relationship between the state and its population, and among the population itself.

The subsection on mental and emotional inductions is exceptionally important due to the fundamental premise of hierarchology and hierarchography, which posits that societal hierarchical associative systems operate (perhaps predominantly) on the basis of mental and emotional inductions. This can be described as the internal or hidden operation of these systems, driven by biochemical processes and electromagnetic waves.

4.4 Introduction to mental and emotional induction in relation to social hierarchical associative systems

To better understand the concept of mental and emotional induction, we will begin with a brief examination of an edge case of such induction. In nature, induction is a very common phenomenon, appearing in contexts such as electromagnetic waves, genetics, biology, the mixing of air masses, and so on. Before providing a more precise explanation, a general definition will suffice for now. Induction is an interdisciplinary concept that, at its core, refers to the transfer or adoption of a particular state from one entity (e.g., subject or object) to another, based on the influence of an existing field (e.g., a magnetic field), without direct physical contact. Examples include magnetized iron, rubbing a plastic rod against clothing, the spread of information through economic propaganda, communication between neurons that are not directly connected, or long-distance communication among ants.

An example will be presented involving the synthesis of individual and collective thought, which can be understood as a process in which an individual partially adopts collective thinking — a process that occurs without direct physical contact.

4.4.1 Interviews on the definition of concepts such as phenomenon, event, and rule

A total of 32 interviews were conducted with randomly selected individuals, and one additional interview was carried out by the initiator or researcher of this brief study with himself. The participants were encouraged to define the concepts of phenomenon, event, and rule. These definitions were then cross-checked using various lexicons. At the end of the research process, the initiator and interviewer redefined the studied concepts (more on this in the conclusion).

Definitions of the concepts Phenomenon, Event, and Rule by the researcher:

- Phenomenon: Something that is either familiar or unfamiliar to us (e.g., "That’s a completely normal phenomenon.")
- Event: A temporal and spatial orientation within a social network, connected to the organization of both the collective and the individual.
- Rule: A socially standardized assumption through which a person, as a collective being, navigates life.

Definitions by interviewees:

1.

- Phenomenon: Anything you see for the first time, something perceived in the moment.
- Event: Linked to the phenomenon. Something a person experiences.

- Rule: A way of life one should follow, influenced by institutions. A normative guideline.

2.

- Phenomenon: A surprise, something new.
- Event: An experience, a surprise.
- Rule: An obligation.

3.

- Phenomenon: Something invisible.
- Event: An occurrence that you notice and remember.
- Rule: A regulation or law.

4.

- Phenomenon: Something that suddenly appears, a surprise.
- Event: Can be positive or negative.
- Rule: The framework of a game.

5.

- Phenomenon: Natural, unnatural, and human.
- Event: An incident that triggers positive or negative consequences.
- Rule: A question on how to derive a rule from certain guidelines.

6.

- Phenomenon: Sign of illness, meteorites.
- Event: Something positive or negative.
- Rule: The Ten Commandments.

7.

- Phenomenon: Something that seems impossible, yet exists. Something positive.
- Event: Positive or negative; success or failure.
- Rule: Something that is prescribed.

8.

- Phenomenon: A person.
- Event: A broken leg.
- Rule: Earned money.

9.

- Phenomenon: Something that appears at certain intervals and may or may not be defined.
- Event: Something that has happened and been recorded; also, an expectation of what might occur.
- Rule: A specific or appropriate rule should apply to a set of phenomena and events.

10.

- Phenomenon: Eternity, the beginning.
- Event: A fleeting moment.
- Rule: Law, love.

11.

- Phenomenon: A miracle.
- Event: A moment.
- Rule: Law.

12.

- Phenomenon: A moment in cosmic time.
- Event: A moment of fate in the universe.
- Rule: A moment of law in the universe.

13.

- Phenomenon: Depends on your perspective.
- Event: A surprise.
- Rule: Something to be broken.

14.

- Phenomenon: An event that happens in a moment.
- Event: An expectation regarding length or brevity.
- Rule: Laws that must be followed.

15.

- Phenomenon: A consequence of an event.
- Event: All of life combined.
- Rule: A limitation of consciousness.

16.

- Phenomenon: Something you haven't seen before.
- Event: Something you've lived through.
- Rule: Existing in a society.

17.

- Phenomenon: You are a phenomenon.
- Event: You are an event.
- Rule: Something to be studied.

18.

- Phenomenon: A meteorite.
- Event: A meeting.

- Rule: Police matters.
19.
- Phenomenon: The right to define terms in your own way. A dormant emotion that erupts at a given moment.
- Event: The complete consequence of a phenomenon, its outcome depends on chance.
- Rule: A fact confirming a hypothesis. A rule is a natural or unnatural limitation.
20.
- Phenomenon: I don’t know.
- Event: Same as a phenomenon.
- Rule: Law.
21.
- Phenomenon: A drunk person.
- Event: Birth.
- Rule: Be self-critical.
22.
- Phenomenon: A natural phenomenon – games of nature.
- Event: Happy and unfortunate occurrences.
- Rule: Natural rules.
23.
- Phenomenon: Nothing.
- Event: More.
- Rule: Three rules.
24.
- Phenomenon: A person.
- Event: A lifted railroad barrier.
- Rule: Right and left turn signs.
25.
- Phenomenon: Silence.
- Event: In your own space.
- Rule: Walking in one direction, then changing it.
26.
- Phenomenon: Hard to explain... the birth of a child.
- Event: Positive / negative.
- Rule: The golden rule.

27.
- Phenomenon: What we see.
- Event: Something that might happen... a wedding.
- Rule: Something we must follow—or not.
28.
- Phenomenon: Positive or negative.
- Event: A consequence of a phenomenon.
- Rule: You must follow rules so you don't cross the line of the law.
29.
- Phenomenon: A lasting phenomenon.
- Event: A one-time occurrence.
- Rule: Grounded in space, time, and place.
30.
- Phenomenon: The interviewee.
- Event: A divorce.
- Rule: Doesn’t exist.
31.
- Phenomenon: A green-colored siding track.
- Event: Horse racing in the third halftime.
- Rule: A diabetic.
32.
- Phenomenon: Something that captures our attention. That “something” consists of a process and a state. The state then triggers a result, which can be either concrete or abstract.
- Event: A process.
- Rule: A diabetic.

As we can see, the responses to the stimulus terms are extremely diverse. In the following section, we will look at definitions of these terms from lexicons and dictionaries.

Wahrig German Dictionary
- Phenomenon: In relation to an object, it refers to the outward visible form, appearance, dream image, vision, spirit, apparition; something that suddenly becomes visible; something that stands out; when a person suddenly becomes receptive; a striking personality; a strongly built person; a charming girl; a well-known person; someone who becomes effective.

- Event: Something that happens, an incident, a grand adventure. For example: The performance was magnificent, a joyful occasion, a happy event, the birth of a child, a sad event, it happened a long time ago...
- Rule:
  1. A guideline, regulation, something generally accepted, a norm.
  2. In art: completely proper, very diligent and clean. In orthography, this would mean placing appropriate marks in appropriate places—rules of the game.
  3. Establishing new rules, adhering to rules, breaking rules.

Philosophical Terminology and Repertoire (Dr. Vlado Sruk)
- Phenomenon:
  - In a broader philosophical sense: Anything consciously accepted, experienced.
  - In a narrower sense: Perceived through the senses. Already in Greek philosophy, distinguishing between phenomenon and essence was very important. Kant differentiated between phenomenon (thing-for-us, the phenomenon) and essence (thing-in-itself, the noumenon, what can be understood or conceived). The phenomenon is knowable, while the essence is not.
  - For the theory of reflection, the phenomenon is a reflection of actual reality. Phenomenality is especially important in empiricist and sensualist epistemological orientations (as opposed to rationalists and the world of reason).
- Event: Everything in nature and society is said to happen according to purposes inherent in the processes themselves.
- Rule: Logical rules define the ways in which statements are derived from others. We talk about rules whenever we regulate an area with specific guidelines (e.g., grammatical rules, mathematical rules, game rules).
  - A norm is a rule, principle, guideline, standard—a prescribed model or the amount of work that should be done in a certain time.
  - In philosophy, we mainly deal with ethical, aesthetic, and logical norms, which is why ethics, aesthetics, and logic are called normative disciplines.
  - In empirical disciplines, a norm is a statement or finding about what actually happens and what will happen based on identified regularities. Thus, a norm is an experiential pattern, model, or standard (criteria for behavior based on a set goal or command).

Duden Dictionary
- Phenomenon: We expect a person, and then they appear (e.g., He did not show up at work). The coast appeared on the horizon. His novel will be published in the fall. His explanation seems completely incomprehensible to me.

- Event: The otherwise normal course of the day is interrupted—for example: the birth of a child, a historical event (e.g., the agreement between the PLO and Israel).
- Rule: An agreement or regulation for handling hazardous materials; rules of behavior in road traffic; procedural rules; justice always prevails; grammar; diligence at work. Things usually turn out differently than we expect.

Sprach Brockhaus

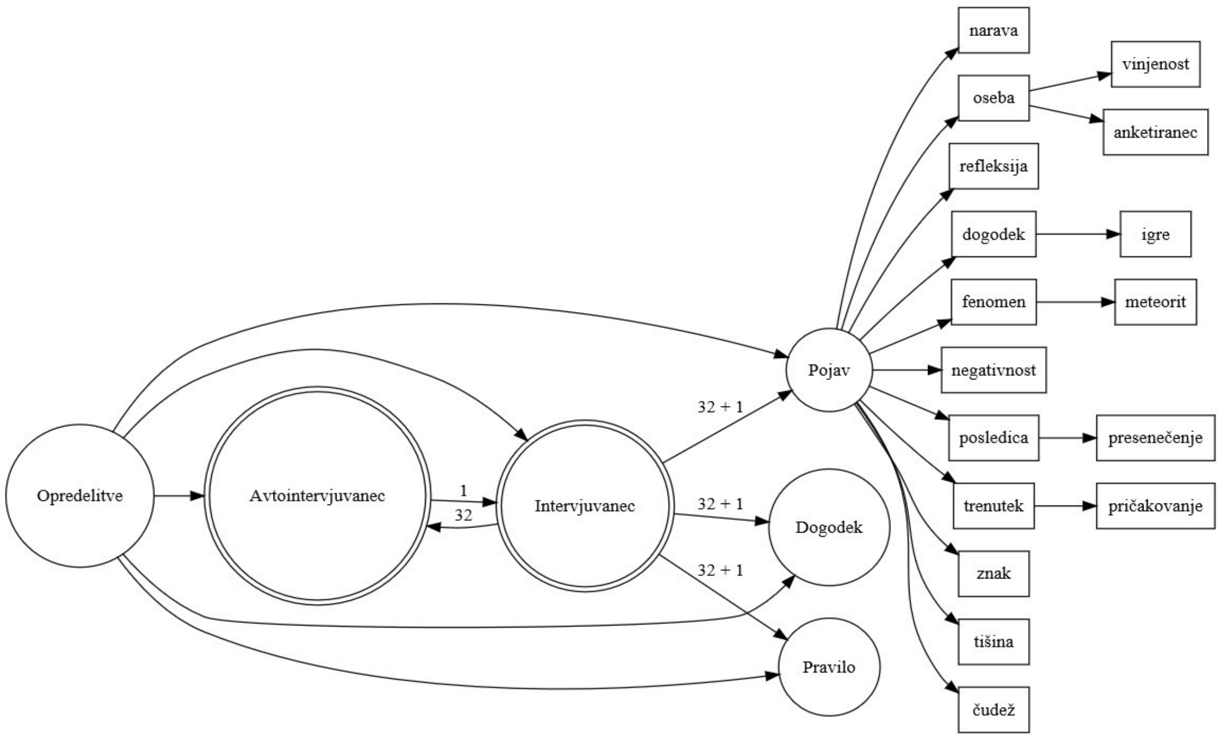
- Phenomenon: Something visible; an insight into the outward appearance of a thing; publication; entering a space… Everything that we come to know and learn.
- Event: An incident, joyful event, he was met by death, he was overtaken.
- Rule: Guideline, norm, regulation. For example: menstruation occurs in a regular cycle; the rules of a particular community.

Bartel Dictionary

- Phenomenon: A display, a face appears, announcement.
- Event: Something happens, something is compared, they found a sample skull—a Neanderthal; a coincidence or chance.
- Rule: Usually… (e.g., I always meet my neighbor in the store), commonly, regulation (e.g., if the pH in the stomach is low, you can take baking soda).

In the continuation, the definitions from the interviews and from the lexicons/dictionaries were stored in a `.txt` file and imported into the software tool AntConc. Within AntConc, N-gram clusters were identified. N-gram clustering is a common technique in corpus linguistics. The basic principle of an N-gram cluster is that a text can be broken down into phonemes, morphemes, words, etc., which carry greater meaning within the context of the entire text.

In this case, the N-gram clusters were identified for the terms phenomenon, event, and rule. The next step was to perform a visualization using the software tool Graphviz, where directed graphs (digraphs) were drawn for the aforementioned concepts. The first term to be examined is phenomenon.



4.4.1.2 Figure 166: Directed graph for the concept "Phenomenon" based on N-gram clustering

Figure 166 shows a directed graph (digraph) for the concept of phenomenon, based on an N-gram cluster. The most influential words in the entire text related to the concept phenomenon include: nature, person (e.g., intoxicated person, respondent), reflection, event (e.g., games), phenomenon (e.g., meteorite), negativity, consequence (e.g., surprise), moment (e.g., expectation), sign, silence, and miracle. The approach used here allows us to highlight how the original definition of the concept phenomenon evolved during the interview process (see the self-interviewee).

To what extent, then, did the definitions provided by interviewees and various lexicons or dictionaries influence the revised definition formulated by the interviewer, who also takes on the role of the researcher? It is useful to compare the initial definition with the final one for the concept phenomenon.

Initial Definition:

A phenomenon is something we either know or is unfamiliar to us.

Final Definition:

A phenomenon is a consequence of a natural, social, or even a natural-social process that we evaluate based on certain laws or principles valid in nature and society. If we do not know any of the laws related to a particular phenomenon, it is foreign to us because we do not understand its causal background.

We can observe that the initial definition—based on a brief process of social communication and intellectual engagement (examining definitions from lexicons and dictionaries)—has been significantly developed and thus transformed to a considerable degree. Despite the involvement of mental and social processes, we primarily attribute natural characteristics to the phenomenon.

In the case of a phenomenon, we are never actively present as participants; rather, we take on the role of more or less distant observers. Most of the time, a phenomenon does not take the form of a person, although there are exceptions that, at their core, represent analogies to the essential meaning of the phenomenon (e.g., a person appeared like a flash, a large crowd appeared on the horizon).

Our perception of a particular phenomenon strongly depends on our experiences, expectations, and the length of the retention time (i.e., from the initial situation where we don't expect any change, to the final situation where an unexpected change occurs). An unexpected change in the situation, combined with a short retention time, usually triggers a feeling of surprise (e.g., the arrival of someone we haven't seen in years; the sudden opening of a classroom door when no one is there; a sudden weather shift from sunny to cloudy and stormy).

There is a fine line between the concepts of phenomenon and event, as events can also surprise us. The difference lies in the fact that events usually have broader content, a longer retention time, and establish certain contextual or meaningful positions. People who appear unexpectedly are not considered events, but rather phenomena. If such a person performs an action that triggers an emotional response, a nearby observer will interpret it as an event (pleasant, unpleasant, or neutral). The same applies to natural phenomena such as lightning and thunder. A distant observer perceives them as an unpleasant phenomenon, but if the lightning causes damage, the observer becomes a victim of the event.

A phenomenon is usually not attributed with long duration, unless it recurs in different situations. In such cases, we speak of a recurring condition that stems from the phenomenon, but due to the extended retention time, it no longer provokes surprise.

Phenomena can be associated with symbols or symbolic messages. A good example is film, where weather phenomena often carry symbolic value and represent a central theme of the story.

The most important aspect in understanding the concept of phenomenon is recognizing the underlying processes, which we often do not know at the moment we perceive the effect. Every phenomenon is the result of a certain process, even if it seems to appear suddenly. On an everyday level, we don't deal with the causes; we perceive the phenomenon as a surprising moment. On a philosophical level, however, science seeks to understand the phenomenon through causal chains and processes.

The concept of phenomenon can conceal important facts or justify the inability to understand causes. Because of this, it can guide individuals toward a phenomenological focus—both mentally and emotionally. We often emphasize that alcoholism is a negative social phenomenon. But when this alcoholism suddenly expands in scope, we quickly say that this negative social phenomenon has spread so widely it threatens a large portion of the human population. This is one of many examples that show how real facts and causes are hidden behind a term such as phenomenon. When we equate alcoholism with a phenomenon, we do so based on findings that surprise us and are more a result of our perception—arising from our senses and our ability to interpret them.

We are well aware that alcoholism is not the result of a single moment, but stems from long periods of diverse cognitive and social processes. Thus, for alcoholism, criminality, negative social stress, inflation, and similar occurrences, it is not appropriate to speak of phenomena, but rather of entropic sociological movements. The concept of phenomenon often serves to fulfill encoded constructs that act as masks for intentional or unintentional ignorance. This concept, much like the concept of fate, often simplifies complex backgrounds.

When we perceive a specific natural phenomenon, we are in fact observing the current state of a particular natural process, which we evaluate based on whether it is familiar to us or not.

From a psychological perspective, a phenomenon is the result of communication between our senses and the conscious and subconscious evaluation of these perceptions. From a sociological perspective, a phenomenon results from the interaction between our senses and the individual-collective receptiveness to that phenomenon. The hierarchical aspect of the concept of phenomenon takes into account both psychological and sociological viewpoints, and additionally includes the natural science perspective, which seeks to better understand the connections and hierarchies between different aspects under the influence of varying situations, causes, and conditions.

The concept of phenomenon presents a semantic and logical challenge because it is extremely broad and often overly expansive. It is used across many scientific disciplines, as well as in popular and mass media communication.

By examining both the original and the revised definitions, we can see that the enhanced version includes elements of the original—which is not surprising. This is the result of a dialogue between the individual and the collective, in which poly-meaning consciousness communicated with mono-meaning consciousness, thereby expanding and enriching it. It represents a dialogical process between the individual, the collective, and source materials (lexicons, dictionaries) that hold collective authority.[53] Both monosum consciousness and polisum consciousness are present within

53 The concepts of monosum (literal translation: "one self") and polisum (literal translation: "multiple selves") are new and do not have an established tradition in scientific research.

an individual's awareness. Humans are by nature largely open to the world, and therefore, consciously or unconsciously, constantly communicate with their environment. Polisum consciousness represents the voice of the multitude within the consciousness and subconsciousness of an individual, while the integrity of the personality is generally maintained (although there are exceptions, such as in cases of schizophrenia).

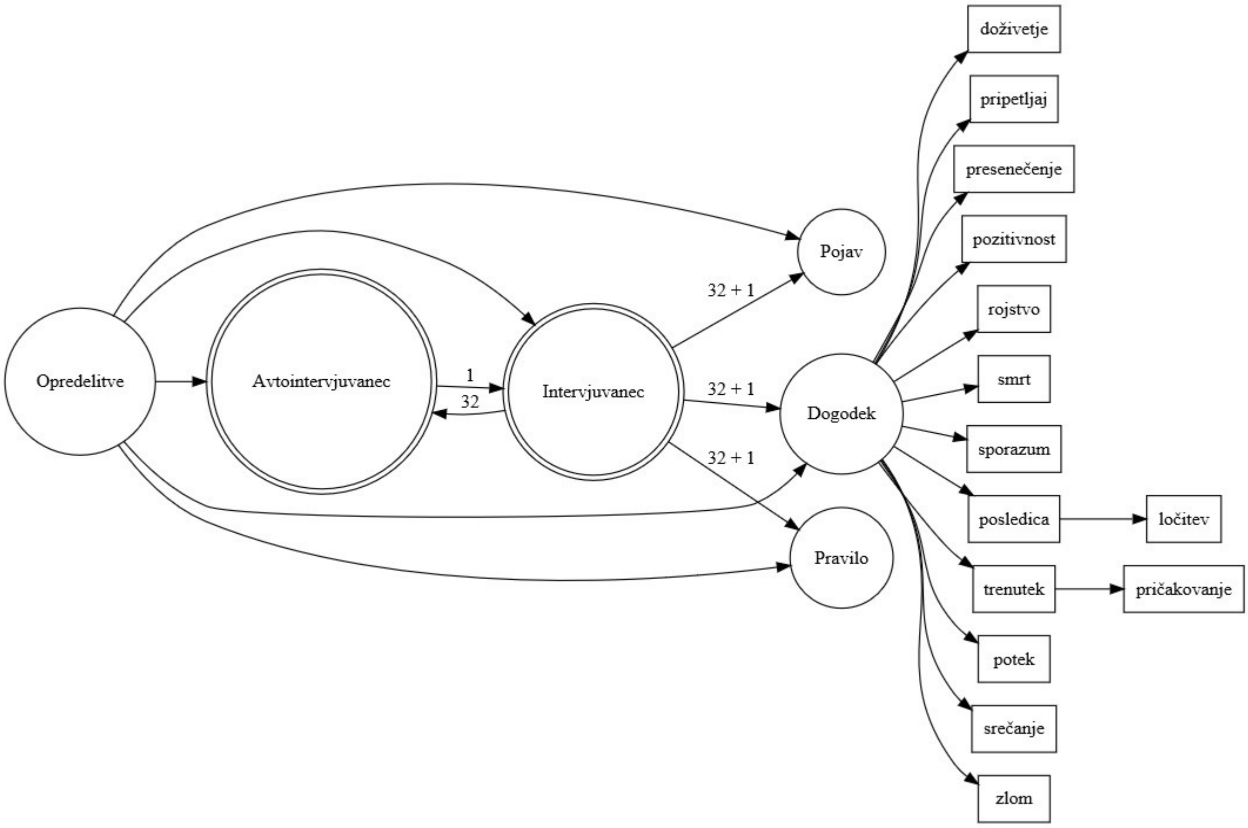
The researcher, who initiated the interviews, considered not only their own opinion but also those of the interviewees and the reference literature. These data were processed over an extended period and, in the final phase, used to formulate a new and improved definition. During the interview process, the researcher had verbal contact with 32 interviewees. However, during the processing and analysis of the provided data, there was no direct physical interaction. Based on this, we can assume that at least partial mental—and to some extent emotional—induction took place.

People often convey more without words than with them. What matters is not only nonverbal communication but also emotional charge, tension, and relaxation. Figure 165 clearly illustrates the stronger influence of certain words within the entire text, many of which can be observed directly or indirectly in the new definition.

Communication between monosum and polisum consciousness generally takes place to the benefit of the individual. This process strengthens the personality and guides the person along a more or less appropriate path.

As we have seen, the concept of phenomenon is extremely broad and deserves thorough research across the natural sciences, social sciences, and humanities. The term phenomenon can enrich or diminish the essence—or remain neutral toward it. A phenomenon is largely independent of our will but highly dependent on our attention, which must be triggered by a sufficiently strong stimulus. This stimulus causes changes in blood circulation and the central nervous system, resulting in a sense of surprise. From the perspective of its effect, a phenomenon is a highly situational concept with a short-lived positional tendency.

To further illuminate the concept of mental and emotional induction, we will next examine the concept of event in a similar manner as we did with phenomenon.



4.4.1.3 Figure 167: Digraph of the concept Event based on an N-gram cluster

Figure 167 shows a digraph representing the concept event based on an N-gram cluster. The most influential words from the entire text in relation to the concept event include: experience, incident, surprise, positivity, birth, death, agreement, consequence (e.g., divorce), moment (e.g., anticipation), course, encounter, and collapse. The same analytical approach used for the concept phenomenon will be applied here. Let's first examine both definitions:

Original Definition:

An event is a temporal and spatial orientation within the social network, connected to the organization of both the collective and the individual.

Final Definition:

An event is the result of a social and natural process, in which specific conditions emerge in space and time, allowing us to coordinate our thoughts and actions within the social network.

The original definition is limited exclusively to the social aspect, while the final definition—developed through the processing of data gathered from interviewees and literature—also incorporates the natural dimension. Nevertheless, it can be argued that people living in larger urban communities tend to perceive the concept of an event primarily through the lens of social dynamics. There is no event that is entirely random in nature, even if it often appears that way. This perception usually arises when we are unaware of the background of an apparent event, and thus, it surprises us. The concept of chance is, in reality, often an excuse for our lack of understanding regarding certain content, developments, or processes. In every case, it reflects situations that interpreters fail to grasp due to insufficient experience.

Unlike the concept phenomenon, the concept event is more positionally oriented, typically formed on the basis of a larger number of situations. An event can be seen as a waypoint in an ongoing process, which has a specific trajectory and direction. The term event designates a social and/or natural process that may or may not be investigated.

We don’t usually assign much importance to everyday events because we are quite used to them—so much so that we often fail to notice small changes. When these small changes accumulate into larger shifts, they can eventually catch us by surprise. From this perspective, we can infer that special events arise from escalated changes in everyday events.

A good example of this claim is a person who has been playing the lottery regularly for many years. After five years of playing, they win an exceptionally large cash prize. Before the win, their life involved going to work, raising children, watching television, and playing the lottery. After the win, however, their lifestyle changed significantly—they quit their job, divorced their spouse, and began living in hotels. Over time, they became increasingly dependent on alcohol. One day, heavily intoxicated, they were driving and failed to see a pedestrian, resulting in a fatal accident. This represents a negative scenario.

Positive scenarios following a large monetary gain are also possible, but they may seem somewhat less likely.

The roots of this unfortunate event stem from so-called everyday, ordinary occurrences. After receiving the monetary gain, the described individual did change their lifestyle, but in doing so, they adopted a certain established negative behavioral pattern, thereby recreating the usual everyday situations that ultimately led to the unfortunate or catastrophic event.

Nothing happens suddenly. No event is merely the result of a single moment, as every event is preceded by processes. The difference lies in whether these processes unfold with greater or lesser dynamics, making them more or less complex. Events can relate to the past, present, or future. In an event, an individual can take on the role of an active participant, a passive observer, or remain neutral. They may be an actor or a spectator.

Interviewees often expressed the opinion that events are either positive or negative. Some were more specific and chose one of these two options (e.g., marriage, divorce). Events are frequently subjectively colored because perceptions of them are mostly emotionally influenced.

Take, for example, the eruption of an active volcano in Sicily (Etna), whose glowing lava threatens nearby residents. Although people are not actively involved in this event, they involuntarily think about how terrible it must be for the locals. They might reassure themselves that they are lucky and reflect on how they would never want to visit Sicily under such circumstances. An event consists of situations or arises due to various situations that can provide it with a very stable position. For instance, consider the event that occurred in Hiroshima in 1945. This event will maintain its solid position for a long time—it is considered one of the so-called historical events.

Individual events are significant and hold a pronounced meaning for individuals as they help them orient themselves further in life. If the event was positive, subsequent decisions made by the person in similar situations will likely follow the same pattern. Conversely, if it was negative, the individual will analyze the situation, causes, effects, etc., and attempt to find appropriate solutions.

In addition to individual events, there are collective events that can be divided into those occurring in a narrower or broader sense. Collective events in a narrower sense include family, work-related, club-related, and friendship events. Collective events in a broader sense may be political, economic, national, historical, or cultural (e.g., national holidays or victories by national teams).

Through these events, people orient themselves within the social network since events often act as a compass for belonging and personal integrity. Events are closely tied to societal organization and personal identity. Similar to phenomena, events can also carry communicative or symbolic value. Every event encompasses both known and unknown facts. Symbols can emerge as results of rules, phenomena, and events.

Events can also be automatisms—things we do unconsciously—that hold significant meaning for others. Some events may evolve into other events over time; meanwhile, evident events tend to be highly persistent and remain in our memory as long as we remain aware of our existence. Every evident event contains a wealth of data and information. An event can serve as a crystallization of phenomena, rules, symbols, human organization—marking states within specific communities—and as temporal and spatial projections of individuals or collectives.

Unfortunately, we are unable to decode all encoded information, as it is too vast and interwoven. An event that becomes evidently significant gradually intensifies before its occurrence, until it reaches a peak. The emergence of this peak depends on the individual and collective attention given to situations, which in a certain way condense into an evident event. This event represents a temporal, spatial, and organizational position and is connected to the organization of nature, which enables the survival of the human species.

Individuals and collectives constantly orient themselves through events, which organize incomprehensible situations into more understandable wholes. Positive or negative social phenomena can arise from events, especially when we are unaware of the background of illegal or concealed occurrences.

Events are largely dependent on the functioning of the brain, which governs four key functions: memory, movement or coordination, imagination, and logic. Without external stimuli, these functions are mostly directed inward (e.g., in autism or catatonic schizophrenia). Humans are generally open by nature and interact with the external world through external stimuli, aligning these interactions with their internal physiological processes.

To maintain this openness, our brains and senses must enable the reception and processing of stimuli that are crucial for the survival of both individuals and collectives. Events can encompass the creation of good and evil. This raises the question: “Do good and evil not coexist in a symbiosis, where sometimes one prevails over the other?”

What is good, and what is evil? From a human perspective, the meaning of good lies in developing and maintaining a purposeful organization of the human species, thereby contributing to positive outcomes for society, individuals, and the natural environment. Evil, from a human perspective, expresses opposing tendencies and contributes to negative outcomes for these same aspects.

Optimal organization of human groups entails their coordinated movement within societal structures and an appropriate and constructive relationship with the natural environment. In short, from a human standpoint, good is defined by actions that benefit humanity as a species, society as a whole, and the natural world. Anything that harms these can be interpreted as bad or evil.

There are many processes in nature that humans evaluate as evil because they cause immense harm. However, we do not possess the complete cosmic picture, meaning our subjective interpretation is far removed from the greater cosmic or divine truth. We cannot comprehend why so many negative events occur in both society and nature. For example, consider a serial killer who takes 300 lives—a deed we label as great evil. From a broader cosmic perspective, could we hypothesize that such criminal events were necessary for the greater cosmic organism to function more effectively and contribute to a proportional balance within humanity? In essence, we do not know the underlying processes occurring at higher or lower levels of universal existence.

Good and evil are constructs that help evaluate the outcomes of events on the mesocosmic level of human existence, thereby contributing to the better orientation and organization of human societies. Anything that harms the individual, society, or the natural environment can be labeled as evil from a human perspective.

This ignorance is encountered not only concerning the causes and effects of negative and positive events, but also regarding numerous inventions that can cause both positive and negative changes in the development of the human species. A little over 120 years ago, humans created machines, devices, etc., whose operating principle is, to a considerable extent, similar to the functioning of certain segments within the human organism (e.g., the transmission of information in the brain operates in a manner similar to a telephone exchange).[54] A little over 120 years ago, scientists knew very little about the workings of the brain. Where could humans have gotten the idea for a telephone exchange? One could answer that this idea was present in the brain. This very realization can lead us to the assumption that humans perceive not only external events but internal ones as well; however, we are often not fully aware of the latter because humans are, more or less, oriented towards openness to the world.

Our internal senses effectively perceive our brain and its functioning, but the external senses are more developed, or rather, more activated. This is necessary for monitoring the external environment and contributes to greater chances for the survival of the human species. Nevertheless, a dialogue often occurs between the perception of our inner self and our external environment. We are mostly unaware of these dialogues or pictorial exchanges. We can imagine two valves, one of which is more open than the other. Let's imagine two radiators connected to each other. The first radiator represents our external environment, and the second represents our internal one. Both radiators occupy their own space and radiate their heat into a common space, which could be compared to our brain. The valve on the first radiator is more open, representing the relationship between the external senses and the external environment. Influences from the external environment convey a vast amount of information to our brain. The valve on the second radiator is less open, representing the relationship between our internal senses and the internal environment. Influences from the internal environment are less pronounced due to the pressure from the external environment.

Despite the strong prevalence of world-openness, we can assert that humans also instinctively close themselves off from the external world, which makes us somewhat world-closed in nature. Based on what has been written, we can conclude that events are often influenced by motives, the intensity of our actions, and the balance between world-openness and closedness. World-openness and closedness are generally regulated so that neither hyper-world-openness nor autism occurs.

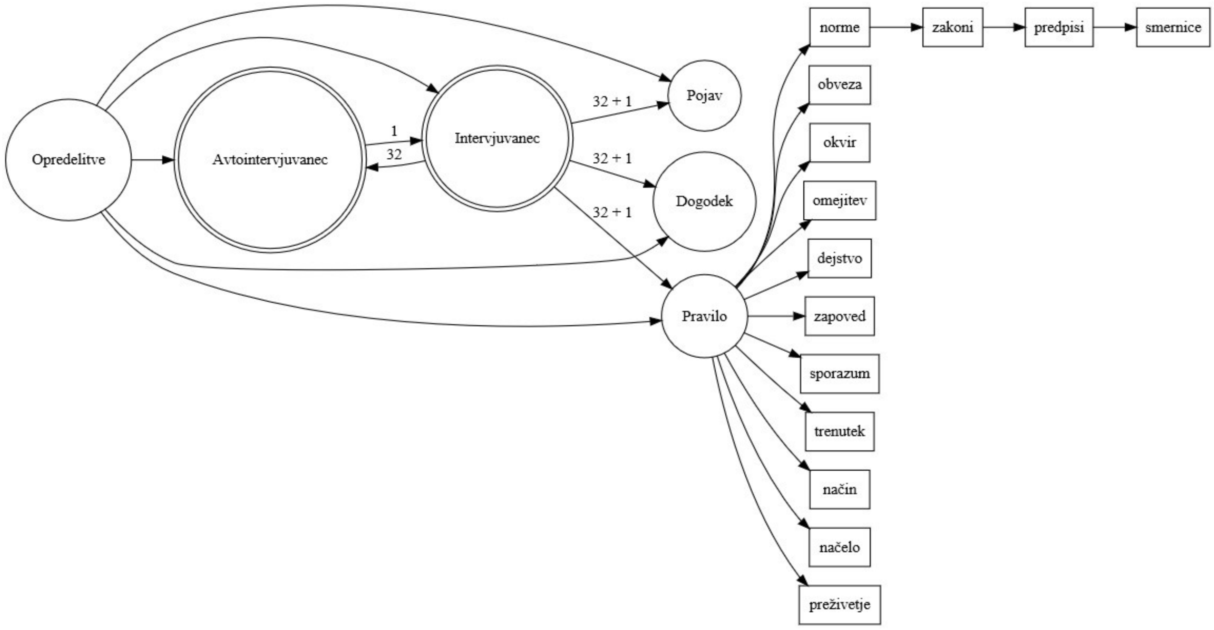
The extent to which a person is directed inward, towards internal events, or outward, towards external ones, is determined precisely by the previously mentioned balance. Whether we could view the condition autism as another modification of the senses, trending towards excessive monitoring of the internal environment and the consequent predominance of internal senses over external ones, is a difficult question that will surely remain open for a long time. The same applies to the question of whether autistic individuals actually monitor internal processes—and consequently, perhaps even beings at the micro-level—with their internal senses. Certain abilities of some autistic individuals are more than astonishing and surprising (Savant syndrome).

54 Saparina, J. (1965). *Kibernetika v našem telesu*. Ljubljana: Cankarjeva založba.

When speaking of events, it is necessary to emphasize our memory, in which numerous pieces of data are stored. Without memory, there are no evident events, nor can we remember a single rule; indeed, without memory, our human species would likely have become extinct long ago. In the previously cited work by Jelena Saparina, a very interesting question was posed: "How can the brain preserve traces of once-excited nerve connections for years and years?" There is evidence that nerve cells are special tiny magnets, acting like a kind of tape recorder that records all signals from our internal environment and also erases them if they are not essential. This special kind of tape recorder can rewind or fast-forward. Ancient signals leave traces, but why do we tend to forget them? Most likely, these old signals are covered by current ones. Therefore, if we wish to access forgotten information, we must remove the upper layer to rediscover their traces and thus their meaning, of which we have long been unaware. A very interesting experiment showed how we can revive already forgotten events: A weak electrical current was passed through the temple using two electrodes and a power source. The outcome of this procedure is astonishing, as long-forgotten events appear before the subjects' eyes in all their detail.

In these few sentences, we have touched upon memory that is oriented towards the past. However, we also know of memory that directs us towards the future. This future-oriented memory is the "acceptor of action," which is a unique "fakir for time." The acceptor of action anticipates in advance which movements will be necessary in a future situation, but this prediction applies only to a specific, concrete situation (e.g., avoiding an obstacle). Without memory, there is no orientation, neither in the social nor the natural environment. Actions are active participants in events; we can be actively present in them or merely observers, while memory itself has the task of leading us, through actions or without them, to a set goal. Actions can offload memory space, empty it, by temporarily binding memory units needed for a specific action. Strong evidence for this claim comes from an experiment conducted with ten volunteers who were confined to small cells for ten days without new sources of visual, auditory, or tactile information. In these cells, they merely rested passively, which had detrimental effects on the functioning of their nervous systems. In this isolation, they began to show strong symptoms of hallucinations, depression, and other signs of mental illness. Events are therefore also necessary from the perspective of human mental health.

We have again recognized the significant influence of the relatively brief social communication process and established literature, viewed through the prism of defining the concept of 'event'. The final definition was the result of the conscious and unconscious influence of collective thinking on the mindset of the individual—or in this case, the researcher. This partial mental and/or emotional induction caused a merging of the collective voice with the individual voice, involving the conscious and unconscious adoption of thoughts and emotions without direct physical contact with interviewees or the authors of the established reference literature. Figure 167, in the form of a digraph, illustrated influential words from the entire text. During further processing and data analysis by the researcher, these words were transformed into general codes, which subsequently served as a starting point for an expanded conceptual tree structure. These general codes essentially broadened the conceptual tree to include content that is hierarchically and associatively dependent on them. Based on the expanded conceptual tree, the researcher also broadened both the definition and the entire description of the concept of an event. Can we essentially report on induced content elements that caused the researcher to consciously and unconsciously adopt thoughts and perhaps even certain emotional nuances? In the following section, we will perform another demonstration of mental/emotional induction regarding the concept of a rule.



4.4.1.4 Figure 168: Digraph for the concept 'rule' based on an Ngram cluster

Figure 168 shows the digraph for the concept 'rule' based on an Ngram cluster. The most influential words from the entire text for the concept 'rule' are norms (laws, regulations, guidelines), obligation, framework, limitation, fact, command, agreement, moment, way, principle, and survival. The same approach was used again as with the other two examined concepts. Let's first look at both definitions:

Original definition: A rule is a social, standardized assumption through which a human being, as a collective entity, orients themselves through life.

Final definition: A rule can be an individual and/or collectively standardized provision that originated from acquired experiences from natural and social processes, phenomena, and events,

and helps the human species in the organization of societies, thereby enabling a greater possibility for organized survival.
Again, we can observe that the definition has been considerably expanded and upgraded. The original definition only referred to a social connotation, while the upgraded definition also considers natural circumstances. A very important change can be seen in the addition of acquired experiences, which in any case influence the establishment of any experiential rules. Most people live in larger or smaller communities where collective rules also apply to every individual (e.g., rules of language, work rules, friendship rules, family rules, house rules, rules of the game).
If we go back to the time when humans first emerged, it must be said that the first rules were the 'rules of the stronger'. In this symbiosis, the stronger and weaker individuals further solidified certain rules. The emergence of the rules of the human species dates back as far as when humans began to develop in their evolution. Original rules, which certainly still exist today, are a true outcome of our natural instinct. From what has been written so far, we can conclude that behind the rules of every kind lies a more or less lengthy process, as rules are the result of natural and social processes. As an example, we can give the influence of a natural phenomenon on the establishment of a very important rule for the survival of a certain individual.
A person is standing under a large oak tree. Lightning and thunder frighten nearby animals and people. From experience, we know very well that lightning tends to strike any large tree, and therefore in this case it is not advisable to stand under an oak tree. A natural phenomenon such as lightning, which is caused by a natural process (discharge of clouds – a consequence of electrification), essentially co-created a very important experiential rule for humans, which reads: 'Never stand under a tree when it is thundering and lightning! Move as far away from trees as possible!' Most people know this rule very well, and therefore they will rarely stand under a tree.
As an example of a rule that originated from social processes and influenced human thought and behavior, we can cite the following case: A person enters a store, and an unwritten social rule dictates that they should greet everyone present in the store. This unwritten rule is important to such an extent that the salesperson is aware of the arrival of a new customer who is polite and well-mannered, which implies that they are worthy of attentive service. The salesperson, who is in the role of selling products and/or services, should return the greeting to the new customer. If the salesperson is busy with other customers, they do not need to return the greeting, and this impoliteness can be considered irrelevant. Once the salesperson has attended to all other customers, it is their duty to greet the new customer and ask about their needs. This general rule is actually in use everywhere, although it is losing importance in some places (e.g., in department stores). With the help of this rule, which has a long historical background, we also orient ourselves in human

communities. Even in the times of tribal communities, a greeting was a sign of non-aggression and willingness to communicate. Rules arose from phenomena and events that became established based on experience. Once the first rules were established and implemented, humans used them to evaluate individual phenomena and events and assign them a substantive supposition. This is still done today, mostly without realizing that all existing rules have their roots in past events and phenomena. People often evaluate these very events and phenomena with rules that were essentially created under the influence of those events and phenomena.

When we evaluate certain phenomena and events with some collective rules, we essentially create certain constants. A constant within a certain social and/or natural dynamic means that it is relatively independent of time and changes within a given system. However, constants can change, which can have a particularly negative impact on predicting the future. In the past, weather forecasting had considerable difficulties in more accurately determining weather conditions. This deficiency has been largely and effectively eliminated today. Weather forecasts are now very accurate and effective. The most important reason for today's successful weather forecasting lies, on the one hand, in improved methods and more modern equipment, and on the other hand, meteorologists have observed that certain constants in determining weather conditions change in a relatively short period of time. The same applies to written laws, where it is necessary to actively monitor and analyze phenomena and events so that laws are adapted to new situations.

Changes in certain constants can also be observed in economic systems, where unpredictable dynamics can occur, causing economic crises. Despite the fact that certain social patterns of behavior repeat themselves over longer periods, they still need to be constantly monitored and analyzed. In cases of predicting the future, mathematical formulas can be too narrow in scope, insufficiently empirical, and as a model, they mostly capture only a moment that may never be repeated.

People in social systems form certain symbioses, depending on which they move and think. The first symbiosis could be called the symbiosis between nature and people. Under this symbiosis, we understand relationships such as: Sun – people, Earth – people, atmosphere – people, animals – people, plants – people, water – people, minerals – people, etc. The second symbiosis is certainly the symbiosis between people – people, which is strongly influenced by collective rules. The third symbiosis is the individual in relation to themselves. This is influenced by both individual and collective rules.

It would be beneficial to examine more closely the established codex rules that influence social relationships within social hierarchical associative systems.[55] Different organized social strata also

55 Malinovski, B. (1970). *Naučna teorija kulture*. Beograd: Zodijak.

have different prevailing codex rules, which are primarily dictated by people from the extreme hierarchical complex and advancement group. A very important factor that influences our thinking and consequently our rules is communication. The well-known American sociologist Stuart Chase, in his most famous work, listed nine perspectives on the study of communication:[56]

1. Individual – poor communication as a psychiatric problem.
2. Dynamic groups – communication within groups where individuals know each other well.
3. Communication between subordinates and superiors – this should be relatively bidirectional.
4. Advertising as communication – advertising should positively influence people.
5. Propaganda analysis – extract negative propaganda techniques and replace them with positive ones.
6. Rumor analysis – false or distorted rumors need to be exposed. If this cannot be proven, countermeasures need to be taken – positive rumors.
7. Gathering public opinion as an aid in professional communication.
8. Mass media – they should be used to create positive communication.
9. Semantics – the study of the relationships between signs and what is signified, and people's reactions to these signs.

Stuart Chase essentially recommended or pointed out nine communication rules that would improve the communication process between society and the individual. Mass media, in particular, can do a great deal to create a more optimistic mood among the population by encouraging greater creativity and a positive orientation.

Figure 168 illustrates, similarly to the phenomenon and event, the significant influence of certain words from the entire text, which contributed to the researcher adopting these mental charges from interviewees and authors of established reference literature without direct physical contact. The result of this partial mental/emotional induction was an expanded and improved definition, which contributed to a comprehensive description of the concept of a rule.

Phenomena, events, and rules are essentially important carriers of information that we receive from the external and internal environment. In the following section, we will undertake a more detailed explanation of the complex concept of mental/emotional induction, based on the principle of which social hierarchical associative systems are believed to operate covertly.

56 Chase, S. (1951). *Die Wissenschaft vom Menschen*. Stuttgart: Humboldt Verlag.

4.4.2 Mental and/or emotional induction

The term 'mental induction' is not frequently mentioned in global scientific literature. While there are online contributions that report on mental induction, these can be better regarded as popular science articles that touch upon fringe sciences.[57]

More scientific articles can be found using two key concepts: mood induction and emotional induction.[58] A similar concept to mental induction can be found in articles in the fields of computer science and informatics, which use theories from cognitive psychology and behavioral sciences as their substantive background.[59] These types of articles essentially deal with teaching computers to recognize users' thought patterns through an interface in the form of electrodes. Acquisitions of this kind are also used in computer games. As we can observe, the scientific literature in the fields of mental, mood, and emotional induction is relatively scarce, which mainly means that we will have to rely on experiences or examples from everyday life. Despite the relatively small number of bibliographic records in the field of mood induction, a content analysis will be performed later based on the titles of works and journals, with the aim of determining the main substantive emphases of scientific and professional works.

It will also be necessary to distinguish between the concept of mental projection, established in psychoanalysis, and mental induction. Mental projection (to discard, to get rid of) fundamentally means, from a psychoanalytic perspective, that a certain individual attributes positive and/or especially negative characteristics to other individuals with the aim of positively and/or especially negatively influencing them in order to get rid of their own problems. In short, the concept of mental projection is more related to individuals, where it can involve psychological manipulation with the aim of obtaining psychological, positional, or material benefits.

A somewhat related concept, mental induction (to insert, to embed), refers to the transfer or embedding of certain moods, emotions, and especially mental content from one individual to another without direct physical contact. This can be done with various goals in mind, such as psychological and/or social manipulation of an individual and/or a group to obtain psychological, positional, and material benefits, positively influencing an individual and/or a group, etc. Given the above, the essential difference between mental projection and mental induction should be noted. In

57 Atkinson, W. W. (2010). *Practical mental influence*. El. izd. Hollister: Yogebooks.

58 Cranston, S. M. (2013). *Effects of mood induction, thought-action fusion beliefs, and coping strategies on intrusive thoughts : master thesis*. Ohio: College of Arts and Sciences
Cyr, D. G. A. (2016). *The influence of personality traits on mood : dissertation*. Thunderbay: Lakehead University.
Fusito, L. M. and Juliano, L. M. (2009). Depression moderates smoking behavior in response to a sad mood induction. *Psychology of Addictive Behaviors*, Vol. 23, No. 3, str. 546-551.
Borges, L. M. (2015). An experimental examination of the interaction between mood induction task and personality psychopathology on state emotion dysregulation. *Behavioral Sciences*, Vol. 5, No. 1, str. 70-92.

59 Jantke, K. P. and Drefahl, S. (2016). *Theory of mind modeling and induction : Ausdrucksfähigkeit und Reichweite*. Weimar: Adisy.

every respect, mental projection is more noticeable than mental induction, which operates very covertly and is only observable with a perceptive mind.

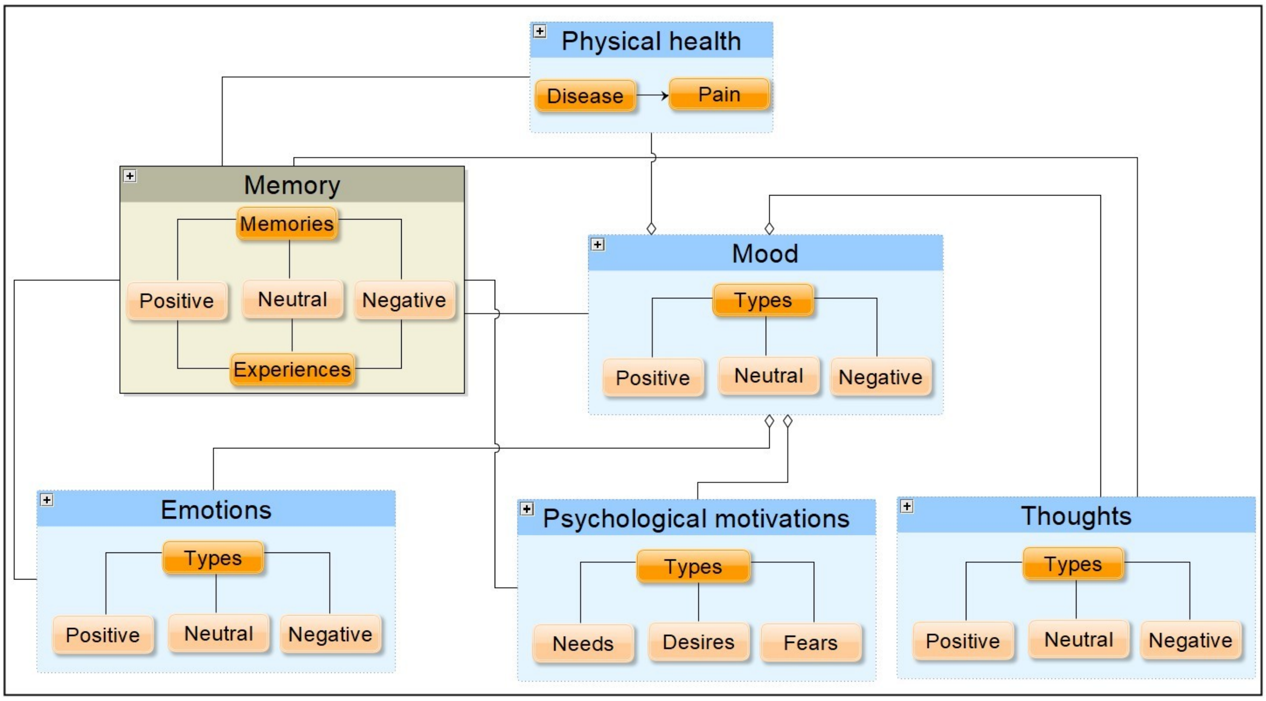
Moreover, mental induction is not just about the psychoanalytic aspect, but also other aspects such as the sociological aspect (e.g., the spread of rumors), the neurological aspect (e.g., neural communication of thoughts), the economic aspect, the political aspect (e.g., economic propaganda, political propaganda), the artistic aspect supported by mass media (e.g., feature films, series, novels), etc. Before tackling the extremely complex concept of mental induction, it would be sensible to first examine mood in connection with induction (mood induction).

4.4.2.1 Mood and induction

Basically, we recognize two types of mood induction, which are often intertwined. The first type, mood induction, is related to the psychological climate of a particular individual, involving the transfer or embedding of a certain mood state from one individual to another without direct physical contact. The second type refers to the sociological climate of smaller, larger, and vast groups of people (crowd mood and behavior), where a certain mood state is transferred or embedded by mood creators and/or mass media, without direct physical contact, onto typically large masses of people.

But what exactly does mood mean? From a psychological perspective, mood signifies a certain internal climate composed of emotions, realized and/or unrealized desires, needs, and fears, thoughts, and physical health, and it is very closely linked to memory. Essentially, mood represents a global snapshot of the aforementioned components.

Mood induction, where a negative, positive, or neutral mood is transferred from one individual to another without direct physical contact, is also extremely common among people. It is evident that based on the mood of a particular individual, we could presuppose their emotions, realized and/or unrealized desires/needs/fears, their thoughts, memories, and even their physical health, provided that we have more compiled substantive data/information available about that individual.



4.4.2.1.1 Figure 169: Hierarchical associative package diagram of mood and its components

Figure 169 shows a hierarchical associative package diagram of mood and its components. The first package (see the upper left part of Figure 169) represents memory, which contains positive, neutral, and negative memories. Experiences hold a special position and can also be positive, neutral, and negative. As long as experiences are not used, they remain in the memory package until the moment when an individual tries to solve a pressing problem that is present or will be present. At that point, the individual can access the memory archive of experiences. In this case, experiences become thoughts. If these experiences are new, they return to the memory unit until needed for recall. The memory package is associatively linked to mood, emotions, existing psychological motives, and thoughts, as it influences both mood and its components.

The second component shows mood, which we classify as positive, neutral, and negative. From the perspective of an individual's psychological climate (similar to the sociological climate), mood is a superordinate entity encompassing emotions, existing or triggered psychological drives, as well as thoughts. Mood represents a mixture of the previously mentioned components, as the resulting mood depends on the predominance or concentration of a particular component (e.g., a prevalence of fears of failure, sadness, unfulfilled desires, strong needs, or negative thoughts results in a poor mood).

The third component presents emotions, which are classified as positive, neutral, and negative. The fourth component represents existing or triggered psychological drives, which are divided into needs, desires, and fears. The fifth component represents thoughts, which are classified as positive, neutral, and negative. Lastly, we have the sixth component (see the upper middle section of Figure 169), which represents physical health, upon which physical well-being depends (e.g., physical pain can negatively affect mood).

In this diagram, for ease of understanding the subject matter, we have omitted stimuli from the internal and, particularly, the external environment, which undoubtedly exert a strong influence on mood, emotions, the triggering of psychological drives, and thoughts. If we were also to include the dependency of mood and its components on past, present, and anticipated stimuli, we would have a dynamic model.

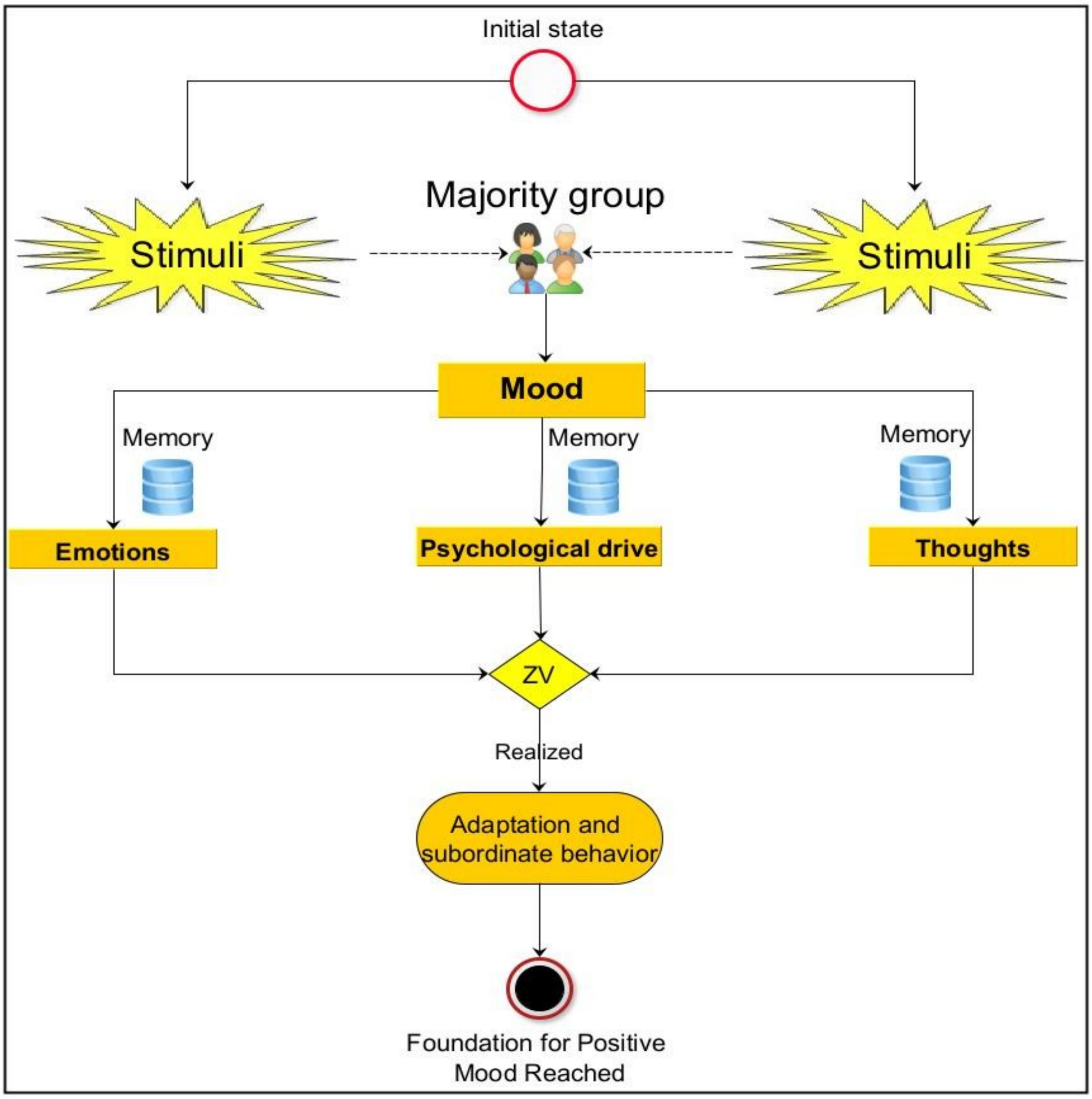
Moving forward, it would be worthwhile to attempt modeling the mood of four sociological groups, such as the majority group, the anomaly group, the extreme hierarchical complex group, and the progress group. Such mood modeling could be useful for further determining the varying susceptibilities to induced mood among these four sociological groups. At the micro-level, this would mean that we could examine the stimuli (visual, auditory, olfactory, and tactile) that more or less strongly influence the induced mood of these sociological groups.

4.4.2.2 Possible mood models of the four sociological groups

In this subsection, possible mood models for the majority, anomaly, extreme hierarchical complex, and progress groups will be presented. From the relatively extensive descriptions of the main characteristics of these four groups, we learned that members of these groups are subject to certain psychological drives.

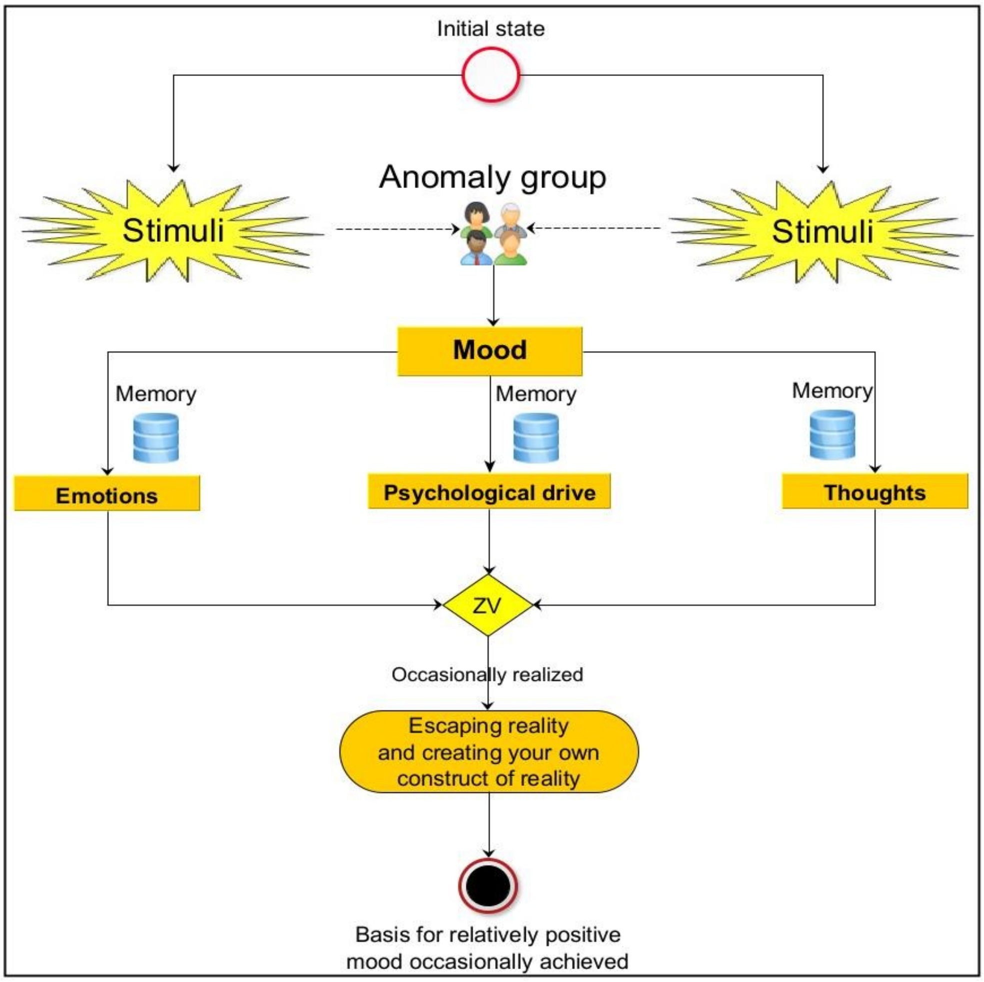
In this modeling, we will use only the main characteristic of each sociological group. For the majority group, we highlighted adaptability towards predominantly subordinate behavior; for the anomaly group, passivity towards reality alongside their own constructs of reality was highlighted; for the extreme hierarchical complex group, a strong need for dominance over people was highlighted; and for the progress group, a strong need to demonstrate intellectual abilities, accompanied by desires for positive changes, was highlighted.

It should also be noted that, for easier understanding of this otherwise complex subject matter, these are simplified models (e.g., only one psychological drive is considered, and the influence of physical health is neglected).



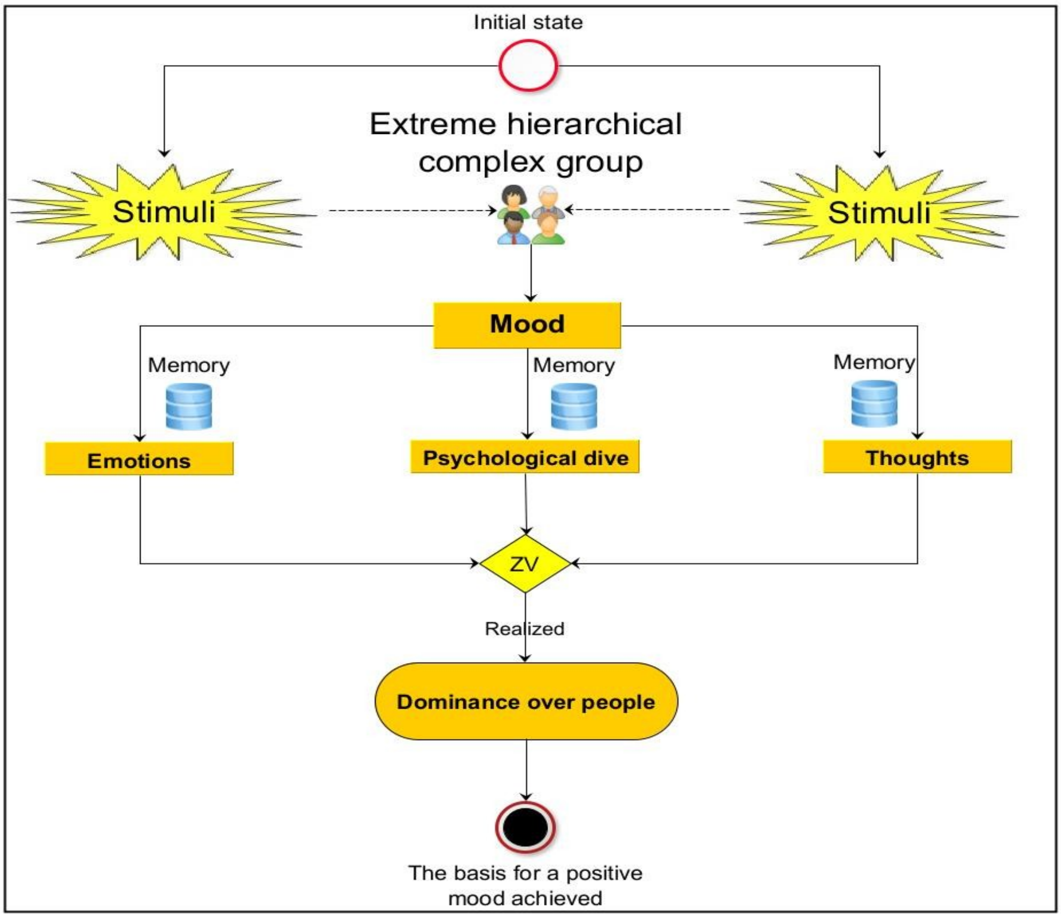
4.4.2.2.1 Figure 170: Possible model of positive mood for the Majority group

Figure 170 depicts a possible model of positive mood for the majority group, where continuous stimuli influence the mood of people in this group. Mood, emotions, psychological drive, and thoughts, along with incoming stimuli, are dependent on and connected to memory, which is subject to a process of discharging and recharging. Emotions, the key psychological drive, and thoughts converge into a central node (see the ZV rhombus). The outcome of this process is reflected in the fulfilled psychological drive concerning the desire and need for adaptation and subordinate behavior, which is the fundamental prerequisite for achieving a positive mood in people from the majority group. This fulfilled key psychological drive essentially represents the foundation for a range of aspects of life that members of this group pursue. On one hand, these include starting a family, the desire and need for offspring, regular employment, relationships with superiors, a roof over one's head, a secure life without social exclusion, belonging, etc. These same desires and needs can trigger fears of otherness, social exclusion, life without offspring, etc. Based on these desires, needs, fears, and other factors, people from the majority group can be very receptive or even suggestible to mood and other types of induction.



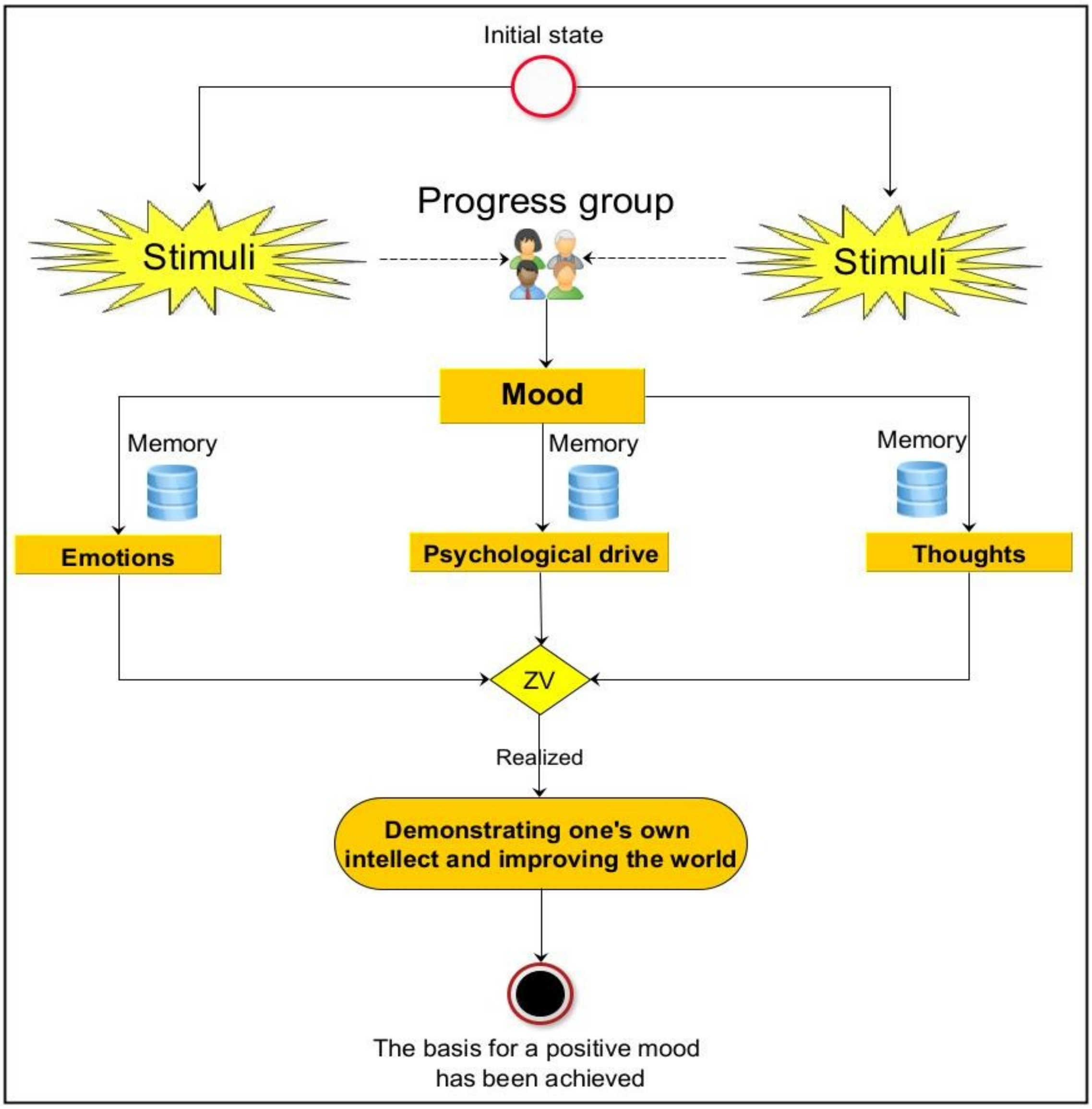
4.4.2.2.2 Figure 171: Possible model of positive mood for the Anomaly group

Figure 171 shows a possible (proportional) model of positive mood for the anomaly group, where constant stimuli intensely influence the moods of such individuals. Mood, emotions, psychological drive, and thoughts, in addition to penetrating stimuli, are dependent on and connected to memory, which is subject to a process of emptying and filling. Emotions, the key psychological drive, and thoughts converge in a collection node (see rhombus CN - Collection Node). The outcome of this process is shown in the realized psychological drive regarding the desire and need to escape from reality and create one's own construct of reality, which, to the detriment of these individuals, is the basic mental tactic for occasionally achieved positive mood. The occasionally realized key psychological drive means that representatives of this group have great difficulty adapting to social circumstances and are very vulnerable to certain types of stimuli that increasingly distance them from agreed-upon reality. Occasionally, such individuals may experience a positive mood, which is, however, proportionally unstable and quickly transitions into a negative mood with negative signs of their mental difficulties. Representatives of the anomaly group are extremely susceptible and suggestible to mood and other inductions.



4.4.2.2.3 Figure 172: A possible model of positive mood for the group with an Extreme Hierarchical Complex

Figure 172 presents a possible model of positive mood for individuals belonging to a group characterized by an extreme hierarchical complex. In this group, constant external stimuli significantly influence their moods. Mood, emotions, psychological impulses, and thoughts—along with these penetrating stimuli—are closely connected to memory, which is subject to a process of depletion and replenishment. Emotions, key psychological impulses, and thoughts converge at a central node (see rhombus ZV). The outcome of this process is the realization of a psychological impulse driven by an excessive desire and need to dominate others. This impulse is the fundamental prerequisite for achieving a positive mood in individuals from this group. The realization of this key psychological impulse forms the basis for various life goals that members of this group pursue. These include forming a family, the desire and need for children, success in life, holding leadership positions, maintaining control over their environment, influencing others, forming opinions or stances for themselves and others, the pursuit of wealth, a polarized lifestyle, and building large social networks, among others. These desires and needs can also trigger fears—such as fear of failure, of a life without children, of losing strategic material or social status, or of losing dominance over others. Typically, individuals from the group with an extreme hierarchical complex exert strong and intense influence over other groups. Nevertheless, due to their desires, needs, fears, and other factors, they remain highly susceptible—or even suggestible—to mood and other forms of psychological induction.



4.4.2.2.4 Figure 173: A possible model of positive mood for the Progress-oriented group

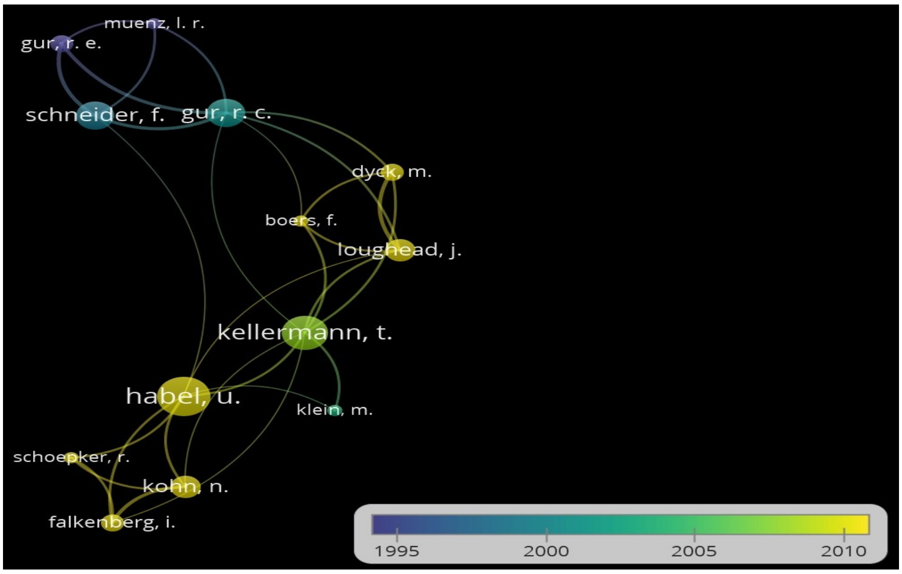
Figure 173 illustrates a possible model of positive mood for the progress-oriented group, where constant external stimuli influence the moods of such individuals. Mood, emotions, psychological impulses, and thoughts—alongside these penetrating stimuli—are dependent on and connected to memory, which undergoes a process of depletion and replenishment.

Emotions, key psychological impulses, and thoughts converge at a central node (see rhombus ZV). The outcome of this process is the realization of a psychological impulse characterized by an excessive desire and need to demonstrate intellectual abilities in the pursuit of improving the world. This realization serves as the fundamental prerequisite for achieving a positive mood in individuals from the progress-oriented group.
The realization of this key psychological impulse essentially forms the foundation for various life pursuits typical of this group. These pursuits may include developing innovative solutions, the desire and need for spiritual immortality, and a strong drive for collaboration, among others. However, these same desires and needs can also trigger fears—such as fear of intellectual crises, loneliness, lack of understanding from others, a life without offspring, or the theft of their ideas. Based on these desires, needs, fears, and other factors, people from the progress-oriented group can be highly susceptible—or even suggestible—to mood-related and other forms of psychological induction.
Based on these simplified models alone, we can conclude that there is an exceptionally large number of such models or scenarios for positive, neutral, or negative mood states. All individuals, across the sociological groups mentioned, may be more or less susceptible to mood induction, which can alter their emotional state.
The most susceptible to induced moods are, without a doubt, members of the "anomaly" group. At this level, we encounter various mood inductions that often stem from more severe mental disorders. These types of mood inductions can manifest in forms such as depressive, paranoid, hypochondriac, severe obsessive-compulsive, or megalomaniac states. These are extremely powerful bioenergetic influences, where the mental disorders present in a member of the anomaly group can negatively affect the mood of another individual—or even entire groups—who previously showed no such symptoms.
In psychiatry, there are even documented cases where a paranoid patient induced their paranoid thoughts in other family members. In such instances, it wasn’t just mood or emotions and thoughts that were being transferred—it went deeper.
If members of the majority group have stable social status, good health, a family with children, and so on, they tend to be the least susceptible to mood induction. On the other hand, in the absence of these conditions, they can become highly vulnerable and prone to chaotic group behavior.
As for individuals belonging to the group with an extreme hierarchical complex, we can say that they are essentially the main creators of induced moods, emotions, and thoughts. However, they must also invest a great deal of energy in order to maintain a positive mood.

The same applies to members of the progress-oriented group, who must invest significant intellectual effort to achieve and maintain a positive emotional state.
This brief overview also touches upon the concept of suggestibility, which is the result of induced moods, emotions, and thoughts. Suggestibility essentially refers to the degree of susceptibility to such inductions, with the aim of influencing a person’s thoughts and/or actions.
The concept of suggestibility is particularly well known in the context of hypnosis, where more suggestible individuals can be hypnotized more easily.

4.4.2.3 Analysis of bibliographic records in the field of mood induction

Using the software tool Publish or Perish, global scientific and professional publications in the field of mood induction were gathered through the queries “mood induction” and “Stimmungsinduktion.” The English-language query yielded 657 bibliographic records, while the result for the German-language query was more modest (only 30 hits). Additional queries were conducted in French (2 hits), Italian (no hits), Portuguese (6 hits), Spanish (5 hits), Dutch (3 hits), Russian (no hits), Japanese (38 hits), and Korean (10 hits). These results were not included in the analysis—on one hand, because there were too few of them, and on the other hand, because the Japanese and Korean results were incomprehensible.
Primarily, scientific and professional monographs (doctoral dissertations, books, conference proceedings) were included, as well as scientific and professional articles and various other academic and professional online works. Based on the bibliographic records, two files were created (in .ris and .txt format). Both files were subsequently processed using the software tool Vos Viewer. The first file was used to identify productive authors in the field of mood induction, while the second file contained the titles of works and journals, from which the most important and most frequently used terms were extracted.



4.4.2.3.1 Figure 174: Most productive authors

Figure 174 presents the most productive authors in the field of mood induction, who primarily published their scientific work between 1995 and 2016. A co-authorship analysis of 1,169 authors highlighted 13 authors who had published at least two scientific works in this field. What these most productive authors wrote about and how they were cited will be explained further in the following sections.[60]

1. Habel, U.: The author can be traced from 2001 to 2016 through eight scientific contributions, which are as follows:

- Real-time fMRI of Single Trial Amygdala Activation during Sad Mood Induction with Feedback – 1 citation. The article is one page long. (2001)
- Lacking amygdala activation in first-episode schizophrenia patients during mood induction – 0 citations (published in NeuroImage, 2004)
- Schizophrenia patients show aberrant prefrontal activation during working memory performance under negative mood induction – 0 citations (12th Biennial Winter Workshop on Schizophrenia, Volume: 67, 2004)
- Comparison of changes in mood: Cartoons vs. mood induction paradigm – 0 citations (International Journal of Psychology, 2008)
- Mood induction with olfactory stimuli reveals differential affective responses in males and females – 52 citations (Chemical Senses, 2008)
- Mood induction in depressive patients: A comparative multidimensional approach – 30 citations (PLOS ONE, 2012)

60 Wang, J., & Kim, H.-S. (2023). Visualizing the landscape of Home Iot Research: A Bibliometric analysis using VOSviewer. *Sensors*, 23(6), 3086. https://doi.org/10.3390/s23063086.

- In a sweet mood? Effects of experimental modulation of blood glucose levels on mood induction during fMRI – 0 citations (NeuroImage, 2015)
- Vergleich verschiedener Techniken der Stimmungsinduktion mittels EDA und Selbstbewertung – 0 citations (doctoral dissertation, in the role of supervisor, 2016)
In the area of mood induction, Ute Habel accumulated a total of 83 citations between 2001 and 2016. Her scientific work has primarily been in the fields of neurology and psychiatry. The main thematic focuses were negative mood and depression. She worked mainly with sensory stimulation using chemical and olfactory stimuli.
Between 2000 and 2019, she achieved an impressive 9,176 citations in total. This indicates that the topic of mood induction represents a relatively minor part of her body of work (0.90% in terms of citations). Her broader research output (290 bibliographic entries) shows thematic emphasis in the following areas:
- The neurobiological foundations of emotions and cognition, as well as gender differences in healthy and psychiatric patients, using functional magnetic resonance imaging (fMRI).
- Characterization of brain dysfunction in psychiatric patients and the potential for reorganization in the context of psychotherapeutic (biofeedback, training procedures) and somatic (psychopharmacological, deep brain stimulation) interventions.
- Neuropsychological examination of emotions and cognition.
Mental disorders: e.g., schizophrenia, depression, anxiety, personality disorders, alcohol dependence.
- Research in the field of vascular surgery in patients, and kidney transplantation.
- Forensic psychology: psychosocial support for witnesses, the epidemiology of psychiatric disorders in prisons, scientific psychological assessments with a criminal focus.
Despite this author's exceptional productivity, it can be concluded that she has dealt with the topic of mood induction relatively infrequently.
2. Kellermann, T.: The author can be traced from 2003 to 2013 through six scientific contributions, which are as follows:
- Emotion Discrimination and Mood Induction in First Episode Schizophrenia Patients: An fMRI Study – 0 citations (conference paper, EuroCogSci03), 2003
- Lacking amygdala activation in first-episode schizophrenia patients during mood induction – 0 citations (NeuroImage), 2004
- Schizophrenia patients show aberrant prefrontal activation during working memory performance under negative mood induction – 0 citations (conference paper, 12th Biennial Winter Workshop on Schizophrenia, Volume: 67), 2004

- The neural correlates of emotion experience – mood induction with facial expressions and classical music – 2 citations (NeuroImage), 2009
- Cognitive versus automatic mechanisms of mood induction differentially activate left and right amygdala – 83 citations (NeuroImage), 2011
- Neural correlates of effective and ineffective mood induction – 32 citations (Social Cognitive and Affective Neuroscience), 2013

On the topic of mood induction, Thilo Kellermann achieved a total of 117 citations between 2003 and 2013. His scientific work has primarily focused on neurology and psychiatry. The main thematic emphasis was on negative mood and depression. He dealt primarily with the neural correlates of effective and ineffective mood induction, as well as schizophrenia in relation to mood induction.

Between 2000 and 2019, he accumulated a substantial 3,892 citations. This suggests that mood induction is a relatively minor topic in his body of work (100 bibliographic entries), accounting for about 3.00% of his total citations. His broader research output shows thematic focus in the following areas:

- Functional magnetic resonance imaging (fMRI)
- Statistical analysis methods (particularly fMRI data)
- Cognitive processes (e.g., attention, working memory, and executive functions)
- Brain function in relation to emotional processes (facial expressions, emotion induction using olfactory stimuli)

Similar to the previously discussed author, it can be concluded that Kellermann has also engaged with the topic of mood induction only occasionally.

3. Kohn, N.: The author can be traced from 2008 to 2015 through three scientific contributions, which are as follows:

- Comparison of changes in mood: Cartoons vs. mood induction paradigm – 0 citations (International Journal of Psychology), 2008
- Neural correlates of effective and ineffective mood induction – 32 citations (Social Cognitive and Affective Neuroscience), 2013
- In a sweet mood? Effects of experimental modulation of blood glucose levels on mood induction during fMRI – 8 citations (NeuroImage), 2015

On the topic of mood induction, Nils Kohn received a total of 40 citations between 2008 and 2015. His scientific work mainly falls within the fields of neurology and psychiatry. The primary thematic focus was the study of stimuli that influence mood induction. He primarily explored the neural correlates of effective and ineffective mood induction, as well as mood changes.

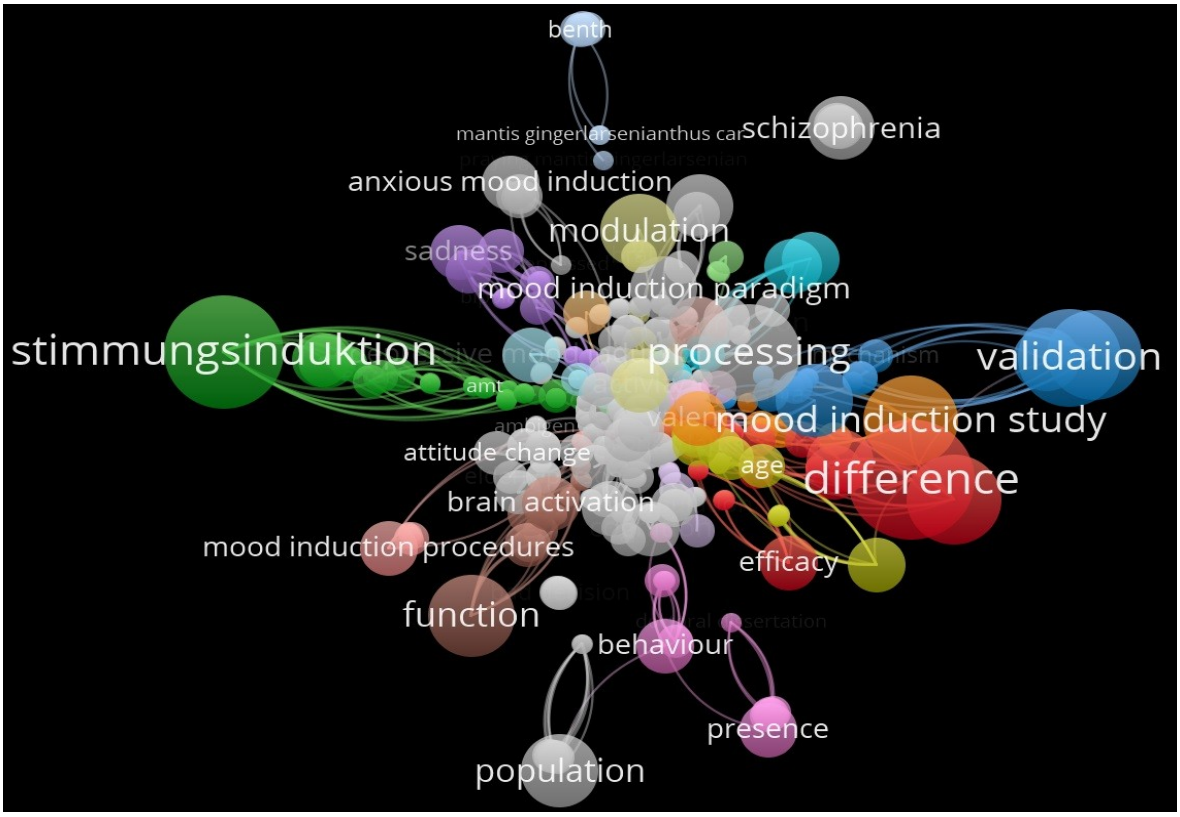
From 2008 to 2019, he achieved a total of 1,175 citations. This indicates that mood induction represents a relatively minor topic in his body of work (51 bibliographic entries), accounting for approximately 3.40% of his total citations.

4. Schneider, F.: The author can be traced from 1994 to 1998 through four scientific contributions, which are as follows:

- Effects of Mood Induction on rCBF – An O-15 PET Study – 1 citation (Human Brain Mapping), 1994
- Standardized Mood Induction with Happy and Sad Facial Expressions – 206 citations (Psychiatry Research), 1994
- Standardized Mood Facial Expressions Induction with Happy and Sad. Methods – 2 citations (Psychiatry Research), 1994
- Neurobehavioral Substrates of Mood Induction – 4 citations (Advances in Biological Regulation), 1998

On the topic of mood induction, Frank Schneider received a total of 211 citations between 1994 and 1998. There are no more recent contributions from this author in the field of mood induction, which means he cannot be considered a leading figure in this area. Based on this analysis, it quickly became clear that there are no prominent scientific authorities actively working in the field of mood induction. The most connected and frequently cited authors were based in Germany.

The following section will present the previously announced content analysis of scientific and professional publications, based on the titles of academic works and journal names.



4.4.2.3.2 Figure 175: Word analysis of scientific work titles and journal titles

Figure 175 presents a portion of the results from the word analysis of the titles of scientific works and journal names, based on bibliographic records processed using the software tool Vos Viewer. A 60% relevance threshold was applied to determine the significance of word combinations based on their frequency and interconnections within the text. From this analysis, we can identify the main topics that authors of scientific works have focused on. At first glance, it becomes immediately apparent that topics from the social sciences (e.g., sociology, ethnology, politics, economics, etc.) and the influence of the arts are extremely rare. The scientific publications mainly report on neurological, psychological, biochemical, and psychiatric or medical subjects. A large portion of the research deals with mental illnesses at the individual level (e.g., schizophrenia, depression, anxiety, bipolar disorders), which is certainly valid. However, the research efforts to date have not achieved optimal outcomes in the field of mood induction, which deserves greater scientific attention—not only from physiologically and psychologically oriented disciplines (which, even in their own fields, show relatively low levels of creativity on this topic), but also from the social sciences and the domain of artistic expression. This includes especially areas like film, prose, poetry, music, architecture, and more. Overall, one could argue that mood induction is a cultural theme in the broadest sense—encompassing science, art, sports, daily life, customs, etc.

In the study of mood induction—particularly within the social sciences—the main challenge appears to lie in how to measure this phenomenon, which, as previously mentioned, is quite common. This raises questions such as how to measure mass psychosis or the influence of mass media on large groups of people. In organizational science, there is a strong focus on determining organizational climate within structured groups, but these studies do not typically examine the causes and effects, conditions, or consequences of people's moods—or how certain induced moods influence general positive, neutral, or negative atmospheres.

Sociology does explore crowd behavior and even how certain mood states affect the collective, but it rarely addresses induced moods directly—a significant oversight. Socially hierarchical associative systems, especially in their more subtle or concealed operations, function through induction—emotional, cognitive or mental, and mood-based.

Today's entire information and communication infrastructure forms a foundational platform for mood induction—not only in individuals but also across very large groups. This topic will be revisited in the subchapter on cognitive or mental inductions.

Subjects for further consideration: Concepts derived from text analysis that may influence mood and thus mood induction

1. Autobiographical memory

It has already been stated that every individual constructs their own life story over time, stored in a part of the brain called autobiographical memory. This memory is closely linked to the perception of one's own personality. It contains data about past events, experiences, actions, fulfilled and unfulfilled desires, needs and fears, personal achievements in everyday and professional/creative life, successes and failures, perceptions of one's abilities (strengths, weaknesses), and more. In short, autobiographical memory stores the perception of one's personality, which may be negative, relatively neutral (a balance between positive and negative self-perception), or positive.

Each autobiography is formed largely based on subjective interpretation, influenced by the individual's ego, which continuously evaluates and shapes this personal narrative—consciously or subconsciously. Any stimulus that affects self-perception can, through autobiographical memory, evoke various mood states. For example, if a stimulus undermines an individual's self-confidence and conflicts with their self-image and ego, it may trigger negative mood states such as sadness, helplessness, anger, or hostility toward the environment. Conversely, a reinforcing stimulus may lead to feelings of joy, euphoria, or empowerment.

Autobiographical memory, in conjunction with the ego, can influence the intensity of a mood induced by external or internal factors. It may weaken, sustain, or strengthen a person's self-esteem.

So, what types of stimuli can generally influence the mood of most people and thus potentially result in either positive or negative mood induction?

2. Stimuli

Stimuli can be external (e.g., sunlight) or internal (e.g., feeling hungry). From a sensory perception standpoint, they can be categorized into chemical, electrical, mechanical, light, and thermal stimuli. There are specific sensory receptors for each type:

- Photoreceptors (respond to light),
- Mechanoreceptors (respond to mechanical pressure or touch),
- Thermoreceptors (respond to temperature),
- Electroreceptors (respond to electromagnetic stimuli),
- Chemoreceptors (respond to chemical changes),
- Nociceptors (respond to pain stimuli).

These stimuli are processed by the central nervous system and may have either inhibitory effects (preventing action) or impulsive effects (prompting action).

Stimuli that commonly negatively affect mood include:

- Excessive fears about the future (e.g., unmanageable debt, fear of violence or crime),
- Unmet needs and desires (e.g., inability to secure stable housing, dissatisfaction in one’s sex life),
- Negative stressors (e.g., physical overwork, excessive psychomotor burden, physical pain, anxiety, interpersonal conflict, overwhelming noise leading to headaches, rejection by a loved one, social exclusion, persistent negative thoughts), and more.

As evident, the list of stimuli that can negatively impact mood is extensive. Similarly, there are many stimuli that positively influence mood, often by simply being the opposite of the negative ones. While people share many common traits, individual differences in the perception of stimuli are significant.

For a more comprehensive list of positive and negative mood-inducing stimuli, it would be worthwhile to conduct a survey with a large sample size—ideally 500 participants or more. In fact, about a year ago, a study was conducted on the impact of stress where participants reported their positive and negative stress factors. From this, a substantial list of mood-related stimuli can be extracted. This study will be presented in a later subsection on stress.

Although not as extensively as might be expected, scientific and professional literature on mood induction has also addressed the topic of stress. This includes subjects such as:

- Chronic depression,
- Negative associations,
- Negative cognitive responses,

- Affective states,
- Stress sensitivity,
- Emotional imbalance,
- Stress related to education,
- Coping with stressors,
- Stress induction through physical pain or migraines,
- Levels of negative stress in relation to the sensory system,
- The influence of music on distress,
- Cognitive flexibility,
- High-stress lifestyles,
- Alcoholism,
- Eating disorders,
- Menstrual difficulties,
- Heart problems,
- Physical discomfort, etc.

3. Intelligence

There are various types of intelligence, such as social, cognitive (mental), emotional, moral, and spiritual intelligence. A high level of any of these types can serve as a strong factor in maintaining a positive mood. Surprisingly, scientific and professional literature in the field of mood induction has not extensively explored the relationship between mood and intelligence. Only two publications have addressed emotional intelligence in negotiation contexts—which is remarkably few.

It could be expected that individuals with high emotional intelligence are better equipped to neutralize negative moods and foster a relatively positive emotional state. Particularly well-organized personalities may tend to have a predominantly positive emotional climate and be more receptive to positive mood induction.

Research would be worthwhile to compare individuals with high, average, and below-average intelligence levels in terms of their mood variability. One could hypothesize that universally intelligent individuals (i.e., those with high emotional, mental, social, moral, and spiritual intelligence) are more receptive to positive mood induction and are rarely found in a state of negative mood. However, it's also worth highlighting that individuals with high mental intelligence but low emotional and social intelligence may be more frequently affected by negative mood states.

4. Physical health

Physical health refers to a person’s physiological well-being in the absence of pain and dysfunction within the body’s systems—factors that can influence both positive and negative moods. While scholarly literature on mood induction does mention illness, it surprisingly offers little on how physical health itself impacts positive, neutral, or negative mood states.

Physical health is a powerful factor in the experience of mood. It is generally assumed that physically healthy individuals, especially when also mentally healthy, tend to experience more positive moods. However, this cannot be guaranteed, as mood is also influenced by other factors such as fulfilled needs and desires, emotions, thoughts, and memories associated with them. Nevertheless, it can be confidently stated that optimal physical health is a solid foundation for experiencing positive moods and reduces susceptibility to negative mood induction via negative audiovisual stimuli. Lifestyle also plays a crucial role in mood; a physically healthy person who consumes large amounts of alcohol, for instance, may damage their health over time and thus negatively affect their mood.

5. Personality, ethics, and morality

Personality has been rarely addressed in academic and professional works on mood induction. Even less attention has been given to ethics and morality, though these can have a significant impact on mood and one's susceptibility to induced emotional states.

Personality—on its own and in connection with ethical or moral frameworks—is a major factor in mood variability. From a temperament perspective, it is evident that some temperaments are more susceptible to mood induction. For example, a melancholic person may be more prone to sadness, while a choleric individual may more quickly become angry compared to sanguine or phlegmatic types. Sanguine and phlegmatic individuals tend to gravitate toward cheerful moods more readily. The existing literature on mood induction mostly focuses on psychological and medical aspects—such as cognitive vulnerability in depression, personality traits related to functionality, stress sensitivity, borderline personality and anxiety. While this focus is informative, it is also limited and presents an opportunity for further scientific exploration of personality from sociological, ethical, and moral perspectives.

Looking at four sociological groups, we can observe that each consists of different personality types who share common attitudes toward ethics and morality, as well as character traits (e.g., intellectual dominance, desire for control over others). This diversity enables mood induction on a larger scale, where subtle exchanges of information occur within social groups. The concept of social mood induction is, in every respect, a fascinating topic deserving of deeper scientific attention.

6. Virtual reality

This is undoubtedly a relevant topic, as it is closely tied to mass media and has a powerful influence on public mood, particularly in socially, legally, and technologically developed countries. In the literature on mood induction, virtual reality is acknowledged as a significant factor—not only in affecting mood but also in deliberately fostering positive emotions.

Virtual reality serves as a powerful tool in any advanced socio-legal-technological hierarchical associative system, enabling widespread dissemination of information based on mood induction principles.

7. Microcosmic and macrocosmic influences

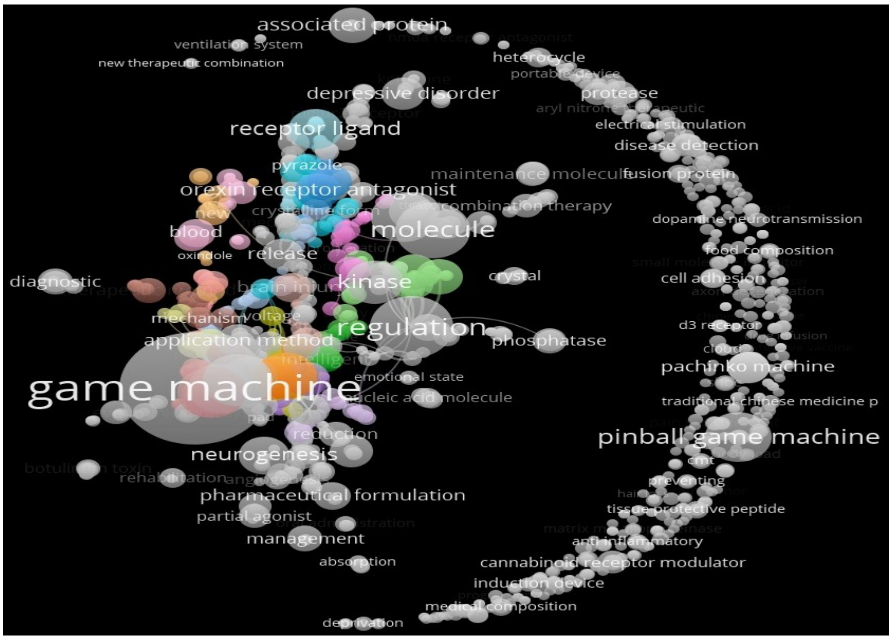
Mood induction studies have largely overlooked the influence of genes, bacteria, and viruses (microcosmic factors), as well as electromagnetic, gravitational, strong, and weak physical forces (macrocosmic factors), all of which undoubtedly have a significant impact on mood and emotional susceptibility.

For instance, illness caused by a specific virus or bacterium can be a reliable predictor of negative mood. Similarly, the influence of celestial bodies (e.g., full moon, sunlight, warmth) should not be dismissed, as they can noticeably affect the mood of individuals.

Based on an analysis of 687 bibliographic records on mood induction, it was possible to identify the key thematic elements and highlight compelling research opportunities. From this analysis, seven major factors emerged as having a strong influence on various mood states—and, by extension, on the strength or weakness of mood induction.

Before transitioning to the topic of emotional induction, the next section will present patents aimed at fostering positive mood states.[61]

61 Search on Google patents: https://patents.google.com/?q=mood&q=induction&oq=mood+induction (2019-10-20).



4.4.2.3.3 Figure 176: Patents for generating positive mood

Figure 176 illustrates patents aimed at generating a positive mood. A total of 40,353 patents have been documented. Below are examples of some patents designed to create a positive mood in individuals:

1. Patent for generating positive mood based on the speaker's positive emotional prosody using a computer and peripheral devices (e.g., microphone, headphones): This patent is particularly intended for individuals suffering from dementia but can also be used by healthy individuals. It operates on the principle of a speaker sending audio messages with positive content and emotional intonation to the recipient (e.g., a person with dementia). Continuous exposure to these positive audio messages is expected to place the recipient in a positive mood (Koichi Nakayama, 2013).
2. Mobile phone application for creating positive mood through audiovisual effects and games: This app leverages interactive features to enhance mood (Wu Longfei, 2012).
3. Device for inducing positive mood using sound: This technology uses auditory stimuli to improve emotional states (Wu Longfei, 2012).
4. Device for detecting mood using a computer and graphical interface: It can capture facial expressions and calculate mood based on the detected expressions (Lao, 2013).
5. Determination of an individual's psychological state based on speech analysis: This patent analyzes vocal patterns to assess emotional well-being (Osman Kibar, 2004).

Upon reviewing patents aimed at achieving a positive mood, technological innovations emerge that stimulate, detect, or analyze positive emotions (see the five patents listed above). Additionally, there are pharmacological patents designed to enhance mood. However, there is a notable lack of patents related to cognitive methods (e.g., self-observation methods based on movement analysis, internal

and external expressions, which could also be facilitated by computers and analytical tools) and sociological approaches to achieving positive mood (e.g., group projects aimed at environmental cleanliness to strengthen mutual belonging and creativity). Similarly, patents focusing on effective massages, artistic creation, and alternative medical methods are scarce.
While technological and pharmacological patents are beneficial, other products—such as those involving cognitive techniques or sociological initiatives—can also significantly contribute to improving mood.

4.4.2.4 Emotional induction

Emotions are an important component in the experience of mood, as they are the medium through which emotional processes occur. These processes can lead to more or less lasting emotional states and express an individual's relationship to their internal and/or external world. Emotions can manifest in various forms, and these forms can appear in numerous shades and combinations. The basic emotions are considered to be joy, sadness, anger, fear, disgust, and surprise (for example, anger and disgust can give rise to hatred, while joy and surprise can foster love). Emotions can be closely linked to values, which have already been discussed. Evidence for this claim is provided by various classifications of emotions, which essentially represent values, provided that the emotions are positive (e.g., love).
Emotions can be divided into positive and negative. Both positive and negative emotions can be associated with people (e.g., admiration), events and phenomena (e.g., joy, surprise), rules (e.g., love of order), the ego (e.g., self-respect), temporal projection (e.g., hope), characteristics of living and non-living nature (e.g., admiration for dolphins, passion for shiny materials), communication (e.g., love of language), and so on. Emotions can either enhance or devalue life, which is the result of extremely strong emotions (e.g., happy love, unhappy love). As a counterbalance to strong emotions, there are also weak emotions (e.g., boredom, calmness). Certain emotions can be partially controlled (e.g., kindness), while others, especially when they flare up, are more difficult to manage. There are emotions that are very negative (e.g., envy), while others are very positive (e.g., contentment). In any case, it is important to mention emotions that are distinctly extroverted (e.g., expressions of shock, hurt, anger, euphoria). Some emotions express optimism (e.g., joy), while others express pessimism (e.g., sadness).
Emotions can also be considered from the perspective of negative stress factors (e.g., unhappy love, disappointment with internal conflicts) and positive factors (e.g., happy love, positive hopes). Even from this brief list, it is clear that the classification of emotions represents an extremely extensive system, which includes numerous relationships, associations, hypernyms, hyponyms, homonyms,

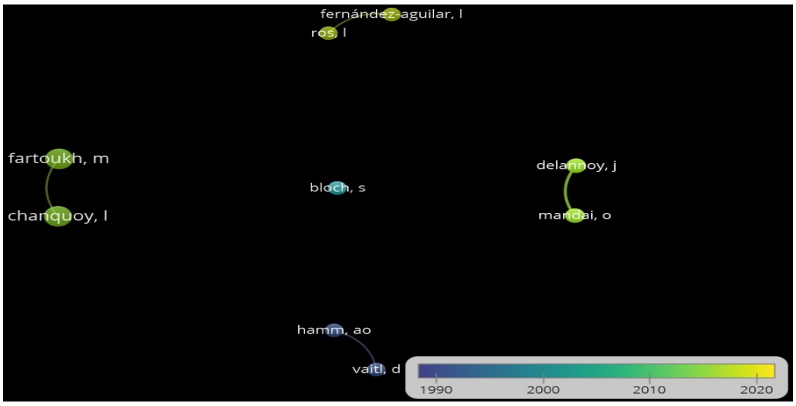
content similarities, content opposites, and so on. This is not surprising, as life is saturated with emotions, which can also be closely connected to thoughts, since thoughts often arise from a particular mood or emotion.

The expression of emotions represents a certain behavioral pattern, which is believed to be largely genetically determined. Emotions stimulate the motivational system of individuals as well as of smaller, larger, and very large, less or more organized groups of living beings (especially humans), which helps strengthen the drive for survival. Despite the predetermined nature of emotions, it should be emphasized that emotions are the product of long cognitive and social processes (e.g., the process of learning), which are connected to experience, memory, rules, situations, and thoughts. Emotions can trigger self-awareness, which is especially important for the human species, as it leads to life motivation and survival.

Various neurotransmitters play an extremely important role in the experience of emotions, serving as key tools for strengthening the motivational system. Emotions also play a crucial role in emotional induction. Certain emotions, especially those that are stronger and harder to control, are conducive to the transfer of emotions from one individual to another, from an individual to a group, and even from an individual or group to large masses without direct physical contact. Mood itself can, to some extent, remain neutral, as many emotions can be rationalized through intellectual thought, which reduces the concentration of emotions in this mix. If strong positive or negative emotions prevail, this can lead to the establishment of a distinctly positive or negative mood. People in such a state may be more susceptible to emotional induction, which simultaneously affects mood and even thoughts.

There are certain psychological drives that various economic and political propagandas skillfully exploit to increase their influence over the masses for the purposes of profit, control, and strategic leadership. Such psychological drives (e.g., the desire/need for love, the desire/need for wealth, the desire/need for belonging, fear of mortality) can be especially effective in combinations and carefully considered nuances when creating emotional induction, both in individuals and in society as a whole.

Before presenting concrete examples of emotional induction, we will first review the global scientific and professional literature in German and English. Similar to the analysis of mood induction, an analysis of productive authors and content from publication titles was conducted. Queries were made in French (17 results), Italian (one result), Portuguese (six results), Spanish (10 results), Dutch (no results), Japanese (one result), Korean (two results), Chinese (four results), and Russian (no results). Results from these language areas were not included in the analysis for the same reasons as in the analysis of publications on mood induction. A composite query was conducted in English and German ("emotional induction" OR "Emotionsinduktion" OR "Emotionale Induktion"). For the analysis of publications in the field of emotional induction, 76 bibliographic records were included. The analysis of the most productive authors was conducted first.



4.4.2.4.1 Figure 177: Most productive authors in the field of emotional induction

Figure 177 highlights the most productive authors in the field of emotional induction, who predominantly published their scientific and professional works between 1990 and 2019. An analysis of co-authorship among 141 authors identified eight closely connected individuals who have published at least two scientific and/or professional works in this area. A detailed discussion of their topics and citation frequency follows:

1. Michaël Fartoukh

Fartoukh contributed three scientific works between 2012 and 2014:

- Influence of an emotional induction procedure on 4th and 5th graders' emotional feelings and spelling performances (conference paper, no citations, 2014).
- Influence of an emotional induction procedure on 4th and 5th graders' emotional feelings and spelling performances (journal article in L'Année psychologique, seven citations, 2014).
- The use of task-based mood-induction procedures to generate high-quality emotional assets (conference paper, no citations, 2014).

Fartoukh's overall body of work includes eight bibliographic entries and has been cited 30 times. Of these, seven citations (23.33% of his total) are related to emotional induction. His publications span from 2012 to 2014, focusing on areas such as:

- Educational psychology
- Childhood and adolescent psychology
- School learning psychology
- Developmental disorders
- Language learning from a psychological perspective

- Developmental psychology theories
- Students with special educational needs
- University-level teaching methods

While Fartoukh cannot yet be considered an established authority in the field of emotional induction due to his modest research output, his focus on this topic suggests potential for future contributions. Additionally, as a relatively young researcher, he has room for growth and development in this domain.

2. Laurence Chanquoy

Chanquoy co-authored the same three papers mentioned above but has not published additional works specifically related to emotional induction. Consequently, she has seven citations in this field. Between 1989 and 2019, Chanquoy authored or co-authored 132 scientific and professional works with a total citation count of 2,135. However, only 0.33% of her citations are tied to emotional induction, indicating limited engagement with this area. Her broader research interests include:

- Developmental psychology
- Cognitive psychology with a focus on learning written skills
- Psycholinguistics and learning processes
- Statistics in psychology

Like Fartoukh, Chanquoy cannot be classified as a scientific authority in emotional induction based on her research output. Both authors come from a French-speaking academic background.

In summary, while these authors have contributed to the field of emotional induction, neither can be considered leading authorities due to their limited focus on this specific area relative to their broader research interests.

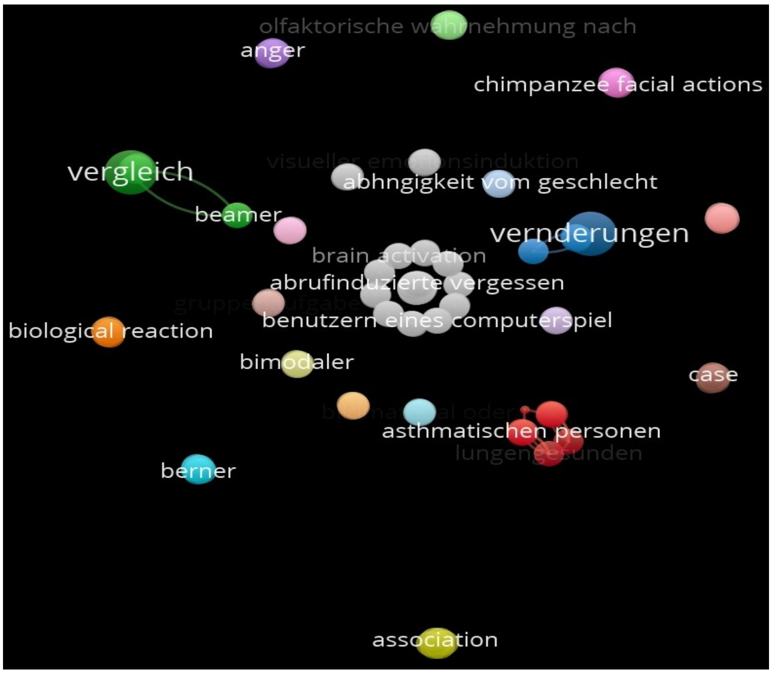
3. Fernández-Aguilar, L.:

The author has published two scientific contributions in the field of emotional induction:

- Emotional induction through films: a model for the regulation of emotions (two citations), presented at a conference in 2016.
- Emotional differences in young and older adults: films as mood induction procedure (seven citations), published in the journal Frontiers in Psychology in 2018.

Fernández-Aguilar’s academic output comprises eight bibliographic entries, with a total of 16 citations. Her scientific and professional works were published between 2015 and 2019. As a relatively young researcher at the beginning of her academic career, Luz Fernández-Aguilar cannot yet be considered a scientific authority in the field of emotional induction. Her research efforts are focused on cognitive neuroscience, cognitive psychology, and the study of emotions. The author comes from a Spanish-speaking academic background.

Similar to mood induction, no clear scientific authority can be identified in the field of emotional induction. Furthermore, there is no significant connection between authors who have written on mood induction and those who have focused on emotional induction. Overall, productivity among authors in emotional induction is notably lower than in mood induction, although productivity in the latter field is also relatively modest. While mood induction includes comparatively more productive authors, those working on emotional induction tend to be less experienced and generally younger. The analysis continues with an examination of the titles of scientific and professional works related to emotional induction.



4.4.2.4.2 Figure 178: Analysis of titles of scientific and professional works in the field of emotional induction

Figure 178 shows a visualization of the analysis of titles of scientific and professional works in the field of emotional induction. A significant difference can be observed in the number of word combinations obtained from the titles of works in the field of emotional induction compared to mood induction, which is a consequence of lower productivity in the field of emotional induction. A content review will be conducted based on the obtained word combinations.

1. The connection between emotional induction and asthmatic and healthy individuals: Are individuals with impaired respiratory tracts more susceptible to emotional induction than healthy individuals? There is a possibility that strong emotions can trigger asthma attacks in asthmatic patients. Because of this, they may be more susceptible specifically to negative emotional inductions (e.g., negative associations from the work environment can, when watching a film whose content they connect with unpleasant events in the workplace, trigger stronger feelings of hostility. Consequently, a severe asthma attack may occur).

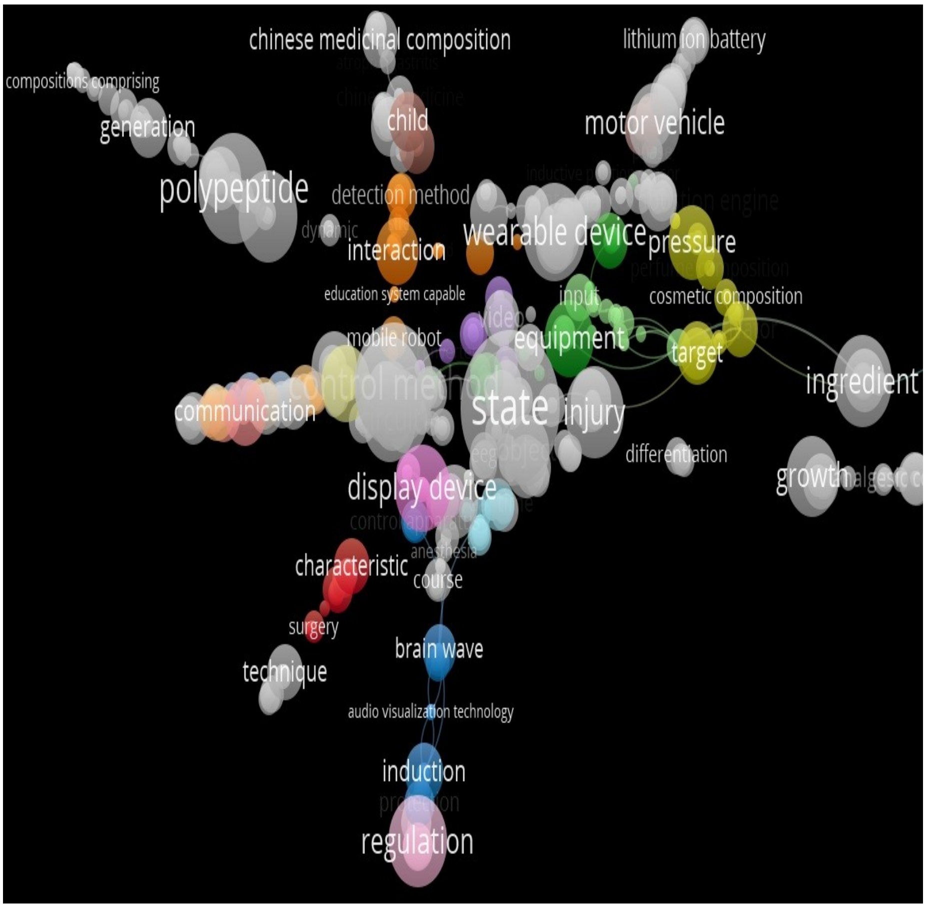
2. Emotional induction using video projections.
3. Autonomic cardiovascular neuropathy can affect heart function disorders, which can increase susceptibility to negative emotional inductions.
4. Parkinson's disease and emotional induction.
5. The influence of emotional induction of sadness on anger and facial expressions.
6. The influence of music on emotional induction.
7. The influence of cancer on negative emotional induction.
8. The influence of film on emotional induction between genders.
9. Emotional induction based on motor stimuli.
10. The influence of negative autobiographical memory on emotional induction.
11. Computer games and emotional induction.
12. Borderline disorders and emotional induction.
13. Negative emotional induction through the stimulation of fear.
14. Emotional induction and sports.
15. Social emotional induction.

Based on this brief content overview, we can conclude that scientific and professional works in the field of emotional induction mainly address the following topics: physiological and psychological illnesses of individuals, the influence of mass media, the influence of audiovisual stimuli, the influence of physical activities, social influences, and the influence of various emotions (e.g., fear, anger) in connection with emotional induction. The content is similar to that of mood induction, but the field of emotional induction is less rich in content.

Patents related to emotional induction

By searching for the phrase "emotional induction" in the Google Patents search engine, 49,033 patents were identified. These patents were exported to Excel. Based on the titles of the patents, a .TXT file was created and then imported into the Vos Viewer software tool. The tool calculated a 60% relevance for the word combinations. In the content analysis of the patent titles, 1624 word combinations were included.

Based on these word combinations, which roughly represent the direction in patent production, products intended for controlling and/or influencing the positive emotions of users were identified. A very small selection of these patents will be presented on the next page.



4.4.2.4.3 Figure 179: Analysis of patent titles in the field of emotional induction

Figure 179 shows an analysis of patent titles in the field of emotional induction. Similar to mood induction, patents that roughly represent the method of influencing positive emotions through emotional induction will be selected.

1. System guide of emotions using the emotional induction method (2010): Using a communication agent and an emotional induction device, an attempt is made to positively influence drivers in road traffic, where traffic jams often lead to a breakthrough of negative psychological stimuli that negatively affect emotions (e.g., anger).

2. Intelligent robot for positively influencing an autistic child (2019): Positively influencing the emotions of an autistic child with the help of a humanoid intelligent robot.

3. Chinese medicine for the treatment of schizophrenia (2019): Using medicinal substances to improve the emotional state of schizophrenic patients.

4. Detecting a state of satisfaction (2019): Using spectral technology to remotely detect an individual's facial expressions and thus their emotional states.

5. Device for inducing emotions and method (2005): Influencing positive emotions with the aim of creating conditions for optimal decisions.

Undoubtedly, these are interesting and useful patents that are intended to influence positive emotions, monitor emotions, detect negative and positive emotions, treat or improve the emotional states of mental patients, etc. Similar to patents in the field of mood induction, we can also observe in patents in the field of emotional induction that the main emphasis of effectiveness is based on technology and pharmacological products.
In the following section, thought or mental induction, which is of a more complex nature, more difficult to implement, and often very closely related to emotions, will be examined. In fact, the term thought/emotional induction might be more appropriate, especially due to the fact that thoughts very often arise precisely because of emotions.

4.4.2.5 Thought induction

Thought induction (also referred to as mental/emotional induction), in its simpler form, refers to the transmission of thoughts from one individual to another without any direct physical contact. In its more complex form, thought induction can involve the transmission of thoughts from one individual to a group of people, again without any direct physical interaction.
These definitions naturally lead to an association with the concept of telepathy, which essentially refers to the ability of certain individuals to read the thoughts of others—or even of multiple people. In the case of telepathy, the process is not necessarily a deliberate transfer of thoughts from one person to another without physical contact, but rather a conscious or unconscious intrusion into another person’s mental space.
A different picture emerges when we consider two individuals who are able to exchange thoughts through telepathic ability, thereby sharing information or even knowledge over great distances and without physical contact (e.g., identical twins). This can be seen as a special form of thought induction.
Telepathic ability has been widely researched. However, despite significant intellectual efforts, there is still no definitive scientific proof that it actually exists. Reports of telepathy still tend to be treated as parapsychological phenomena, primarily because such occurrences cannot yet be scientifically explained, and also because our expectations of telepathic abilities are often quite rigid—for example, imagining that someone "hears" another person’s voice in their mind while reading their thoughts.
If science eventually succeeds in providing undeniable proof of the existence of telepathic ability, certain forms of telepathy could then be classified as thought induction without hesitation. Despite the current scientific stance, telepathy will also be considered and discussed in this subsection.

Although many people view parapsychological sciences as unscientific speculation or even associate them with fraud, these fields can still contribute to the discovery and recognition of phenomena that we are not yet able to fully understand. Telepathy will be addressed further on. For now, we will focus on the so-called classical forms of thought induction, which are easier to grasp—though they can still be complex and difficult to fully comprehend.

An exceptionally skillful example of mental and emotional induction applied to a large audience can be found in the field of film production. For a clearer understanding of how mental and emotional induction works, let us consider the internationally known TV series *Vikings*.

While watching this series, one can observe that all events and characters provoke certain thoughts, which are strongly reinforced by emotions. With some historical knowledge about the Vikings, we know that they were farmers, organized in clans, innovative in shipbuilding and weapon-making, violent raiders, and barbarians who lived for their gods, survival, battle, and glory. In the series, they are portrayed as violent and brutal, but also as noble and intelligent. Despite their cruelty and ruthlessness, viewers often sympathize with them—which, from an ethical standpoint, is highly problematic.

The Vikings attacked Saxon territories, looting, torturing, raping, and killing. The Saxon kings were essentially just defending themselves, as the Vikings were the ones aggressively invading their lands. The main character, Ragnar Lothbrok, eventually surrendered, was tortured, and killed. He knew his sons would seek revenge for his death, which they ultimately did—brutally.

Here's the key point: from an objective ethical standpoint, their revenge was unjustified, as it was their father who led the violent and unjust raids on the Saxons. Nevertheless, viewers continue to sympathize with the cruel and malevolent Vikings, even though objective ethical reasoning clearly contradicts this sympathy. The creators—writers, directors, and actors—portrayed the Vikings in such a skillful way that they mentally induced emotional elements into the viewers' ethical reasoning, effectively overriding objective logic.

Through storytelling, without any direct physical contact, they succeeded in evoking sympathy for the Vikings—who were, fundamentally, extremely negative figures. This is a strong example of mental and emotional induction, where thoughts and emotions are transmitted to large audiences through mass media, without physical interaction.

On top of this, a certain internal paradox emerges: how can we sympathize with such extremely negative individuals when our ethics and morals should, in theory, reject them? It's worth exploring the reasons behind this paradox.

The causes of this cognitive paradox may lie in the emphasis on certain psychological impulses that override ethical and moral logic. In the cognitive process of thinking, these impulses can transform into values that many people come to believe in. First, we must highlight the appealing image of the main characters, the Vikings. The charismatic leader is portrayed as a caring family man, a man of his word, an innovative thinker, and a highly skilled warrior. These are traits that naturally evoke sympathy. However, we overlook his ruthlessness, egocentrism, thirst for glory, and criminal violence.

The creators of the series cleverly emphasized values stemming from the desire for family life, love, and physical and mental strength. The Vikings did not fear warrior death and had strong belief in their version of heaven. This particular trait may have triggered sympathy in viewers, as most people live with a fear of death.

In battle, the Vikings were portrayed as honorable, loyal, and friendly—positive values rooted in psychological drives such as the need for loyalty, honor, friendship, competition, and belonging. These emotional triggers, presented through audiovisual stimuli, overpowered a more complete ethical and moral logic.

A possible explanation can be found in scientific studies on thought control via computer interfaces. Researchers introduced two groups of neurons—one storing data (visual imagery, biography, creativity, etc.) about Marilyn Monroe, and the other about Josh Brolin.[62] Researchers found that a competitive effect can indeed occur between two groups of neurons, with the dominant group being the one that is more strongly activated. Neurons function similarly to switches that prioritize stronger stimuli. Whether neurons control our will, or our will controls the neurons, is a fascinating question. The first assumption that arises is that the will controls the neurons. However, in the case of mental and emotional induction—as illustrated by the TV series Vikings—we might argue the opposite. Despite the presence of a strong group of neurons associated with ethics and morality, the induced group of neurons dominated, ultimately producing sympathy for the Vikings.

Scientists have shown that the will can influence the competitive outcome between two or more neuronal groups, and this can be achieved through mental training.

Now a legitimate question arises: how can we induce antipathy toward the Vikings in such a globally popular TV series? Anyone who followed the series from beginning to end may realize that it is extremely difficult—or even impossible—to rid themselves of the sympathy they feel toward the main characters and their essentially criminal or immoral acts. This example of mental/emotional induction illustrates the powerful influence media can have on how we perceive

62 Video presentation: Thought projection by neurons in the human brain (2010). Access via URL: https://www.bing.com/videos/search?q=neurons+marilyn+monroe&&view=detail&mid=D65A70DAFC97F6A80A6FD65A70DAFC97F6A80A6F&&FORM=VRDGAR (2019-10-27).

content, characters, events, and so on. This influence can overpower our existing moral and ethical framework for judging right and wrong.
Of course, this doesn’t mean that our ethical and moral compass disappears due to such strong mental and emotional induction. Rather, media—and this series in particular—is perceived as something separate from real life. Because of this, the viewer’s sense of morality and ethics remains intact. However, the positive values emphasized in the series may still influence a person’s decisions or preferences.
In short, after watching all the episodes of Vikings, a viewer might unconsciously begin to favor values such as loyalty, competitiveness, honor, strength, belonging, bravery, and friendship. These are essentially positive values, and they have the power to neutralize the brutality, ambition, and criminal violence depicted in the series.
Whether this counts as “negative learning” is still an open question. However, the next example of mental-emotional induction can be more definitively labeled as negative learning—or even a kind of thought programming.
In the case of intense and frequent playing of violent video games, scientists have already proven that this can significantly influence a person’s perception of everyday life. Such individuals may become socially withdrawn and obsessed with playing games saturated with mindless violence. These games typically focus solely on defeating enemies and promoting a consumerist ethos. Players are not exposed to positive values but rather accumulate points through imaginary acts of violence, with the aim of achieving high scores and virtual rewards.
This is especially true of games with impressive audiovisual effects, where the player’s objective is to conquer cities and territories without any meaningful or positive motivation. Surrounded by enemies that must be eliminated from this imaginary world, these games are a prime example of negative learning or negative mental-emotional induction.
People can become addicted to such games and lose touch with reality. As a result, positive values fade or become distorted. Repeated exposure to imaginary killing can form extremely strong neural networks that override normal, everyday networks. Through mass media—such as television, the internet, or print publications—we’ve often heard of violent massacres committed by disturbed individuals who lost touch with reality and succumbed to an imaginary world, driven by negatively induced mindsets and a real-life passion for killing "opponents."[63] In short, violent video games can increase a person's readiness to engage in violent behavior, which may ultimately lead to

63 Wildt te B, E. H. (2007). Computerspiele und Amoklauf: Die Verzweiflung hinter der Wut. *Dtsch Ärztebl*, *6*, str. 163-165.
Gewalt durch Ego-Shooter. (2016). *Frankfurter Allgemeine*. Dostopno na URL: https://www.faz.net/aktuell/gesellschaft/ungluecke/diskussion-ueber-killer-computerspiele-nach-amoklauf-in-muenchen-14355353.html. (2019-10-31).

irreversible criminal consequences. On the other hand, even video games filled with violent content can sometimes have a positive impact on individuals. For example, a person suffering from cancer might, through their willpower, symbolically destroy cancer cells by defeating imaginary enemies in the game. In this case, the mental and emotional induction is more positive in nature, with a clear motive of overcoming a life-threatening illness and striving for survival.

To what extent this actually helps in overcoming such diseases is not yet fully understood or conclusively proven. However, there are indications that such therapies may indeed be beneficial.

To better understand this complex topic, two examples of mental and emotional induction through mass media were presented. In the next section, the concept of mental-emotional induction will be explored through specific examples and examined from the perspectives of libidinal, everyday, and philosophical ways of thinking.

It is important to note that these modes of thinking are not strictly separated; rather, they are interconnected and often overlap to varying degrees. Finally, it’s crucial to emphasize the underlying focus of this topic, which is the dissemination of data and information with the aim of influencing large groups of people—whether for positive or negative purposes.

4.4.2.5.1 Mental/Emotional induction on the libidinal level of thinking

This type of induction is extremely common, as it appears in the world of mass media, everyday conversations, public events, art, sports, work life, and more. It is triggered by numerous stimuli from both the internal world (e.g. instincts related to reproduction or sexual identity) and the external world (e.g. erotic stimuli in the form of touch, visual images, sounds, or scents). These stimuli can significantly enhance the spread of data and information to individuals or even large groups of people across great distances—without any direct physical contact.

The libidinal level of thinking represents an important part of our socially constructed reality. One of the most well-known examples of mental/emotional induction can be found in economic propaganda, where thought creators, especially by stimulating desires/needs for eroticism and entertainment, pursue the main goal of gaining consumers and, consequently, material profit. Erotic stimuli are also often used in political propaganda to influence people’s decisions. Economic propaganda is frequently closely tied to political propaganda (e.g., during elections), and such a

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Willoughby, T., Adachi, P. J., & Good, M. (2012). A longitudinal study of the association between violent video game play and aggression among adolescents. *Developmental psychology*, 48(4), str. 1-14.
Bajovic, M. (2012). Violent Video Game Playing, Moral Reasoning, and Attitudes Towards Violence in Adolescents: Is There a Connection? : dissertation. Brock University. http://hdl.handle.net/10464/4115.
Hollingdale, J., & Greitemeyer, T. (2014). The effect of online violent video games on levels of aggression. *PLoS one*, 9(11), e111790.

synthesis of economic and political narratives is commonly referred to as economic-political propaganda.

Mental/emotional inductions on the libidinal level of thinking primarily aim to direct and stimulate people's desires and needs toward consumerist and political content. Over time and through repeated exposure in various forms, these desires and needs become ingrained in the thinking of individuals and the collective mindset of society.

Such inductions are not limited to economic and political propaganda; they also occur in ordinary everyday communication, psychological therapy, boosting the morale of sports teams, the military, or police forces, in intelligence operations, in efforts to attract a romantic partner, in workplace competition, in gaining social approval, in spreading rumors (positive or negative) about individuals or groups, and so on.

The implementation of mental/emotional induction on the libidinal level of thinking—whether targeting individuals or large audiences—can take many different forms and involve various types of content. It can also intertwine with elements of both everyday and philosophical levels of thinking. However, this kind of induction generally does not occur during intense mental concentration or complex physical and/or mental activities, such as playing chess, intense sports like football, scientific research, child-rearing, contemplating social or technological issues, deep religious devotion supported by prayer, focused driving, mountaineering, financial analysis, grieving after the loss of a loved one, or extreme fatigue due to overwork.

It’s also important to point out the cultural differences in how libidinal stimuli are perceived. In some cultures, such stimuli provoke strong disapproval or outrage (e.g., the display of a woman’s cleavage in certain Islamic countries). Perception of these stimuli depends heavily on living conditions, personality traits (e.g., temperament, emotional disposition, experience), social influences, national laws (some countries enforce stricter regulations regarding erotic advertising), and broader cultural factors (including science, art, sports, daily life, ethnography, etc.).

Mental/emotional induction—whether directed at individuals or large groups—relies on the transmission of values and symbolic (e.g. the power of symbols), sensory (sight – visual stimuli; hearing – auditory stimuli; smell – olfactory stimuli; taste – gustatory stimuli; touch – tactile stimuli), and vocal codes (a speaker presenting libidinal content with specific intonation), all of which can temporarily or even permanently alter a person’s or group’s mental concepts. These changes happen by either becoming embedded in existing neural networks or forming entirely new ones.[64] In both cases, desires are triggered and eventually evolve into a felt need to fulfill or satisfy

64 A more detailed description of the aforementioned codes can be found in the section: Rosenthal, S. (2012). *Erotische Reize als Codes für die Markengestaltung*. Göttingen: Verwaltungs- und Wirtschaftsakademie und Berufsakademie.

an ingrained mental concept. In this process, no one explicitly tells an individual or a group what specific need they should fulfill. Instead, all mental constructs arise as a result of inductive communication without direct physical contact.

The phenomenon of mental/emotional induction has a long history. On one hand, it is deliberately constructed by opinion makers; on the other hand, these inductions often appear to lack a clear plan, as they result from numerous interactions and exchanges of data and information based on fundamental psychological impulses—desires, needs, fears. There is ample evidence to support this claim, which can be found in certain mental stereotypes, attitudes, beliefs, perceptions, social conventions, and so on.

For example, economic advertisers often employ libidinal stimuli through vocal cues—specifically, using a native language spoken with a French or Italian accent. These accents are generally perceived by many as more erotic. People believe this because such perceptions have been mentally and emotionally induced into their mental concepts over decades.

Another example of such long-term induction is seen in product naming, where French (e.g., Shampooing la couleur), Italian (e.g., Alfa Romeo), or English (e.g., Paradise dream) language is used. These mental/emotional inductions targeted at large groups of people lead to the unification of mental concepts, which, from an individual's perspective, are usually shaped by subjectivity.

As a result of mental/emotional induction—including mood and emotional cues—a shared reality can emerge. This does not only occur in political and economic propaganda, but also finds its place in the broader spectrum of human culture. These inductions also happen in the worlds of science, art, religion, and sports.

In science especially, there are many theories and models that cannot be easily—or at all—proven based on the mesoscale (middle-sized) view of reality. Nonetheless, humans have accepted many abstract mental concepts and even believe in them (e.g., the Earth orbits the Sun, black holes, string theory, photon theory, theory of relativity).

The same applies to the world of art, where certain artistic styles and mental concepts dominate for a time, only to fade and be replaced by newer styles and ideas. In fashion, many mental/emotional inductions take place—not only regarding clothing, but also accessories, hairstyles, cars, and even the ideal of male and female beauty. During the Renaissance, beauty ideals for women were shaped by rulers and visual artists. The perception of female beauty at that time differs significantly from today’s standards.

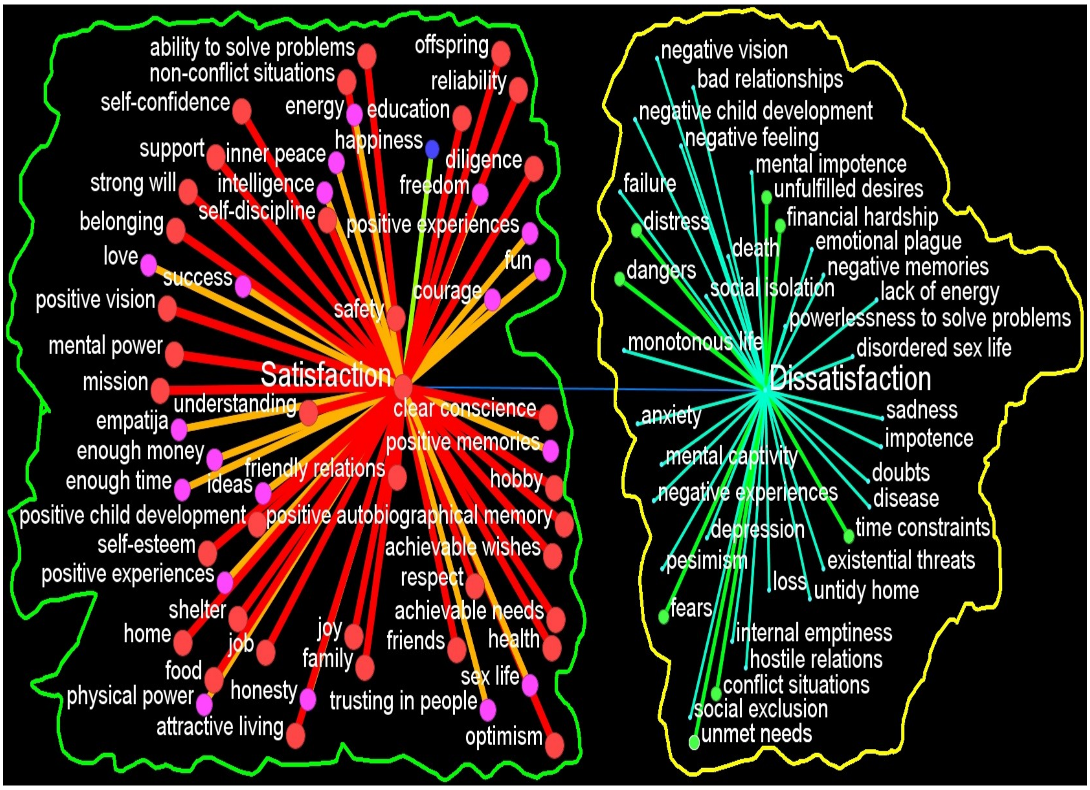
Libidinal stimuli trigger core psychological impulses such as the desire/need for eroticism, humor, love, entertainment, fear of failure, and more. Mental/emotional inductions often operate through ambiguity, depictions of boredom, presentations of adventurous experiences, color combinations (e.g., red paired with black), feelings of safety, strength and energy, and polarized ideas that influence will, attraction, and so on.

As already mentioned, this section will present concrete examples of how mental concepts are embedded in individuals and/or large groups of people. This is important, as it helps us understand the process of mental/emotional induction through the exchange of data and information—one of the foundations of social existence for the human species.

Next, a model of two neural networks will be presented, representing the mental concepts of satisfaction and dissatisfaction. This model serves as the basis for developing various scenarios of mental/emotional induction on the libidinal level of thinking.

Persistent and sufficiently strong libidinal stimuli—in the form of symbolic, sensory, and vocal codes—can influence the mental concept of satisfaction or reinforce the mental concept of dissatisfaction. This, in turn, can motivate both individuals and groups to take action in order to satisfy their desires or needs and restore a state of satisfaction. If the need remains unmet, a negative scenario can emerge, manifesting as dissatisfaction.

These models are based on the assumption that neurons are carriers of data and information, and therefore of mental concepts, which are organized into different thematic clusters or formations of neural networks.



4.4.2.5.1.1 Figure 180: Basic model of two neural networks from the perspective of two mental concepts

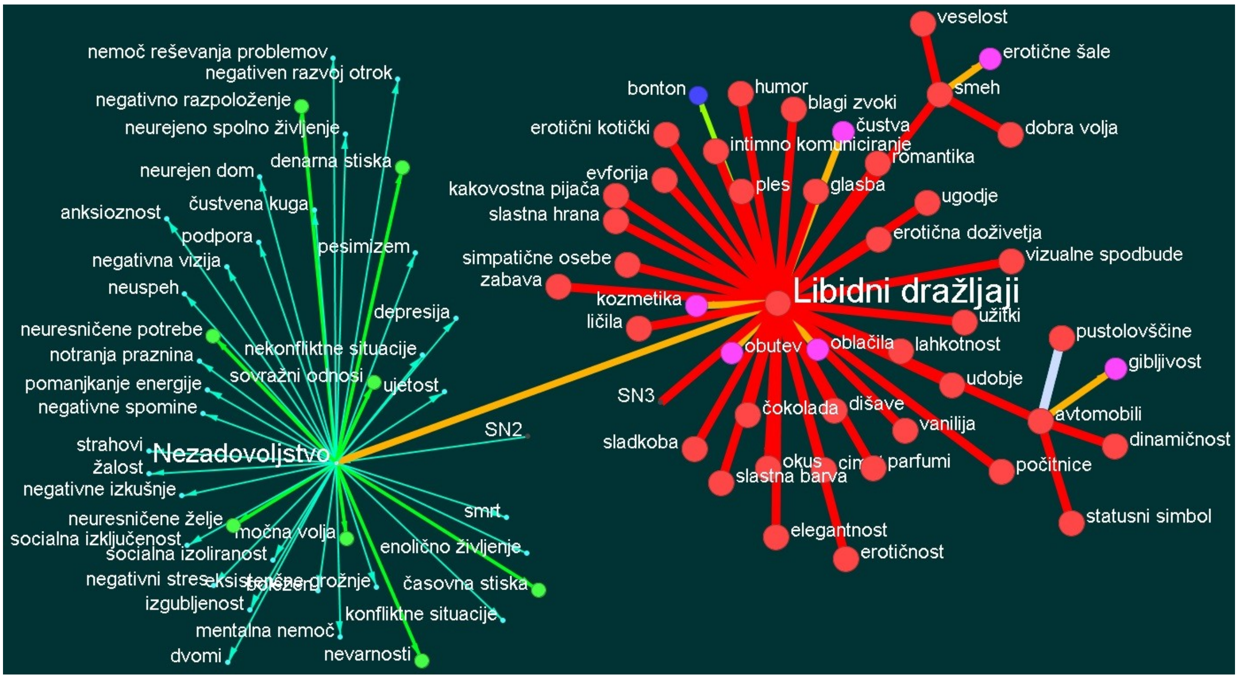
Figure 180 illustrates a basic model of neural networks from the perspective of two mental concepts: satisfaction and dissatisfaction.[65] Both concepts are depicted in the form of a cluster (see the green and yellow delineations) and are only loosely connected (see the weak blue link), as the person or people are predominantly in a state of satisfaction (see the left side of Figure 180: strong red and orange connections and larger nodes in light blue and red). The polarization of the state of satisfaction is illustrated on the right side of Figure 180, where weaker connections and much smaller nodes are visible.

The connections and nodes were defined using a value scale from one to five, where a value of one represents the weakest level of connectivity and smaller nodes, while a value of five indicates stronger connections and larger nodes. The left cluster contains positive mental concepts, such as existential goods (e.g., food, heating), prestige (e.g., hobbies, entertainment), and values (e.g., health, love, diligence, safety). In contrast, the right cluster includes mental concepts with a negative content orientation (e.g., pessimism, conflict situations, sadness, threats).

Regardless of whether we are assessing the condition of an individual or a group based on the given setup, we can state that the level of satisfaction is strongly weighted on the positive side. The left cluster has reached a value of 273, while the right cluster has reached a value of 45 (out of a total sum of 312). Despite the positive state of the examined entity (individual or group), which shows

65 The network was created using the Midos Thesaurus and Ora Casos software tools.

85.90% satisfaction and 14.10% dissatisfaction, it can be assumed that the state of satisfaction cannot improve significantly any further. On the contrary, it could deteriorate with the influence of appropriate libidinal stimuli, especially from the external environment.
It can be anticipated that exceeding a 95% level of satisfaction might have harmful consequences for both the individual and the collective. Excessive satisfaction can, in the long term, lead to blindness to real threats from both internal and external environments. This blindness could jeopardize the survival of an individual or group. When a person becomes overly satisfied, they may become too self-satisfied and mentally and physically passive. In natural conditions, such excessive passivity can pose a serious threat to survival due to evolutionary competition among species.
In short, every animal species—including humans—is, by its very nature (e.g., genes, bacteria, neurons, heart, environmental threats), compelled to engage in optimal activity in order to survive and evolve. Without the driving force of deficiency, the human species in particular would struggle to sustain itself in the fight for survival and advancement. The presented example of a satisfied individual or group essentially illustrates the high likelihood of a change in this highly positive state of satisfaction. This change will be illustrated by the next model.
The processes of mental, emotional, and mood induction thus represent a vital part of human survival, as these very inductions help establish homeostasis between illness and health.

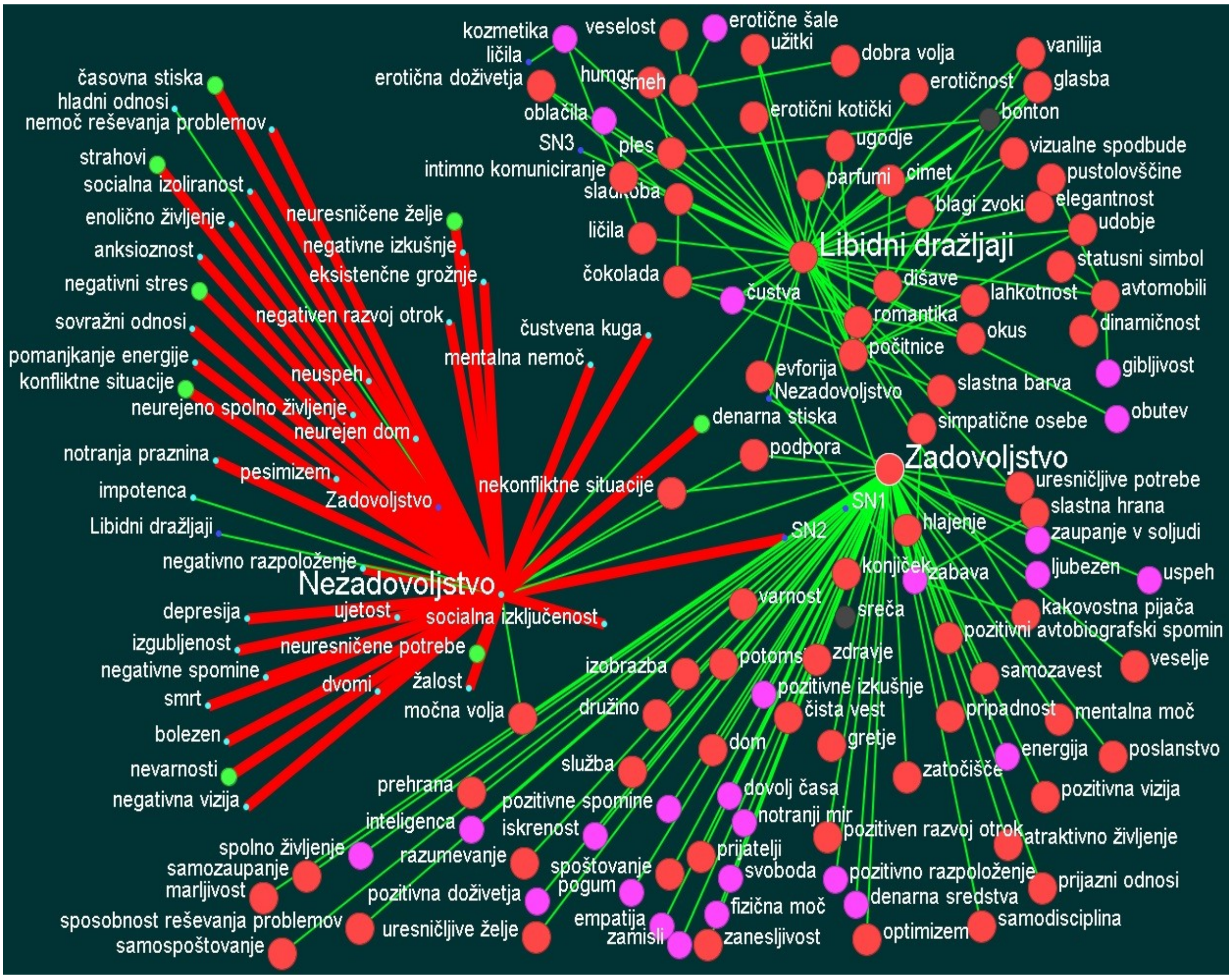


4.4.2.5.1.2 Figure 181: The influence of libidinal stimuli on the neuron group of dissatisfaction

Figure 181 illustrates the influence of libidinal stimuli (see the right side of Figure 181) on the group of dissatisfaction-related neurons (see the left side of Figure 181). As previously established (see Figure 180), the content strength of the dissatisfaction neuron group is relatively weak, which is shown through faint green connections and smaller light blue and green nodes. This means that the content associated with dissatisfaction does not pose a threat or dangerous rival to the satisfaction-related neuron group.

At the libidinal level of cognition, various strong libidinal stimuli stand out and penetrate through the sensory system—such as eroticism, clothing, footwear, pleasant scents, elegance, enjoyable tastes, soft sounds, and so on—which can form a distinct and powerful mental concept. This concept is represented in the form of strong connections and large nodes. In the next phase, this mental concept can influence the reinforcement of the dissatisfaction neuron group's content, particularly when an individual or group feels a certain lack or deficiency, which then triggers a strong desire and subsequently a need to eliminate that deficiency.

In such a case, the scenario might involve the fulfillment of an exotic vacation on a Polynesian island, where a range of appealing erotic and gourmet experiences is promised. It is clear that such a desirable vacation is not inexpensive, and most people around the world cannot afford such luxury. However, the desire for it can grow significantly and evolve into a powerful mental concept that demands fulfillment. In short, the resulting strong mental concept—formed through continuous and intense influence of libidinal stimuli—strengthens the state of the dissatisfaction neuron group. This state is illustrated in the following figure.



4.4.2.5.1.3 Figure 182: Strengthening the state of dissatisfaction due to the effect of processed libido stimuli in relation to the group of satisfaction neurons

Figure 182 illustrates the strengthening of the state of dissatisfaction due to the effect of processed libido stimuli in relation to the group of satisfaction neurons. On the libidinal level of thinking in an individual or group of people, the outcome is seen in the enhanced content strength of the dissatisfaction neuron group (see the strong red connections). The nodes are still relatively small for now, but this can change with the continued influx of libido stimuli, which, when content-wise united, can develop into a strong mental concept. This concept is also connected to the satisfaction neuron group, which is, in turn, related to the dissatisfaction neuron group.

The final outcome of the depicted multi-layered influence may lead to a reduction in the strength of certain contents within the satisfaction neuron group. This is shown in Figure 182 by weaker green connections and purple nodes, which are smaller than the red nodes within the satisfaction network. If we revisit the scenario of an exotic vacation, we can highlight contents such as freedom, love, positive mood, financial resources, fun, energy, and positive memories. These contents are strongly linked to the desire for an exotic holiday.

An individual or group of people theoretically has several different decisions available. A strong desire can be compensated or rationalized by creating a counterbalance and focusing on other desires that are easier to fulfill. Another option is a compromise, where instead of an exotic vacation, they choose a vacation at home. The third option is saving money until the financial conditions for an exotic vacation on a Polynesian island are met.

Various libido stimuli, especially from the external environment, can influence the successful process of mental and emotional induction in both satisfied individuals and satisfied groups of people. It is clear that these stimuli have a much greater impact on less satisfied individuals and groups of people. There are numerous research opportunities to study the dynamic content networks of various neuron groups that carry data and information. In cases of neuron clustering, these groups also contain content or mental concepts. It would be possible to show different individuals and/or groups of people based on their level of satisfaction or dissatisfaction, using five or more levels. An even greater research challenge would be to show mental and emotional induction based on interactions between individuals in different states of satisfaction and/or dissatisfaction. In such studies, it is hard to imagine serious scientific research work without powerful computers, software tools, and collaborative research efforts.[66] The written text can be applied to both mood and emotional inductions at various levels of thinking. In this section, many possibilities (not even a small portion of them) will not be addressed, as they actually exceed the capabilities of an individual. Another reason is that there is still a substantial amount of material ahead, and discussing even a small number of these possibilities would go beyond the scope of this section.

To what extent libido stimuli in the form of various codes influence the strength and significance of the content of the satisfaction and/or dissatisfaction neural network depends, on one hand, on the state of the individual, society, and natural circumstances (e.g., weather), and on the other hand, on internal conditions (e.g., changes in the pH levels of certain neurons due to more or less intense stimulation, exchange of potassium and sodium ions, and neural electrical activity).[67] In addition, it is worth mentioning the established semantic categories, which can more or less distinctly denote various aspects, such as actions (e.g., moving a specific part of the body), auditory phenomena (e.g., noise, sound), visual elements (e.g., sunlight), olfactory elements (e.g., the smell of roasted meat), emotional elements (e.g., a sad group, a happy group), temporal elements (e.g., last Sunday, the next meeting, time pressure, old age), and spatial dimensions (e.g., crowd, land area, spaciousness, volume). These already established semantic categories actually enable the understanding of

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66 A good example of group scientific research work is the "Human brain project"! See URL: https://www.humanbrainproject.eu/en/ (2019-11-16).

67 An example of the impact of changing the pH value of neurons: Farnam, A. (2014). pH of soul: how does acid-base balance affect our cognition?. *BioImpacts: BI*, 4(2), 53.

linguistic and numerical symbols that are stored within neural networks. This type of memory is called the mental lexicon.[68]

Once again, we cannot overlook the significant autobiographical memory that essentially co-creates different types of personalities and, indirectly, society itself. How an individual perceives their own personality strongly influences their susceptibility, and/or the susceptibility of a multitude of people, to libidinal stimuli and, consequently, to mental-emotional induction.

According to the official scientific standpoint, neurons are not treated as living beings but rather as organic particles with the ability to move, communicate, orient themselves, and, in a certain, less strictly defined sense, even the capacity to reproduce. Neurons could be viewed as an envelope within which living entities reside, enabling the storage of data and information from the internal and external environment. Within networks, they function as various magnetized information systems where data and information are not only stored but also processed and contribute to diverse decisions made by individuals and society.

Even imagination and will can be interpreted as large and important neural networks that, under certain circumstances (e.g., except for most automated processes within the bodily system), more or less direct the functioning of other neural networks. Human will essentially represents the medius locus between influential neural networks in the brain and external factors (e.g., social, climatic, gravitational forces, external electromagnetic fields, and weak and strong forces).

Human will is not solely bound to the brain or to neural networks. This essentially means that the process of mental-emotional induction does not only occur on an external level but also within our inner selves. The world we perceive, model, surmise, presuppose, etc., is essentially a copy (albeit in an abstracted form) within various neural networks. Neurons, or neural networks, have demonstrated their capacity and adaptability throughout the development of the human species, as they have contributed to the emergence of numerous different languages that we use in diverse social hierarchical and associative systems. Furthermore, an individual can learn not just one but even several different languages. This indicates that the emergence of other languages is possible, and it is difficult to determine the limitations of neural networks.

In every language, concepts have arisen that denote deities, even though individual nations have opted for polytheistic or monotheistic interpretations. It is true that god or gods have been named differently. God and/or gods also reside within us, and each individual could, if we refer to the words of the philosopher Nikolai Hartmann, represent a god for themselves, connecting with other

68 Sripada, P. N. (2008). Mental lexicon. *Journal of the Indian Academy of Applied Psychology,* 34(1), 181-186.

gods or individuals.[69] Similarly, we can assert this about powerful and adaptable neural networks. The emergence of different types of languages could be explained precisely based on climatic conditions, landscape characteristics (e.g., forests, water sources, animals), methods of nutrition, more or less developed social interactions, and various neural electrical activities. Even slight changes in the pH value within a specific group of neurons can lead to different behavioral patterns, which consequently influences the different naming of certain parts of our world.
We continue with the discussion of mental-emotional induction on the everyday level of thought.

4.4.2.5.2 Cognitive(mental)/emotional induction at the everyday level of thinking

Cognitive and emotional induction at the everyday level of thinking is even more common than at the libidinal level and is generally less concealed, as people are more open when talking about everyday topics. The same applies to mass media, which usually face fewer restrictions when sharing information at this level compared to the libidinal level. It is important to stress once again that there are no strict boundaries between different levels of thinking. A good example is the mental concept of "entertainment," which can appear at both the libidinal and everyday levels. At the libidinal level, the focus is on intense, intimate physical closeness, whereas at the everyday level, it refers more to pleasant communication, which can be enhanced by dancing and/or drinking wine.
Parties, for example, can also have a strong practical or interest-based purpose, such as forming useful social connections. Everyday thinking usually relates to either our leisure time or work-related activities. Within these two categories, we can develop both mental concepts of satisfaction and dissatisfaction. At the everyday level of thinking, at least four key mental concepts are present: satisfaction, dissatisfaction, leisure time, and structured (or "obligated") time. Leisure time and obligated time directly influence how we experience satisfaction or dissatisfaction.
Research into the impact of negative stressors (which will be discussed in more detail in a later section) clearly shows that dissatisfaction is most strongly reinforced during obligated time (e.g. at work or when managing complex family responsibilities). On the other hand, surveys show that people feel most satisfied during their leisure time, even if it involves significant effort, such as raising children, building a house, or shopping for materials.
So, both leisure and obligated time include the mental experiences of both satisfaction and dissatisfaction. Findings suggest that the neural networks involved in everyday thinking are more complex and branched out, due to the wide range of events, actions, experiences, rules, phenomena,

69 Nikolai Hartman (1882-1950): German philosopher of critical realism.

existential factors, and obligations we encounter—features not as prominent at the libidinal level of thought.

At the everyday level, we deal with numerous stimuli (e.g. paying bills, a child getting injured, lack of money, admiration of luxury cars, workplace conflicts), which can sometimes overlap with libidinal stimuli. What stands out at this level is the importance of symbols, values (ethics and morality), rules, existential conditions (e.g. access to food and shelter), and external circumstances (e.g. weather, traffic jams, social interactions, economic crises, politics, sports events, exhibitions, celebrations).

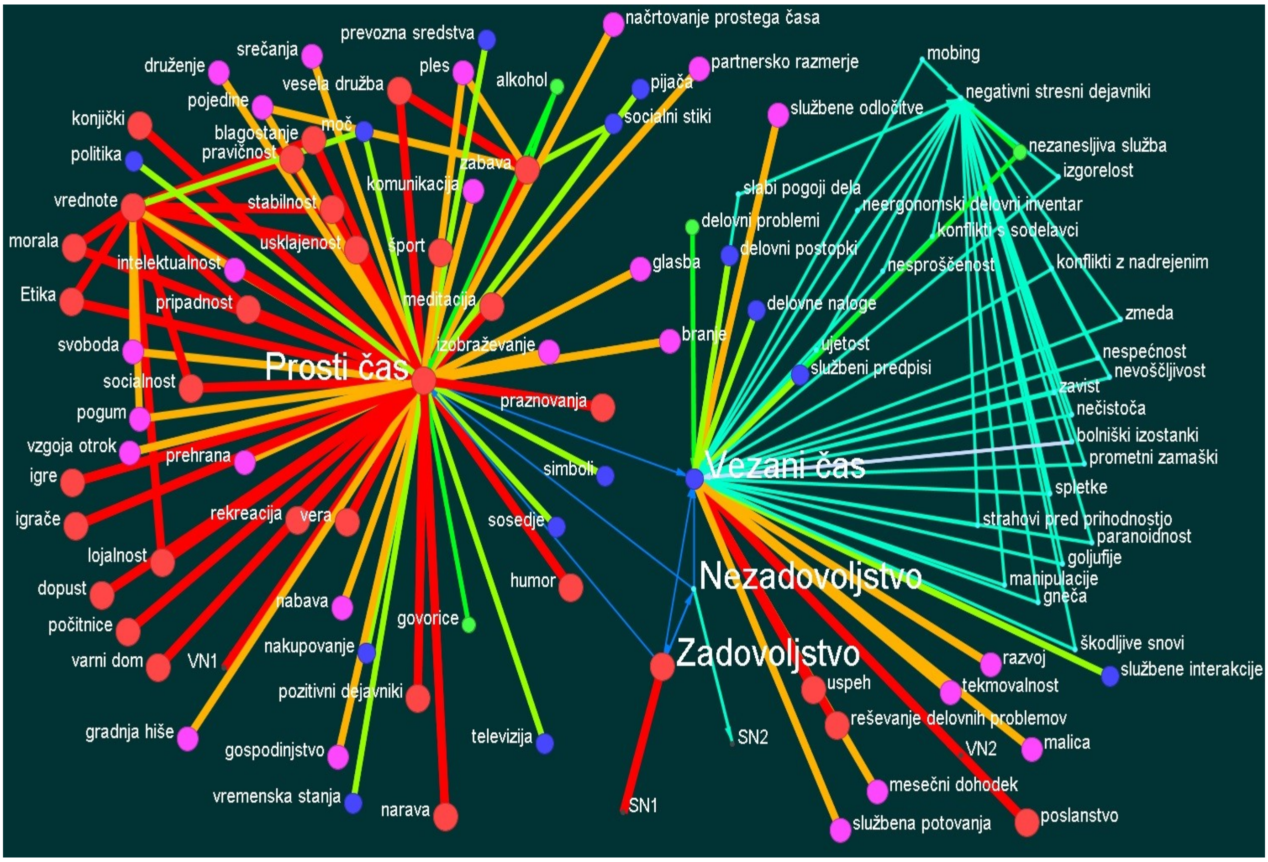
Both economic and political propaganda often use—or even exploit—psychological mechanisms tied to everyday thinking. Economic propaganda, in particular, targets mental-emotional elements related to family life, emphasizing themes like friendly, fast, and efficient communication; entertainment (e.g. amusement parks); happy children; health (e.g. physical fitness); sports adventures; touching or joyful moments; humor; harmonious relationships; healthy and tasty food and drink; religious values; and outward appearances tied to virtue and happiness—along with cheerful and festive holidays.

Political propaganda at the everyday level, on the other hand, primarily focuses on inducing emotional and cognitive responses connected to values such as justice, loyalty, belonging, stability, courage, harmony, intellect, strength, freedom, social awareness, and prosperity. It also plays on temporal and spatial themes (e.g. progress over time, proper orientation), widespread ideas of success and development, and the symbolic power of things like colors, buildings, and religious icons.

Political propaganda vs. economic propaganda at the everyday level of thinking

Unlike economic propaganda, political propaganda makes less use of libidinal stimuli and focuses more on complex mental or content-based concepts. While political propaganda does address individuals, it always does so within the context of the collective—emphasizing either a stable or unstable society. As a result, it often highlights various fears, such as fear of scarcity, economic crises, fear of wrong or harmful decisions, and fear of manipulation.

From both forms of propaganda, we can extract a list of everyday stimuli as well as mental and thematic concepts at the everyday level of thinking. The next step will be to attempt a visual and descriptive representation of the neural networks and stimuli associated with everyday thinking. The method for building these networks will be similar to the one used for the libidinal level of thinking. The difference will be that a larger number of smaller thesauri will need to be created, which will then be processed using the software tool Ora Casos to visualize the networks.



4.4.2.5.2.1 Figure 183: A possible scenario of cognitive (mental)/emotional induction at the everyday level of thinking

Figure 183 illustrates a possible scenario of cognitive-emotional induction at the everyday level of thinking, represented as a content-based neural network. In this network, we are dealing with four main nodes: leisure time (see the larger red node), structured/obligated time (see the smaller dark blue node), satisfaction (see the larger red node), and dissatisfaction (see the smaller light blue node). At this level of thinking, both positive influences and negative stressors act as stimuli that affect the behavior and decision-making of individuals as well as groups. It is important to note that libidinal stimuli were not taken into account, even though they often interact—more or less actively and intensely—with both positive influences and stressors.

In this scenario, the individual and/or group is shown to be in a state of satisfaction, represented in Figure 183 by stronger red and orange connections. Cognitive-emotional inductions at the everyday level function particularly through six strong polarities, such as:

- the contrast between satisfaction and dissatisfaction,
- the experience of leisure time versus obligated time,
- satisfaction gained from utilizing leisure time,
- dissatisfaction resulting from energy loss during obligated time,
- dissatisfaction occurring during leisure time,

- and satisfaction that can still be derived from obligated time.

As seen, these relationships are quite complex, which is why the network has been simplified to a certain extent. Without strong polarizations, powerful cognitive-emotional and mood-based inductions in individuals or groups would not be possible.

Cognitive (mental)-emotional inductions at the everyday level involve significantly more complex mental and content-related concepts than those at the libidinal level. This complexity makes them more enduring over longer periods of time (e.g., ethics, morality, values, faith—especially collective symbols—negative stress factors, job performance, monthly income or basic survival, personal development, sense of purpose). These broadly significant content concepts (such as basic survival needs) tend to become deeply ingrained in the mindset of individuals or groups. They carry greater weight for survival than those at the libidinal level (e.g., physical pleasures, entertainment, sexuality).

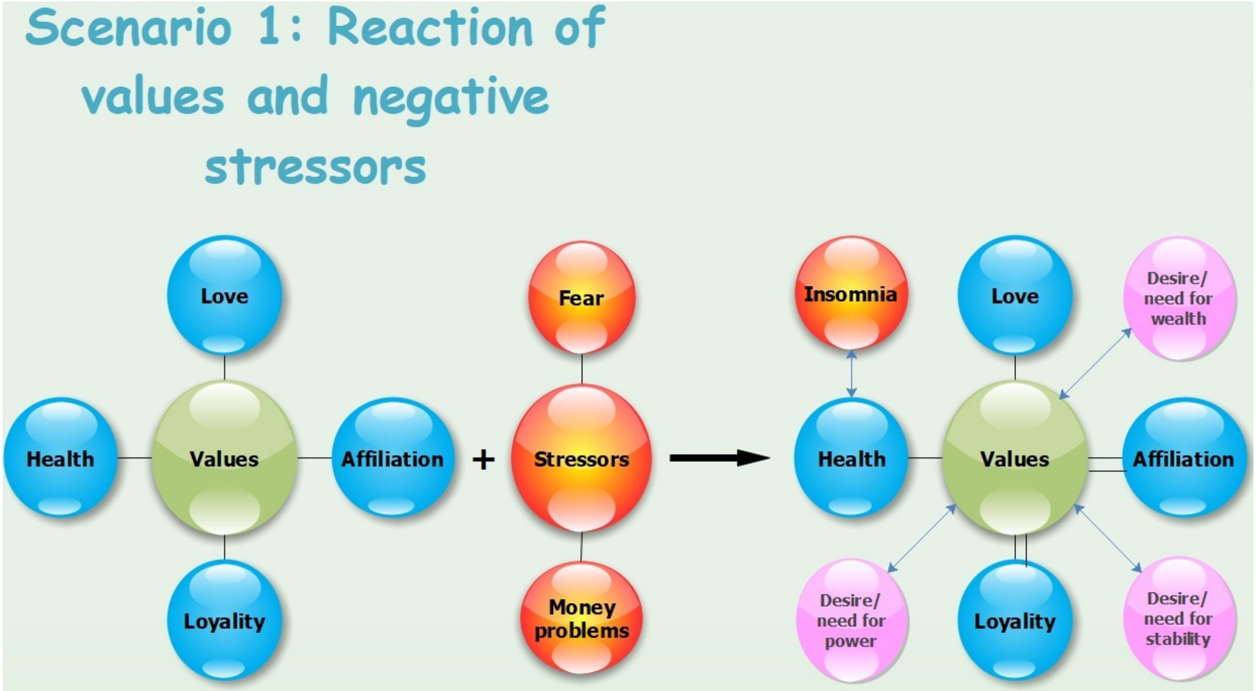
The mentioned strong polarizations likely influence the pH levels of neural networks, which are not only carriers of key content concepts but may also reflect shifts in cognitive-emotional states. The extent of this influence is still not explicitly known. However, the implication is that cognitive-emotional and mood-based inductions have a strong effect on altering the pH values within the brain's neural networks.

How exactly these inductions implant specific content concepts into neural networks is a question that cannot be answered based solely on Figure 183. To understand this, it would be necessary to break down the key content components of these networks and combine them—whether as reactions, stimuli, or through other content-based networks—in order to form new or modified mental/content concepts.

It is a fact that, within the competitive processes between neural networks, more or less intense reactions can occur, resulting in the formation of new networks in the form of radicals. These radicals may supplement existing networks or help establish entirely new ones with significantly altered internal structures, despite the long-term stability of some core elements, such as values or symbols.

It will be necessary to develop simplified models in the form of different scenarios, which can demonstrate how changes in the initial state might lead individuals or groups to accept a certain decision, and subsequently, to take a specific action. Additional stimuli are essentially required—emerging as the result of a reaction between relatively stable values and, for example, negative stress factors—in order to enable the realization of cognitive (mental)/emotional induction at the everyday level of thinking, both in individuals and in groups. In short, based on negative stimuli that threaten part of the value system, various negative and positive scenarios can unfold.

The process of cognitive-emotional induction at the everyday level of thinking can act as a catalyst for a more or less intense reaction between a set of values and negative stimuli. This type of induction may arise from everyday events (e.g., daily interpersonal communication), mass media (e.g., economic and political propaganda), phenomena (e.g., weather, celestial bodies), and regulations (e.g., new laws on austerity measures).

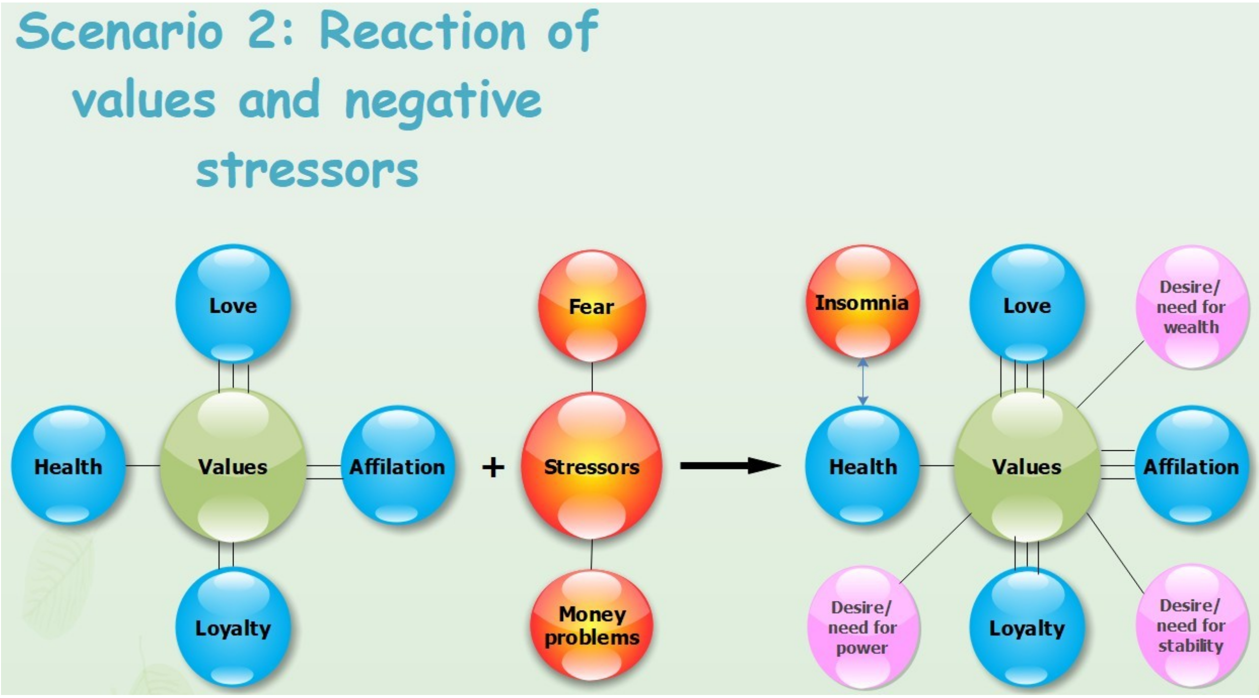


4.4.2.5.2.2 Figure 184: A possible reaction between a compound of values and negative stress factors

Figure 184 illustrates a possible reaction between a compound of values (see the single or bold connections between health, love, belonging, and loyalty) and negative stress factors (such as fear and financial difficulties), resulting in a changed structure and composition of the value compound. When analyzing the outcome of this reaction, we can observe that insomnia threatens health, thereby increasing concern for both mental and physical well-being. The insomnia was caused by fear of the future, further intensified by financial difficulties that may endanger basic life necessities. These negative stress factors also amplified various desires and needs (such as the desire/need for wealth, stability, and power). These desires and needs can themselves become values, strengthening in a way that weakens other values (as shown in Figure 184 by the double connections between values relative to belonging and loyalty).

In short, both an individual and a group of people can find themselves in a state that is conducive to either positive or negative cognitive-emotional induction at the everyday level of thinking. Both the individual and the group may arrive at a particular decision, which could lead to an action—or perhaps not. If the intensity of the problem increases, the path toward action (or actions) becomes shorter. We can imagine that, as long as the issue remains unresolved, typical negative stimuli will keep recurring, and their intensity could grow exponentially over time.

The individual and/or group becomes trapped in the mechanism of cognitive (mental), emotional, and mood-based induction. This process is entirely natural, as the phenomenon of induction is not only encountered in individuals and socially hierarchical associative systems, but also in nature (e.g., two clouds approach each other and trigger a lightning strike). We can confidently state that induction is one of the fundamental mechanisms by which the universe operates.

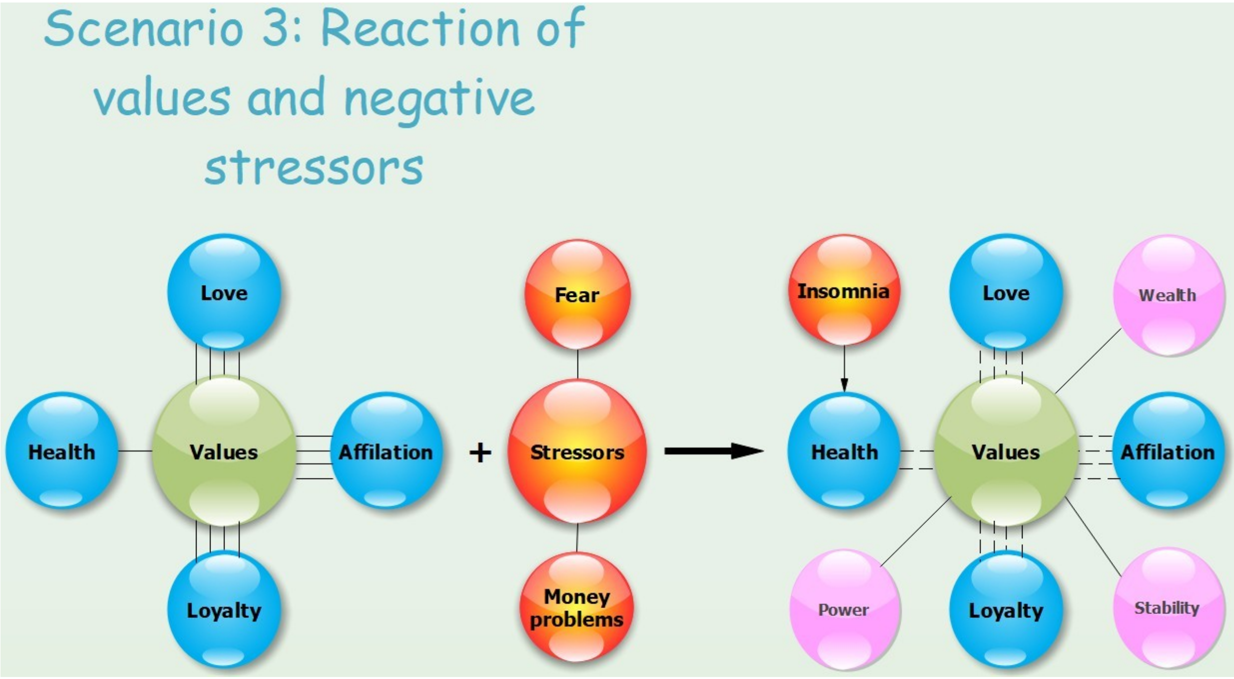


4.4.2.5.2.3 Figure 185: Another example of a possible reaction between a compound of values and negative stress factors

Figure 185 illustrates another example of a possible reaction between a compound of values and negative stress factors. From the outset, we can observe a difference in the compound of values: the connection between the main node and the values of belonging and loyalty is weaker (shown in the diagram as a double bond). An even weaker connection is visible between the main node and love (illustrated by a triple bond), while the connection between the main node and health remains strong (represented as a single bond). The second reagent—the negative stress factors—remains the same as in the first scenario. The outcome of the reaction between the two reagents is reflected in the changed composition and structure of the new compound of values. Values such as love (now shown with a quadruple bond), belonging (triple bond), and loyalty (also triple bond) have lost semantic strength. The represented desires and needs have essentially become strong radicals, now forming values in themselves—such as wealth, power, and stability (depicted with single bonds).

In terms of neural competition, this suggests that values like love, belonging, and loyalty have been overridden by desires and needs for wealth, power, and stability. This shift can significantly influence future decisions made by both individuals and groups. The newly formed compound of values is less stable than in the first scenario (see Figure 184). This reduced stability creates a favorable environment for further reactions, which in turn can lead to stronger cognitive-emotional inductions at the everyday level of thinking. In this scenario, both the individual and the group are approaching a strong polarization between satisfaction and dissatisfaction, forcing neurons out of a dormant state and causing them to fire intense signals that may activate additional neurons. It is highly likely that on a mesocosmic level, intense reactions will take place—both on the part of the individual and the group. As a result, large numbers of people may end up making identical decisions or taking similar actions, even if they are unaware of one another and live in geographically distant locations, without any direct physical contact. It may even happen that many individuals end up at the same place and time, without any prior coordination.

Social hierarchical associative systems often operate very strongly and intensely based on this principle.



4.4.2.5.2.4 Figure 186: A third example of a possible reaction between a compound of values and negative stress factors

Figure 186 illustrates a third example of a possible reaction between a compound of values and negative stress factors at the everyday level of thinking. The initial compound of values, or the first reagent, contains four very weak connections, which indicates that values such as love, belonging, and loyalty hold less significance for a particular individual and/or group of people. If this first reagent is combined with a second reagent containing negative stress-related content, the resulting

reaction may lead to a drastically different value compound—one in which values such as wealth, power, and stability clearly dominate (depicted with single bonds). Values like love, belonging, loyalty, and even health have diminished in value, as shown by the dashed connections.
The individual and/or group is affected by insomnia, which can seriously impact both mental and physical health. The problem in this scenario is that the individual or group no longer even pursues the desire or need for health—instead, there is an extreme focus on wealth, power, and stability. This hyper-focus can lead to the neglect of other important values, such as empathy, friendship, harmony, integrity, honesty, and honor, allowing negative and harmful traits to surface—traits like dishonesty, sociopathic tendencies, excessive egocentrism, hatred, envy, cruelty, and others.
Such an individual or group may still function within the bounds of what appears to be mental normality (e.g., no detectable psychotic disorders), but from an ethical and moral standpoint, their mental state cannot be considered healthy. This scenario describes people who have entered a state of tunnel-like mental focus. While psychiatry does not yet classify this as a severe obsessive-compulsive disorder, and even less so as a psychotic disorder, all other mental faculties—such as intelligence, temporal and spatial orientation, communication, and speech—remain intact. Perhaps it would be worthwhile to study such individuals more closely?
Both the individual and the group in this third scenario are highly susceptible to cognitive-emotional inductions centered around material wealth, power, and stability. They are far less, or not at all, receptive to inductions related to positive values. This could mean that through their extreme or tunnel-like thinking—which is often socially accepted—they spread negative influence to others.
Only three scenarios from the neural network depicted in Figure 183 have been presented here, but we can imagine many more, involving more or less intense neuronal reactions. These reflect the competitive dynamics between various content-based neural networks. This competition gives rise to stronger or weaker polarizations, especially between satisfaction and dissatisfaction, creating fertile ground for cognitive-emotional induction processes—even without direct physical connections.
We now continue with the subchapter on cognitive-emotional inductions at the philosophical level of thinking.

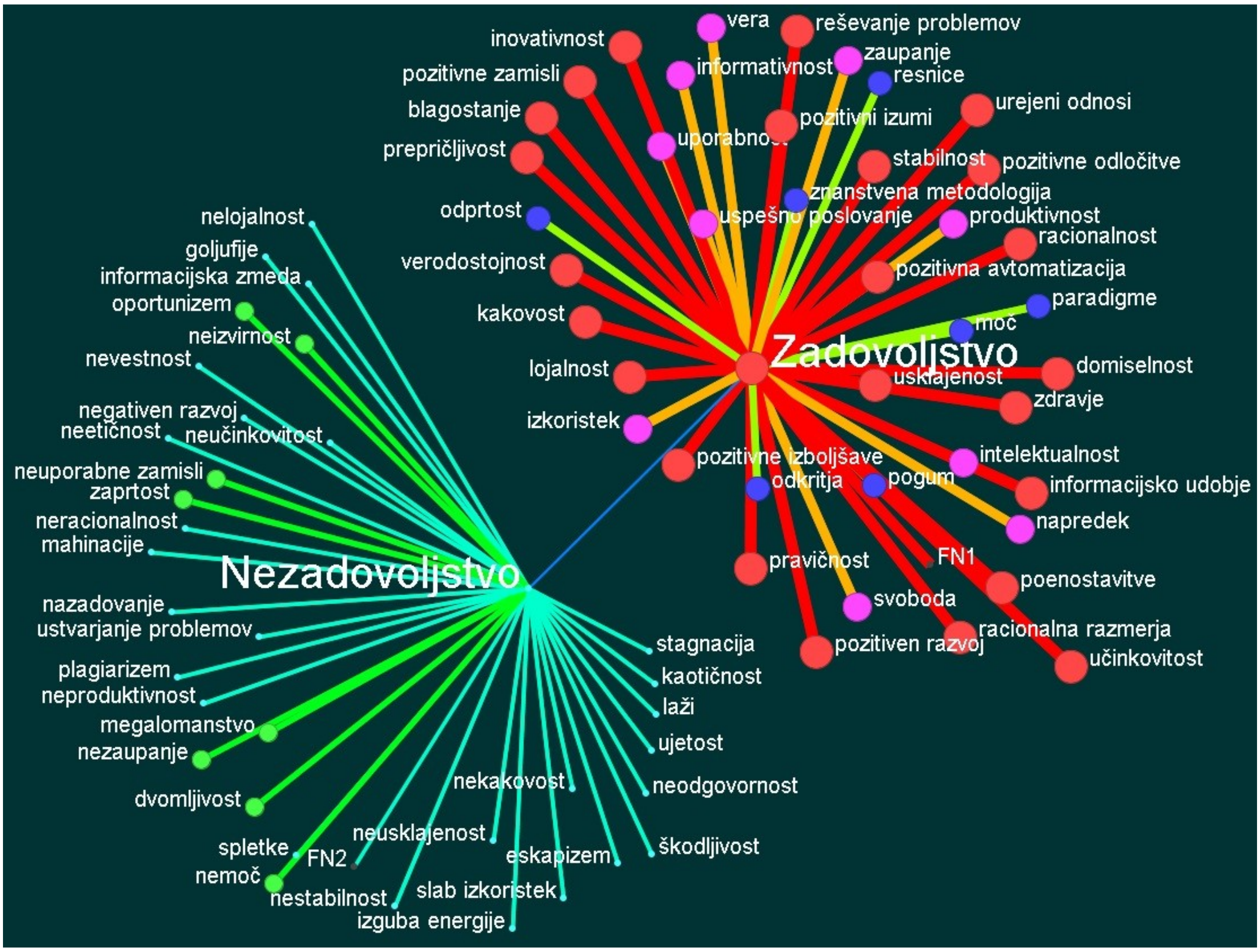
4.4.2.5.3 Cognitive (mental)/emotional induction at the philosophical level of thinking

The philosophical level of thinking is a content-based extension of the libidinal and everyday levels of thinking, meaning that cognitive-emotional inductions are even more complex at this level—though not as rare as one might expect. They appear in areas such as business, politics, innovation, and science. These are fields that exert the most significant influence on every social hierarchical associative system.

Although these systems could theoretically function without the philosophical level of thinking, this level does not form the foundation for the survival of the human species. The same cannot be said for the libidinal and everyday levels of thinking, which together form the basis for survival. The philosophical level of thinking most likely emerged out of a necessity for more reliable survival and system functioning.

The human brain often operates by seeking optimal solutions that include a degree of prestige—a pattern already discussed in the subchapter on the physical system, specifically in relation to sugar absorption. The human brain is not satisfied with just the basic amount of sugar it extracts from the blood; it will never resist an excess of this substance and can be extremely greedy in this regard. In survival terms, this means that the bare minimum is not sufficient—there is always a need for a certain level of surplus or prestige (e.g., food storage, banks, supply chains, production, event planning, food acquisition, data/information, buying clothes and shoes).

Based on this premise, we will first present the content-based neural network of satisfaction and dissatisfaction at the philosophical level of thinking.

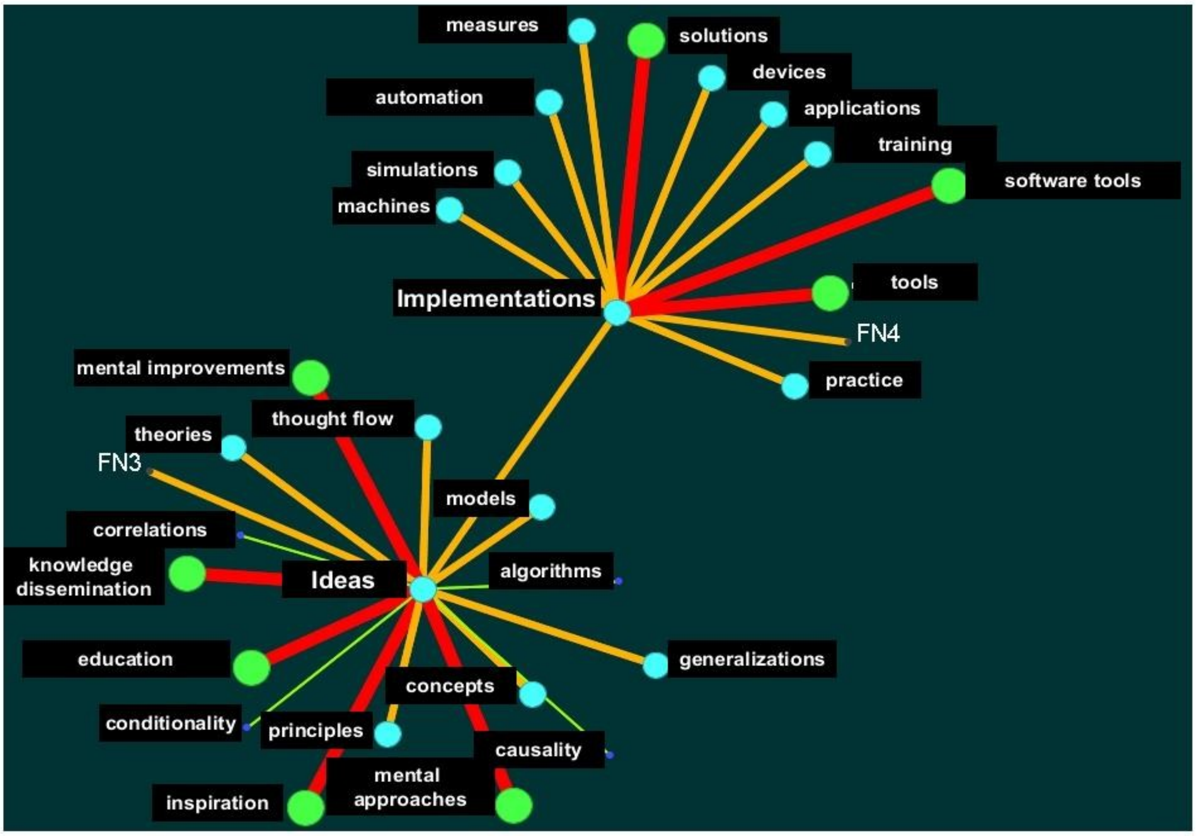


4.4.2.5.3.1 Figure 187: Content-based neural network of satisfaction and dissatisfaction at the philosophical level of thinking

Figure 187 illustrates the content-based neural network of satisfaction and dissatisfaction at the philosophical level of thinking. This network is predominantly composed of values (e.g., courage, loyalty, stability, justice, efficiency, intellectuality, progress), positive orientations (e.g., positive improvements, informational comfort, discoveries, simplifications, positive decisions), and negative orientations (e.g., misalignment, closed-mindedness, informational confusion, distrust, regression). Within this content-based neural network, emotional elements appear to be absent—not because emotions do not exist, but because they are largely rationalized and, as will be explained later, are linked to the libidinal and everyday levels of thinking. Cognitive-emotional induction at the philosophical level of thinking is, from an emotional standpoint, more concealed and less noticeable. Therefore, it can be said that emotions mostly influence this level of thinking indirectly. The core directions of the philosophical level of thinking are built upon content-based components such as progress, efficient use of resources, useful ideas, positive decisions, problem-solving, positive development, constructive ideas, and informational quality or informational comfort. On one hand, the philosophical level of thinking aims to create a better world. On the other hand, it strives to achieve a certain level of prestige, which is intended to provide an advantage over competitors—who may be other people or even other animal species.

From this second perspective, the goal is essentially the realization of superior management and control functions. However, these do not always result in a better world; they can also lead to intense competition and, consequently, to many conflicts and chaotic outcomes.

A positive balance between satisfaction and dissatisfaction at the philosophical level of thinking depends on two main currents: idea generation and execution. Without both, satisfaction at this level of thinking cannot be achieved.

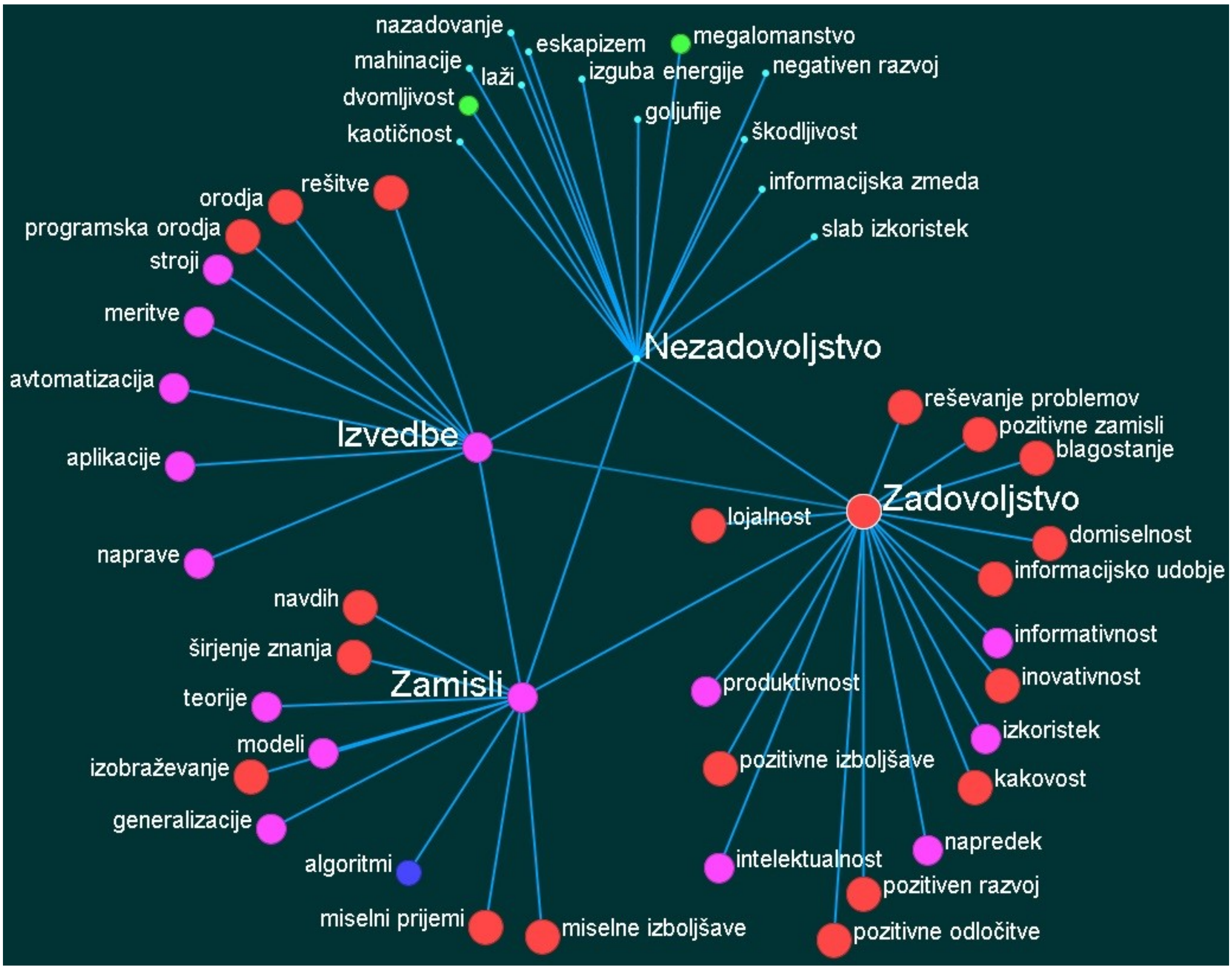


4.4.2.5.3.2 Figure 188: Content-based neural network of ideas and implementation/execution at the philosophical level of thinking

Figure 188 illustrates the content-based neural network of ideas and execution at the philosophical level of thinking, which serves as the main driver of satisfaction in relation to dissatisfaction. If the generation of ideas (e.g., theories, models, cognitive improvements) and their implementation (e.g., applications, solutions, tools) begins to decline, a negative scenario of dissatisfaction arises. In contrast, as shown in Figure 188, a positive scenario of satisfaction emerges when both are active and sustained.

The outcome of a positive scenario does not depend solely on the content-based neural networks of satisfaction/dissatisfaction and ideas/execution. It is also influenced by the positive or negative tendencies of the neural networks at the libidinal and everyday levels of thinking, including stimuli that vary in intensity and strength as they reach neurons in the brain.

In the following sections, it will be important to present the merging of both neural networks—satisfaction/dissatisfaction and ideas/execution—in order to demonstrate their generic interdependence. It can be assumed that this combined network will be fairly extensive and complex, and therefore will need to be abstracted down to its most essential content-based components.

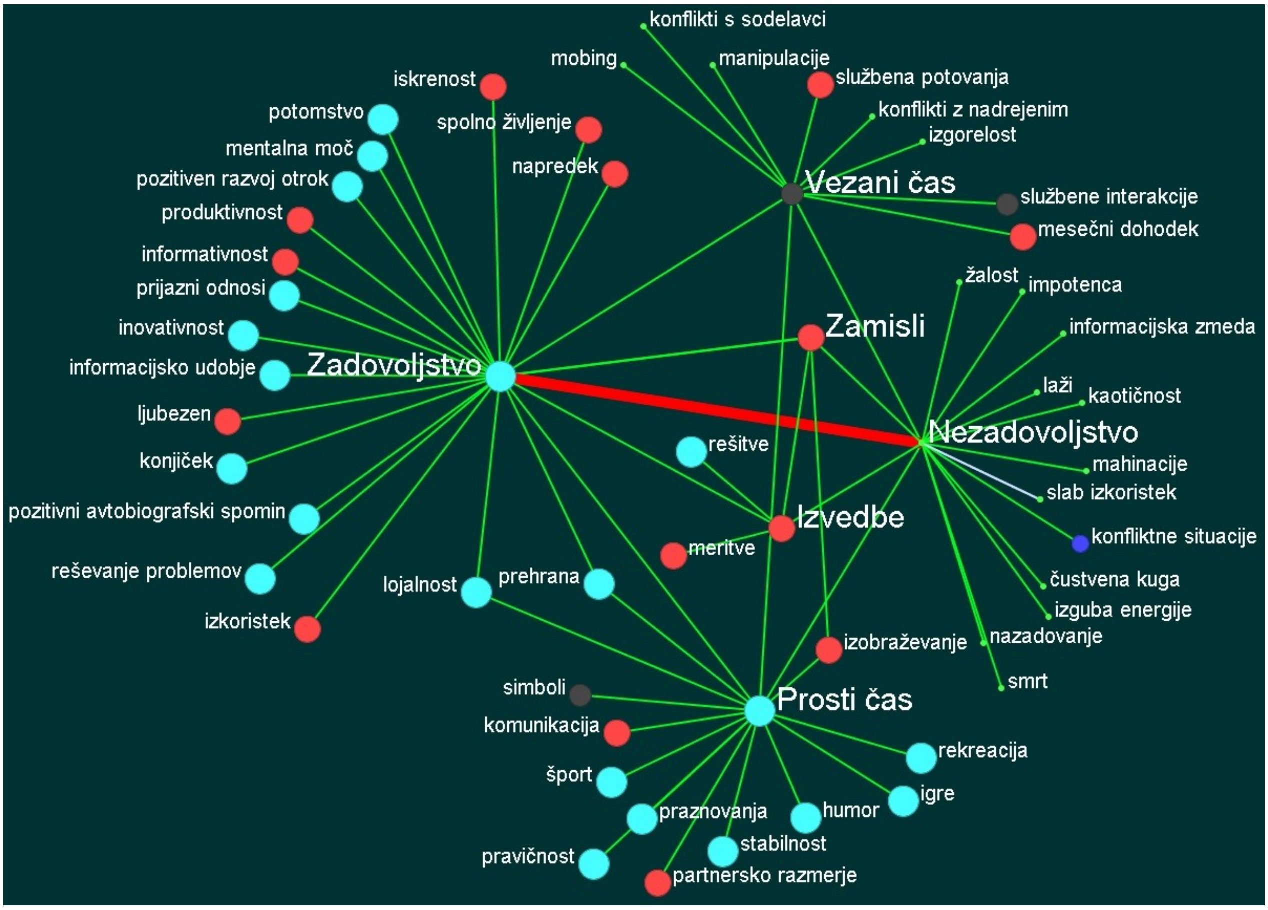


4.4.2.5.3.3 Figure 189: A small section of the neural network of satisfaction, dissatisfaction, ideas, and execution at the philosophical level of thinking

Figure 189 depicts a small section of the content-based neural network of satisfaction, dissatisfaction, ideas, and execution at the philosophical level of thinking. We can observe a continuous interconnection between the main nodes (represented in larger font in Figure 189) and their content components (e.g., theories, models, progress, positive development, solutions, applications, informational confusion, fraud).

Based on this illustration, we can identify a positive scenario in the form of satisfaction, which results from both positive and practical ideas as well as their successful execution. The part of the neural network labeled "Dissatisfaction" has a weaker influence, as indicated by smaller nodes. In this network—characterized by both collaboration and competition—satisfaction prevails, being the outcome of strong ideas and effective implementation.

As previously announced, the next step will be the synthesis (in a simplified form) of the main nodes from the libidinal, everyday, and philosophical levels of thinking. This synthesis will illustrate the constant interconnectedness between these different levels of thought. Such a presentation is necessary for further explanation of how mental-emotional inductions operate in relation to a given individual and/or a given group of people.



4.4.2.5.3.4 Figure 190: Synthesis of content-based neural networks in a simplified structure

Figure 190 presents the synthesis of content-based neural networks in a simplified structure, where we can observe the connections between the libidinal, everyday, and philosophical levels of thinking. The state of satisfaction at the philosophical level is not only dependent on useful ideas and their execution but also on the positive contributions from the libidinal level (e.g., love, sexuality) and the everyday level (e.g., hobbies, kind relationships, food), which is illustrated in Figure 190 by a strong red link between the nodes of satisfaction and dissatisfaction.

We are shown a positive scenario of satisfaction, represented by a large blue node, while the node of dissatisfaction is significantly smaller. From the history of science, business, warfare, innovation, etc., we know that useful ideas and executed solutions were not solely the result of positive influences—they often emerged precisely due to negative stress factors and other pressures from external circumstances (e.g., climate change, natural disasters, population mortality).

On the one hand, the development of useful ideas and executions in human evolution can be attributed to the internal content-based neural networks in the human brain (e.g., internal will, mental lexicon, autobiographical memory). On the other hand, we must also acknowledge the impact of external networks at the mesocosmic level (e.g., social networks, collective will) and the macrocosmic level (e.g., cosmic networks, light, higher-level will).

In short, the human neural network of will is not limited to the interconnections between various neurons in the brain that carry different types of data/information/knowledge. These neurons are also connected to other networks that collectively influence the will of individuals, groups of people, social hierarchical associative systems, as well as natural hierarchical associative systems. This ultimately means that humans are not the only beings that act as magnetized information systems—other living beings also manage similar functions, though usually in a less complex form, driven by the will to live. In this regard, the human species is the most advanced in processing and transmitting data/information, and is also driven by the will to live.

Human dependence on other living beings and the very foundation of the Earth is extremely strong and intense—something we often overlook in our partial isolation. The desire and need for prestige is much greater in humans than in other living beings, and this can be explained by the structure and flexibility of content-based neural networks in the human brain.

So how does mental-emotional induction affect an individual and/or a group of people? We can answer this question using the example of scientific social networks, which, despite relatively strict hierarchical relationships, cooperate and are not solely exclusionary in nature.

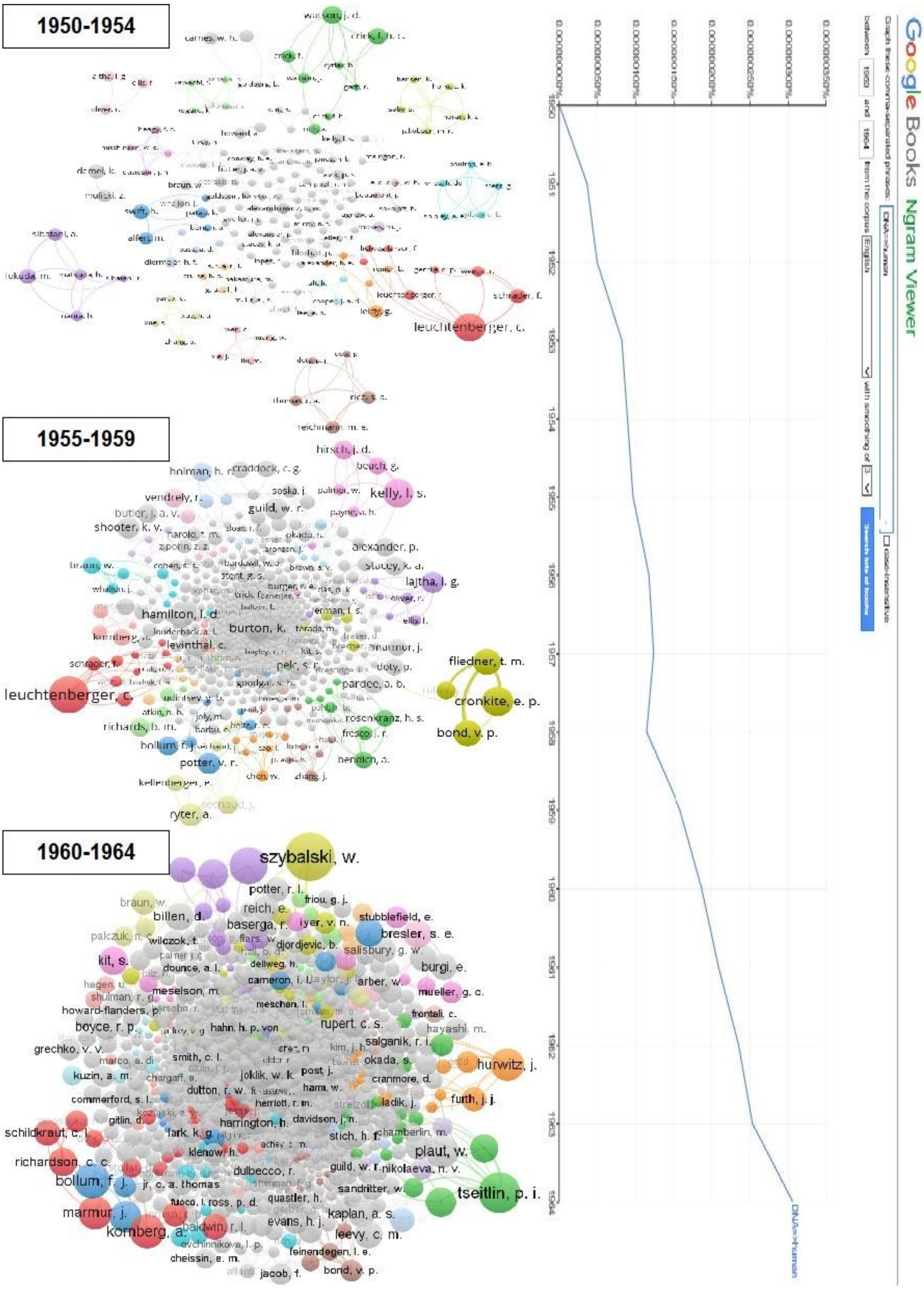
As an example, we will use the exponential growth in publications related to the topic of DNA from 1950 to 1964. A query using the software tool Publish or Perish was conducted with the keyword "DNA" appearing in titles and the keyword "human." Various types of publications were included—articles, scientific monographs, conference proceedings, online works, etc. A similar search was performed using Google Ngram Book Viewer (1950–1964, DNA => human), which included only monographic publications.

The concept of DNA was not unknown before 1950; writings about DNA existed already in the 19th and early 20th centuries. However, the true turning point for intense interest in human DNA occurred around 1950 to 1953, when scientists James D. Watson and Francis Crick developed the double helix model, which explained the storage and replication of genetic information in living organisms. Their model was based on evidence derived from X-ray diffraction methods, with Rosalind Franklin making a particularly critical contribution.

There were rumors that Watson and Crick partly appropriated Franklin's idea of the double helix, although clear evidence never surfaced, and these rumors eventually died down. In 1962, Watson and Crick were awarded the Nobel Prize for their groundbreaking scientific discovery.

The discovery spread rapidly across the world, with new researchers continually contributing to DNA-related scientific work. It even reached the point where scientists were researching day and night, constantly uncovering new components of the DNA molecule. The double helix model became a kind of belief system—because science cannot exist without belief. And in this context, belief does not only mean faith in God or gods. True scientists must believe in certain theories and models as strongly as priests believe in their deities.

Debating the relevance of belief is ultimately unnecessary, because without it, humanity would be merely a shell without true function or motivation. Every belief represents a certain program of diverse mental concepts—without which our neural networks would not be what they are.



4.4.2.5.3.5 Figure 191: Exponential growth of publications and authors in the field of DNA

Figure 191 illustrates the exponential growth of publications and authors in the field of DNA from 1950 to 1964, highlighting a remarkable increase in the number of contributors. This is depicted on the left side of the figure in the form of scientific social networks. An increasing number of scientists began to believe in the double helix model.

The right side of the figure shows a graph shaped like an exponential function, created using the online application Google Books Ngram Viewer. This demonstrates the exceptional production of monographic publications that were written and publicly released in the field of human DNA. Notably, within the network of authors, many contributors (e.g., 2,610 authors between 1960 and 1964) worked independently of one another, often without any personal acquaintance or direct contact. The belief in the double helix model of human DNA enabled a shared cognitive program and thus provided a strong basis for mental-emotional induction. It is well known that belief systems can unite and connect large groups of people, even without physical interaction. There are numerous cases in which scientists independently arrived at the same idea or theory while living in completely separate and distant locations.

Often, certain theories—and eventually even their practical implementations—build upon existing ones, even though the individuals involved were unaware of each other. Though it may seem magical, there are explanations for this phenomenon.

In the case of the discovery of the DNA double helix, we can infer that scientists were primarily driven by desires and needs related to health, as a better understanding of DNA's structure could offer new ways to treat diseases that had previously eluded humanity. At the same time, there were ambitions to manipulate genetic material to enhance traits and even search for the elusive formula for eternal youth and immortality. These very desires and needs were already present among alchemists in the 16th and 17th centuries.

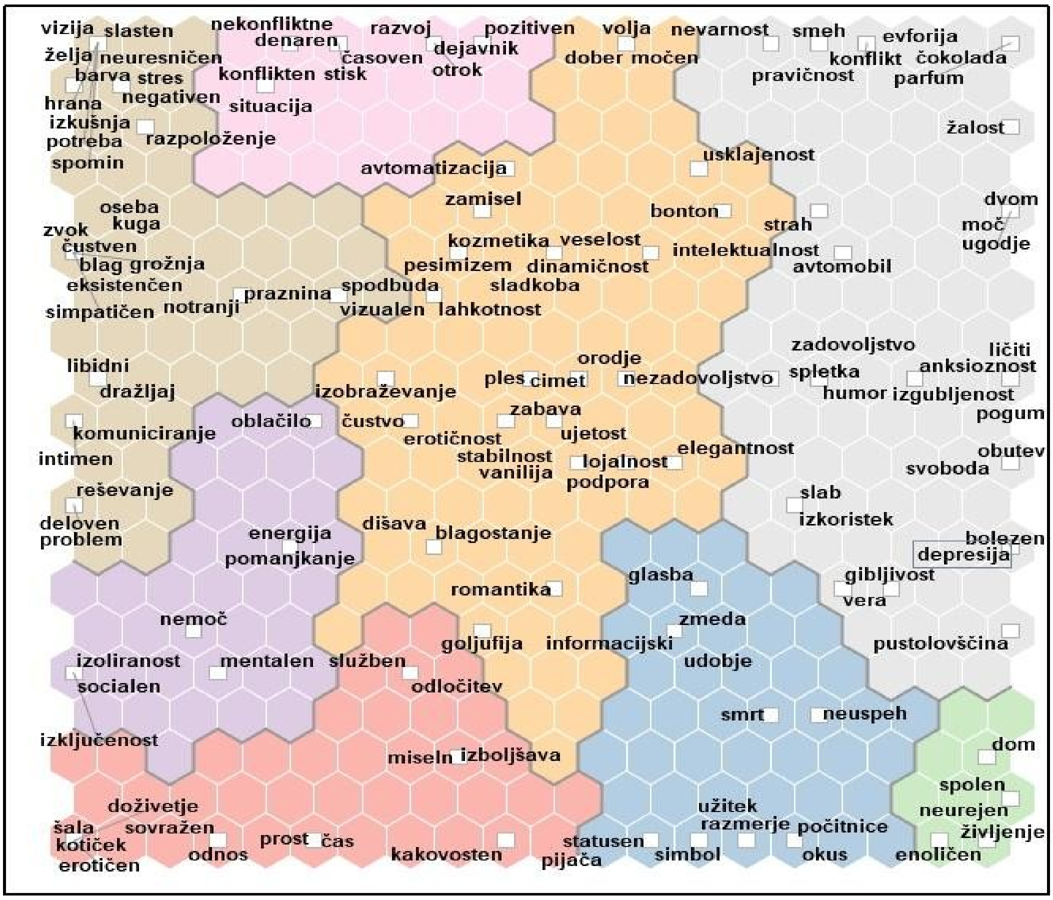
In the following section, a series of visualizations will present important content-based concepts that can form the foundation for the process of mental-emotional induction—a process to which much of the human population is subject. Using the text analysis tool KH Coder, an analysis was performed on texts extracted from previously presented micro-thesauri (e.g., libidinal, everyday, and philosophical levels of thought).

The purpose of this analysis is to illustrate the content concepts that collectively form a programmatic algorithm of thinking, in which various levels of thought are interwoven. It can be assumed that both individuals and groups who share a specific belief (in this case, the DNA double helix model) and a common conceptual foundation will think and even act similarly. These individuals and/or groups become relatively unified, even without knowing each other.

Within such a relatively uniform content-based network infrastructure, important information, insights, and even knowledge can be processed in the collective conscious and unconscious.

In short, to initiate the process of mental-emotional induction, identical conceptual building blocks and a certain global motivational force are required—something we can define as the will to live and belief. Belief—whether in gods, theories, models, progress, or even immortality—is the motivational engine that other living beings in nature likely do not possess. The written text provides an additional reason why members of the human species are the most powerful carriers of diverse data and information, which are processed, analyzed, and disseminated among individuals and/or across larger or smaller social networks.

Already fifty years ago, reports warned of an information explosion, and today we are essentially in need of solutions to mitigate this issue. It should also be noted that the processes of mental-emotional induction may become even more intense and powerful in the future—especially due to increasingly large and densely populated urban communities—which could potentially trigger a surplus of critical population mass and, consequently, collective telepathy.



4.4.2.5.3.6 Figure 192: Content concepts grouped into clusters

Figure 192 presents content concepts organized into clusters that primarily illustrate the interwoven nature of different levels of thinking, represented through terms grouped as conceptual "landscapes." These landscapes should not be viewed as static, since the intense activity of neurons and neural networks causes them to change frequently. Concepts that are currently in the foreground may fade into the background due to processes such as synthesis, association, and dissociation, or new conceptual compounds may emerge, potentially reshaping the boundaries between groups.

Based on a simulated snapshot of the content from various neurons or neural networks within an individual and/or a group of people, it is difficult to clearly identify a link between the topic of DNA and other concepts. Additionally, within this snapshot, there is no strong presence of the concept of "health." Instead, health is indirectly expressed through terms such as "disease" (see the white conceptual landscape), "depression" (see the white conceptual landscape), and "death" (see the blue-gray conceptual landscape).

Such conceptual snapshots are highly dependent on the current situation, optimal health conditions, personal experience, knowledge, mood, emotions, mental focus, and the dominant level of thinking.

The lowest level of interweaving between different levels of thought occurs when an individual or group is in a state of strong mental concentration directed toward scientific research, accompanied by a positive or at least neutral mood, positive or neutral emotions, rich experiences, a well-stocked knowledge base, and favorable conditions for research and critical thinking.

Under such conditions, many content concepts—such as dance, cinnamon, entertainment, sweetness, romance, cosmetics, and nutrition—recede into the background (but do not disappear entirely). At the same time, already present concepts like development, tools, automation, problem-solving, energy, efficiency, information, vision, improvement, and factors may become more prominent.

Individuals and/or groups who, under the influence of mental-emotional induction, decide to explore the field of DNA are assumed to share a common mental foundation. This foundation could most easily be identified with the help of a short questionnaire, asking about their reasons for interest in DNA, their visions regarding it, and so on. In essence, the area of mental-emotional induction is closely connected to the question of how a particular individual and/or group came to a specific idea.

The next logical step would be to present a snapshot of an individual and/or group in a state of minimal interconnection between different levels of thinking.

4.4.2.5.3.7 Figure 193: A new snapshot of content concepts

Figure 193 presents a new snapshot of content concepts that significantly obscure many of the previous elements due to intense mental concentration on scientific research. This naturally raises the question of what caused these changes.

The content concepts shown in Figure 192 were primarily focused on everyday life (e.g., family well-being, colleagues, friends, family, leisure) and to a lesser extent on the libidinal level of thinking (e.g., relaxation, entertainment), while already hinting at elements of the philosophical level of thought (e.g., reading, books, culture, development). The main reason for the change in conceptual landscape lies in the tendency of both individuals and groups to seek a favorable balance between comfort and discomfort—ultimately striving for comfort and resulting satisfaction.

Another significant factor is the autobiographical memory of individuals and/or groups, which, supported by the will to live and belief in purpose, guides people into specific mental positions and corresponding activities. Yet another important cause lies in the overcoming of problematic content concepts (e.g., negative development, problems), which can undermine the personal integrity of individuals and/or groups.

Equally relevant is the need to defend core values (e.g., stability, peace, understanding, security, cooperation), without which it becomes difficult for a person to build and develop their personality.

The snapshot in Figure 193 highlights particularly strong content concepts from the world of scientific research in the health field, which can be associated with medicine, biology, pharmacology, genetics, and more.

We can assume that individuals and/or groups working on the subject of human DNA share a common content foundation, which guides and regulates the more or less intense reactions of content-based neural networks in the human brain. This assumption helps to explain the processes of mental-emotional induction, which—consciously or unconsciously—unite both individuals and groups involved in human DNA research.

In short, there is a specific set of core content concepts that influence relatively uniform thinking and behavior directed toward the exploration of human DNA. This shared conceptual basis—or even a kind of mental program—interacts with mass media and both formal and informal communication, ultimately contributing to the exponential growth of authors in the field of human DNA between 1950 and 2019.

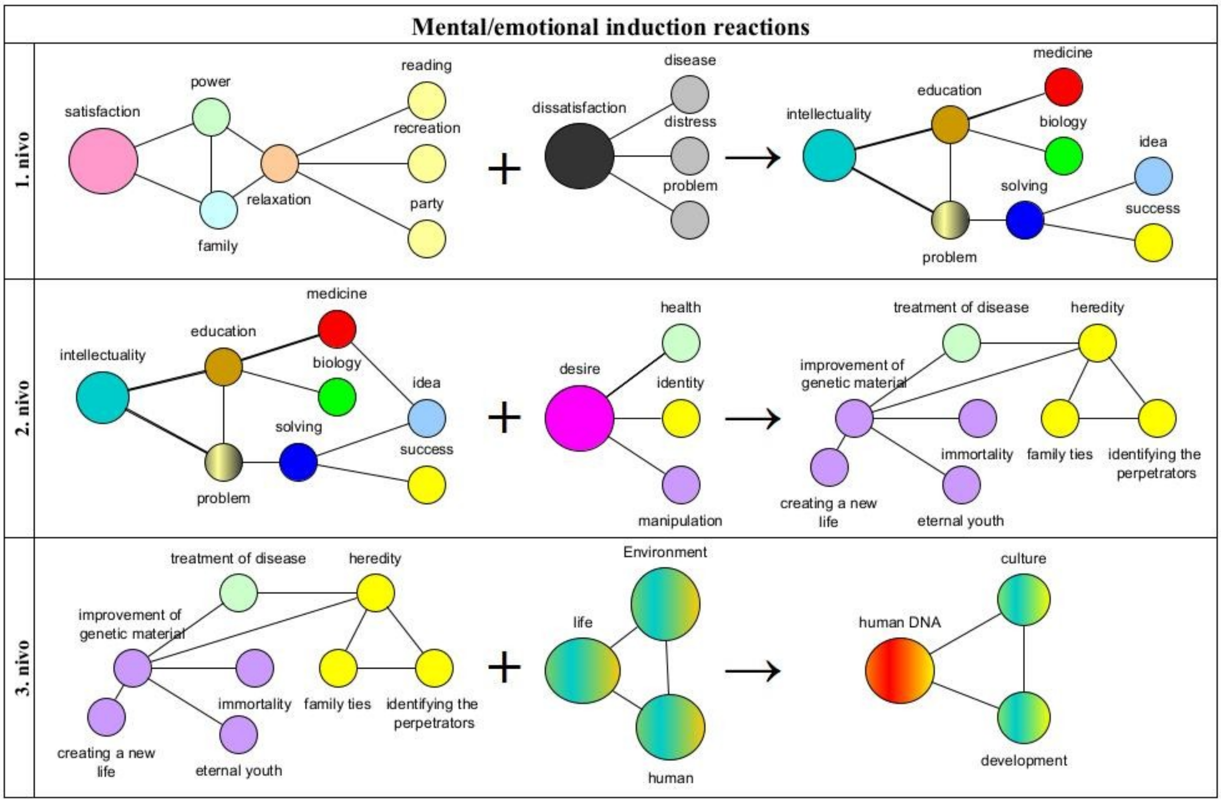
Some scientists are closely connected, while many others are only indirectly linked—or not at all—but are still united by a common intellectual program, certain scientific authorities, and, to some extent, shared visions (e.g., curing diseases, the quest for eternal youth, or even immortality).

For greater clarity, it would be useful to illustrate some of the interactions that could occur between content concepts and, consequently, among parts of the content-related neural networks.

The field of human DNA fundamentally revolves around three main directions:

1. Identity – including heredity, family relationships, and criminal forensics;
2. Health – such as the desire to cure previously incurable diseases;
3. Manipulation – the enhancement of genetic material and thus human capabilities, the pursuit of eternal youth and immortality, and the creation of biological artificial intelligence or lab-generated life.

Scientists deeply involved in DNA research typically align with at least one of these three pathways. This alignment creates a strong content concept we can call a vision, which essentially serves as a program for thinking. That vision can shape similar foundational algorithms for ideas, activities, and decisions—both for individuals and larger groups.



4.4.2.5.3.8 Figure 194: A possible course of mental/emotional induction reactions using the example of human DNA

Figure 194 illustrates a possible course of mental and emotional induction reactions across different levels, using the example of human DNA. All the reagents shown are derived from the conceptual snapshots presented in Figures 192 and 193.

At the first level, a reaction occurs between the content concepts of satisfaction (which includes values like strength and family, and activities such as reading, recreation, and entertainment) and dissatisfaction (which includes content elements such as illness, stress, and problems). On the right side of this level, where the interaction takes place, the result is shown as a content molecule. This molecule contains elements such as intellectuality, education in medicine and biology, problems paired with solutions, all of which are tied to the ideas of innovation and success.

This reaction is far from over. It continues to the second level, where the first reagent is the result from the first level, and the second reagent consists of desires related to health, identity, and manipulation. The outcome at this level forms a clearly defined content molecule that may drive individuals and/or groups toward specific conceptual directions.

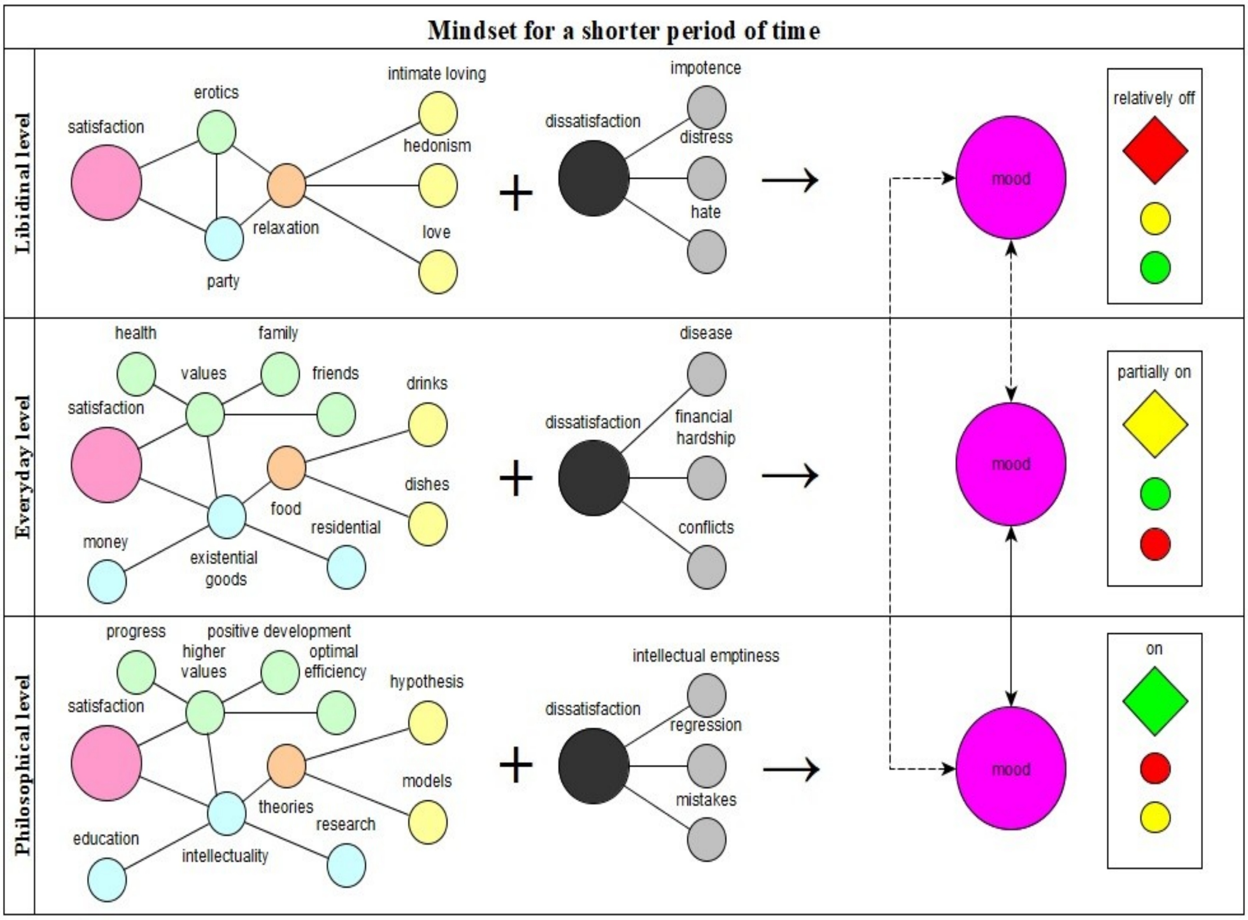
The reaction then moves to the third level, where the previous result reacts with a reagent representing the global content foundation of human reality (life, environment, and humanity). The outcome here suggests that certain individuals and/or groups have consciously chosen to focus on the field of human DNA in relation to scientific development and culture.

These multi-level reactions (of which there could be many more) illustrate the conceptual potential that can be embedded in individuals and/or groups, prompting them to engage in scientific research related to human DNA. The final result at the third level can be interpreted as a content-based programmatic algorithm that influences the thoughts and activities of various individuals and/or communities.

The number of possible combinations for such mental-emotional induction reactions—especially at the philosophical level of thinking—is virtually endless, both within individuals and among groups. Depicting even a fraction of these reactions would require an entirely new scientific monograph.

In truth, this subsection has explored highly complex content-related neural networks, which often operate in the background of consciousness in sequential time patterns. In contrast, the foreground of human consciousness at any given moment tends to be dominated by much simpler content concepts. This seems to be a natural predisposition—ensuring that the conscious mind focuses only on the most existentially and personally vital content concepts, thereby preventing cognitive overload.

To better illustrate this explanation, a visual representation of this thought process is also suggested.



4.4.2.5.3.9 Figure 195: Mental reactions over a short time period across levels of thinking

Figure 195 illustrates mental reactions over a short period of time, organized by levels of thinking, which may apply more or less to any individual. The outcome of these reactions results in a specific mood, which in this case is positively oriented.

The libidinal level of thinking is relatively deactivated, the everyday level is partially active, while the philosophical level is fully engaged. In Figure 195, this is represented by traffic lights at each level: a green diamond indicates full activation, yellow indicates partial activation, and red indicates relative deactivation.

This mental state, however, can quickly shift with the appearance of new stimuli—for example, receiving a phone call about an unpaid bill, feeling hungry, or noticing an attractive person. In such cases, either the everyday or libidinal level of thinking may become dominant.

Based on the illustrated reagents and reactions, it appears that philosophical-level thinking processes are at the forefront, while reactions at the other two levels occur more subtly in the background. This type of mental pattern could be characteristic of individuals from the progressive group or those with an extremely hierarchical mindset, but is less likely to apply to members of the general population or those exhibiting anomalous behaviors.

Satisfaction (e.g. eroticism, entertainment, existential security, values, intellectual motivation) results in a sense of pleasure, which leads to a positive mood. On the other hand, dissatisfaction (e.g. impotence, negative stress, financial difficulties, intellectual emptiness) produces a sense of discomfort, leading to a negative mood.

In all cases, the mental reactions—whether at the forefront or in the background of human consciousness—are shaped by existing circumstances and specific situations. This tells us that the dynamics of thought processes can vary in intensity depending on context.

From Figure 195, we can also deduce that, within a limited time frame, the active thinking at the forefront of consciousness is not overly complex. Only small parts of the vast content-based neural networks are engaged at any one time; the rest remain dormant or operate in the background.

In principle, the model from Figure 194 could be mathematically represented as a system of three equations, but with a twist: in addition to addition, other mathematical operations such as subtraction, multiplication, and division could be used.

We could take it a step further by assigning weights (e.g. from 1 to 5) to the individual components of satisfaction (X = satisfaction) and dissatisfaction (X = dissatisfaction). These weights would represent the intensity of the value, while the levels of thinking could be assigned exponents—libidinal level as exponent 1, everyday level as exponent 2, and philosophical level as exponent 3. This would result in a system with one linear and two exponential equations. Using this computational model, we could calculate a mood coefficient (Y = mood).

The mathematical formulas for calculating the mood coefficient across levels of thinking could be as follows:

$$Y_{rl} = 6x - 3x = 3x$$

$$Y_{rv} = 10x^2 - 3x^2 = 7x^2$$

$$Y_{rf} = 10x^3 - 3x^3 = 7x^3$$

Based on the given example, the result would be coefficients of positive mood. However, there are other possible methods for determining the value of x. Let us present another method as an interesting experiment.

In this conceptual context, the values of x would not be determined using ratings from one to five, but rather through the pH values of individual components of satisfaction and dissatisfaction, which could be obtained via a chemical reaction between one molar hydrochloric acid (HCl) and one molar sodium hydroxide (NaOH). In this setup, sodium hydroxide (NaOH) would represent the reagent for satisfaction, while hydrochloric acid (HCl) would represent the reagent for dissatisfaction.

In a 500 ml beaker, we would add 10 ml of NaOH for each content component of satisfaction (for example, at the libidinal level of thinking: eroticism, entertainment, relaxation, intimate interaction, hedonism, love) and 10 ml of HCl for each component of dissatisfaction (e.g., at the libidinal level: impotence, negative stress, hatred). After the chemical reaction between NaOH and HCl, we would measure the total pH value of the resulting solution, which would represent the mood value. The higher the pH, the more positive the resulting mood would be.

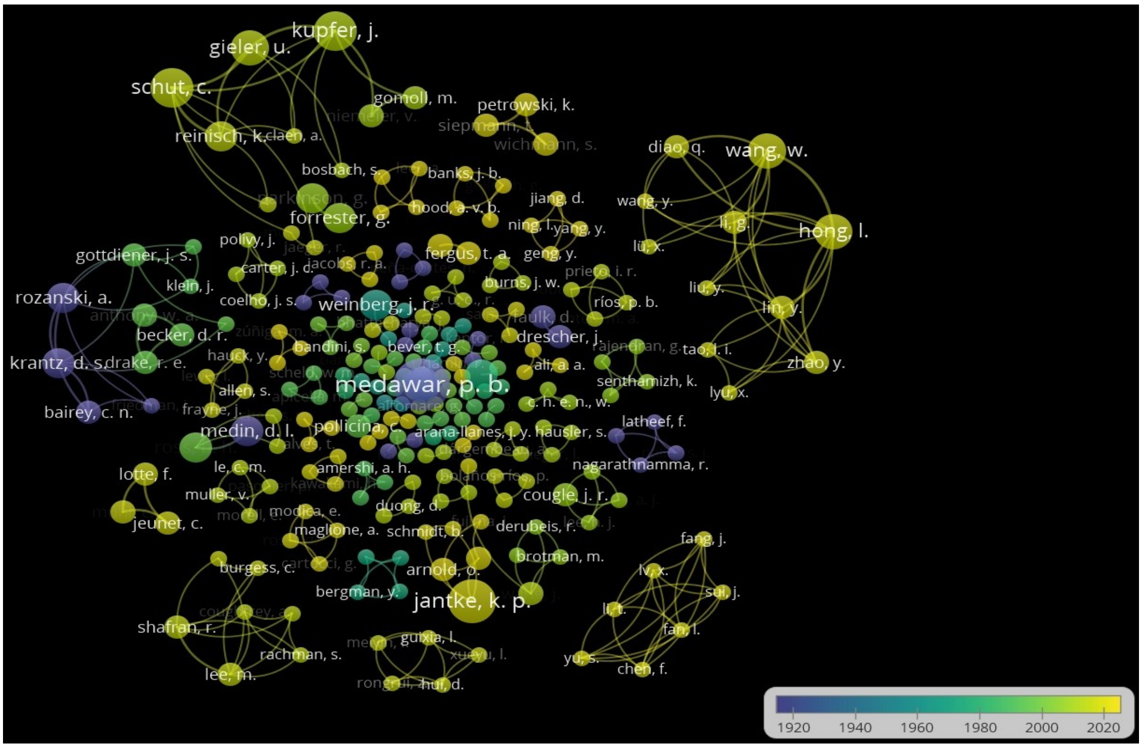
This same experiment would then be repeated for the everyday and philosophical levels of thinking. Using this approach, and through many tests with various combinations of components, one could construct a system (similar to DNA) for determining mood.

It is clear that a single individual is not capable of creating such a precise system or model for determining mood. Instead, numerous scientific teams would have to believe in this idea and work tirelessly day and night to make progress in this area. Belief in such a model necessarily demands a vision of its practical and added value. This, ultimately, is the essence of science.

As a final thought, one could consider the possibility of determining mood, emotional states, and mental/emotional induction with exact precision. Within this context, we could imagine assigning both content and pH value to every neuron in the human brain. At first glance, this may seem like a distant dream—but if we consider the efforts of the Human Brain Project and current technologies capable of recording neurons and measuring their pH, then we can assume that such a concept could one day become reality.

Realizing this idea could lead to a better understanding of individuals and society, potentially driving the development of new information technologies, such as biologically-based information systems (e.g., intelligent humanoid robots based on biological or biologically-inspired foundations).

With this thought-provoking concept, we conclude the subsection on mental-emotional induction. At the very end of this chapter, we will also present a network of global literature (including titles and authors) related to mental induction, in order to provide a general sense of how relatively underexplored this field remains.



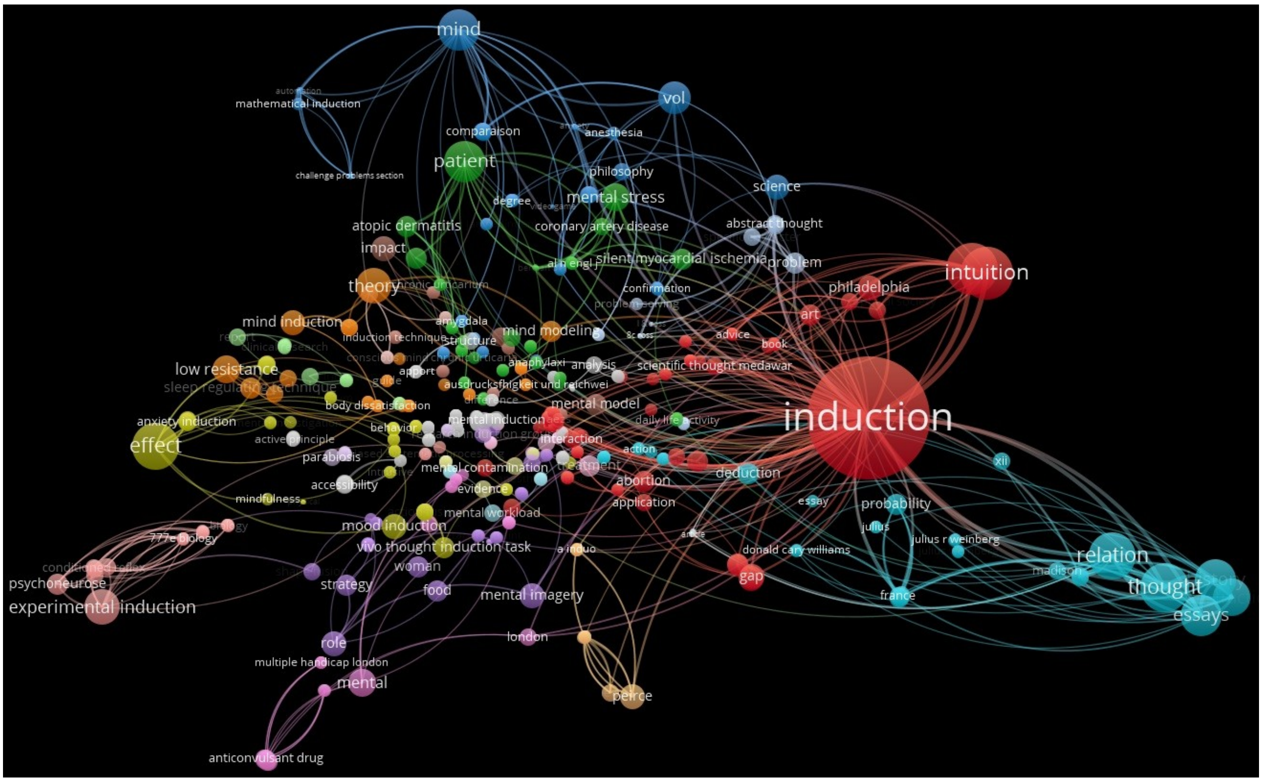
4.4.2.5.4 Figure 196: Network of authors in the field of mental induction

Figure 196 depicts a network of 340 authors who have published their scientific and professional works in various journals, monographs, etc. These publications were released from 1920 to 2019. It can be observed that the highest number of authors published their scientific and professional works between 2010 and 2019. This indicates that interest in the topic of mental induction increased during this period.

The author network in the field of mental induction is not at all similar to the networks of authors in the areas of mood or emotional induction. Moreover, in this field, we are still unable to establish scientific authority. Within this network, two authors stand out:

1. Wei-Dong Wang: He published works on mental induction (also called mind induction, thought induction, or mental induction) from 2011 to 2018. He authored 10 publications covering topics in psychology, psychotherapy, and medicine. His work in this area has been cited 15 times.

2. Klaus Peter Jantke: He published works on mental induction from 2012 to 2018. He authored 12 publications related to computer science, informatics, and game theory. His research primarily focused on user modeling in connection with mental induction through computers and user interfaces. His work has also been cited 15 times.



4.4.2.5.4.1 Figure 197: Network of concepts from the titles of works in the field of mental induction

Figure 197 presents a network of concepts (696 in total) drawn from the titles of works in the field of mental induction. Scientific and professional publications on mental induction primarily originate from the fields of computer science, mathematics, psychology, psychotherapy, biology, and medicine. Particularly noteworthy are works that discuss the treatment of diseases in patients using positive emotional induction (for example, slowing the progression of cancer by influencing positive emotional states).

With regard to patents in the field of mental induction, it can be observed that the products are similar to those found in the areas of emotional and mood induction. In the following section, we will briefly introduce a special possible form of mental/emotional induction, which is more commonly known as telepathy.

4.4.2.5.5 Telepathy

Telepathy has been extensively explored by both parapsychologists and psychologists. Telepathy is essentially a natural phenomenon where communication or the transfer of thoughts or data/information occurs in a universal language without direct physical contact. This can be verbal, auditory, visual, tactile, olfactory, energetic, thermal, etc. Telepathy represents a means of communication and, consequently, the exchange of data/information among members of various social groups, not limited to humans but also including other living beings (e.g., ants, bees, wolves, plants).[70]

In the previously discussed inductions, we somewhat neglected the diversity and multiplicity of the universal language and focused more on the conceptual part of content neural networks for easier understanding. Therefore, it is important to highlight this fact here. Telepathy can be a special form of mental induction if thoughts are accepted and integrated from one individual to another or into a group of people.

From a strictly materialistic perspective, telepathy is attributed the characteristic of a parapsychological phenomenon because it cannot be explained or understood through materialistic views. The existence of telepathy serves as evidence for external consciousness that coexists with the internal consciousness of every living being in a kind of informational/communicative symbiosis. The interaction between external and internal consciousness involves energy fields that together form a specific energy infrastructure, which can also be referred to as the spirit, which similarly cannot be explained or understood using a materialistic model. In short, the fields of the spirit exist both within and outside our brains.

The essence of all these communications and the subsequent exchange of data/information or thoughts lies in the exchange of various types of energy, which can move a static state (or not) and create dynamics directed towards actions from the perspective of living beings (this dynamics can translate into movement for inanimate parts of nature). Emotions are of exceptional importance for the transfer of thoughts from one living being to another, as emotional closeness between two living entities determines the effectiveness of the telepathic process.

Regarding the energy fields within and outside the human brain, it has been mentioned that they represent the spirit. In this connection, there is also the human soul, which is not limited to the human brain but to the entire human body system, which produces and loses energy based on the exchange of data/information and thoughts (thoughts can be information or represent knowledge and even wisdom). The spirit is connected to the soul through energy fields within the human brain, which essentially means a kind of repository or storage of signals, data, information, knowledge, wisdom, or the total energy that a particular person possesses.

The spirit and soul cannot function in symbiosis without faith, which is not just belief in a monotheistic or polytheistic god but also other beliefs, such as faith in science or positive values. The spirit and soul also cannot create a meaningful and pragmatic symbiosis in the form of exchanging data/information, thoughts, etc., and consequently energy, without the will to live.

70 Petrič, K. (2020). The social and scientific challenge of telepathy [preprint]. https://www.doi.org/10.13140/RG.2.2.12236.80004/1.

Telepathy does not occur only among people but also between people and animals, particularly emphasizing pets (e.g., dogs, cats). Telepathic transmissions between people and other living beings are not possible without an appropriate energy, information, and communication infrastructure. The basic building blocks for the existence of the telepathy phenomenon are induction fields in the form of mood, emotions, and thoughts, which can be conditionally equated with software. There must also be a hard component, which can be called the physical part of the materialistic infrastructure, capable of producing or converting energy.

From our perspective, the universe is so comprehensive that we can assert and even believe many things, with a small probability of being mistaken. The question now is whether our assertions are sufficiently key and useful? The prevailing materialistic dogma, especially in exact and applied sciences, is not wrong in itself, but its emphasis is overly strong, leading to a situation where humans cannot see, let alone understand, many things crucial for their survival. Telepathy is a natural phenomenon that we still do not understand because this materialistic dogma of doubt prevents us from establishing the appropriate mental infrastructure. This is an excellent example of the strong influence of mental and emotional inductions on humanity, which lives in technological, relatively legally and socially organized hierarchical associative systems.

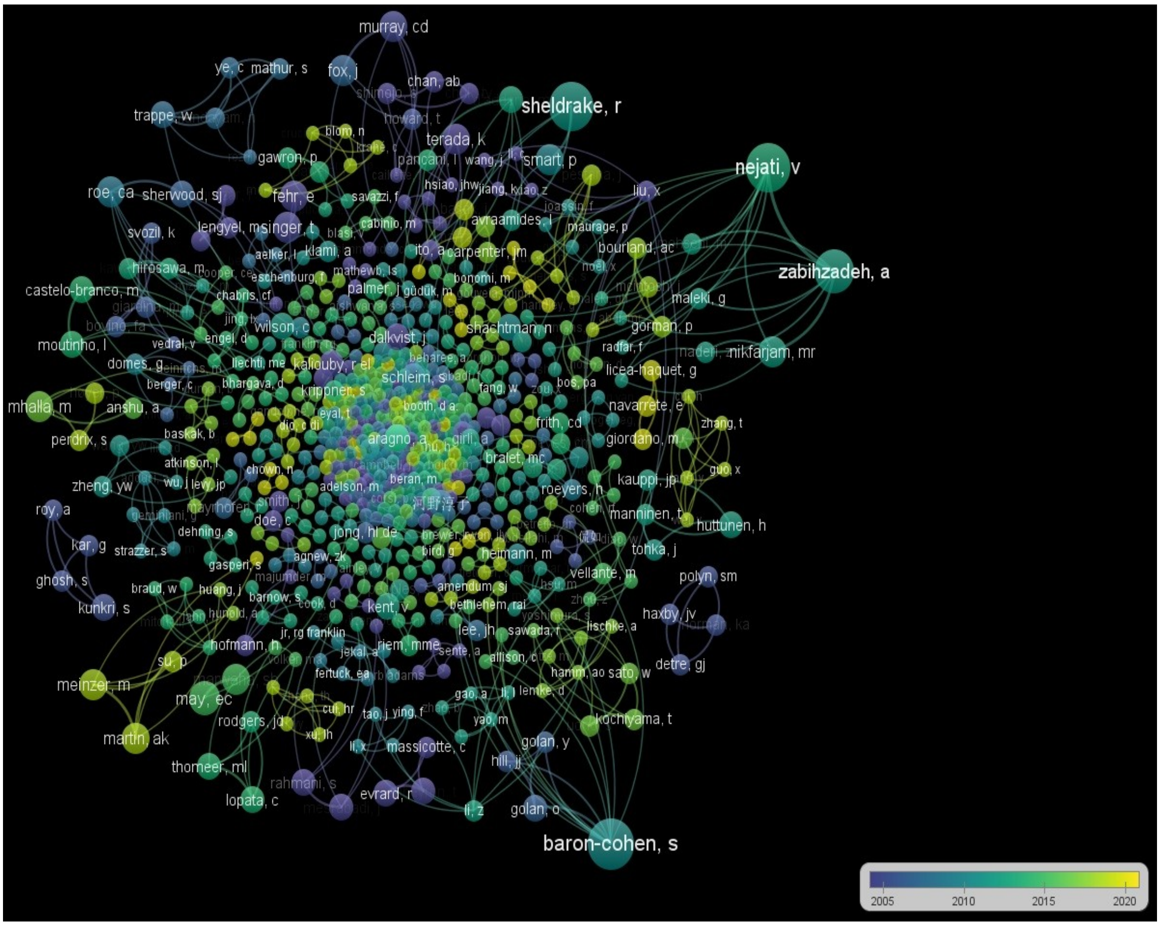
We can convince ourselves that we believe in telepathy and even assert that it is a completely normal natural phenomenon (see definition), but the content of the materialistic dogma, which has been embedded for centuries, is so influential that faith in the existence of telepathy is unwittingly in doubt. Telepathy is very difficult to place within an extremely materialistic-oriented social hierarchical associative system because an extreme materialistic view excludes external or extended consciousness of living beings, which is a prerequisite for the existence of telepathy. By acknowledging external or extended consciousness, it could happen that the structure of the social hierarchical associative system, which is relatively pyramidal, would change significantly. Precisely in this regard, there is no global interest among influential members of the social system, who are predominantly business and management motivated (in control and expanding influence). In short, there are strong reservations about the phenomenon of telepathy because, from the perspective of certain influential individuals, it could mean disrupting the social balance that seeks to maintain an extremely profitable and influence-expanding materialistic logic. This type of mindset is encountered not only at the business and political levels but also within the world of science. The widespread recognition of external or extended consciousness would simultaneously imply that not only visible or socially acknowledged hierarchies exist, but also hidden or unofficial ones. This primarily means that individual A might hold a superior position over individual B within a recognized hierarchy, while being subordinate to individual B in a hidden hierarchy. Thus, two hierarchies would emerge: one operating in the foreground and one in the background, because external or extended consciousness presupposes that people are, consciously and unconsciously, interconnected in complex spiritual networks without direct physical contact (similar to the internet).

Within these extended or external spiritual networks, not all people are connected with equal strength, and often these connections are merely indirect. Likewise, not all people possess equally strong and intense telepathic abilities, as someone might transmit signals, data/information, and even thoughts that other individuals can receive, yet both individuals remain unaware of this process. Numerous combinations and speculations are possible, as it is difficult, or perhaps even impossible, to prove this. Telepathy, despite numerous persistent and rigorous scientific efforts, remains poorly understood. Furthermore, we do not yet possess adequate technological tools to demonstrate the existence of hidden or unofficial hierarchies.

It is also very difficult to comprehend the full meaning of a universal language that is not limited merely to words. The primary prerequisite for a better understanding of the phenomenon of telepathy is the explanation of the concept of mood, emotional, and mental induction. This means we need to gain a better understanding of (content-based) neural networks and even individual neurons, not just within the human brain but throughout the entire bodily system. The fundamental global building blocks that enable the transmission of thoughts without direct physical contact over greater or lesser distances are the will to live, the power of belief, and an action-oriented mindset. The aforementioned essentially constitutes the basic programming backbone that enables the establishment of a telepathic energy-information communication infrastructure at the libidinal, everyday, philosophical, as well as the holistically intertwined levels of thought. There is little doubt that such an infrastructure exists, yet we cannot currently prove it. The same applies to the transfer of data/information from past periods to the present, occurring when dying living beings, just before death, release energy in the form of data/information into other living beings, who are mostly unaware of this process. Thus, a piece of distant history remains latently present, albeit in fragments. They can only be recalled by specific events, phenomena, rules, emotions, experiences, substances, etc.

Through these aforementioned spiritual fields or spiritual networks, data/information travels from both the distant and short-term past into the relative present, and consequently, into the future. The question now is whether data/information travels only gradually from distant past epochs into the relative present? For certain data/information, we know that humanity has recorded it in numerous publications of various forms. In this respect, we can assert that that data/information travels gradually from the distant past into our relative present. However, we can neither assert nor prove a

similar transfer of data/information via spiritual fields or networks from the distant past into the relative present. It may even happen that certain fragments of data/information from the distant past only manifest after many centuries or even millennia.
Such a transfer of thoughts from distant time periods would imply that every living being is effectively a kind of time machine, storing and disseminating diverse data/information. This would simultaneously mean that absolutely nothing is lost. If we were to consider the model of parallel worlds, explaining the telepathic transfer of thoughts across distant past time periods through diverse spiritual fields or networks would become even more complex. This could imply that the entire universe is an extremely flexible mass and energy simultaneously, and that it can truly be interpreted associatively. Based on collected mental associations, representatives of the human species can agree upon and form hierarchical associative models of a given reality.
In short, in this view, hierarchy arises based on numerous mental associations, as the entire universe and our given reality can be interpreted hierarchically and associatively based on the will to live, belief (e.g., meaning, vision, mission, God), and an action-oriented mindset. The entire universe can appear as a specific flexible/elastic mass and energy simultaneously, which can be explained precisely through a hierarchical associative mindset. This simultaneously means that everything we can directly and indirectly perceive, and subsequently develop, can be valid. Numerous different paths lead to a certain validity, whereby we can use various models for explaining a given reality, which can be solidified as universal truths through multilateral agreements among members of the hierarchical associative system.
Within the universe, which is simultaneously flexible and elastic mass and energy, we can create our given, accepted reality. In this reality, we can perceive hierarchies, rules, laws, etc., while simultaneously also perceiving chaos. The telepathic transfer of thoughts is merely a small part of this freely assembled cosmic puzzle, which may be connected to travel through different time intervals.
To conclude this subsection on telepathy, let us examine the trends of interest in world literature on telepathy from 2005 to 2020.



4.4.2.5.5.1 Figure 198: Network of authors in the field of telepathy

Figure 198 displays the network of authors in the field of telepathy, which was obtained using the query Telepathy OR "mind reading" OR "thought transference" OR "extrasensory perception" within the title words search field in the Publish or Perish software tool.[71] The time constraint for the query was set as the interval from 2005 to 2020. During this period, 1,237 authors contributed 922 scientific and professional papers in the field of telepathy, with these papers being cited 17,041 times (an average of 18.48 citations per paper). We will now examine in more detail the authors who published the highest number of papers in the field of telepathy.

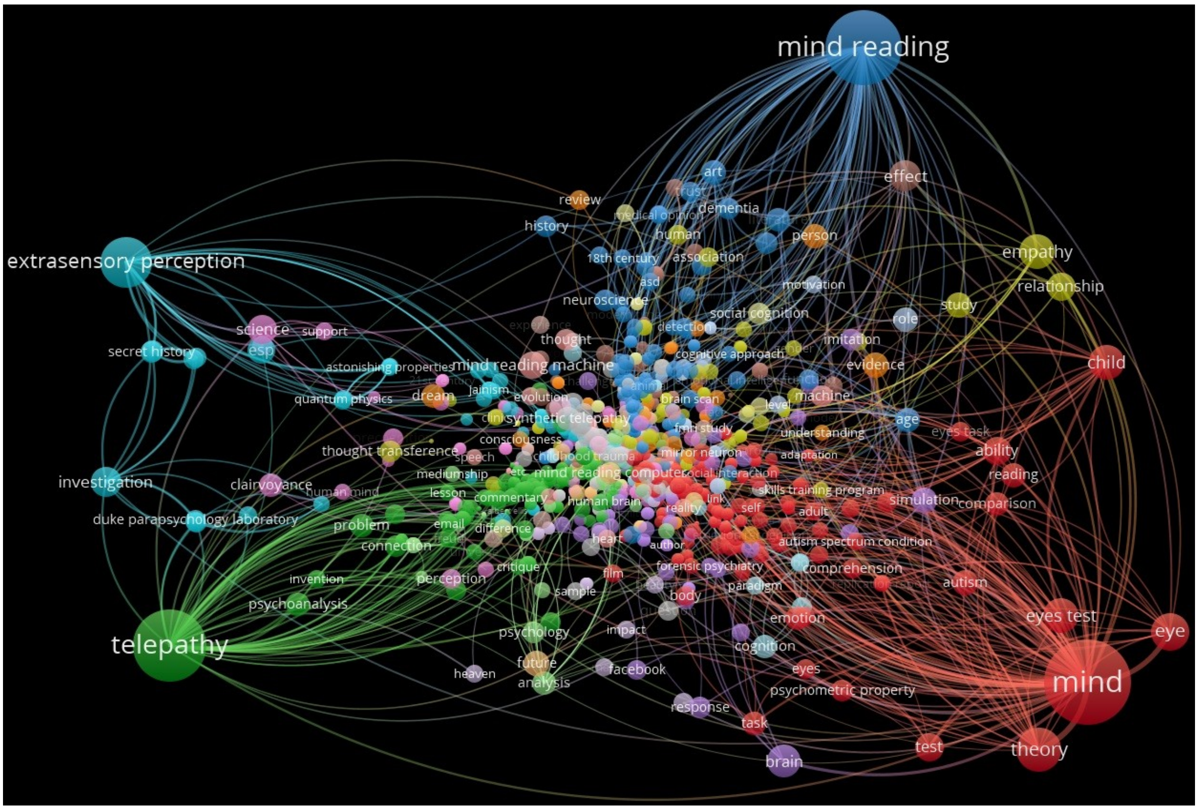
1. Simon Baron-Cohen: An English psychologist who published 14 scientific papers related to telepathy (published between 1995 and 2017), which have been cited 6,477 times. This author has been very active in the fields of psychology and cognitive neuroscience, focusing primarily on the study of autism. This means his overall scientific endeavors are not focused on the field of telepathy, and therefore he cannot be considered a scientific authority in this specific area. This assertion can be supported by the fact that this scientist published 956 scientific and professional papers between 1995 and 2020, which were cited 118,391 times. Simon Baron-Cohen focused more on mind reading than on telepathy itself. Mind reading involves the interpretation of thoughts rather

71 The query was performed on January 4, 2020 at 3:00 p.m.

than their transmission, which is why the concepts of telepathy and mind reading cannot be entirely equated. In connection with autism, the scientist Diane Powell conducted interesting experiments claimed to be promising in demonstrating that some individuals with autism possess exceptional telepathic abilities.

2. Rupert Sheldrake: An English biologist and parapsychologist who published 15 scientific and professional papers related to telepathy between 2002 and 2016, with these works being cited 248 times. His areas of interest are diverse and interdisciplinary, as the author has published works in the fields of spiritual studies, philosophy, biochemistry, and biology. He has engaged significantly with the topic of science itself. His body of work comprises 396 scientific and professional papers, cited 10,006 times. In one of many interviews, he indicated he would continue to work on telephone and email telepathy in the future. Nevertheless, Rupert Sheldrake is also not currently considered a scientific authority in the field of telepathy.
3. Vahid Nejati: An Iranian scientist in the fields of psychiatry and neurology, focusing on human brain research. Between 2012 and 2018, he published nine scientific and professional papers in the field of telepathy, which were cited 48 times. His entire scientific research output includes 215 bibliographic units, cited 1,127 times. This author also focused much more on mind reading than on telepathy.
4. Abbas Zabihzadeh: Also an Iranian scientist in the fields of cognitive science and psychiatry. In the field of mind reading, he published six papers between 2012 and 2020, which were cited 35 times. His entire body of work consists of 27 bibliographic units, cited 63 times. Similar to Vahid Nejati, he is a relatively young author who also cannot be considered a scientific research authority in the field of telepathy.

An analysis of the directions of interest in the field of telepathy, based on words from the titles of scientific and professional papers, follows.



4.4.2.5.5.2 Figure 199: Conceptual network of the telepathy field based on publication titles

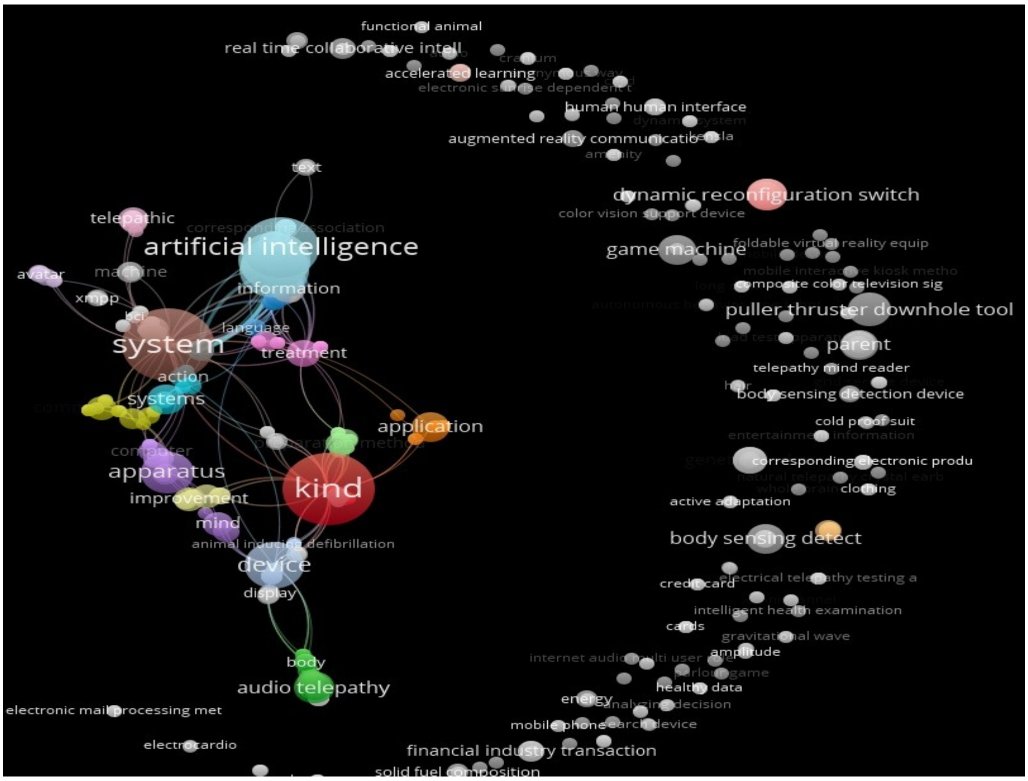
Figure 199 displays the conceptual network of the telepathy field, based on the titles of scientific and professional papers. This conceptual analysis will be used to examine the main directions of interest within the field of telepathy. The main directions of interest were as follows:

- Quantum telepathy – connects various scientific disciplines, such as quantum physics, game theory, information technology, mathematics, etc. A very interesting concept is quantum entanglement, which roughly means that two particles can be extremely distant, yet if the state of one particle changes, the state of the other particle also changes.
- Mental telepathy – emphasizes experiments with various tasks.
- Telepathy in everyday life.
- Telepathy and the senses.
- Electronic telepathy with neural interfaces.
- Dream telepathy – transmission of thoughts from one individual to another through dreams.
- Ganzfeld telepathy experiment – power of extrasensory perception.
- Computer programs for performing telepathy.
- Telephone telepathy.
- Theory of natural human telepathy, which can cause various social phenomena and even catastrophes.

- Technological telepathy – this particularly involves the use of computers and brain interfaces.
- Telepathic machines – computer-supported (e.g., phonogram interpreter).
- DNA and telepathy – genetics, DNA molecules display telepathy as a property.
- Telepathy experiments in groups.
- Robotic telepathy.
- Telepathy over long and short distances.
- Transcendental telepathy operates based on empathy and sympathy.
- Telepathy and affects – intuition of emotions, heart, etc.
- Twin telepathy.
- Digital telepathy – e.g., creation of a smart website that anticipates a specific user's needs in advance.
- Synthetic telepathy – technology based primarily on the use of EEG.
- Spiritual telepathy.
- Verbal telepathy.
- Vertical telepathy – includes categories such as consciousness and intuition.
- Clairvoyance, telepathy, and emotions.
- Chain telepathy.
- Ant colony telepathy algorithm.
- Radio telepathy.
- Telepathic lamp.
- Telepathy and Facebook.
- Analysis of telepathy data in groups.
- Musical telepathy – brain waves and combinations.
- Telepathy project – verbal communication.
- Telepathy in the military.
- Telepathic chips – for controlling and monitoring computers.
- Data theft and hacking attacks related to telepathy.
- Communication framework for telepathy.
- Spectral telepathy.
- Consensual telepathy – merger of humans and computer technology.
- Collective telepathy.
- Telepathy and neuromodulation in a specific cultural environment.
- Programming telepathy.
- Telepathic virtual environment.

- Telepathic science and technological equipment related to thought transmission.
- Internet telepathy and thought transmission over long distances.
- Telepathy research.

Based on this list, which was obtained as a result of the word analysis of publication titles in the field of telepathy, it can be stated that telepathy is not studied solely by marginal sciences, but also by the natural sciences and particularly the applied sciences. There are numerous scientific and professional papers in the fields of synthetic and bioelectronic telepathy, social psychology, cognitive psychology linked to neurology, psychiatry, and computer science and informatics (e.g., artificial intelligence, robotics). Interest in the field of telepathy is also significant on the part of the military and intelligence agencies. Papers also exist that report on the criminal misuse of modern technology in relation to synthetic telepathy.[72] We will return to this topic in the subsection on hidden (fictional) criminality, which in an official sense does not yet actually exist. There is certainly no shortage of patents, especially technological ones, in the field of telepathy. Let us present a small selection of such patents as an interesting point.



4.4.2.5.5.3 Figure 200: Conceptual network of patents in the field of telepathy based on work titles

Figure 200 shows a small part of the conceptual network of patents in the field of telepathy based on the analysis of work titles. A search for "Telepathy" in the Google Patents search engine yielded

72 Soleilmavis, L. (2015). Mind control technology with electromagnetic frequency. *E-leader* (10/1), 1-12. Earth's International Research Society. (2011). *Mind Weapon*. Available at: https://www.academia.edu/1934233/MIND_WEAPON (2020-01-07).

approximately 613 results. Even with the limited set of existing patents in the field of telepathy, we can identify the main areas of interest. The most prominent area is artificial intelligence and computer systems in the direction of intelligent humanoid robots. Let's take a closer look at some patents as an interesting point.

1. Alshdaifat, W. (2019). Autonomous city transportation means with artificial telepathy. Geneva: World Intellectual Property Organization. Patent No.: WO2019025872A3.

This patent reports on autonomous urban transport based on telepathic artificial intelligence, involving cooperation between various devices and machines (e.g., robots, artificial telepathy devices, RFID, GPS). This patent is not limited to road transport but also envisions use in air and rail transport.

2. Nemeth, A. D. (2000). Telepathy table game. Geneva: World Intellectual Property Organization. Patent No.: HU9901402A1.

This is a patent that can be classified among games that require cognitive visual abilities from players in the direction of achieving telepathic effects.

3. Richard, P. ... [et al.]. (2016). Brain computer interface (BCI) system based on gathered temporal and spatial patterns of biophysical signals. World Intellectual Property Organization. Patent No.: KR101680995B1.

This patent focuses on a brain-computer interface based on gathered spatial and temporal biophysical signals associated with brain activities.

4. Wei, W. ... [et al.]. (2017). A kind of telepathy guiding implanted wall of the chest port. World Intellectual Property Organization. Patent No.: CN107050563A.

The patent reports on an implanted medical device in the chest that can read the needs of the bodily system in the direction of blood transfusion during chemical therapeutic treatment.

5. Moody, L., Phillips Moody, M. (2005). System for producing artificial telepathy. World Intellectual Property Organization. Patent No.: WO2005055579A1.

This patent deals with reading thoughts using mobile telephony.

In summary, the largest number of patents in the field of telepathy are found in areas such as artificial intelligence (autonomous vehicles, robotics), computer systems, communication systems (e.g., e-mail, mobile telephony), medicine (e.g., blood transfusion), and games. Based on the given sample of Google patents, we can conclude that they are primarily technologically oriented, and it is difficult to find patents that attempt to improve, for example, the social climate, educational processes and didactic methods, crime prediction (e.g., domestic violence, murders, robberies, fraud), project methods, etc. Thus, we have reached the end of the subsection on mental, emotional, and mood inductions.

4.5 Anomalous social phenomena

In this subsection, we will examine anomalous social phenomena that are generally not found in the living environments of other species, but are instead characteristic of the human species—especially within technologically, legally, and socially organized hierarchical associative systems. The main focus will be on anomalous social phenomena such as distress, various forms of addiction (e.g., alcoholism, drug use, gambling, gaming), psychotic disorders, scheming, and different types of criminal behavior (including crimes that have not yet been formally defined).

4.5.1 Stress

The term stress originates from the Latin word stringere. It was first used in English in the 17th century to describe hardship, pressure, or trouble. In the 18th and 19th centuries, stress referred to a force, pressure, or strong influence exerted on an object or person (in the context of physical science). It was not until the 19th century that people began to consider the effects of stress on physical and mental health.[73]

A little stress is necessary for life, as both the mind and body need a certain level of tension to remain active and engaged. The problem arises when there are too many stressful situations, leading to a state of excessive stress. The growing prevalence of stress among people is largely a result of life in increasingly large urban communities, within societies that, while becoming more integrated, also experience a high degree of activity diversification. This is due to the rising number of opportunities for human interaction, the proliferation of various interests, the centrality of consumerism in daily life, and the emergence of complex conflicts stemming from competing interests.

As a result, the pace of life accelerates, pushing us into an illusion of comfort—where physical comfort may be increasing, but psychologically, we are more burdened than ever before. This imbalance between our physiological and psychological structures amplifies the feeling of stress, because from a physiological perspective, humans have not significantly changed through evolution (for example, a normal heart rate still ranges between 60 and 70 beats per minute, while the mental "pulse" of life is rapidly speeding up).

Stress has become a global issue that must be taken as seriously as environmental pollution (ecology) or high unemployment rates (social justice), as these three are equivalent global problems of the modern civilized world. Many people perceive stress as something normal or even stimulating, and do not view it as a major issue (these are the positive aspects of stress, or eustress).

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73 Spielberger, C. (1985). *Stres in tesnoba*. Murska Sobota: Pomurska založba.

However, about 10% of the global population suffers from excessive stress (the negative aspect of stress, or distress).
Excessive stress manifests in a variety of symptoms, ranging from physical (neck pain, headaches, digestive issues, etc.) to psychological problems (anxiety, depression, helplessness, obsessive-compulsive disorders, bipolar disorders, and so on). The main reason some individuals are more vulnerable to excessive stress lies in their very low tolerance for stressful situations. For such people, this can be a lifelong struggle.
Those experiencing high levels of stress often begin showing signs of overload as early as adolescence. Teenagers may turn to stimulants as a way to cope, but this only worsens their condition.[74] The condition of overly stressed people is also worsened by the use of narcoleptics.[75] The use of both pick-me-ups and put-me-downs is a result of the extreme consumerist mindset of society and individuals who have deeply surrendered to the illusion of comfort, ultimately falling into a state of passivity (e.g., watching television all day, lounging on the couch, etc.). Another reason for the rise in excessive stress, according to some scientists, is the increasing saturation of the human environment with technological devices.[76] Particularly interesting is an article from the scientific journal Science, which discusses the effects of fields generated by electricity. Under certain conditions, low-frequency magnetic waves can cause changes at the cellular level. These changes are especially noticeable in animals.[77]
Stress causes problems both for individuals who no longer see meaning in life and for the functioning of society as a whole. In consumerist societies, this issue is often viewed in terms of rising sick leave rates, increased traffic accidents, and the growing prevalence of alcoholism, drug addiction, neuroses, and psychoses—all of which represent significant financial burdens for society. The global issue of stress—or more precisely, excessive stress—may be the result of an unnatural pace of life that is out of sync with our biological rhythms, as well as the rapid proliferation of technological products that emit various forms of ionizing and other radiation. These influences can greatly affect people who have surrendered to a passive lifestyle and the illusion of comfort.
By nature and through evolution, humans are designed to move. Physical activity strengthens both the body and the mind, and in this regard, humans are not significantly different from other living beings on Earth. In short, the solution to the problem of excessive stress lies in our own hands—in aligning our minds with modern technology and adopting a new way of life.

74 The English call stimulants PICK-ME-UPS. They include sugar, chocolate, caffeine, alcohol, nicotine, etc. in this category.
75 The English use the term PUT-ME-DOWNS for these types of substances. These include: valium, paxipam, barbiturates, ativan, centrax, etc.
76 Bunge, W. Miller, J. Kupersmith are authors who wrote about this problem and called it technostress.
77 Gabrščček, S.(1990). Elektrika ubija tudi drugače. *Življenje in tehnika*, 61.

Key concepts related to stress include: negative emotional experiences, external environmental forces (where numerous stressors are present), stress triggered by strong stimuli, and ultimately, biological, behavioral, and psychological changes. These may result from direct stressful events or from the process of adapting to the effects of such events. It is important to note that stress can be either harmful or beneficial. Stress is a natural process that can be studied from physical, psychological, social, and biological perspectives, and it can have both positive and negative effects on how individuals interact with and process information from their environment and society.[78]

4.5.2 A study on stress in everyday life and the calculation of stress intensity/power

4.5.2.1 Introduction

This section presents the results obtained through an online survey questionnaire regarding stress in everyday life. It will also include a comparison between the findings of this questionnaire and the results based on students' opinions about stress factors in a library environment.

In addition, a brief overview of a previous study on stress within the Ministry of the Interior/police force will be included (from a comparative perspective).

4.5.2.1.1 Research objective

The aim is to identify both the positive and distressing (i.e., negative) influences of everyday life on public servants and academics. The question is whether daily life has become so distressing that even the segment of the population typically considered stable—with regular employment and structured family lives—is now at risk. According to the author's expectations, this demographic should not be experiencing critical or alarming levels of distress on either a physiological or psychological level.

Hot spots of distress are more commonly anticipated in police departments, industrial settings, and healthcare institutions. The results of this research will be compared with findings on distress factors in libraries, which are generally considered oases of peace and knowledge—places typically characterized as distress cold spots, or zones of predominantly positive influence.

The calculation of distress intensity in various social environments can provide useful feedback about these hot and cold zones. Furthermore, it offers insights into how individuals from different social structures perceive, understand, and emotionally respond to their surroundings—particularly within established hierarchical and associative societal systems.

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78 The introduction and definition are taken from the diploma thesis: Petrič, K. (2001). *Uporabniki knjižnic in stres: diplomsko delo*. Ljubljana: [K.Petrič]. The classification and calculation of stress factors in later subsections are also based on the cited diploma thesis.

Rigid and bureaucratic hierarchical systems tend to generate more distress, as they hinder social progress by suppressing the developmental potential of many individuals. The larger and more intense the distress hot spots, the higher the energy expenditure—seen in wasted calories on unproductive and soul-draining tasks, lost time and financial resources, and depletion of positive bioenergy—both within organized institutions and in the home environment.
Additionally, there may be a closer connection between levels of distress and various forms of crime (e.g., violent crime, economic crime, fraud), which can also be observed across different social settings.

4.5.2.1.2 Research hypotheses

a. According to educated public servants and scientists, the intensity of distress in everyday life is extremely high.
b. According to educated public servants and scientists, the intensity of distress in everyday life is very low.
c. The intensity of distress in everyday life is not generally high, but certain factors are extremely distressing.

4.5.2.1.3 Research questions

a. How do public servants and scientists perceive the concept of stress?
b. Do public servants and scientists believe that stress or excessive stress poses a major problem for society?
c. In the opinion of public servants and scientists, does everyday life create many stressful situations?
d. Which factors do public servants and scientists identify as the most stressful or distressing in daily life?
e. Which factors in everyday life have the most positive impact on public servants and scientists?
f. What suggestions do public servants and scientists offer for reducing stressful situations in everyday life?

4.5.2.1.4 Methodology

The research sample consisted of public servants and scientists from various ministries, universities, schools, libraries, institutes, and scientific social networks. The total sample included 200 respondents.[79]

79 Petrič, K. (2025). Gaining Knowledge through Understanding Distress and Positive Factors in Social Environments. *European Review of Applied Sociology*, 18(30), 26–49. https://doi.org/10.2478/eras-2025-0003.

4.5.2.1.5 Research tool

An online survey questionnaire was used to test the hypotheses.

4.5.2.1.6 Procedure

The pilot study included 10 public servants, followed by the main study involving 200 public servants and scientists. Both phases of the study were conducted using the online survey tool Enklik. Alongside the Slovenian version of the questionnaire, an English version was also prepared. The English version was published on the scientific platforms ResearchGate, Academia.edu, and Facebook, while the Slovenian version (with permission from the HR department) was published on the intranet portal of the Ministry of the Interior (MNZ). The HR department also distributed invitations to participate via the MNZ internal mailing list.

The researcher contacted other organized institutions (universities, schools, libraries, scientific institutes) using email lists compiled from various websites. The survey primarily targeted educated professionals (from university graduates to master's and doctoral degree holders) based in Ljubljana, Maribor, Koper, and Celje.

Data collection proceeded as follows:

a. Collection of demographic data (gender, age, language)

b. Gathering opinions on familiarity with the concept of stress, the societal impact of excessive stress, and the main sources of stress

c. Gathering opinions on negative (distress-inducing) and positive influences in everyday life

d. Gathering suggestions for eliminating, preventing, or mitigating stress

e. Collecting comments about stress

Data regarding positive and distressing (negative) factors, as well as proposed solutions, were categorized.[80] Before presenting the results, the following pages will first be dedicated to a brief discussion on classification. After statistical analysis, the findings of the research were interpreted based on the stated hypotheses and research questions.

4.5.2.1.7 Classification of factors and suggestions

The classification of factors and suggestions is based on the same principle, using the same classification categories. These include: the attentional-physical category, the partially social category, the individual-psychological category, the social category, the performance-related category, and the health-biological category.

80 More about the classification of factors and its background at http://unidip125.beepworld.de/ (2017-11-28) and more precise at https://www.researchgate.net/publication/236278726_Merjenje_in_izracunavanje_stresnih_dejavnikov_znotraj_organiziranih_zdruzb_z_vidika_razvijanja_razlicnih_izboljsav (2025-02-26).

4.5.2.1.8 Stress factors

1. Attention-related physical stress factors (hereinafter: APSF):

- Light: Inadequate lighting (e.g., fluorescent lights with a pronounced stroboscopic effect, which, after prolonged exposure, can cause headaches or even worsen vision; lighting that is too weak or too strong). The reflective properties of computer screens can mix with ambient and sunlight, causing disruptive reflections that, over time, significantly impair the user's vision and intellectual concentration. The light emitted by computer screens should be adapted to the ambient light in the room.
- Noise: Silence is very important for intellectual work.
- Sensory Deprivation: Prolonged exposure to a lack of sensory stimuli in a given space can cause public employees to lose motivation, which may lead to apathy, melancholy, or even depressive feelings about the work environment (e.g., a strong dominance of one color, complete silence, dimness, etc.).
- Climate: Appropriate temperature and relative humidity in the workspace are prerequisites for adequate mental focus. If an individual feels a lack of energy, they will be more sensitive to the atmosphere in the room. Higher temperatures and lower relative humidity cause fatigue in public employees. Unpleasant odors also negatively affect people (e.g., the smell of sweat, mold, etc.).
- Ergonomic Characteristics of Office Furniture: For example, bookshelves should be properly labeled and not too high or too low; chairs should be comfortable; desk height should be appropriate, etc.

2. Partial social stress factors (hereinafter: PSSF):

These are factors that originate from the individual and are related to social norms and goals, or those that social norms and goals reflect onto the individual and negatively affect other people. Examples:

- Punitive stimuli (e.g., a public employee feels that criticism for completed work is unjust).
- Stimuli related to proving one's personality (e.g., a public employee strives for as much social recognition as possible and wants to acquire as much quality information as possible in the shortest time, but does not use an effective strategy).

3. Individual psychological stress factors (hereinafter: IPSF):

These are factors already present in the individual—they are subjective (e.g., negative experiences, negative feelings) and negatively affect the psyche of a particular person, so that environmental stimuli, through subjective interpretation, intensify them. Examples:

- Feeling of confinement (e.g., an individual feels cramped).
- Anxiety (e.g., fear of a supervisor).

- Inner tension (e.g., a user needs literature for a very demanding exam).

- Constant rushing (e.g., a public employee completes all tasks at the last minute).

4. Social stress factors (hereinafter: SSF):

These are factors that negatively affect interactions between people and the organization of work at home and in the office. Examples:

- Too many employees per square meter in the office, causing overcrowding, which is a very disruptive factor (e.g., waiting for a free computer, waiting at the photocopier, etc.).

- Interpersonal problems (e.g., constant disputes between a supervisor and a colleague, etc.).

5. Performance-related stress factors (hereinafter: PRSF):

These are factors that cause people to exert excessive or unnecessary effort, which can lead to a waste of time and energy. Examples:

- Searching for a file in storage (a public employee spends a lot of time and energy finding a document—unnecessary effort).

- Studying and writing in the library (e.g., a user reads demanding study literature available only in the reading room, so they must come to the library from a distant place—unnecessary effort).

- Inaccessibility and outdated information (e.g., a public employee tries very hard but cannot obtain the necessary information because they lack internet or computer access, or must wait too long for information—excessive effort).

- Filling out numerous forms and compiling less important reports, lifting heavier loads.

6. Health-related biological stress factors (hereinafter: HBSF):

These are factors whose disease agents (e.g., viruses) are already present in the office space or are brought in, which can adversely affect the physical health of employees. Examples:

- Spatial and personal hygiene (e.g., there should not be too much dirt and dust in the office—dust allergy, etc.).

- Infectious diseases of a particular colleague (e.g., skin disease, flu, etc.).

- Epidemic among employees (e.g., flu).

- Contaminated office equipment (e.g., documents, desks, chairs, etc.).

- Biological entities (plants, animals, algae, etc.).

Positive factors and suggestions can be classified in a similar manner.

4.5.2.1.8 Positive factors

1. Attention-related physical positive factors (hereinafter: APPF):

These are factors that positively influence the senses and thereby improve people's well-being, resulting in beneficial effects on the performance of various activities (they increase the level of attention in people, for example, a pleasant climate stimulates an employee's intellectual ability when performing more demanding intellectual tasks). Examples:

- Light: Optimal lighting, protected computer screens, etc.
- Noise: Non-intrusive but pleasant music, pleasant natural sounds, etc.
- Climate: The room temperature should ideally be between 20 and 22 °C, and slightly lower during summer. The rooms should also have pleasant scents (e.g., the smell of fir trees).
- Relative Sensory Variety: Varied colors, pleasant sounds, etc.
- Ergonomic Features: Comfortable chairs, easily accessible document shelves, etc.

2. Partial social positive factors (hereinafter: PSPF):

These originate from the individual and are connected to social norms and goals, or those that social norms and goals impress upon the individual and positively influence people. Examples:

- Reward Stimuli: For example, a manager praises an exemplary employee, which the employee perceives as a reward.
- Stimuli for Proving One's Personality: For example, a scientist is highly motivated to search for information because they master effective search strategies, thereby strengthening their sense of competence.

3. Individual psychological positive factors (hereinafter: IPPF):

These are factors already present in the individual—they are subjective and unique to each person (e.g., positive experiences, positive feelings) that can be reinforced by environmental stimuli through subjective interpretation. Examples:

- Optimism.
- Inner relaxation (e.g., a space where an employee can have a juice or snack, read newspapers, etc.).
- Calmness and orderliness.
- Personal satisfaction (e.g., a public employee has completed their work and feels personally satisfied).

4. Social positive factors (hereinafter: SPF):

These positively affect interactions among people and the organization of work both at home and at the workplace. Examples:

- Enough space for employees (e.g., no overcrowding).
- Friendly interpersonal relationships (e.g., a kind manager, encouragement of a social atmosphere).

5. Performance-related positive factors (hereinafter: PrPF):

These facilitate employees' efforts, saving them significant time and energy. Examples:

- Easy information retrieval (e.g., a scientist quickly finds the desired information).
- Accessible and up-to-date information (e.g., access to the internet, computer catalogs, etc.).
- Convenient library opening hours (e.g., if a scientist wants to visit the library, but the library has favorable opening hours, saving time and energy because they don’t have to go to another library).

6. Health-related biological positive factors (hereinafter: HBPF):

These positively influence the physiological health of people in the library. Examples:

- Healthy colleagues, a healthy department manager, hygienic office and sanitary facilities.
- Exemplary spatial hygiene and personal hygiene of employees (e.g., little dust in the library, so even people allergic to dust can stay there comfortably).

4.5.2.1.9.1 Suggestions

1. Attention-related physical suggestions (hereinafter: ARPS):
   For example, decorations with fragrant flowers.
2. Partial social suggestions (hereinafter: PSS):
   For example, symbolic rewards for employees.
3. Individual psychological suggestions (hereinafter: IPS):
   For example, an isolated space can sometimes improve mental well-being.
4. Social suggestions (hereinafter: SS):
   For example, staff training in rhetoric.
5. Performance-related suggestions (hereinafter: PrS):
   For example, having several different rooms for various purposes so that employees can relax.
6. Health-related biological suggestions (hereinafter: HBPS):
   For example, devices to monitor employee stress levels.

4.5.2.2 Analysis of statistical data and interpretation

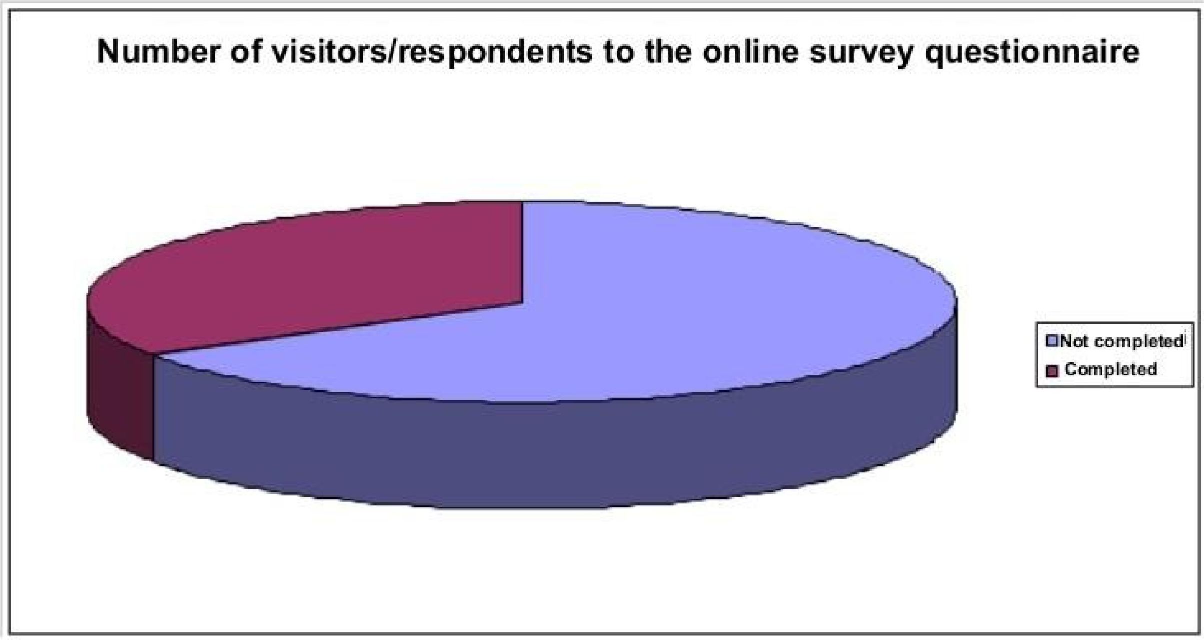
4.5.2.2.1 Introductory points of interest

The online survey tool Enklik allows for the collection of diverse data, ranging from technological usage to the IP location of respondents. The largest number of visitors/respondents to the online survey questionnaire used a computer for access (205 visits), followed by a mobile phone (five visits) and a tablet (one visit). All visitors had JavaScript enabled. The most frequently used browser was Google Chrome (89 visits), followed by Firefox (41 visits), Internet Explorer (49 visits), Edge (10 visits), Safari (five visits), and other browsers (17 visits). In terms of operating systems, the most frequently used was Windows 7 (91 visits), followed by Windows 10 (62 visits), Windows 8 (13 visits), Windows 32 (11 visits), Linux (seven visits), macOS (six visits), Windows

Phone 10 (one visit), iOS (one visit), and finally other operating systems (17 visits). Technologically speaking, the respondents under consideration use quite modern equipment!

4.5.2.2.1.1 Table 114: Number and percentage of visitors/respondents

	Number of visitors	Percentage (%)
Not completed	413	66.19
Completed	211	33.81
Total	624	100



4.5.2.2.1.2 Figure 201: Number of visitors/respondents to the online survey questionnaire

Table 114 and figure 201 show the number of visitors/respondents to the online survey questionnaire. Out of 624 visitors to the online survey questionnaire about stress in everyday life, only 211 or 34% (data from November 28, 2017) completed the survey questionnaire. The completion of the survey questionnaire took an average of two minutes and 48 seconds. On October 20, 2017, and October 25, 2017, the largest number of respondents (24) completed the survey questionnaire.

4.5.2.2.1.3 Figure 202: Respondents from Slovenia

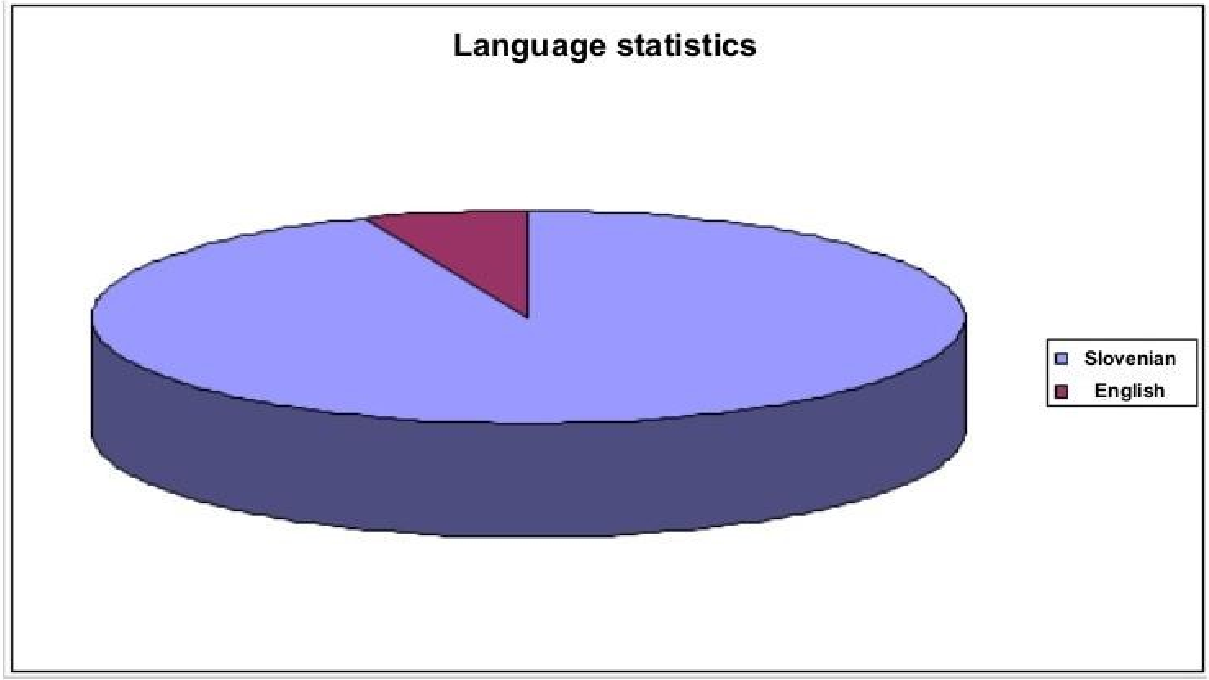
The respondents came from numerous geographical locations across Slovenia, most frequently from Ljubljana (376; 60.3%) and Maribor (53; 8.3%). Among them were particularly respondents from the University of Maribor (various faculties), IZUM, the Maribor Libraries, the University of Ljubljana (various faculties), the Ljubljana Libraries, the Jožef Stefan Institute, the University of Primorska (various faculties), and other institutions.

4.5.2.2.1.4 Figure 203: Respondents from abroad

The respondents also came from abroad, most frequently from the USA (47; 7.5%) and Canada (6; 1%). These respondents also visit scientific social networks such as ResearchGate.

4.5.2.2.1.5 Table 115: Language statistics

Language	Number of respondents	Percentage (%)
Slovenian	587	93.77
English	39	6.23
Celota	626	100

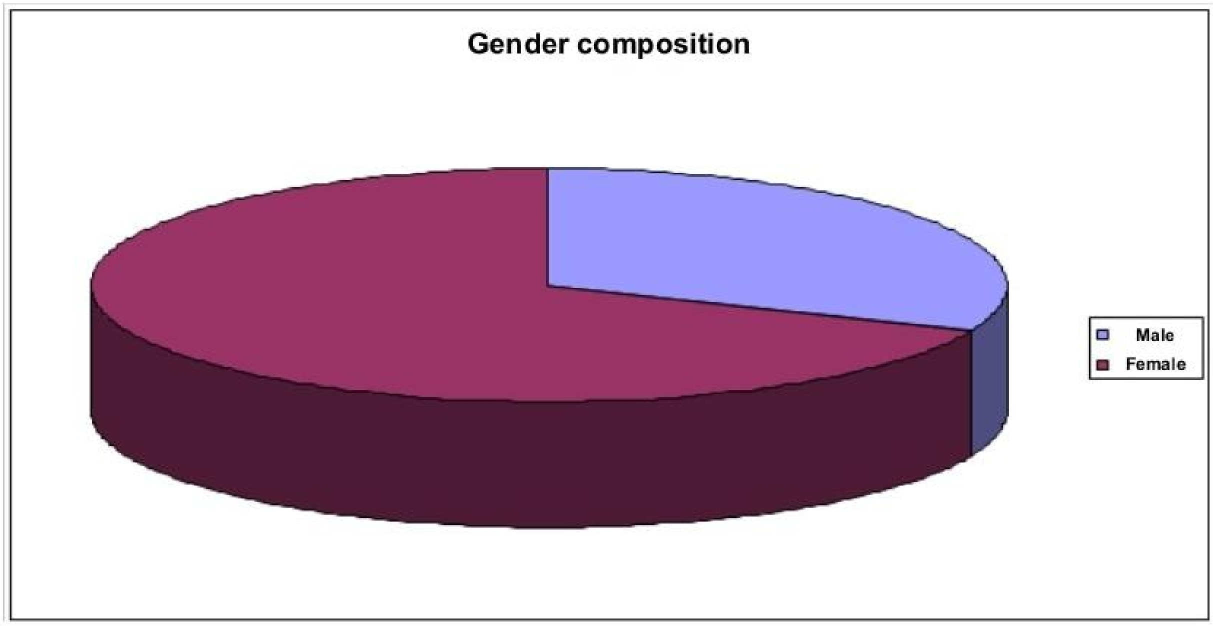


4.5.2.2.1.6 Figure 204: Language statistics

Table 115 and Figure 204 show the number of respondents who visited the Slovenian and English versions of the online survey questionnaire (data collected on November 29, 2017). Out of a total of 200 respondents, 195 completed the Slovenian version of the survey, while only five completed the English version. The link to the English version of the online survey questionnaire was published on ResearchGate, Academia, and Facebook pages. In the end, only five respondents from the ResearchGate social network fully completed the online survey questionnaire.

4.5.2.2.1.7 Table 116: Gender composition

Odgovori	Frequency	Percentage
1 (Male)	63	31.5
2 (Female)	137	68.5
Total	200	100

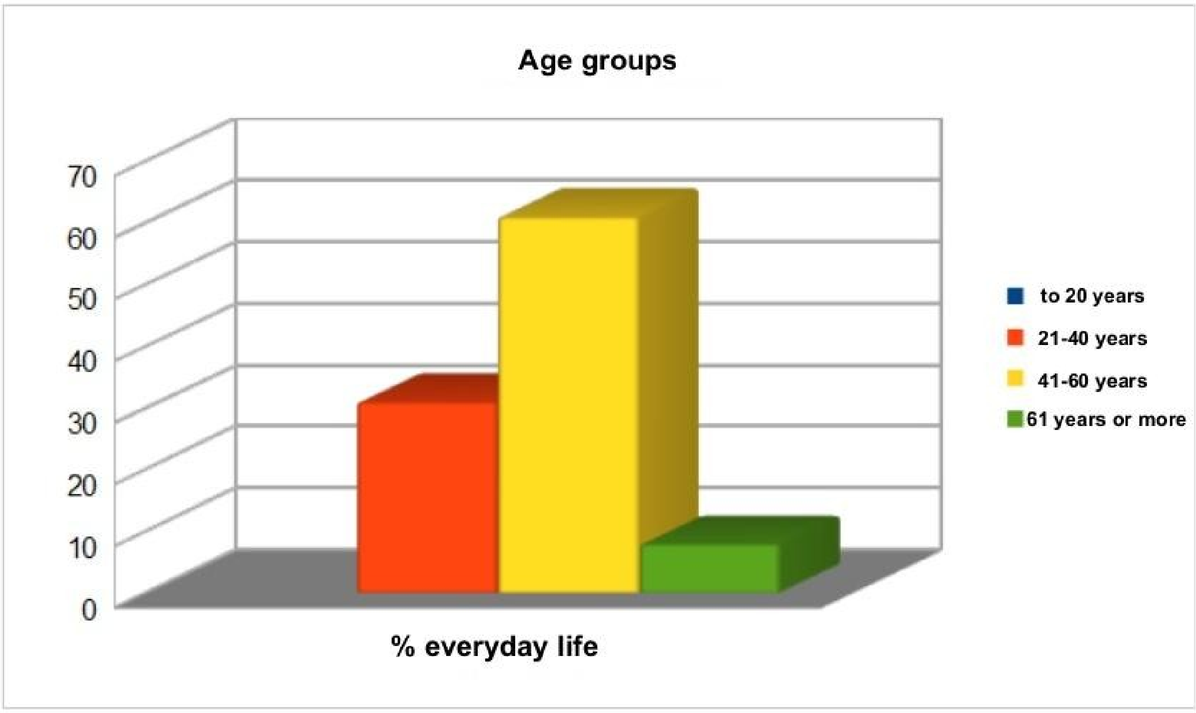


4.5.2.2.1.8 Figure 205: Gender composition

Table 116 and figure 205 show a pie chart of the gender composition among 200 respondents. As expected, the majority of respondents to the online survey questionnaire were female (137; 68.5%), while there were considerably fewer male respondents (63; 31.5%). These results are not surprising, as most of the respondents who fully completed the online survey questionnaire are employed in schools, faculties, libraries, institutes, and ministries, where women are predominant.

4.5.2.2.1.9 Table 117: Age groups

Responses	Frequency	Percentage
– 20 years	0	0
21-40 years	62	31
41-60 years	122	61
61 years and more	16	8
Total	200	100



4.5.2.2.1.9.1 Figure 206: Age groups

Table 117 and Figure 206 show the age groups of the respondents: up to 20 years (0; 0%), from 21 to 40 years (62; 31%), from 41 to 60 years (122; 61%), and 61 years or older (16; 8%). As can be seen, the age structure of the acquired respondents is relatively high. The majority belong to the second and especially the third age group. Based on this observation, it could be concluded that the age structure of employees in public administration is already quite high. This trend will likely not change in the future; rather, it will intensify if the retirement conditions remain the same.

The thematic section will be presented below.

4.5.2.2.2 Table 118: Familiarity with the concept of stress

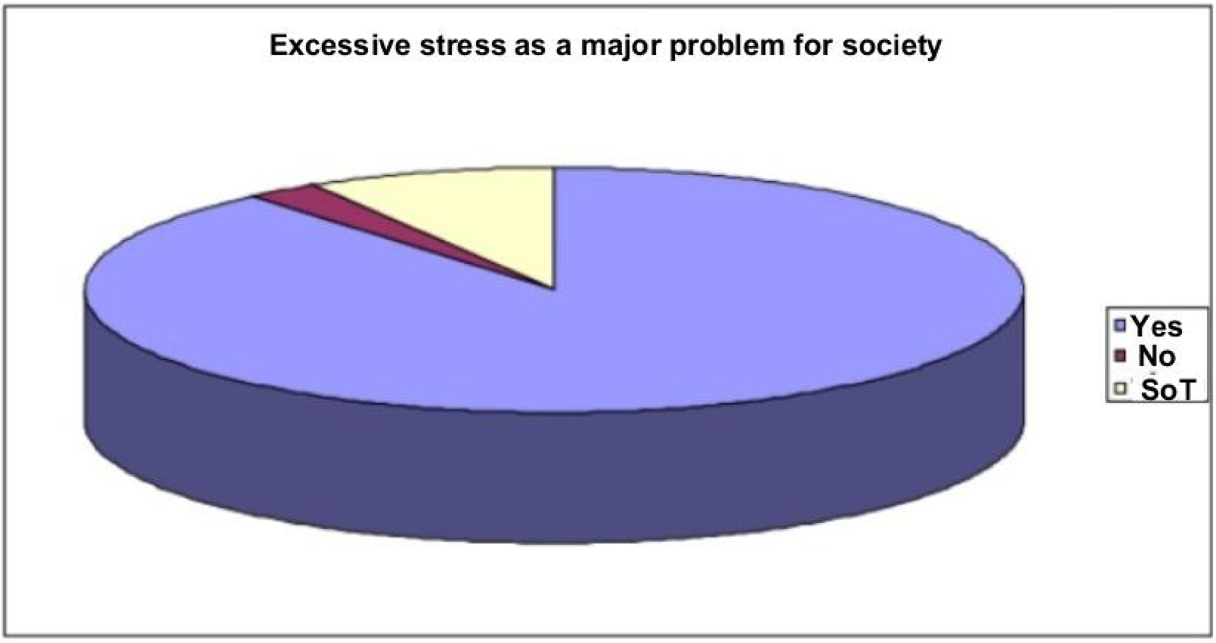
Responses	Frequency	Percentage
Yes	196.00	98.00
No	1.0	0.50
I don't know (IDK)	3.0	1.5
Total	200	100

4.5.2.2.2.1 Figure 207: Familiarity with the concept of stress

Table 118 and Figure 207 illustrate the respondents' familiarity with the concept of stress. Based on the results, we can conclude that this concept is generally well known to people (196; 98%).

4.5.2.2.2.2 Table 119: Excessive stress as a major problem for society

Responses	Frequency	Percentage
Yes	178.00	89.00
No	5.0	2.50
Sometimes (SoT)	17.00	8.50
Total	200.00	100.00



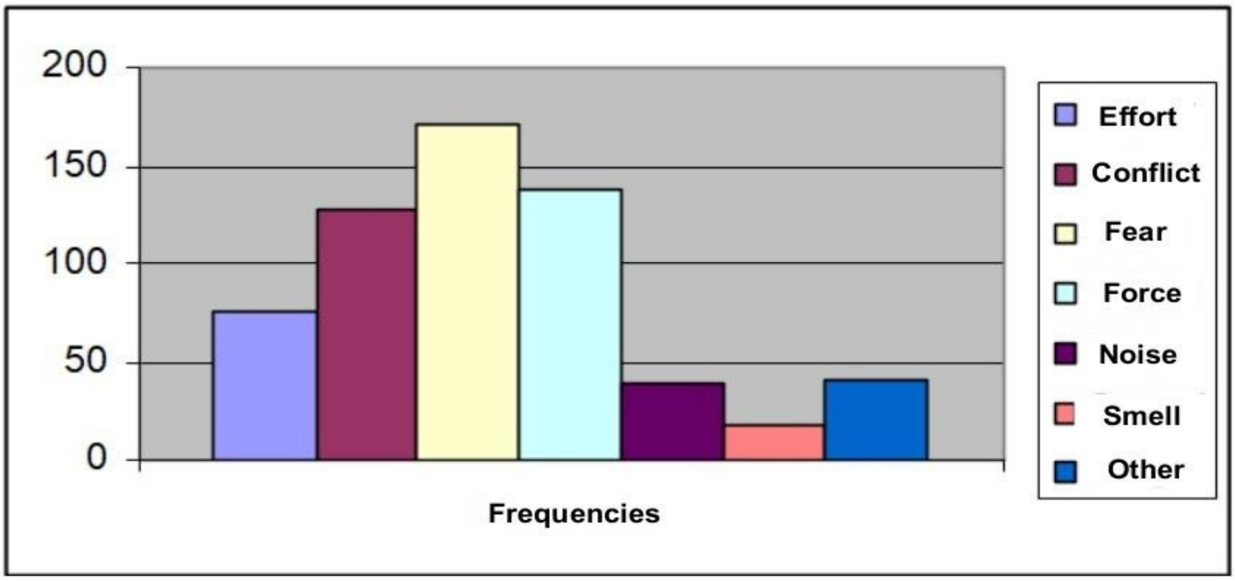
4.5.2.2.2.3 Figure 208: Excessive stress as a major problem for society

Table 119 and Figure 208 present the respondents' views on excessive stress as a serious societal issue. A total of 178 respondents (89%) who completed the online survey agreed with this statement. Seventeen respondents (8.5%) believed that excessive stress only occasionally (SoT) poses a major problem, while five (2.5%) considered it not to be a significant societal issue.

The majority of respondents therefore believe that excessive stress is dangerous and should not be underestimated. It not only poses a threat to individuals but can also evolve into a serious societal problem. A key factor here is an individual's tolerance threshold for stressors, which—due to the complexity of social processes—can be highly varied and often unpredictable. Some stressful situations are difficult to foresee, and even harder to prevent. Excessive stress can lead to serious health problems in individuals who perform essential and irreplaceable functions in society.

4.5.2.2.2.4 Table 120: Top causes of distress

Responses	Frequency	Percentage
Effort	76	38.00
Conflict	127	63.00
Fear	171	85.00
Force	138	69.00
Noise	39	19.00
Smell	18	9.00
Other:	40	20.00
Total	609	100.00



4.5.2.2.2.5 Figure 209: Major causes of distress

Table 120 and Figure 209 show the main causes of distress (multiple answers were allowed). The most common factors causing distress among respondents are:

a. Fear (171 responses)

b. Pressure or coercion (138 responses)

c. Conflict (127 responses)

d. Effort or exertion (76 responses)

e. Other (40 responses) – these included:

- the opinion that work is not stressful,
- the belief that the concept of stress is overused,
- lack of self-confidence,
- poor communication,
- time pressure, overload, constant time constraints,
- excessive workload,
- self-imposed responsibility,

- desire for material abundance,
- worries, uncertainty, interpersonal relationships, chronic overload,
- inadequate lighting, poor work habits,
- dissatisfaction with oneself, lack of respect for human dignity,
- helplessness in solving problems, lack of communication, financial difficulties,
- bullying, mobbing, expectations of others, lack of free time,
- too many administrative duties, high taxes and levies,
- constant emails and being permanently reachable via mobile phone,
- negative news, societal and workplace relations,
- demanding work without rest, unsolvable workplace situations,
- anxiety, overwork, poor diet,
- too many obligations, fast-paced lifestyle, changes,
- unequal treatment, unfair and unjust workplace practices,
- corruption and poor interpersonal relations.

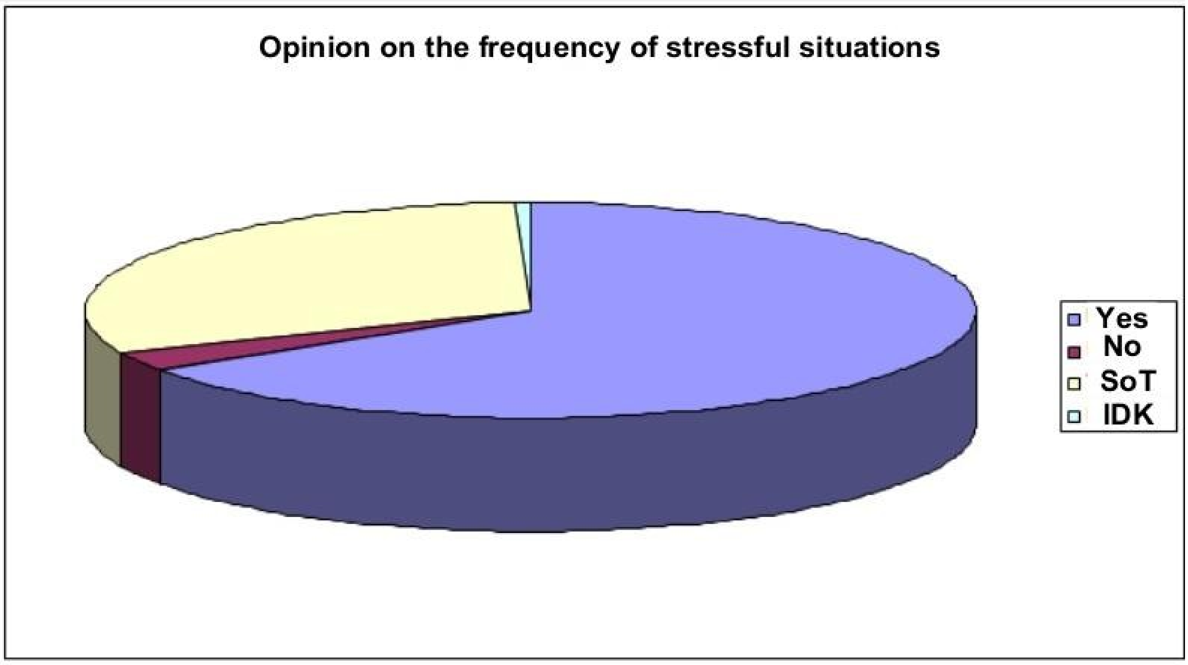
f. Noise (39 responses)

g. Bad odors (18 responses)

The results indicate that distress arises from a wide range of factors, with psychological and interpersonal factors—such as fear, pressure, and conflict—being the most common.

4.5.2.2.2.6 Table 121: Opinion on the frequency of stressful situations in everyday life

Responses	Frequency	Percentage
Yes	131	65.50
No	6	3.0
Sometimes (SoT)	62	31.00
I don't know (IDK)	1	0.50
Total	200	100.00



4.5.2.2.2.7 Figure 210: Opinions on the frequency of stressful situations

Table 121 and Figure 210 present respondents' opinions on the frequency of stressful situations in everyday life. The majority believe that stressful situations occur frequently in daily life (131 respondents; 65.5%). Sixty-two respondents (31.0%) believe that a greater number of stressful situations occur occasionally. Six individuals (3.0%) think that stressful situations are not very common in everyday life, while one respondent (0.5%) chose not to answer, stating they did not know.

In summary, respondents are aware of the risks that stress presents and largely attribute significant impact to it.

The following sections will present an analysis of both positive and negative (distress-inducing) factors, along with suggestions for addressing the latter. This will be followed by calculations leading to the final assessment of stress load levels. As a point of interest, the results will also be compared with findings from a study on distress factors in the library environment.

4.5.2.2.3 Calculation of stress intensity in everyday life

This subsection presents the calculations and results based on the collected responses regarding positive and negative (distress-inducing) factors, as well as suggestions for managing them. First, the results of the study on stress in everyday life will be presented, including both the pilot and the main study. This will be followed by a comparison of the results concerning the intensity of stress in everyday life and in the library environment, covering both the pilot and main studies.

4.5.2.2.3.1 Positive and negative factors and suggestions

The collected concepts first had to be classified using a system of categorization for factors and suggestions, developed in 2000/2001 based on various theories (Janke, Bouscein, and others) and stress models (e.g., Levi's model of stress). This classification system allows for the organization of both positive and negative factors as well as the proposed solutions. The results were as follows:

4.5.2.2.3.2 Table 122: Number of opinions and diverse opinions regarding positive factors

Positive factors	Number of opinions	Diverse opinions
AtPF	25	**18**
IPPF	63	**48**
PSPF	49	**44**
SoPF	217	**180**
StPF	156	**129**
HBPF	21	**18**
Total	531	**437**

Table 122 presents the results of the intellectual classification of positive factors. The outcome is represented by the number of opinions collected. After analyzing the responses, it was necessary to count the distinct opinions. During this process, repetitive and very similar opinions were excluded (for example, the phrase "good relationships" appeared three times and was therefore counted only once). Based on both indicators, it was possible to calculate the density (ρ) and complexity (K) of the positive factors (this will be discussed in more detail later). The rankings of individual positive factors were as follows:

1. SoPF (fSoPF = 217, frSoPF = 180): This category includes opinions such as good relationships with people, good interpersonal relationships, good workplace relationships, professional relationships, family relationships, human relationships, friendships, positive relationships, genuine relationships, mutual cooperation and problem-solving support, organized family life, positive

communication, etc. Respondents reflected on positive relationships with people from both their home and work environments, with an emphasis on the home environment.

2. StPF (fStPF = 156; frStPF = 129): In this category, the most frequently mentioned positive factors were: spending time in nature, walks in the forest, recreation, sports and leisure activities, gardening, hobbies, gentle exercise, yoga, reading, swimming, etc.

3. IPPF (fIPPF = 156; frIPPF = 129): Respondents listed opinions such as: feeling well, good self-esteem, mental and physical balance, peace, love, enthusiasm, being carefree, positive mindset, self-confidence, contentment, and positive thinking.

4. PSPF (fPSPF = 49; frPSPF = 44): For example: a sense of achievement, an abundance of new things to learn, time pressure, professional success, appropriate and fair pay, a feeling of security, feeling respected, awareness of having a job one deserves, being rewarded for success, and a sense of belonging.

5. AtPF (fAtPF = 25; frAtPF = 18): For example: a peaceful environment, nice sunny weather, living away from city noise, good food prepared and enjoyed in peace, good music.

6. HBPF (fHBPF = 21; frHBPF = 18): For example: being healthy, good overall health, a healthy environment, taking care of one's health through exercise, a good diet, and appropriate nutrition.

4.5.2.2.3.3 Table 123: Number of opinions and diverse opinions regarding negative stressors

Negative stress factors	Number of opinions	Diverse opinions
AtSF	17	13
IPSF	74	67
PSSF	61	54
SoSF	244	222
StSF	128	107
HBSF	19	17
Total	543	480

Table 123 presents the results of the intellectual classification of negative stress factors.

The rankings of individual negative factors were as follows:

1. SSF (fSSF = 244; frSSF = 222): For example: aggressive communication, job loss, cynicism within the organization, working with difficult colleagues, loss of a loved one, threats from coworkers, mobbing, harassment, conflictual relationships, negative workplace relations, inappropriate behavior from superiors, difficult romantic relationships, long waiting times in

healthcare, competitiveness, family issues, poor workplace relationships, terrorism, abuse of power by superiors.

2. StSF (fStSF = 128; frStSF = 107): For example: tight deadlines for tasks, work overload, excessive job demands, commuting to work, raising children, lack of physical activity, not enough time for family, urgent unexpected tasks, disorganized processes, insufficient time to relax, lack of time for hobbies, poor working conditions, etc.

3. IPSF (fIPSF = 74; frIPSF = 67): For example: fear of not having enough time for everything, tension, negative emotions, discomfort, impatience, egoism, insecurity, frustration, restlessness, gloom, hysteria, psychological pressure, rejection of current circumstances, worries, loneliness, existential fear, arrogance, mental abuse.

4. PSSF (fPSSF = 61; frPSSF = 54): For example: expectations, threats, rushing, low income, lack of influence, failure, sense of inequality, constant time pressure, feeling of alienation among people, wrong decisions leading to negative consequences, dishonest people, chasing material goods, fast-paced lifestyle.

5. HBSF (fHBSF = 19; frHBSF = 17): For example: illness, poor diet, health problems, unhealthy eating habits, mistreatment of animals, death, serious illnesses in the family, health-related issues, fatigue, and physical exhaustion.

6. AtSF (fAtSF = 17; frAtSF = 13): For example: noise, cold, pollution, weather, fast-paced lifestyle, and poor nutrition.

4.5.2.2.3.4 Table 124: Number of opinions and diverse opinions on proposals/suggestions

Proposals / suggestions	Number of opinions	Diverse opinions
AtPR	9	9
IPPR	69	61
PSPR	57	50
SoPR	159	143
StPR	131	112
HBPR	21	20
Total	446	395

Table 124 presents the results of the intellectual classification of proposals or suggestions for eliminating negative stress factors. The rankings by category were as follows:

1. SPR (fSPR = 159; frSPR = 143): Respondents proposed the following solutions to counter negative stress factors: more socializing with friends; an optimal economic level for people and

sufficient autonomy at work—without constant fear of suddenly losing one's job; living in smaller towns; family-friendly and flexible work hours; improved organizational climate; better work organization; a more relaxed society; longer lunch breaks; decentralized decision-making; social security; teamwork; assessing leadership and people-management skills when hiring managers; help from colleagues at work (although this is often unrealistic due to their own workload); hiring competent employees with the required knowledge and experience; more empathy from superiors; greater organizational focus on workplace climate; physical activity; leaders who are willing to do the tasks themselves before delegating them; socializing with friends; a systematic reduction in the standard 40-hour workweek to less than 40 hours, e.g., 30 hours; structuring the day to balance work, family, leisure, and recreation; trained leadership capable of managing people and organizing work; regular discussions about stress and coping with stress with professionals and peers in similar situations; planned and organized responses to the causes of stress, etc.

2. StPR (fStPR = 131; frStPR = 112): Suggestions included: a six-hour workday; aerobic exercise; reading; breathing techniques; daily relaxation or meditation; good working conditions; sufficient physical activity; both physical and mental recreation; yoga; outdoor activities; reduced screen time; fewer obligations; massage; continuous training of managerial staff in leadership and people management; aligning work hours with the needs of young families; allowing shorter work hours for employees; relaxation techniques during work; more breaks and holidays; consciously managing the volume of tasks; relaxing walks in nature; gardening, etc.

3. IPPR (fIPPR = 69; frIPPR = 61): Suggestions included: cognitive-behavioral therapy (CBT); making good choices; having enough time to relax; not taking things too personally; psychological support; investing more in oneself; self-actualization; self-control; finding satisfaction in small things; developing emotional intelligence; self-confidence and healthy self-image; and awareness of how to manage stressful situations.

4. PSPR (fPSPR = 57; frPSPR = 50): Suggestions included: a calmer pace of life; empathy and compassion toward others; avoiding negative and unnecessary situations; identifying stressors at home and eliminating them; using praise and motivational encouragement; and rational time management.

5. AtPR (fPPR = 9; frPPR = 9): For example: a more positive attitude toward the environment; classical music; a good movie.

6. HBPR (fZBPR = 131; frZBPR = 112): For example: valuing personal health; flowers; understanding stress-inducing situations and managing them; maintaining proper nutrition; promoting workplace health; healthy eating; and establishing a support system for employees caught in a cycle of stress.

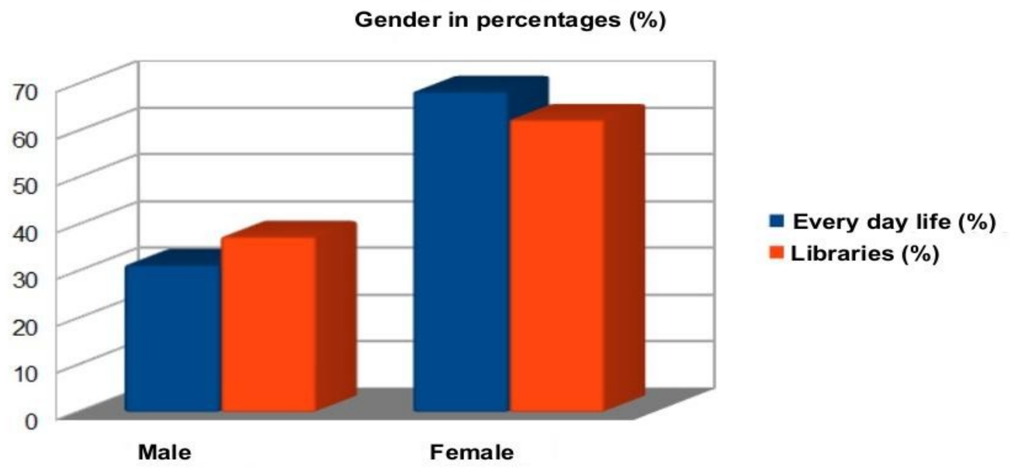
Based on the presented data, it will be possible to calculate the "stress strength" in stress levels. Before this is introduced, it is useful to compare the data on stress in everyday life and in libraries. Both studies are identical in terms of sample size (N = 200 people) and other characteristics (e.g., methodology).

4.5.2.2.4 Comparative study on stress in everyday life and in libraries

The values from both studies will be compared based on the analyses conducted so far. In short, we will compare gender distribution, age groups, familiarity with the concept of stress, the impact of excessive stress on society, the main causes of stress, the frequency of stressful situations, positive influences, negative influences, suggestions, and additional comments.

4.5.2.2.4.1 Table 125: Composition by gender

Responses	fv	% v	fk	% k
Male	63	31.5	75	37.5
Female	137	68.5	125	62.5
Total	200	100	200	100

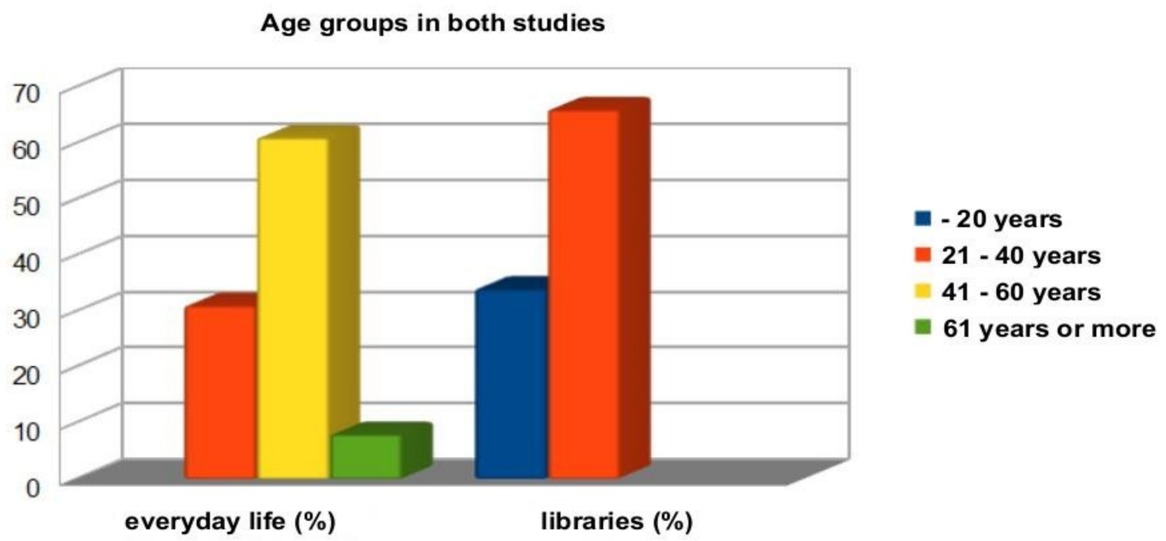


4.5.2.2.4.2 Figure 211: Gender composition

Table 125 and Figure 211 show the gender composition in both studies, where the female population is relatively strongly predominant. The study on stress in libraries was conducted at the Faculty of Arts in Ljubljana, where, especially among students, there are more female representatives. The study on stress in everyday life included faculties, schools, ministries, research institutes, research social networks, and libraries, where there are more female employees than male (particularly in ministries, schools, faculties, and libraries). The results are not surprising and provide us with feedback on the gender composition within public administration (excluding the police, military, and healthcare).

4.5.2.2.4.3 Table 126: Age groups

Responses	Fv	% v	Fk	% k
– 20 years	0	0	68	34
21-40 years	62	31	132	66
41-60 years	122	61	0	0
61 years or more	16	8	0	0
Total	200	100	200	100



4.5.2.2.4.4 Figure 212: Age groups

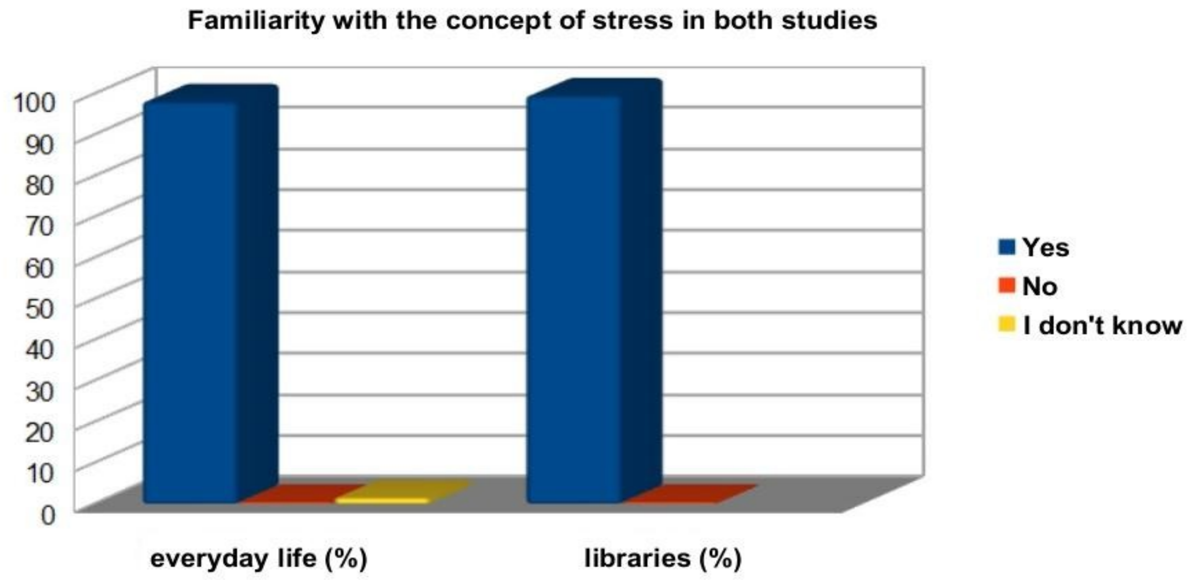
Table 126 and Figure 212 show the age groups that participated in both studies. In the study on stress in everyday life, it can be stated that the age structure of employees in the previously mentioned key sectors of public administration is relatively high (ages 41 to 60: 122 individuals or 61%). The second age group, ages 21 to 40 (essentially the younger generation), was much less represented (62 individuals or 31% of respondents).

In the study on stress in libraries, the oldest student was around 40 years old and was included more or less by chance. The other students were significantly younger, with an average age of about 23 years.

It is concerning that the age structure in the first study is relatively high. This situation is unlikely to change in the near future, as there is currently a rather contradictory trend of extending employees' working life. Young people who successfully complete their studies—such as those graduating from the Faculty of Arts—will find it increasingly difficult to secure appropriate employment, not just permanent positions, but even temporary ones. At this point, permanent employment appears to be more of a wishful dream for young people. How this will affect the existing pension system remains unknown. Are changes to the pension system on the horizon?

4.5.2.2.4.4 Table 127: Familiarity with the concept of stress

Responses	Fv	% v	Fk	% k
Yes	196,00	98,00	199	99,5
No	1,00	0,50	1	0,5
I don't know	3,00	1,50	0	0
Total	200	98,00	200	100

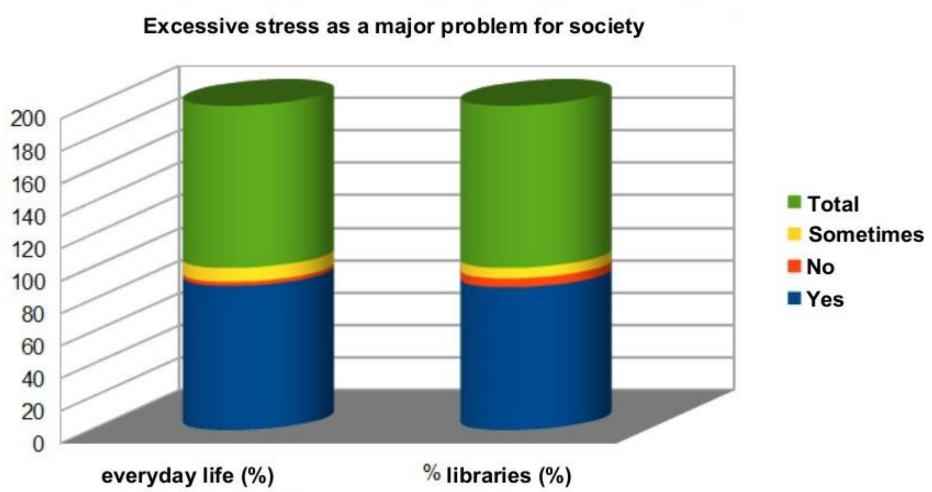


4.5.2.2.4.5 Figure 213: Awareness of the concept of stress

Table 127 and Figure 213 show the respondents’ awareness of the concept of stress. In both studies, it was found that people are generally familiar with the concept of stress. Only a few individuals were not familiar with it.

4.5.2.2.4.5 Table 128: Excessive stress as a major problem for society

Responses	Fv	% v	fk	% k
Yes	178	89.00	176	88
No	5	2.50	11	5.5
Sometimes	17	8.50	13	6.5
Total	200	100	200	100



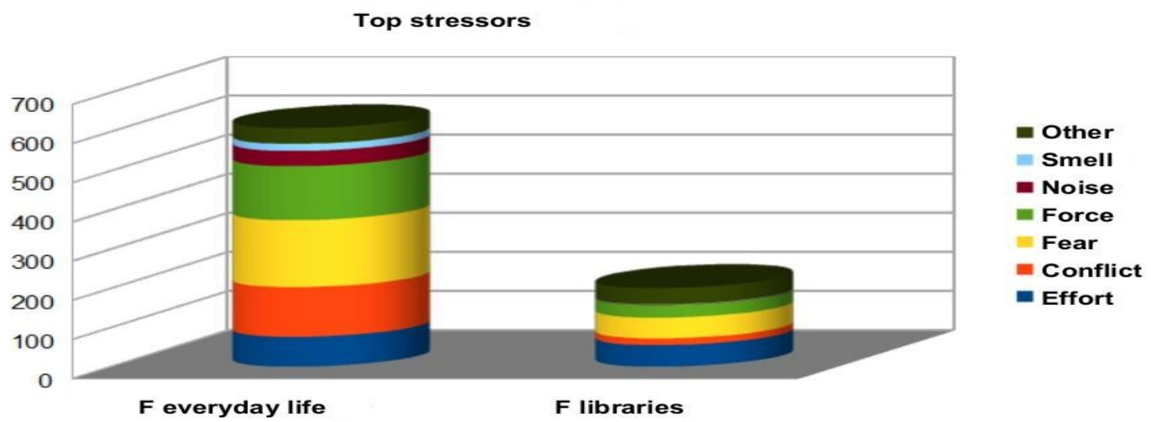
4.5.2.2.4.6 Figure 214: Excessive stress as a major social problem

Table 128 and Figure 214 present respondents' opinions on excessive stress as a major problem for society. Most people believed that excessive stress represents a significant issue for society. This view was shared in both the study on everyday stress (178 respondents or 89%) and the study on stress in libraries (176 respondents or 88%).

A slightly higher number of students expressed the opinion that excessive stress is not a danger to society (11 respondents or 5.5%), while this view was held by only a few public sector employees (five respondents or 2.5%). A slightly higher percentage of public sector employees (17 respondents or 8.5%) compared to students (13 respondents or 6.5%) believed that excessive stress only occasionally causes problems for society.

4.5.2.2.4.6 Table 129: Top stressors

Responses	Fv	Fk
Effort	76	55
Conflict	127	17
Fear	171	53
Force	138	32
Noise	39	1
Smell	18	1
Other:	40	42
Total	609	201



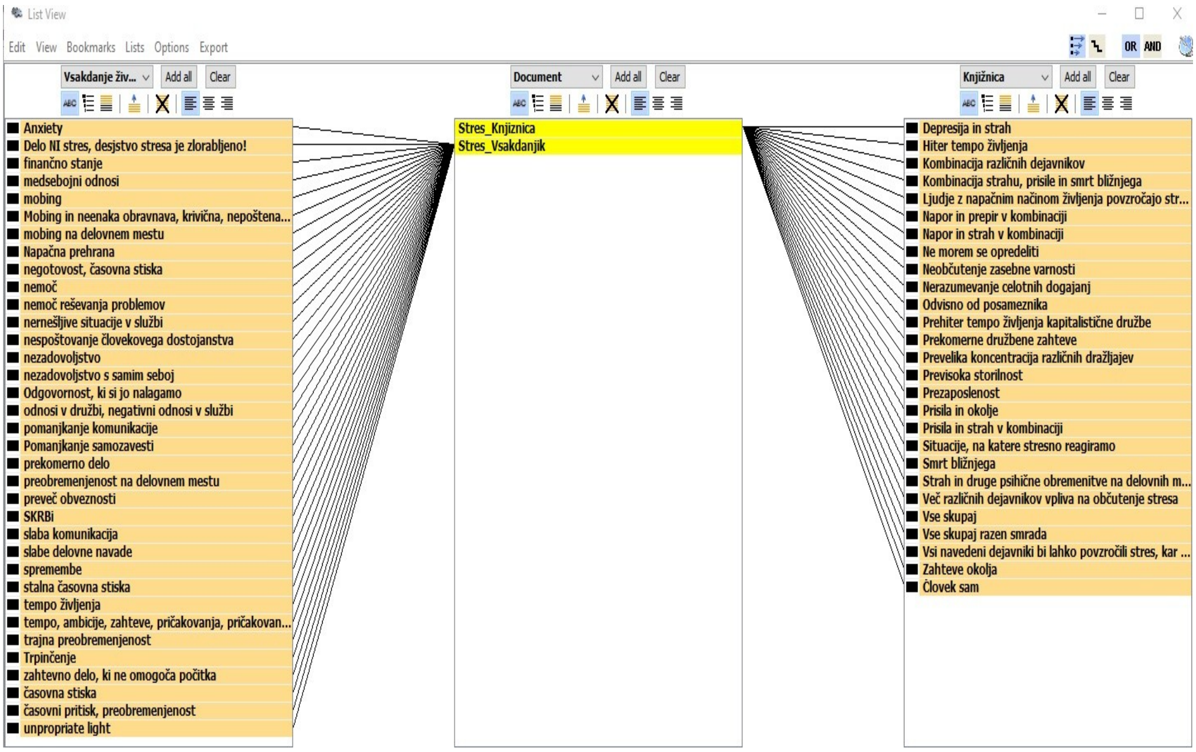
4.5.2.2.4.7 Figure 215: Major causes of stress

Table 129 and Figure 215 present the main causes of stress identified in both studies. Multiple answers were allowed for this question. Interestingly, students provided fewer responses (201 responses) compared to public sector employees and researchers (609 responses).

Public employees and researchers more frequently selected the offered options such as fear (171 respondents), coercion (138), conflict (127), physical exertion (76), noise (39), unpleasant smells (18), and the open-ended option “other” (40 respondents provided additional input).

Students attributed the most negative impact to physical exertion (55 respondents), followed by fear (53), the open-ended “other” category (42), coercion (32), conflict (17), and lastly noise and unpleasant smells (one respondent each).

We will take a closer look at the responses given under the “other” category. While the number of responses may not indicate significant differences, the variety of answers is quite broad.



4.5.2.2.4.8 Figure 216: Responses under the open option “Other”

Figure 216 displays the responses given under the open-ended “Other” category in both studies. The additional comments varied significantly. Student remarks were more general and largely aligned with the provided options, whereas the comments from public employees and researchers were more specific and focused on the work environment.

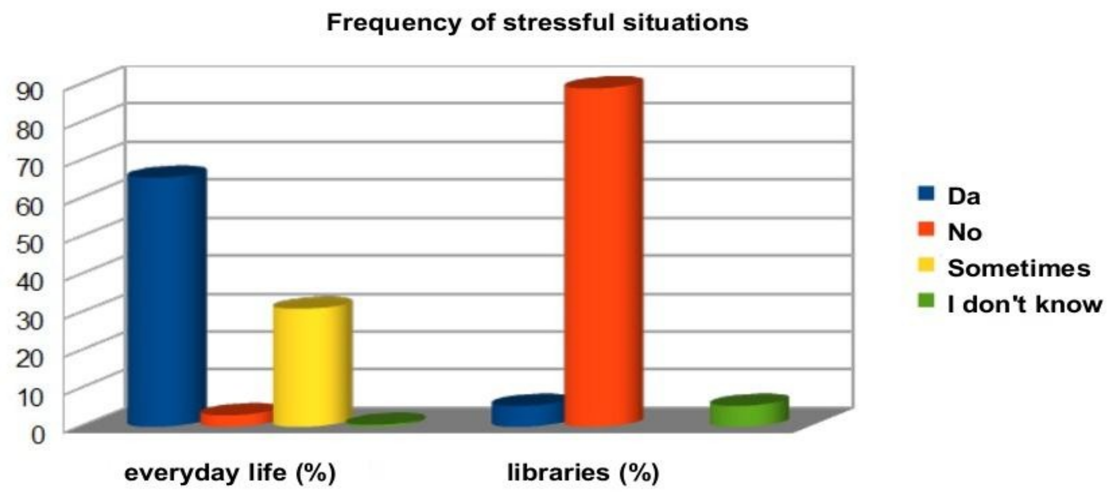
These included issues such as: workplace bullying (mobbing), interpersonal relationships, unsolvable work situations, demanding jobs that don’t allow for rest, poor work habits, poor or lacking communication, time pressure and overload, societal relations, negative workplace dynamics, inability to solve problems, unequal treatment, unfairness and dishonesty at work, the idea that work itself isn’t stressful but that stress is misused as an excuse, abuse, and the fast pace of life.

The additional comments from public employees and researchers reflect the fact that these individuals have had deeper and broader experiences with negative stress compared to students. They seem to interpret stress-related factors with greater concern. These findings are not surprising, as students generally have fewer negative experiences than older individuals. Many of the older respondents had already faced serious stress-related situations both at work (e.g., workplace bullying) and at home (e.g., divorce, loss of a child, financial difficulties).

The study on stress in libraries was conducted in 2000/2001, a time when young people found it easier to obtain suitable employment. For this reason, employment-related issues were not mentioned in that study.

4.5.2.2.4.9 Table 130: Opinion on the frequency of stressful situations

Responses	Fv	% v	Fk	% k
Yes	131	65.50	11	5.5
No	6	3	178	89
Sometimes	62	31	0	0
I don't know	1	0.50	11	5.5
Total	200	100	200	100



4.5.2.2.4.9.1 Figure 217: Frequency of stressful situations

Table 130 and Figure 217 show the frequency of stressful situations in everyday life and in libraries. It should be noted that the question related to libraries was phrased somewhat differently, as students were asked whether libraries were a source of stressful situations (and in this question, there was no option for "Sometimes"). Because of this, the comparison between the two studies is only conditional.

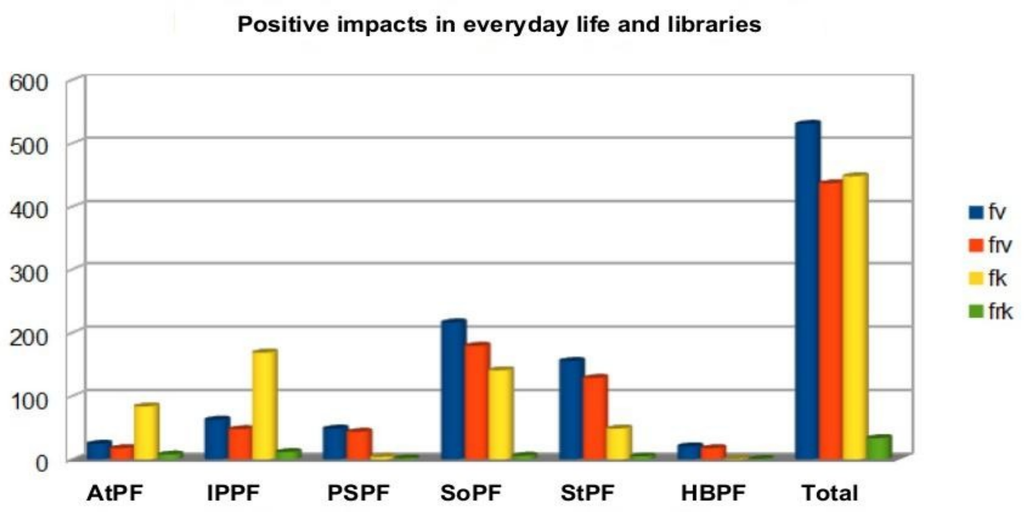
According to students, libraries are generally not a source of stress (179 students or 89%). A small portion of the population (11 students or 5.5%) believed that libraries do cause stress, and an equal share of students said they didn’t know. From these results, we can conclude that libraries are not typically associated with stressful situations.

In contrast, the study on the frequency of stressful situations in everyday life shows significantly different results. According to public servants and researchers, stressful situations in daily life are very common (131 respondents or 65.5%). Another 62 respondents (31%) believed that such situations occur occasionally. A very small percentage of public servants and researchers considered stressful situations in everyday life to be rare (6 respondents or 3%), and even fewer (1 respondent or 0.5%) said they didn’t know.

From these results, we can conclude that, unlike libraries, everyday life is a significant source of stressful situations.

4.5.2.2.5 Table 131: Positive impacts in everyday life and libraries

Positive factors	fv	frv	fk	frk
AtPF	25	18	84	8
IPPF	63	48	169	12
PSPF	49	44	4	2
SoPF	217	180	141	6
StPF	156	129	49	5
HBPF	21	18	1	1
Total	531	437	448	34



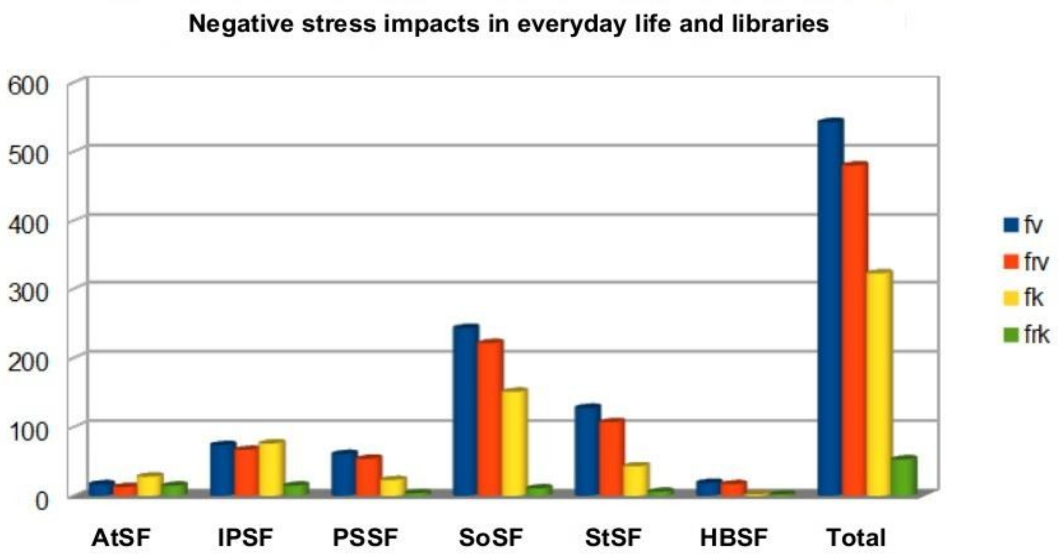
4.5.2.2.5.1 Figure 218: Positive influences in everyday life and libraries

Table 131 and Figure 218 show the number of positive opinions (fv) and varied opinions (fr) regarding everyday life, as well as the number of positive (fk) and varied opinions (frk) regarding libraries—both for individual factors and overall. The differences between the values in the two studies are clear, both in terms of the total number of opinions and the variety of responses.

When it comes to everyday life, respondents mentioned a large number of positive factors, especially for frequently occurring everyday situations (SoPF), such as socializing with friends, entertainment, and good interpersonal relationships at work, as well as for occasionally occurring everyday situations (StPF), like exercise, nature walks, and yoga. Students also listed many positive SoPF related to libraries, such as friendly librarians, but fewer StPF, such as difficulties in finding information. They cited a greater number of permanent positive factors (AtPF), such as good lighting and quiet, and internal personal positive factors (IPPF), such as mental peace and relaxation. Public servants and researchers tended to associate positive influences more with their home environment (e.g., stable family relationships) than with the workplace (e.g., friendly coworkers). In short, the responses regarding stress in everyday life are much more complex and less predictable, whereas the responses about stress in libraries are simpler and more predictable.

4.5.2.2.5.2 Table 132: Negative stress impacts in everyday life and libraries

Negative factors	fv	frv	fk	frk
AtSF	17	13	28	15
IPSF	74	67	76	15
PSSF	61	54	23	4
SoSF	244	222	151	11
StSF	128	107	43	6
HBSF	19	17	2	2
Total	543	480	323	53



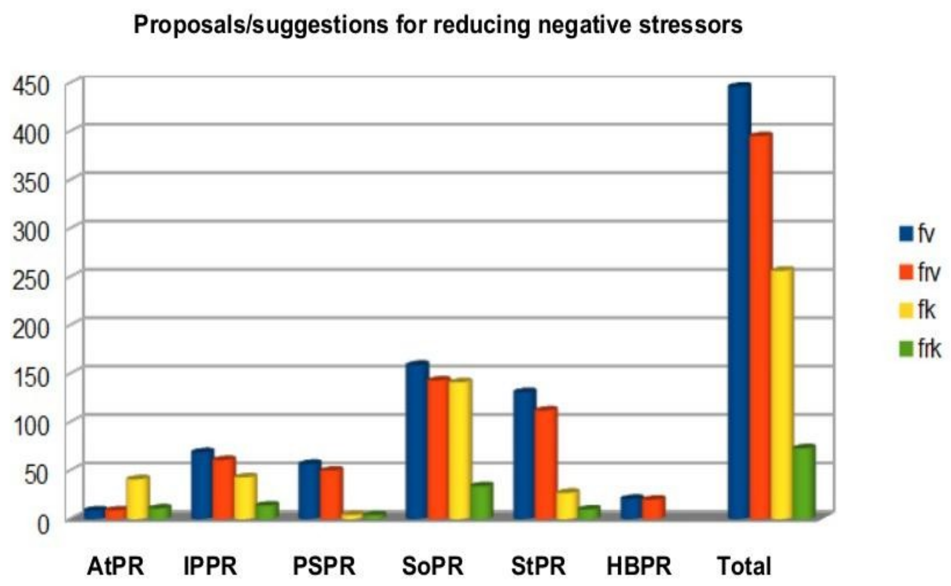
4.5.2.2.5.3 Figure 219: Negative stressful influences in everyday life and libraries

Table 132 and Figure 219 show the number of negative opinions (fv) and varied opinions (fr) related to everyday life, as well as the number of negative opinions (fk) and varied opinions (frk) related to libraries—both by individual factors and overall. In both studies, short-term stressful situations (SoSF) were the most prevalent—for example, unfriendly librarians, workplace bullying, harassment, and conflicts with supervisors.

In the study on stress in everyday life, there was a significantly greater variety of opinions compared to the library study. Public servants and researchers tended to associate SoSF more with the work environment than with the home. This tendency was even more pronounced in responses about long-term stressful situations (StSF), which, according to the data, are much more common in the workplace—such as heavy workloads, tight deadlines, and poor working conditions.
As with the previous results, the opinions of public servants and researchers were both more numerous and more diverse.

4.5.2.2.5.3 Table 133: Proposals/Suggestions for eliminating negative stressors

Proposals/Suggestions	fv	frv	fk	frk
AtPR	9	9	41	11
IPPR	69	61	43	14
PSPR	57	50	4	4
SoPR	159	143	141	34
StPR	131	112	27	10
HBPR	21	20	0	0
Total	446	395	256	73



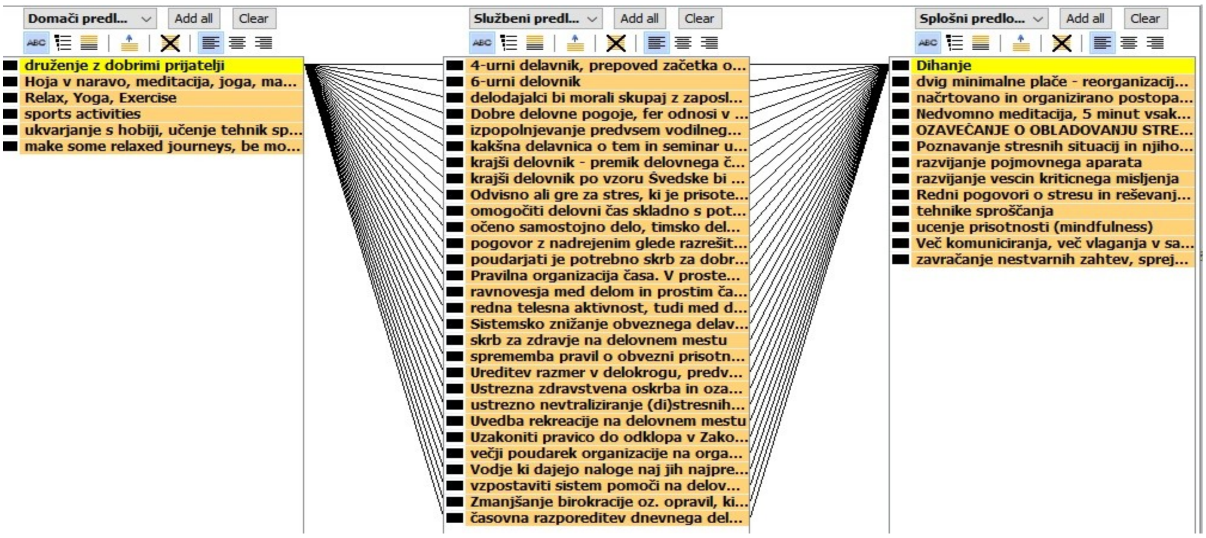
4.5.2.2.5.4 Figure 220: Proposals/Suggestions for eliminating negative stress factors

Table 133 and Figure 220 show the number of suggestions (fv) and varied opinions (fr) related to everyday life, as well as the number of suggestions (fk) and varied opinions (frk) related to libraries

—both by individual factors and overall. The highest number of suggestions were of a social nature (SoPR) and related to productivity (StPR).

In the study on stress in libraries, more suggestions focused on eliminating attention-related physical stress factors—for example, improved lighting, aromatherapy in library spaces, and more comfortable chairs.

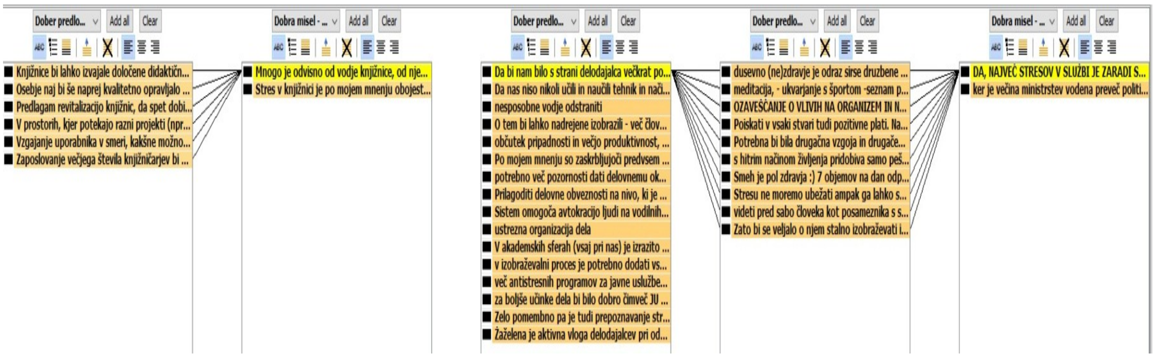
Public servants and researchers provided more numerous, detailed, and diverse suggestions for reducing negative stress factors in the library environment compared to students. Their suggestions mainly targeted the elimination of short-term stressful situations (SoSF) in the workplace rather than in the home. The same applies to suggestions for addressing long-term stressful situations (StSF).



4.5.2.2.5.5 Figure 221: Selection of suggestions

Figure 221 presents a selection of suggestions, divided into those for the home environment, the work environment, and general suggestions. Suggestions for the home environment primarily include spending time with friends, physical activity, and meditation. Suggestions for the workplace focus on shorter working hours, managing and preventing stress at work, training managers in stress-reduction strategies, introducing exercise at the workplace, and similar initiatives. General suggestions are applicable to both home and work environments. These include proper breathing techniques, relaxation methods, practicing mindfulness, rejecting unrealistic demands, developing conceptual understanding, and strengthening critical thinking skills.

4.5.2.2.5.6 Additional comments on the topic of negative stress



4.5.2.2.5.7 Figure 222: Additional comments on libraries and everyday life

Figure 222 presents additional comments regarding libraries and everyday life. Some students praised libraries and everything related to them, while others criticized certain aspects or specific libraries. Two students felt that society should take the issue of stress more seriously. Another two believed libraries could play a more significant role in society; however, only one student offered a concrete idea—suggesting that libraries could implement special educational programs to help students better understand their mental potential and thereby experience less stress while studying. Regarding additional comments on stress in everyday life, public servants and researchers primarily emphasized the importance of specialized training focused on stress, its management, and prevention. As with short-term stressful situations (SoSF), they also highlighted issues such as workplace bullying (mobbing) and poor leadership. One respondent additionally noted that government ministries are overly influenced by politics, which may further hinder the selection of competent leadership.

4.5.2.2.6 Method for calculating the intensity of stress factors (SF) in everyday life

The calculation of the intensity of stress factors (SF) in organized groups is divided into three levels, and it is necessary to consider both the whole group and individual SF units:

Level 1:

a. Calculation of opinion density per person (ρ_0):

$$\rho_0 = \frac{f_0}{N_0}$$

f_0 ... frequency of all opinions N_0 ... sample size or number of respondents

b. Calculation of opinion complexity (K_0):

$$K_0 = \frac{f_0}{f_r}$$

f_0 ... frequency of all opinions   fr ... frequency of varied opinions

c. Calculation of opinion complexity within individual units (KE):

$$K_E = \frac{(f_0 - f_E)}{(f_r - f_{\Re})}$$

f_0 ... frequency of all opinions f_r ... frequency of varied opinions

f_E ... frequency of all opinions within a specific unit f_{rE} ... frequency of varied opinions within a specific unit.

Level 2: This involves the calculation of the real factor (F_o), which is determined by comparing the actual opinion density and complexity with the theoretical density (ρt = 10 opinions per person) and theoretical opinion complexity (K_t = 1 – the maximum possible complexity, e.g., when 1,000 responses result in 1,000 different opinions).

The real factors are calculated for stress factors (SF), positive factors (PF), as well as for proposals/suggestions (PR) aimed at reducing stress impacts within specific organized groups.

$$F_0 = \frac{(K_0 \cdot \rho_0)}{(K_t \cdot \rho_t)}$$

Level 3: Based on the three calculated real factors (SF, PF, and PR), we calculate the intensity of stress factors in stress degrees (º S):

$$\sigma_{0\mathrm{SF}} = \arcsin\sqrt{\left(\frac{F_{SF} \cdot F_{PR}}{F_{PF}}\right)}$$

σ_{0SF} … intensity of stress factors (SF) F_{0SF} … real factor of stress factors

F_{0PR} … real factor of suggestions (SG) for reducing stress factors F_{0PF} … real factor of positive factors (PF)

The intensity of stress factors in stress degrees, by individual SF units, is calculated in a similar way. However, in the first level, it is first necessary to calculate KE (opinion complexity) within individual units:

a. Attention physical SF (AtSF):

$$\sigma_{0\mathrm{AtSF}} = \arcsin\sqrt{\left(\frac{F_{AtSF} \cdot F_{AtPR}}{F_{AtPF}}\right)}$$

b. Performance SF (StSF):

$$\sigma_{0\mathrm{StSF}} = \arcsin\sqrt{\left(\frac{F_{StSF} \cdot F_{StPR}}{F_{StPF}}\right)}$$

c. Partial social SF (PSSF):

$$\sigma_{0\mathrm{PSSF}} = \arcsin\sqrt{\left(\frac{F_{PSSF} \cdot F_{PSPR}}{F_{PSPF}}\right)}$$

d. Individual psychological SF (IPSF):

$$\sigma_{0\mathrm{IPSF}} = \arcsin\sqrt{\left(\frac{F_{IPSF} \cdot F_{IPPR}}{F_{IPPF}}\right)}$$

e. Social SF (SoSF):

$$\sigma_{0\,SoSF} = \arcsin\sqrt{\left(\frac{F_{SoSF} \cdot F_{SoPR}}{F_{SoPF}}\right)}$$

f. Health biological SF (HBSF):

$$\sigma_{0\,HBSF} = \arcsin\sqrt{\left(\frac{F_{HBSF} \cdot F_{HBPR}}{F_{HBPF}}\right)}$$

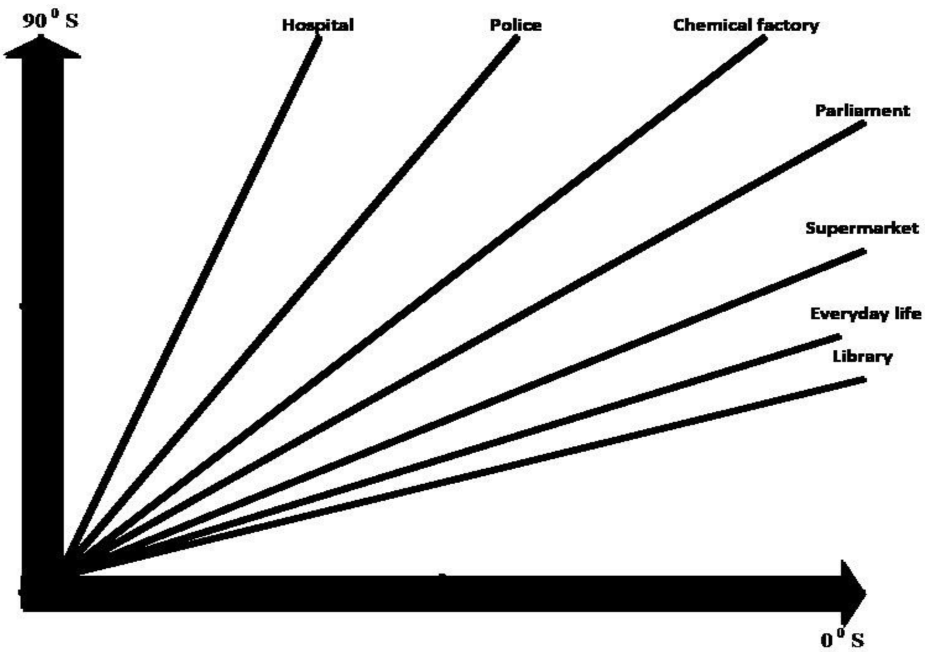
Stress is generally not a linearly increasing process; instead, it initially grows slowly and then increases more or less intensely. For this reason, an inverse square function or square root was used in the calculation. The inverse sine function (arcsin) was mainly used to obtain an angle in degrees, which can be effectively visualized using the slope model presented later.

4.5.2.2.6.1 SF Slope Model

The slope model assumes that 90 degrees represents the highest level of SD, and 0 degrees the lowest. This model allows for a clear illustration of different levels of SD intensity, both for the whole and for individual units.

4.5.2.2.6.2 Table 134: SF strength ranking scale in stress degrees

SF area in stress degrees	Rated SF power level
00.00 ^{0}S - 15.04 ^{0} S	Very low
15.05 ^{0} S – 30.04 ^{0} S	Low
30.05 ^{0} S – 45.04 ^{0} S	Medium
45.05 ^{0} S – 60.04 ^{0} S	Higher
60.05 ^{0} S – 75.04 ^{0} S	High
75.05 ^{0} S – 90.00 ^{0}S	Very high



4.5.2.2.6.3 Figure 223: SF intensity in stress degrees for various organized groups

Table 134 presents the scale for ranking SF intensity in stress degrees, while Figure 223 shows the SF intensity in stress degrees for various organized groups. Using this model (which is a fictional representation), one can clearly illustrate which organized groups contain the highest number of distress and eustress factors (e.g., peace institutes show the lowest SF levels, whereas hospitals show the highest). This approach would ultimately identify the main stress hotspots in society. Additionally, it would gradually lead to solutions that could be integrated into various work systems. The following section presents calculations of stress intensity in stress degrees (º S) for the study on stress in everyday life.

4.5.2.2.6.4 Stress intensity in everyday life

$$\rho_0=\frac{f_0}{N_0}=\frac{1520}{200}=7.6$$

The opinion density amounts to 7.6 opinions per person. This result includes all opinions—both positive and negative factors, as well as suggestions (for the library environment, the result was 5.14 opinions per person).

$$K_0=\frac{f_0}{f_r}=\frac{1520}{1312}=1.16$$

The overall complexity, which is the result of the ratio between the total number and the total number of distinct opinions, is 1.16. The following section presents the key calculations of complexity and opinion density for positive and negative factors, as well as suggestions.

$$\rho_{PF}=\frac{f_{PF}}{N_0}=\frac{531}{200}=2.65$$

The opinion density for positive factors (PF) is 2.65 opinions per person.

$$\rho_{SF}=\frac{f_{SF}}{N_0}=\frac{543}{200}=2.71$$

The opinion density of negative stress factors (SF) is 2.71 opinions per person.

$$\rho_{PR}=\frac{f_{PR}}{N_0}=\frac{446}{200}=2.23$$

The opinion density of proposals/suggestions is 2.23 opinions per person.

$$K_{PF}=\frac{f_{PF}}{f_{rPF}}=\frac{531}{437}=1.21$$

The opinion complexity for positive factors (PF) is 1.21.

$$K_{SF}=\frac{f_{SF}}{f_{rSF}}=\frac{543}{480}=1.13$$

The opinion complexity for negative stress factors (SF) is 1.13.

$$K_{PR}=\frac{f_{PR}}{f_{rPR}}=\frac{446}{395}=1.13$$

The opinion complexity for proposals/suggestions (PR) is 1.13.

$$F_{PF}=\frac{(K_{PF}\cdot\rho_{PF})}{(K_t\cdot\rho_t)}=\frac{(1.21\cdot 2.65)}{(1\cdot 10)}=0.32$$

The real factor for positive factors (PF) is 0.32.

$$F_{SF}=\frac{(K_{SF}\cdot\rho_{SF})}{(K_t\cdot\rho_t)}=\frac{(1.13\cdot 2.71)}{(1\cdot 10)}=0.31$$

The real factor for negative stress factors is 0.31.

$$F_{PR}=\frac{(K_{PR}\cdot\rho_{PR})}{(K_t\cdot\rho_t)}=\frac{(1.13\cdot 2.23)}{(1\cdot 10)}=0.25$$

The real factor for proposals/suggestions is 0.25.

Based on the obtained real factors, it is possible to calculate stress intensity or power.

$$\sigma_{0SF}=\arcsin\sqrt{\frac{F_{SF}\cdot F_{PR}}{F_{PF}}} = \arcsin(0{,}31 \cdot 0{,}25 /0{,}32)^{-1/2}= 32{,}\ 76\ {}^{\circ}\mathrm{S}$$

Based on the opinions gathered from public servants and researchers, the stress intensity for everyday life amounts to 32.76°S, which can be evaluated as a moderate level. This result disproves the first two hypotheses and confirms the third. If the study had shown a stress intensity above 50°S or even 60°S (a high or very high level), it could be assumed that our society is facing catastrophic problems. Why? Considering that the respondents were mostly well-educated individuals with at least a university degree (many held a master's or even a doctoral degree), had stable employment, regular income, and well-organized family lives, we could argue that they are relatively well-off compared to the workforce in manufacturing, hospitals, and similar sectors. The expected outcome actually points to more serious issues in everyday life, primarily work-related (especially social and performance-related negative stress factors, which are relatively strong), as the home environment brings significantly fewer negative stress situations.

In short, it makes sense to calculate stress intensity within individual categories of factors. Only one example will be shown here—stress intensity calculation for attentional physical factors and suggestions. Calculations for the remaining factors follow the same principle. (All values have already been calculated and prepared in Excel.).

Attentional physical positive factors (AtPF)

$$\rho_{AtPF}=\frac{f_{AtPF}}{N_0}=\frac{25}{200}=0.13$$

The opinion density for positive attentional physical factors (AtPF) is 0.13 opinions per person.

$$\rho_{AtSF}=\frac{f_{AtSF}}{N_0}=\frac{17}{200}=0.09$$

The opinion density for negative attentional physical factors (AtSF) is 0.09 opinions per person.

$$\rho_{AtPR}=\frac{f_{AtPR}}{N_0}=\frac{9}{200}=0.05$$

The opinion density for attentional physical proposals (AtPR) is 0.09 opinions per person.

$$K_{AtPF}=\frac{(f_0-f_{AtPF})}{(f_r-f_{rAtPF})}=\frac{506}{419}=1.21$$

The opinion complexity for attentional physical positive factors (AtPF) is 1.21.

$$K_{AtSF}=\frac{(f_0-f_{AtSF})}{(f_r-f_{rAtSF})}=\frac{526}{467}=1.13$$

The opinion complexity for attentional physical negative stress factors (AtSF) is 1.13.

$$K_{AtPR}=\frac{(f_0-f_{AtPR})}{(f_r-f_{rAtPR})}=\frac{467}{386}=1.13$$

The opinion complexity for attentional physical proposals/suggestions (AtPR) is 1.13.

$$F_{AtPF}=\frac{(K_{AtPF}\cdot\rho_{AtPF})}{(K_t\cdot\rho_t)}=\frac{(1.21\cdot 0.13)}{(1\cdot 10)}=0.02$$

The real factor for attentional physical positive factors (AtPF) is 0.02.

$$F_{AtSF}=\frac{(K_{AtSF}\cdot\rho_{AtSF})}{(K_t\cdot\rho_t)}=\frac{(1.13\cdot 0.09)}{(1\cdot 10)}=0.01$$

The real factor for attentional physical negative stress factors (AtSF) is 0.01.

$$F_{AtPR}=\frac{(K_{AtPR}\cdot\rho_{AtPR})}{(K_t\cdot\rho_t)}=\frac{(1.13\cdot 0.05)}{(1\cdot 10)}=0.006$$

The real factor for attentional physical proposals/suggestions (AtPR) is 0.006.

In the next step, the stress intensity of the attentional physical unit is calculated.

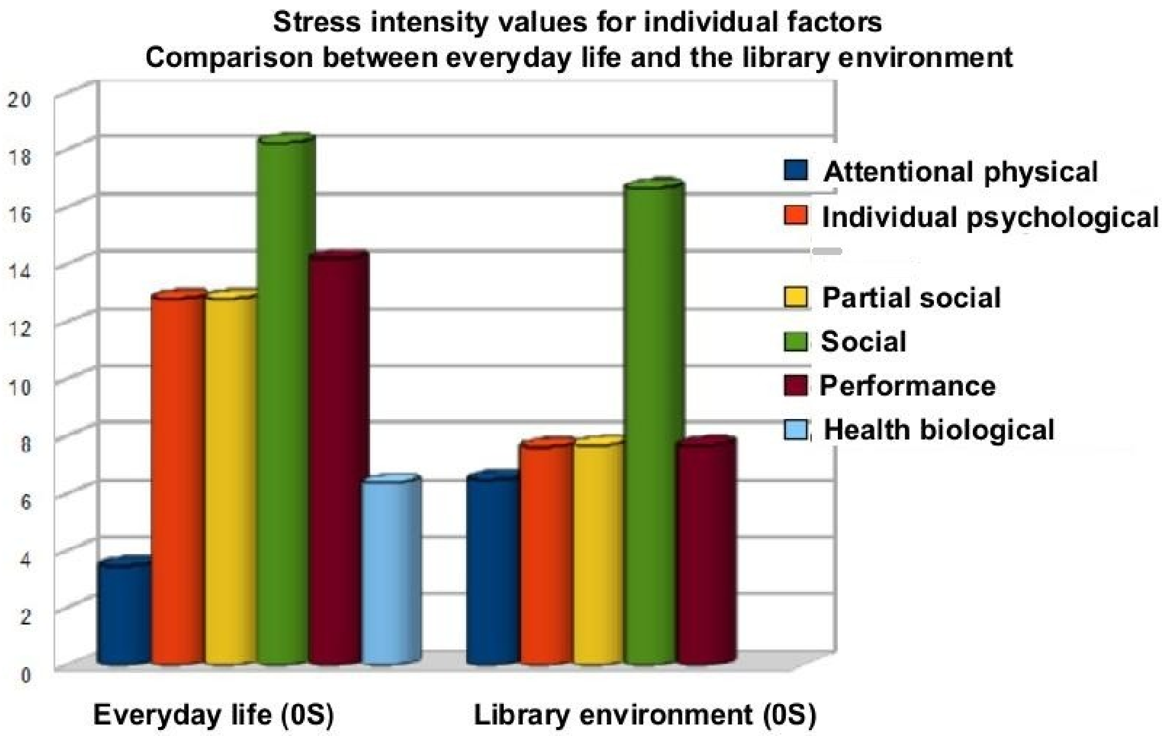
$$\sigma_{0AtSF}=\arcsin\sqrt{\frac{F_{AtSF}\cdot F_{AtPR}}{F_{AtPF}}} = \sigma PSD = \arcsin(0{,}01\ \cdot\ 0{,}006/0{,}02)^{-1/2} = 3{,}49\ {}^{0}S$$

The stress intensity for attentional physical negative stress factors is low, which means that, according to public servants and researchers, these types of factors do not cause significant problems in everyday life, either at home or in the workplace. Respondents may have focused more deeply on social and performance-related disruptive factors, which could have led them to overlook or underestimate the attentional physical negative stress factors.

The remaining stress intensity values for other factors, including the one calculated above, will be presented in a table and a bar chart.

4.5.2.2.6.5 Table 135: Stress intensity values for individual factors

Factors	Everyday life $\boldsymbol{\sigma}_v$ (^{0}S)	Library environment $\boldsymbol{\sigma}_k$ (^{0}S)
Attentinal physical	3.49	6.5
Individual psychological	12.82	7.64
Partial social	12.82	7.7
Social	18.26	16.68
Performance	14.21	7.7
Health biological	6.38	0
Total	32.76	22.71



4.5.2.2.6.6 Figure 224: Stress intensity for individual factors

Table 135 and Figure 224 present the stress intensity for individual factors, both for the study on everyday life stress and for the library environment. Based on the opinions of public servants and researchers, the results indicate a high exposure to stress intensity (see the left side of Figure 224) from social, performance-related, partially social, and individual psychological factors, while health-related biological factors—and especially attentional physical factors—are less prominent. It is important to highlight the strong connection between individual psychological and partially social factors (stress intensity for both categories was 12.82°S). Students who provided input for the library environment also identified social factors as the most disruptive. They focused somewhat more on attentional physical factors, while health-threatening factors were not perceived. Also worth noting is the strong correlation between negative individual psychological factors (σIPSF = 7.64°S) and partially social stress factors (σPSSF = 7.70°S). Performance-related stress factors (σStSF = 7.70°S) also fall into this same category in terms of stress intensity.

Given the low stress intensity within the library environment, libraries could be considered social oases of peace and harmony, whereas everyday life is far more complex and socially fragmented. Societies consist of various layers of people living in different conditions, with varying levels of resources, orderly or less orderly lifestyles, and more or less optimistic visions for the future.

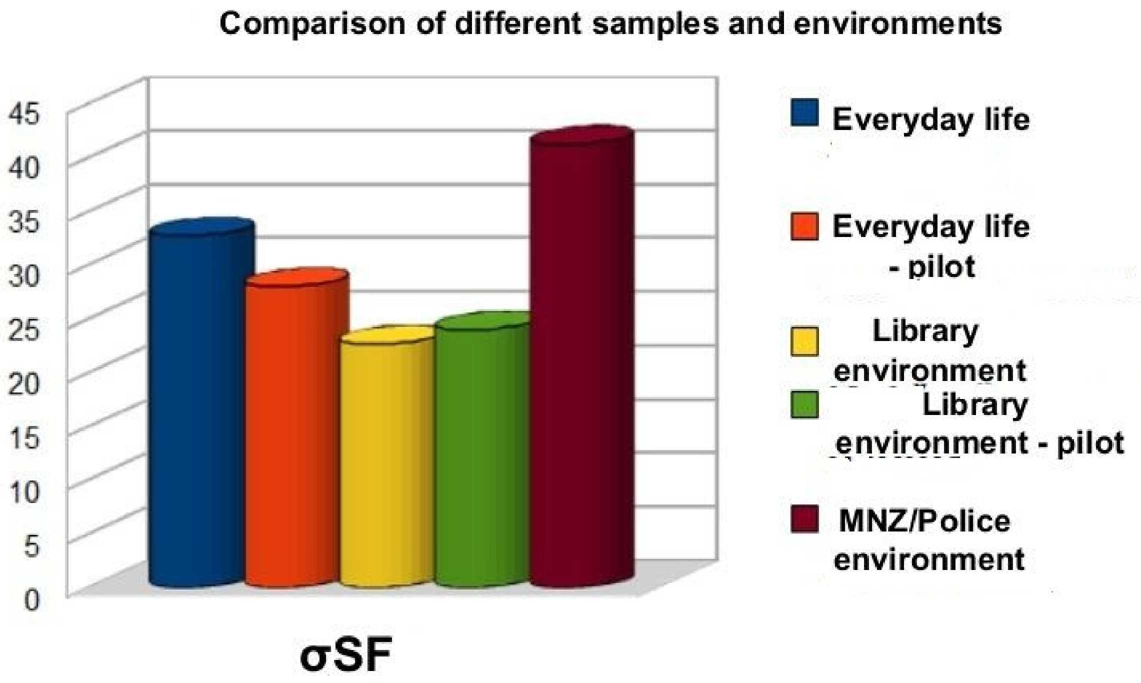
In the everyday life stress study, the sample consisted primarily of individuals from the upper-middle class in terms of financial resources, or from the highest social class in terms of intellectual capital. The results, based on this sample, show that these individuals tend to lead relatively organized family lives, pursue hobbies, raise children, and so on. If we were to model an average person from these 200 participants, we could conclude that the home or family environment is not particularly stressful, but rather harmonious.

A different picture emerges when analyzing their detailed responses about the workplace environment. The study shows that top-level management should strive to eliminate at least some of the disruptive workplace stressors—such as poor communication with supervisors, selection of competent leaders with high levels of empathy for their colleagues, simplification of certain work processes (gradually and consistently, case by case, regardless of political leadership changes), extending deadlines for specific tasks (where possible), seriously considering remote work (where applicable), preventing or eliminating workplace bullying, reducing political influence within public administration and research institutes, and carefully reviewing the distribution of work tasks.

In short, the goal should be to create a more harmonious work environment, which is far more achievable within public administration and research institutions than in industrial sectors such as glass, paint, mining, metals, etc. It is highly likely that our public servants and researchers would be even more motivated and deliver better work and intellectual results. It must be understood that without this societal layer, the stability (proper functioning, credibility, public guidance and education, knowledge transfer, etc.) and future (e.g., patents, innovations, inventions) of the social system would be at risk.

4.5.2.2.6.7 Table 136: Comparison of different samples

	Every day life	Every day life - pilot	Library environment	Library environm.- pilot	MNZ/Police environment
σ_{SF}	32.76	28.03	22.71	24.02	41.25



4.5.2.2.6.8 Figure 225: Comparison of different samples and environments

Table 136 and Figure 225 present a comparison between two full and two pilot studies (focused on everyday life and the library environment), as well as a study on stress intensity (σ_{SF}) within the Ministry of the Interior/Police (MNZ). In this last study, 31 respondents participated, only nine of whom were police officers.

The study on stress in everyday life yielded a result of 32.76 º S, while the pilot study with 10 participants resulted in 28.03 º S. When comparing the full and pilot studies for the library environment, it was found that a sample of just 10 people provided nearly the same insights as a sample of 200. However, this finding did not apply to the stress levels in everyday life, as responses from public servants and researchers were too diverse.

When analyzing 100 respondents, it also became clear that this number still did not provide the same insights as a sample of 200. The limited study on stress within the Ministry of the Interior/Police was conducted in 2012/2013. The intranet-based questionnaire was completed by 31

participants—27 public servants filled it out entirely, while four completed it partially. Among them were nine higher-ranking police officers (e.g., police advisors, district heads, chief inspectors).
The measured stress level in this group was significantly higher than in previous studies, reaching 41.25 º S. This result still falls within the upper range of moderate stress levels. However, it's important to note that the sample size was too small, so no conclusions could be drawn about physical attentional factors or biological health-related factors.
Social and performance-related stress factors were most prominent, particularly those resembling previously mentioned conflict situations with management and poor task distribution. It would be advisable to conduct a study solely within the police environment—not only involving higher-ranking representatives but especially operational officers (e.g., special forces, traffic police, communications center staff, and young officers working night shifts), as well as other professionals such as criminal investigators dealing with violent crimes, forensic experts, and financial crime investigators.
If the stress intensity were found to exceed 60 º S, this could serve as an "orange alert" for police leadership. Such results would likely indicate issues in interpersonal relations (e.g., overly autocratic leadership, workplace bullying), organizational/technological areas (e.g., poor task allocation, outdated IT systems), performance challenges (e.g., working with intoxicated individuals at night, arriving at accident scenes, especially during night shifts), and health-related concerns (e.g., severe injuries, psychological trauma from past incidents).

4.5.2.2.7 Conclusion on the study

Social hierarchical associative systems in civilized societies are built both hierarchically and relationally. Within these hierarchies, not only are duties and rights distributed, but so are needs. The more rigid these hierarchies are, the more energy is lost—by both individuals and social systems (e.g., measured in kilocalories in ergonomics, in units of bioenergy, manifesting as discomfort, tension, stress, and financial losses).
Negative stress—alongside crime, violence, emotional epidemics, and other anomalies—typically results in an energy drain for both individuals and social systems. However, some relatively rare individuals (such as leaders of criminal organizations, autocratic rulers, or excessively self-centered people) tend to benefit significantly from such situations.
The additional negative stress generated by these anomalies does not simply disappear; rather, it tends to grow exponentially over time. Both individuals and hierarchical social systems have the capacity to transform negative stress into positive energy, but there are limits. These include the

hierarchical structure itself, and so-called “double-edged” rules, which are necessary for safety but at the same time hinder the implementation of effective solutions.

As negative stress evolves into excessive stress, converting it into positive energy becomes more difficult. Problems become chronic, embedding themselves like a negative program in the mindset of individuals and the organizational culture of social systems.

In summary, it is essential to continually monitor and measure distress factors—especially in environments where major stress hotspots are likely—and to implement appropriate measures through a range of improvements or innovations, such as:

a. Organizational and legal improvements/innovations

(e.g., more logical and efficient regulations, better geographic location planning, improved spatial arrangements within departments, and better human resource management).

b. Information and communication improvements/innovations

(e.g., faster and more effective communication channels, better use of collective intelligence through knowledge management, development of positive and creative social networks within organizations).

c. Technological improvements/innovations

(e.g., high-quality, modern, and affordable IT, development of useful applications for both employees and external users, more efficient machines and devices).

d. Business improvements/innovations

(e.g., effective training and education for business and other users, reducing operating costs, a developmental orientation in business operations, and improved business outcomes).

e. Planning improvements/innovations

(e.g., large, medium, and small projects—with higher efficiency usually achieved in small to medium-sized projects).

f. Improvements/innovations in external collaboration

(e.g., more effective interdepartmental cooperation, use of only necessary external contractors to improve quality and reduce costs, and prevention of social engineering and cybercrime).

These types of improvements and innovations can serve as transformative tools, enabling us to convert negative energy into positive energy at the right time.

It would also be extremely interesting to study other social environments—such as healthcare, law enforcement, and manufacturing—where numerous sources of negative stress are likely to be found. For this reason, the method presented for calculating stress intensity across different societal contexts could be highly informative and perhaps even necessary, both locally and internationally.

As a further development, an energy consumption estimate (in kilocalories) related to negative stress factors in libraries and everyday life could be presented, based on the stress intensity calculation model. Determining or estimating energy consumption in various systems of our reality (e.g., individual, society, nature, the universe) is one of the key scientific interests of hierarchology and hierarchography.

4.5.3 Energy consumption and efficiency based on stress levels

Before presenting the calculation for estimating energy consumption and efficiency, it's useful to first outline some basic information about energy needs and sources.

Humans primarily need energy to maintain a relatively constant body temperature, perform bodily functions (such as movement, digestion, and organ function), support growth (e.g., during childhood and adolescence), enable regeneration (e.g., skin, hair, nails), and carry out substance exchange processes (like breathing). Energy is primarily obtained through food and fluids (e.g., carbohydrates, fats, water), as well as sunlight (e.g., for vitamin D production).

Energy requirements can be defined in the following ways:

a. Basic energy requirement:

In a lying position, the body requires about 24 kcal per day to maintain body temperature.

b. Activity-based requirement:

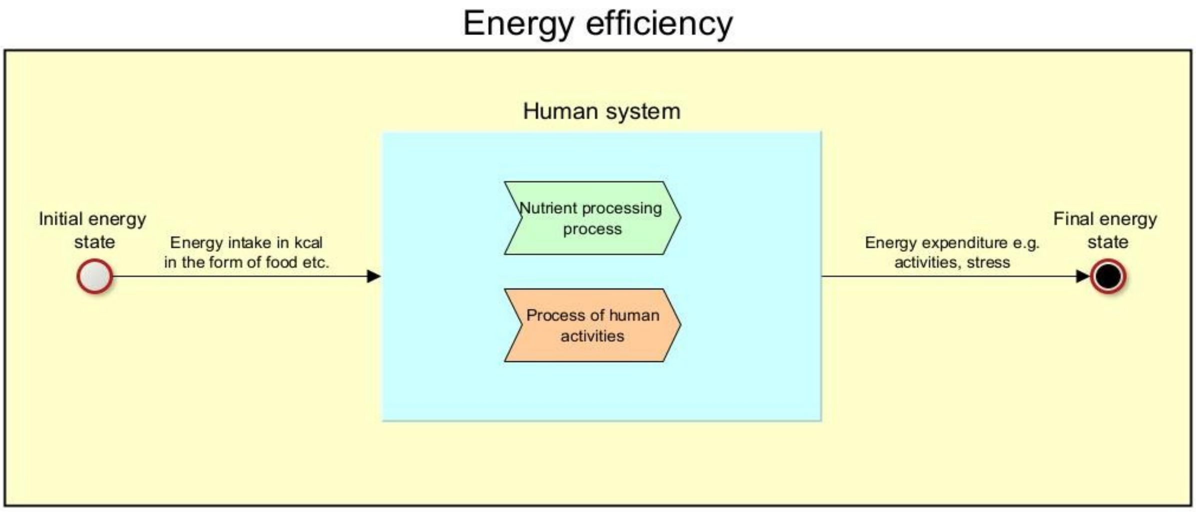
This includes energy needed for lying down, sitting, physical and mental work, and exercise.

There are differences in energy needs and consumption between genders, primarily due to differences in body structure—such as height, weight, and muscle mass. Women generally have slightly lower energy consumption. Therefore, relative average values will be used for estimating energy consumption and efficiency:

- At rest: approximately 1,832 kcal - While sitting: approximately 2,213 kcal
- During intense physical activity: approximately 3,800 kcal

For the sake of simplification in calculating energy consumption and efficiency, a reference value of 2,500 kcal will be used. This same value will also be applied as the energy intake, meaning both the system input and output will be set at 2,500 kcal.

In this context, a human will be considered as a system that produces and consumes energy through two key processes: the metabolism of nutrients and the performance of activities—including the impact of negative stress factors.



4.5.3.1 Figure 226: System model of the human being in terms of energy efficiency

Figure 226 illustrates a system model of a human being from the perspective of energy efficiency. On the left side of the diagram, energy input is shown in the form of nutrients, expressed in kilocalories (kcal). In the center of the figure, two key processes are depicted: the metabolism of nutrients and the performance of human activities. During these activities, individuals encounter various and numerous negative stress factors. This highly simplified model will serve as the basis for a mathematical formula to estimate human energy consumption and efficiency. Both the energy input and output values (set at 2,500 kcal) will be considered, along with the influence of stress factors (specifically measured and maximum stress gradients).

Given that the study on everyday life stress included 200 public sector employees and researchers, the final energy output value will be multiplied by this number. As an additional point of interest, energy efficiency will also be assessed within a library environment (i.e., among students).

$$W_{EP} = \left(W_I - W_{PS} \cdot \frac{\sigma_i}{\sigma_m}\right)$$

$$W_{EP} = 2500\,Kcal - \left(2500\,Kcal \,.\, \frac{32{,}76^0\,S}{90{,}00^0\,S}\right) = 1590\,Kcal$$

Legend:

- W_{EP} – Effectively used energy in kcal
- W_I – Input or supplied energy in kcal
- W_{PS} – Energy consumed due to stress gradient in kcal
- σ_i – Measured or calculated stress power in stress degrees
- σ_m – Maximum stress power in stress degrees, defined as 90 °S

The calculation showed that the effectively used energy per public sector employee—based solely on the stress gradient or stress power—was 1,590 kcal. If we were to calculate the effective daily energy expenditure for 200 public sector employees based on stress power, the result would be 318,000 kcal, which (as a rough comparison) is approximately equivalent to heating 8,000 liters of water by 39.85 °C![81] On the condition that the stress power were 0 °S, the result would be an impressive 500,000 kcal of effectively used daily energy—enough to heat nearly 12,500 liters of water by 39.5 °C. However, these values alone do not tell us by what percentage the efficiency of effective daily energy use in human functioning is reduced due to stress power. Therefore, a calculation of energy efficiency will be presented next.

$$\eta_W = \frac{W_{EP}}{W_I} . 100\,\%$$

$$\eta_W = \frac{1590\,Kcal}{2500\,Kcal} . 100\,\% = 63{,}60\,\%$$

The effective daily energy efficiency (ηW) was only 63.60%, which means that, in our case, a public sector employee lost 36.4% of their energy due to stress power. Where this energy goes after the reactions—in terms of physical, psychological, and social energy (if we allow for a rough comparison)—is an interesting question that would be worth attempting to answer, at least experimentally.

Before doing so, as previously mentioned, we will first calculate the loss and efficiency of effective energy due to stress power in the library environment.

$$W_{EP} = (W_I - W_{PS} . \frac{\sigma_i}{\sigma_m})$$

$$W_{EP} = 2500\,Kcal - (2500\,Kcal . \frac{22{,}70^0\,S}{90{,}00^0\,S}) = 1869{,}4\,Kcal$$

The calculation showed that the effectively used energy per student—based solely on the stress gradient or stress power in the library environment—was 1,869.4 kcal. If we were to calculate the effective energy expenditure for 200 students based on stress power, the result would be 373,880 kcal, which (as a rough comparison) is approximately equivalent to heating 9,200 liters of water by 39.85 °C!

However, these values still do not indicate by what percentage the efficiency of effective daily energy use in human functioning is reduced due to stress power. Therefore, the efficiency calculation will be presented next.

81 To heat 1000 liters of water to 39.85 degrees Celsius, we need 46.6 KWh or 40068.79 Kcal. Data found at URL: https://www.energie-lexikon.info/kilowattstunde.html (2020-01-25) RP – Energie Lexikon.

$$\eta_W = \frac{W_{EP}}{W_I} . 100\,\%$$

$$\eta_W = \frac{1869{,}4\,Kcal}{2500\,Kcal} . 100\,\% = 74{,}78\,\%$$

The effective daily energy efficiency (ηW) was 74.78%, which means that, in our case, the student lost 25.22% of their energy due to stress power. The resulting value for the loss of effective daily energy is significantly lower than in the study on stress power in everyday life.[82]

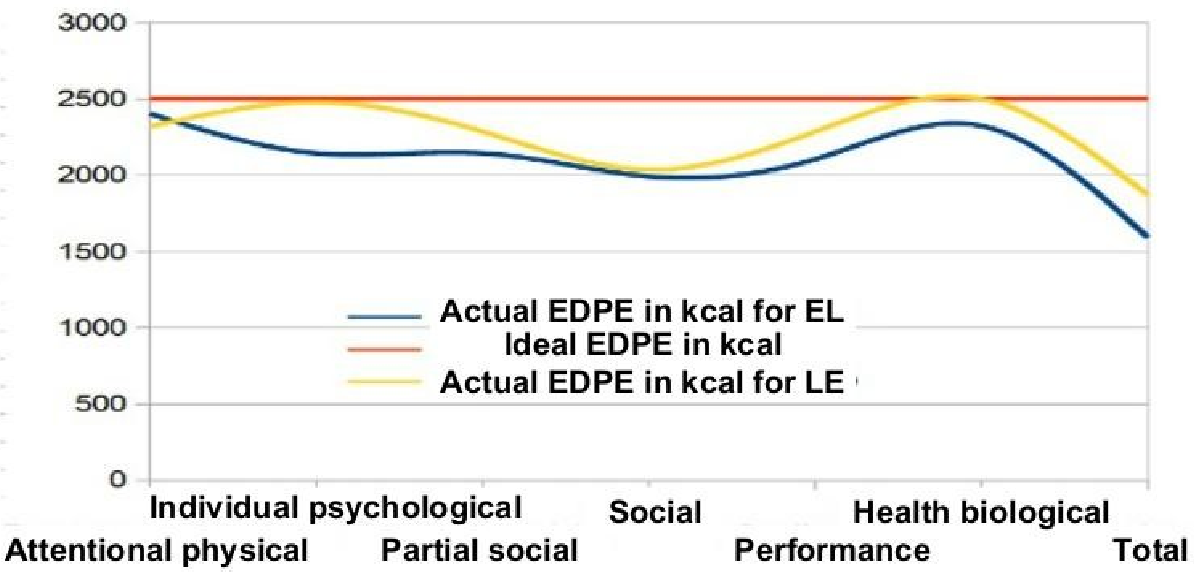
As an interesting next step, let's calculate the effective daily energy expenditure based on stress power across individual categories of stress factors—attentional physical, performance-related, partially social, individual psychological, social, and health-biological—both for everyday life and the library environment.

For this purpose, a table will be prepared with the relevant data and results, which will serve as the basis for presenting a curve of effective daily energy consumption caused by stress power in each category. Additionally, the graph will also display the ideal effective daily energy expenditure for each stress factor category, with a baseline value of 2500 kcal.

82 For the Ministry of the Interior and Police environment, the effective daily energy efficiency would be only 54.17%, meaning a 45.83% loss of energy. As previously mentioned, the sample size was too small and did not include police officers performing more mentally and physically demanding tasks.

4.5.3.2 Table 137: Actual and ideal effective daily energy consumption by individual categories

Categories	Actual EDPE in Kcal for EL	Ideal EDPE in Kcal	Actual EDPE in Kcal for LE
Attentinal physical	2403.6	2500	2319.44
Individual psychological	2143.89	2500	2477.78
Partial social	2143.89	2500	2286.11
Social	1992.78	2500	2036.67
Performance	2105.28	2500	2286.11
Health biological	2322.78	2500	2500
Total	1590	2500	1869.4



4.5.3.3 Figure 227: Daily effective energy expenditure by categories and overall

Table 137 presents data on daily effective energy expenditure for individual categories of stress power (in kcal), as well as the ideal effective daily energy expenditure. Figure 227 shows a graph with the ideal daily effective energy consumption (red horizontal line), which is set at 2500 kcal, alongside the curve of effective daily energy consumption in everyday life (blue line labeled EDPE for EL) and in the library environment (yellow line labeled EDPE for LE).

It can be observed that the values of effective energy expenditure across different categories of stress factors are generally lower for everyday life. An exception is the category of attentional physical stressors, where energy consumption for everyday life (2403.6 kcal) is slightly higher than for the library environment (2319.44 kcal). The most pronounced difference appears in the social stressors category, where the effective energy use is the lowest—1992.78 kcal for everyday life and 2036.67 kcal for the library setting—clearly illustrated by the divergence of the blue and yellow curves from the red line.

From this, we can conclude that social factors are the primary cause of energy efficiency loss, as they contribute to the emergence of many other stress-related factors. For example, science as a societal category developed neon lighting, which can harm eyesight; hierarchical structures often create conflicts between employees and management, affecting psychological well-being; greed for profit can lead to working in extreme and hazardous physical conditions; irrational task distribution causes unnecessary conflicts and high costs. Environmental pollution driven by profit-based logic further contributes to public health issues.

If we were to analyze the main causes of negative stress factors, we could estimate that in approximately 90% of cases, social factors are the main trigger of negative stress. This means that in legally, socially, and technologically advanced hierarchical systems, humanity loses the most energy due to social factors. It would be meaningful to explore more deeply the causal and conditional relationships between social stressors and the onset of stress.

This brings us again to the question: Where does this lost energy go? In reality, it isn't lost—it is redistributed into more or less meaningful activities within societal hierarchical systems. Extreme materialistic profit-driven logic causes massive energy loss for the majority of the population, while a few individuals convert it into material and positional gain. In other words, this energy transforms into mass—for instance, in building environmentally unfriendly factories, irrational distribution of financial resources within social systems, etc. Although this mass may later contribute to energy production, the long-term energy losses become evident in the form of poverty, environmental degradation, and wars.

Thus, we've at least partially addressed the question of energy loss at both individual and societal levels. This also opens a fascinating research opportunity to study the transformation of energy into mass and vice versa within social systems—a significant scientific challenge that could be tackled by well-organized research teams.

The calculation of effective daily energy expenditure is based on a benchmark value of 2500 kcal, which roughly corresponds to activities predominantly carried out in a sitting position. Factors such as age, body weight, height, and various physical tasks performed both at work and at home (e.g., rushing to meetings, commuting, business travel, lab work, app testing, mailing documents, inventory taking, gardening, home construction, sports, and recreation) were not precisely accounted for.

It would also be important to calculate effective daily energy expenditure and efficiency for different activity levels, such as resting, moderate physical activity, and intense physical labor—each of which assumes different levels of energy intake from the outset. Next, we will present the calculation of effective daily energy expenditure and efficiency for the case of intense physical activities. We will assume a male person, 1.80 meters tall, 40 years old, and weighing 75 kg.[83] Based on two online applications, we obtained an energy requirement of 4132.73 Kcal (input energy) and the same value for energy consumption, 4132.73 Kcal. The stress gradient will be set at a value of 80 0 S (an exceptionally high stress power is intentionally chosen).

$$W_{EP}=(W_I-W_{PS}\cdot\frac{\sigma_i}{\sigma_m})$$

$$W_{EP}=4132{,}73\,Kcal-(4132{,}73\,Kcal\,.\,\frac{80{,}00^0\,S}{90{,}00^0\,S})=459{,}19\,Kcal$$

As a result, we obtained 459.19 Kcal of effective energy consumed per day, which is an extremely low value. The efficiency calculation will illustrate this even more clearly.

$$\eta_W=\frac{459{,}19\,Kcal}{4132{,}73\,Kcal}\,.\,100\,\%=11{,}11\,\%$$

The daily energy efficiency for the individual under the given conditions would be only 11.11%, meaning that 88.89% of the energy would be lost. Based on this extreme condition for performing extremely heavy physical tasks, the individual would need to intake much more energy in the form of nutrients. In any case, this person would require multiple breaks to prevent complete burnout. 88.89% of the energy was converted into mass, which is located outside of this individual (e.g., house construction, sewer ditches, foundation, etc.). This conversion into external mass also led to a loss of body weight for the individual.

Such extremely demanding activities can be extremely harmful to a person, as a state with 0% or even negative energy values could lead to complete burnout and even death of the individual. Energy is crucial for the survival of all living beings on our Earth, and thus, of course, for humans and social hierarchical associative systems.

The subsection on stress is now concluded. We will continue with the subsection on mental illnesses.

83 The energy requirement and consumption for heavy physical activities was calculated based on two online applications located at the URL: https://www.kalorienbedarf.de/rechner/ and https://www.fitrechner.de/kalorienverbrauch/USC11050/Bauarbeiter%2C+schwere+Lasten+tragen (2020-02-02).

4.5.4 Mental illnesses

According to the International Statistical Classification of Diseases and Related Health Problems (ICD-10), mental illnesses are classified into the following groups:[84]

a. F00–F09 Organic, including symptomatic, mental disorders.

This group includes conditions such as various forms of Alzheimer's disease, dementia, Pick's disease, Parkinson's disease, Creutzfeldt-Jakob disease, delirium not caused by the use of psychotropic substances (e.g., alcohol), organic hallucinations, mood disorders, bipolar disorders, catatonic states, manic-depressive disorders, anxiety, emotional instability, cognitive disorders, mixed syndromes, and others.

b. F10–F19 Mental and behavioral disorders due to the use of psychoactive substances.

This group includes all mental disorders resulting from the influence of substances like cocaine, opiates, alcohol, and nicotine. Symptoms can manifest in various forms, such as auditory hallucinations, visual hallucinations, delirium, and behavioral disorders.

c. F20–F29 Schizophrenia, schizotypal personality disorders, hallucinations.

This category primarily includes different forms of schizophrenia, such as paranoid schizophrenia, disorganized schizophrenia, catatonic schizophrenia, hebephrenia, atypical schizophrenia, other forms of schizophrenia, and unspecified schizophrenia.

d. F30–F39 Affective (mood) disorders.

This group includes various forms of mania, bipolar disorders, mood disorders, depressive disorders, and others.

e. F40–F48 Neurotic, stress-related, and somatoform disorders.

Included here are different forms of phobias, anxiety, obsessive-compulsive disorders, low stress tolerance, dissociative disorders, somatoform disorders, etc.

f. F50–F59 Behavioral syndromes associated with physiological disturbances and physical factors.

This group includes eating disorders, sleep disorders, sexual dysfunctions, intellectual disability, psychosis during pregnancy, and misuse of stimulants.

g. F60–F69 Personality and behavioral disorders.

This category includes disorders such as borderline personality disorder, paranoia, kleptomania, gaming addiction, sexual deviations (e.g., pedophilia, sadism, masochism), identity disorders (e.g., transsexuality, transvestism).

h. F70–F79 Intellectual disabilities.

This group includes, for example, mild, moderate, and severe intellectual disabilities.

84 Current online edition: https://www.dimdi.de/static/de/klassificationen/icd/icd-10-who/kode-suche/htmlamtl2019/ (2020-02-08).

i. F80–F89 Developmental disorders.

This group includes speech disorders, autism, Asperger’s syndrome, and movement disorders.

j. F90–F98 Behavioral and emotional disorders with onset in childhood and adolescence.

This group includes disorders such as hyperactivity, attention deficit, emotional disorders, poor social functioning, tics (e.g., vocal tics, motor tics), and infantilism.

k. F99 Unspecified mental disorders.

This group includes relatively undefined disorders such as organic mental disorders and mental disorders caused by brain injury or disease.

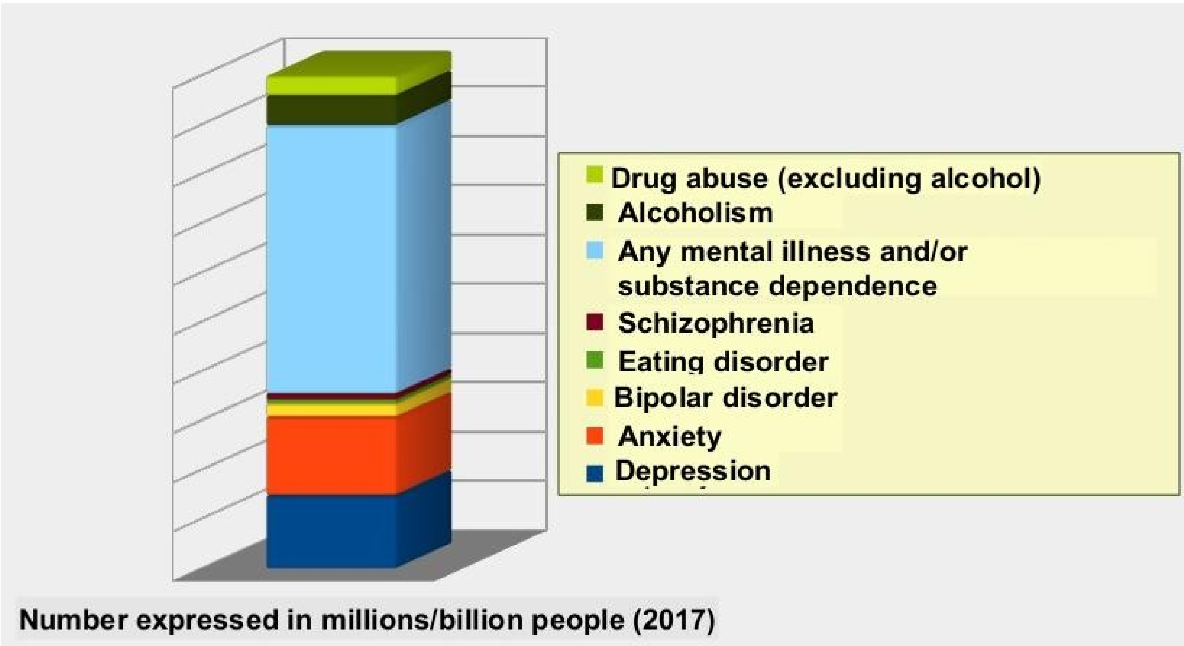
Note: Based on global statistical data on mental illnesses for the year 2017, a table will be compiled containing information on the type of mental illness, the number of affected individuals, and an approximate estimate of hospitalized individuals (the values in the second column were divided by five, so the resulting numbers are very approximate).[85]

Based on the values in the third column, an estimate of the loss of effective energy expenditure will be presented later. It should be emphasized that the results obtained will represent only rough estimates!

85 Data on the number of people affected was obtained from the article: Ritchie, H., Roser, M. (2020). "Mental Health". Access URL: https://ourworldindata.org/mental-health (2020-02-09).

4.5.4.1 Table 138: Mental illnesses and number of people affected

Type of mental illness	Number expressed in millions/billion people (2017)	Rough estimate of people hospitalized (2017)
Depression	264000000	52800000
Anxiety	284000000	56800000
Bipolar disorder	46000000	9200000
Eating disorder	16000000	3200000
Schizophrenia	20000000	4000000
Any mental illness and/or substance dependence	970000000	194000000
Alcoholism	107000000	21400000
Drug abuse (excluding alcohol)	71000000	14200000
Total	1778000000	355600000



4.5.4.2 Figure 228: Bar chart of mentally affected individuals for the year 2017

Table 138 shows the number of mentally affected individuals and a rough estimate of those hospitalized in psychiatric hospitals, while Figure 228 presents a bar chart showing the number of mentally affected individuals by drug abuse (excluding alcohol), alcoholism, various mental illnesses potentially related to psychotropic substances, schizophrenia, eating disorders, and bipolar disorders.

The highest number of mentally affected individuals is found in the third group (see the light blue bar), which refers to heterogeneous forms of mental illness that may also be influenced by various drugs (e.g., cocaine, heroin, stimulants) and substances (e.g., alcohol). Overall, the data indicates a strong connection between mental health issues and psychotropic substances.

We can observe that depression (264 million people) and anxiety (284 million people) are very common examples of mental illness in relatively "pure" form. They are followed by bipolar disorders (46 million), schizophrenia (20 million), and eating disorders (16 million). Given the relatively precise classification of mental disorders, these statistics cover only a small fraction of all mentally affected individuals. Furthermore, it is important to note that mental disorders often manifest in hybrid forms (e.g., depressive and anxious symptoms may appear in individuals with schizophrenia, paranoia, and other mental conditions).

Based on this data, it is evident that the values are very high, yet they present a somewhat optimistic picture, as many undiagnosed cases are not included. In reality, the actual numbers would likely be much higher.

The causes of mental disorders are numerous, including brain injuries, brain diseases, circulatory abnormalities, the influence of psychotropic substances, and a lower threshold for stress tolerance. However, as with negative stress, social factors stand out the most — they are often the main cause of mental health problems. It is worth emphasizing again that socio-hierarchical associative systems are the primary drivers of mental illness. These systems are largely responsible for an enormous loss of energy, as individuals hospitalized in psychiatric institutions are, from a pragmatic point of view (they do not produce goods, provide useful services, and incur high costs), relatively unproductive.

In short, the structure of socio-hierarchical associative systems contains numerous systemic flaws. From an energy and cost perspective, this system is a significant consumer of financial resources and various forms of energy (e.g., thermal, light, kinetic energy). To support this claim, an estimate of the loss of effectively used energy for the group of individuals under consideration — in terms of product creation and/or service provision — will also be provided. As a reference value for energy in Kcal, the example from everyday life will be used, where the calculated value was 1590 Kcal.

4.5.4.3 Table 139: Estimated loss of effectively consumed energy for a group of hospitalized persons with mental health problems

Type of mental illness based on a small list	*Hospitalized persons based on a rough estimate*	*Effective energy expenditure deficit per unit Kcal*
Depression	52800000	83952000000
Anxiety	56800000	90312000000
Bipolar disorder	9200000	14628000000
Eating disorder	3200000	5088000000
Schizophrenia	4000000	6360000000
Any mental illness ...	194000000	308460000000
Alcoholism	21400000	34026000000
Drug abuse (excl. alcohol)	14200000	22578000000
Total	355600000	565404000000

Table 139 presents an estimate of the loss of effectively used energy for a group of hospitalized individuals with mental health issues.

From a productivity standpoint, these individuals are relatively unproductive, as they typically do not produce any useful goods for the market or perform any valuable services. The individual numbers of hospitalized persons were multiplied by the value of 1590 Kcal, which represents the amount of effective energy expenditure of a public employee in everyday life. The resulting figures represent a relative loss of effectively used energy, based on the assumption that these hospitalized individuals only take medication, rest, and eat.

It is important to highlight the sum of these individual energy values. The final result shows an extremely high figure: 565,404,000,000 Kcal, or 565,404 Gcal of lost global energy within social hierarchical associative systems. This is comparable to the energy output of nuclear power plants, which can generate around 50 Gcal/h of thermal energy. The obtained value of 565,404 Gcal of thermal energy (used here as a conditional comparison) would correspond to the annual energy production of a floating nuclear power plant, approximately 144 meters in length and 30 meters in width, with a displacement of 21,500 tons, operating for roughly one year, 106 days, and 4 hours.

As previously mentioned, the causes and conditions for the development of mental disorders are numerous. There is a need for more detailed analysis of negative social stressors. A study on the impact of stress in everyday life and in library environments produced a comprehensive list of negative social stress factors. Some of these—especially when very strong and intense—could serve as triggers for mental, or more specifically, psychological illnesses.

This group of causes could include various types of crime (e.g., workplace mobbing, economic crime, organized crime such as drug trafficking, human rights violations, war), physical and psychological abuse, discrimination based on ethnicity, race, social status, religion, beliefs, sexual orientation, and gender, bullying, manipulation, severe conflicts at work or at home, social isolation or exclusion, poverty, lack of financial resources for a decent life, injustices in the workplace related to career advancement or job responsibilities, etc.

The list of negative social stimuli could be almost endlessly long.

Moreover, we should not overlook one very important consequence of negative social stress: physical and mental fatigue, which may result from lifestyle, partial or broader social factors (e.g., excessive demands, overwhelming responsibilities, relentless competition), environmental factors (e.g., severe air pollution affecting the respiratory system, traffic congestion, overcrowding), organic disorders or diseases (e.g., anemia, sleep apnea, thyroid dysfunction, diabetes), and mental disorders (e.g., depression, anxiety).

It is therefore reasonable to take a closer look at the listed groups that cause constant fatigue and, in some cases, even physical and psychological burnout.

a. Lifestyle:

Lifestyle can have a significant impact on both physical and mental fatigue. For example, consider a married couple with three children, both of whom are employed. They often lack sufficient financial resources for various household needs. As a result, in addition to their work and family obligations, they are forced to take on extra activities (e.g., freelance or craft work) to earn additional income. This means they work eight hours at their regular jobs and an additional six to seven hours at home. On top of that, they have numerous family responsibilities, such as caring for school-age children. It can happen that both spouses begin using various stimulants to better cope with the intense physical and psychological demands. The problem arises when these stimulants, although temporarily effective in overcoming severe fatigue, begin to disrupt their sleep. At that point, both may start taking sleeping aids (e.g., sleeping pills). It becomes clear that such a lifestyle can lead to excessive stress, harming both physical and mental health, and in some cases causing complete physical and psychological burnout.

These kinds of cases are not uncommon. Some studies in health management have even shown that at least 50% of working individuals believe they are at high risk of complete physical and mental burnout.[86]

The lifestyle described above can lead to serious mental health issues in various forms, such as depression, anxiety, paranoia, bipolar disorder, eating and sleep disorders, phobias, aggression, suicidal tendencies, and more.

86 Matusiewicz, D., Kardys, C., & Nürnberg, V. (2020). *Betriebliches Gesundheitsmanagement*. Medizinisch Wissenschaftliche Verlagsgesellschaft.

An individual's lifestyle—whether it belongs to a single person or to smaller or larger groups—can be influenced by partial social and broader societal factors that essentially shape the activities and decisions of many people.

On one hand, these are standards set by individuals based on their own needs and desires (e.g., purchasing an expensive car as a status symbol, or striving to be as respected and admired as possible). On the other hand, societal demands, expressed through various norms (e.g., values, laws), shape people's behavioral and decision-making patterns (e.g., the need to produce as many goods and/or provide services as possible, or the obligation to pay taxes).

b. Partial social and societal factors:

These are closely linked to lifestyle, emotions, and social norms. In addition to the factors already mentioned, we can highlight time pressure in performing work and daily tasks, emotional stress, long commutes to and from the workplace (a productivity-related stress factor stemming from broader social stressors), heavy traffic congestion, and an unhealthy organizational climate at work (e.g., bullying, mobbing, inappropriate stalking), conflicts with colleagues, management, or partners, an excessive number of work tasks within a very limited timeframe, favoritism in the workplace (e.g., a manager showing preferential treatment to another employee), and high household expenses, among others.

These are critical conditions essential for people's survival. When certain existential needs (e.g., financial security, social belonging, housing) are threatened and exert strong, persistent pressure on an individual, mental health can deteriorate to the point where psychological problems develop, potentially progressing into full-blown disorders such as depression, anxiety, eating disorders, bipolar disorder, manic-depressive states, paranoia, and addiction to various drugs and substances (e.g., severe addiction to hard drugs can cause psychological symptoms that closely resemble various forms of schizophrenia, etc.). Adverse social conditions can even accelerate the onset of psychotic disorders, such as schizophrenia and severe borderline personality disorders. It has been found that schizophrenia and borderline disorders, in their various forms, are largely genetically determined.[87] The same applies to a low tolerance threshold or poor resistance to stress factors. Generally, various forms of epilepsy are also considered to be genetically determined, and it has long been known that there is a connection between epileptic seizures and psychoses.[88]

87 Max-Planck Geselschaft. (2014). Einblicke in genetische Ursachen der Schizophrenie. Dostopno na URL: https://www.mpg.de/8316066/gene_schizophrenie (2020-02-16).
Volker Faust. (2007). Borderline-Persönlichkeitsstörung. Available at URL: https://www.psychosoziale-gesundheit.net/pdf/faust1_borderline.pdf (2020-02-16).

88 Köhler G.K. (1993) Epilepsie und Psychose. In: Möller HJ., Przuntek H. (eds) *Therapie im Grenzgebiet von Psychiatrie und Neurologie*. Springer, Berlin, Heidelberg.
Available at URL: https://link.springer.com/chapter/10.1007/978-3-642-78040-0_18 (2020-02-16).

In the purest form, or classic paranoia, it can be reliably assumed that it develops primarily due to strong and intense social stress factors. People may be more or less prone to paranoid tendencies, but in most individuals, this mental illness does not fully develop and instead manifests only as occasional symptoms. This form of mental disorder is particularly characteristic of legally, socially, and technologically advanced hierarchical associative societies, and occurs less frequently in sparsely populated regions and less developed, more or less culturally isolated environments (e.g., pygmies in the rainforest, inhabitants of certain Polynesian islands, various African tribes).
Negative social stress factors—such as mobbing, stalking, harassment, injustice, social exclusion, political beliefs, and religious affiliation—can act as strong triggers for this mental illness. One could even argue that this form of psychosis has a particularly social origin, something that cannot necessarily be said for many other forms of psychosis, such as schizophrenia. Therefore, paranoia could be referred to as a social psychosis.
In many cases, eating disorders are also influenced by high societal expectations and the need for recognition (e.g., in bulimia, the affected person lives in fear of becoming overweight, constantly thinking about food and body weight, which they then manage through vomiting and laxatives; in anorexia, the fear is similar, but the method of control is extreme food restriction, which can be life-threatening).
c. Environmental factors: These can be said to be not directly related to the lifestyles of individuals, but rather partially to the lifestyle of societal hierarchical associative systems. Weather conditions can be powerful triggers for mental health issues. Especially in regions with insufficient sunlight, scientists have found that a lack of sunlight can contribute to depressive states and increase the risk of suicidal tendencies and alcoholism.
Another major environmental factor is tied to the lifestyle of more technologically developed societal hierarchical associative systems (mesocosmic influences), which—through the production and use of technological products and chemical compounds—heavily pollute the environment. This pollution endangers human health and the survival of many other living beings (e.g., animals, plants). Environmental pollution can affect the health of the respiratory and digestive systems and contribute to the emergence of dangerous known and unknown viruses and bacteria (microcosmic influences), which in turn negatively impact both physical and mental health.
This may result in digestive disorders, infertility, chronic stress, depression, anxiety, bipolar disorders, brain diseases, and more. Harmful macrocosmic influences—which may intensify as a result of severe environmental pollution—should also not be overlooked (e.g., the greenhouse effect can lead to climate change, which may have deadly consequences for plants, animals, and humans alike).

Additionally, shifts in electromagnetic wave frequencies can occur, which may negatively affect both physical and mental health (e.g., headaches, dizziness, migraines, depression, anxiety). All the above-mentioned microcosmic, mesocosmic, and macrocosmic factors—and many others—can contribute to the persistent and excessive fatigue experienced by the population.

d. Organic disorders: These can be genetically determined and/or caused by any of the previously mentioned factors. Such organic disorders can significantly contribute to chronic and excessive fatigue in individuals.[89] Among the most common and impactful organic disorders, we include:

- Anemia, which occurs when a person has too few red blood cells in their blood, resulting in insufficient oxygen supply to certain organs. Symptoms typically include headaches, dizziness, constant fatigue, impaired functioning of the urogenital system, and weakened attention and cognitive focus. In healthcare, this condition is usually treated by supplementing the body with iron ions.
- Thyroid dysfunction is another relatively frequent organic disorder. The thyroid gland's primary role is to produce hormones that regulate blood circulation, which in turn affects the body’s ability to resist negative stress factors. Symptoms often appear as increased body weight and a constant sensation of feeling cold. Treatment typically includes dietary adjustments and lifestyle changes recommended to the patient.
- Diabetes is caused by a lack of insulin, the hormone responsible for transporting sugar from food into the cells to supply vital organs with the energy they need. The main symptoms include constant cravings for sweets, persistent fatigue, and eventual physical and mental burnout. Chronic fatigue can also be caused by depression, which itself may result from various organic disorders.
- Sleep apnea is another common organic disorder, usually linked to heavy snoring during sleep, which can lead to breathing interruptions. These episodes can be extremely dangerous, as the person may suddenly stop breathing, potentially resulting in suffocation or even death. Individuals with chronic sleep apnea are often monitored in specialized sleep laboratories. Symptoms include headaches, excessive tiredness, significantly reduced libido, forgetfulness, and poor concentration.

Prolonged and extreme fatigue can also lead to various types of hallucinations, including auditory, visual, tactile, and olfactory.[90]

It often happens that affected individuals find themselves in a state between wakefulness and sleep. Sometimes, it only takes a split second of dozing off for a person to experience a visual or auditory hallucination. The agreed-upon reality—shaped through various norms and information-

89 Wolf, S. (2015). *Gründe für anhaltende Müdigkeit*. [Frankfurt a. M.]: Vistano.

90 Schuster, N. (2018). Bilder und Stimmen im Kopf. V: *Pharmazeutische Zeitung : die Zeitschrift der deutschen Apotheker*, Ausg. 22. Dostopno na URL: https://www.pharmazeutische-zeitung.de/ausgabe-222018/bilder-und-stimmen-im-kopf/ (2020-02-23).

communication networks—essentially creates specific energy waves. However, due to continuous and excessive fatigue, these energy waves can be altered to such an extent that new waves are formed, enabling various types of hallucinations, which in turn may shift the existing energetic platform.

In short, persistent excessive fatigue is a global issue—especially in technologically advanced hierarchical associative societies—that should not be underestimated. From an energetic perspective, this suggests that despite technological advancement, there is a significant lack of various forms of energy (e.g., bioenergy, thermal energy). Chronic fatigue among the population is a sign of poor energy efficiency within these societal systems. Today, constant over-fatigue can be measured using a range of technological tools and methods.[91]

We have now reached a point where we can begin to ask which strong and intense negative stress factors are capable of causing severe neurotic and psychotic symptoms. To answer this question, we will select a number of key, frequent, strong, and intense negative stressors that have the potential to trigger serious neurotic and psychotic issues.

In addition, we will outline the most characteristic symptoms of mental illnesses such as depression, anxiety, borderline disorders, paranoia, and schizophrenia. In the next step, assumptions will be made regarding the negative stress factors that may lead to the onset of severe neurotic and psychotic symptoms.

As this exploration continues, we will also present some causal and conditional reactions between the dominant patterns of thought concentration among previously discussed groups of people (the majority group, anomalies, extreme hierarchical complexes, and progressive groups) and the negative stressors.

It is understood that only a small portion of possible reaction scenarios will be presented, since the potential combinations—especially from an individual's perspective—are virtually limitless.

1. A list of negative stress factors can be compiled based on research into stress intensity in everyday life. Some of the negative stressors that lead to persistent excessive fatigue have already been mentioned.

2. A list of symptoms for certain neurotic and psychotic disorders—such as depression, anxiety, drug addiction, paranoia, borderline disorders, and schizophrenia—can be obtained through the descriptions of these mental illnesses.

a. Depression:

91 Amann-Jennson, G. W. (2018). Müdigkeit und Schlafneigung lassen sich messen. V: Einfach. Gesund. Schlafen : *das Online-Magazin für perfekten Schlaf*.

Depression is a neurotic disorder stemming from mood disturbances. It manifests in various symptoms, such as frequent feelings of sadness, emptiness, hopelessness, anger, irritability, and frustration; a lack of interest in many positive activities (e.g., sports, hobbies, recreation, spending time with friends); sleep disturbances (e.g., excessive sleeping or insomnia); persistent fatigue; loss of appetite (weight loss) or increased appetite (weight gain); anxiety, agitation, inner restlessness; slowed thinking, speech, and physical movements; frequent thoughts about death, suicidal ideation, or even suicide attempts; and unexplained physical issues (e.g., neck, back, or head pain).

People affected by depression often don't understand the cause of their symptoms and struggle with basic tasks like housekeeping, work, and social activities (e.g., interacting with others or studying).

The causes of depression vary. It may result from physical changes in the brain, a lack of "happiness hormones," or genetic factors. Regardless of the cause, one should not overlook the factors that can contribute to persistent fatigue and depression.

b. Anxiety (Anxiety disorders):

Anxiety is a neurotic disorder that causes individuals to feel frequent, persistent, and excessive fear and worry in everyday situations.

Examples of anxiety disorders include various phobias (e.g., social phobia). Symptoms of anxiety can include feelings of nervousness, tension, restlessness, panic, dread, weakness, fatigue, and danger; increased heart rate; rapid breathing; sweating; trembling; difficulty concentrating and sleeping; digestive issues; uncontrollable worries; and strong reactions to normal warnings, which may be perceived as serious threats.

The exact causes of anxiety disorders are not fully understood, but they are likely linked to life experiences. From a physiological standpoint, they may arise from heart disease, diabetes, thyroid problems, respiratory conditions (e.g., asthma, bronchitis), substance abuse (drugs, alcohol), intestinal diseases, or brain disorders (e.g., rare tumors).

c. Borderline disorders:

Borderline disorders can be either neurotic or psychotic and may be caused by genetic or social factors.

Key characteristics of individuals with this disorder include black-and-white thinking, fear of losing others' affection, emotional instability, excessive self-doubt, polarized feelings of love and hate, and a tendency to engage in risky behavior.

Due to the variety of borderline personality types, this disorder is difficult to define clearly.

Symptoms may include impulsiveness, a strong tendency toward risky actions (e.g., gambling, unsafe sex, reckless driving), fear of abandonment, intense emotional states, sudden outbursts of

anger, difficulty managing emotions, a distorted self-image, suicidal behavior, excessive fear of loneliness, feelings of emptiness, unstable relationships, and tendencies toward paranoia.
In more severe stages of paranoia, individuals may enter a psychotic state, which can later revert to a neurotic form.
Causes may be genetic, psychological, or social (e.g., low stress tolerance, smaller amygdala, traumatic childhood experiences, etc.).
Such individuals are more commonly found in technologically advanced, hierarchical societies, where interpersonal relationships can significantly impact the development of such disorders.
d. Paranoia:
Paranoia is a psychotic disorder in which a person develops beliefs of being persecuted, targeted by conspiracies, or experiencing hostility from others.
Symptoms may include doubts about others' loyalty and commitment, excessive distrust, hypersensitivity, resentment, low tolerance for criticism, a tendency to interpret messages as hostile, suspicion in romantic relationships, emotional coldness, attempts to control others, argumentativeness, difficulty relaxing, stubbornness, and hostile attitudes.
The exact causes of paranoia are not fully understood, but it is believed to be linked to negative social stressors and traumatic life experiences.
There is a form called paranoid schizophrenia, but it should not be confused with classic paranoia. Both types can lead to a breakdown of the personality.
e. Schizophrenia:
Schizophrenia is a psychotic disorder with a genetic basis. It is characterized by the breakdown of logical thought processes, loss of control over perceived reality, behavioral disturbances, and emotional instability.
This disorder negatively affects rational thinking and leads to serious behavioral, emotional, and social issues. Depression and anxiety are common co-occurring conditions.
Symptoms include hallucinations, delusions, disorganized thinking, speech disturbances, lack of emotional expression and logical thought, the use of invented words (neologisms), grandiose ideas, persecutory delusions, a sense of detachment from reality, multiple personalities, and feelings of being controlled by external forces.
Schizophrenia can present in various forms (e.g., paranoid, hebephrenic, catatonic, simple, etc.).
The causes are not completely known, but are thought to involve genetic factors, brain injuries, drug abuse, and traumatic life experiences.
3. The main thought patterns of the four sociological groups have already been discussed. For the sake of greater clarity, they will be briefly summarized again:

- The majority group: characterized by conformity and predominantly subordinate behavior.
- The anomaly group: characterized by escaping from agreed-upon reality and constructing their own version of it.
- The extreme hierarchical complex group: focused on dominance over others and maintaining or even increasing their influence and control.
- The progress group: driven by constant efforts to prove their intellectual capabilities and by visions of a better world.

What follows is the previously announced analysis or overview of possible causal and conditional reactions.

Three customized micro-thesauri were prepared to cover:

- Negative stress factors
- Symptoms of selected mental illnesses
- Key personality traits of the four sociological groups

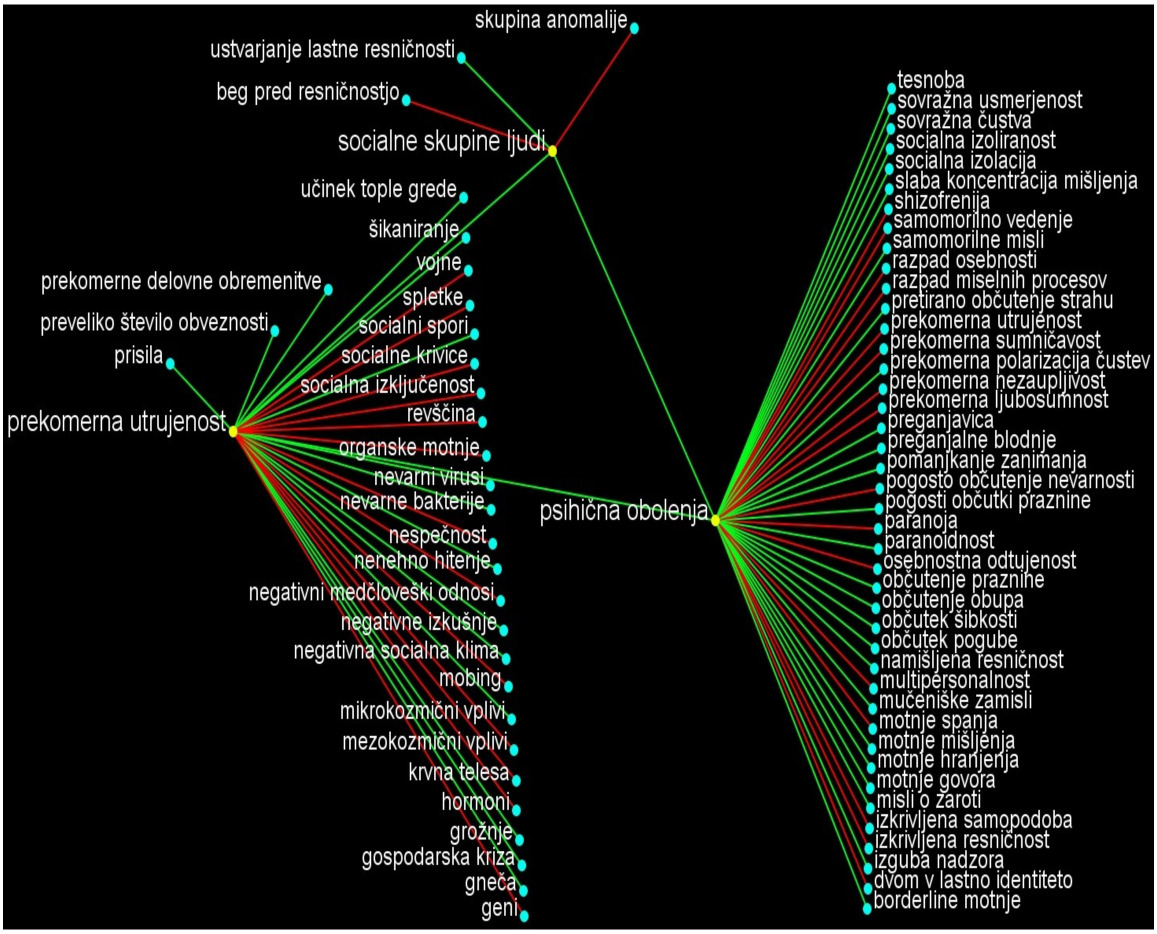
These micro-thesauri were exported as `.TXT` files and then imported into Excel as spreadsheets.

Descriptors or subject terms in all three micro-thesauri were evaluated using a rating scale from one to five, where one represents the lowest and five the highest level of influence.

Delimited `.TXT` files were then created and imported into the Ora Casos software tool. Using this tool, conceptual networks were generated and later merged into a single conceptual network through a consolidation process.

To enhance clarity and focus on the most influential factors, a 4.1 filter was applied—this excluded all phrases with a rating lower than four.

The resulting refined conceptual network, which includes negative stress factors, symptoms, and the key personality traits of the four sociological groups, will be presented and described in the following section.



4.5.4.4 Figure 229: Conceptual network of negative stress factors and symptoms of mental illness in the anomaly group

Figure 229 shows a conceptual network of negative stress factors and symptoms of mental illness in the anomaly group, using a 4.1 value filter.

The category of excessive fatigue includes a variety of negative stress factors, which may be:

- Biological and health-related (organic disorders, harmful bacteria, dangerous viruses, hormones, genes, blood cells, insomnia, greenhouse effect)
- Individually psychological (negative personal experiences)
- Partially social (threats, constant rush, coercion)
- Performance-related (excessive workloads, too many obligations)
- Social (economic crisis, wars, poverty, social exclusion, overcrowding, bullying, harassment, social injustice, scheming, negative social climate, social conflicts, negative interpersonal relationships)

These negative stress factors stem from:

- Microcosmic influences (e.g., harmful viruses, dangerous bacteria)
- Mesocosmic influences (e.g., poverty, war, bullying)
- Macrocosmic influences (e.g., the greenhouse effect)

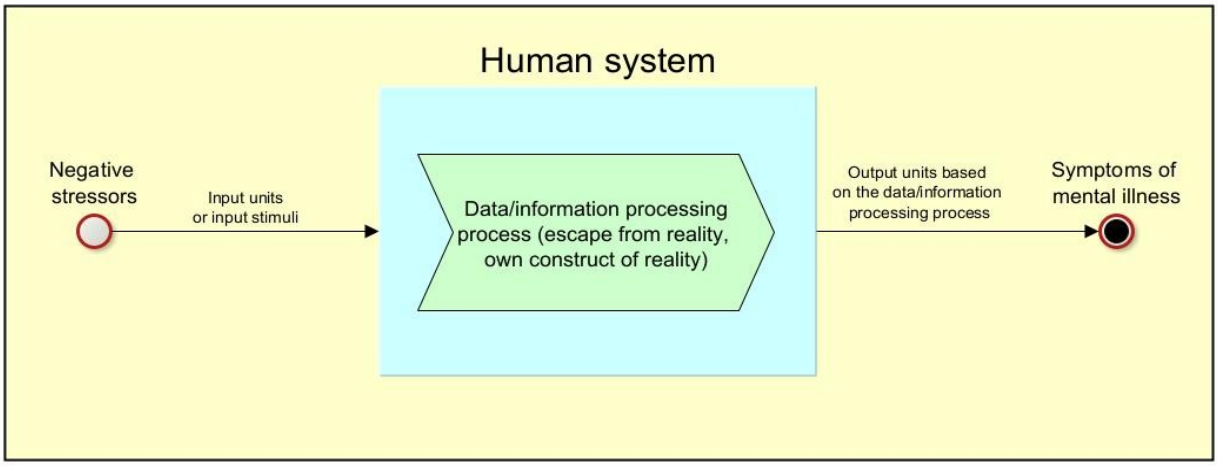
Among these, social and biological stressors stand out as especially significant. They are essentially the main contributors to excessive fatigue in individuals belonging to the anomaly group (see the connection between the category of excessive fatigue and the social group of individuals).
Based on the prominent negative stressors and the key psychological characteristics of the anomaly group (such as escape from shared reality and the creation of a personal version of reality), a variety of mental illness symptoms clearly emerge. These include:

- Paranoia
- Breakdown of coherent thought processes
- Multiple personality disorder
- Distorted self-image
- Doubt about personal identity
- Suicidal behavior
- Feelings of emptiness

These symptoms are typical of disorders such as borderline personality disorder, paranoia, and schizophrenia (see the category of mental disorders).
If we consider a human being as a system in which various data/information processing activities occur, we can define:

- Negative stress factors as the input units
- Key psychological characteristics of the anomaly group as the potential cognitive processing tools
- Symptoms of mental illness as the output units

To enhance clarity and understanding, the content will be further supported by a visual representation.



4.5.4.5 Figure 230: A systems model of the human being for data and information processing in relation to the core psychological traits of individuals from the reduced anomaly group

Figure 230 illustrates a systems model of the human being as a processor of data/information, in relation to the core psychological traits of individuals from the reduced segment of the anomaly group.

All the variables in the model are relatively well-known. The system inputs (causes), the primary psychological mechanism for processing the data/information, and the outputs (effects) are all clearly defined.

In this model:

- Negative stress factors are considered the causes (system inputs) behind the symptoms of mental illnesses, which are the effects (system outputs).
- The central processing phase represents the individual's methods of coping with negative stress stimuli, which can vary in speed and effectiveness.

This causal model applies to stress factors that typically lie outside an individual’s control—such as pollution, the greenhouse effect, overcrowding, economic crises, and wars.

In contrast, the conditional model focuses on inputs seen as given conditions. In this context, a well-organized individual may have greater influence over some outcomes (like feelings of weakness, emptiness, or poor concentration) and less influence over others (like hostile emotions or lack of interest). These outputs are called consequences.

- Conditional responses usually take place at the mesocosmic level (social/interpersonal systems created by humans).
- Causal responses may occur at microcosmic, mesocosmic, or macrocosmic levels (ranging from personal biology to global systems).

Individuals from the anomaly group generally struggle more with coping—both from the causal perspective (where cause leads to effect) and the conditional perspective (where condition leads to consequence). Their typical cultural response to these causes/conditions is to escape shared reality and construct their own version of reality.

In this model:

- Symptoms are the dependent variable (Y)
- Negative stressors are the independent variable (X)
- The dominant psychological focus used to process information is a (relatively) constant variable (K)

Based on this setup (see Figure 230), the entire process can be expressed in the form of mathematical equations, both for causal and conditional perspectives. The ratings of all involved categories (Y, X, and K) are represented as exponents in these equations, and this structure applies to both causal and conditional interpretations.

$$Y_k = \log(K^n \cdot X_k^n) \qquad Y_p = \log(K^n \cdot X_p^n)$$

As a result, two mathematical equations were created, with the symbols representing the following meanings:

- Y_k … Symptoms resulting from a causal reaction (where the cause leads to an effect)
- K … Constant representing the dominant mental focus
- X_k … Negative stress factors interpreted as causal
- Y_p … Symptoms resulting from a conditional reaction
- X_p … Negative stress factors interpreted as conditional
- n … The rating of a given category, expressed as an exponent

These two mathematical equations help to better understand causal and conditional reactions. Essentially, they are models that take into account both the strength (represented by the exponent values) and the intensity (the frequency of occurrence of negative stressors, e.g., per day) of negative stress factors.

The constant K_n (dominant mental concentration) reflects the number of mental tools used to primarily process negative stress stimuli (K), while the exponent n reflects the strength and influence of each specific mental tool, expressed as a rating.

Before these reactions are presented, some assumptions regarding negative stress factors need to be defined. Based on the network graph, both causal and conditional negative stress factors will be identified.

A. Causal negative stress factors:

As previously mentioned, these generally lie outside the control of an individual's will, are based on cause and effect, and lead to certain neurotic and/or psychotic symptoms.

1. Environmental pollution is an extremely strong biological-health-related negative stress factor that, with frequent human exposure, can lead to both organic disorders (e.g., damage to the respiratory system, digestive issues, impaired fertility, emergence of new dangerous bacteria and viruses) and/or psychological disturbances (e.g., anxiety, depression).

Over the decades, environmental pollution has led to the greenhouse effect, which has been rated with the highest possible level of negative impact (score of five). The greenhouse effect is the result of short-sighted and tunnel-vision thinking by collective masses, focused excessively on consumerism and extreme profit-driven logic.

The greenhouse effect essentially causes changes in atmospheric temperature, which in turn brings about climate change, gradually affecting all living nature (plants, animals, humans) in a negative way.

In terms of the frequency of use of the mental coping tool—namely, escaping agreed-upon reality and constructing one's own version of reality—we can state that individuals from the anomaly group use this tool frequently, despite the lack of positive effect.

The outcomes often appear as unpleasant psychological symptoms, especially in the form of fears, nervousness, poor well-being, headaches, etc.

As a point of interest, the intensity or visibility of these psychological symptoms will be calculated in relation to the greenhouse effect.

$$Y_k = \log\left(K^n \cdot X_k^n\right)$$

This refers to a causality-based mathematical equation, where we can define K as the numerical value two, and n as the rating score, which, as previously mentioned, is five. For the independent variable (X_k), we determine a number based on the frequency of a specific negative stress factor (e.g., five times per day) and assign a rating based on its impact strength.

The resulting numerical value is then logarithmized using the base-10 logarithm.

Based on the given data, it is then possible to calculate the intensity or visibility of a specific negative psychological symptom (Y_k).

$$Y_k = \log\left(K^n \cdot X_k^n\right) = \log\left(2^5 \cdot 5^5\right) = \log\left(32 \cdot 3125\right) = \log\left(100000\right) = 5$$

The resulting modeled value of 5 primarily indicates that the negative psychological symptoms are strong and highly visible, and largely escape the control of the individual’s will. It is important to understand that this calculation primarily serves to enhance the understanding of causal and conditional reactions. If the negative stress factors are extremely strong and intense, we can expect pronounced and visible psychological symptoms.

In general, after a causal and/or conditional reaction between negative stress factors and dominant mental concentrations has taken place, the result is clearly visible negative symptoms of mental illness.

2. Wars represent extreme social conditions that can trigger various negative psychological symptoms or disorders. In such unfavorable social environments, symptoms like paranoia, anxiety, depression, and many other disorders can emerge. Individuals have little influence over the outbreak of wars, which are also a product of distorted collective thinking.

3. Economic crises also constitute extreme social conditions, within which many of the previously mentioned negative psychological symptoms may arise. These can be signs of mental illnesses. Economic crises often stem from reckless decisions made by the collective, particularly by individuals in positions of key decision-making power.

4. Dangerous bacteria and viruses are another category of negative stress factors that evade both individual and collective control. They can influence individual and collective behavioral patterns and lead to changes in decision-making frameworks.

In recent months, we have seen the impact of the coronavirus, which caused a state of emergency across societies. The virus has already resulted in huge economic losses globally. On the other hand, it has altered collective behavior patterns (e.g. suspension of public transport, limited hospitality services, increase in remote work, reduced traffic congestion). These changes also contributed to reduced environmental pollution and a cleaner environment. Both bacteria and viruses primarily cause organic disorders, which can lead to negative psychological symptoms and even mental illnesses.

5. Genes, hormones, and blood cells can represent microcosmic-level negative stress factors over which individuals have little or no control. Unfavorable genetic makeup, lack of happiness hormones, and low blood cell counts can provide a basis for severe psychological symptoms and potentially incurable mental disorders.

Such unfavorable biological conditions make health vulnerable, and even a minor external stress trigger may be enough to provoke both physiological and mental illnesses. In the case of schizophrenia and borderline disorders, it has already been established that they are genetically influenced.

6. Poverty, social injustice, and social exclusion are extremely powerful negative social stressors that are largely beyond the control of the individual. These factors can give rise to paranoid,

anxious, and depressive symptoms, as people pushed to the margins of survival face not only economic discrimination, but also personal and social devaluation.

Social inequality is a fertile ground for feelings of persecution, fear of the future, and doubt in one's identity.

7. Crowding also belongs to the group of negative social factors that individuals can hardly influence. It typically causes feelings of nervousness and fear of crowds.

B. Conditional negative stress factors

These are stress factors over which the individual does have some degree of control, as they are linked to conditions and consequences, and can trigger certain neurotic and/or psychotic symptoms.

1. Insomnia can lead to both organic and mental disorders. When insomnia is caused by psychological or social issues, it may be the result of an inappropriate lifestyle that significantly disrupts the natural biorhythm. Insomnia forms the basic platform for a state of chronic and excessive fatigue. As a result, individuals may experience nervousness, anxiety, despair, emptiness, optical illusions, and hallucinations, which are not uncommon.

If insomnia is viewed as a negative individual psychological stressor, we can assume that the person may be able to change certain conditions in daily life to achieve positive outcomes. However, these conditions are often very demanding, making it difficult for the individual to counteract the negative consequences.

2. Negative experiences fall into the category of negative individual psychological stressors, over which the individual has some influence. In the case of traumatic events, the influence of positive will is considerably lower.

Negative experiences can trigger feelings of threat, suspicion, hostility, rejection, emotional withdrawal, or fear of crowds, among others. A person typically attempts to counterbalance them through positive experiences or by rationalizing the negative thought core.

These experiences arise from unfavorable conditions that continuously generate negative consequences. It's important to note that negative experiences can be examined from both causal and conditional perspectives. For people from the "anomalies" group, these experiences often represent an insurmountable barrier.

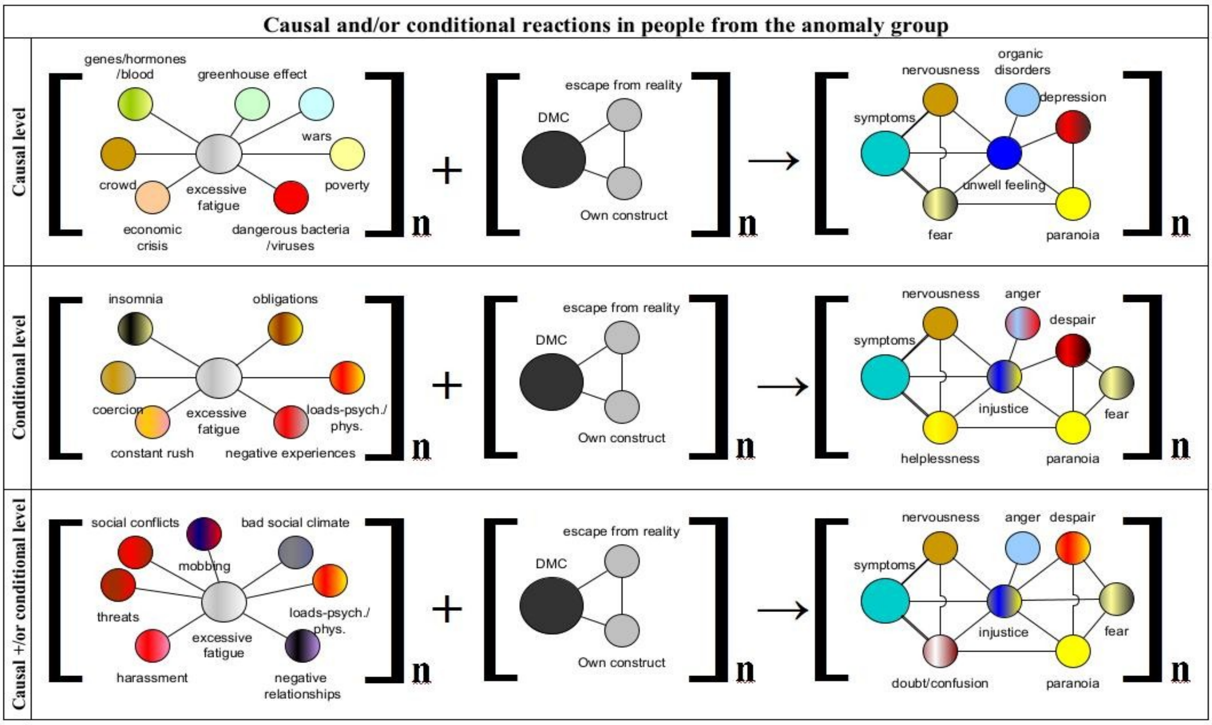
3. Social conflicts, negative social climates, and poor interpersonal relationships are negative social stressors that an individual can somewhat influence, though generally less so than with insomnia. These stressors can be considered from both causal and conditional viewpoints. They may lead to feelings of rejection, unpopularity, depression, anxiety, hostility, and even paranoia.

Individuals can confront such stressors by avoiding conflict, engaging in it, or seeking resolutions through various tactics and strategies. People from the anomalies group tend to escape from agreed-upon reality and construct their own version of it. This dominant mental focus may cause confusion and a weakening of self-identity in such individuals.

4. Threats, bullying, mobbing, and scheming are extremely unpleasant negative social stress factors, which create a breeding ground for suspicion, paranoia, hostility, injustice, helplessness, anxiety, depression, and more. An individual may counter these actions by identifying the underlying causes and conditions, which helps reduce the feeling of helplessness. People may also seek alliances or report the issue to relevant authorities such as the police. These types of intense social stress factors can also be examined from both causal and conditional perspectives.

5. Coercion, constant rushing, excessive responsibilities, and work overload can be classified as negative performance-related stress factors. These may trigger obsessive-compulsive tendencies, nervousness, chronic fatigue, feelings of suppression, injustice, despair, anger, and more. An individual's willpower can significantly influence the intensity of these stressors. This group of stress factors can also be approached from both causal and conditional standpoints.

In the following section, several examples of causal and conditional reactions will be presented for four social groups of people, under the assumption that the examined negative stress factors are extremely intense and powerful.



4.5.4.6 Figure 231: Possible causal and/or conditional reactions in individuals from the Anomaly goup

Figure 231 illustrates the possible causal and/or conditional reactions in individuals from the anomaly group, where complex, strong, and intense compounds of negative stress factors, coping mechanisms, and the resulting symptoms are depicted (in the figure, these complex compounds are marked with square brackets and the variable “n”).

The course of these reactions can be imagined as sequential and/or parallel—they may occur separately (one reaction follows another) or simultaneously (one may occur in the foreground or background).

From Figure 231, we can observe that certain psychological symptoms consistently appear as the result of completed reactions—nervousness, fear, and paranoia—and essentially act as the common denominators of both causal and conditional reactions. Depressive symptoms also appear as outcomes of completed reactions, both on the causal and conditional levels. Meanwhile, feelings of anger and injustice tend to occur at the conditional and interwoven levels (conditional and/or causal).

In this reaction model, we also identify a shared input factor. For negative stressors, this is excessive fatigue. As for the coping strategy, the common denominator is dominant mental concentration (DMC). Individuals in the anomaly group are particularly prone to escape from agreed-upon reality, creating their own construct of reality with personal conditions and rules.

Looking at the levels of potential causal and conditional reactions, we can broadly assume that the purely causal level plays a smaller role in the development of psychological disorders. It is followed by the conditional level, which emphasizes negative performance-related and partially social stress factors (e.g., excessive workload, too many obligations, constant rushing, coercion).

Within this context, insomnia can be interpreted as a consequence of these stressors. However, for individuals in the anomaly group, this assumption does not hold true—especially for psychological conditions like borderline disorder and schizophrenia, where hereditary traits or genes have a significant impact.

This broader assumption, though, would be accurate for the other three social groups.

In individuals from the anomaly group—particularly those suffering from severe mental health conditions such as borderline personality disorder and schizophrenia—it can be observed that hereditary traits (microcosmic influences) and negative social stressors are the primary causes of serious mental illnesses.

In the development of paranoia, the main contributors are primarily mesocosmic influences (e.g., bullying, mobbing, excessive workloads, social conflicts, and poor social climate). These factors can trigger severe paranoid symptoms, which often cause significant problems not only for the affected individuals but also for the broader social community—such as intense conflicts, social maladjustment, hostility, and confusion.

This raises a legitimate question: What measures could social hierarchical associative systems take to reduce the frequent occurrence of severe mental illnesses, particularly paranoid psychosis?
One particularly effective past measure was the recognition of mobbing as a serious criminal offense. Any individual affected by mobbing has the right to report it to the appropriate law enforcement authorities, even at the slightest suspicion. Of course, proving mobbing can be extremely difficult, especially when it is covert and highly organized. A more detailed discussion of mobbing will be provided in the subsection on criminal behavior.
It can already be noted, however, that the most common motive for mobbing lies in the pursuit of positional and material gain. Mobbing cannot be entirely prevented, as it is one of the tools frequently used by individuals from the extreme hierarchical complex—those who hold key supervisory and leadership positions in society. For these individuals, acquiring positional and material advantages is a dominant drive, which enables them to more effectively fulfill their strong desire to dominate others.
While mobbing cannot be eliminated, its impact can be mitigated by placing a stronger emphasis on appropriate values. Social hierarchical associative systems must, in the future, commit to and cultivate a conscious society rooted in positive values. These positive values should become a central hub of information and communication in public life, helping society to operate in a more rational and resource-efficient manner, both in terms of energy and finances.
In short, positive values must become a kind of axiom—a foundational principle—understood, shared, and supported by all members of society. This long-term developmental measure would significantly reduce the number of severe mental illnesses and save considerable energy and financial resources.
Short-term measures should include the careful monitoring of interpersonal social relations, along with constant promotion and demonstration of positive values by key leaders and the mass media. At the same time, the main actors within social hierarchical associative systems should also work to create conditions that reduce the unpleasant phenomenon of chronic over-fatigue among people. Especially within organized work environments, it would be advisable to regularly measure levels of chronic fatigue among employees, as such fatigue can lead to the development of mental illnesses, provoke social conflicts, and even cause fatal traffic accidents.
At the purely causal level of reactions triggered by negative stress factors, social hierarchical associative systems have relatively little influence. However, this is not the case at the conditional and intertwined levels of reaction, where their influence is more significant. Therefore, it is worth reemphasizing the need for more intensive monitoring and measurement of negative stress factors, especially within organized work environments.

One possible method that has proven useful and effective is the stress intensity measurement method, which was previously presented in the subsection on stress.

Let us now take a closer look at the symptoms that appear as common outcomes of completed causal and conditional reactions. Why do people experience nervousness, fear, and paranoia? Humans generally become nervous, frightened, or paranoid in response to strong and intense threats, particularly those originating from the social environment. The result of such threats is a sense of endangerment, which calls for a cultural response.

People from the anomaly group often use escape tactics and strategies involving the construction of their own version of reality, which in the long term deepens their feelings of vulnerability. This can be understood as a complex network of mental patterns, which have become automated and are, in many cases, even genetically conditioned. The same applies to complex combinations of negative stress factors, which have become automated both individually and collectively.

What is essentially needed is a gradual change to the programmatic algorithm of how social hierarchical associative systems function at the process level, in order to mitigate the most critical negative stress factors. Only on this foundation of long-term reform can we begin to positively influence individuals from the anomaly group and gradually introduce alternative ways of coping with negative stressors.

Although this is very difficult to implement, it could become achievable with strong collective will, especially when considering the potential benefits in terms of energy and financial savings.

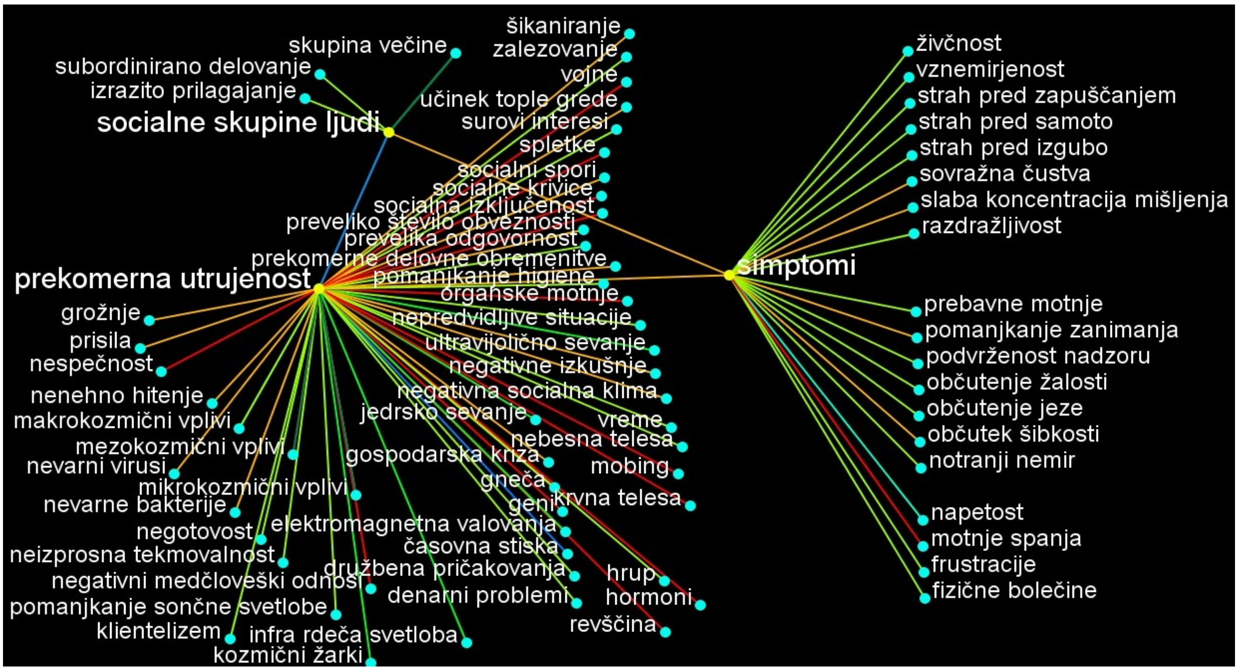
It’s important to recognize that a significant number of mental illnesses arise from the inefficiency and dysfunctionality of social hierarchical associative systems. This highlights the urgent need for systemic improvements in society—an area that is central to the fields of hierarchology and hierarchography.

Feelings of threat reduce the sense of safety, and when a large number of people experience this symptom, the security of the entire social hierarchical associative system may be at risk.

Moreover, with the constant pressure of purely causal events—such as natural disasters, global warming, unknown viral diseases, or uncontrolled social migrations from impoverished continents—global security itself may also be endangered.

At the mesocosmic level, it is possible to change certain conditions and causes that could lead to more positive outcomes and effects. This is less true at the microcosmic and macrocosmic levels, as both of these dimensions lie beyond the full grasp of human senses and perception.

In the following section, we will present the potential risk faced by the majority population for the development of mental illnesses.



4.5.4.7 Figure 232: Conceptual network of negative stress factors and possible symptoms of mental illness in members of the Majority group

Figure 232 illustrates the conceptual network of negative stress factors and the possible symptoms of mental illness among individuals belonging to the majority group.

We can observe that the list of possible symptoms of mental illness, when compared to the penetrating negative stress factors and the prevailing mental concentration typical of individuals in the majority group, is considerably less extensive. It has already been noted that people from the majority group tend to express a more or less pronounced inclination toward adaptation and subordinate behavior. This key characteristic largely eliminates many potential symptoms that might otherwise lead to mental illness.

The core conceptual framework of individuals from this group is simple and clearly defined, but that does not mean they are entirely immune to various forms of mental illness. If certain life circumstances change—such as the death of a loved one, loss of a leader, social exclusion, severe financial difficulties, war, economic crisis, poverty, social threats, natural disasters, or separation from a partner—the likelihood and severity of symptoms can increase and become more apparent. While serious psychiatric disorders such as schizophrenia and borderline personality disorder are less likely, as genetic predispositions tend to exclude them, it is still possible for mental disorders such as anxiety, depression, bipolar disorder, and even paranoid psychosis to develop, particularly under the influence of strong and intense stressors of a social, performance-related, or health-biological nature. Basic symptoms such as nervousness, restlessness, tension, frustration, physical pain, sleep disturbances, feelings of weakness and helplessness, poor concentration, fear of abandonment, loneliness, and sadness can form a fertile ground for the development of depression and anxiety. If additional symptoms emerge, such as anger, hostile emotions, a strong feeling of being controlled, and irritability, this can lead to the onset of paranoid psychosis and even suicidal tendencies.

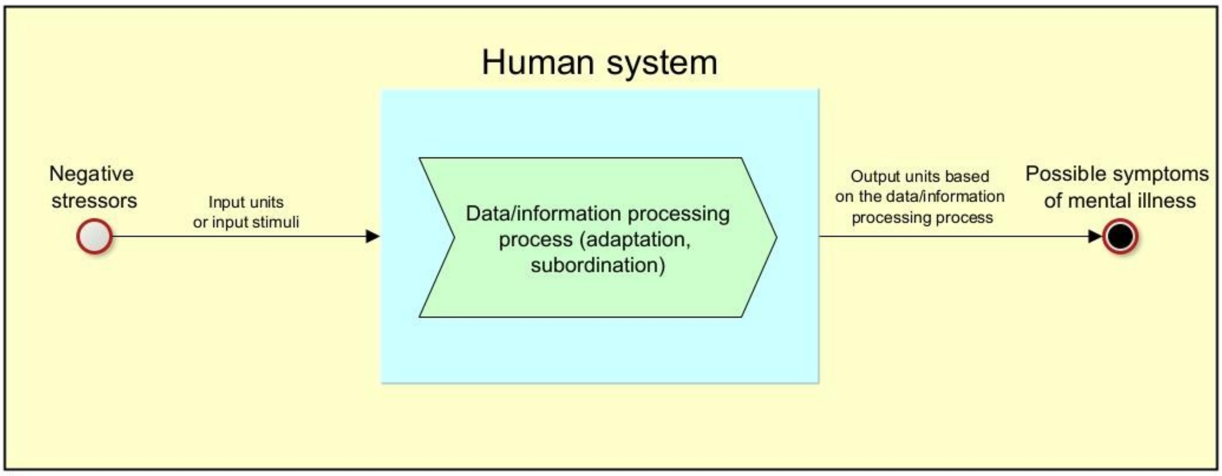
In particular, existential threats—such as lack of food, lack of money, or loss of one's home—can lead members of the majority group into a state of disorientation and chaotic behavior. It has already been stated that individuals in this group tend to rely heavily on a particular authority figure, which could be a workplace manager, a national leader, or a local official. If trust in such a leader is lost, or if the leader departs, their core mental (social) framework can be shaken, making it difficult for them to satisfy their need for adaptation and subordinate behavior. This may result in disorientation, self-doubt, and even a loss of meaning in life.

This scenario reveals a strong social and psychological symbiosis between the majority group and those from the extreme hierarchical complex, who more often occupy leadership roles. When a leader is threatened, members of the majority group may also become vulnerable. This deep interconnection is often not immediately visible on the surface.

People from the majority group can even transition into the anomaly group, which is not beneficial for social hierarchical associative systems. Such a transition would mean an additional energy and financial burden on these systems. Moreover, certain positive values that contribute to greater organization and societal stability could also be endangered.

A negative scenario, which assumes an increase in mental illness, should be prevented or at least mitigated. Typically, members of the majority group cope better with negative stress stimuli. As long as optimal living conditions are maintained—conditions that fulfill basic existential needs, provide a reliable social network, and allow for adaptive and subordinate behavior—they are not at high risk of developing severe mental illnesses.

However, sporadic symptoms related to depression and anxiety may occur in response to stronger and more intense stress stimuli. The picture changes significantly when optimal conditions are no longer present. Let us now take a look at the systemic perspective for this group of people.



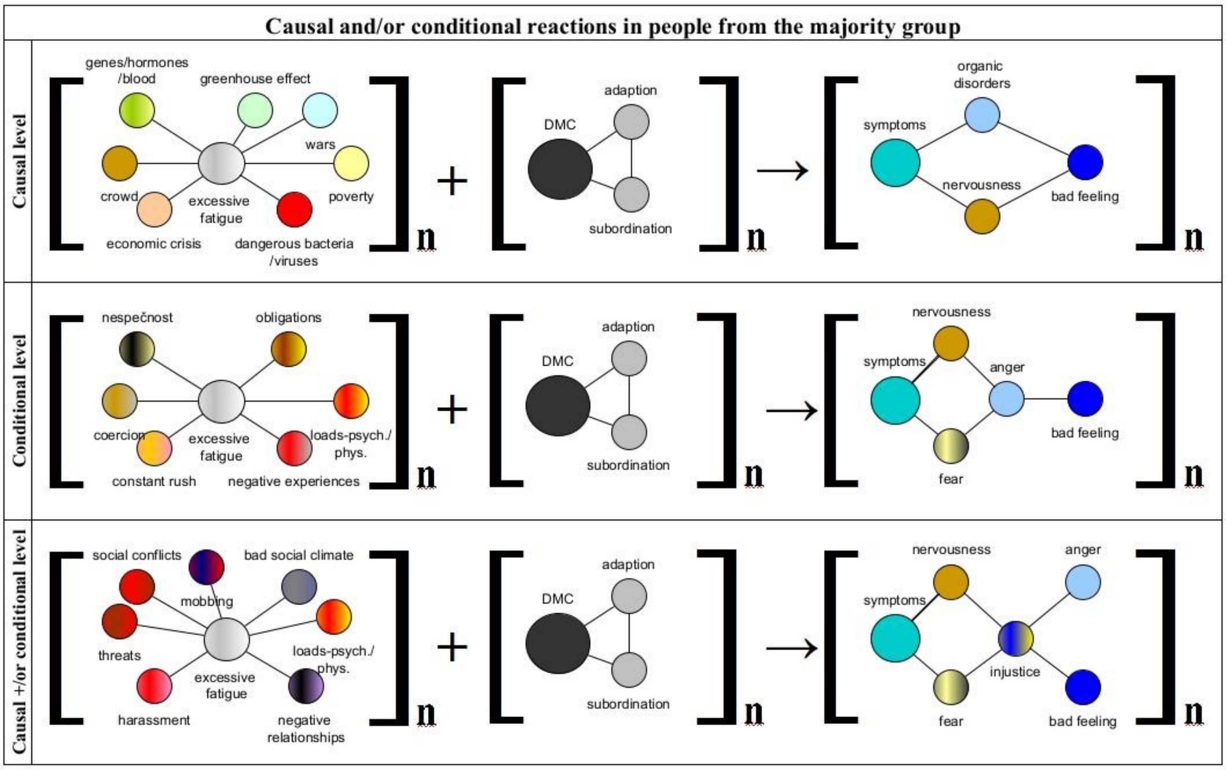
4.5.4.7.1 Figure 233: Systemic model of human information/data processing in relation to key psychological characteristics of individuals from the Majority group

Figure 233 presents a systemic model of how individuals from the majority group process information/data, in correlation with their key psychological characteristics. The model is very similar to the one introduced for individuals from the anomaly group, but it differs primarily in the processing phase, where members of the majority group handle negative stress stimuli differently. Unlike those from the anomaly group, they do not attempt to escape from agreed-upon reality or create their own version of reality. Instead, their core mental focus reflects a strong need to accept shared reality, which naturally leads to a tendency toward adaptation and subordinate behavior. This provides them with a satisfying emotional and cognitive platform needed to fulfill their mission and vision in life.

However, if this core mental framework is significantly disrupted, the result may be the emergence of symptoms associated with certain mental illnesses.

Their mental structure often relies heavily on authority figures who represent social and moral leadership. This means their mental framework supports and reinforces belief in such authorities, which in turn strengthens their faith in the agreed-upon reality. That reality serves as a foundational platform for meeting basic existential needs and for realizing their tendencies toward adaptation and subordinate functioning.

In the continuation of this section, we will examine the possible causal and conditional reactions to already identified negative stress factors and key mental concentrations, which may result in the emergence of psychological symptoms.



4.5.4.7.2 Figure 234: Possible causal and/or conditional reactions in people from the Majority group

Figure 234 illustrates the possible causal and/or conditional reactions among individuals from the majority group, focusing on complex combinations of strong and intense negative stress factors, coping mechanisms, and the symptoms that result from these reactions. In the figure, complex compounds (similar to those shown for the anomaly group) are marked with square brackets and the letter "n."

The reactions can occur sequentially or in parallel—that is, one reaction may follow another, or several reactions may happen at the same time, either in the foreground or in the background. From Figure 234, we can observe that the combinations of symptoms related to potential mental disorders are less complex than in the anomaly group, and that certain symptoms (such as nervousness, fear, and general discomfort) consistently emerge as the outcome of completed reactions. These symptoms act as a common denominator for both causal and conditional reactions.

Symptoms like fear, nervousness, and discomfort appear across purely causal, conditional, and intertwined levels, while feelings of anger emerge primarily on the conditional and intertwined levels (i.e., either conditional, causal, or a mix of both).

In this model of potential causal and conditional reactions, the input factors also share common elements. The primary negative stress factor is identified as excessive fatigue, and the shared aspect of coping mechanisms is referred to as dominant mental concentration (DMC). This reflects the majority group's strong tendency toward adaptation and subordinate behavior.

Like the model for the anomaly group, this model also depicts various levels of possible reactions in a broader context. The purely causal level plays a lesser role in the emergence and development of mental disorders. The conditional level, by contrast, places greater emphasis on performance-related and partially social stressors (e.g., excessive workloads, too many responsibilities, constant rushing, pressure). In this context, insomnia can be seen as a result of such stress factors.

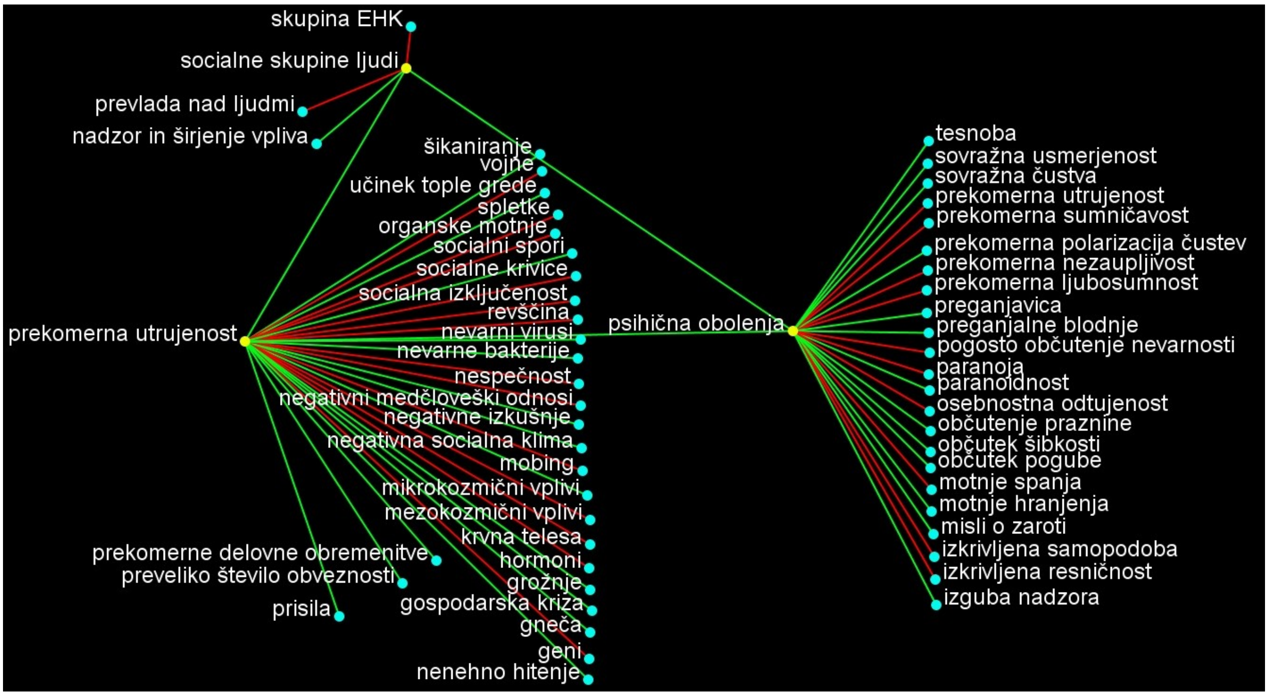
Members of the majority group are not entirely immune to developing paranoid psychosis, especially under mesocosmic influences like bullying, mobbing, overwork, social disputes, and poor social climates. The main triggers of severe paranoid symptoms can cause significant disruption for both affected individuals and the broader community, resulting in conflicts, maladjustment, hostility, and confusion.

This leads us to a justified question: What preventive actions could social hierarchical associative systems take to reduce the frequency of severe mental illnesses, particularly paranoid psychosis? This question has already been addressed, but it’s worth reiterating the importance of the close collaboration between the majority group and the extreme hierarchical complex group. This collaboration is marked by a strong hierarchical symbiosis, rather than equal cooperation.

In short, individuals from the extreme hierarchical complex hold a key role in improving society, potentially saving significant energy and financial resources, and thereby enhancing the efficiency of social hierarchical associative systems. This further underscores the value of a previously proposed systemic solution: a society grounded in positive, conscious values, with deep understanding and consistent application of those values.

It is also worth emphasizing again the need for ongoing measurement of both chronic fatigue and stress intensity within organized work groups. These actions should be seen as preventive corrective measures, which can help prevent mental illness, reduce social conflict, and even lower the number of fatal traffic accidents.

People from the majority group represent a vital component of every social hierarchical system, and it is essential to protect and support them by providing optimal living conditions. This is the primary responsibility not only of the extreme hierarchical complex but also of the progressive group. The former are tasked with enabling and monitoring preventive measures, while the latter—driven by their mission to improve the world—are responsible for measuring, researching, and solving social disruptions. Next, we will examine individuals from the extreme hierarchical complex, using the same visualization techniques to present their conceptual network, systemic model, and the progression of purely causal, conditional, and intertwined reactions.



4.5.4.8 Figure 235: Conceptual network of negative stress factors and potential symptoms of mental illness in people from the Extreme Hierarchical Complex group (EHC)

Figure 235 presents a conceptual network of negative stress factors and possible symptoms of mental illness in individuals belonging to the Extreme Hierarchical Complex group (EHC). Compared to the majority group, this group shows a broader and more specific range of potential symptoms, influenced by intense stress factors and dominant mental concentrations.

People in the EHC group tend to exhibit strong drives for dominance, control over others, and influence expansion, which is well illustrated in the network graph (see upper left of Figure 235). This fundamental drive largely shapes the range of potential symptoms that may lead to mental illness.

The core mindset of the EHC group contrasts with that of the majority group but is just as clearly defined. These individuals not only express a strong desire for dominance and control, but they also invest significant energy in building authoritative personas and in developing advantageous social relationships.

However, they may suddenly find themselves socially isolated, as their lifestyles and interpersonal relationships are often highly polarized. They tend to form alliances and instigate conflicts, sometimes escalating into hostile relationships and the creation of enemies. Because of this, loyalty becomes a crucial value for members of this group. They require a close inner circle of individuals they can trust and rely on.

This trusted circle must possess traits similar to those found in the majority group—namely, high adaptability and a willingness to submit to a relatively extreme level of subordination. People in the

EHC group depend on near-unquestioning belief from their followers. This is both their greatest strength and vulnerability: losing this inner circle can expose them to mental health issues or even full-blown disorders.

If other life conditions also deteriorate—such as business failure, loss of influence, or family problems—EHC individuals become even more susceptible to mental illness. These can range from severe neurotic disorders (e.g., depression, anxiety, obsessive-compulsive disorder) to serious psychotic conditions (e.g., bipolar disorder, paranoid psychosis, megalomania). Their intensely polarized emotions create fertile ground for the development of paranoid psychosis.

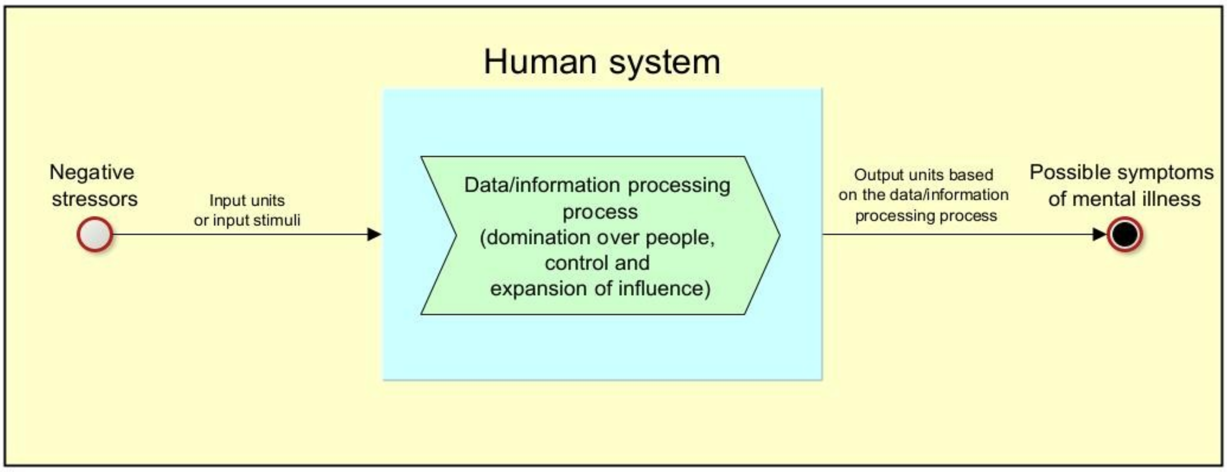
People from the EHC group are typically extremely sensitive to disrespect. Even small deviations from their expectations can threaten their hierarchical worldview, where they see themselves at the center. It's therefore no surprise that they often show symptoms such as paranoia, excessive suspicion, jealousy, hostile emotions, distorted self-image, and conspiratorial thinking—all contributing to the onset of paranoid psychosis.

Historical figures in positions of power often displayed symptoms consistent with severe paranoid psychosis—albeit unofficially—including Stalin, Hitler, King Henry VIII of England, and Roman emperors Caligula and Commodus. Although never formally diagnosed, a close analysis of their behavior and decisions may suggest this possibility.

In short, people from the EHC group are not immune to mental illness, as their worldview is heavily intertwined with hierarchical structures, loyalty, and polarized relationships. Some may even shift into the group of societal anomalies, though often without receiving psychiatric diagnoses. This transformation is particularly dangerous and undesirable, as a significant number of such cases can lead to the collapse of social hierarchical systems and even to unnecessary human casualties, such as through war. The resulting financial losses are astronomical, and the energy drain is nearly incalculable.

Compared to the majority group, EHC individuals are slightly less resilient to mental illness due to their intensely dynamic and polarized lifestyle, which demands enormous bioenergetic input. It would therefore be sensible to regularly monitor their levels of exhaustion and sensitivity to negative stress stimuli.

If many EHC individuals become mentally unstable, this could pose a risk to other social groups, particularly the majority group. In a broader context, this instability could even threaten the safety of the hierarchical social system and the natural environment—for example, through irrational and dangerous nuclear arms competitions between world leaders.



4.5.4.8.1 Figure 236: A systemic perspective on data/information processing in individuals from the EHC group

Figure 236 illustrates the systemic perspective of data and information processing in individuals from the Extreme Hierarchical Complex group (EHC). The model shown is quite similar to the one previously observed in individuals from both the anomaly group and the majority group. However, it differs significantly in the processing phase, as individuals from the EHC group process data and information—particularly in the form of negative stress stimuli—in a unique way.

Rather than attempting to escape from agreed-upon reality, they seek to exploit it for their own benefit, aiming to become influential creators. The extent of their power is largely dependent on their egocentric needs and their ability to reshape agreed-upon reality.

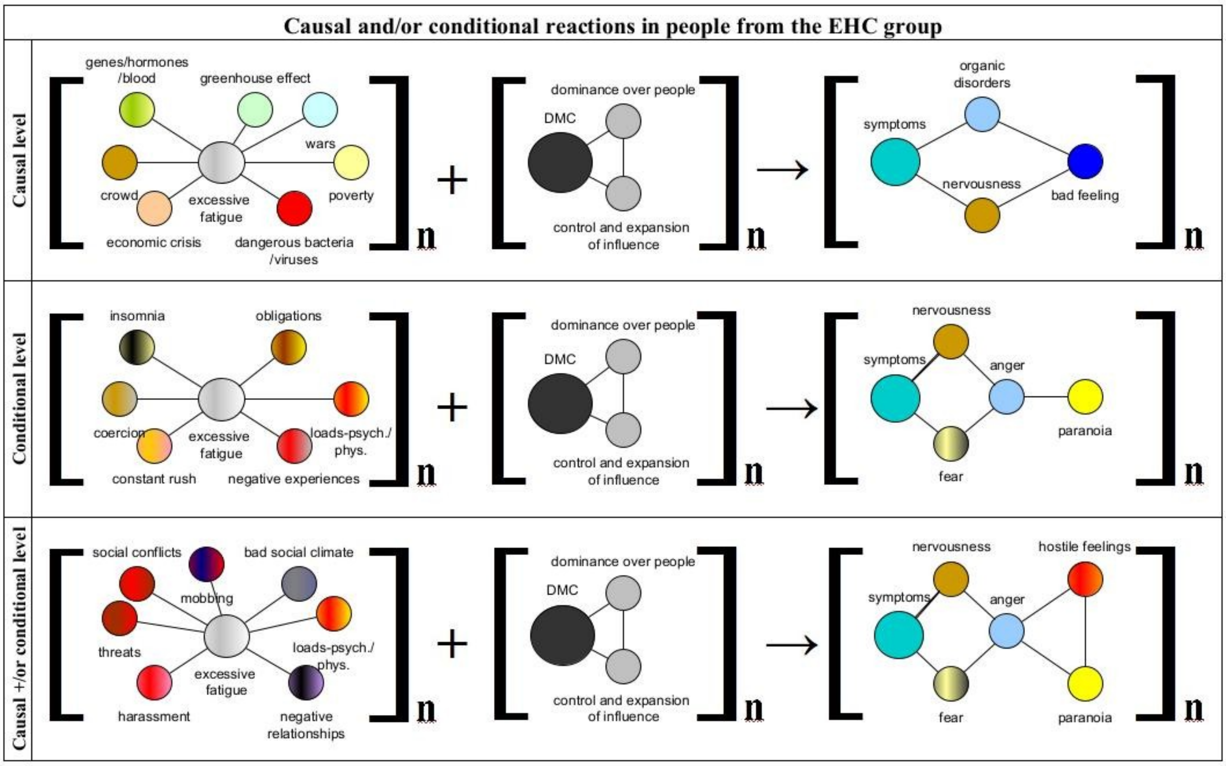
Their core cognitive orientation reveals a strong need not only to accept but also to influence the established reality. This orientation provides them with the necessary emotional and intellectual foundation to pursue their mission and vision. If their fundamental belief system becomes significantly destabilized, it may lead to the emergence of symptoms of mental illness.

Their mindset is often strongly anchored in power, wealth, and a close circle of trusted individuals—people they can rely on and confide in. This mental framework supports social and moral authority, in which they see themselves as playing a crucial role. It further reinforces their faith in the constructed reality, which they can reshape as needed through wealth, power, and social influence.

This capability provides them with a basic orientation that enables them to meet essential existential needs and to fulfill their intense drives for dominance, control, and influence over others.

As previously noted, there is a relatively strong inherent connection between the majority group and the EHC group—a relationship that might be described as a natural social symbiosis. Individuals from the EHC group primarily function as emitters of data and information, while those from the majority group primarily act as receivers of that data and information.

In the following section, we will take a closer look at the potential causal and conditional responses to the already defined negative stress factors and the key cognitive concentrations that may lead to specific mental health symptoms.



4.5.4.8.2 Figure 237: Possible causal and/or conditional reactions in individuals from the EHC group

Figure 237 illustrates the possible causal and/or conditional reactions in individuals belonging to the Extreme Hierarchical Complex (EHC) group. These reactions involve complex and intense interconnections between negative stress factors, coping mechanisms, and symptoms that represent the outcome of these reactions.

As in the models for the anomaly and majority groups, the complex links in Figure 237 are marked using square brackets and the number “n”. The sequence of reactions can be imagined as either sequential (one reaction follows another) or parallel (reactions happen simultaneously, with one potentially being more dominant than the other).

From Figure 237, it is evident that the interconnections between symptoms of possible mental illness are less complex than in the anomaly group, but more complex than in the majority group. Each symptom indicating a potential mental disorder always arises as the end result of completed reactions, with nervousness acting as a common denominator across both causal and conditional levels of response. Nervousness appears as a reaction outcome at the pure causal, conditional, and interwoven levels, whereas fear, anger, and paranoia only manifest at the conditional and interwoven levels.

In this model of causal and conditional responses, there is also a shared input factor. The primary negative stress factor is excessive fatigue, while the dominant mental concentration (DMC) acts as the shared coping mechanism. Individuals from the EHC group are subject to strong and intense drives for dominance, control over others, and the expansion of influence.

Similar to the models for the anomaly and majority groups, this model also presents levels of possible causal and conditional responses, which can be broadly interpreted. The purely causal level plays a lesser role in the development of mental illnesses. It is followed by the conditional level, where performance-related and partially social stress factors (e.g., excessive workload, too many responsibilities, constant rushing, coercion) are key. Within this framework, insomnia can be seen as a consequence of these stressors.

Individuals in the EHC group are not immune to developing paranoid psychosis, which can primarily be triggered by mesocosmic influences (e.g., social manipulation, business failure, disloyalty among partners or trusted individuals, hostile and competitive adversaries). The main triggers of severe paranoid symptoms can cause substantial problems not only for the affected individuals but also for the broader social group. These issues may manifest as serious conflicts, maladjustment, hostility, confusion, and in extreme cases, even military confrontations.

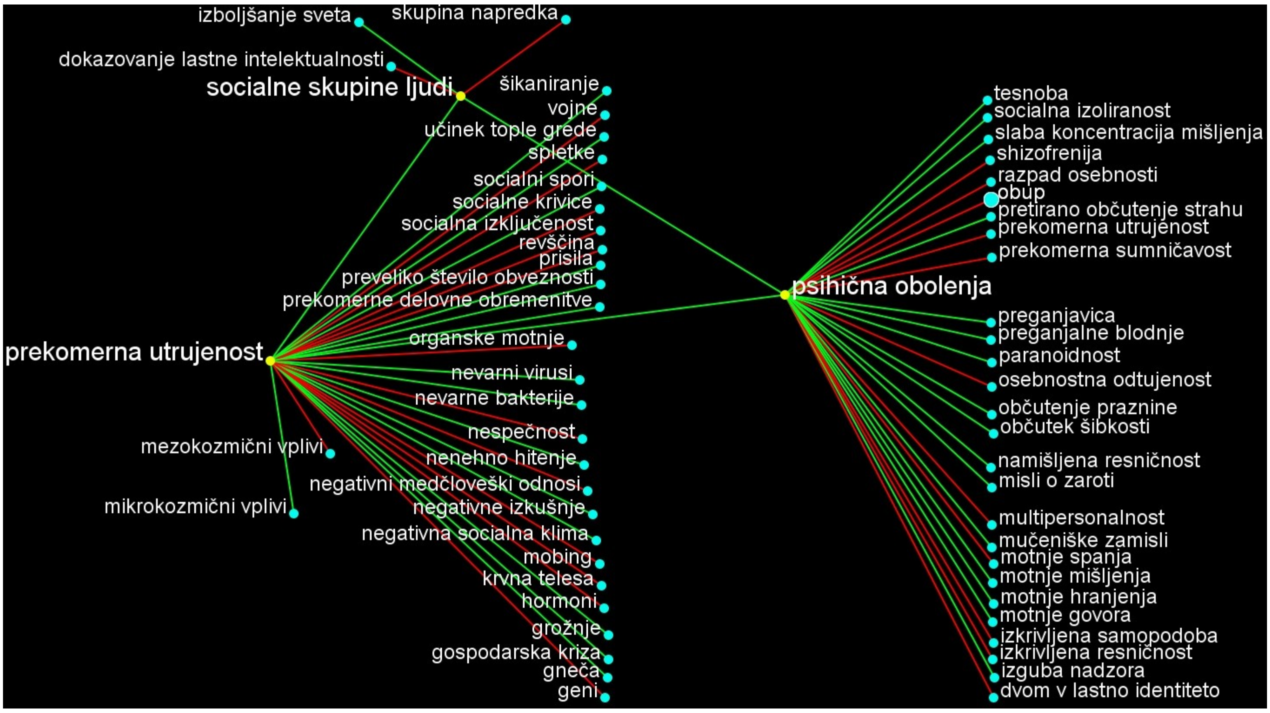
This raises an important and legitimate question: What measures can be taken by hierarchical associative social systems to prevent the frequent occurrence of serious mental illnesses, especially paranoid psychosis?

Once again, the importance of previously mentioned process-based solutions is emphasized—namely, the development of a society rooted in conscious, positive values, with deep understanding and practical implementation of those values. Continuous monitoring of excessive fatigue, particularly in influential leadership roles, and measuring stress intensity within organized working groups (including state authorities) are also crucial. These efforts should be understood as preventive and corrective measures that can reduce the risk of mental illness and prevent both serious social and even ecological consequences.

The individuals in the EHC group represent a critical and vital part of any hierarchical associative social system. They should therefore be better protected and positively guided, so they can fulfill their important roles as leaders, maintaining social balance, especially in terms of welfare and cohesion.

This responsibility is central not only to the EHC group but also to the group of progress. The former are responsible for implementing and overseeing preventive and corrective measures, while the latter are responsible for research, measurement, and developing solutions to societal challenges.

In the next section, we will examine the Progress group, presenting its conceptual network, systemic human model, and the course of pure causal, conditional, and interwoven reactions, using the same analytical framework.



4.5.4.9 Figure 238: Conceptual network of negative stress factors and possible symptoms of mental illness in individuals from the Progress group

Figure 238 illustrates the conceptual network of negative stress factors and possible symptoms of mental illness in individuals belonging to the Progress Group. It is evident that the list of potential symptoms in this group is somewhat more extensive than in the Majority and EHC (Extreme Hierarchical Complex) groups. This is due to the penetrating nature of negative stressors and the dominant mental concentrations that characterize this group.

Members of the Progress Group exhibit a strong drive to demonstrate intellectual capability and to improve the world, which is clearly reflected in the conceptual graph (see Figure 238, top left). This fundamental aspiration predisposes them to a range of potential disturbances that can lead to mental health issues. Although their orientation differs from that of the Majority and especially the EHC group, it is equally clearly defined.

Like those in the EHC group, individuals in the Progress Group are driven not only by an ambition but also by a strong will to prove their intellectual worth and to enact positive changes in the world. They pursue this through careful observation and analysis of their environment, systems, and interrelations.

They invest considerable energy in developing their intellect and in collecting and analyzing information. However, this pursuit often leads to social isolation, as they are deeply committed to gaining knowledge and wisdom and driven by a vision of a better world. Rather than engaging in polarized conflict, they prioritize rational, interpersonal relationships.

Despite their peaceful nature, their visions for a better future can provoke resistance, especially when these visions challenge established social norms—something that may not align with the interests of the Majority or the EHC groups. Their ideas may threaten existing hierarchical or economic structures, which can lead to conflict and even hostile relationships.

People in the Progress Group place great value on intellectualism, quality, constructive output, and positive change. However, these values are often undervalued or misunderstood by members of the Majority and particularly the EHC group, potentially leading to misunderstanding or perceived threats. Due to the more explosive nature of EHC personalities, they may resist these changes or attempt to reshape them to fit their own interests. If resistance occurs, it may lead to complex social manipulation and moral pressure, placing Progress Group individuals in difficult social positions.

The social and psychological pressures arising from conflicts between the Progress Group and members of the EHC or Majority groups can result in symptoms of anxiety and depression, and in some cases, even paranoid psychosis accompanied by martyrdom ideation. This shows that individuals in the Progress Group are not immune to mental illness, even though their emotions tend to be more rationalized.

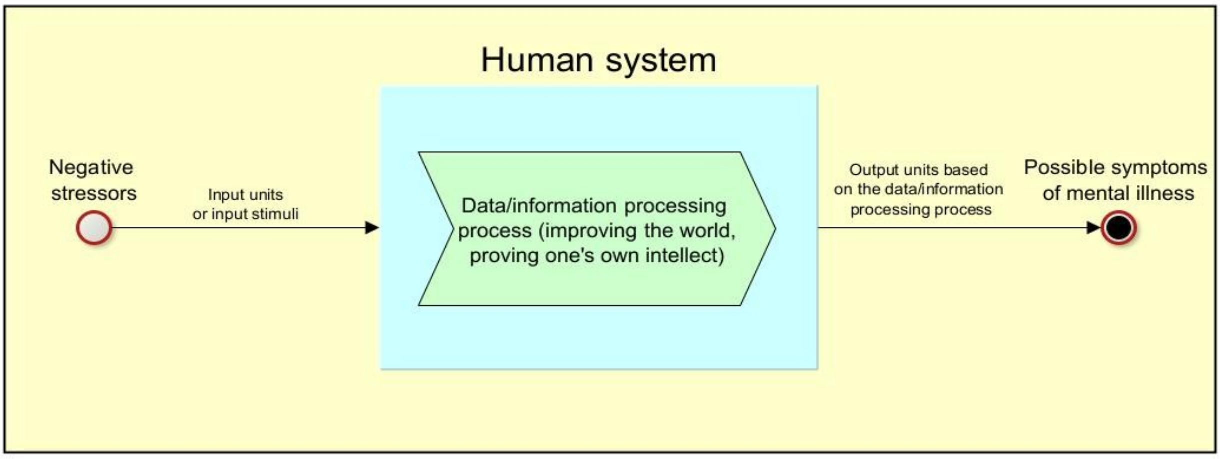
Additional negative life events—such as failure in research endeavors, intellectual crises, loss of social connections, financial troubles, or family issues—can further increase the risk of neurotic disorders (e.g., depression, anxiety, OCD, hypochondria, social phobia) or even psychotic disorders (e.g., bipolar disorder, paranoid psychosis, megalomania, schizophrenia).

Although individuals in the Progress Group are generally less prone to paranoid psychosis due to their emotional rationalization and preference for constructive dialogue, this does not make them immune to long-term psychological strain. They are highly sensitive to their intellectual performance, and even minor threats can trigger self-doubt. They usually invest great effort into compensating for perceived intellectual shortcomings, primarily by striving to improve the world.

Progress Group individuals function primarily within associative structures rather than rigid hierarchies. In these contexts, their self-importance is often seen in a positive light, but symptoms such as poor concentration, paranoia, identity confusion, loss of control, distorted self-image, and altered perception of reality tend to emerge in response to external social and cultural pressures from other groups.

If individuals from the Progress Group, due to external pressures and social conditions, transition into the Anomaly Group, this results in a significant loss of energy and innovation for society as a whole. Such a transformation can lead to stagnation, an innovation gap, and negative impacts on economic, social, health, and security systems. The potential consequences include severe economic and social crises and the loss of developmental potential.

Overall, individuals in the Progress Group are less resistant to mental disorders compared to those in the Majority or EHC groups. This is largely because they set extremely high goals, where failure quickly leads to a sense of helplessness and self-doubt. Just like with other groups, it would be sensible to regularly monitor levels of exhaustion and resistance to stressors in this group. If it were shown that a large portion of this group is psychologically at risk, this would not directly endanger other groups, but could pose a long-term threat to the entire system of human civilization—with serious consequences for all people and even the natural environment.



4.5.4.9.1 Figure 239: A systemic perspective on data/information processing in individuals from the Progress group

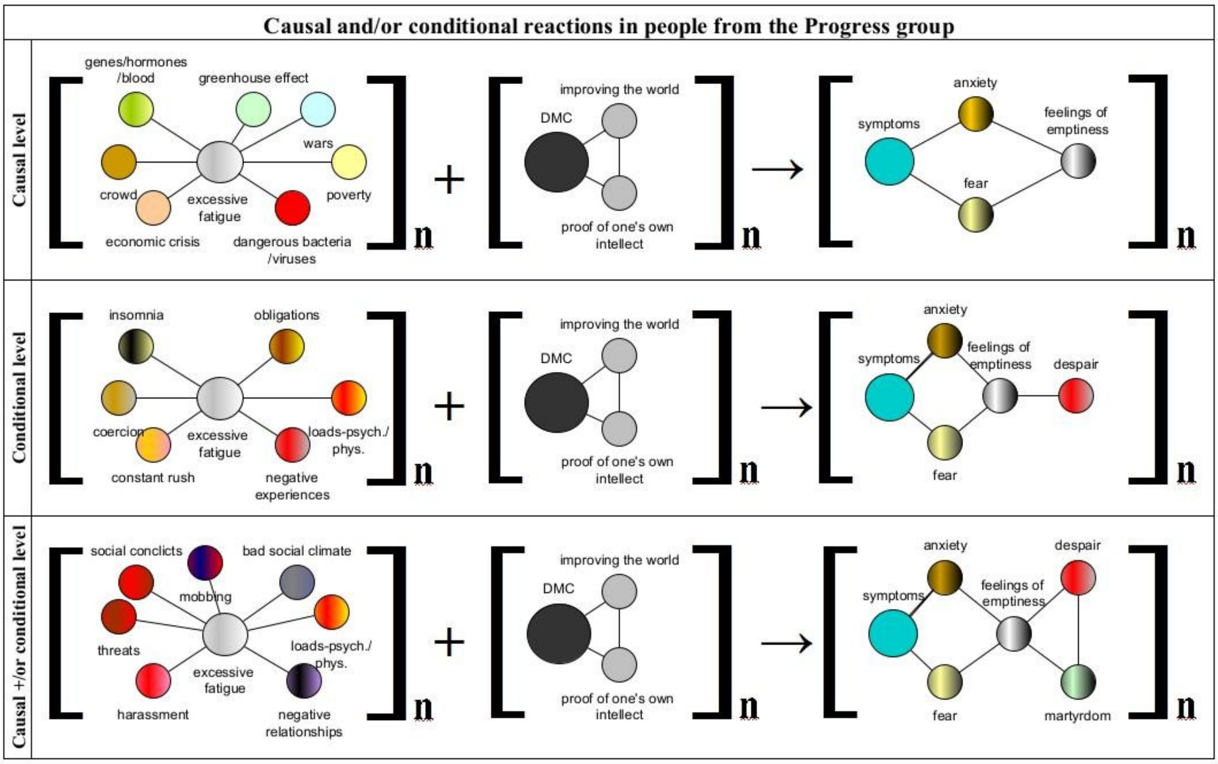
Figure 239 illustrates the systemic perspective of how individuals from the Progress Group process data and information, which differs in its procedural aspects from other groups. Negative stress stimuli are processed differently in this group—primarily due to their core mental focus on demonstrating intellectual capability and striving for a better world. These inputs are then more or less analyzed and interconnected.

In general, members of the Progress Group do not reject the agreed-upon reality, but at the same time, they do not renounce the possibility of creating their own construct of reality, which they often seek to share with broader society. Similar to individuals in the EHC group, they are inclined to influence the transformation of reality, aspiring to be remembered as spiritually immortal or historically significant figures. This aspiration provides them with a satisfying emotional and intellectual foundation necessary to pursue their mission and vision.

If their core mental system collapses significantly, this can result in the emergence of symptoms associated with certain mental disorders. Their mental framework typically relies on intellectual fulfillment, innovative ideas, and alignment with like-minded individuals in both ideological and moral terms. While their mindset may partially support social and moral authorities, it places a strong emphasis on originality and individuality. In this self-constructed world, they often see themselves as important figures, with a significant role in both life and legacy, which further reinforces their belief in both accepted and transformed realities.

People in the Progress Group are among the most prolific creators and transmitters of data and information, which they convert into new knowledge—and, with continued development, even into wisdom. They are also the most capable recipients of specialized data, information, and rich archives of experiences and knowledge, which they gather primarily from various reference sources and a specialized circle of experts.

The following section explores possible causal and conditional reactions to known negative stressors and key mental focal points, which can lead to the development of specific symptoms.



4.5.4.9.2 Figure 240: Possible causal and/or conditional reactions in individuals from the Progress group

Figure 240 illustrates the possible causal and/or conditional reactions in individuals from the Progress Group. These reactions involve complex combinations of intense negative stress factors, coping mechanisms, and resulting symptoms. As in models for the Anomaly, Majority, and EHK groups, the complex compounds are marked with square brackets and the variable "n".

The course of these reactions can be sequential and/or parallel—meaning they can occur one after the other (a new reaction begins after one ends) or simultaneously (one reaction is dominant, the other in the background). The figure shows that the symptom compounds indicating potential mental disorders are less complex than those seen in the Anomaly group but more complex than those found in the Majority and EHK groups.

Symptoms of possible mental disorders always appear as the outcome of completed reactions (e.g., feelings of emptiness, fear, and anxiety), serving as a common denominator for both causal and conditional reactions. These symptoms may emerge on purely causal, conditional, or intertwined levels, while feelings of despair appear only on the conditional or intertwined levels.

In this model of causal and conditional reactions, there is also a shared denominator at the input stage. For negative stress factors, it is excessive fatigue; for coping mechanisms, it is predominant mental concentration (PMC). Individuals in the Progress Group are particularly prone to a strong and intense drive to prove their intellectual abilities and to improve the world.

As with models for other groups, this one also presents levels of potential causal and conditional reactions on a broader scale. The purely causal level plays a smaller role in the development of mental disorders. The conditional level is more strongly linked to performance-related and partly social stressors (e.g., excessive workload, too many obligations, constant urgency, compulsion). Within this context, insomnia can be understood as a consequence of these stressors.

People from the Progress Group are not entirely immune to the development of paranoid psychosis, especially when triggered by mesocosmic influences such as social manipulation, isolation, loss of moral and intellectual allies, scientific isolation, or hostile competition—particularly from the EHK group. These factors can lead to severe paranoid symptoms, causing significant issues for the affected individuals and society, such as deep conflicts, rigidity, hostility, confusion, and even cultural decline in certain communities.

This leads us again to ask: What measures can hierarchical and associative societal systems implement to prevent frequent occurrences of severe mental disorders like paranoid psychosis? It is essential to emphasize process-based solutions aimed at building a society grounded in conscious and positive values, supported by deep understanding and implementation.

It is equally necessary to continuously monitor excessive fatigue, especially among individuals engaged in critical scientific projects, and to measure stress levels in organized scientific research environments. Both approaches can serve as preventive corrective measures to help reduce the likelihood of mental disorders and, in turn, avert serious social crises.

Members of the Progress Group are a crucial part of any hierarchical associative social system, and thus, should be better supported and protected so they can fulfill their social roles as ideational individuals. These individuals act as an alert and information system, contributing to the optimal functioning of every social, legal, and technologically advanced system.

This is a shared concern for both the EHK group and the Progress Group. The EHK group is responsible for enabling preventive and corrective actions and for fostering and monitoring creative collaboration, while individuals from the Progress Group are fundamentally tasked with measuring, researching, and finding solutions to social challenges and disruptions.

In this relatively brief overview of four defined groups, we have highlighted potential threats in the form of negative stressors and the core coping strategies, which may ultimately lead to symptoms of mental disorders.

At the end of each simulation—whether presented as a conceptual network, a systemic perspective, or through causal and conditional reactions—the importance of preventive corrective measures was emphasized. These include promoting, deeply understanding, and applying positive values, ongoing monitoring of excessive fatigue, and measuring stress levels, particularly in organized work environments.

Throughout the long history of human development, from antiquity to the present day, there have been various approaches to treating mental illness. However, these approaches have predominantly focused on treatment rather than prevention. Defining abnormal behavior that may indicate a mental disorder is extremely complex and multifaceted, as the identification of individual symptoms is often influenced by social factors (e.g., political conditions, social and healthcare circumstances, beliefs, myths, and culture in the broadest sense), as well as by broader natural conditions (e.g., unfavorable climate, poor harvests, lack of sunlight, excessive rainfall, natural disasters).[92] As early as ancient Greek times, many thinkers were concerned with defining mental illnesses and exploring possible treatments. At that time, methods such as water therapy, walks in nature, the use of herbal medicine—often supported by the preparation of healing herbal potions—recommendations for lifestyle changes, dietary adjustments, bibliotherapy, playing soothing music, performing projective puppet plays, therapeutic baths, and the use of religious symbols, among others, were commonly used. Many of these treatments, in slightly modified forms, are still in use today.

In the Middle Ages, additional approaches emerged alongside these methods, such as bloodletting and even early experiments with electroshock, using electric eels. In the modern era, treatments such as lobotomy, electroconvulsive therapy, electroshock using modern devices, and intensive interaction with domestic animals have been introduced. Since the 1950s, the pharmaceutical

92 The idea was derived from the work: Plante, T. G. (2013). *Abnormal psychology across the ages*. Santa Barbara: Praeger. (Abnormal psychology). Based on this material, the following will outline various types of treatment of mental illnesses from antiquity to the present day.

industry has advanced significantly, offering an almost endless array of medications for treating mental disorders.

It wasn't until the 19th century that the idea emerged that excessive stress could contribute to the onset of mental disorders such as hysteria and neurasthenia (chronic fatigue). About 150 years later, this hypothesis was confirmed as fact. Moreover, its relevance extended beyond just these two disorders, as it became widely accepted that excessive stress can be a significant factor in the development of various mental illnesses.

The belief that social conditions (e.g., the social climate, intense conflictual relationships, ruthless competition driven by selfish interests, upbringing, poverty, and social stigma) play a crucial role in the emergence of mental disorders also emerged relatively late.

It has already been established that there is a strong link between negative stressors and various social relationships and conditions. This raises the question: What societal solutions—in addition to those already mentioned—could help alleviate negative stress factors and thereby reduce the incidence of mental illnesses?

4.6 Stigma and measurement

One of the common barriers that negatively affects social relationships among people is stigma (social, mental, and physiological stigma). Its significance was pointed out relatively late, but it can hinder many positive social solutions.[93] Social stigmas, in particular, are often politically and professionally motivated and serve as a tool for increased social control over marginalized groups, which can lead to discrimination and abuse. Social stigmas are usually created by influential groups who define relatively rigid rules about acceptable patterns of behavior. Those who belong to marginalized groups—such as the poor, the socially excluded, individuals with mental health conditions, or people with physical disabilities—are often prevented from meeting these standards. Certain rules are established in advance that make it difficult for these groups to be included in humane and relatively equal social relationships. As a result, the quality of social identity for these individuals is diminished, which can negatively affect their self-image and overall quality of life. A process of socially negative perception of behavior emerges—one that politics, legislation, and the psychiatric profession can easily exploit for material and status-driven interests. This only increases the number of people affected by mental health issues.

Our preliminary analysis has already shown that the entire hierarchical associative system of society not only loses a significant amount of financial resources due to these narrow interests, but also an

93 Goffman, E. (1963). *Stigma : Notes on the management of spoiled identity.* Englewood Cliffs, NJ Prentice-Hall.

exceptionally high amount of energetic value. It is necessary to find a way for certain social stigmas —especially those rooted in the crude interests of narrow elites—to lose their power and influence. The first step is a change in legislation, which, with the support of certain political and psychiatric factions, would largely prevent or at least mitigate the effects of social stigmatization of marginalized groups.[94] Stigma, as a higher-level conceptual framework, can exist only if at least the following subordinate conceptual elements are present:[95]

a. A more influential group of people defines and labels human differences,

b. Cultural beliefs predefine certain characteristics of people as deviant,

c. Labeled groups of individuals are classified into categories, thereby being predesignated as abnormal,

d. Labeled individuals experience a loss of status and increased discrimination, which in turn creates a sense of inequality.

Let us now examine sources of empirical research related to the measurement of mental illness stigma. Using the software tool Publish or Perish, the following query was conducted:

TI=mental illness stigma AND KW=("measurement" OR "measuring") AND ("empirical studies" OR "surveys").

As a result, 302 hits were retrieved within the time range from 1997 to 2020, indicating that scientific research into the measurement of mental illness stigma is a relatively young field. Measuring the stigma surrounding mental illness represents a first step toward a better understanding of this social and cultural phenomenon and opens the door to considering treatment or improvements aimed at reducing various types of stigma (social, mental, and physiological) within hierarchical associative systems in society.

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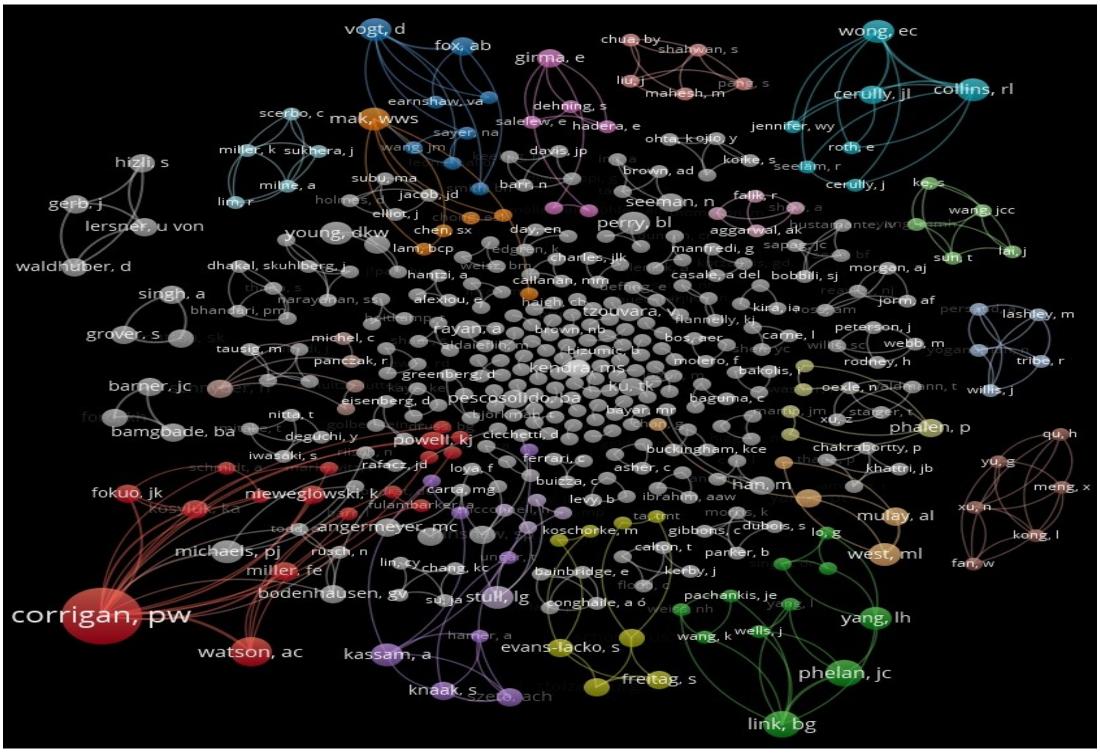
94 The idea developed after reading Donovan, J. (2008). A history of stigma : towards a sociology of mental illness and American psychiatry : [master thesis]. Montreal: Concordia University. The problem of stigma was first introduced by the French sociologist Emile Durkheim, but was more precisely defined by Erving Goffman.

95 Link, B. G., Yang, L. H., Phelan, J. C., & Collins, P. Y. (2004). Measuring mental illness stigma. *Schizophrenia Bulletin*, 30(3), 511–541. https://doi.org/10.1093/oxfordjournals.schbul.a007098.



4.6.1 Figure 241: Reduced network of authors conducting measurements related to mental illness stigma

Figure 241 shows a reduced network of authors (a total of 510) who conducted measurements related to mental stigma. Five of the most productive authors in this field will be selected and described.

1. Patrick W. Corrigan: He is an exceptionally productive and highly cited American psychologist who published 420 works between 1990 and 2020 in the field of stigma research and has been cited 40,152 times. Between 2002 and 2020, he published 40 studies specifically on the measurement of mental illness stigma, which have been cited 7,792 times. Patrick W. Corrigan can be confidently recognized as a scientific authority in the broader field of stigma, particularly in relation to the measurement of mental illness stigma. His main area of interest is the stigma associated with mental health issues among socially discriminated individuals and efforts aimed at their rehabilitation. Below is a summary of the content of some of his most cited articles:

a. Corrigan, P. W., Watson, A. C. (2002). The paradox of self-stigma and mental illness (Clinical Psychology)

This article has been cited 1,740 times. It presents a situational model of individual responses to the stigma of mental illness, using a method based on personal narratives from people with severe mental disorders. The article discusses how individuals with mental illness react to stigma. The authors discovered a paradox in how mental illness stigma is perceived: responses were not uniform. Some individuals responded with a loss of vital self-image, others focused on unjust prejudice and felt overwhelmed by anger, while a third group appeared to ignore societal prejudices altogether.

Note: Given the complexity of this issue, it is difficult to generalize among different types of individuals with various mental illnesses. Such measurements should ideally be conducted within distinct, categorized groups, with a representative sample size (e.g., at least 200 interviewees per category of mental illness).

b. Corrigan, P. W., Watson, A. C., & Barr, L. (2006). The self-stigma of mental illness: implications for self-esteem and self-efficacy (Journal of Social and Clinical Psychology)

This article has been cited 1,201 times. The authors applied a three-stage model to examine the relationships between elements such as stereotypical agreement, self-concurrence, self-esteem, self-efficacy, and depression. Two measurements found that stereotypical awareness was not significantly associated with the elements of self-stigma. However, significant links were found between self-concurrence, diminished self-esteem, and reduced self-efficacy—connections that remained significant even when accounting for depression. The article aimed to explore the consequences of these factors to gain a better understanding of self-stigma.

Note: Given the complexity of the topic, the sample sizes used (54 and 60 participants) were relatively small, which, despite the study's success, limits its representativeness.

c. Corrigan, P. W. … [et al.]. (2012). Challenging the public stigma of mental illness: a meta-analysis of outcome studies (Psychiatry Online)

This article has been cited 1,068 times. It presents a meta-analysis of scientific studies focused on changing public attitudes toward the stigma of mental illness. The article emphasizes that stigma essentially serves as a fertile ground for the discrimination of affected individuals.

Public stigma and discrimination have a highly detrimental effect on the well-being of people with severe mental health issues. Based on numerous studies focused on changing the stigma of mental illness, this article presents a meta-analysis examining the effectiveness of different anti-stigma program approaches, including social activism (such as public protests), public education, and direct contact with individuals affected by mental illness.

A large number of studies on changing public stigma toward individuals with mental illness have shown that personal interaction is the most effective approach. Anti-stigma video presentations have also yielded positive results. In terms of educational efforts, many studies found that education about mental illness stigma is more effective for adults than adolescents. For younger populations, educational programs tailored to youth appear to have the greatest impact on changing attitudes about mental illness stigma.

The research was extensive and demanding, as the authors analyzed various global data sources and extracted the most relevant results based on the topic.
Note: Expanding efforts to reduce public stigma toward people with mental illness should be pursued intensively and continuously, targeting various influential social groups—such as politicians, police officers, judges, lawyers, journalists, advertising professionals, managers, and employees in TV, radio, and internet media, as well as artists.
Psychiatric institutions, with the help of additional professional staff (not necessarily from medical fields), could promote the talents and capacities of people with mental illness (e.g., in art, science, humor, literature), seeking public engagement through performances and events. Furthermore, interpersonal communication channels could be created through discussion groups involving direct personal contact and/or digital media. In this context, it could be argued that the state does not do enough to support the capacities of either psychiatric institutions or individuals with mental illness.
d. Corrigan, P. W., Druss, B. G., & Perlick, D. A. (2014). The impact of mental illness stigma on seeking and participating in mental health care
(Cited 730 times; published in Psychological Science in the Public Interest)
The authors note that while various well-developed treatment methods for mental illness have been tested and proven effective, many people with mental health issues still avoid using these services due to stigma. The article explores the complex components of stigma to better understand its negative impact on those with mental illness, who often reject care because of stigma.
The authors also review key concerns about how effectively public policy helps reduce the power of stigma to increase people's willingness to seek mental health care. Stigma is defined as a complex construct involving public, personal, and structural components, directly affecting both individuals and their use of the mental health care system.
Understanding stigma is crucial to reducing its harmful effects on the self-confidence of those affected by mental illness, for whom stigma often acts as a barrier to treatment. Separate strategies have been developed to combat the effects of stigma on public, personal, and systemic levels. The authors emphasize the importance of programs for health service providers that would encourage people with mental health challenges to use the available treatment options more effectively. Mental health literacy, cultural competence, and family involvement campaigns can also help reduce the negative impact of stigma on treatment-seeking behavior.
The authors argue that changes in public policy are essential to overcoming structural stigma, which undermines government mental health promotion efforts.
Note: Stigma related to mental illness creates both external and internal negative perceptions of individuals with mental disorders. Key efforts to improve both should lie in stronger cooperation

between public policy and psychiatric institutions, involving various ministries, particularly the Ministry of Health.

e. Corrigan, P. W. & Miller, F. E. (2009). Shame, blame, and contamination: a review of the impact of mental illness stigma on family members

(Cited 451 times; published in Journal of Mental Health)

The authors find that stigma related to mental illness harms not only individuals with mental health conditions but also their relatives and close family members. In this regard, the article explores various programs that could help alleviate the different forms of stigma that affect families.

Note: In this context, closer collaboration between the Ministry of Labor and Family Affairs and the Ministry of Health would be advisable, as it would strengthen public policy support for such initiatives.

2. Amy C. Watson:

An American author in the fields of criminal justice and criminology, Amy C. Watson frequently addresses the issue of stigma related to individuals with mental illness. However, from a productivity standpoint, she cannot be considered a leading scientific authority in the area of measuring stigma against people with mental illness. Between 2001 and 2017, she published 40 scientific and professional works related to stigma, which have been cited 8,648 times. Much of her citation count can be attributed to frequent collaboration with previously discussed author P. W. Corrigan.

In the specific area of measuring mental illness stigma, she published only five scientific articles between 2002 and 2017, which gained 3,324 citations—primarily due to her cooperation with the recognized authority Corrigan. The two most frequently cited articles have already been summarized.

a. Corrigan, P. W., Watson, A. C. & Miller, F. E. (2006).

Blame, shame, and contamination: the impact of mental illness and drug dependence stigma on family members

(Cited 320 times; published in the Journal of Family Psychology)

This article reports that family members and relatives of people with mental illness or drug addiction experience negative effects of public stigma from members of the public. However, no large-scale population study has clearly confirmed the public's view on whether stigma is indeed extended to the families of individuals with mental illness.

To explore this, the authors conducted a study examining the impact of mental illness and family roles on family stigma, using a sample of 968 participants. A vignette-based model was employed, describing family members and their health conditions. The study found that the link between schizophrenia and family stigma was minimal, whereas stigma associated with drug addiction was strong. Respondents believed that the family, in both its upbringing and social roles, was largely responsible for the development of drug addiction and could have prevented it.

Note: Respondents were presented with only two options: mental illness and drug addiction. In this comparison, they attributed greater stigma to drug addiction, which may have downplayed the effect of mental illness on family stigma. This created a “elephant and fly” effect—where the more stigmatized issue overshadowed the other. A future study focusing only on different types of mental illness (excluding addiction) could potentially reveal a much stronger link between mental illness and family stigma.

b. Corrigan, P. W. & Watson, A. C. (2005).

Mental illness and dangerousness: fact or misperception, and implications for stigma

(Cited 48 times; published in Practical Strategies for Research and Social Change)

In this article, the authors explore public stigma that labels people with severe mental illness as extremely violent and dangerous. Some study participants associated increased violence with inadequate mental health care, while others pointed to mass media and the entertainment industry as major contributors to the distorted image of people with mental illness as violent.

So, what is the actual link between mental illness and violence? The authors begin by briefly reviewing scientific studies comparing the risk level of individuals with mental illness to the general population. They then examine how the public perceives this connection and how these perceptions impact individuals with mental illness. The article concludes with a discussion on the social and political consequences of stigma, especially when it frames mentally ill individuals as environmental threats.

Note: While it's true that some people with mental illness may be violent and dangerous, the same is true for individuals without any psychiatric history. Public education must clearly distinguish between different types of mental health conditions and personalities. Stigmas often persist because they contain a grain of truth in isolated cases, even though they don’t reflect broader reality.

c. Watson, A. C. (2007).

Social work faculty and mental illness stigma

(Cited 10 times; published in the Journal of Social Work Education)

Stigma can be a major barrier for people with mental illness in terms of recovery and social inclusion. Social work educators can play an important role in reducing the power of social stigma, yet little is known about their attitudes. This study surveyed social work faculty to understand their general views about people with mental illness, their practical experience working with them, and their attitudes toward students with mental health conditions.

Overall, faculty attitudes were not overtly negative. However, they did distinguish between students with and without mental illness. The findings suggest that social work educators should be more self-aware of their attitudes and reinforce the core values of social work, especially in supporting all students.

Note: This finding is not limited to social work educators—it also applies to a broad range of educational professionals, including preschool teachers, primary and secondary school teachers, university professors, driving instructors, and others. Educational personnel may accompany an individual's development from early childhood well into adulthood, even beyond age 30. Their influence can be significant, either strengthening or weakening a person's self-concept and personal development.

3. Bruce G. Link:

American psychiatrist and sociologist Bruce G. Link published 67 scientific and professional works on the topic of mental illness stigma between 1987 and 2020. His publications have been cited 22,289 times. His research and professional interests span psychiatry and social epidemiology, which include public health, mental health, biostatistical methods, and chronic illnesses. Given the high number of citations, Link can be regarded as a leading authority in the field of stigma research, even though the majority of his academic output does not focus solely on stigma. In collaboration with Patrick W. Corrigan, he co-authored a paper on mental health stigma in 2018, which has been cited 13 times. Between 1989 and 2020, Link published 17 research papers specifically on measuring mental illness stigma, which have been cited 3,630 times. Below are summaries of his five most frequently cited works:

a. Link, B. G. et al. (2004). "Measuring mental illness stigma."

Published in Schizophrenia Bulletin and cited 1,282 times, this review article profiles 109 studies conducted between 1995 and 2003 on measuring mental illness stigma. The main goal was to improve understanding of stigma processes and identify effective methods for measuring key stigma components such as stereotypes, cognitive separation, emotional responses, status loss, and discrimination. The reviewed studies employed various methodologies, including experimental and non-experimental designs, qualitative approaches, attitude surveys, vignettes, observations, interviews, and questionnaires. Dimensions used for measuring stigma included social distance, semantic differentials, community attitudes, emotional reactions, rejection experiences, personal testimonies, and assessments of institutional roles in mental health care. The article concludes by identifying major gaps in measurement regarding conceptual coverage and population samples.

Note: This article provides a comprehensive overview of how stigma measurement is approached by various researchers, highlighting strengths and weaknesses. It frames stigma as a multi-layered phenomenon operating both within individuals and across social hierarchies (e.g., communities, organizations, government). Stigma consists of ingrained negative thoughts and emotions, often directed at marginalized or vulnerable groups. Understanding emotional and cognitive mechanisms could improve strategies for reducing stigma, which poses both individual and societal challenges by creating negative social climates and inefficient communication within hierarchical systems.

b. Link, B. G. et al. (2013). "Stigma as a fundamental cause of population health inequalities."

Published in American Journal of Public Health and cited 1,198 times, this article warns about the threat stigma poses to public health. The authors argue that stigma should be recognized as a significant risk factor for various health problems and inequalities. Examples include stigma associated with HIV, disabilities, mental illness, sexual orientation, and racial or ethnic identity. Stigma can lead to social isolation, behavioral and psychological issues, and health disparities. The paper emphasizes the need for large-scale future studies to improve stigma measurement and public health strategies, as the current understanding underestimates its impact.

Note: Stigma functions as a potent social stressor, encompassing subcomponents like discrimination and exclusion. It is a man-made phenomenon that can only be reduced by collective human action. From a public health perspective, stigma is a threat; for sociologists, it represents a societal disorder. Systemically, stigma hinders the exchange of quality information, while communicatively, it disrupts constructive dialogue. Hence, addressing stigma requires a multi-disciplinary approach—not just medical, psychological, or sociological, but also political and legislative.

c. Link, B. G. et al. (2001). "Stigma as a barrier to recovery: the extent to which caregivers believe most people devalue consumers and their families."

Published in Psychiatry Online and cited 355 times, this study evaluated the perceptions of 461 caregivers of mentally ill individuals using two devaluation scales. Seventy percent believed that most people hold negative views of mental health service users, while 43% felt that such attitudes extended to their families. The results highlight the psychological burden and health risks faced by caregivers, compounded by a lack of community understanding. The authors advocate for the development of strategies that promote a more positive public perception of mentally ill individuals and their support networks.

Note: Poor communication contributes to both health and social problems. The flow of low-quality or irrational information hampers effective mental health treatment. Studies like this are valuable for understanding the affected individuals and the broader community, which often lacks proper information and orientation regarding mental illness.

d. Link, B. G. (1997). "The stigma of homelessness: the impact of the label 'homeless' on attitudes toward poor persons."

Published in Social Psychology Quarterly and cited 337 times, this article explores how poverty and homelessness are stigmatized. Based on a vignette experiment, the study found that homeless individuals are blamed for their situation and harshly stigmatized. The stigma of being labeled "homeless" is as strong as that associated with psychiatric hospitalization, and the two stigmas are independent. Homeless individuals face existential struggles alongside social rejection.
Note: Poverty, especially homelessness, signals systemic failure caused by irrational and asymmetric wealth distribution. Collective and rational redistribution efforts could alleviate poverty and reduce related societal issues like stigma, crime, and mental illness. Stigmatization of poor people is not just a medical or sociological issue but also one of economic policy and legislation. Future monetary systems like cryptocurrency could offer survival opportunities for a larger portion of the population.
e. Stuber, J., Galea, S., & Link, B. G. (2009). "Stigma and smoking: the consequences of our good intentions."
Published in Social Service Review and cited 106 times, this study explores whether smokers feel stigmatized in the context of increasing social disapproval of smoking in the U.S. Although this disapproval may motivate some to quit, it may also lead to social withdrawal and concealment among smokers. Based on a random sample of smokers in New York, the study developed new measures of perceived stigma, differential treatment, social withdrawal, and concealment of smoking status. Forty-four percent of smokers felt looked down on, and 17% reported being treated differently due to smoking. The findings suggest that smoker stigma is a powerful but often invisible force that can harm social relationships and health outcomes.
Note: On one hand, this type of stigma could arguably be seen as one of the few examples of a potentially positive form of stigma, since smoking is associated with increased mortality and poses a constant threat to the health of those who continue to smoke. However, the discussion of its counterproductive consequences warrants a more critical evaluation. In this respect, it is important to highlight that the issue of smoking is not solely medical, psychological, or social in nature—it is also deeply rooted in technology and the profit-driven logic of the economy. For a long time, it has been technically possible to develop and widely distribute smoking devices that are less harmful to health and more affordable. Although e-cigarettes, which are marketed as less harmful alternatives, have been available for some time, they remain relatively expensive. Meanwhile, the tobacco industry continues to produce massive quantities of tobacco products, and there appears to be no end in sight.
4. Jo C. Phelan:

Jo C. Phelan is an American scholar and researcher in the field of social medicine. Between 1997 and 2020, she published 47 academic and professional works on the topic of stigma (out of a total of 135 publications), and her work has been cited 19,696 times. She can be regarded as a scientific authority in the field of stigma research, although this does not necessarily extend to the specific area of stigma measurement related to mental illness. Based on the given query, she has authored two scholarly contributions on the measurement of mental illness stigma, the first of which has already been discussed.

a. Link, B. G. & Phelan, J. C. (2014). Mental illness stigma and the sociology of mental health. This contribution, published in the academic monograph Sociology of Mental Health, has been cited 10 times. In this chapter, the authors provide a developmental review of research related to labeling and stigma in connection with mental illness over the past 30 years. They note a strong relationship between the growth of this research field and the development of the American Sociological Association's Section on the Sociology of Mental Health. As this section evolved, scientific output on labeling and stigmatization of mental illness also increased. As a result, researchers have gained a deeper understanding of stigmatization processes.

Note: Why not establish and support an organization dedicated to fighting stigma, led by a selected group of individuals with lived experience of mental illness? Such an initiative could also include external supporting members and psychiatric institutions. With such a conceptual foundation, it seems likely that, in the long term, the processes of mental illness stigmatization could become less intense and pervasive.

5. Winnie Wing-Sze Mak: The Chinese scientist from Hong Kong published 49 scientific and professional works on stigma between 2004 and 2020, and was cited 2,214 times (out of a total of 163 publications). She published three papers specifically on the measurement of stigma related to mental illness, which have been cited 67 times. Based on these figures, the author can be classified as having a medium level of productivity in the field of stigma research.

a. Mak, W. W. S., Chong, E. S. K. & Wong, C. C. Y. (2014). Beyond attributions: understanding public stigma of mental illness with the common sense model. This article has been cited 38 times (published in the American Journal of Orthopsychiatry). In this study, the authors used the Common Sense Model to assess the causes, controllability, timeline, consequences, and coherence of illness, in order to better understand public attitudes toward mental illness. Based on a random sample of 941 households in Hong Kong, the structural equation modeling results showed that people influenced by cultural lay beliefs about mental illness tended to view the course of mental illness as less controllable. On the other hand, people with psychosocial characteristics interpreted the course of mental illness as more manageable. Respondents who perceived the course of mental illness as less controllable, more chronic, and less understandable were less empathetic toward people with mental illness, and stigma associated with mental illness was stronger. Furthermore, they felt a greater social distance from people with mental illness. People with a higher level of understanding of mental illness were more likely to help those affected seek health services and felt less social distance from them. The Common Sense Model provides a multidimensional framework for understanding both mental illness and stigma. The authors conclude with the important insight that research should not only focus on biological, psychological, and social factors, but should also examine cultural myths about mental illness.

Note: The authors highlighted the extremely important insight regarding the lack of research on cultural myths and mental illness. They also pointed out the large number of people with a lower level of understanding of those with mental illness, which is also a cultural problem that can be addressed with educational and other programs. Cultural myths about mental illness represent a persistent problem for overcoming stigma, as they have been ingrained in the mindset of many people over centuries and are thus linked to a core set of values. This complex is very difficult to break. Therefore, future research is recommended both on cultural myths about mental illness and on the values that lead many people to accept the stigma surrounding mental illness.

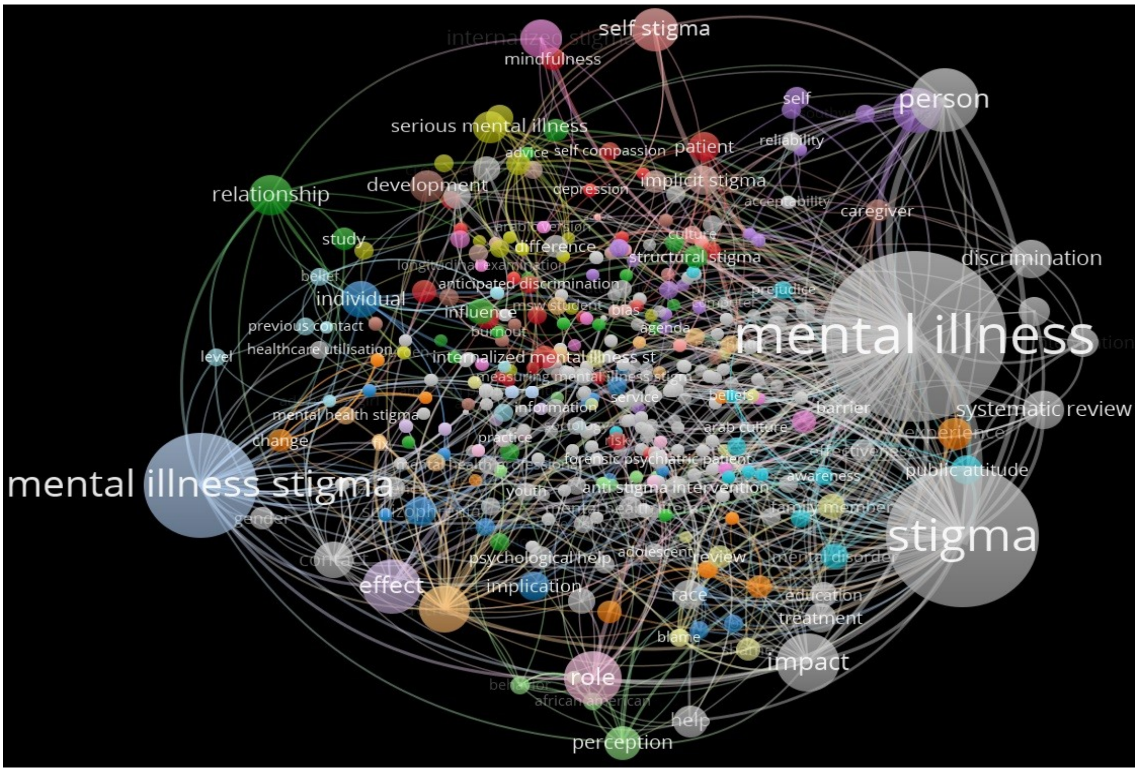
b. Yang, X. & Mak, W. W. S. (2017). The differential moderating roles of self-compassion and mindfulness in self-stigma and well-being among people living with mental illness or HIV. This article has been cited 29 times (published in the journal Mindfulness). Frequent rumination about self-stigma by affected individuals further worsens their well-being. This study examined the role of self-compassion and mindfulness in mediating the relationship between the content and process of self-stigma and subjective well-being among people with mental illness and those living with HIV. The study included 169 people with mental illness and 291 people living with HIV from Hong Kong. Participants reported their levels of positive self-image, mindfulness, content and processes of self-stigma, and overall life satisfaction. Analyses showed that, in both groups, well-being and mindfulness were significantly associated with life satisfaction. Self-compassion mediated the relationship between the content of self-stigma and life satisfaction in the group living with HIV, while mindfulness mediated the relationship between self-stigma and life satisfaction in the group with mental illness. The article concludes with a discussion on reducing stigma and promoting well-being in various stigmatized groups.

Note: It may be worth considering groups of people for whom we would not expect to be burdened by stigma and self-stigma. For example, excessively wealthy people, who can also find themselves at the center of stigma and self-stigma. This could also include famous public figures. Other stigmatized groups could be sailors, carpenters, police officers, lawyers, etc. Such research would also be useful with these groups.

c. Chen, S. X., Mak, W. W. S. & Lam, B. C. P. (2020). Is it cultural context or cultural value? Unpacking cultural influences on stigma toward mental illness and barriers to help-seeking. This article has not yet been cited (published in the journal Social Psychological and Personality Science). This study, which included 555 university students (Chinese from Hong Kong, Chinese from mainland China, and Europeans), examined cultural influences on stigma toward mental illness. Significant cultural differences were found at the group level, as both Chinese groups reported higher levels of stigma toward mental illness than the European group. This cultural difference appears to stem mainly from higher levels of concern. Both Chinese groups found seeking health care for mental illness more problematic than the European group. Cultural differences in perceptions of mental illness and stigma are extremely important and meaningful.

Note: The authors of this article addressed an important topic that undoubtedly has a significant impact on perceptions of both mental illness and stigma. In this context, different values can also be compared. The only issue in this study may be the "apples and oranges" effect, as Europeans are not a homogeneous group, but consist of diverse ethnic, historical, and cultural backgrounds. It seems as if the authors lumped all Europeans together. Similarly, Europeans may also generalize about Asian peoples (e.g., we may struggle to distinguish between Chinese and Koreans).

The following is an analysis of the titles of scientific and professional works in the field of measuring stigma related to mental illnesses.



4.6.2 Figure 242: Concept map of titles in the field of measuring mental illness stigma

Figure 242 displays a concept map of the titles of works in the field of measuring mental illness stigma, containing 726 phrases and 81 clusters or groups. Within the concept map, the largest node is labeled "Mental illness," followed by the node "stigma," and in third place, the node "mental illness stigma." Let us first examine the largest node.

a. Mental illness

The largest node contains 46 phrases and 36 clusters or groups; here, only those including three items will be highlighted.

The first group contains three items: internalized mental illness stigma, mental illness self-stigma, and mental illness study protocol. A research protocol is a document in medical science and practice that provides a systematically organized basis for investigating a specific phenomenon and for collecting and analyzing data. When studying internalized stigma and self-stigma, such a protocol is exceptionally clear and useful, as it gives researchers valuable insight into complex topics. It typically includes elements such as the research aim, methods, types of assessment, data collection procedures, and statistical aspects of data analysis. Additionally, it provides guidelines for the protection of participants and ensures data quality.

Next, we review the eighth group, which also contains three phrases: Measuring stigma toward mental illness (the title of a scientific article), mental illness stigma scale, and mental illness stigma theory.

Within this cluster, let us look more closely at the scientific article:
Day, E. N., Edgren, K., and Eshleman, H. (2007). Measuring stigma toward mental illness: Development and application of the Mental Illness Stigma Scale. The article has been cited 144 times and was published in the Journal of Applied Social Psychology.
According to stigma theory, a Likert scale was used to measure seven factors of attitudes toward people with mental illness: interpersonal anxiety, relationship disruption, poor hygiene, visibility, treatability, professional efficacy, and recovery. The scale was validated among students and community members and measured attitudes toward people with mental illnesses (e.g., depression, bipolar disorder, and schizophrenia).
In the second phase, students first completed the scale from their own perspective, and then from the imagined perspective of a person with mental illness. Psychiatric patients completed the scale first from their own perspective, and then from the imagined perspective of a person without mental illness. Psychiatric patients anticipated that students would stigmatize them more, but the students' results did not confirm this.
In the ninth group, there are also three items: mental illness scale, mental illness stigma framework, and mental illness stigma impact. It is appropriate here to briefly review the following scientific article:
Fox, A. B. et al. (2018). Conceptualizing and measuring mental illness stigma: The Mental Illness Stigma Framework and Critical Review of Measures. The article has been cited 21 times and was published in the journal Stigma and Health.
This article introduces the Mental Illness Stigma Framework (MISF), which provides a unified structure and terminology for understanding the mechanisms of mental illness stigma, relevant to both those who are stigmatized and those who stigmatize. The framework is used to systematically review and classify over 400 measures of mental illness stigma, according to their corresponding stigma mechanisms. The review found that stereotypes and discrimination have received the most research attention, while mechanisms focusing on the perspective of individuals with mental illness (such as experienced, anticipated, or internalized stigma) have been studied the least.
In the past decade, there has been a surge of research on the stigma of mental illness. Nevertheless, the authors of this article note that such research still lacks both consistency and clarity in the conceptualization and measurement of mental illness stigma, which in turn limits the accumulation of scientific knowledge. In this article, the authors connect various research focal points using the Mental Illness Stigma Framework. This framework offers a unified approach and terminology for better understanding the mechanisms of mental illness stigma, which are important for studying both those who are stigmatized and those who perpetuate stigma.

This methodological framework is then used for a systematic review and classification of stigma measures employed in the past decade. The authors identified more than 400 different measures of mental illness stigma, with two-thirds of these lacking systematic psychometric validation. The greatest research attention has been given to stereotypes and discrimination, while mechanisms focusing on the perspective of individuals with mental illness (such as experiences, expectations, and internalized stigma) have been the least studied.

In the article's conclusion, the authors discuss the advantages and disadvantages of the conceptual framework for measuring mental illness stigma, highlight gaps in the scientific literature, and provide recommendations for future research.

Group 20 also includes three items: personal mental illness, stigma toward mental illness, and toward understanding mental illness. In this context, let us briefly review the following scientific article:

Klik, K. A., Williams, S. L., and Reynolds, K. J. (2019). Toward Understanding Mental Illness Stigma and Help-Seeking: A Social Identity Perspective. The article has been cited eight times and was published in Social Science & Medicine.

People with mental illness are often thought not to seek healthcare. Research shows that mental illness stigma negatively affects help-seeking, but there is little data on the factors associated with stigma. A very important aspect here is social identity, which includes group social identification—how individuals with mental illness perceive themselves as a group and how this guides them in seeking and using health services.

The authors aimed to identify two key factors—social identification and group perception—that influence stigma and are linked to the multi-stage process of help-seeking. They also sought to explore whether there is a positive connection between these factors and the stages of the help-seeking process that occur before actual service use (such as recognizing illness and symptoms), as well as the actual behavioral use of these services. The findings indicate that social identification among people with mental illness is positively associated with the multi-stage help-seeking process and may be especially important for those experiencing stigma due to mental illness.

Note: Scientific articles on measuring mental illness stigma often report on the use of health services, where individuals seek help. However, there has not yet been research on the level of independence among stigmatized people with mental illness. The key question remains how to encourage beneficial activities and greater independence among people with mental illness, so that they do not rely solely on seeking help. Excessive passivity does not lead to real progress.

b. Stigma

The second largest node contains 76 word combinations and 46 clusters or groups, whereby we will highlight only those that include more than two units.

The first group contains four units:

- antistigma training (education about stigma and the prevention of discrimination),
- anticipated stigma (expected stigma or the fear of future stigmatization by other individuals, e.g., towards a person with a mental illness),
- internalized mental illness stigma,
- mental illness self-stigma.

The second group contains three units:

- mental illness related stigma,
- state level structural stigma,
- structural stigma (societal or cultural circumstances that hinder the well-being of stigmatized individuals).

The seventh group contains five units:

- family stigma stress scale (a scale for measuring stress due to family stigma or a tool for assessing negative stress associated with stigma),
- measuring stigma toward mental illness,
- mental illness stigma scale,
- mental illness stigma theory,
- stigma stress.

The eighth group contains three units:

- internalized stigma,
- mental illness stigma framework,
- mental illness stigma impact.

Group 50 contains three units:

- adolescent mental illness stigma,
- stigma reduction programs,
- youth stigma development.

c. Stigma of mental illness

The third largest node contains 21 word combinations and 19 clusters or groups, whereby we will highlight only two groups, each containing two units.

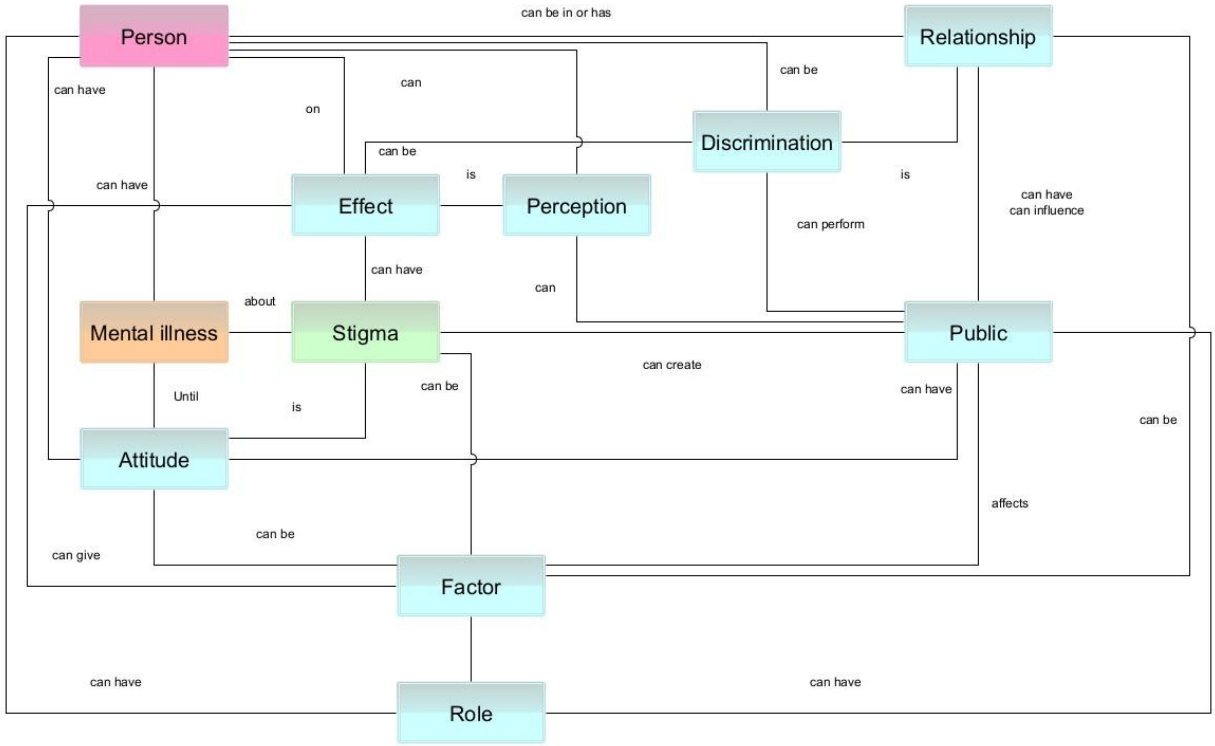
The seventh group contains two units:

- mental illness stigma scale,
- mental illness stigma theory.

The eighth group also contains two units:

- mental illness stigma framework,
- mental illness stigma impact.

Based on the entire conceptual network (see Figure 242), nodes that can be classified as mid-sized based on their size will first be selected (person, discrimination, public stigma, impact, role, attitude, effect, relationship, and perception). Subsequently, in interdependence with the three largest nodes, an adapted metamodel will be intuitively formed. The purpose of this metamodel is to illustrate the fundamental content concept of previous scientific research efforts in the field of measuring the stigma of mental illness.



4.6.3 Figure 243: Adapted metamodel regarding the measurement of stigma

Figure 243 depicts an adapted metamodel for measuring the stigma of mental illness, encompassing only the most basic and significant content concepts formulated based on the conceptual network (see Figure 242). The central concepts include a person (entity) who may have a mental illness (attribute) and their own and induced attitude towards their condition (attribute), which stigma can further reinforce (factor). Public stigma is typically created by society (entity), which can negatively impact a person with a mental illness through the process of stigmatization. The public holds certain attitudes and acts as a powerful factor influencing the well-being of individuals with mental illnesses. Both the person and the public play a specific role in the stigmatization process – the person often remains in a passive role, while the public acts actively. Stigma can have a negative effect on a person with a mental illness, which they perceive through the cognitive process of perception. The public creates stigma, consequently leading to negative relationships with individuals or groups. These relationships can be markedly discriminatory – the person perceives them as an effect of stigma, while the public often does not recognize them but merely recreates them. In the long term, it is the public that causes public stigma and thereby contributes to the emergence of self-stigma and internalized or induced stigma.

In the entire process of studying stigma, the key investigated factors remain both the person with a mental illness (the affected) and society (the agent). Both the effects and the causes of stigma are measured, which are reflected in complex relationships formed based on the attitudes of the public and individuals with mental illnesses. Attitudes represent a significant factor as they determine the way the person, society, and their mutual relationships are perceived, especially in the context of stigmatization. This process leads to the final effect of discrimination, devaluation, or social exclusion.

Scientific research efforts in the field of measuring the stigma of individuals with mental illnesses mostly focus on the psychosocial, social, and medical aspects of stigma as a negative stress factor. The analysis of titles of scientific and professional works in this area reveals hierarchically structured relationships between the public and individuals with mental illnesses, as collaborative relationships are mostly present only within the groups that create stigma and determine the rules of differentiation and comparison. Stigma, as a negative stress factor, defines social norms and categorizations of social anomalies, which is paradoxical since stigma itself is a social anomaly arising from the need for hierarchical stratification of society and the formation of influential groups. Within these groups, decision-making and collaboration processes take place, which determine the rules of social differentiation.

There are various types of stigma that can be based on professional, scientific, or artistic activity, health status, race, nationality, religion, gender, sexual orientation, political and ideological affiliation, social status, class affiliation, physical characteristics, temperament, or lifestyle (e.g., eating habits, alcohol consumption, smoking, drug use, etc.).

Stigma often forms the basis for the development of various forms of social strategies, including more or less complex intrigues or plots, which in some cases can lead to criminal or even felonious acts, although this is not necessarily the rule. Precisely because of this, plots will not be treated as a form of criminality in this analysis, as a special subsection will be dedicated to this area.

4.7 Intrigues (plots, schemes, conspiracies)

An intrigue is a strategy planned by an individual and/or a group of people with the aim of gaining material benefits (e.g., money, land, real estate), positional advantages (e.g., dominance, political power, strengthening social connections), ideological benefits (e.g., achieving a higher good), and/or emotional benefits (e.g., love, hatred, favor). Intrigues are purposefully directed and motivated by various intentions—ranging from acquiring material or psychological benefits, satisfying excessive hedonistic needs (including sexual promiscuity), ensuring a privileged position with a chosen person, fulfilling vengeful intentions, or simply for personal entertainment.

Intrigues generally have a negative connotation and proceed secretly and (partially) unplanned, under the control of the individual and/or group that implements them using various actions. There are exceptions, such as plotting for a higher good, but this often risks creating numerous victims, justified by the belief that the end justifies the means.

To execute an intrigue, at least three people are required: the plotter, the accomplice, and the victim. Without these conditions, an intrigue cannot exist. As is evident, an intrigue is based on certain rules and conditions that clearly define it.

Methods and Tools of Plotting

The tools or methods of plotting are diverse and multi-layered. Plotters can use the following to achieve their goals:

- Bullying,
- Stigmatization of certain groups,
- Causing negative stress factors,
- Organized crime,
- Social networking,
- Backstabbing,
- Bribery,
- Sexual abuse,
- Spreading false rumors and information,
- Espionage,
- Abuse of legislation,
- Economic propaganda,
- Mass manipulation,
- Use of mass media,
- Murder,
- Environmental and health harm,

- Use of art as a tool of manipulation,
- Poisonous substances,
- Extortion, etc.

These and many other methods can be used by plotters to gain benefits and/or harm an individual, group, or larger population. It is not necessary for them to commit a criminal act, as they can also use lawful methods that are not formally criminal offenses. For example, a plotter might praise and/or reward their future victim, thereby triggering in others (the victim's opponents) a desire to harm that person. Plotters or organized plotting groups can conduct the entire process entirely within legal boundaries.

Intrigue across various social domains and environments

Intrigues can be categorized based on the fields in which they occur, such as:

- politics,
- espionage,
- emotions,
- hedonism,
- economics,
- law,
- criminal activity,
- art,
- science, and so on.

Wherever ruthless interests exist, intrigues are also present. They occur at local, regional, national, and international levels and remain hidden and undetectable in 98% of cases.

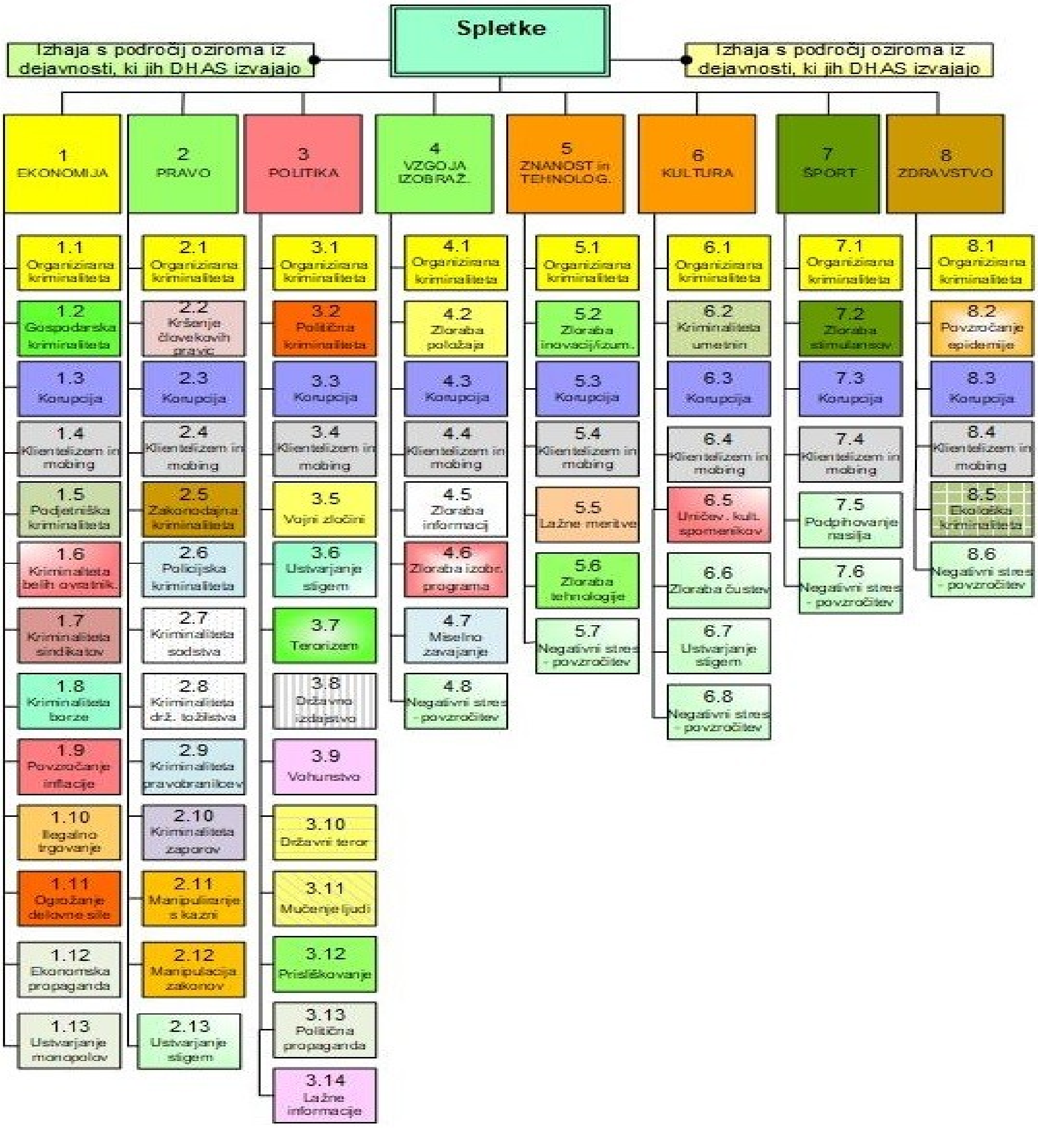
The difficulty of measuring intrigue

The greatest challenge with intrigue lies in its measurability, as it often goes unnoticed within hierarchical social systems. Statistical data on intrigue is extremely limited, since in many cases its existence is only suspected or believed. So-called conspiracy theories are known, often based on mental constructs and expressing skepticism toward officially accepted facts. Occasionally, intrigues in areas such as politics, terrorism, banking, or stock market speculation come to light, but these are just a few revealed cases—most remain obscured, as the true background is usually inaccessible.

The social impact of intrigue

Intrigue is a highly intense social phenomenon that affects the flow of information, energy, and resources within hierarchical social systems. It often involves methods of disinformation, carried out through manipulations of mood, emotion, and cognition.

Can we understand intrigue as the subconscious of social systems? It's difficult to give a definitive answer, as intrigues are always planned and goal-oriented, even though most people are unaware of them. Many individuals act merely as tools in the process of intrigue, without even realizing it.
Much like stigmatization, intrigue can contribute to a deterioration in the social climate and public health, especially through the rise of mental health disorders. In fact, it can be seen as a significant negative social and health-related stress factor.
Given the complexity of intrigue as a social phenomenon, it makes sense to illustrate its function with a structural diagram that can better represent its pervasive presence within hierarchical, associative social systems.



4.7.1 Figure 244: A possible structural diagram of tools used to execute intrigues

Figure 244 presents a possible structural diagram showing the tools used to carry out intrigues. It illustrates only some of the elements that stem from fields or activities carried out by hierarchical associative social systems (see Figure 244: HASS). The diagram includes eight areas:

- Economy (e.g., activities in business, various economic sectors, finance, taxation, banking, stock markets, trade, import and export),

- Law (e.g., law-making, court systems, legal practice, prosecution, and notary services),

- Politics (e.g., legislation, elections, citizen initiatives, the functioning and oversight of ministries, military command),

- Education and Upbringing (e.g., knowledge transmission, early childhood education, training for future roles in business, education, and politics),

- Science and Technology (e.g., development of patents, innovations, inventions, application of modern technology, and addressing social or technological issues),
- Culture (e.g., reinforcing national identity, language, artistic expression, and providing entertainment),
- Sports (e.g., recreational, amateur, and professional sports activities, and organizing events of various scales),
- Healthcare (e.g., public health preservation, disease prevention and treatment, drug development).

Each of these domains involves numerous and interconnected activities. For example, healthcare might develop a medicine using medical science, the pharmaceutical industry, and modern technology, while politics legalizes its use via parliament and medical boards.

Due to the complexity of these fields, intrigues can emerge in any of them. Their perpetrators may use a wide array of tools—from criminal activities (see Figure 244: clientelism and mobbing are the most common tools of intrigue) to spreading false information, inducing harmful stress, and manipulating values or collective symbols (e.g., through film, theater, etc.).

The structural diagram reveals that commonly used tools include crime, information manipulation, harm to public health, and the legal system (e.g., passing laws that serve narrow interests, monopolizing goods and services). While not all intrigues are complex, they tend to grow in complexity when they involve more participants and activities, especially when tied to powerful interests.

Although the structural diagram offers a good insight into the branching nature of intrigue, it does not show spatial distribution. Therefore, it would be useful to create a city map and classify locations into different zones, such as:

- Commercial zone (artisan, retail, hospitality, and hotel centers),
- Financial zone (banking and stock exchange hubs),
- Industrial zone (industrial facilities and activities),
- Cultural zone (museums, galleries, sports venues, schools, libraries, scientific institutes),
- Residential zone (housing complexes and homes),
- Migration zone (bus and train stations),
- Agricultural zone (farmland and buildings),
- Administrative zone (municipal offices, police, ministries, courts, military, clinics, and hospitals).

The scale of an intrigue is often influenced by the strength of the involved interests and the number of participants from different zones. A key factor in intrigue is also the personal characteristics of its initiators—for example, a mastermind may have a wide social network of friends and contacts across various zones, many of whom hold influential positions.

To better illustrate this concept, it would be helpful to present a simple scenario using a map that shows the social zones involved.

4.7.2 Figure 245: A section of the urban community with mapped zones

Figure 245 shows a section of an urban community with marked zones, specifically:

- Commercial Zone (see red polygon: includes shopping centers, a gas station with a convenience store, a hotel with a casino, and dining establishments),

- Cultural Zone (see green polygon: includes a cultural center, a school, sports facilities, and a city park with a monument),

- Industrial Zone (see brown polygon: includes two factories).

This simplified scenario presents only three of the eight previously mentioned social zones. At first glance, the commercial zone appears to be the most extensive, followed by the cultural zone, with the industrial zone being the smallest.

There is no clear direct connection between the industrial and commercial zones, whereas a direct link between the commercial and cultural zones is suggested—beer is sold in the city park, which slightly overlaps with hospitality services.

In this simplified model, at least three distinct interests can be identified:

- In the commercial zone, businesses aim to attract as many customers as possible and boost sales.

- In the cultural zone, the focus is on entertainment and promoting residents’ physical and intellectual activities.

- In the industrial zone, the primary goal is product manufacturing and sales to achieve strong business performance.

Based on these core interests, it's evident that the commercial and industrial zones share a similar objective: increasing sales.

Where and when might intrigue arise within this triangle of social zones?

The most intense competition is expected among the various retail chains—Hofer, Lidl, Tuš, and Mercator—as they all strive to capture the largest customer base and increase sales. These retailers follow similar sales strategies, primarily offering food products.

Within this competitive environment, it's worth noting that Hofer, Lidl, and Mercator are owned by foreign business entities, while Tuš is Slovenian-owned.

Tools of Intrigue and Their Effectiveness

One of the most basic mechanisms of intrigue is rumors, which can be:

- Negative,
- Positive,
- Hybrid (simultaneously negative and positive).

Rumors in themselves do not constitute an intrigue unless they are intentional and serve a specific purpose.

- If hybrid rumors emerge, one competitor might be spreading negative rumors while the other responds with positive countermeasures.
- It's also possible that a third competitor is simultaneously spreading both positive and negative rumors to intensify the rivalry between the first two. In such a case, we could speak of a more complex intrigue.

The main business motive behind intrigue is to maintain market position. As long as rumors remain balanced, we can assume the intrigue is either ineffective or not present at all.

In the short term, a significant number of customers switching from one retailer to another could suggest the presence of an intrigue—but this isn't solid proof. It could just as easily mean the competing store improved its offerings by providing better quality at lower prices.

The connection between intrigue, crime, and other motives

Intrigues often resemble criminal acts, as they can be identified through characteristic behavior patterns and the operational dynamics of individuals or organized groups.

However, intrigues are not limited to business interests—they may also involve:

- Political motives,
- Personal or friendship-based interests,
- Emotional impulses,
- Cultural influences.

When these motives are present simultaneously and are particularly strong, a more complex intrigue can be expected. Nevertheless, without concrete evidence, we cannot confirm the existence of an intrigue with certainty.

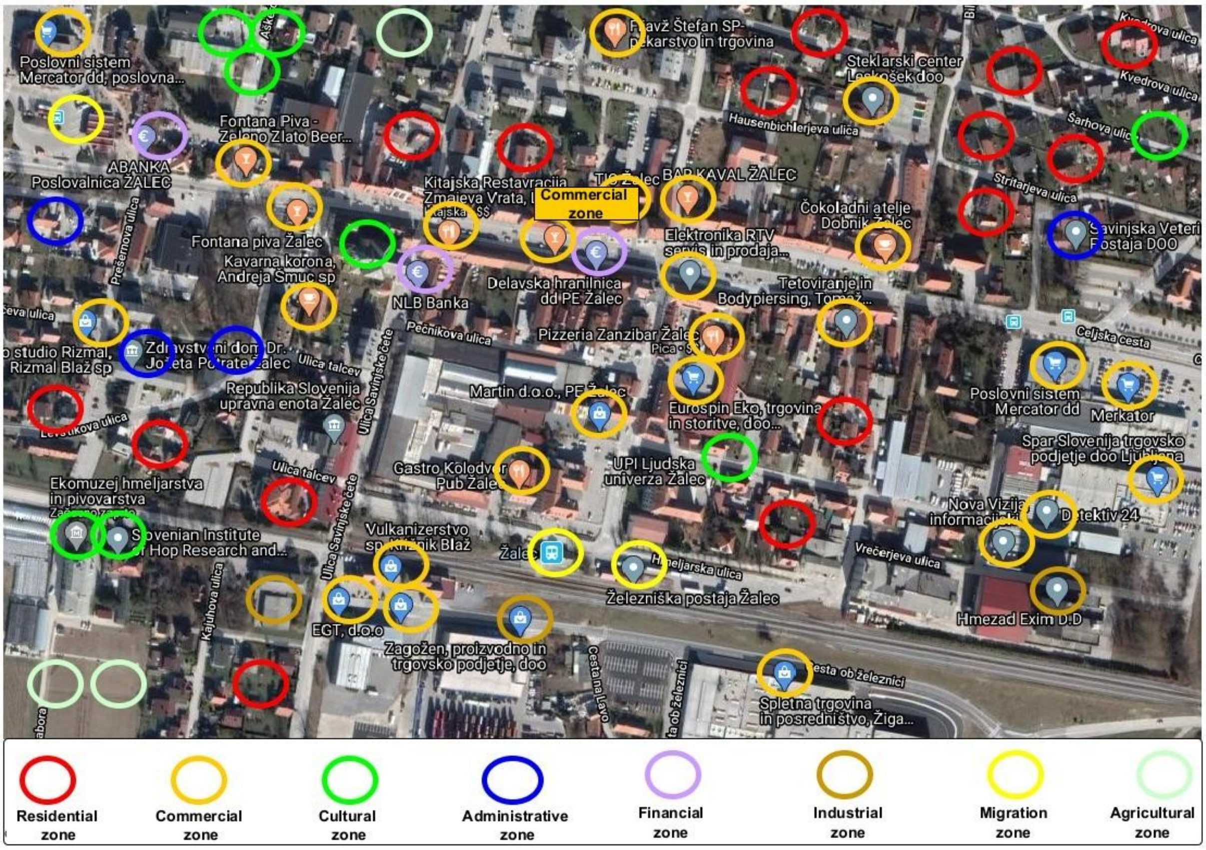
<u>Monitoring and Evaluating Intrigues</u>

In analyzing intrigues, it is useful to assess the balance between harm and benefit. Key questions include:

- Which individuals or groups suffered material and/or psychological harm?
- Which individuals or groups gained material and/or psychological benefits?

Both quantitative and qualitative indicators may be time-sensitive, as situations can shift quickly and unexpectedly.

The method for analyzing the relationship between benefit and harm will be discussed later. For now, let's take a look at a simpler example that involves all eight social zones.



4.7.2.1 Figure 246: Urban community with marked social zones

Figure 246 shows the same urban community, now divided into eight social zones. The most dominant is the residential/family zone, followed by the commercial, cultural, administrative, financial, industrial, migration, and agricultural zones.

The strong presence of the residential/family zone is expected. Less logical, however, is the notable presence of the commercial zone, marked with orange circles. The urban community has only about 5,000 residents, meaning the number of geographically optimal consumers is relatively low compared to the supply—especially of food products.

We also notice that the industrial zone, marked with brown circles, is weakly represented. On the other hand, for such a small urban community, the cultural zone—marked with green circles—is relatively well represented. In some areas, it is linked with tourism and the commercial zone.

The administrative zone (blue circles) and the financial zone (purple circles) are both proportionately and optimally represented.

The migration zone (train and bus stations), marked with yellow circles, is also appropriately sized to meet public transportation needs. However, the train station has somewhat limited connectivity to other urban centers.

The agricultural zone, marked with light green circles, is minimally represented within the community, which is not surprising, as agricultural zones are usually located outside urban areas. Nonetheless, there are many such zones surrounding the urban community, where agricultural land and farm buildings dominate. The most common type of farmland in the area is hop fields, as the community is heavily economically dependent on hop cultivation.

The network of zones and the likelihood of intrigue

In this complex and interconnected network of different zones, the commercial zone still stands out, being the most likely place for intrigue with business-driven motives.

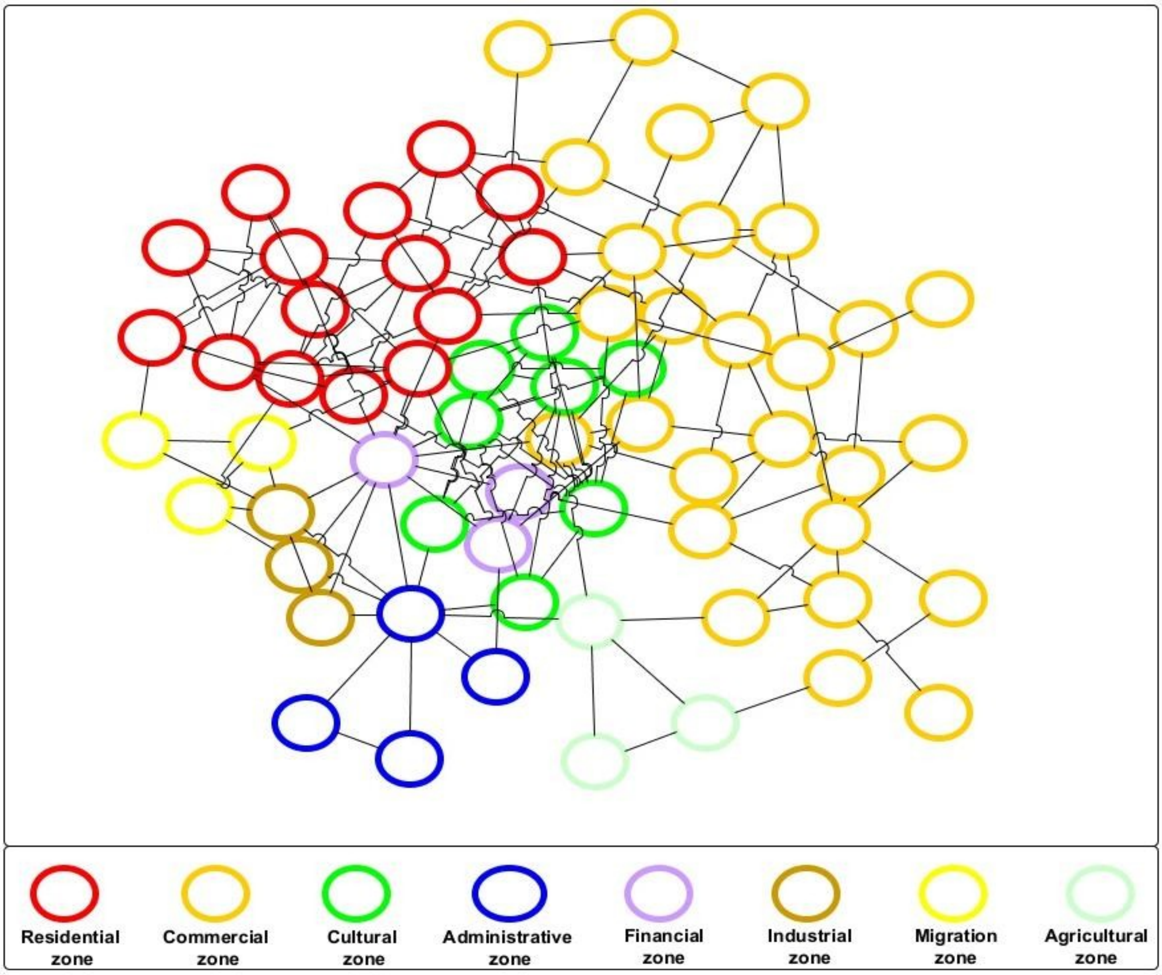
Each marked zone essentially acts as a node, providing data and information about its function, location, connections, purpose, vision, and future development.

This means that these nodes operate as data/information hubs which, when connected to other nodes, form data/information networks.

Monitoring the dynamics of connectedness and disconnectedness is the next step, allowing for analysis, evaluation, and the drawing of insights and conclusions.

This methodological approach represents one possible way of detecting, monitoring, and analyzing intrigues.

To illustrate this concept, let us take a look at a potential intrigue network, based on the social zones of the urban community (see Figure 246).



4.7.2.2 Figure 247: A possible network of intrigue between different social zones

Figure 247 illustrates a possible network of intrigue between various social zones within the examined urban community. Numerous connections between individual social zones can be observed, with the commercial zone once again standing out due to its strong dominance. Despite this observation, we still cannot conclusively confirm that intrigues with business motives are occurring within these nodes.

It is necessary to examine the balance between harm and benefits—not only for individuals and groups of people, but also for organized work units. In this context, there is a need to develop models, evaluation matrices, and calculations that would allow for an analysis of both outcomes: harm and benefit.

Harm-benefit analysis is more commonly used in animal testing and in medicine, particularly in treating and predicting certain diseases. Therefore, in this section, we will introduce a modified version of harm-benefit analysis adapted for the purpose at hand.

When developing the model and later applying evaluation matrices for the adapted harm-benefit analysis, it's best to begin with simple examples—cases that involve an instigator and executor of the intrigue, an ally, a motive, a goal, and a victim.

To illustrate more clearly, let us look at the simplest possible example of an intrigue with an emotional motive.

4.7.3 A simple example of an intrigue with an emotional motive

The direct participants in this emotionally motivated intrigue are three minors: Subject A (male), Subject B (female), and Subject C (male). Subject A is the planner and executor of the intrigue against Subject C, with Subject B acting as an ally. The motive of Subject A is emotional in nature—he aims to break up the romantic relationship between Subjects C and D (female), in order to harm Subject C and gain emotional benefit by winning over Subject D. Thus, Subject D represents an indirect participant and serves as the central motive behind the intrigue.

The participants can be defined as Dimension 1, where each individual has a specific role and characteristics. Dimension 2 is the motive, and Dimension 3 refers to the methodology of executing the intrigue (e.g., the methods, tools, and techniques used). The key question is: Which methods and/or tools might Subject A use to weaken the bond between Subjects C and D?

People usually make decisions based on past experiences and current signals, as both inform their expectations about the future. Subject A possesses past information about Subjects C and D, so it can be assumed that he will use this knowledge as part of his strategy.

The motive of Subject B, who acts as an ally to Subject A, is based on their friendship. Subject B does not have a hostile relationship with Subject C but offers support to Subject A out of loyalty to their friendship.

In this intrigue scenario, we are dealing with two core values—love and friendship. These values also serve as the main motives for the intrigue. This is an example where otherwise positive values are placed into a context with a negative connotation, which can be defined as a misuse of positive values.

Subject A may primarily use the following methods and tools:

a. He will use both negative and positive information from the past and present about Subject C and Subject D (e.g., health status, family background, social status, religion, political affiliation, fears, desires, activities).

b. With the help of Subject B, he will spread negative information about Subject C to Subject D.

c. Together with Subject B, he will create distorted information about Subject C.

d. He will initiate negative rumors about Subject C with Subject B's assistance.

e. He will try to create a negative emotional atmosphere between Subjects C and D.
f. He will attempt to use various set-up scenarios to deceive or discredit Subject C.
g. With Subject B's help, he may try to seduce Subject C or at least create the impression of a romantic relationship between Subject C and Subject B (possibly using mobile phones to record videos or audio, or using computers and social media platforms).
h. He will try to create the illusion of a romantic connection between himself and Subject D.
i. Subject B will befriend Subject D, while Subject A will establish contact with Subject C. In doing so, Subject A will try to put Subject C in a compromising situation (e.g., inviting him for an alcoholic drink with the intention of heavily intoxicating him, possibly using KO drops or other intoxicating substances).
j. Subject A could resort to the most extreme forms of crime, such as murder, causing a car accident, and similar acts.

The list of potential methods or tools for carrying out an emotionally motivated intrigue can be quite extensive. The listed methods primarily focus on information and actions.

In which social zones could such an intrigue take place?

Given that all involved are minors, it can be assumed that this emotionally motivated intrigue would most intensively unfold within:

- the residential/family zone,
- the cultural zone (e.g., school, sports activities, online activities),
- the commercial zone (e.g., pubs, nightclubs).

Social zones represent the fourth dimension. Each zone has specific characteristics and roles, and defines individual areas of activity in which all participants are involved.

In addition, three more dimensions must be considered: location, date, and time of the events or activities. In this context, the key factors are geographical distance and time span.

The description of the seven dimensions essentially represents a tabular collection of data and information.

Harm (Fact 1) and benefit (Fact 2) represent tables of facts, showing the harm caused—primarily to Subject C—and the benefits gained, especially from Subject A's perspective.

In short, we are dealing with seven dimensions and two key facts. The result is a model of tables, consisting of:

- Two fact tables (harm and benefit),
- The outcome (or multiple outcomes, if applicable),
- Seven dimensional tables with their respective attributes.

This means there is a link between the seven dimensions and the harm fact table, and an identical set of seven dimensions connected to the benefit fact table. Both fact tables are interconnected and illustrate the relationship between the identified harm and benefit—for both Subject A and Subject B.

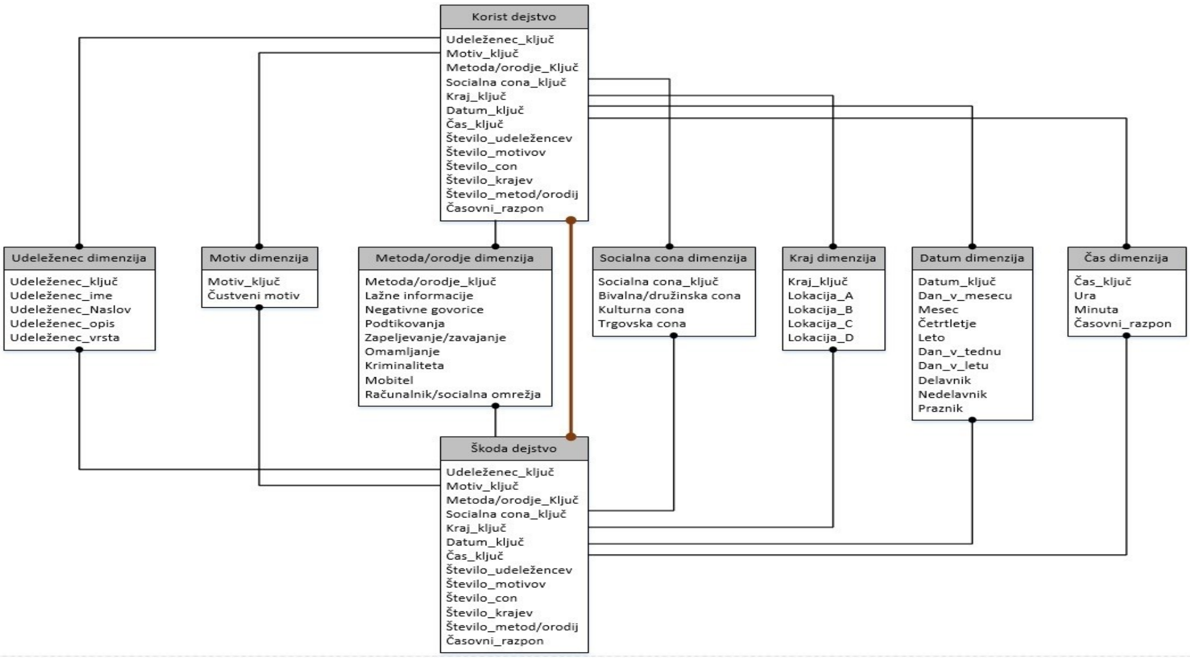
Based on this, it is possible to calculate the harm-benefit ratio.

This ratio can provide feedback regarding:

- The existence of the intrigue,
- Its negative impacts,
- Its negative consequences,
- The effectiveness of the intrigue.

As mentioned earlier, intrigues generally occur in the background and in secret, which makes it crucial to first demonstrate the likelihood of their existence. Otherwise, the intrigue could remain nothing more than a conspiracy theory—something one may believe in or not.

It would therefore be useful to illustrate this concept more clearly using a diagrammatic model in the form of a tabular schema.



4.7.3.1 Figure 248: Conceptual model in the form of a tabular diagram

Figure 248 presents a conceptual model in the form of a tabular diagram, which shows the connections between the dimensions and the two primary categories of facts: harm and benefit. As illustrated in Figure 248, these two facts are interconnected (see the brown-colored link).

Both fact tables are linked to seven dimensional tables, which allow for the monitoring, collection, and analysis of data across all dimensions. Based on this data, conclusions and insights are drawn using the two fact tables, which then yield a ratio as the outcome. This ratio can also be expressed as a numerical value.

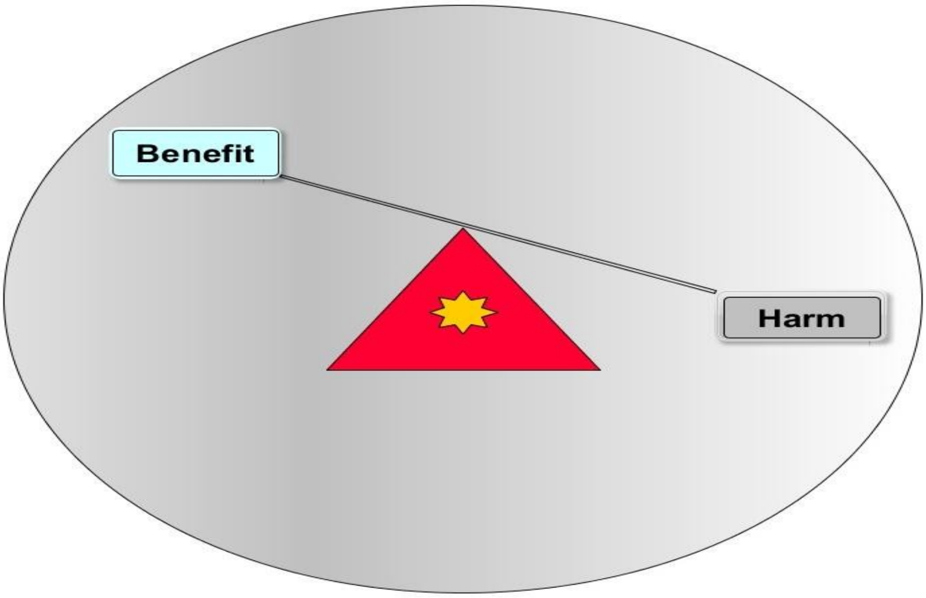
The core idea behind this data monitoring, collection, and analysis model is to identify an intrigue and determine its negative effects or consequences, expressed as the harm-benefit ratio. In short, it is a simple conceptual model designed to facilitate a customized harm-benefit analysis resulting from a particular intrigue.

For a more precise representation, it will be necessary to use appropriate weighting, so that the balanced or imbalanced state of harm and benefit—from the perspective of both the perpetrator and the victim—can be effectively illustrated.

Participants are tracked across several aspects:

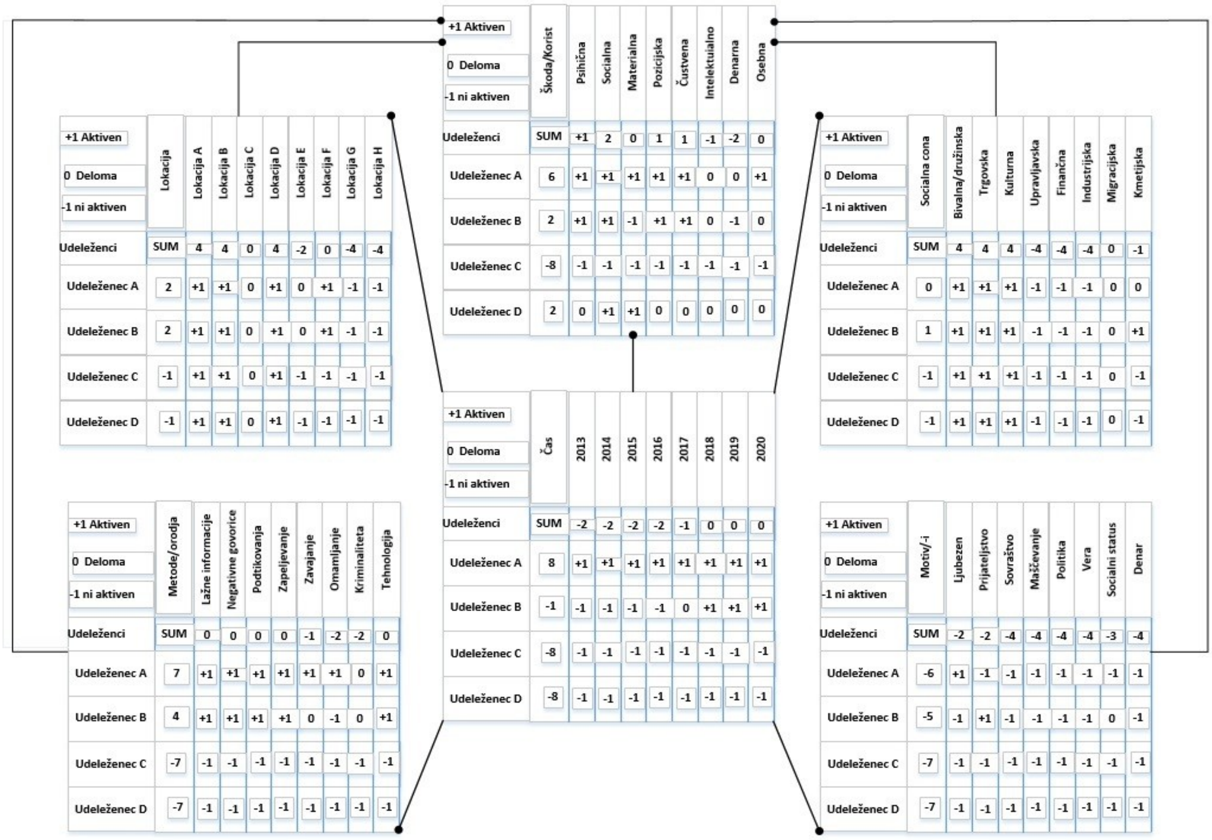
- Informational,
- Geographical,
- Social,
- Action-based,
- Motivational,
- Migrational,
- Temporal.

The most illustrative representation of this concept is the scales model, which demonstrates both balanced and imbalanced states. Significant tilts of the scale to either side can provide valuable insight into the gains acquired or the harm/losses incurred.



4.7.3.2 Figure 249: The balance scale model of harm and benefit

Figure 249 shows the balance scale model of harm and benefit, which clearly illustrates the balance or imbalance between the two quantities.



4.7.3.3 Figure 250: Matrix network for customized harm and benefit analysis

Figure 250 illustrates the matrix network for the customized analysis of harm and benefit arising from the presence of a manipulation with an emotional motive. The common denominator for all the tables, both dimensional and fact tables, are the participants, who are evaluated with weights based on the intensity of their activities:

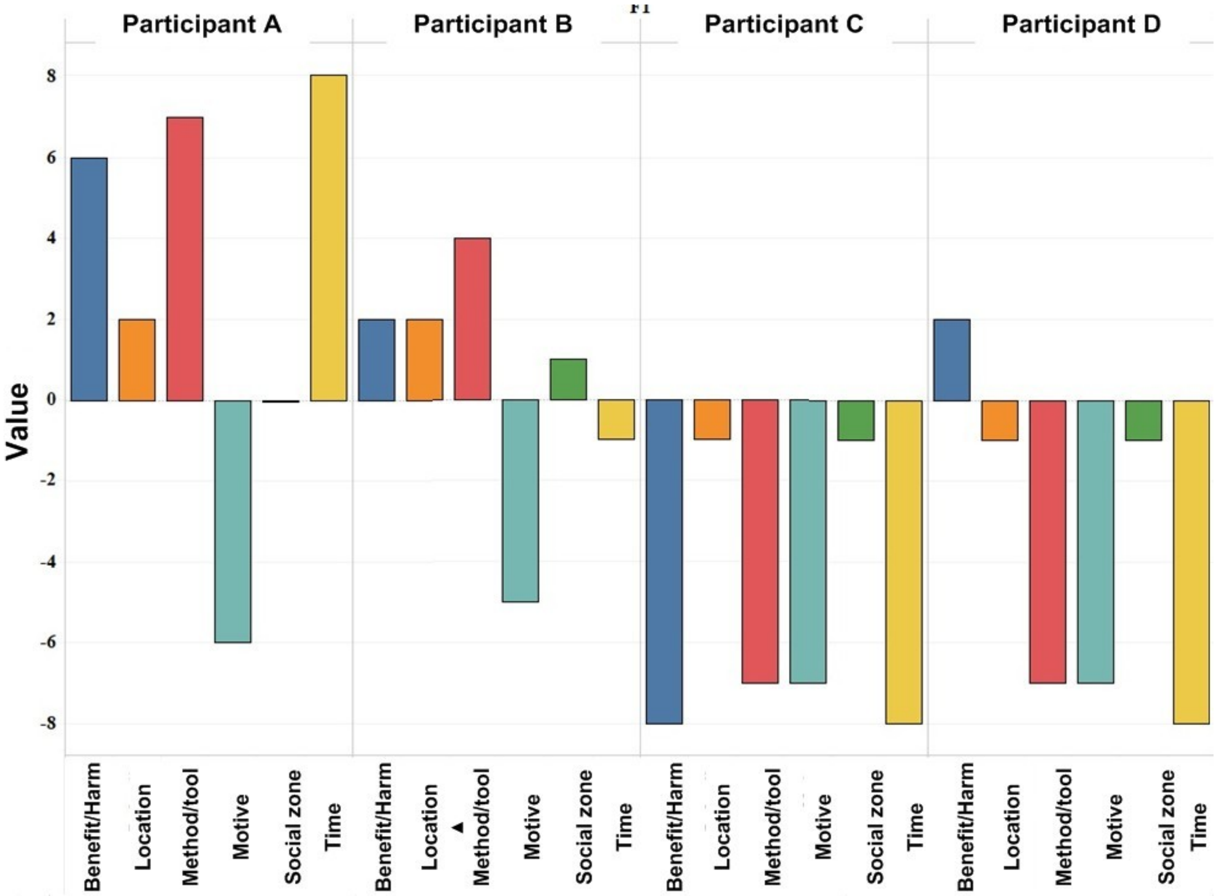
- Strong activities → value +1
- Partial or moderately strong activities → value 0
- Passivity → value -1

Dimensions such as "Location," "Social Area," "Method/Tool," and "Motive" share the common denominator of the "Participant" dimension and are connected through the temporal dimension. This dimension is also linked to the synthesis of two fact tables, named "Harm/Benefit." All other previously mentioned dimensions are connected to this fact table as well.

The sum of values, determined based on the weights across rows, is shown in the following table.

4.7.3.4 Table 140: Sum of values based on assigned weights

Participant	Time (Years)	Motive	Method/tool	Social zone	Location	Harm/Benefit
Participant A	8	-6	7	0	2	6
Participant B	-1	-5	4	1	2	2
Participant C	-8	-7	-7	-1	-1	-8
Participant D	-8	-7	-7	-1	-1	2



4.7.3.4.1 Figure 251: Bar graphs of dimensions and facts

Table 140 shows the sum of values by rows based on the matrix network (see Figure 250), while Figure 251 illustrates these values using bar graphs.

It is immediately apparent that the bar graphs for person C and person D show negative values, while the values for person A and person B are predominantly positive. This result is not surprising, as the simulated activity measurements of all involved participants were taken over a long period from 2013 to 2020, from the perspective of:

- Methods/tools used,
- Motivations,
- Location switching dynamics,
- Social zones.

At the end of the analysis, various types of active benefits in relation to the harm caused were evaluated. In terms of evaluating motivation, all participants received negative values except for two cases:

- Love motivation (person A) and
- Friendship motivation (person B),

which were the only ones to achieve positive values. All other motivations were evaluated negatively as they were not observed or identified in the participants.

In this relatively simple emotional-motivation-based plot, there is no greater complexity in the various motivations. More complicated plots would typically involve several different motivations that the perpetrators would intertwine and adjust depending on the circumstances.

Based on activity measurements, we can determine the dynamic nature of the participants. If we observe that some participants are significantly more active than others, we can conclude that they are the main perpetrators of the plot.

By further monitoring the benefits achieved compared to the harm for each participant, we can calculate the ratio of harm to benefit. If the benefit greatly outweighs the harm for certain participants, we can classify them as plot perpetrators. On the other hand, the predominant harm for certain participants indicates that they are victims of the plot.

When measuring spatial and social behavioral patterns, such as the dynamics of location changes and social zones, additional information about the physical movement of participants can be gathered. More complex spatial and social behavioral patterns could suggest the presence of a more complex plot.

In the case of this emotional-motivation-based plot, we can determine that both spatial and social behavioral patterns are relatively predictable. Certain locations, such as Location G and Location H, show negative values, meaning participants are not frequently present there. In social zones, the most prominent are:

- Residential/family zone,
- Commercial zone,
- Cultural zone.

Based on the results of the simulated plot, we can conclude that the final outcome was very favorable for participant A and extremely unfavorable for participant C.

Through the analysis of various types of invested energy – informational, spatial, temporal, social, psychological, and technological (e.g., the use of information technology and social networks) – we can relatively easily determine the perpetrators and victims of a plot.

The time span of the plot's duration can provide additional information about the intensity and determination of the perpetrators to achieve their set goals.

In short, the concept of a tailored analysis of the relationship between harm and benefit is focused on monitoring, measuring, discovering, exploring, and investigating various plots. We can assume that plots are the source of many criminal activities within societal hierarchical associative systems. Numerous forms of criminality arise precisely because of the pervasive presence of both simpler and more complex plots. We are aware that emotional-motivation-based plots are difficult to monitor, as they are opaque and almost innumerable. Additionally, they unfold at the individual level, which further reduces their detectability.

With the future development of modern technologies in measurement devices and artificial intelligence, it would also become easier to detect, research, and – in the case of criminal consequences – investigate such plots. The question arises whether there is enough societal interest in exploring plots at the microsociological level. Currently, this field is relatively under-researched, meaning there is a lack of empirical data.

Nevertheless, it is crucial to emphasize the need for active research into more complex plots that have business, political, terrorist, and hybrid motivations. There should be strong societal interest in such cases, as criminality often does not stop at minor offenses but extends from bullying, corruption, and clientelism to murder, robbery, violence, fraud, and financial, economic, business, and organized crime.

The origin of these criminal activities can be more complex plots, especially those based on business, political, and terrorist motives. It is also important to consider the hidden fact that various hierarchical associative groups (e.g., political parties, trade and sports associations, organized workgroups, criminal organizations, non-governmental organizations, and gangs) can engage in more or less complex plots, leading to numerous officially recognized and unrecognized criminal acts. Plots are hidden social processes that occur intensely and are based on mood, emotional, and mental inductions. Planners and perpetrators of plots often try to exploit social events and individuals for their own benefit, striving to gain advantages, most often expressed in the form of positional dominance and financial gains. This does not mean that other motives are insignificant, as they frequently arise as well. As an interesting note, two word analyses were conducted based on two publications. The first analysis covered an encyclopedia of plots and conspiracy theories.[96] The second e-publication was a bibliography on research related to plots and conspiracy theories.[97] With

96 Newton, M. (2006). *The encyclopedia of conspiracies and conspiracy theories*. New York, NY : Facts On File.
97 Bibliography of Conspiracy Theory Studies. (2018). Available at https://conspiracytheories.eu/_wpx/wp-content/uploads/2018/10/Bibliography-of-Conspiracy-Theory-Studies-6.pdf. (2025-02-26).

the help of a list of unnecessary words, frequency analyses of specific keywords were conducted, which were then visualized with a word cloud. Based on the structural diagram, we were able to gain a good insight into the broad content range of plots, stemming from activities typically carried out by more socially, legally, and technologically advanced societal hierarchical associative systems.

Based on both word analyses, we obtained additional feedback on the fields that deal with plots and conspiracy theories. Moreover, the analyses also revealed which organized groups, including criminal ones, carry out complex plots. Notable figures from human history were also highlighted.

The top added informational value on plots and conspiracy theories, obtained through two simple word analyses, gives us a clearer understanding of the motives that drive every plot, both simple and more complex ones.

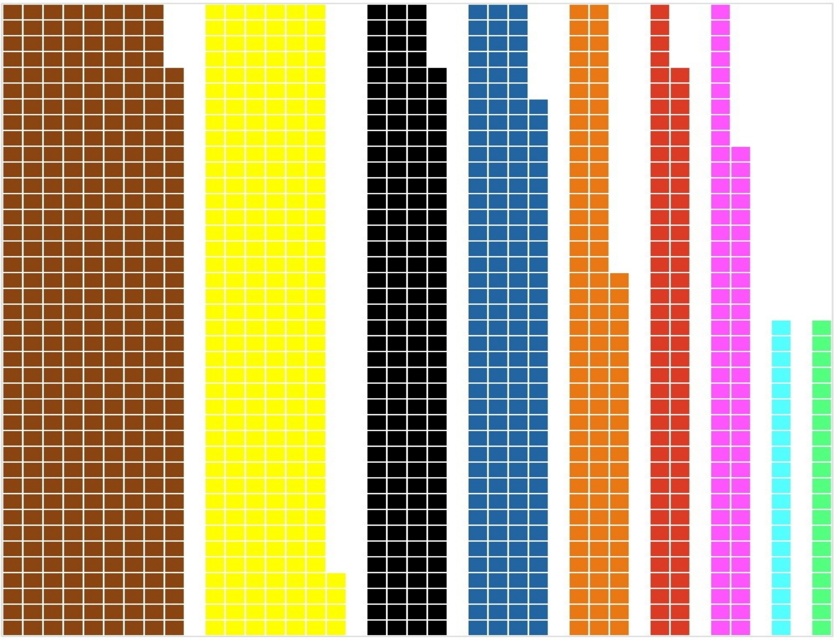
The mentioned encyclopedia also illustrated the distribution of individual categories with keywords, with the text being encoded.

4.7.3.4.2 Figure 252: Word clouds for the encyclopedia and bibliography

Figure 252 shows word clouds representing the most common keywords from two sources: the Encyclopedia of Plots and Conspiracy Theories (see the left side of Figure 252) and the Bibliography on Plots and Conspiracy Theories (see the right side of Figure 252).

Based on the results, we can infer that conspiracies commonly occur within politics, police, military, prisons, religious institutions, criminal organizations, judicial bodies, government activities, and social elites. These conspiracies are often driven by motives such as the desire for

dominance, hostile ideologies (e.g., racism, Nazism, antisemitism), secrecy (e.g., hiding knowledge, restricting access to confidential data), religious beliefs (e.g., Islam, religious sects), and ideologies (e.g., terrorism, anarchist movements, activist groups).
On the right side of the figure, we also see academic disciplines that study plots and conspiracy theories, including information science, sociology, psychology, history, cultural anthropology, the humanities, semiotics, communication studies, political science, cognitive science, legal studies, security studies, medicine, and fringe sciences.
Both word clouds reveal methods and tools commonly associated with conspiracies, such as assassinations, murders, wars, fraud, spreading rumors, instilling fear, public disinformation, enemy creation, propaganda, and fostering distrust. The word clouds make it clear that conspiracies mainly occur at national and international levels.
Interestingly, neither word cloud shows evidence of conspiracies driven by business interests. Similarly, there is no indication of efforts by police or criminological sciences to detect or suppress conspiracies. On the contrary, the police and military are often implicated in executing complex conspiracies and are sometimes even central players in drug and arms trafficking.
Finally, let us take a look at the distribution of categories within the Encyclopedia of plots and conspiracy theories.



4.7.3.4.3 Figure 253: Categorized dstribution of keywords within the Encyclopedia of plots and conspiracy theories

Figure 253 presents a categorized distribution of keywords found in the Encyclopedia of plots and conspiracy theories. The categories are shown as color-coded columns and are as follows:

a. Politics (brown): This category, which includes keywords related to politics, is the most frequently and densely represented in the encyclopedia.
b. Crime (yellow): Keywords related to crime make up the second most common and dense category.
c. Hostile ideologies (black): This category includes terms such as antisemitism, racism, and Nazism and ranks third in frequency and density.
d. Government (blue): This includes keywords related to state governance (e.g., government departments, state apparatus) and ranks fourth.
e. Criminal organizations (orange): This category includes terms connected to organized crime (e.g., the mafia) and is fifth in frequency.
f. Social events (red): Includes keywords related to events in society (e.g., wars, sports events), ranking sixth.
g. Sects (pink): This category, which includes references to sects (e.g., the Aghori cult), ranks seventh.
h. Police and military (light blue): This includes keywords associated with police and military institutions (e.g., the FBI, federal army), ranking eighth.
i. Espionage (green): This category includes terms related to spying and espionage scandals and ranks ninth.

Several content-based connections can be observed among these categories:

A thematic link between politics, social events, government, police, and the military.

Another connection appears among crime, criminal organizations, social events, sects, the military, and the police.

A stronger connection emerges between espionage, politics, and the military, as well as between social events, hostile ideologies, sects, and criminal organizations.

The encyclopedia is therefore heavily focused on politics, crime, and hostile ideologies.

Encyclopedias are typically considered reliable reference works that cover specific subject areas over long periods and act as thematic overviews. It’s reasonable to assume that other encyclopedias on conspiracies and plots might show similar results.

If this assumption holds, we could argue that more complex conspiracies often originate in the political realm, which appears to be the most powerful driver of emotional and cognitive influence on the population within hierarchical social systems.

In the political sphere, various raw interests can arise that cannot be realized without effective and powerful channels of informational communication. However, this doesn't mean that politics is the sole source of covert informational and communicative manipulation. The political world may also

collaborate with criminal organizations, police, military, cultural institutions, and other areas within society (see the structural diagram).
It would be inaccurate to conclude that politics is the primary producer of criminal acts. However, it can certainly promote and support such harmful activities. In any case, these phenomena should be closely monitored, researched, analyzed, and, wherever possible, prevented, as social hierarchical systems cannot function optimally if there are excessive losses of energy and financial resources. Such conditions can lead to economic crises, environmental issues, organizational dysfunction, unemployment, poverty, increased mental illness, and a chronically poor social climate.
Conspiracies are an intriguing and widespread social phenomenon that can be classified as a social anomaly. Investigating conspiracies—especially more complex ones—should be grounded in empirical data. This would involve developing various matrices of threats or risks aimed at organized groups, collectives, and individuals.
Studying conspiracies in real-life environments would be difficult to carry out within the scope of individual disciplines alone (e.g., sociology, psychology, cultural anthropology). Therefore, it is essential to promote interdisciplinary collaboration, including cooperation with police and criminological sciences. This approach would enable a more comprehensive exploration of the social anomaly that is conspiracy, and allow for the lawful collection of real-world empirical data.
Moreover, it is important to highlight that the police can only investigate when a crime is already evident, which is not always ideal—since preventing and predicting criminal activity becomes impossible once the crime has already occurred. Nevertheless, it is crucial to research and investigate security risks within hierarchical social systems, which should be a primary objective not only for police forces but also for other security services.
From this discussion of the social anomaly of conspiracies, we now turn to the next, already anticipated social anomaly: crime.

4.8 Crime

Crime can be defined as a social anomaly within hierarchical associative social systems, which contrasts with the interpretation offered by French sociologist Émile Durkheim. Durkheim considered crime to be an inevitable and normal social phenomenon. Debating what is right or wrong in this context would be misplaced, as hierarchology and hierarchography perceive all social phenomena as anomalies if they do not operate in a purposefully distributed system of energy and material benefit within hierarchical associative structures.
Additionally, a secondary principle draws comparisons between the behavior of animal species and humans. In humans, we observe numerous unique traits that are either absent or rare in the animal

kingdom—such as upright walking, values, various psychological disorders, conspiracies, health-damaging addictions, a wide range of sexual orientations, high suicide rates, diverse sexual practices, and additional stress induced, including through modern technology.

Hierarchology and hierarchography maintain that the majority of crime in society originates from organized groups, which may include political, professional, athletic, criminal, business, sectarian, informational, economic-propagandistic, and media organizations, among others. From this perspective, crime is seen as a pathological signal, indicating suboptimal or irrational functioning of hierarchical associative social systems.

Excessive crime is essentially a systemic flaw, whether at the level of the individual (e.g., a psychopathic killer), a group (e.g., special interest organizations), or the society/state (e.g., state-level crime). Crime can be catalyzed by mood-based, emotional, or cognitive-emotional inductions, which often emerge from more or less complex conspiracies.

Defining crime is an exceptionally challenging and interdisciplinary task. Historical definitions often capture only a fraction of the broader meaning and are typically shaped by narrowed scientific or professional viewpoints. Disciplines involved in the study of crime include criminology, criminalistics, police science, sociology, psychology, cultural anthropology, forensic science, medicine (especially psychiatry), ethnography/ethnology, law, political science, economics (e.g., financial crime), and statistics. In addition to these, many other scientific and applied fields also contribute valuable insights into the study of crime. These include:

- Natural sciences (e.g., astronomy, meteorology, physics, biology, chemistry),
- Applied sciences (e.g., computer science, information technology, communication studies),
- Social sciences (e.g., history, economics, ethnography),
- Humanities (e.g., linguistics, library science, pedagogy),
- Interdisciplinary sciences (e.g., geography, management, organizational studies),
- Marginal sciences (e.g., astrology, palmistry, dowsing).

Naturally, this is not an exhaustive list of all the disciplines that can contribute to the study of crime. The interweaving of diverse scientific approaches shapes our understanding of crime, giving it a broad, interdisciplinary scope. It is well known that criminologists and sociologists have traditionally claimed authority in defining crime. Within this discourse, we find both narrow, fundamentalist perspectives and broad, multidisciplinary and interdisciplinary approaches. This diversity is not surprising, especially given that modern analyses of crime often involve advanced information, communication, engineering, and other technologies. As an interesting note, let’s take a look at some specific approaches to defining crime.[98]

4.8.1 Table 141: Overview of continuity in the definition of crime

Approach 4						
Approach to definition						
	Legal	**Modified legal**	**Normative**		**Newer**	
Representatives	Tappan	Sutherland	Sellin	Mannheim	Taylor, Walton, Young	Schwendingers
Types of definitions	Legally determined from the perspective of violating criminal law	A socially harmful act with a provision that the state will punish it	Violations against normative behavior	Antisocial behavior	The political and economic product of deviance (behavior)	Violation of human rights
Criminological focus	On known criminals	White collar crime and the response against the white collar	Different types of norm violations and reactions to them	Different types of proven antisocial behaviors and reactions to them	Political and economic factors. State responses to deviations	Imperialism, racism, sexism and poverty

Table 141 presents the most prominent figures who have shaped the fundamental approaches to defining crime. Based on the previously discussed interdisciplinary and multidisciplinary nature of criminology, we can conclude that definitions of crime are relatively narrow in scope. They primarily focus on violations of criminal law, normative behavior, human rights, and political or economic factors that may lead to deviant behavior or criminal acts.

Upon reviewing specific definitions of crime, it becomes evident that the relatively narrow perspective of criminology in studying this phenomenon is widely accepted and established.

Examples of definitions of crime:

1. Actions and/or omissions of a certain responsible behavior that are defined as criminal offenses and are punishable by law.
2. Crime is an unlawful act that can be punished by law.
3. Crime may involve harm to public welfare, the degradation of moral standards, or encroachments on the interests of the state.
4. Crime is considered an irrational, insensitive, and disgraceful act.

98 Brown, S. E., Esbensen, F-A. & Geis, G. (2013). *Criminology : explaining crime and its context. Waltham* : Anderson Publisher. The table was created based on the cited source.

5. Crime (as a synonym for a criminal offense) is illegal conduct that harms individuals, communities, society, or the state and is punishable by law.
6. Crime refers to unlawful behavior by individuals, groups, organized entities, or states that violates criminal law.
7. Crime is a deliberate act that breaches criminal law and is committed without mitigating circumstances, and is therefore punishable by the state.[99]
8. A fundamental characteristic of crime is that it is a prohibited and harmful act against the state, to which the state can respond with punishment. It is a legal description of an act that is socially harmful and therefore requires a legally defined penalty.[100]
9. Crime is an inevitable and normal social phenomenon that can also be functional, as rule violations encourage the state to develop additional or new regulations, thereby improving the functioning of laws and preventing social anomie—when existing laws are no longer effective (adapted from Durkheim, E.).
10. Crime serves as a warning signal that certain aspects of society are not functioning properly (adapted from Cohen, A.).

The sociological perspective on crime is somewhat broader and not focused primarily on criminal law, as is typical in criminology. This is not surprising, since sociology uses a different methodological framework than criminology, which is already evident in their respective subjects of study (criminology: crime; sociology: society).

The framework of scientific paradigms used to study crime includes several approaches: rational choice theory, positivism, interactionism, critical theory, and the integrative approach:

- The rational choice paradigm is based on the belief that criminal laws are designed to prevent violations by assuming that individuals, guided by their own consciousness, freely choose how they behave—and thus whether or not to commit a crime.
- The positivist paradigm assumes that criminal behavior is determined by both rational choices and external forces, such as illness or drug intoxication. This approach seeks to explain crime through causal analysis.
- The interactionist paradigm focuses on the actions of individuals and groups, and their interactions, in order to uncover deviant and criminal behaviors that are then managed and neutralized through social control mechanisms (e.g., the police).

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99 Tappan, P. W. (1947). Who is the Criminal? *American Sociological Review*, 12(1), 96–102. https://doi.org/10.2307/2086496.

100 Sorensen, R. C. (1950). [Review of White Collar Crime, by E. H. Sutherland]. *Journal of Criminal Law and Criminology (1931-1951)*, 41(1), 80–82. https://doi.org/10.2307/1138403.

- The critical paradigm, or critical criminology, is distinctly radical and influenced by Marxist theory. It questions the criminal justice system, particularly how it harshly punishes minor crimes while being more lenient toward members of the elite who commit white-collar crimes.
- The integrative paradigm does not rely on a single theoretical perspective, but instead combines several different approaches to studying crime in a balanced manner. Proponents of this approach argue that existing theories need to be updated and that the integrative paradigm opens the door to future scientific perspectives on crime.[101] In this context, we note the absence of several important scientific paradigms in the study of crime, such as conventionalism, pragmatism, empiricism, and structuralism. It seems that the scientific framework surrounding crime remains relatively narrow in scope.

It is evident that, due to this limited theoretical framework, criminology struggles to fully and comprehensively identify the causes of different types of crime and often must collaborate with experts from other scientific fields. As a result, crime is frequently interpreted not only by sociologists but also by computer scientists, whose methodological approach is broader. Computer science, in particular, uses a wide theoretical base along with various methodological tools, such as data analysis, data visualization, and predictive algorithms, to forecast criminal activity. By contrast, criminologists are less likely to engage with the field of computer science.

In short, criminology alone cannot provide a comprehensive explanation for crime; it often requires collaboration with experts from various disciplines such as psychology, sociology, geography, computer science, psychiatry, cultural anthropology, forensic science, chemistry, physics, and others. Ultimately, there is nothing inherently wrong with a narrower theoretical framework—it may actually present a challenge and opportunity for the science of hierarchology and hierarchography. As stated in the theoretical introduction, this discipline's theoretical and methodological framework is extremely broad and is more strictly tied to its research subject: hierarchical associative systems in the broadest sense.

There are various explanations for the causes of crime—biological, psychological, and sociological in nature—but regardless of their orientation, it can be asserted that none of these theories alone adequately meets the need for a more comprehensive view of crime.[102] We are presented with biological explanations for the causes of crime, which were particularly influential in the 19th and the first half of the 20th century. These explanations were strongly shaped by Darwin's theory of evolution and the economic theory of Thomas Malthus. Malthus observed that, due to the rapid

101 Povzeto iz dela: Brown, S. E., Esbensen, F-A. & Geis, G. (2013). *Criminology : explaining crime and its context*. Waltham : Anderson Publisher.

102 The description of different explanations of crime is based on the following work: Marsh, I. (2007). *Theories of crime*. Routledge.

expansion of industrialization, urban communities were growing quickly, leading to exponential population growth. Alongside economic gain, this also brought numerous poor individuals and various diseases. Biologically-oriented theorists used these factors as key elements in explaining criminal behavior.

In the earliest phase of biological theories, scientists sought the so-called “criminal gene” thought to be responsible for criminal behavior in individuals. Italian professor Cesare Lombroso studied the physiological features of offenders and compared them with those of people who had no criminal record. It was eventually concluded that criminal personality cannot be determined solely based on physiological characteristics.

Biological explanations have, at times, been misused for propaganda and stigmatization. Some state authorities used them to reinforce beliefs in supposed biological differences between races, ethnicities, and religious groups, leading to racism, Nazism, and anti-Semitism. Although such views have been scientifically disproven, they still persist in certain circles. It is now well established that all humans share 99% of their genetic makeup, meaning that scientifically, we cannot truly speak of separate human races.

Some proponents of biological explanations explored factors influencing criminal behavior such as the drive to reproduce, competitiveness, physiological traits (e.g., whether more physically built individuals are more prone to violence than weaker ones), the need for dominance and control, and the effects of hormones and neurotransmitters. Later, biological theories began to merge with environmental ones, suggesting that while genes provide behavioral predispositions, the environment influences their development and expression.

With advancements in neuroscience and molecular genetics, research has increasingly focused on the role of neurons in the brain and their significant influence on both normal and criminal behavior. It was found that interactions between brain neurons are highly dependent on hormones and neurotransmitters. Researchers also examined various types of brain damage (e.g., to the temporal or frontal cortex) and neurological diseases (e.g., tumors, Alzheimer’s, psychoses), which can negatively affect personality and potentially lead to criminal behavior. A significant amount of research has also gone into studying the effects of harmful substances like drugs and psychoactive substances on human behavior, as these can play a major role in the formation of a criminal personality.

In summary, while biological theories of crime offer many useful insights, the biological model alone is insufficient for fully and accurately explaining the causes of criminal behavior.

In the history of crime research, scientists from the fields of psychology and behavioral sciences have also actively contributed. As these disciplines developed, numerous theories and models emerged that attempted to explain crime through psychological approaches.[103] An interesting aspect of these efforts is that they often focused solely on explaining specific forms of crime (e.g., rape, financial fraud, murder). It was assumed that intelligence might play an important role in the development of criminal behavior. Some believed that, in particular, the inability to learn rules could later lead individuals to commit criminal acts. As examples, they pointed to financial fraudsters and serial killers.

Later, it became clear that intelligence can influence the development of criminal personalities, but in many cases, low or high intelligence alone is not sufficient to explain criminal behavior. Much attention was also given to low levels of self-control in certain individuals, which was believed to make them more prone to criminal acts. However, research did not confirm that all criminal personalities have low self-control. In fact, it was found that especially organized criminal personalities often possess a high degree of self-control and do not act impulsively. Moreover, organized offenders can demonstrate an exceptionally high level of focus, unaffected by disturbances such as hyperactivity.

Cognitive-behavioral theories (e.g., Hans Eysenck) attempted to explain the causes of crime and the formation of criminal personalities through two behavioral dimensions: introversion and extraversion. As with intelligence, these personality traits alone cannot reliably explain criminal behavior. Many individuals can be introverted for most of their lives, but under certain stimuli, their behavior can shift to the extent that extroverted traits dominate. There is, however, a strong likelihood that extroverted offenders can be classified as organized criminal personalities.

Within the field of criminal psychology, a specialized approach known as personality profiling has emerged, focusing on distinguishing between organized and disorganized criminal personalities. It has been found that such offenders often follow a certain spatial logic. This means they display a characteristic geographic behavioral pattern, which can be pathological to the extent that they are unable to fully control it.[104] Criminal investigation practice has shown that the approach of personality profiling can be very effective, but also risky, as this method has often proven to be inaccurate. For this reason, scientists and experts in the fields of criminology and criminalistics recommend caution when using offender profiling methods. This will be discussed in more detail later. Psychodynamic theories also contributed to the explanation of criminality and criminal personalities, focusing on the constant dynamic between consciousness and the subconscious. These theories particularly emphasized the importance of a positive relationship between mother and child, which was seen as a crucial foundation for healthy personality development. Criminal

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103 Similar to biological explanations, this description draws on the previously cited work.
104 Canter, D. (2005). *Mapping Murder: Walking in Killers' Footsteps*. Virgin Books.

investigation practice has often shown that this factor can be important, but it does not guarantee accurate insight, as many criminal individuals had positive maternal relationships yet still became involved in criminal environments.

Theories of conditioned reflex were also used to explain criminal potential, suggesting that certain environmental stimuli can strongly influence the decision to commit a crime. According to this theory, an individual learns criminal behavior patterns through negative reinforcement. Analysts also highlighted the role of the perceived balance between reward and punishment—if the fear of punishment outweighs the desire for reward, the likelihood of committing a crime decreases. This represents a form of experiential learning in which individuals assess the potential gain versus the risk of punishment.

With the rise of mass media, various media violence theories emerged. These are based on the assumption that violent and criminal behavior can result from the influence of media messages on individuals. Special emphasis was placed on the impact of violent and criminal content in action and crime films, combat-themed video games, economic propaganda, and even cartoons. Such content can affect children's perception of reality and potentially lead to delinquent or criminal behavior. While many studies confirmed a degree of validity in this assumption, the results were not conclusive. Therefore, media theories alone cannot fully explain the emergence of criminal behavior or criminal personalities.

Cognitive theories focused on traits such as empathy, decision-making power, the ability to understand the consequences of decisions, a desire for power and dominance, worldview, poverty, social cognition, upbringing, moral development, and values. In terms of upbringing and moral learning, a key aspect is the long-term process of personality development, moving from pre-conventional morality (early childhood), through conventional morality, to post-conventional morality (the stage of learning and understanding positive values). The fear of becoming a victim of crime was also frequently mentioned, as in certain cases, this fear itself could lead to criminal behavior.

Routine activity theory assumes that three elements must coincide for a crime to occur: a motivated offender, a suitable target, and the absence of effective protective measures. Over time, many additional variables were highlighted, including different temporal perspectives (e.g., long-term, retrospective, and prospective), family characteristics, upbringing styles, adverse social circles, unemployment, child abuse, and the influence of the school environment. Similar to biological theories of criminality, this theoretical framework also offers many valuable insights, but individual factors alone cannot provide a complete explanation of the causes of criminal behavior.

Sociologists have extensively studied the causes of crime and criminal personalities, contributing important sociological explanations. One foundational concept comes from classical criminology, whose main representatives were Beccaria and Bentham. They advocated for a system of criminal law that, in addition to defining rules, also categorizes types of crimes and assigns punishments. Penalties for different offenses should be determined according to a value-based scale with appropriate weights—meaning that the more severe the offense, the heavier the punishment. Sociologist Émile Durkheim, previously mentioned, argued that the occurrence of crime is closely tied to collective consciousness and societal values. He believed that crime is a cultural reaction to a weakened collective conscience, resulting from a decline in respect for positive values. He also emphasized that crime can serve a positive function by highlighting violations of human rights, restrictions on freedom of speech and thought, and outdated laws.

A similar view was supported by the Chicago School, whose members saw crime as a logical response to environmental conditions, particularly emphasizing social disorganization. Ernest Burgess developed the concept of social zones within urban areas and pointed out that impoverished neighborhoods create favorable conditions for excessive levels of crime. Sociologist Robert Merton focused on the concept of value anomie, which creates a favorable situational environment for criminal activities.

Subcultural theory advocate Albert Cohen believed that delinquent behavior emerges within groups that form their own deviant norms. These groups often arise due to stark social inequality. Sociologist Travis Hirschi, one of the main proponents of control theory, argued that crime results from weak social control, which leads to nonconforming behavior, poor self-control, and negative socialization processes starting in early childhood. As a result, social bonds—even those with close family members—can be severely weakened, creating an environment conducive to various forms of criminal behavior.

This theory is partly supported by Edwin Sutherland, who claimed that criminal behavior patterns are acquired through a prolonged learning process. Every criminal individual must first learn how to behave criminally before committing an offense, a notion especially relevant to perpetrators of economic and financial crimes.

The interactionist theory of crime focuses on the processes of social labeling and stigmatization. For example, criminal law can stigmatize certain ethnic groups, police officers may be influenced by stereotypes when dealing with offenders, and social workers may fail to support their clients due to personal prejudices.

Conflict and Marxist theories emphasize that crime is a result of unjust and exploitative capitalist systems, which intensify social processes of alienation, inequality, and poverty. These deepening issues lead to a crisis in the capitalist social order. Increasing industrialization and technological development have contributed to the rise of corporate and economic crime, which has an extremely negative impact on individuals, businesses, and society as a whole—often resulting in astronomical costs. According to Marxist theorists, criminal law in capitalist societies tends to protect the interests of the upper social classes while treating other groups more harshly.

Some sociologists and feminist theorists have also examined the issue of women and crime. They have found that the percentage of female offenders is increasing. Possible reasons for this trend include changes in the socialization process of women, greater equality, enhanced decision-making power, and a stronger drive for dominance. They also studied the social characteristics of female offenders and identified various risk factors—such as poverty, minority status, unemployment, adverse social conditions, and lack of education—that can contribute to criminal behavior. Nevertheless, crime rates among women remain significantly lower than those among men, which serves as an important basis for further research.

Based on sociological theories of crime, we can once again highlight their partial success. Even sociological explanations alone are not entirely sufficient for determining the causes behind crime or the development of criminal personalities.

Both historically and today, the demonological theory of crime remains present. This theory is based on religious and supernatural beliefs—such as possession by demons or Satan. However, these are belief systems without any scientific foundation.

We now arrive at the central question: which explanations come closest to identifying the actual causes of crime and criminal personalities? This book has already discussed an attempt to model various psychological personality theories that offer an optimal description of individuals. But when it comes to crime and criminal personalities, the explanation becomes significantly more complex, as it must take into account at least psychological, biological, and sociological factors.

The causes of crime and the development of criminal personalities are partly rooted in psychological factors. While people have the power to make decisions about their actions and thoughts, there are also influences over which individuals have little or no control. Nevertheless, these factors can significantly shape a person's personality and even affect broader society—examples include genetic makeup, international agreements, climate, viruses, bacteria, and the movement of celestial bodies. Both the internal and external environment contain numerous factors beyond the control of the individual, and even of the human species as a whole.

We can once again focus on the three levels of our reality: the microcosm, the mesocosm, and the macrocosm. Within the interconnectedness of these three levels, we can identify stronger and weaker relationships that shape certain dynamics and reveal the most likely causes of both criminal behavior and the formation of criminal personalities.

At the microcosmic level, one example involves certain bacteria that form large microbiological networks and influence specific human behaviors—such as eating habits, smoking, and more. Under unfavorable social conditions, the bacterium latent Toxoplasmosis has been linked to the emergence of violent behavioral patterns in humans.[105] It is evident that a certain type of bacteria could potentially influence the development of a criminal personality and thereby contribute to criminal behavior. However, there is currently insufficient research and evidence in this area to confidently claim that bacteria have a direct impact on delinquent and criminal behavior patterns in humans.[106] Microorganisms (such as bacteria and viruses), which inhabit our bodies from birth until death, are nearly impossible to count; their total number can only be roughly estimated. They occupy the entire human body and even influence human reproduction. Certain viral and bacterial infections can damage the central nervous system to such an extent that they may trigger antisocial and criminal behavior patterns—for example, the bacterium Bartonella henselae. There is a strong likelihood that microorganisms, particularly bacteria and viruses, can play a role in the development of criminal personalities and criminal behavior.

This example essentially illustrates the dynamic interconnection between two cosmic levels: the microcosm and the mesocosm. In the realm of the microcosm, we should consider not only the influence of genes but also the role of microorganisms. This would encourage closer collaboration between various fields—such as genetics, virology, bacteriology, forensic medicine, criminology, sociology, and psychology—in order to better understand the causes behind the emergence of criminal personalities and different forms of criminal behavior.

The fact that the human body contains around 100 trillion microorganisms—a number at least ten times greater than that of human cells—is striking. The genetic material of these microorganisms (including viruses and bacteria) in the human body is known as the microbiome. The number of microbial genes is estimated to be about 200 times greater than the number of human genes. Bacteria in the microbiome are responsible for extracting nutrients, regulating our immune system, protecting us from harmful disease-causing bacteria, and producing essential vitamins such as B, B12, and K (the latter aids in faster blood clotting in case of injury). Large bacterial networks can even influence the functioning of human genes by activating or deactivating them.[107] Genes have the ability to regulate the activity of various bacterial networks. In this intricate interplay between

105 Shotar, A., Alzyoud, S. A., & AlKhatib, A. J. (2015). Social Impacts of Infectious Diseases: Latent Toxoplasmosis and Crime. *The Social Sci*, 10, 1677-1681.

106 Johnson, Katerina V.-A., Foster, K. R. (2018). Why does the microbiome affect behaviour? : opinon. Nature reviews. *Microbiology*, (16/10), 647-655.

Availabe on (URL): https://www.nature.com/articles/s41579-018-0014-3 (2020-06-08).

genes and bacteria within the microcosm, it becomes apparent that human genes, as the building blocks of life, are not as stable and unchangeable as one might expect. Therefore, it makes sense to encourage research into the possible influence of microorganisms on the development of both criminal personalities and criminal behavior.

Thanks to bacteria, oxygen was created in our atmosphere, which enabled the existence of many other, both simple and complex, organisms, including humans. Microorganisms have a remarkable impact not only on human health, but also indirectly on the functioning of social and natural processes within hierarchical associative systems. Certain types of bacteria, especially when organized in extensive networks (for example, Toxoplasma and Bartonella), could therefore influence individuals to develop delinquent and criminal personalities, and thus contribute to the occurrence of criminality.[108]

If the aforementioned hypothesis were to become fully proven, it would significantly alter our understanding not only of criminality but also of human personality. The latter would no longer be viewed as primarily dependent on genes, brain neurons, physiological structure, and environmental factors (mesocosmic and macrocosmic influences). In short, certain extensive bacterial networks would emerge as influential agents that must be seriously considered in researching the root causes of criminal behavior.

Science and scientists in any field contribute fragments of truth to a grand puzzle, though the final outcome remains unknown. Under an optimistic scenario for humanity’s development, scientific theories and models will continue to evolve in the future—building on existing frameworks while uncovering flaws in past approaches and proposing upgraded or value-added alternatives. It appears this grand puzzle of scientific theories and models will only be completed when the existence of the human species comes to an end.

To comprehensively understand the causes of various types of criminality, we must consider three interconnected realities: the microcosmic, mesocosmic, and macrocosmic levels. These frameworks allow us to categorize biological, sociological, psychological, environmental, and other explanations, each with distinct emphases and connections. Investigators of criminal acts are more familiar with mesocosmic-level factors (e.g., social interactions, immediate environments) because they align closely with human sensory perception and traditional investigative methods. By contrast, microcosmic (e.g., genetic, cellular) and macrocosmic factors (e.g., cosmic influences,

107 Babraham Institute (2018). "How good bacteria control your genes: Chemical signals from gut bacteria influence gene regulation in the gut lining." *ScienceDaily,* 9 January. Dostopno na URL: https://www.sciencedaily.com/releases/2018/01/180109102758.htm (2020-06-07).

108 Pillai, S. D. (2015). Can microbes control criminal behavior? *Linkedin*. Dostopno na URL: https://www.linkedin.com/pulse/can-microbes-control-criminal-behavior-suresh-pillai (2020-06-10).

large-scale electromagnetic fields) require highly precise instruments to detect, as they lie far beyond natural human sensory capabilities.

Key challenges in criminological analysis

1. Hierarchical prioritization:

Mesocosmic factors dominate current explanations of criminal behavior because crimes manifest through actors and actions within this intermediate scale (e.g., social networks, situational dynamics). However, this focus risks overlooking critical micro- and macro-level influences. For example:

- Microcosmic: Genes interacting with bacteria or viruses could be key to understanding criminal predispositions, but current tools cannot conclusively prove such hypotheses.
- Macrocosmic: Electromagnetic, gravitational, and nuclear energy fields—or celestial movements—might influence human behavior in ways science cannot yet measure. Weapons using electromagnetic radiation, for instance, could disrupt brain function (e.g., memory erasure), but comparative data on perpetrators' brain activity in such cases are lacking.

2. Measurement limitations:

While phenomena like the full moon's effect on human behavior are widely acknowledged, there is no definitive evidence linking it to murders or accidents. This underscores the scientific community's inability to quantify subtle macrocosmic influences, reinforcing the reliance on mesocosmic explanations.

3. Distorted perspectives:

A mesocosmic-centric view may skew interpretations by neglecting stronger micro/macro factors. For instance, prolonged exposure to intense electromagnetic fields could theoretically drive violent acts (e.g., a perpetrator in a dissociative state killing multiple victims), but without advanced measurement tools, such hypotheses remain speculative.

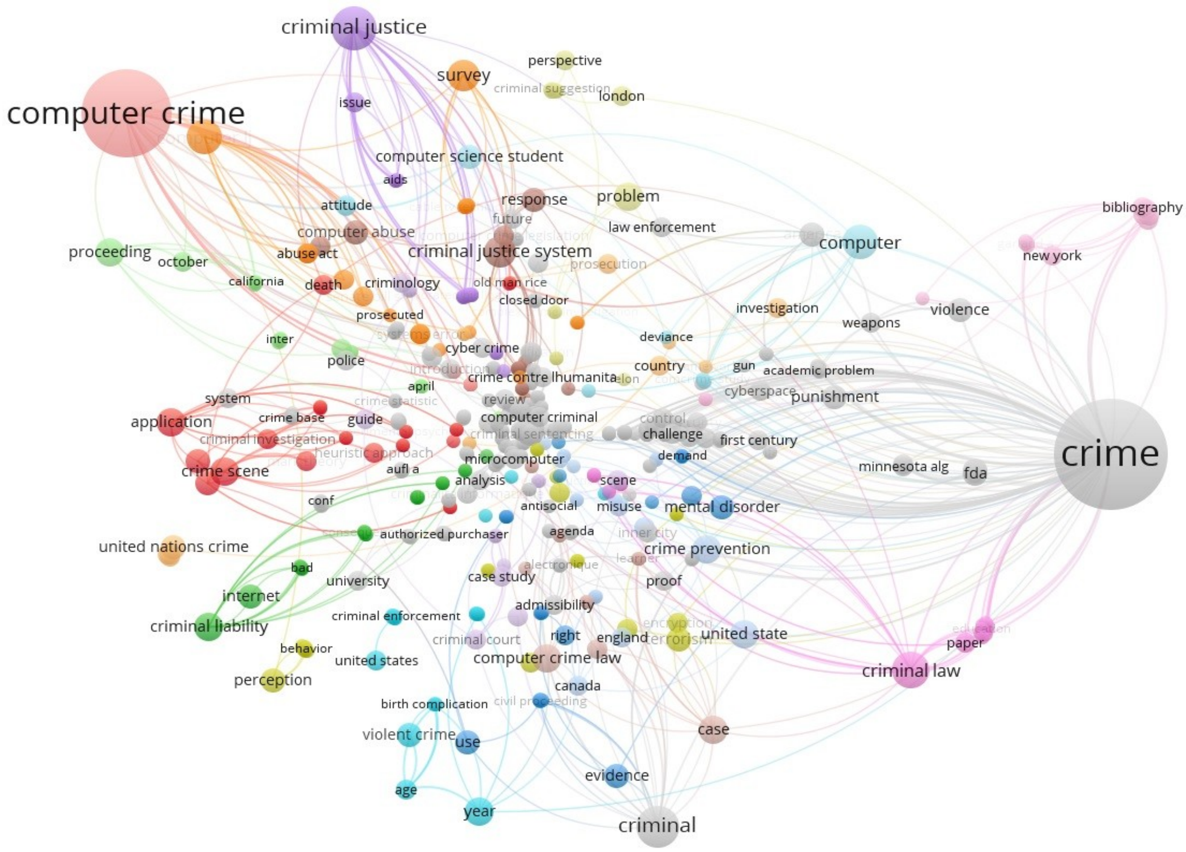
Implications for criminology and science

The limitations of current technology highlight the need for interdisciplinary research integrating all three levels. While mesocosmic analysis remains pragmatic for investigations, a holistic approach—combining micro- and macrocosmic insights—could unveil deeper causal mechanisms behind criminal personalities and acts. This raises fundamental questions about science's capacity to explore crime comprehensively and the ethical implications of emerging technologies capable of manipulating human biology and behavior.

We need an overview of various scientific disciplines that, alongside criminology, medicine, psychology, and sociology, study criminality. A review of global scientific databases quickly reveals that many scientific fields examine criminality, even though it is not their primary research focus.

As a result, different methodological approaches are used in studying criminality, each pursuing distinct goals but nonetheless contributing valuable insights. In reality, a comprehensive interdisciplinary review of the sciences that have dealt with criminality does not yet exist.
The same applies to other scientific fields. For example, a geneticist typically has relatively little knowledge of advances in bacteriology and virology. If a more effective synthesis of knowledge from genetics, bacteriology, and virology were achieved, it could trigger a new scientific revolution. Today, scientists are also attempting to study criminality using analogies, such as comparisons between mesocosmic and microcosmic levels—for instance, drawing parallels between the social environment and the human immune system.
As an interesting note, consider an assessment of scientific and professional publications on criminality in connection with computer science and information technology between 1970 and 2019. Using the software "Publish or Perish," the following query was performed:
TI = "crime" OR "criminal" | AND KW = "informatics" OR "information technology" OR "computer science" | PY1 = 1970 to PY2 = 2019.
Based on this analysis, we can expect insights into the scientific research efforts of computer science and informatics in the field of criminality studies. Additionally, it provides a glimpse into knowledge and interests that criminologists tend to overlook, enabling the discovery of new research directions.
The main problem in criminology is that criminologists find it difficult to keep up with innovations in scientific and professional publications related to computer science and informatics in connection with criminality. This shortcoming could be addressed by establishing a high-quality specialized information center or specialized library, where librarians and information specialists actively collaborate on such research.
Many libraries and information centers, similarly to the fields of computer science and informatics, are still limited to providing basic services (such as lending, cataloging, information retrieval, and researchers' bibliographies) and lack a scientific research focus. However, special libraries and information centers could actively participate in scientific research activities, both within ministries and faculties, as well as other scientific institutions. There is no doubt that such libraries and information centers exist, but unfortunately, they are rare. The main problem in integrating library and information science into crime research, especially within public administration, lies in rigid bureaucratic rules and procedures that prioritize officialdom over research work. In public administration, scientific research work often carries less weight, as libraries and information centers are mostly just support services for officials who primarily deal with legislation. In Slovenia, the police operate as a body within the Ministry of the Interior, which falls under public

administration. Such an organizational structure inherently limits the development and progress of police science. However, police science could play an important role in crime research and contribute to the more successful prevention of negative social phenomena.



4.8.2 Figure 254: Conceptual network of scientific and professional publications in the field of computer science and informatics related to crime from 1970 to 1999

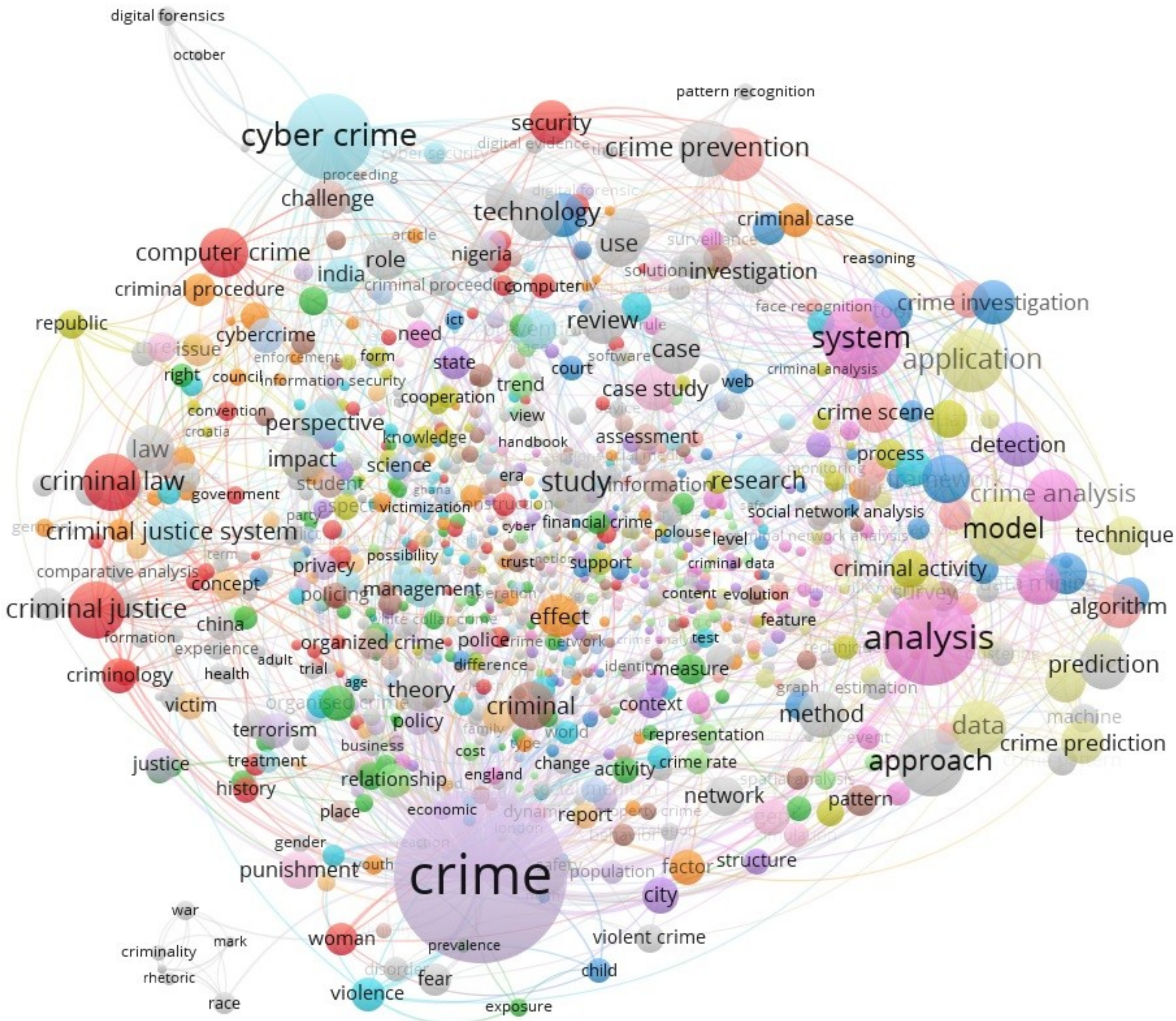
Figure 254 shows the conceptual network obtained based on the titles of scientific and professional works in the field of computer science and informatics related to crime in the period from 1970 to 1999.

In the early 1970s, some works already reported on electronic crime, which actually began to occur only when the American military enabled the wider use of the internet. Writing about computer crime began in the early 1980s, while by the mid-1980s, considerations were already being made regarding criminal justice information systems.

The scientific and professional community in the field of geography and informatics began to more intensively research the use of geographic information systems in crime monitoring in the early 1990s, particularly in the analysis of behavioral patterns in relation to space, although this term had already been coined in 1968.

The concept of computer networks was already known in the 1950s. Computer networks were initially used by the American military in radar systems. In the 1990s, internet speed significantly increased, which led to the boom of computer networks that were no longer used only by state institutions but also by criminal organizations (e.g., pedophile rings).

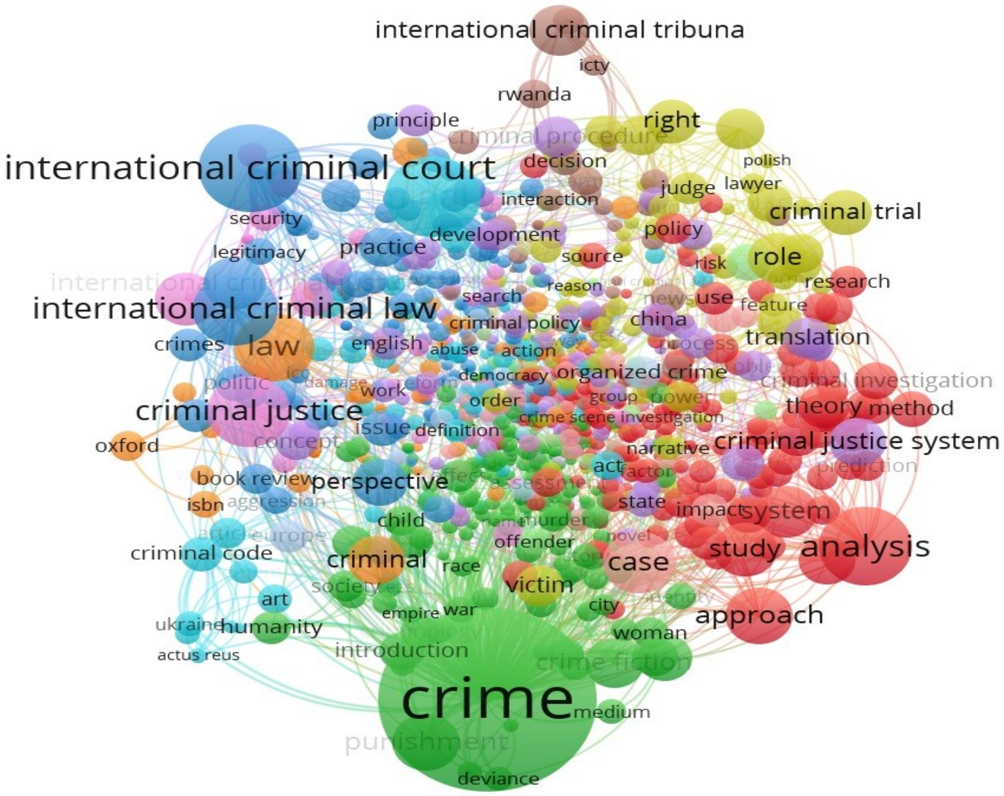
The period from 1970 to 1999 could thus be described as a period of awareness that electronic or computer crime exists and is possible, and at the same time as a period of development of the practical aspects of information technology. With the help of the latter, it became possible to analyze criminal behavioral patterns, connect computers in networks, and develop data management systems. In short, this summarizes the beginnings of a more active involvement of scientists in the field of computer science and informatics in crime research.



4.8.3 Figure 255: Conceptual network of scientific and professional publications in the field of computer science and informatics related to crime from 2000 to 2019

Figure 255 shows the conceptual network obtained based on the titles of scientific and professional publications in the field of computer science and informatics related to crime in the period from 2000 to 2019. Only phrases that appeared at least three times in the titles of the works were

considered. At first glance, it is noticeable that within a relatively short period, numerous changes occurred, and even a surge in the more active involvement of scientists and experts in the field of computer science and informatics in crime research took place. These research efforts are no longer limited solely to awareness of the existence of computer crime, the possibility of analyzing crime using geographic information systems, and the development of information systems for the field of crime. In this new era, discovering patterns in data is becoming an extremely important tool for crime analysis, especially in processing large amounts of data and predicting future trends.
The development of software algorithms for crime simulation also experienced a real boom, and researchers are increasingly encountering the field of artificial intelligence. Computer science and informatics are now extremely active in the field of digital and cyber forensics. In short, without computer scientists and informaticians, it is already difficult to imagine many criminological studies, which are largely supported by modern information technology.
Precisely for this reason, it would make sense for criminology to gain a precise overview of publications on crime that have been largely created by experts in the field of computer science and informatics. Such an overview can be achieved through annotated bibliographies, which, in addition to brief notes, also contain more extensive content summaries or at least abstracts, or through customized thesauri. The creation of such resources is predominantly within the domain of librarians or information scientists.
A similar assessment can be made for the field of linguistics in relation to crime with the following query:
TI = “crime” OR “criminal” | KW = “linguistics” OR “text mining” OR “forensic linguistics” OR “philology” | PY1 = 2010 to PY2 = 2019



4.8.4 Figure 256: Conceptual network of scientific and professional publications in the field of linguistics related to crime from 2010 to 2019

Figure 256 shows the conceptual network obtained based on the titles of scientific and professional publications in the field of linguistics related to crime in the period from 2010 to 2019. Only phrases that appeared at least twice in the titles of the works were considered.

In connection with crime, linguists often deal with law, criminal law, courts, legislation, and translation (e.g., in criminal proceedings). Various methods are used in this field to discover patterns in texts, with a particular emphasis on the analysis of hate speech patterns. Politics, where the focus is on the security of messages and criminal law, also represents an interesting area of research for linguists.

The important role of linguists in relation to crime can be observed in the field of forensic sciences, where a relatively new discipline – forensic linguistics – has developed. This includes the development and application of methods that are essential in some cases for criminal investigations. The contributions of linguists to crime research are relatively numerous, which may not be expected at first glance.

Similar to the field of computer science and informatics, in this case too, we lack a comprehensive systematic overview of the scientific production of linguists in connection with crime. Knowledge is often formed in narrow research circles, which are known to individual experts in the field of linguistics but do not reach criminologists who could develop additional useful insights based on this knowledge.

Similar analyses could also be carried out for numerous other scientific disciplines that have dealt with crime, such as ethnography, ethnology, anthropology, art history, library science, physics, and astronomy. In this way, we would gain different perspectives on crime and new insights and findings that could contribute to a better understanding of its causes, which would be particularly beneficial for criminology.

What processes take place at the macrocosmic level that ultimately always lead to certain ordered patterns or chaos? Can such formations create such strong energy fields that they could be responsible for the emergence of crime and criminal personalities or at least indirectly contribute to their formation?

Astrology, as a fringe science, probably already dealt with similar questions in the distant past (e.g., determining the influence of celestial bodies on fertility or determining an auspicious date for military conflicts).[109]

In this context, it's worth mentioning another thought model that advocates the view that everything originates from the functioning of a higher or macro level (e.g., sunlight falls like a waterfall from a higher to a lower level). This philosophical way of thinking is also important in crime research – does crime occur as a consequence of the microcosm, which then influences the meso- and macrocosm, or is the cause in the functioning of the macrocosm, which influences the meso- and microcosm?

Science strives to find arguments and evidence with which to develop models and theories, or it shapes these models intuitively and later confirms them with empirical research. It is difficult to say with certainty which of the three levels (micro-, meso-, or macrocosm) plays a key role in the occurrence of crime. However, criminology, sociology, law, economics, political science, and psychology have largely focused on the mesocosm, as it is closest and most understandable to people. In both negative stress and crime, we face the "flight or fight" syndrome, which is closely related to fundamental concepts such as "punishment or reward," "discomfort or pleasure," and "to be or not to be." Before moving on to the presentation of different types of crime, we will first focus on profiling perpetrators of criminal acts.

109 Thakur, C. P., & Sharma, D. (1984). Full moon and crime. *Br Med J (Clin Res Ed)*, 289(6460), 1789-1791. An interesting scientific article that allows for the possibility that the occurrence of a full moon may influence the increased incidence of crime.

4.8.5 Profiling of criminal offenders (perpetrators)

The well-known debate tackled by many world-renowned philosophers (e.g., Jean-Jacques Rousseau: "Man is naturally good; it is society that corrupts him") about whether humans are inherently good or bad might be somewhat redundant, as the truth likely lies somewhere in between. Humans possess certain potentials that, depending on social and/or natural circumstances, can steer them toward either righteous or wrongful paths. One form of these wrongful paths is undoubtedly criminal behavior, which individuals or groups may use to assert their existence. However, this doesn't necessarily mean they are inherently evil. As long as there's a small white dot within a black circle, we cannot claim the circle is entirely black – it still contains a bit of white (Ludwig Wittgenstein, Philosophical Investigations → The right statement).

The dialectic of pleasure and displeasure, according to many philosophers (e.g., Eduard von Hartmann, Ludwig Klages, among others), plays a crucial role, as it leads humans to evaluate other opposing pairs such as order and disorder (chaos), predictability and unpredictability, warmth and coldness, sweetness and bitterness, love and hate, light and darkness, the concrete and the abstract, freedom and oppression, openness and closedness, equality and difference, large and small, black and white, and ultimately, lawful and unlawful.

The core phenomena of human existence, as discussed by Eugen Fink, are shaped by the driving force of life, which generates ideas and actions and forms them into central "protagonists." The realization of these "main characters" is based on various value judgments, which are influenced by both individual and collective experiences. Every person is the author of their own actions, but the guiding thought—shaped as a central protagonist—leads them down a path that may be socially acceptable or unacceptable. When an individual or group enacts an idea through criminal acts, this form of existence becomes harmful to society, but it simultaneously serves as a warning signal that certain segments of society may be wounded or sick.

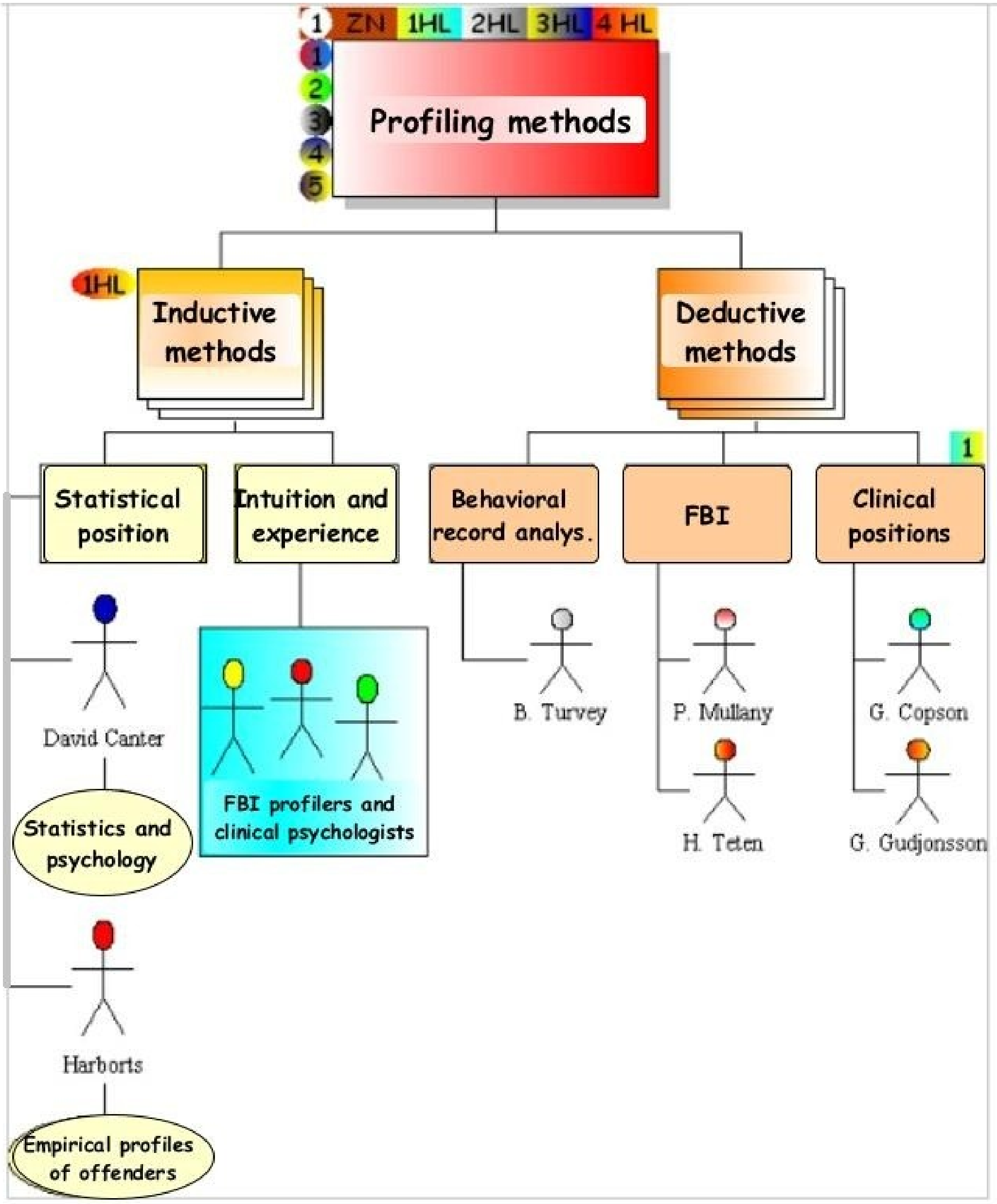
These societal anomalies are addressed or treated by various "social surgeons," such as social work centers, religious organizations, law enforcement agencies, the police, and specialized criminal analysts and profilers. Crime is a logical outcome of various actors within a hierarchically organized social system, where some are more passive and others more active in engaging in criminal behavior. It can represent either a defensive or offensive reaction by a specific segment of the social system. As a result, such reactions can escalate into conflicts, occurring on local or even international levels.

The most extreme form of crime, committed by aggressive hierarchical social systems, is undoubtedly war. Crime is always an external expression of a given society and leaves traces in the form of various patterns. These patterns, which suggest a pathological order, often go unnoticed due to the lack of developed methods and techniques for their detection – which may directly or indirectly lead to criminal activity (e.g., economic crime).

When profiling criminal offenders, it is also useful to analyze crime as an external expression: What is its purpose? What message does it convey? Does it reflect the current state of society and its future?

It is undeniable that human civilizations strive for survival, especially through the paradigm of the rule of law, which defines the organizational rules of society. Nevertheless, crime continues to emerge – sometimes merely as a signal, other times as a concrete indication of an alternative vision of survival within human communities.

In the last decade, criminal profiling has become increasingly recognized, partly due to the influence of mass media, and is frequently used within certain criminal investigation units (e.g., the FBI) as a method of investigation and/or analysis. The methodological approaches to profiling are diverse in terms of both their effectiveness and the quality of criminal investigations. At a basic level, profiling methods are divided into the following categories:



4.8.5.1 Figure 257: Methodological approaches to offender profiling

Figure 257 presents the methods and methodological directions used in profiling criminal offenders. These methods are divided into inductive and deductive approaches. It's important to note that inductive profiling methods—used for analyzing crime and offenders—are of older origin, while deductive methods are considered more recent and somewhat more precise.

The inductive method, which relies on statistical data, is particularly associated with:

- David Canter (UK), who emphasizes the use of statistical techniques and psychological insights—such as geographical profiling;
- Stephan Harbort (Germany), who bases his work on empirical offender profiles, for example through case-based operational analysis.

Another inductive approach is grounded in intuition and extensive professional experience in criminal investigation. The leading figures here are FBI profilers and clinical psychologists.

Deductive methods, in contrast, are further divided into:

- Behavioral Evidence Analysis, led by Brent Turvey;
- Heterogeneous deductive FBI methods, developed by Patrick Mullany and Howard Teten;
- A deductive method with clinical emphasis, represented by G. Copson and G. Gudjonsson.

The theoretical foundations and development of offender profiling and crime analysis are widely accessible online, so this section will not explore them in detail.

What is worth emphasizing, however, is the role of specialized criminal analysts, or profilers, who act as deconstructors and reconstructors of negative social events. Profilers are, in essence, specialized problem-solvers with a broad and multidisciplinary knowledge base, including:

- Psychology
- Sociology
- Forensic medicine
- Criminology
- Statistical methods
- Data analysis
- Information science
- Linguistics
- Ethnology
- Communication studies
- Technology
- Criminal investigation techniques, tactics, and procedures

This makes it clear that becoming a profiler is extremely demanding. The necessary expertise cannot be gained through a four- or even eight-year university program alone. It is a field where true professional competence develops over 20 to 30 years. Most profilers come from specialized areas like psychiatry or psychology, and build on this foundation with additional knowledge and experience over time.

A profiler must have an exceptional ability to organize data and extract relevant information, as their job often involves sifting through vast amounts of information to uncover meaningful insights about an offender.

Profilers primarily focus on serious crimes, such as homicide, rape, major bank robberies, and economic crimes, and are less commonly involved in cases like burglary, assault, or suicide. In fact, practice has shown that profilers may not be particularly effective in certain areas of criminal investigation.

Globally, there are two prevailing views on profiling methodology. Some advocate for complete methodological freedom, allowing each profiler to use their own approach. Others call for the standardization of profiling practices, aligning them with a unified methodology.

A reasonable approach would be to allow methodological freedom to profilers who have demonstrated consistent success, while also ensuring their methods are scientifically analyzed and evaluated using specialized analytical models.

Scientific research into heterogeneous methodologies could lead to the development of new models that address the shortcomings of existing approaches. Intuition, while a powerful tool, can sometimes lead investigators down the wrong path due to its inherently subjective nature. This subjectivity can result in serious consequences, such as an innocent person being wrongly imprisoned—a deeply troubling outcome, as it involves the destruction of a human life.

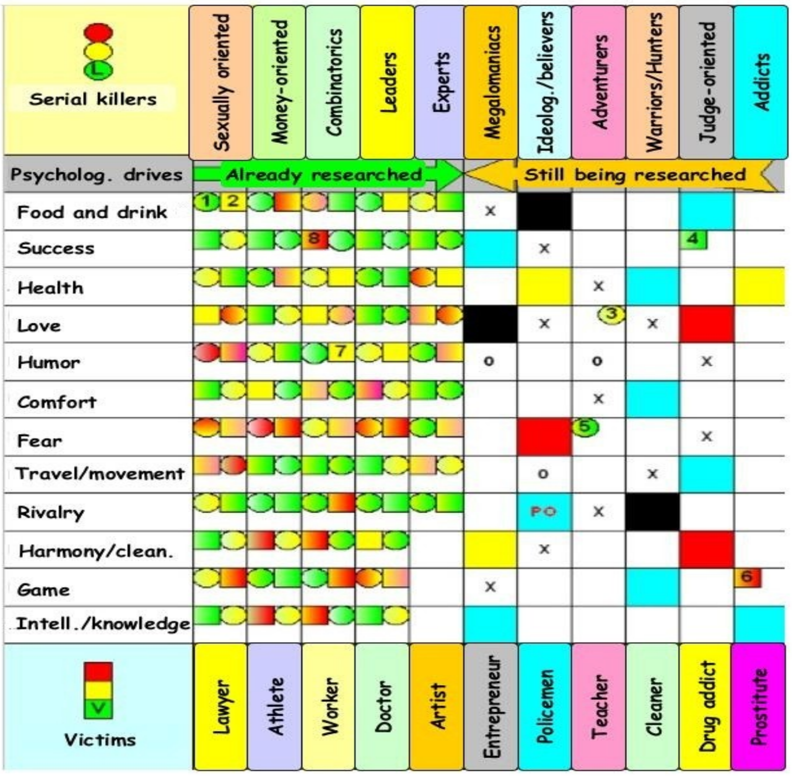
In offender profiling, knowledge from fields such as biography (the analysis of life paths of notable individuals or ordinary citizens) and genealogy can also prove valuable. Both biographical and genealogical research reveal various turning points in a person's life, often the result of significant and sometimes unexpected decisions. The underlying reasons for such decisions—such as economic crises or natural disasters—may serve as topics for further scientific investigation.

When examining the life stories of notable or influential individuals who have shaped human societies—whether in a positive or negative way—it is impossible to overlook one of history's most notorious dictators: Adolf Hitler. His initial life path was oriented toward art, specifically painting. At that time, the leading art theorists and artists in Viennese society were predominantly of Jewish origin. Hitler applied twice to the Vienna Academy of Fine Arts, but was rejected both times. The professors did not recognize any particular talent in him, considering him completely untalented and giving him the lowest marks.

This part of his life story is important, as Hitler built the core concept of his existence on the belief that painting was his true calling. This idea was central to his thinking. After failing completely in the field of art, he gradually shifted toward radical political ideology, eventually developing a mental framework rooted in anti-Semitism. His original vision and sense of purpose became secondary, replaced by a new main goal shaped by altered circumstances and beliefs—he became a political strategist.

What can a central idea of purpose and vision, and consequently a primary goal, bring about? In this case, the answer is provided by history. Adolf Hitler is remembered as one of the greatest criminals in human history, responsible for ordering the mass destruction of cultural monuments and human

lives. From a criminalistics standpoint, he committed numerous crimes, including murder, genocide, theft, fraud, conspiracy, and other serious offenses. According to historical sources, he ultimately took his own life, not out of guilt or remorse, but due to the catastrophic failure of his central idea and the collapse of his ultimate goal—the victory of the German people. In short, he killed himself because he was defeated, and because his ideology had been defeated.
This life story is instructive and reveals important insights into individual psychology and collective societal influences. Equally instructive and valuable are the life stories of lesser-known mass and serial killers, who act destructively and often believe they are doing the right thing. In the profiling of criminal behavior and offenders, the victims also play a significant role—this field is known as victimology. A killer, aside from considering societal factors, often evaluates individuals and may select a specific person as a victim. That victim must possess certain traits that act as triggers for the serial killer. These triggers can evoke internal conflict within the offender, which they are unable to manage effectively—leading them to commit brutal acts for which they become the authors.
The following section will present a special profiling matrix for serial killers and their victims, based on the most well-known underlying psychological motives.



4.8.5.2 Figure 258: Profiling different types of serial killers and victims

Figure 258 shows a matrix used to profile various types of serial killers and their victims based on fundamental psychological drives. For this example, the following drives have been selected: desire for food and drink, success, health, love, humor, comfort, fear, movement or travel, competitiveness, harmony or cleanliness, play, and intellect or knowledge.

Different shades of red, yellow, and green (see Figure 258 – both "traffic lights") indicate the strength of each psychological drive in different types of serial killers and victims. Green represents a strong presence of a particular psychological drive in a person, yellow indicates a moderate presence, and red signifies a weak presence.

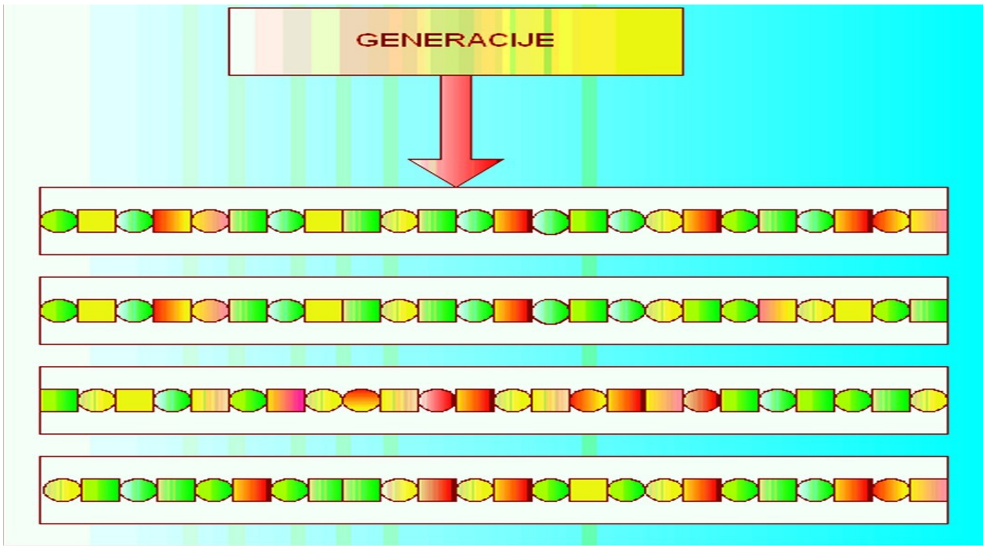
In the upper part of Figure 258 (serial killers such as those motivated by sex, money, etc.), these drives are marked with circles. In the lower part (victims such as lawyers, athletes, etc.), the drives are marked with squares.

Other symbols within the matrix may represent additional notes during the study of individual profiles. For example:

- A black field may indicate a "dark spot" or unknown area,
- An "X" may mark an incorrect entry,
- A "0" may indicate a need for re-evaluation,
- A red field may denote a temporarily suspended study.

Based on the patterns observed, it may be possible to develop "genetic algorithms" to illustrate which type of serial killer, based on their psychological drives, might choose a particular type of victim, as well as which patterns are either identical or diametrically opposed.

The following visual representation is intended to illustrate this more clearly.



4.8.5.3 Figure 259: Simulation of a genetic algorithm based on the psychological drives of serial killers and victims

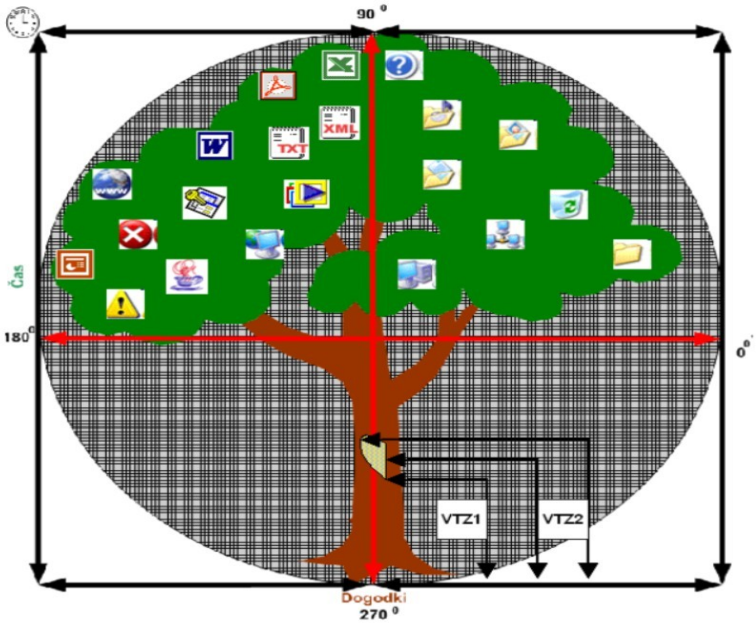
Figure 259 presents a modified simulation of a “genetic algorithm” based on the psychological drives of serial killers and their victims. The primary aim is to provide a clearer insight into various chain patterns, or so-called generations. Some profiles are mutually exclusive, while others may overlap (for example, the likelihood of a murder by a serial offender from the first chain is very low when compared with the second chain, which represents a specific type of victim).

Psychological drives can be linked to associations or associative networks (connectionism), which are the result of processing various stimuli from the environment (such as negative, neutral, positive, or hybrid stimuli). A positive association—for example, with a favorite food—can reinforce the psychological drive for food and drink in general, even though some foods in the same domain may trigger disgust or revulsion.

Associations (visual, auditory, olfactory, tactile, conceptual, etc.) are always the outcome of individual and/or collective experiences. For instance, prejudices may stem from collective influence, even if the individual has had no negative personal experience with a specific object or person.

It is well known that certain stimuli can critically influence future behavior in serial killers, even determining their choice of victim. In the case of serial killers who meticulously plan their crimes, it is highly likely that their victims are not chosen at random. However, with some psychopaths and/or sociopaths, the opposite can be true—victims are often chosen randomly, as these types of serial killers are less influenced by personal characteristics and more by various distressing events or conflict situations that they are unable to process effectively.

This leads to the question of (negative) turning points in life experienced by certain individuals. To address this, Wittgestein's Index will be briefly introduced.



4.8.5.4 Figure 260: Wittgestein index for the tree drawing

Figure 260 presents a model of a drawn tree, which can be evaluated using the Wittgestein Index. Based on the observation that tree drawing can sometimes be a highly effective method in psychodiagnostics—and at other times entirely ineffective—Wittgestein arrived at an intriguing interpretation.[110]

"An integral part of interpreting the tree is determining the time periods during which the most significant events in the subject’s life occurred".

The following elements of the tree drawn by the test subject are also of particular interest:

- The height of the tree may represent the age of the person drawing it.
- Specific marks or scars on the tree may symbolize a particular traumatic event.

Using a mathematical formula, it is sometimes possible—especially in the case of children—to determine at what age a traumatic event occurred based on the drawn tree.

$$STI = \frac{(VTZ \cdot KS)}{VD}$$

STI ... age of the subject at the time of the traumatic experience

VTZ ... distance between the lowest point on the tree and the traumatic marker (e.g., a knot)

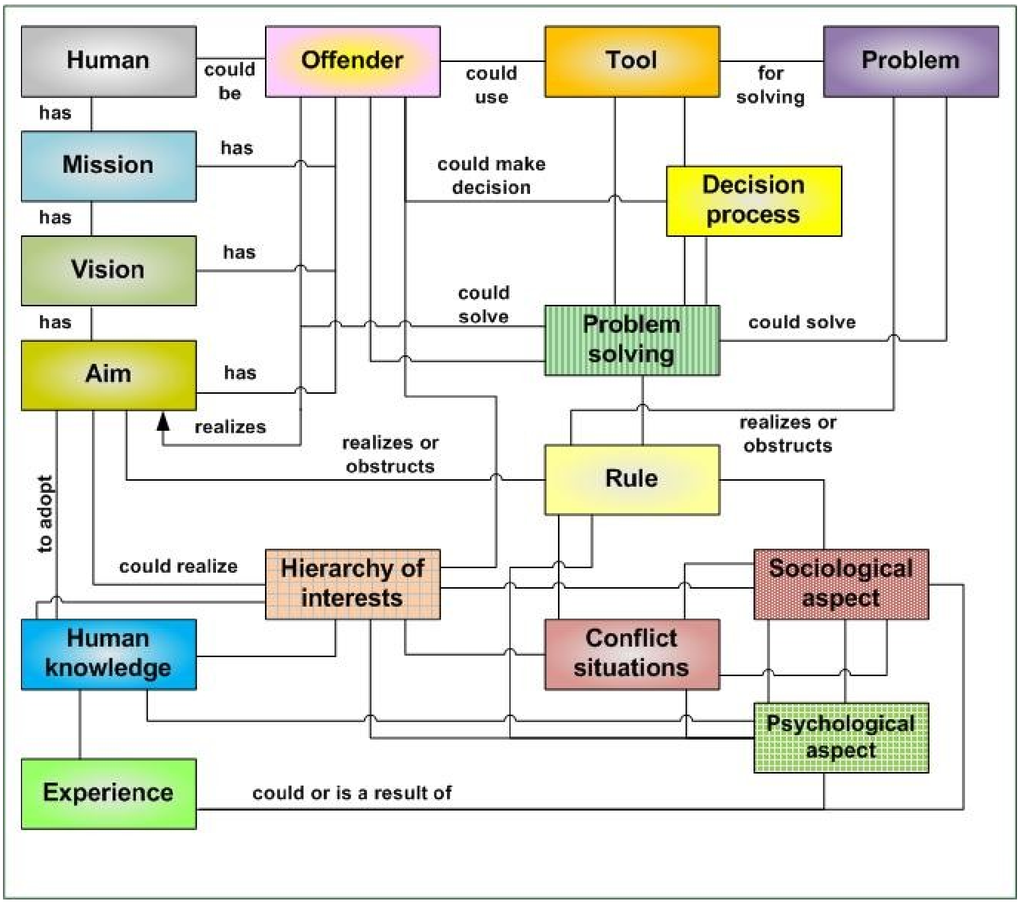
KS ... (current) age of the subject

VD ... distance between the lowest and highest point on the tree

In short, if the circumstances, type, and timing of a specific traumatic event—such as in the case of a serial killer—are known, it would be possible to compile a list of various stimuli that excessively influence the individual’s personality and cause distress.

The efforts of criminal profilers can, in a broader sense, be summarized in the following metamodel:

110 Tušak, M. (1992). *Risanje v psihodiagnostiki*. Znanstveni Inst. Filozofske Fak. Ljubljana.



4.8.5.5 Figure 261: A possible metamodel for offender profiling

Figure 261 presents a possible metamodel used by criminal profilers to profile offenders. It is a highly general framework, offering a rough outline of such individuals based on key building blocks, such as mission, vision, goal, decision-making process, problems, problem-solving, rules, hierarchy of interests, experiences, information processing (e.g., negative associations), classification systems, and more.

The primary advantage of this metamodel is that it highlights essential elements believed to be common among all criminal offenders. The entities within the model are generally presented in singular form (e.g., for the purpose of data collection, database construction, analysis, and pattern detection) and are accompanied by explanatory connections. While readers are encouraged to interpret the model freely, it is recommended to follow a certain reading order for clarity:

a. Top left:

It begins with the idea that a person should have a mission, vision, and goal in life. A person can also be (or become) a criminal offender who lacks a clear sense of mission, vision, and life goals. While many offenders pursue bio-positive goals (i.e., goals that affirm life), there are exceptions such as spree killers and suicidal individuals whose goals are oriented toward a premature end of life.

The hierarchy of interests of a (potential) offender is often directed toward rewards, avoidance of punishment, comfort, or basic survival. This does not apply to ideologically or religiously motivated offenders (e.g., terrorists, cult members), whose motivations are fundamentally different. A narrow, rigid vision and mission may ultimately lead to a single solution for satisfying one's needs: committing a criminal act.

b. Bottom left:

Negative experiences can intensify negative associations, which may increase the individual's inclination to commit a crime. These experiences and associations are often sorted into personal classification systems that further reinforce a negative worldview. Such experiences result from both the psychological (subjective) and sociological (external) aspects of life. The impact becomes more pronounced when an individual is exposed to intense and persistent conflict situations driven by these psychological and social factors.

c. Center:

Rules are a crucial element without which neither individual nor societal functioning is imaginable. However, rules can be ambivalent—they can either support or hinder goal achievement. Within interest hierarchies, rules may generate serious internal conflicts and further constrain the individual. Poorly designed rules may either ease or obstruct the problem-solving process, thus weakening or strengthening an individual's decision-making.

d. Top right (left to right):

A (potential) criminal offender may use a tool or substance to commit the crime, and in some cases, may even use another person or a trained animal to do so.

e. Far right of the figure:

The criminal act may be the result of unresolved problems the offender was facing. These problems may include:

- Loss of identity
- Sociological issues (e.g., poor social interactions, an overly demanding environment, forms of discrimination such as bullying)
- Psychological issues (e.g., severe mental illness, extreme stress)
- Orientation problems (e.g., inability to determine one's position or direction in life)
- Biological problems (e.g., terminal illness)
- Ethical dilemmas (e.g., guilt, desire for revenge, ritual suicide)
- Hybrid problems (e.g., a mix of disorientation, psychological disorders, and a perceived need to defend one's honor)

The visual and verbal elements of the model suggest that the commission of a criminal act is often the result of a loss of control and life direction. (This does not entirely apply to ideologically or religiously motivated offenders.)
An individual's existence or identity is best protected when they have a positive mission, vision, and goal in life—making them less likely to engage in criminal activity.
Additional factors such as a sense of loss (e.g., loss of status, possessions, or loved ones), inadequacy (e.g., social exclusion, stigmatization of marginalized groups), and oppression (e.g., belonging to an ethnic or religious minority, living under dictatorship) are particularly relevant in the context of ideologically and religiously motivated criminal offenders.
In such cases, we may encounter a functional aspect of criminal behavior, which often comes at an extremely high cost—including the loss of human life.
The following section provides descriptions of various types of criminal behavior, presented in the form of a modified thesaurus.

4.8.5.6 Adapted thesaurus for criminal law and criminal offenses

343 Criminal law is a specialized branch of law that contains legal rules and principles used to define criminal offenses, criminal liability, and the severity of penalties. Law is not an exact science, and therefore criminal law cannot be entirely exact either, as it determines the criminality or legitimacy of certain acts based on existing rules and principles.
Social hierarchical associative systems are not static dimensions that remain unchanged over long periods; instead, due to rapid technological development, they are becoming increasingly dynamic and less predictable. The changes that have occurred in the field of technology over the past two decades are negligible compared to those expected in the next decade. These forthcoming changes will have an even greater impact on human activities and relationships—both among individuals and within social groups and organized work collectives.
It is well known that criminal legislation is, in certain cases, outdated and unable to encompass new forms of criminality, which remain in so-called grey areas. Harmful forms of criminality are emerging that the legislation does not anticipate and for which it is therefore impossible to determine either liability or penalties. Examples include:
- Harmful stock market speculation that exponentially increases the prices of basic food products and deepens global poverty,
- Fraud committed with the help of humanoid intelligent robots,
- Bionic products that violate human dignity and the right to privacy,
- The use of harmful weapons based on electromagnetic radiation by unknown perpetrators.

Since it is not possible to determine the perpetrator, liability, or penalty for these forms of criminality, criminal proceedings cannot be initiated. If a criminal offense cannot be proven, it cannot be legally defined as a criminal offense.

It is not possible to list all types of criminality in the criminal code, as there are not yet appropriate rules for some that would allow for the determination of liability, penalties, or even the very existence of such acts. Assumptions about the existence of certain forms of criminality are not sufficient grounds for their treatment within criminal law. Various types of criminality that exist in the grey area will be discussed in more detail later.

Every criminal offense can be classified as criminality, but not every criminality is a criminal offense. Criminal law does not deal with the prevention of criminal offenses, but with their sanctioning. Criminal offenses are synonymous with criminality and vice versa, while the term “crime” is not an appropriate legal designation. Criminality is the subject of research, with so-called black areas—fields where legislation has not yet developed appropriate provisions. Criminal codes are often behind the times and lag behind some forms of criminality by a decade or more.

For example, an act may be criminal in a certain period (e.g., criticism of the state regime), but after a change in the political system, it is no longer a criminal offense. In everyday life, various intrigues —political, business, emotional, or religiously motivated—take place, which may use entirely legal methods or operate on the edge of legality. Sometimes, criminal means such as mobbing, extortion, murder, or violence are also used. Due to the covert and undetectable nature of these acts, they often cannot be treated as criminal offenses.

In this context, criminality is a broader concept than a criminal offense, as criminal offenses primarily refer to the criminal code. The two concepts are closely related, but criminality cannot be defined solely through the lens of criminal law—it must also be considered from other perspectives. On the other hand, criminal offenses, which are the subject of every criminal code, are easier to address than criminality, at least until we begin to question their causes, motives, likelihood of occurrence, possibilities for prevention, and so on.

When it comes to defining misdemeanors, the situation is clearer, but misdemeanors can, over time, develop into criminal offenses, or certain criminal offenses can become misdemeanors. For example, prostitution was initially treated as a criminal offense, then as a misdemeanor, and later even as a non-punishable act. In addition, misdemeanors can also indirectly interact with criminal offenses, such as in the case of a bank robbery where unannounced street protests divert attention and make the robbers’ job easier.

In conclusion: criminal offenses are a relatively statistically manageable category, whereas criminality is not. The term criminality is also used to refer to certain groups of people, which is not

directly possible with criminal offenses. Thus, we speak of juvenile criminality (juveniles), white-collar criminality (economic crime), and child criminality (children).
Given all this, it should be emphasized that there is often a dilemma when defining criminality and criminal offenses, as the line between these concepts is very thin. It seems reasonable to consider expanding the scope of criminal law to include preventive aspects and the prevention of criminal offenses.

TT law

BT law

NT punishment refers to a category defined by criminal law, where specific weights are assigned to the severity of penalties for different types of criminal offenses.

Criminal courts are the final decision-making bodies for assigning punishment to a particular suspect who is alleged to have committed a criminal offense.

Criminal sanctions are mechanisms that enable society to respond to criminal offenses through penalties, protective measures, and corrective actions.

Criminal procedure is the tool for implementing criminal law and, consequently, for assigning punishment. This process involves not only (suspected) offenders, but also the police, defense attorneys, prosecutors, courts, and judges.

The criminal code is a publicly available publication that contains at least the majority of the criminal law of a judicial system. It defines the known criminal offenses that can be prosecuted and punished.

Criminal offenses are unlawful acts that can harm nature, society, or individuals and can be punished under existing criminal law.

Criminalistics is the science of investigating, proving, and detecting criminal offenses. With this focus, it is primarily oriented toward criminal law aspects. In investigating, proving, and detecting criminal offenses, it uses various methods, tactics, techniques, and tools. Due to its close connection with criminal law, it generally does not focus on preventing crime but rather on practical and repressive aspects.

Criminality is a negative social phenomenon that, as a macro-phenomenon, encompasses criminal offenses in opposition to criminal law. A broader and more detailed definition of criminality, which is not based solely on criminal law but also on a hierarchical associative perspective, could be as follows:
"Criminality is a negative social phenomenon that arises from intertwined influences within the micro-, macro-, and mesocosm, where stronger and more intense negative attentional-physical, performance, individual-psychological, partial-social, social, and health-biological factors stand out.

As a result, there is a lower energy and financial efficiency within social hierarchical associative systems."
Criminality can also be defined as a distinctly negative social stress factor. We will return to a more precise or improved definition of criminality after examining the results of a survey on criminality and 3M-cosmic influences.
Criminology is a social science that studies criminality interdisciplinarily using other sciences, combining theoretical, practical, and criminal law perspectives. As a scientific discipline dealing with criminal offenses in the context of criminal law, it also examines criminality in terms of etiology, modus operandi, the psychology of offenders and victims, sociology, as well as the prediction and prevention of criminal acts. For this reason, criminology should not be limited solely to the social sciences.
Penology is the science of punishment and prisons. Its research scope ranges from theory and practice to the development and implementation of solutions related to the lives of prisoners and the functioning of prisons.
Prevention of criminal offenses is an activity mainly undertaken by police scientists and criminologists. In practice, there are still many opportunities for competent scientists and experts from various fields to develop more effective methods and solutions for crime prevention.
One very important, yet underused, method of prevention is crime prediction based on the analysis of large volumes of data. In this promising research area, computer scientists and geographers are the most active. In the United States, various police and criminal investigation services are increasingly trying to incorporate this method, which has already shown some successful results in practice.
RT forensic sciences are diverse and operate within the framework of the humanities (e.g., linguistics, philosophy), social sciences (e.g., sociology, ethnography, law, economics), natural sciences (e.g., biology, chemistry, geology), interdisciplinary sciences (e.g., psychology, ecology, geography), and applied sciences (e.g., computer science, technology, psychiatry, medicine). There are many types of forensic sciences (e.g., forensic medicine, forensic psychiatry, forensic psychology, forensic biology, forensic chemistry, forensic toxicology, forensic deontology, forensic anthropology, forensic entomology, forensic ecology, forensic linguistics, forensic archaeology, computer forensics), which investigate and examine crime in cooperation with criminalistics, criminology, criminal law, and courts. Forensic experts and scientists primarily work at crime scenes, in laboratories, and in courts, with the main mission of providing evidence and expert opinions.
343.3/.7 Criminal offenses SY: criminality

First, we will address descriptions of known forms of criminality or criminal offenses that are officially recognized and listed in the criminal code.

NT infanticide is defined in the Slovenian Criminal Code as follows:

a. Definition: “A mother who takes the life of her child during childbirth or immediately after, while she is still under its influence, shall be punished by imprisonment of up to three years.”[111]

b. Etiology (Causes):

The reasons for this type of behavior—which can be observed both in the animal kingdom and in human society—are diverse. These causes can be found in several areas:

- Negative social stressors, such as poor relationships between partners, unfavorable social and health conditions, economic hardship, social inequality, stigma, exclusion, and physical or sexual abuse.
- Partially social factors, like fear of others’ opinions, feeling incapable of handling future responsibilities, and learning harmful values.
- Biological and health-related issues, including mental illnesses, hormonal imbalances, brain injuries, and incurable physical diseases.
- Individual psychological factors, such as anxiety, personal crises, depression, and low resilience to distress.
- Performance-related factors, like work overload leading to constant fatigue.
- Environmental and sensory factors, for example, lack of sunlight, persistent harmful noise, or unfavorable planetary alignments.

In short, using a model based on negative stress factors (see research on stress intensity measurement) and key psychological drivers (needs, desires, and fears), we can understand the origins of all forms of criminal behavior and the development of a criminal personality. These causes are viewed through three interconnected "cosmic" levels:

- Macrocosm: Factors like lack of sunlight, global warming, and planetary influences.
- Mesocosm: Social conflicts, relationship issues, crowded living conditions.
- Microcosm: Viral infections, neurological disorders, effects of microorganisms.

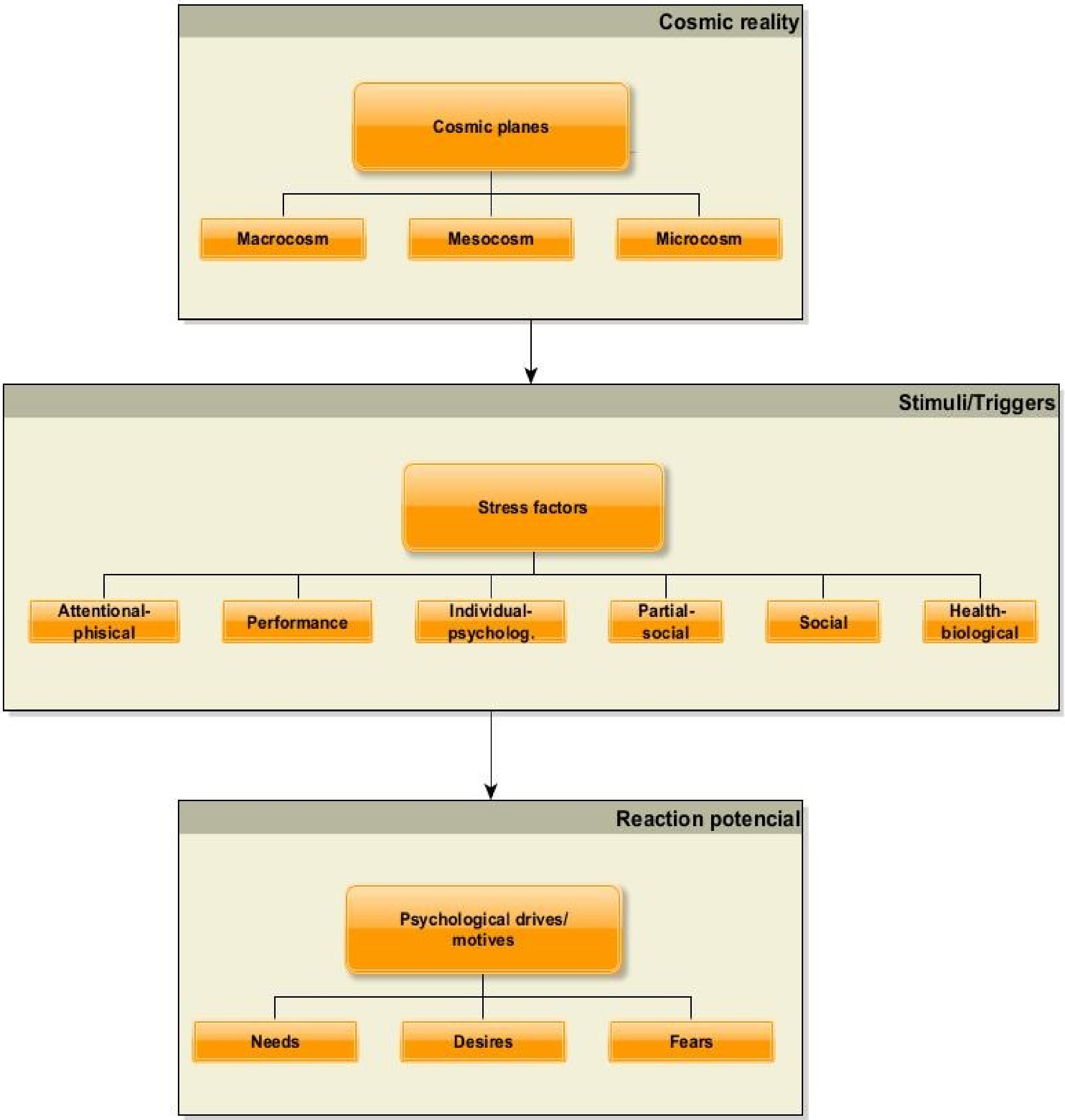
These factors affect how an individual reacts, driven by psychological motivations that broadly fall into the categories of needs, desires, and fears.

This model integrates a variety of approaches to understanding criminality and criminal personality across these three "cosmic dimensions" of our reality. These approaches include biological,

111 See. PISRS: http://www.pisrs.si/Pis.web/pregledPredpisa?id=ZAKO5050 (2020-08-04).
In the form of a monograph: SLOVENIJA. Zakoni itd. (2018). *Kazenski zakonik (KZ-1) : (neuradno prečiščeno besedilo)* / z uvodnimi pojasnili k noveli KZ-1E Matjaža Ambroža ter stvarnim kazalom Janeza Topliška in Sabine Zgaga ; Zakon o odgovornosti pravnih oseb za kazniva dejanja (ZOPOKD). - 1. ponatis. - Ljubljana : Uradni list Republike Slovenije. - 322 str. ; 20 cm. - (Zbirka predpisov / Uradni list Republike Slovenije).

neuroscientific, psychological, feminist, media-related, sociological, and environmental perspectives.

Moreover, the model is highly adaptable. It can be tailored to specific types of criminal behavior and personalities, allowing for different emphases in analysis. This adaptability makes it especially useful for creating computer simulations and animations of various possible scenarios. Hierarchology and Hierarchography advocate for this flexible, interdisciplinary model as essential for explaining criminal behavior and the development of criminal personalities.

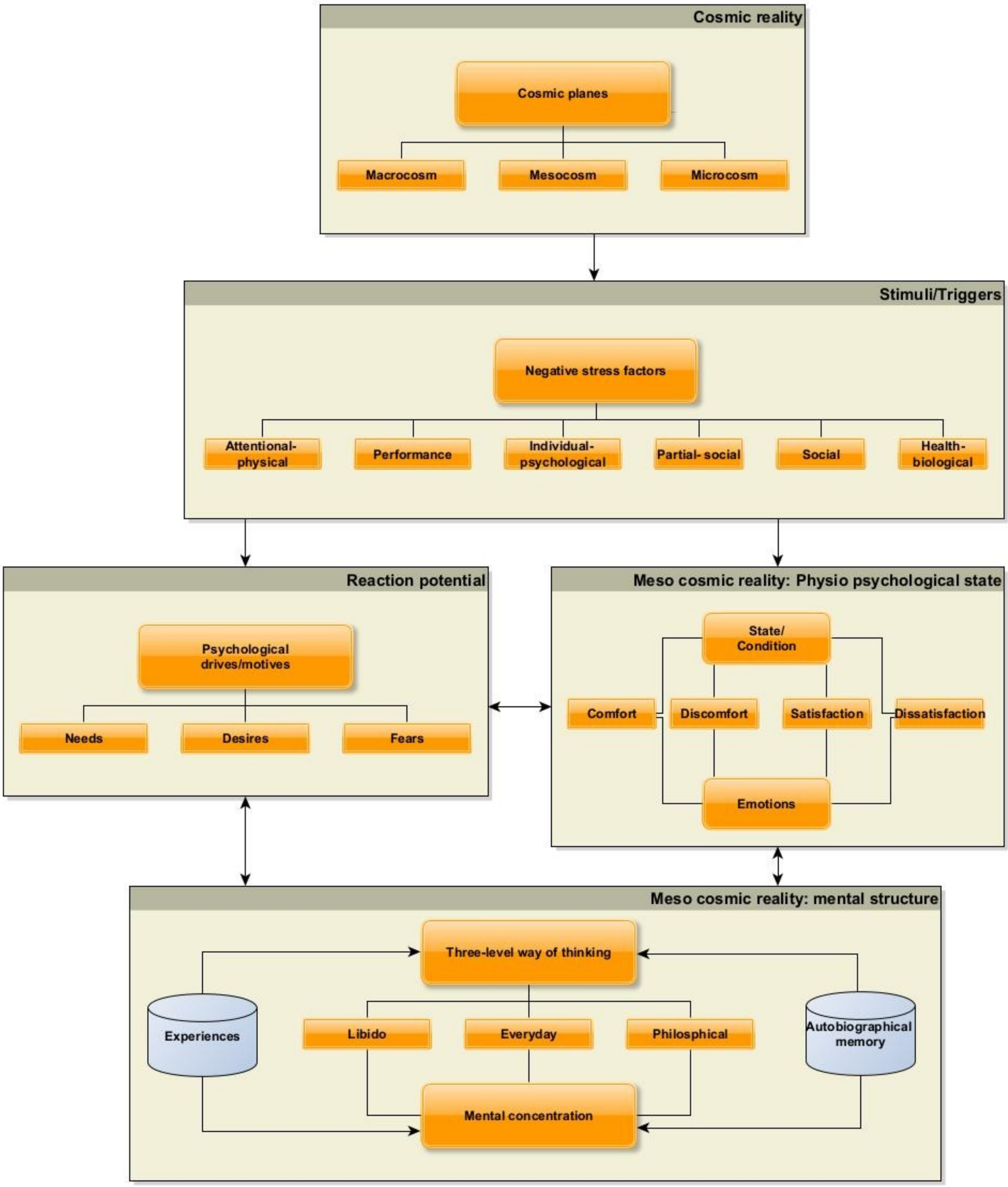


4.8.5.7 Figure 262: The Universal Dynamic Interdisciplinary Holistic Agile Model (DIHAM) for the emergence of criminality and the development of the criminal personality

Figure 262 illustrates the Universal Dynamic Interdisciplinary Holistic Agile Model (DIHAM) for explaining the emergence of criminal behavior and the development of a criminal personality. The model is based on the premise that criminality and the formation of a criminal personality can be interpreted through three cosmic levels of our reality, which are connected to stress stimuli and an individual's reactive potential in a broader sense.

This universal model can also be applied to explain the origin and development of language, scientific theories, and other phenomena. If necessary, it can be expanded with additional elements of our reality, such as emotions, autobiographical memory, neurons, genes, microorganisms, and various sociological, psychological, biological, and environmental interpretations. The model can be enhanced by assembling and/or disassembling components, much like building with LEGO bricks.

For scientific research purposes, the model supports the use of various cognitive approaches, such as assembling, disassembling, bipolar thinking, induction, and deduction. Because of this, the model is dynamic and agile, allowing for the depiction of various dynamics and the adaptation of scientific research methodologies. Furthermore, the model is designed to support an interdisciplinary and holistic explanation of criminality and criminal personalities, enabling the study of the relationship between the whole and its parts—and vice versa. We will illustrate this with an example in the following section.



4.8.5.8 Figure 263: Example of an enhanced DIHAM model for the emergence of criminality and the development of the criminal personality

Figure 263 presents an example of an enhanced version of the DIHAM model, focused on the emergence of criminality and the development of the criminal personality. This version emphasizes negative stress factors that can trigger a reactive potential in the form of psychological impulses (needs, desires, fears), in connection with an individual's physio-psychological state (emotions, comfort, discomfort, satisfaction, dissatisfaction) and mental structures (concentration, experiences, autobiographical memory, ways of thinking).

The model can be further upgraded with negative associative chains—thought patterns that are more or less closely linked with stress stimuli, autobiographical memory, and a threatened ego. The result is a negatively focused mental concentration that places intense pressure on the individual. For instance, in the case of a child-murdering mother (infanticide), this might involve a mental buildup centered on financial hardship, relationship problems, lack of support from family, unfulfilled needs and desires, fear of the future, and possibly postnatal psychotic episodes. Although many women may face similar challenges, only a very small percentage commit the crime of infanticide. This suggests that identifying mesocosmic causes alone is not enough to fully uncover the background of such acts.

This version of the DIHAM model puts particular emphasis on the mesocosmic dimension of our reality. However, the model can also be expanded to include macrocosmic and microcosmic realities—such as the effects of reduced sunlight exposure, climate change, lunar phases, bacterial infections, or brain wave activity (e.g., EEG).

Importantly, we must not overlook the impact of chronic over-fatigue on perpetrators of such crimes. Many of these women may be in a state of complete physical and psychological burnout, which would warrant specific measurement of sustained fatigue levels.

In connection with infanticide, we should also mention the possible variant of cold-blooded profit-driven crime, such as involvement in the trafficking of body organs for transplantation. In such a case, the mother may not be the direct killer but an active participant in the murder of her child, in cooperation with an organized criminal group involved in organ trafficking. This form of criminality is relatively unknown to the public and criminal investigators, and the Slovenian Penal Code does not explicitly mention it—possibly resulting in very low penalties for such crimes. In a similar way to how this model analyzes the crime of infanticide, it can be applied to explain other types of criminal offenses listed in the penal code.

NT genocide / SY ethnocide is a crime against humanity targeting specific members of national (e.g., ethnic minorities), religious, or other groups, with the aim of weakening or completely destroying them. In the Slovenian Criminal Code (see also the entry on *infanticide*), the following is stated:

(1) Anyone who, with the intent to destroy, in whole or in part, a national, ethnic, racial, or religious group, commits any of the following acts:

- Killing members of such a group,
- Causing serious bodily harm or mental impairment to members of such a group,

- Intentionally subjecting the group to living conditions intended to bring about its total or partial physical destruction,

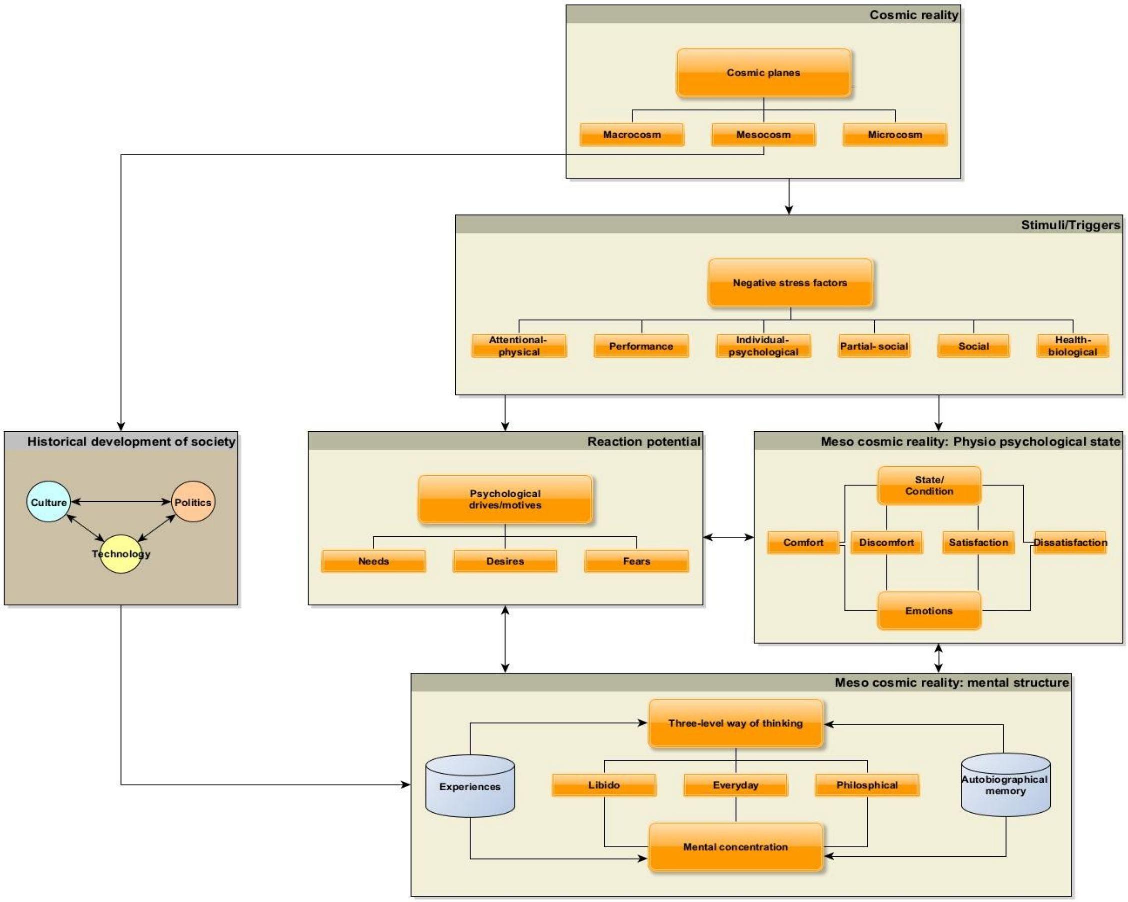
- Imposing measures intended to prevent births within the group,

- Forcibly transferring children from one group to another,

shall be punished with a prison sentence of no less than fifteen years.

(2) The same penalty applies to anyone who commits such acts against a group for the reasons stated in the eighth indent of Article 101.

For criminal offenses of genocide, crimes against humanity, war crimes, and aggression, and under the conditions specified in point 1 of the second paragraph of Article 53 of this code, for two or more offenses under the fifth paragraph of Article 108, Article 116, Article 352, the second paragraph of Article 360, the fourth paragraph of Article 371, and the third paragraph of Article 373, a sentence of life imprisonment may be imposed.



4.8.5.9 Figure 264: Example of an enhanced DIHAM model for genocide

Figure 264 presents an example of an enhanced DIHAM model applied to genocide. In this version, a new component is added—the historical development of society (including culture, politics, and technology), which originates from the mesocosmic level and connects with the mental structure of the individual, where experience, concentration, and autobiographical memory are particularly important. In the case of genocidal crimes, influences from the macrocosmic and microcosmic levels appear to be minimal or negligible. Instead, clear, cold-blooded motives are present—such as total domination over another nation or ethnic group, material gain in the form of land, money, or property, and the reinforcement of one's own national identity under the pretext of fighting for the safety and vitality of the group. The emergence of this type of crime and the development of genocidal criminal personalities cannot be fully explained by mesocosmic factors, stimuli, or individual reaction potential alone. Genocide is an organized form of crime, backed by a long historical development of both legitimate state institutions and key individuals who act as executors of these crimes. Genocide typically involves a variety of criminal acts, such as fraud, discrimination, harassment, murder, and violations of human rights. Furthermore, it often includes complex conspiracies on both local and international levels, resulting in everyday occurrences of manipulation, misdemeanors, and criminal activity. Creating profiles of genocide perpetrators is similarly complex, as they come from a wide range of social groups—people from marginal/anomalous groups, the majority population, members of extreme hierarchical power structures, and those associated with societal progress.

Researchers in the field of genocide studies have found that perpetrators often use neutralization techniques to justify or minimize the severity of their actions. Interviews with genocide perpetrators reveal that many denied responsibility, the harm caused, or even the existence of victims (e.g., claiming self-defense or that the victims "deserved it"). Some, after denying responsibility, would condemn the act, shift the blame, invoke a higher cause, portray themselves as victims ("I had no choice"), or emphasize their own good character.[112]

When profiling genocide and its perpetrators, key turning points in both societal reality and individual personality development are undoubtedly important. In this context, neither the historical development of society nor the diverse range of personalities involved—whether as perpetrators or as victims—should be overlooked.

This is why it is essential to study the periods before, during, and after the genocide in order to gain a comprehensive understanding of the phenomenon.

In profiling key genocide perpetrators, researchers have identified several common psychological traits, such as narcissism, a search for personal identity, a strong need for attention and dominance, and pronounced egocentrism.[113] Moreover, studies of key perpetrators of genocide have revealed strong links to the sociological and cultural characteristics of the time and place. These periods were

112 Bryant, E., Schimke, E. B., Nyseth Brehm, H., & Uggen, C. (2018). Techniques of neutralization and identity work among accused genocide perpetrators. *Social Problems*, 65(4), 584-602.

113 Dekleva, K. B., & Post, J. M. (1997). Genocide in Bosnia: the case of Dr. Radovan Karadzic. *The journal of the American Academy of Psychiatry and the Law,* 25(4), 485-496.

typically marked by highly dynamic social changes, which, when combined with the pronounced psychological potential of the main perpetrators, created exceptional opportunities for social advancement. The influence of the macrocosmic and microcosmic levels on the occurrence of genocide and the formation of such criminal personalities has not yet been thoroughly researched, and thus reliable sources on this topic are lacking. Nevertheless, it can be assumed that both macrocosmic factors (e.g., climate change, global warming) and microcosmic factors (e.g., bacterial networks, the central nervous system) play some role in the emergence of genocide and the development of such individuals. In summary, due to the lack of methodology and tools for measuring and studying genocide in relation to the macrocosmic, mesocosmic, and microcosmic levels, we can currently only form hypotheses. A similar challenge is also faced by the natural sciences (e.g., physics), especially when attempting to establish stronger connections and comparability between the macro- and mesocosmic realms—such as the well-known dilemma between quantum mechanics and the theory of relativity.

NT frauds are generally criminal acts involving the intentional deception of individuals and/or groups of people, organized working associations, or even states, with the aim of gaining positional and/or material benefit, while the victims suffer material and/or psychological harm.

The Slovenian Criminal Code defines the following (previously cited, see infanticide):

(1) Whoever, in order to unlawfully gain property benefits for themselves or another, deceives someone by misrepresenting or concealing factual circumstances, or leaves them in error and thereby induces them to act or omit an act to the detriment of their own or another’s property, shall be punished by imprisonment of up to three years.

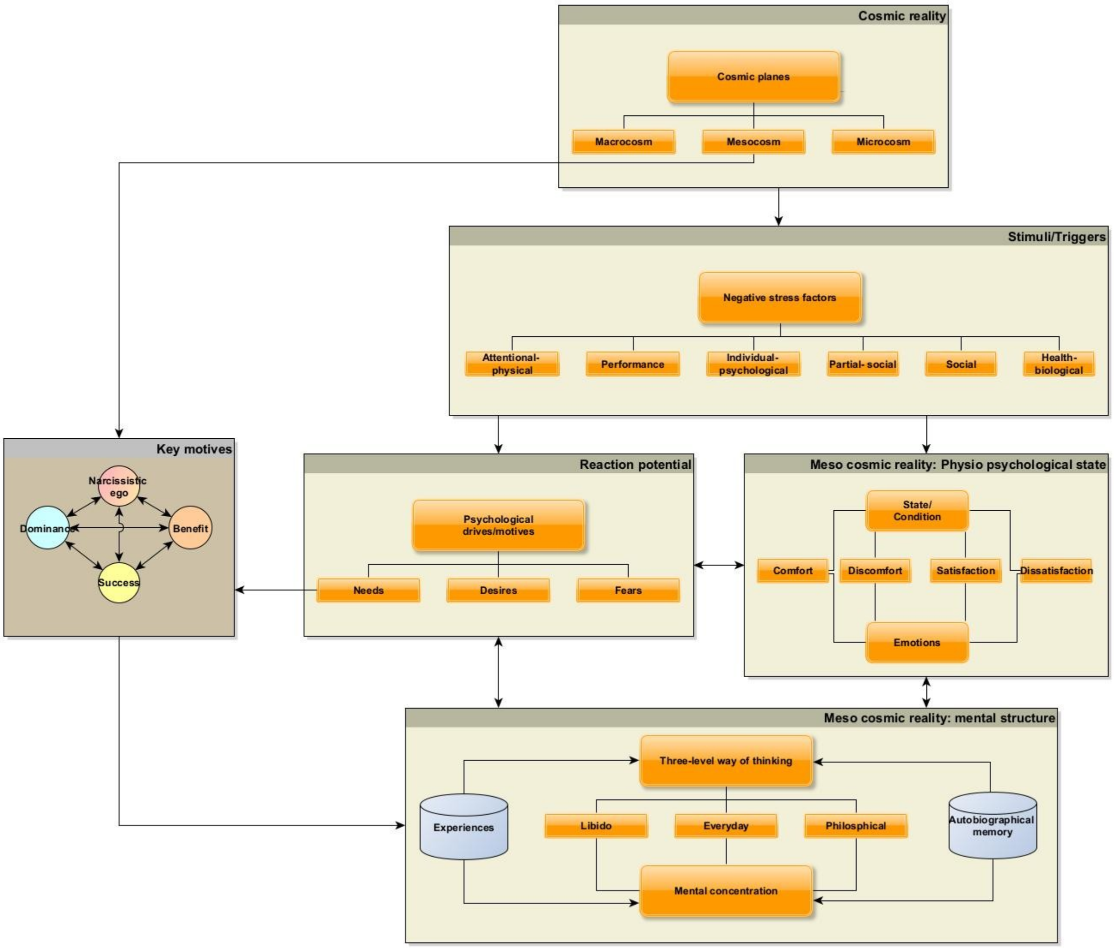
(2) Whoever, with the intent described in the previous paragraph, provides false information or conceals important facts when concluding an insurance contract, concludes a prohibited double insurance contract, concludes an insurance contract after the insured event has already occurred, or falsely presents a damage event, shall be punished by imprisonment of up to one year.

(3) If the fraud was committed by two or more persons who joined together for the purpose of committing fraud, or if the perpetrator caused major property damage through the act described in the first paragraph, they shall be punished by imprisonment from one to eight years.

(4) If the act described in the first or third paragraph was committed within a criminal organization, the perpetrator shall be punished by imprisonment from one to ten years.

(5) If the act described in the first paragraph caused minor property damage and the perpetrator intended to obtain a minor property benefit, they shall be punished by a fine or imprisonment of up to one year.

(6) Whoever, with the intent to harm another, deceives someone by misrepresenting or concealing factual circumstances, or leaves them in error and thereby induces them to act or omit an act to the detriment of their own or another’s property, shall be punished by a fine or imprisonment of up to one year.
(7) Prosecution for the offenses described in paragraphs five and six shall be initiated upon complaint.
There are many different types of fraud, and investigators often face unclear or ambiguous areas during investigations. Many frauds occurring within social hierarchical associative systems happen behind the scenes and may, from a legal perspective, be entirely lawful or exist at the edge of legality. Furthermore, there are types of fraud where no direct victims or beneficiaries are clearly visible. Fraud can serve as a powerful tool for achieving goals in complex schemes.
The Criminal Code also mentions so-called money chains or pyramid schemes as a form of fraud, where the top group can achieve extraordinary financial profits, the middle group gains symbolic profits, and the representatives of the lower group—the most numerous—consistently lose money. The money chain or pyramid scheme is a simplified reflection of a legal state system.
Within this structure, we can observe a handful of extremely wealthy individuals, a few from the middle class, and a large number of people constantly struggling for survival, investing tremendous energy just to maintain a relatively decent standard of living. We must also not forget the significant number of people living at the edge of poverty. In essence, even systemically and legally structured fraud reflects the criminality of everyday life, though it does not constitute a criminal offense.
This is one of the main reasons why many people continue to fall prey to fraudulent money chains.
The Criminal Code also mentions organizing and conducting unauthorized gambling activities, which are a kind of reflection of legal gambling that is regulated by law and system (e.g., Lotto, Toto). Other forms of fraud include extortion, usury, covering up facts, abuse of enforcement procedures, breach of trust, and so on. Frauds can be closely connected to deceit, harmful suggestions, mental and emotional manipulations, illusions, lies, and more. There are also frauds that could be classified as emotional manipulation, betrayal of a marital partner, gaining and abusing dominance over another person, leading people astray, slandering, etc. As can be seen, the list of different types and subtypes of fraud is extensive and almost unmanageable, as certain unethical forms of fraud often intertwine with other unethical and criminal acts. By contrast, the list of key motives behind committing fraud is much shorter and can be summarized as the pursuit of dominance, gain, success, manipulation of people, and the satisfaction of the greedy needs of one's narcissistic ego.



4.8.6 Figure 265: Example of an enhanced DIHAM model for fraud

Figure 265 presents an example of an enhanced DIHAM model for fraud, which highlights the key motives behind fulfilling the needs of a particular fraudster or swindler. Much like perpetrators of genocide, fraudsters also exhibit a strong need for dominance, success, gain, and affirmation of their narcissistic ego. These needs, and consequently the main motives behind the emergence of fraudsters and the occurrence of fraud, can be interpreted from a mesocosmic perspective, which primarily emphasizes criminological, psychological, sociological, and environmental explanations. This is also the scientific domain where most academic and professional publications can be found. However, it is extremely difficult to find scientific literature that examines the emergence of criminal behavior and the development of criminal personalities — including fraud and fraudsters — from microcosmic and macrocosmic perspectives. This makes it challenging to scientifically explain how the microcosm and macrocosm influence the appearance of crime and the formation of criminal personalities.

On the other hand, some scientific hypotheses suggest the influence of genes, microorganisms, brain nerve cells, climate, sunlight, and celestial body movement. In short, we can put forward the scientific assumption that genes — the building blocks of life — in harmony with microorganisms inside and outside our bodies, help form the foundation for the development of a criminal personality and, consequently, the occurrence of crime, including fraud and fraudsters.

Extensive cooperative DNA and bacterial networks may be influenced by the external environment — the mesocosm (interpersonal relationships, food intake, etc.) and the macrocosm (climate, sunlight, etc.) — and may form a reactive basis for the emergence of criminal behavior and personalities. Bacterial networks are especially dependent on the symbiosis with DNA and the intake of nutrients, as an individual's diet essentially determines which bacterial cultures will dominate their body. It is also known that bacteria contain their own DNA, which may influence changes in the structure of human DNA.

We must also not overlook the fact that fundamental needs such as self-preservation, protection, nutrition, excretion, movement, cooperation, competition, control, and dominance are innate. This is demonstrated by the dynamics of living organisms within our own bodies (e.g., the competition of nerve cells in the brain, the control of leukocytes over erythrocytes, the cooperation and competition among sperm cells, and the constant struggle for survival among different bacterial cultures within us). These needs represent a kind of complex of our instinctual drives.

Finally, we must recognize the important role of hormones and neurotransmitters, which influence the state of our health and affect our mood. In this regard, there is a strong link with macrocosmic influences such as heat, sunlight, and climate (e.g., optimal rainfall), since sunlight provides us with vitamin D and stimulates "happiness hormones" in our bodies.

This scientific field opens up many possibilities and clues that may help explain the occurrence of crime and the formation of criminal personalities. When it comes to crimes such as fraud, this could imply that it may be worthwhile — when profiling or researching fraudsters — to collect data about their bacterial compositions and dietary habits. Forensic science is already employing methods for analyzing bacterial traces at crime scenes, as it has been found that burglars in particular tend to leave behind biological evidence in the form of bacteria.[114] Fraud is often encountered in connection with economic, governmental, corporate, financial, business, and cybercrime. In such cases, the primary aim is typically the acquisition of material or positional benefits, as well as the gathering of information — which enables control over social dynamics and influential figures within the societal system. We now continue with other forms of officially recognized criminal offenses. However, from this point forward, we will limit ourselves to more or less general descriptions, without further attempts to profile the various types of crime and the corresponding personalities, as that would exceed the scope of this section.

114 Newman, T. (2018). Using microbes to track down criminals. V: *Medical News Today* (June 10). Available at URL: https://www.medicalnewstoday.com/articles/322069 (2020-08-13).

NT theft is a criminal offense in which an individual, a group of people, an organized organization, and/or a state unlawfully takes material and/or intellectual property from another individual, group, organization, and/or state, thereby gaining illicit benefit.
The Slovenian Penal Code states the following:
1. Whoever takes someone else's movable property with the intent of unlawfully appropriating it shall be punished with imprisonment of up to three years.
2. If the stolen item is of low value and the perpetrator intended to appropriate such a low-value item, they shall be punished with a fine or imprisonment of up to one year.
3. Prosecution for the act under the previous paragraph is initiated upon a complaint.
4. If the perpetrator returns the stolen item to the victim before becoming aware that criminal proceedings have been initiated, the punishment may be waived.
The Slovenian Penal Code differentiates between various forms of theft, including grand theft, robbery, aggravated theft, embezzlement, fraud (previously discussed), misappropriation of property, unauthorized use of someone else's assets, theft of motor vehicles, running illegal pyramid schemes, illegal gambling operations, extortion, usury, betrayal of trust, abuse of enforcement procedures, concealment, illegal export or import of items of cultural or natural value, damage or destruction of such items, damage to another's property, attacks on information systems (e.g., hacking, identity and information theft), intellectual property theft, and copyright infringement.
The motives behind thefts vary. Most commonly, perpetrators seek material gain — either for prestige or basic survival. There is also a relatively frequent motive to prove one's own skill or seek adventure. Less commonly, theft is committed with the sole purpose of harming someone, or to distract from another crime occurring simultaneously in the same location. Even less frequently, the motive is connected to mental disorders.
However, theft is relatively often linked to substance addiction, particularly to psychotropic substances. People who repeatedly engage in theft can become habituated or even addicted to the act itself. This pattern is also seen in other types of criminals (e.g., serial killers).
Geographic profiling of theft offenders (e.g., robbers or burglars) has revealed that they often follow certain psychopathological behavioral patterns that are not entirely under conscious control. The influence of microcosmic and macrocosmic factors on the occurrence of such criminal behavior and the development of these criminal personalities presents an interesting question.
Various forms of physiopsychological dependence originate within the human bodily system, where hormones and neurotransmitters play a significant role. Offenders may become "addicted" to biological drugs such as dopamine, adrenaline, and serotonin — substances that not only influence the emergence of this type of crime but also shape the formation of criminal personalities.

Something similar happens with individuals who consciously seek out dangerous or life-threatening situations (e.g., stunt performers, mountain climbers, race car drivers). The role of genes in symbiosis with microorganisms may potentially drive the urge to produce these "happiness" hormones and, in turn, foster a strong need for risk and thrill-seeking behavior.

This raises the question of the composition of bacterial cultures within the bodily systems of such offenders. In the field of bacterial forensics, researchers have already found that burglars often leave behind distinct biological traces in the form of bacteria, which are unique and function almost like fingerprints.[115] The composition of bacteria in the human body can change over time and is not as stable as genetic makeup. Based on a person's bacterial composition, it is even possible to determine their dietary habits, since eating patterns influence which bacterial cultures dominate in the body.

As for the influence of macrocosmic factors on the occurrence of such criminal offenses and the development of criminal personalities, there is currently no significant evidence of a strong connection. Weather conditions can, however, have a practical impact on the commission of theft-related crimes. For example, snow and icy conditions may discourage someone from attempting a bank robbery, as escaping becomes more difficult under such circumstances.

The effect of a full moon might lie in the fact that the increased brightness deters offenders from acting, since they generally prefer darker, less illuminated locations for committing their crimes.

NT mobbing (workplace etc.) or harassment is a criminal act that centers on the infliction of psychosocial violence against individuals, groups, organizations, or even states, with the intention of causing physical-psychological, material, or positional harm. The Slovenian Penal Code does not explicitly use the term mobbing, but rather the Slovenian equivalent šikaniranje (harassment). It specifically addresses harassment in the workplace.

Article 197 of the Slovenian Penal Code:

1. Anyone who, in the workplace or in connection with work, through sexual harassment, psychological violence, bullying, or unequal treatment, causes another employee humiliation or fear, shall be punished by imprisonment of up to two years.
2. If the act results in psychological, psychosomatic, or physical illness or a decrease in the employee's work performance, the offender shall be punished by imprisonment of up to three years.

However, mobbing is not limited to the workplace—it also occurs in social and recreational environments. Moreover, it is not confined to national borders and can spread into domestic or international contexts. Legally, the Slovenian penal system only regulates harassment in the

115 Saey, T. H. (2010). Genes & cells: To catch a thief, follow grubby paws: Bacterial forensics gives criminals new reason to wear gloves. *Science News*, 177(8), 13-13.

workplace, but when analyzing mobbing beyond this setting, it is also recognized as a form of criminal behavior.
Mobbing may not always target a single individual—it can also be directed at groups of people (e.g., socially excluded or stigmatized communities), organizations (e.g., one company targeting the director of another), or even states (e.g., one state applying pressure or harassment toward the leader of another state). Especially when carried out covertly, mobbing is a preferred method of manipulation for those aiming to undermine or eliminate rivals to gain specific or broad advantages. Mobbing aimed at a particular individual can also serve as a distraction from a larger strategic goal. Attacking one person might symbolically represent an attack on an entire social hierarchy. Harassment and intimidation of a specific individual can serve to destabilize an entire organization. Law enforcement may even use mobbing techniques to reach a criminal leader, while criminal organizations might use mobbing against police officials.
Mobbing is closely related to other forms of criminality, such as discrimination, terrorism, and even genocide, as these often include elements of sustained psychological violence. Certain state institutions may also engage in mobbing to suppress the influence of particular social groups, as seen in historical examples of authoritarian regimes. In such cases, mobbing was often a tool of covert genocide, used to eliminate perceived enemies.
A lesser-known form of mobbing involves harassment based on leisure activities, including psychosocial abuse by satanic cults or other sects against Catholic priests—an extremely sensitive and under-researched area of criminology. Mobbing is also widespread in industries like film and fashion, where it remains largely uninvestigated due to its subtle and systematic nature.
There are different types of mobbing, depending on the social dynamics involved:
- Horizontal mobbing occurs within peer groups (e.g., among members of a dominant group).
- Vertical mobbing typically flows from higher to lower social positions (e.g., superiors bullying subordinates).
- Reverse vertical mobbing happens when subordinates harass their superiors.
- Hybrid mobbing involves various combinations across social and hierarchical groups.
At its core, mobbing involves group-based psychosocial violence targeted at a victim or victims. It represents a form of conflict, making it an extremely negative social stressor. While constructive conflicts can foster development and progress in society, mobbing hinders progress and causes significant health and psychosocial damage.[116] Recognizable signs of mobbing can include the use of physical force, negative verbal and non-verbal communication, threats, blackmail, destruction

116 Alsaker, D. F. (2012). *Mutig gegen Mobbing in Kindergarten und Schule*. Bern: Huber.

and/or theft of the victim's property, insults, deceitful behavior, social violence, spreading harmful rumors, social exclusion, and social isolation.

The primary motives of mobbing perpetrators are a desire for dominance and a need for social belonging.

The negative consequences of successful mobbing are reflected in the victim's mental and physical health problems, such as:

- Anxiety in the form of social phobia
- Depression
- Paranoia
- Heart problems
- High blood pressure
- Severe digestive issues
- Persistent severe headaches
- Chronic migraines
- Chronic neck pain, and more

As a result, there is also a rise in sick leave, which leads to significant financial costs for employers. A general estimate of the percentage of people affected by mobbing in Germany indicates that about 3% of the total population—approximately 2.5 million people out of 83 million—are impacted by it.[117] The assessment does not truly reflect the actual situation, as there is a vast "dark field" in this area, so it can be considered more of an optimistic scenario. In line with the important focus of hierarhology and hierarhography, which attempt to measure or at least assess the energy losses of systems in a broader sense, it is entirely appropriate that an assessment of the loss of thermal energy within the social hierarchical associative system will also be carried out in this part. For this purpose, the value of 2500 kcal, which a given individual consumes in the course of work, will be used again. In the case of sick leave resulting from mobbing, this energy becomes only potential energy. The lost energy value in the form of thermal energy will be calculated based on one working day and the number of employees, which is around 44.5 million.[118] Based on a simple calculation, where we take into account 3% of affected individuals and the number of employees in Germany, we get approximately seven million people affected by mobbing. We will designate Day D, when these affected individuals are on sick leave and are not contributing to the usual business or work output in the work process. A simple multiplication of 2500 kcal by seven million employees on

117 Fehlau, E. G: (2008). *30 Minuten gegen Mobbing am Arbeitsplatz*. Offenbach: Gabal.

118 The data was obtained based on the online statistical source: https://de.statista.com/statistik/daten/studie/1376/umfrage/anzahl-der-erwerbstaetigen-mit-wohnort-in-deutschland/ (2020-08-15).

sick leave gives us 17,500,000,000 kcal or 17,500 Gcal of lost thermal energy in just one working day.

In order to gain a clearer understanding of the lost thermal energy within organized work groups, we can tentatively compare this energy loss with a possible application. Based on the stated energy loss from mobbing, 350 nuclear reactors would produce about 50 Gcal of thermal energy in one hour. In short, the energy loss can be labeled as a loss of thermal energy at the level of nuclear reactor productivity. Regarding the impact of macrocosmic influences on the frequency of mobbing in our societal hierarchical associative systems, we currently have neither experience nor assumptions that could color our thinking. We can assume that excessive heat may increase the level of psychophysiological and social violence. Scientists in the field of micro-neurobiology have somewhat more experience regarding the microcosmic influences on the occurrence of mobbing. Increased negative stress due to mobbing can cause issues in our gut flora, disrupting the normal functioning of intestinal bacteria in our body. This can lead to an increase in the number of new types of viruses (it is estimated that 95% of the viruses in our bodies belong to the group of bacteriophages, which also kill beneficial bacteria), many of which pose a threat to our immune system and overall health.[119] Based on the above, we could assume that the most vehement perpetrators of mobbing behave in such a way that, in order to maintain the optimal functioning of intestinal bacteria, they communicate with them through their thoughts and actions, thereby contributing to the preservation of a healthy psychophysiological structure.[120] This very assumption could further explain not only the occurrence of mobbing and its perpetrators but also all forms of criminal behavior and many other human behavioral patterns. Based on this assumption, we can conclude that the emergence of mobbing and the development of mobbing personalities is a completely natural process, which, when occurring excessively, becomes a natural anomaly and consequently a social problem, as it weakens the existing socio-hierarchical associative system through high financial costs and significant loss of thermal energy.

For this reason, various prevention programs and corrective measures are both necessary and welcome, in order to reduce the incidence of mobbing and the number of such perpetrators to an optimal level for societal functioning and existence. From an ethical standpoint, this statement may be somewhat shocking, as mobbing and its perpetrators should not be tolerated—yet at the same time, we cannot alter the natural processes that occur with a specific purpose. These processes are beyond our ability to fully explain or change.

119 Brookshire, B. (2018). Belly bacteria can shape mood and behavior : Conversations between the brain and gut may influence stress, memory and more. V: *ScienceNewsforStudents* (June 7). Available at URL: https://www.sciencenewsforstudents.org/article/belly-bacteria-can-shape-mood-and behavior (2020-08-15).

120 Gut bacteria and nerve cells in the brain communicate with each other. Taken from the source cited above.

NT illegal migration refers to the unlawful crossing of borders by individuals or groups—either small or large—into the territory of a particular country. According to Article 308 of the Slovenian Criminal Code, this phenomenon is defined as "unlawful crossing of the state border or territory of the country." The content of this article is as follows:

1. Anyone who forcefully crosses the state border of the Republic of Slovenia or unlawfully enters its territory while armed shall be punished with imprisonment from three months to three years or a monetary fine.
2. The same punishment applies to a foreigner who, without a residence permit in Slovenia, remains in the country in such a manner or resists lawful removal.
3. Anyone who engages in the act of illegally bringing foreigners—who do not have entry or residence permits for Slovenia—into its territory, transports them within it, helps them hide, or for payment facilitates their illegal crossing of the border or residence in Slovenia, shall be punished with imprisonment from three to ten years and a monetary fine.
4. The same punishment applies to a public official who enables a foreigner's illegal entry or unlawful stay in the territory of Slovenia.
5. Anyone who recruits or gathers people for illegal migration, provides them with forged documents or transport, organizes illegal migration in any other way, or misleads authorities about the true purpose of entering Slovenia, shall be punished with imprisonment from three to ten years and a monetary fine.
6. If the offender gains disproportionate financial benefit for themselves or others, provides illegal labor, endangers lives or health, or acts as part of a criminal organization while committing the acts listed in paragraphs 3–5, they shall be punished with imprisonment from three to fifteen years and a monetary fine.
7. The above paragraphs also apply to crimes committed abroad, if the country where the crime occurred has, like Slovenia, accepted a common international legal obligation to prevent such crimes and has defined them similarly in its own laws. If the crime was committed within the European Union, citizens of EU member states are not considered foreigners under paragraphs 2–5.

Causes of illegal border crossing or violations of other legally defined boundaries vary. On one hand, these may involve political refugees, persecuted minorities facing genocide, people living in extreme poverty whose home countries fail to provide a means for a dignified life, individuals fleeing criminal prosecution, people escaping war zones, or those who have lost their property due to severe natural disasters.

Less known to the public are mass illegal migrations involving people infected with viruses, allegedly expelled by their own governments as part of biological warfare strategies—using human bodies as tools to create chaos and trigger social and healthcare issues aimed at weakening opponents.

Illegal migration can be seen as a natural and social phenomenon, but when it occurs excessively, it becomes a natural and social anomaly. It is impossible to completely prevent or control illegal migration, as it is often strongly influenced by macro-level factors, such as natural disasters (e.g. hurricanes, tsunamis, volcanic eruptions, earthquakes) and climate change—for instance, global warming, which impairs agricultural production, thereby forcing people to change their living environments and sometimes commit unlawful acts, including illegal migration.

Micro-level factors seem to be less influential in illegal migration, but the spread of contagious diseases can also compel people to flee their homes. Microbiologists have discovered that social migrations across cultures can significantly alter the composition of gut bacteria, potentially leading to more serious health issues.[121]

NT violence refers to the use of physical and/or psychosocial force with the intent to intimidate, humiliate, subjugate, and/or harm another individual, group, or even a large number of people. The Slovenian Criminal Code addresses violent conduct under Article 296, titled Violent Conduct:

1. Anyone who mistreats another person, beats them, or punishes them in a painful or humiliating way, who chases them using force or threats of immediate attack on their life or body, who restricts their freedom of movement, forces them to work or stop working, or otherwise violently limits their equal rights in order to put them in a subordinate position, shall be punished with up to two years in prison.
2. If the act from the previous paragraph is committed by two or more people, or if multiple people are seriously humiliated, or if the perpetrator causes physical injury to another, the punishment increases to up to three years in prison.
3. The same punishment applies to anyone who causes violence or endangers the safety of others at sporting events or in relation to such events.

There are many types, theories, and models of violence. In its broadest sense, violence is a reflection of the values of a social system and an individual’s willingness to either attack or defend against perceived threats. A person’s inclination to attack or defend is influenced by sociological and/or psychological factors.

In any case, engaging in violence often reflects a desire to affirm group identity, preserve or strengthen one's own identity—which can be essential for individual or societal survival. This identity can be upheld through positive values (such as love, respect, faith, or ideology) or through

121 See source on Asian migration to the USA: Vangay, P. ... [et al.]. (2018). US Immigration Westernizes the Human Gut Microbiome. *Cell*, 175(4), 962–972. Available at URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6498444/ (2020-08-16).

enslavement and hatred toward others. In pursuing either path, people often use similar or even identical tools.

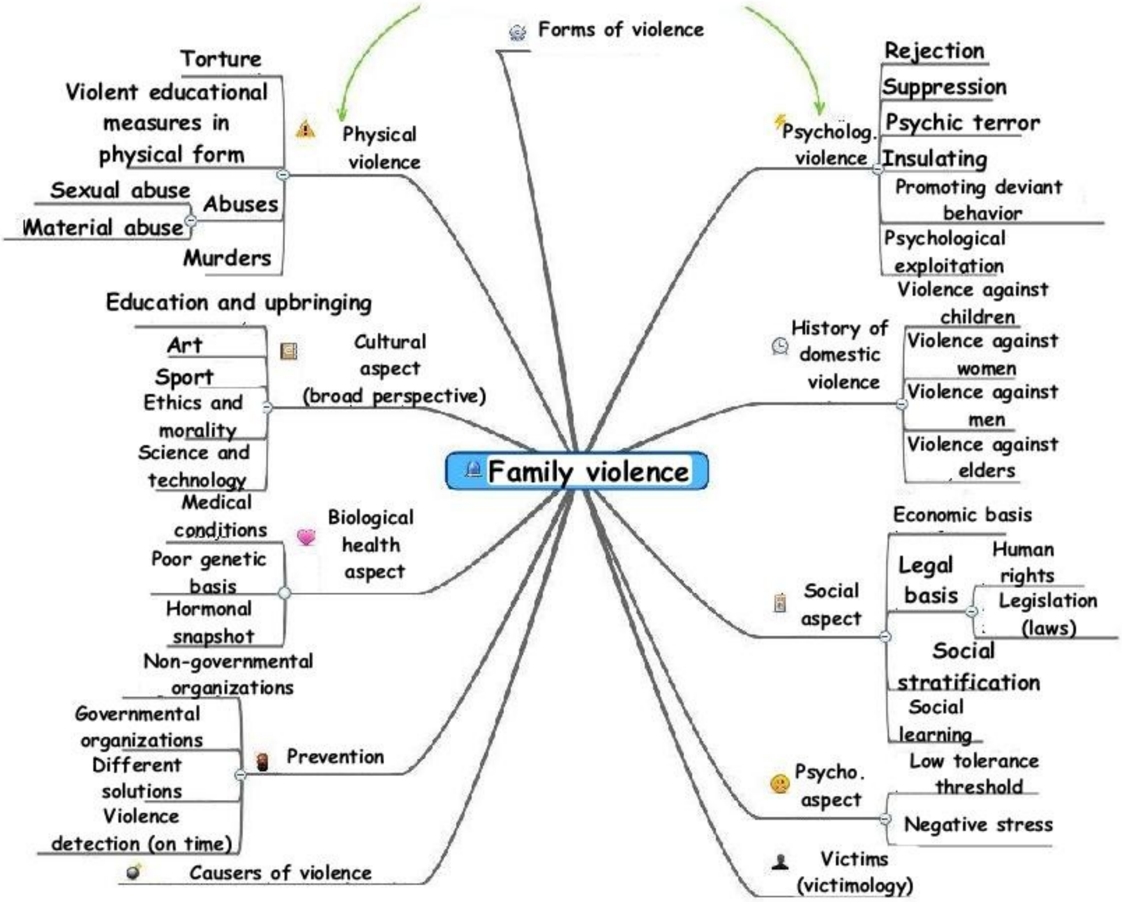
A clear example of this can be seen in the use of modern information technologies. Online platforms like forums, Facebook, or Twitter can be used to offer mutual support or, conversely, to spread intolerance, which may ultimately lead to physical violence.

Today, the readiness of individuals, groups, and societies to act violently is very high, as can be seen in mass media content—including music videos, crime shows, thrillers, and horror films. It appears that a kind of internal restraint—possibly fear of consequences—has weakened. This could be partly due to a lack of positive ideology and/or faith. As a result, society's spirit becomes increasingly materialistic, disrupting the balance between spiritual and material values.

In this context, opinion-makers—in the broadest sense—come to the forefront, as they can instill narrow interests and needs into many individuals (for instance, they can even influence the adoption of new laws).

But what must happen for large and relatively rigid systems to respond to dangerous environmental stimuli? The initial creators of public opinion are typically authors of publications, who can either highlight or downplay certain social problems. First, journalists write articles, followed by participants in other mass media such as television, radio, and the internet.

Eventually, experts in law enforcement, law, and science (such as political scientists, criminologists, sociologists, psychologists, communication experts, IT professionals, educators) get involved. Their aim is not only to report but to develop effective models and solutions for identified social problems. One of the results of such efforts is often new legislation, which is intended to regulate and monitor these societal issues.

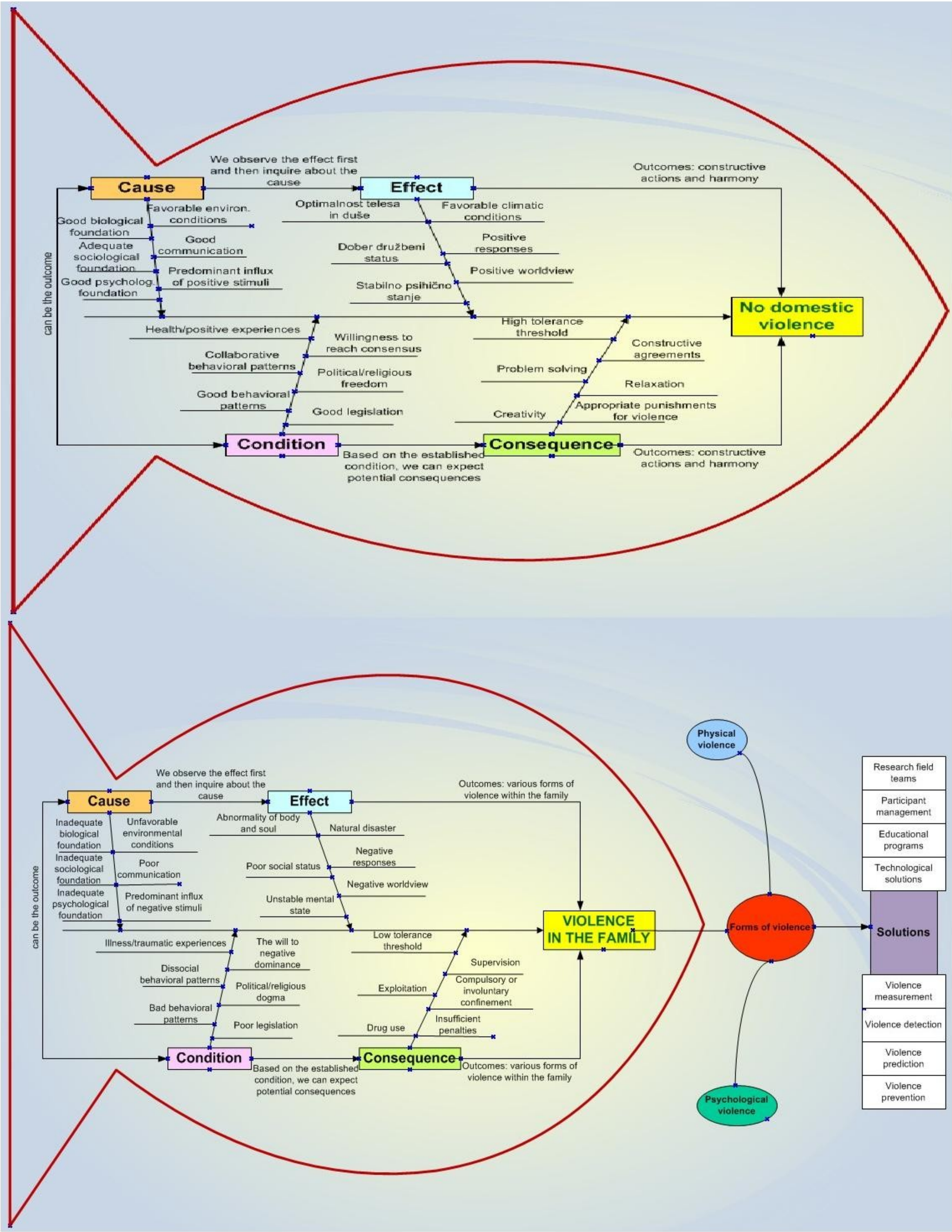


4.8.6.1 Figure 266: Conceptual map of the thematic scope of domestic violence

Figure 266 presents a conceptual map outlining the thematic scope related to the study of domestic violence. The content of scientific and professional publications in the field of violence is often connected with human rights, physical and sexual abuse of women and children, the police, criminology, criminal investigation, politics, culture, religion, war, education, history, and so on. Domestic violence is one of the most significant subjects of research and investigation in the context of violence, since the entity of the “family” is a key building block for maintaining a given social or state system. A high prevalence of domestic violence can pose a serious threat to this system. In times of peace and social/economic prosperity, it has been shown that domestic violence is significantly reduced. However, this does not mean that this form of violence does not occur frequently—especially when considering the historical context of domestic violence.

Throughout history, fathers have often beaten, abused, sold, and even cruelly tortured mothers and children, across both upper and lower social classes. For a long time, children were seen as property. For instance, ancient Greece—often praised as the cradle of democracy and progress—treated women and children in a violent and inhumane way. This brutal behavioral pattern continued

in subsequent historical periods such as the Roman Empire, the Middle Ages, the Renaissance, the Baroque period, and even up to the end of the 19th century.
Only in the 20th century did education and upbringing bring about greater levels of humanity, especially towards women and children. In this context, an important additional category is what might be called a culture of behavior, which includes both upbringing and education.
Upbringing and education are crucial channels of communication. Upbringing can pass on the fundamentals of ethics and morality to a child, while education can provide intellectual depth. A deeper understanding is essential to grasp ethics and morality—without it, concepts can become only partially understood or even completely misunderstood (e.g., merely collecting a large number of factual data without insight). Without depth, true understanding of a problem or fellow human being is not possible.
According to some authors, effective responses to domestic violence should involve cooperation between the following institutions:
- Various government ministries
- Employers (e.g., by organizing practical workshops on domestic violence)
- The judicial system (by providing better and easier protection mechanisms for victims of abuse)
- The education system
- Religious institutions
- Mass media
- The Office of Social Work
- Non-governmental organizations (NGOs)
Additionally, it would be beneficial to utilize the capabilities of current (and future) information technology. Developing effective information systems to address social and/or environmental issues is a meaningful goal. These systems could help the listed institutions—as well as individual potential users—better resolve societal and private problems, communicate more efficiently, and exchange important information and experiential knowledge more effectively.
Based on the numerous thematic concepts in the field of domestic violence (see the conceptual map), we can go on to create a customized causal diagram within a fishbone structure (in English: fishbone cause-effect diagram). This diagrammatic technique—in its pure form—visually represents the relationships between the output of a system and all known factors influencing that output. The fishbone structure essentially illustrates the system boundary and represents a whole, which is compared to its individual parts. The upcoming diagram has already been partially presented in the section on conceptual tools and causal/conditional systems, where a negative scenario was shown; the next diagram will illustrate a positive input and output scenario.



4.8.6.2 Figure 267: Adapted causal and conditional diagrams on the example of domestic violence

Figure 267 presents adapted causal diagrams. The upper diagram illustrates a positive scenario, depicting system inputs (causes, effects, conditions, and consequences) leading to a positive system output such as harmony, equality, and constructive behavior—in other words, the absence of domestic violence. Conversely, the lower diagram represents a negative scenario, showing negative system inputs and outputs, such as various forms of violence within the family.

It is unnecessary to describe both diagrams in detail here; it is sufficient to convey their basic meaning. In the case of the positive diagram, there is no need to search for solutions, whereas in the negative diagram, it is essential to identify solutions due to the intensely manifested physical and psychological violence. These solutions might broadly include:

- Involvement of field research teams
- Appropriate treatment of participants
- Implementation of effective educational programs
- Development of suitable information systems (technical/technological solutions)
- Regular monitoring, measurement, and analysis of domestic violence in urban communities
- Development of methods and methodologies for better detection and prediction of domestic violence
- Creation of various tools for more effective prevention of domestic violence, etc.

The key questions are: What causes, effects, conditions, and consequences lead to a situation where violent behavior in families does not exist? And on the other hand, what causes, effects, conditions, and consequences result in the continual occurrence of violent behavior? These are very important and interesting questions, and perhaps they can be at least partially answered using the methods of exact sciences.

In summary, many paths lead to violent acts, but it must also be clearly stated that many paths do not. Both in Slovenia and abroad, numerous governmental and non-governmental organizations are engaged in addressing domestic violence. For example:

- Centers for Social Work and relevant NGOs work to protect victims and support families
- The police investigate criminal acts and remove offenders from the environment
- Schools and kindergartens detect educational, behavioral, and developmental issues in time
- Healthcare centers act quickly upon recognizing signs of abuse
- The prosecutor’s office gathers evidence for legal proceedings
- Advocates defend the rights of children and human rights in general

In countries like the USA and Germany, the number of NGOs fighting domestic violence is particularly high. Slovenia, too, can be proud of a relatively large number of non-governmental organizations that are actively involved in tackling domestic violence.

The development of an information system focused on domestic violence could be a valuable asset not only for Slovenia but also for other countries. It would make it easier to access needed

information, and services such as legal advice could become faster, more affordable, or even free and automated.
Moreover, such a system would allow governmental and non-governmental organizations (NGOs) to collaborate more effectively, which could lead to less harm for victims. In the business world, where information technology is highly profitable, there is an abundance of information systems—yet for solving critical societal problems, there are relatively few. With the proper use of IT tools (e.g., geographic information systems – GIS, to provide a clearer spatial overview of social issues), it may be possible to indirectly reduce the number of violent incidents within families.
To what extent microcosmic and macrocosmic factors influence the emergence of violence and the development of violent personalities is still not sufficiently researched. Scientists in the fields of neurobehavioral sciences and microbiology have found that there is a communication link between gut bacteria and the brain. When this communication channel is disrupted or unbalanced, it can lead to various physiological conditions (e.g., severe migraines, chronic neck pain) and mental disorders (e.g., autism, depression, Parkinson's disease). These, in turn, may manifest as various behavioral disturbances, such as violent behavior during sleep or argumentative tendencies.[122] A certain degree of violent behavior may also be influenced by macrocosmic factors, such as a lack or excess of sunlight and heat.[123] It can be assumed that violent behavior patterns arise from a more or less intense and continuous interplay of mesocosmic, microcosmic, and macrocosmic factors. Based on our experiences and stronger connection to the mesocosmos, we tend to believe that negative social stressors, in relation to our thinking and actions, are the most significant contributors to the emergence of violence.
NT counterfeiting is a criminal offense that involves imitating something authentic with the intent to steal, destroy, or replace the original for use in illegal transactions or to deceive individuals into believing the counterfeit is at least as valuable, if not more valuable, than the original. There are various forms of counterfeiting, such as counterfeiting money, official documents, artworks, trademarks, and stamps. There are also similar forms of counterfeiting that involve copying intellectual (e.g., patents, innovations, inventions, scientific articles) and artistic works (e.g., paintings, sculptures, songs, melodies).
NT money laundering is closely linked to the criminal offense of counterfeiting money. Money laundering can be defined as a criminal act that seeks to transform illegally obtained funds into

122 Ignatova, V. (2019). Influence of gut microbiota on behavior and its disturbances. V: *Behavioral Neuroscience*. London: IntechOpen.
123 Bosman, E. S., Albert, A. Y., Lui, H., Dutz, J. P., & Vallance, B. A. (2019). Skin exposure to narrow band ultraviolet (UVB) light modulates the human intestinal microbiome. *Frontiers in Microbiology*, 10. https://doi.org/10.3389/fmicb.2019.02410.

legitimate wealth through various financial transfers (e.g., banks, casinos). Article 245 of the Slovenian Criminal Code defines the following:

(1) Anyone who accepts, exchanges, stores, disposes of, uses in economic activity, or otherwise handles money or assets they know to have been obtained through a criminal offense, and thereby launders or attempts to launder its origin, shall be punished with up to five years in prison.

(2) The same punishment applies to anyone who commits the act mentioned above and is also the perpetrator or participant in the offense through which the money or assets were obtained.

(3) If the money or assets referred to above are of significant value, the perpetrator shall be punished with up to eight years in prison and a fine.

(4) If the act is committed as part of a criminal organization aimed at such activities, the perpetrator shall be punished with one to ten years in prison and a fine.

(5) Anyone who should and could have known that the money or assets were obtained through a criminal offense, and still commits the acts described in paragraph one or three, shall be punished with up to two years in prison.

(6) The money and assets described above shall be confiscated.

Money laundering is a common method used by white-collar criminals (economic crime) as well as organized criminal groups. Economic crime and white-collar offenses will be discussed in more detail later.

NT suicide refers to a self-destructive act by an individual or group of individuals that results in death. In the Universal Decimal Classification system, suicide is categorized as a criminal offense. In some countries, such as Iran, suicide is legally defined as a crime. The Slovenian Criminal Code treats incitement and assistance in suicide as criminal offenses, while suicide itself is not. Article 120 of the Criminal Code states:

(1) Whoever intentionally incites another person to commit suicide or assists them in doing so, and the suicide is carried out, shall be punished with six months to five years in prison.

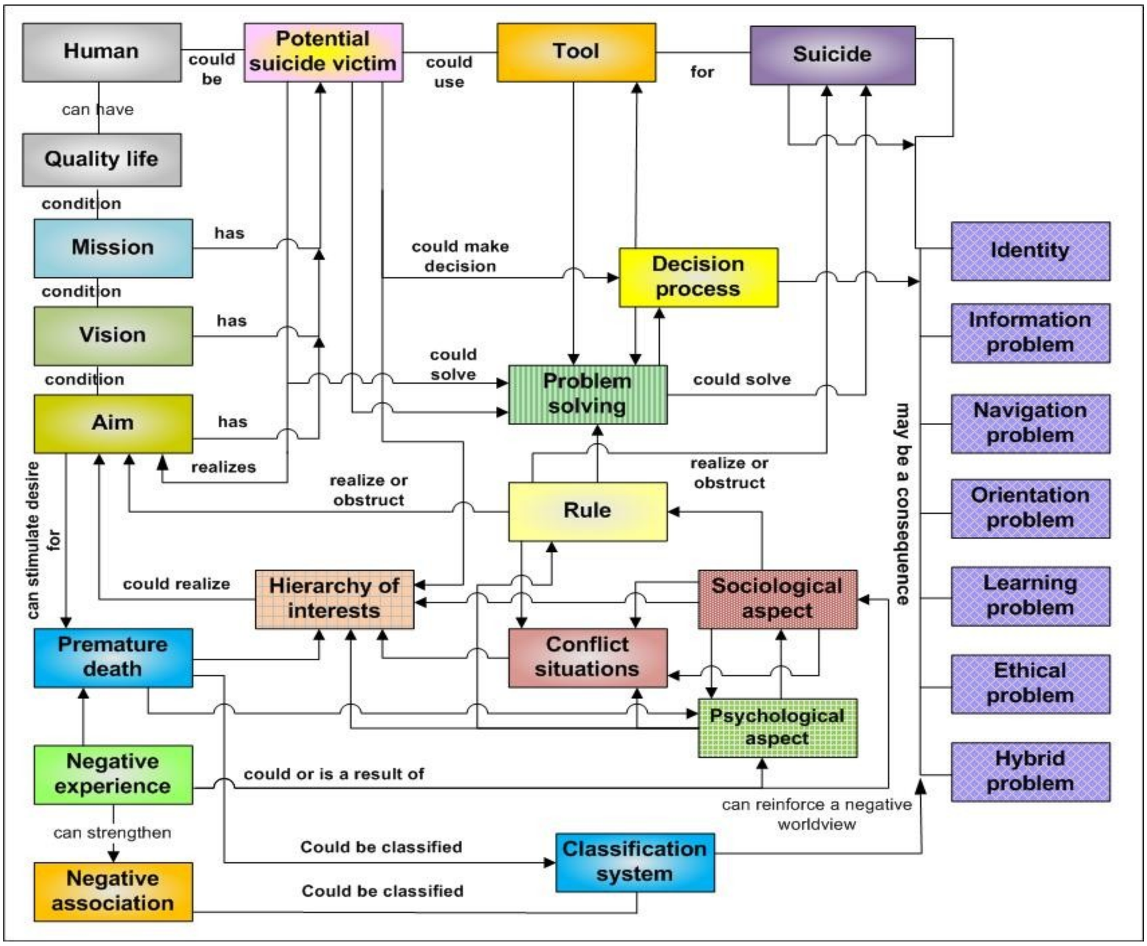
(2) If the act is committed against a minor aged fourteen or older, or a person with significantly diminished capacity to understand the nature of their actions or control their behavior, the penalty is one to ten years in prison.

(3) If the act is committed against a child under fourteen or someone entirely incapable of understanding or controlling their actions, the perpetrator shall be punished as for homicide or murder.

(4) Anyone who treats another person, who is subordinate or dependent on them, in a cruel or inhumane way that leads to suicide, shall be punished with six months to five years in prison.

(5) If someone helps another person commit suicide under particularly mitigating circumstances, they shall be punished with up to three years in prison.
(6) If suicide is only attempted due to one of the above acts, the court may impose a reduced sentence.
To what extent must internal and external negative impulses be so strong that a person becomes willing to renounce life—the highest value of human existence?
When negative stimuli within a person are especially persistent and intense, psychological pain can manifest as intense physical pain. Individuals often have no control over this pain, particularly when they continue to cling to an ineffective lifestyle. We often hear of cases where individuals continuously complain about bodily pain, yet doctors—whether general practitioners or specialists—fail to identify any physical abnormalities. All tests indicate the patient is perfectly healthy. Patients often find this hard to believe, as they experience severe headaches, pain in the tailbone, neck, and even the lower abdomen. Whenever they report these issues to a doctor, the doctor often listens with skepticism and, in the end, offers a familiar reassurance: that the symptoms are most likely due to excessive psychological stress and that certain lifestyle changes will be necessary. Some patients follow this advice and genuinely change their way of living, but despite these efforts, they continue to suffer from persistent, burning, and exhausting ailments.
Only a small percentage of such individuals begin to ask themselves why they feel so dissatisfied in life. Is the reason just the pain? At first, it seems that way. But over time, they arrive at deeper, more fundamental questions such as, “Which events are making me feel unhappy?” or “Have I achieved even a third of my goals?” These questions lead them to seek out the root causes. And then, the crucial question is not far behind: “Are these very causes the reason I feel burned out, exhausted, empty, and without energy?”
There can be many reasons for this poor state of being, such as:
- poor physical condition,
- fear of the future (e.g., unemployment),
- desire for higher education,
- poor housing conditions,
- lack of free time,
- excessive self-demands,
- exposure to violence and a dangerous lifestyle,
- misfortune in love,
- intense conflict in society,
- feelings of inferiority and helplessness in certain situations.

Physical pain that stems from intense and prolonged negative psychological stimuli causes great discomfort. This leads to increasing stress, which can reach a level of total exhaustion, at which point the individual loses their life energy—their "biological battery" is literally drained.
Since humans are by nature beings who require comfort for both physical and mental balance, we can assume that severe physical pain and constant tension are significant factors in some individuals' decisions to commit suicide. The inability to endure chronic exhaustion and relentless pain—lasting up to 16 hours a day—can push them to the brink of despair.
Based on this, we can conclude that maintaining a healthy lifestyle is extremely important for every individual. This lifestyle essentially serves as a life plan that determines how to live well. However, because each person is unique, everyone must explore and shape their own way of living—of course, in alignment with general social norms such as employment, family responsibilities, and interpersonal relationships.
In the next section, we will focus on the metamodel of a (potential) suicidal individual.



4.8.6.3 Figure 268: Metamodel of a (potential) suicide

Figure 268 presents a metamodel of a suicide, which is general in nature and represents a rough profiling of such individuals using key components such as quality of life, mission, vision, goal, decision-making process, problems, problem-solving, rules, hierarchy of interests, experiences, information processing (e.g., negative associations), classification system, etc.

The main advantage of such a metamodel is that it enables the depiction of those fundamental characteristics that are common to all potential suicides. The entities considered in the metamodel are, according to the conventions of such representations, presented in the singular (which facilitates the collection and organization of data for building databases, analyses, and discovering patterns) and are accompanied by explanations at the connections. Reading this model allows for considerable interpretive freedom, but it is still reasonable to follow a certain order.

Structure of the metamodel:

a. Top left:

The fundamental assumption is that a person can live a quality life if they have their own mission, vision, and goal. The opposite applies to a (potential) suicide, who does not have a quality life because they have lost their mission, vision, and goals. Since the suicide does not have a biophilic goal (a goal oriented toward life), their only remaining goal is the premature ending of life. Due to the loss of life's mission and vision, their hierarchy of interests narrows significantly, leading them to see death as the only solution to their problem.

b. Bottom left:

Negative experiences can reinforce negative associations in an individual and encourage suicidal thoughts. Both negative experiences and negative associations are organized by the individual into a certain classification system, which further strengthens their negative perception of the world. Negative experiences are mainly the result of subjective experiences of the world (psychological aspect) and actual social interactions (sociological aspect). This is especially pronounced in the case of intense conflict situations arising from psychological and sociological factors.

c. Center:

Rules represent a key entity without which the functioning of the individual and society cannot be imagined. They can have an ambiguous effect—either supporting or inhibiting the achievement of goals, which can cause severe conflicts within interest hierarchies and further constrain the individual. Rules can facilitate or hinder the problem-solving process, especially when they are inadequate. This consequently affects decision-making—it can either strengthen or weaken it.

d. From left to right, top:

A (potential) suicide uses a certain means, tool, or substance to carry out suicide, and in some cases, even another person or a trained animal.

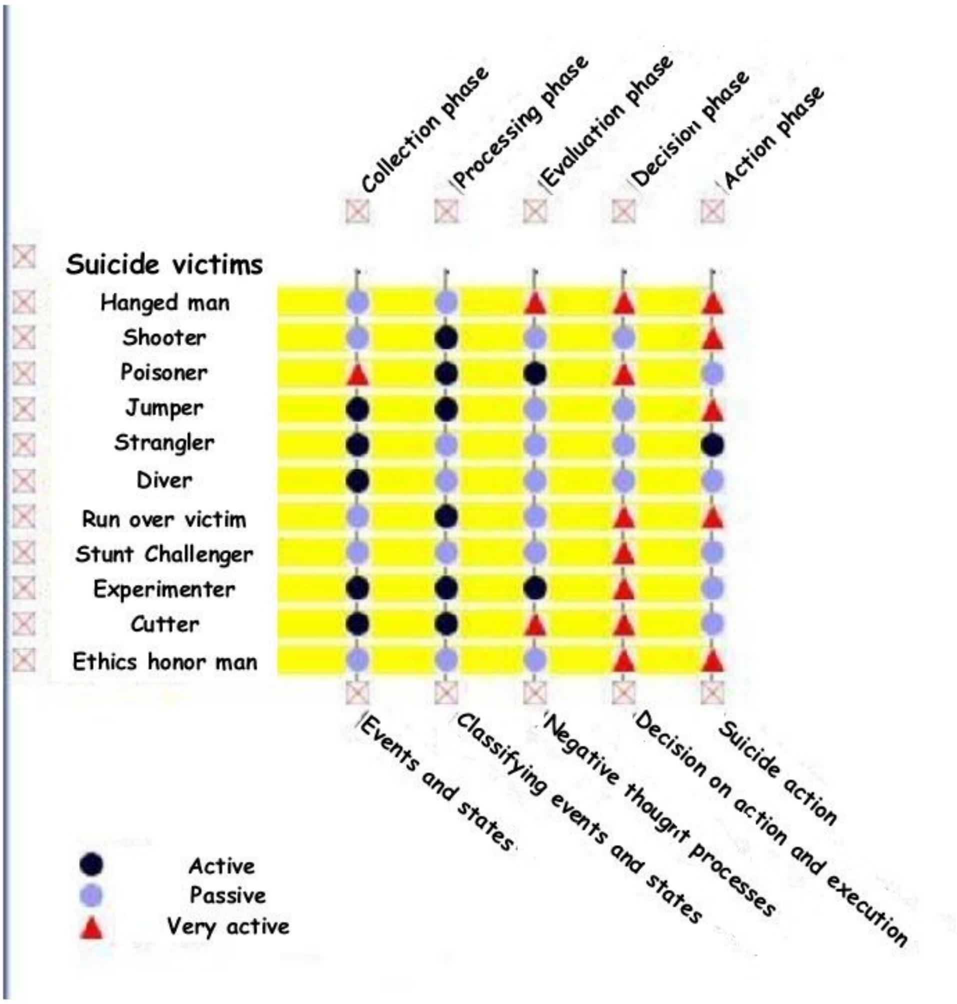
e. Far right side of the figure:

Suicide can result from various problems faced by the individual, including:

- Loss of identity
- Sociological problems (poor-quality interactions, overly demanding social environment, discrimination, bullying, etc.)
- Psychological problems (severe mental disorders, excessive stress, etc.)
- Orientation problems (life becomes too complicated, the individual can no longer determine where they are and where they want to go)
- Biological problems (e.g., incurable illness)
- Ethical problems (feelings of guilt, harakiri—questions of honor)
- Hybrid problems (a combination of loss of orientation, severe psychological disorders, and a sense of honor).

Based on the visual and verbal description, it can be concluded that the final outcome of suicide is a consequence of the loss of control and thus also of orientation in life. An individual's existence or identity is best protected when they have a clearly defined mission, vision, and goals in life. With the help of these fundamental elements, they can form their own life formula or program, which enables them to live a higher quality life.

In the next step, an attempt will be made to model a decision matrix for different groups of (potential) suicides from the perspective of the developmental process. This process includes several phases, among which are: data, signal, and association collection; data and information processing; evaluation of data, information, and insights; decision-making and its realization or action. A more detailed discussion will follow.



4.8.6.4 Figure 269: Decision matrix of different groups of (potential) suicides

Figure 269 illustrates the decision matrix of different groups of (potential) suicides and their methods of collecting, processing, evaluating, and making decisions regarding the successful execution of suicide. It shows varying levels of activity among the groups (passive, active, most active) in gathering signals, data, and information, their processing, evaluation, and the final decision and action. The process depends on various events and states, the classification of these events, negative thought processes, decisions about the act, and the method of carrying out the suicide.

The groups of (potential) suicides are ranked according to the success rate and frequency of completed suicides in the following order:

a. Hanger – individuals who use a rope in the form of a noose placed around the neck to hang themselves.

b. Shooter – individuals who use firearms to commit suicide.

c. Poisoner – individuals who poison themselves with toxic substances, sleeping pills, carbon monoxide, etc.

d. Jumper – individuals who choose suicide by jumping from high bridges, buildings, etc.

e. Strangler – individuals who use a pillow, plastic wrap, or other tools to suffocate themselves.

f. Diver – individuals who drown themselves in deep water bodies, pools, bathtubs, etc.

g. Run-over victim – individuals who deliberately expose themselves to collisions with motor vehicles, trains, etc.

h. Daredevil – individuals who consciously endanger their lives through dangerous stunts (e.g., deadly jumps, etc.).

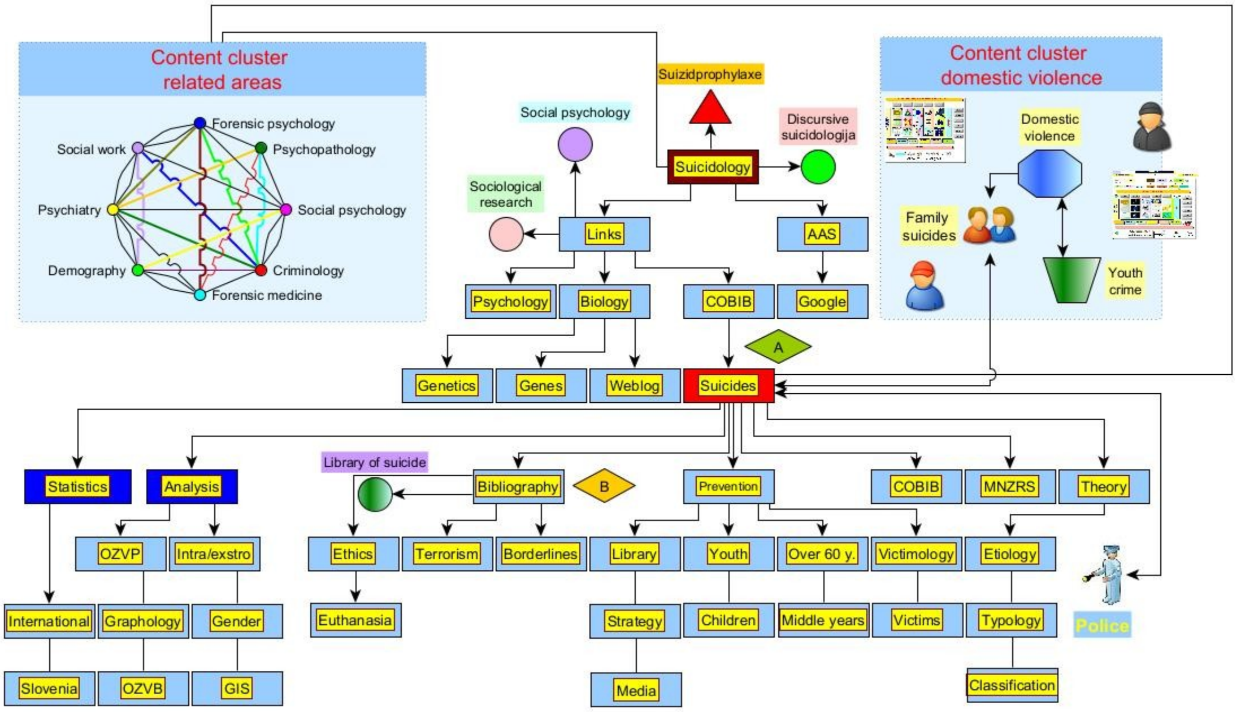
i. Experimenter – individuals who consciously try various suicide methods that often do not lead to death.

j. Cutter – individuals who use sharp objects such as knives, glass, etc., to commit suicide.

k. Ethicist or man of honor – individuals who take their own lives for ethical, honorable, ideological, or religious reasons (e.g., samurai, terrorists, kamikaze, etc.).

Using software tools like Apes Tool, it is possible to create complex decision matrices and compare different categories. The program allows calculation of values based on evaluated categories (e.g., person–person, person–phase, person–event, phase–event) and exports data in .txt format to other software for analysis and pattern discovery in data. This enables further analysis and visualization, leading to the discovery of new patterns and insights about (potential) suicides.

The field of suicide research and investigation is extremely diverse and interdisciplinary. The following figure serves as a better illustration.



4.8.6.5 Figure 270: Conceptual network on suicides and related topics

Figure 270 presents a conceptual (semantic) network on suicide and other related topics. It represents a central content concept that includes two fundamental components: suicidology and suicides. This concept is connected to two additional content clusters: "Related Fields" (such as psychiatry, social work, forensic psychology, psychopathology, social psychology, criminology, forensic medicine, demography) and "Domestic Violence and Juvenile Delinquency."

This condensed overview makes it clear that suicidology—and thus suicide research—requires an extremely complex interdisciplinary and multidisciplinary approach. It is important to emphasize the content cluster of related fields, such as forensic psychology, social work, psychopathology, demography, criminology, psychiatry, forensic medicine, social psychology, juvenile delinquency, and domestic violence.

Key aspects related to suicides and those who die by suicide:

a. The Role of control

A crucial issue in suicide prevention is control, which is strengthened by active problem-solving. Problem-solving is closely connected to decision-making, which enables individuals to be more organized and have a stronger identity. A healthy identity arises from positive autobiographical memory, supporting a life-affirming (biophilic) view of the world. This process also involves identification with people, activities, and events from the past. Successful control over one's life acts as a protective factor against suicidal behavior.

b. The importance of tradition

Tradition is an important orienting factor in life, as it gives individuals a sense of mission, vision, and purpose. Positive orientation strengthens control and organization, since well-organized personalities are often committed to certain traditional values. However, tradition can also be restrictive, especially in societies where, for example, marriages are arranged. Nevertheless, healthy traditional values can strengthen identity and serve as protection against suicidal acts.

c. Dependence on the social system

A large part of the civilized population depends on the state system, which provides security and stability. Citizens maintain the system through taxes and savings, enabling the circulation of capital. Identification with the social community strengthens an individual's identity. If this identification is lacking, apathy, a sense of hopelessness, and feeling lost can arise, leading to doubt about the meaning of life. Belief in the meaning of life is a fundamental source of life-affirming energy, and its absence leads to a negative mindset, which is a high risk factor for suicide. Dependence on the system can become exhausting when a person cannot identify with social values and feels like an outsider. This is exacerbated by societal egoism, which often neglects the vulnerable and focuses on profit-driven and exploitative practices (such as aggressive marketing, accumulation of wealth without social responsibility).

d. Social crises as a threat to a life-affirming worldview

National crises, wars, economic recessions, poverty, and unequal distribution of wealth pose a serious threat to a positive view of the world. Disproportionate distribution of capital hinders social development and increases social tensions. Many social misfortunes originate from criminal acts, such as economic fraud, corruption, clientelism, and ineffective social systems. Global social systems are often outdated and in need of reorganization (e.g., pension system reforms, transition to an information society with greater emphasis on quality of life). Statistics show that during social crises, the number of suicides rises sharply, while it drops significantly during periods of general prosperity.

e. The role of mass media

Responsible reporting during times of crisis can have a positive effect on citizens' mental health. On the other hand, irresponsible media coverage can cause negative effects, such as psycho-social induction, which creates negative emotions and thoughts. The most extreme example of this is mass psychosis, which occurs during wars, riots, and other social unrest. The media should play a key role in a national suicide prevention program by promoting non-violent communication and reducing social stress.

f. The importance of family and education

High birth rates in a country are often associated with lower suicide rates and a higher number of marriages. The family is the basic unit of society, providing individuals with a foundational life framework. The education system plays a key role in this, as well-designed programs can act as a safeguard against suicidal behavior.

g. The influence of geographical and climatic factors

A favorable geographical location and climate often positively impact a person's biophilic (life-affirming) perception of the world. Additionally, genetics, environment, time, and personal lifestyle all play an important role.

h. Excessive expectations and disappointment

High expectations and demands in life can increase feelings of disappointment, which may pose a risk for future generations. Increased violence and social polarization may also contribute to rising suicide rates. It's important to consider the wise words of Dr. Anton Trstenjak:

"Those who expect little from life are less likely to be disappointed."

The principle of the golden mean—setting balanced goals—can help individuals maintain stability and reduce the risk of suicidal thoughts. A person who is aware of their identity and holds realistic expectations is more likely to preserve their biophilic energy and avoid negative thought patterns that lead to depression and self-destructive behavior.

i. Character, history, and culture of a nation

The character, history, and culture of a nation are important areas for exploring possible tendencies toward suicide. For example, in certain situations, the Japanese may view suicide as an honorable act, while Slovenians often see themselves as a small and insignificant nation. We are frequently too hard on ourselves, and our history of subjugation may influence our collective self-image.

j. Is excessive pornography consumption harmful?

The answer is yes. Similar to economic propaganda that often uses erotic imagery, excessive exposure to pornography encourages exaggerated needs, desires, and expectations. Such messaging creates a sense of constant lack and pressure to resolve it quickly. This raises questions about impulse control, which is essential for building a stable self-image and worldview.

Overconsumption of both pornography and aggressive economic advertising can impair a life-affirming view of the world and may indirectly promote suicidal thoughts. In the long term, it also narrows mental horizons—one of the hallmarks of suicidal thinking. It can also lower serotonin levels (the so-called happiness hormone) and increase the risk of developing bipolar disorder (manic-depressive states), which are challenges faced by modern, developed societies.

k. Suicide as a loss of purpose

Suicide is often the result of losing one’s sense of mission, vision, and overall life purpose. Each suicide leaves behind a wave of intense negative emotions, particularly affecting close relatives. Common reasons for suicide include loneliness, loss of reputation or status, feelings of guilt, conflict, substance abuse, illness, hopelessness, and feelings of confinement or entrapment (e.g., suicide rates are higher among prisoners than in the general population). Suicide can also serve as a form of protest against injustice, such as through hunger strikes.

l. The role of suicidologists

Experts who professionally study suicide are called suicidologists. This profession is not yet formally established in Slovenia. Suicidologists may come from various fields, including social work, nursing, education, law enforcement, clergy, and journalism. In other countries, there are also academic programs in suicidology.

m. Methods of suicide

Common methods include hanging, firearms, poisoning, drowning, jumping from heights, stabbing, and suffocation. The most lethal methods are firearms, hanging, carbon monoxide poisoning, and drowning. Less reliable methods—such as overdosing or cutting—are more common in suicide attempts. Statistically, women attempt suicide more often, but men are significantly more likely to complete the act.

n. Suicide research

Most research on suicide is macro-sociological in nature. The central thesis of these studies is that suicide rates are inversely related to the degree of an individual's integration into the social community. In Slovenia, suicide research is mainly conducted by the Psychiatric Clinic in Ljubljana and various statistical agencies.

o. The National Suicide Prevention Program

A national suicide prevention program is extremely important, as countries that have implemented one (e.g., Norway) have seen a significant decrease in suicide rates. Such a program includes various measures and activities, including:

- interdepartmental cooperation (e.g., connecting ministries, police, NGOs, and religious communities),
- healthcare initiatives,
- research centers to analyze (potential) suicidal individuals and monitor trends,
- information centers offering free services to users,
- educational programs to raise public awareness,
- dedicated public relations services for suicide prevention topics,
- various forms of help provided through multiple communication channels (e.g., crisis helplines).

The field of suicide is not only important for various experts and scientists, but for all of humanity, as it indirectly offers answers to fundamental questions about the meaning and driving force of life—the highest value for every living being. People who most often choose suicide are those who have lost the will and strength to confront the negative processes occurring within themselves and society. These negative processes are experienced by everyone, though to varying degrees of intensity.

Throughout the human life cycle—and thus human existence—various phenomena accompany us, such as death, dominance, work, love, and play (as described by Eugen Fink, a German philosophical anthropologist). These phenomena are integral parts of our mental structure and are interconnected through polar relationships: death–immortality, dominance–slavery, work–idleness, play–non-play, love–hatred. The duality of these fundamental phenomena forms the basis of relationships between love and hatred, mortality and immortality, work and idleness, play and non-play, and dominance and slavery. The primary mental concentration resulting from these relationships is a weaving of various mental patterns, with certain phenomena potentially becoming more dominant than others.

In connection with suicides and suicidal individuals, the relationship between negative and positive mental concentration is particularly noteworthy. In the case of negative concentration, increasingly strong hierarchical and associative negative patterns are formed. The mental structure becomes saturated with overwhelming feelings of bitterness, which are reinforced by new experiences—experiences often merely reflections of past ones. Likewise, dynamic life situations can transform into a sense of extreme monotony, experienced as negative and irreversible finality.

Numerous mental impulses, which can also be expressed through symbols, may, through interaction with the social environment, strengthen the belief in the meaninglessness of life and the significance of death. However, there are even more mental impulses that can enhance the sense of life's meaning. Collecting and thoroughly analyzing such data could shed light on the issue of suicide, which, at its core, is the very opposite of life. This could also help identify negative social factors that undermine a biophilic (life-affirming) perception of the world and encourage premature death tendencies. Improving these social systems—often comparable to incomplete electrical circuits that function but suffer significant losses over time—could follow.

Social hierarchical and associative systems frequently operate with large energy losses and relatively poor utilization of the knowledge possessed by individuals in large human communities. National suicide prevention programs could further strengthen the personal engagement of individuals who have lost control over the flood of negative perceptions about themselves, society, and the world. Active self-observation and analysis of one's own mental processes increase personal activity and resilience. Special departments within national suicide prevention programs could assist individuals in analyzing their feelings and impressions and encourage them to participate in such research.

Suicide is not merely an individual problem but a concern of society and human civilization as a whole. It also represents a major loss of life energy, as energy that could have operated in the mesocosm (the intermediate realm between the individual and the universe) simply disappears through the act of suicide. Globally, approximately 800,000 people die by suicide each year. If 800,000 people died by suicide in 2019, it means that in 2020, these individuals could no longer be counted among the inhabitants of our planet.[124] 50% of the individuals mentioned contributed to positive social and business outcomes. With a simple calculation, we can estimate the permanent loss of thermal energy within social hierarchical and associative systems. By multiplying the value 400,000 by 2,500 kcal, we get a result of 1,000,000,000 kcal, or 1,000 Gcal, representing the permanent loss of productive thermal energy—in just one year!

The calculated amount of lost thermal energy is lower than in cases of workplace bullying (mobbing), but still comparable to the thermal energy output of a nuclear reactor (for example, 20 nuclear reactors could produce 50 Gcal in one hour). Furthermore, this loss of thermal energy is permanent, whereas in cases of mobbing this is not necessarily true—victims of mobbing still have the potential to generate positive social and business impacts in the future.

As with other topics discussed, suicide also raises questions about micro- and macrocosmic influences on suicidal behavior. In the fields of microbiology and neurobiology, researchers have already discovered a strong link between certain genes and the predisposition to suicide.[125] They have found that the tendency toward suicidal behavior is hereditary. From a microbiological and psychiatric perspective, they also discovered a link between the onset of depression and an imbalance in gut bacteria, which can lead to suicidal thoughts.[126] In short, it can be assumed that there are direct and potentially fatal connections between genes, happiness and satisfaction hormones, and the dysfunctional organizational structure of gut bacteria. This suggests that mesocosmic influences may be less significant for certain individuals who are victims of an unfavorable constellation of genetic and microbial factors.

As for the strength of macrocosmic influences—such as weather conditions (e.g., storms), the sun, and lunar phases—in relation to biological, social, and cognitive factors, studies have found a

124 Information obtained from an online source: https://ourworldindata.org/suicide (2020-08-18).
125 Zai, C. C., & et al. (2012). 11 Genetic Factors and Suicidal Behavior. V: *The neurobiological basis of suicide*, 213. Boca Raton: Taylor & Francis. ISBN 978-1-4398-3881-5 Available at URL: https://www.ncbi.nlm.nih.gov/books/NBK107191/ (2020-08-18).
126 Cheung, S. G., & et al. (2019). Systematic review of gut microbiota and major depression. Frontiers in psychiatry, 10(34). Available at URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6378305/ (2020-08-18).

stronger correlation with suicidal tendencies, although the results do not show clear statistical significance.[127] By combining micro-, meso-, and macrocosmic factors in the study of suicides, the outcome would likely show a higher level of statistical significance.

NT sexual abuse refers to criminal acts in which a person and/or a group of people force another person and/or group of people into unwanted sexual contact or intercourse. Victims of such violent sexual abuse can be children, women, men, intersex individuals, transgender persons, asexual people, and others. There are also known cases of sexual abuse involving domestic animals. The Slovenian Penal Code addresses this in Article 171 under sexual violence:

(1) Anyone who uses force or threatens a person of the same or opposite sex with direct attack on life or body, and thereby compels them to commit or endure a sexual act not covered in the previous article, shall be punished by imprisonment from six months to ten years.

(2) If the act from the previous paragraph is committed in a cruel or particularly degrading manner, or if it is carried out by several people in succession, or against detainees or others deprived of liberty, the punishment is imprisonment from three to fifteen years.

(3) Anyone who compels a person of the same or opposite sex to commit or endure a sexual act from paragraph one of this article by threatening to reveal something about them or their relatives that would harm their or their family's honor or reputation, or to cause them or their family significant financial harm, shall be punished by imprisonment of up to five years.

(4) If the acts from paragraphs one or three of this article are committed against a person with whom the perpetrator lives in a marital, non-marital, or registered same-sex partnership, prosecution shall begin upon the victim’s request.

Sexual abuse of individuals is a violation of fundamental human rights. Sexual abuse can manifest in various forms, such as inappropriate touching, erotic photography, coercion into filming pornographic material, forced sexual relations and torture, sexually explicit verbal communication, etc. In short, it does not necessarily involve close physical contact. All types of sexual abuse can essentially be considered crimes against the victim. Particularly serious are sexual crimes against the inviolability of children. Perpetrators are often referred to as pedophiles, although this is a general term. The classification of perpetrators of child sexual abuse includes various terms (e.g., hebephilia, ephebophilia).

The future of the human species lies in its ability to develop knowledge and pass it on to future generations. Without children, there can be no future generations, as children build our future based on the knowledge and wisdom of adults. It is therefore in the national and international interest that

127 Kmetty, Z., Tomasovszky, Á., & Bozsonyi, K. (2018). Moon/sun–suicide. *Reviews on environmental health*, 33(2), 213-217. Available at URL: https://www.degruyter.com/view/journals/reveh/33/2/article-p213.xml (2020-08-18).

children are given the opportunity to develop optimally. A basic prerequisite for this is a life of physiological and mental quality, meaning that adults should avoid causing them traumatic events. On the other hand, it is also important that children respect their elders, as this provides a valuable reference point for learning and the formation of autobiographical memory. Without a positive perception of others and of oneself, an individual may develop deeply necrophilic tendencies. One such positive perception is the idea of preventing harmful events, as a strong positive outlook strengthens the will to improve and fix the world around us.

A deep stain on developed human societies is the existence of child sexual abuse recordings on the internet, which indirectly reflects an extremely negative attitude toward the future of humanity. For this reason, it is essential to find solutions to at least mitigate this severe civilizational threat.

Mitigate? The internet is a highly complex mechanism that includes not only the World Wide Web (WWW) but also many other services, applications, and programs. Broadly speaking, the internet is divided into the visible and invisible parts. The invisible internet is particularly problematic, as it hosts numerous criminal activities (e.g., arms trafficking, drug trade, human trafficking, financial scams, pedophile networks), which can endanger not just individuals or small groups, but even entire state systems.

Child sexual abuse recordings are a highly lucrative business, and many people make a living off this disgrace. The profits are enormous, and distributors are often not pedophiles themselves, but they clearly understand the mindset of their actual and potential clients or have deep knowledge of pedophile networks. These networks, both physical and digital, are a serious issue—especially when influential individuals are involved.

Pedophile rings often present as completely normal relationships, and outsiders usually notice nothing suspicious, particularly in the case of pedophile families. The term “pedophile family” is quite complex and can refer to family members who may be fully, partially, or not at all biologically related. One of the most twisted examples includes poor and/or abducted children being adopted by pedophiles—sometimes even those who are married and have children of their own. Such and similar anomalies often arise from social and economic misery in underdeveloped countries. Pedophilia is not just a psychiatric or individual issue but also a societal one (e.g., poverty, cultural norms, greedy profiteers, poor governance).

A special category is the partial social problem caused by negative influences of mass media, tradition, upbringing, and culture on individuals. Preventing crimes related to viewing child sexual abuse content online can be approached in various ways. While technological solutions come to mind first (e.g., partial blocking using traffic sign warnings, domain filtering, website blocking, hacker attacks on pedophile websites), other methods include positive media influence on individuals’ perceptions, profiling of pedophiles, training on pedophile networks, and cooperation with law enforcement and other relevant organizations.

Effectively preventing access to child sexual abuse content appears achievable—at least in the visible part of the internet. This, however, is not the case for the invisible part, such as so-called dark networks. Some people view such efforts as an infringement on personal freedom, but this perspective is misguided. Many people don’t realize that clicking on such content is equivalent to witnessing a crime scene. Content involving child sexual abuse on the internet is considered evidence of criminal acts! People must not turn a blind eye to such crimes against humanity and should report this content immediately (if encountered) to the appropriate authorities (e.g., Cyber Tipline).

To conclude this introduction, statistical data from the U.S. Department of Justice (2010) on the exchange of files containing child sexual abuse recordings will be presented.

4.8.6.6 Table 142: Child sexual abuse file sharing

Date	All hits	USA share of hits	USA percentage of hits	Unique IP addresses
19.9.2009	18,965,165	8,781,521	46.30%	1,033,134
27.9.2009	20,144,735	9,226,370	45.80%	1,052,217
30.9.2009	20,862,015	9,493,631	45.51%	1,060,522
3.10.2009	21,425,113	9,698,67	45.27%	1,067,617
04.10.09	21,670,444	9,793,43	45.19%	1,073,065

Table 142 presents data on the exchange of files related to child sexual abuse over a very short period. Without delving into the details, a key takeaway is clear: a large number of individuals have, in effect, participated in child sexual abuse. Such files can be regarded as evidence of crimes committed against the future of humanity.

How can these harmful activities be prevented? This challenging question will be addressed in the following sections.

In addition to the issue of the invisible (dark) internet, we must highlight another, equally significant problem—one that was not as noticeable in the previous century. On one hand, access to recordings of child sexual abuse must be denied to adults; on the other, such access must also be blocked for minors and children. In short, we are dealing with multiple generations, which calls for different strategies in punishment, education, and treatment.

This issue does not involve only pedophiles—who cannot all be categorized the same way—but also a variety of personality types from different social backgrounds. Therefore, it is necessary to develop diverse personality profiles based on technological, psychological/cognitive, medical, geographical, and sociological/familial factors. This is complex but most feasible when undertaken by well-organized scientific and professional teams.

We should also seek answers to long-standing questions such as: What stimuli trigger pedophilic tendencies in the first place? At the same time, both politics and civil society should do more to reduce the influence of exploitative business models (e.g., children’s makeup, child models), which, due to extreme profitability, encourage premature (sexual) development in children.

Possible approaches to preventing the spread of child sexual abuse material (CSAM) online:

a. Conceptual-inductive approach

This approach involves redefining terminology and phrases used by the media and public figures in politics, science, art, and sports. A key goal is to strengthen the use of the term child sexual abuse material (CSAM) instead of the misleading and inappropriate term child pornography. The latter has become deeply ingrained due to long-term use and its association with mainstream pornography, making change difficult.

b. Educational and training approach

Training and education for adults and other target groups could be implemented in schools, universities, and online classrooms within appropriate institutions (e.g., Ministries of the Interior or Education, law enforcement). People often make harmful mistakes out of ignorance, and better education could significantly reduce visits to and exchanges on criminal websites related to pedophilia and CSAM trafficking.

There are various online awareness and training programs available in this area, including OSIG, CCLEA, COEU, SOLAS, and numerous articles and courses like Classroom Teaching, Computer Forensics Training, and Child Protection Training. It may also be worth considering training programs for certain groups of pedophiles or potential offenders aimed at crime prevention.

A crucial step is to block financial flows that support CSAM trade, while simultaneously ensuring the comprehensive protection of children, who are the foundation of humanity's future.

Governments should invest in developing new professional roles specialized in detecting these crimes online. Investigations could even use older computer equipment. Given the severity of this issue, child sexual abuse prevention should be a central part of political party platforms. Only through proactive strategies can we significantly disrupt pedophile networks.

It is important to note that although there are many programs and initiatives, they may appear too scattered and disconnected—at least to the general public.

c. Collaborative approach

Strong collective efforts can yield significant results—either negative or positive. One of the key success factors is the cooperation of various stakeholders, including organizations and individuals, in preventing access to pedophile websites. These include:

- organized families and parents,
- organized retirees,
- informed and trained children and adolescents,
- schools (educators, psychologists),
- religious institutions (e.g., churches),
- Ministry of Labour, Family, Social Affairs and Equal Opportunities (e.g., social workers),
- Ministry of Justice (judges, prosecutors, lawyers),
- healthcare institutions (psychiatrists, therapists),
- consumer protection organizations,
- internet service providers (e.g., Telekom, Siol),
- internet content monitoring agencies (e.g., police, intelligence services),
- search engine providers (e.g., Google, Najdi.si),
- web platform operators (e.g., online stores),
- publishers and online bookstores.

Success in limiting the spread of child sexual abuse material (CSAM) online is only possible through a comprehensive and coordinated approach involving all of the previously mentioned stakeholders.

While listing these stakeholders is easy, effectively and successfully aligning them toward a single goal—protecting children and their rights—is far more challenging. From a technological or technical standpoint, connecting such organized groups is not a major obstacle. The main barriers to unifying these entities under a common framework are financial, legal, organizational, cultural, authoritative, political, and communicative in nature. Despite these challenges, it is not reasonable to assume that such collaboration is impossible. Open-source information technology, when paired with a suitable conceptual framework, can significantly support this effort.

d. Analytical and predictive approach

This approach relies on various methods and techniques from disciplines such as data analysis, text analysis, network analysis, psychology, sociology, and others. Access to websites hosting CSAM can be further restricted by gaining a better understanding of the thought processes of pedophiles, content traffickers, and other involved individuals.

We are particularly interested in the motives, triggers, fears, and desires that drive individuals to visit such sites. The key is to identify behavioral patterns among those more or less involved in this activity. The goal of this approach is to predict and prevent highly negative events that have not yet occurred but are likely to—for example, the emergence of a new pedophile website.

It’s worth noting that few comprehensive webometric analyses exist on the informational and behavioral patterns of internet users who visit CSAM sites—or at least, such studies are rarely published.

e. Technological/technical approach

The most tangible and effective method of disabling access to CSAM websites is through a technological or technical approach. Various means of restricting access to these materials have long been known. The most common include:

- blocking,
- filtering,
- deleting,
- hacking the websites,
- password protection,
- algorithmic detection,
- and other technological solutions.

It is important to note that filtering and blocking are equivalent methods. These techniques are applied in various internet regulation systems, such as:

- filtering systems,
- web proxy systems,
- systems for blocking CSAM content,
- models for large-scale website blocking,
- “cleanfeed” systems,
- and content blocking systems.

Effective use of these technologies can significantly reduce access to illegal and harmful content. These systems typically work by using extensive blacklists of internet addresses, domains, or hostnames that are meant to be blocked. Such lists are implemented in many countries by governments, internet service providers, and network operators.

However, these systems often have limitations—they may fail to block enough harmful websites or unjustly restrict access to legitimate content. Because of these flaws, hybrid blocking systems such as “packet dropping and content filtering” have been introduced in countries like the UK.

The most proactive countries in blocking illegal online content were initially Scandinavian nations (Norway, Sweden, Finland, and Denmark), followed later by the UK, USA, Canada, Australia, Malta, and Italy. Since 2010, Interpol has become increasingly involved in these efforts. In 2011, a

STOP warning began appearing on CSAM websites, alerting visitors to the illegality and harmful nature of the content.
New systems are also in development, including:
- tracking and hacking systems,
- internet traffic and data monitoring systems,
- and algorithmic systems for identifying user profiles.
There are also useful mechanisms for reporting such websites to the appropriate authorities. For example, if a user encounters a site with CSAM, animal abuse, etc., they can report it to organizations like the Internet Watch Foundation. In Slovenia, this role is fulfilled by the Spletno oko portal, which accepts reports of child sexual abuse cases.
Currently, there are many uncertainties regarding the blocking of pseudo-pornographic content created using 3D technologies. This includes:
- animated child pornography,
- highly advanced computer-generated 3D graphics,
- or manipulated/retouched legal pornography that has been transformed into pedophilic material.
Regulating and restricting such content poses a unique challenge, as these technologically sophisticated methods often bypass existing control systems.
Historically, humanity has faced the issue of pedophilia across many eras (e.g., ancient Greece, the Roman Empire, the Middle Ages, the Baroque period), when children had far fewer rights and were often at the mercy of adults. It is therefore deeply troubling that in today's world—despite progress in child rights—serious child abuse cases still occur. Unfortunately, the internet has significantly enabled the expansion of pedophile networks.
At the same time, some parts of the world still grapple with social poverty and cultural traditions that tolerate or enable pedophilia—such as arranged marriages between adult men and 10-year-old girls.
In the animal kingdom, a phenomenon that could be compared to pedophilia is extremely rare (it has been observed in dogs, bonobos, and cats). However, it can become more pronounced under certain circumstances, especially during major conflict situations or increased social stress (e.g., among bonobos). In human societies, the problem could, in addition to social stress, partly be attributed to the excessive emphasis on sexuality in the media and entertainment industry, as these business models are highly influential, aggressive, and pervasive.
In any case, solutions are necessary to ensure that children can have a high-quality and safe life, which also includes responsible and effective social policies. Blocking pedophilic (including hebefilic, etc.) websites is an important but small step in combating child sexual abuse online.

Additional technological and systemic solutions need to be developed, such as a socially responsible information system (or system for managing and spreading knowledge) in the field of child sexual abuse prevention in the broadest sense. Such an application system, supported by an appropriate conceptual framework, could contribute to reducing the percentage of negative pedophilic (including hebefilic, ephebophilic, paraphilic, etc.) activities in the world.

It is also important to emphasize that pedophilic tendencies should not automatically be equated with sexual assaults or abuse, and thus not with criminal acts, as pedophilia itself is considered a mental disorder.[128] Some studies have found that individuals with pedophilic tendencies not only differ in certain physiological characteristics (e.g., shorter stature, more frequent left-handedness), but also exhibit differences in the size and functioning of the prefrontal and temporal cortex.[129] The aforementioned directs us to consider the role of genes and, by extension, microcosmic influences on the emergence of pedophilia and the formation of pedophilic personalities. Given the fact that a certain percentage of pedophiles have committed criminal acts related to sexual assaults or child sexual abuse, the question arises about the microcosmic influences on the occurrence of these acts. What could the microcosmic influences on the occurrence of child sexual abuse and the development of a sexually active pedophilic personality be? Research on the influence of genes suggests that they could represent a risk factor for the development of a pedophilic personality, but there is still no conclusive scientific evidence to support this hypothesis.[130] Regarding the influence of gut bacteria on the emergence of pedophilia and the formation of pedophilic personalities, there have been no clear studies found that report a definitive connection between gut bacteria and a pedophilic personality. Likewise, no research has been found studying the transmission of gut bacteria from a healthy heterosexual individual to a pedophilic person. Furthermore, there are no scientific studies that explore the link between gut bacteria, genes, hormones, and nerve cells in the brain, and their potential impact on the development of a pedophilic personality.

A holistic and interdisciplinary approach to studying pedophilia, which would incorporate insights from sociology, criminology, biology, neuroscience, environmental science, psychology, and medicine, could enable a clearer understanding of this disorder, as defined in the DSM-5 diagnostic manual, as well as the broader issue of sexual abuse.

128 Kaplan, M. (2014). *Pedophilia: A disorder, not a crime*. Retrieved November, 27, 2016.

129 Tenbergen, G. ... [et al.]. (2015). The neurobiology and psychology of pedophilia: recent advances and challenges. *Frontiers in human neuroscience*, 9, 344. Available at URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4478390/ (2020-08-20).

130 M Berryessa, C. (2014). Potential implications of research on genetic or heritable contributions to pedophilia for the objectives of criminal law. *Recent Advances in DNA & Gene Sequences (Formerly Recent Patents on DNA & Gene Sequences)*, 8(2), 65-77. Available at URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4393782/ (2020-08-20).

Regarding macrocosmic influences in connection with mesocosmic and microcosmic factors in the occurrence of pedophilic sexual abuse and the formation of pedophilic personalities, there are also no studies that comprehensively address this topic. It seems that an analysis to uncover hidden knowledge and a synthesis of existing insights from various scientific research disciplines would be necessary in this research area.

NT human trafficking is a criminal offense that violates fundamental human rights and involves the unlawful exploitation of individuals for labor or business purposes. The Slovenian Criminal Code addresses human trafficking in Article 113, which states the following:

1. Anyone who, for the purpose of exploiting prostitution or other forms of sexual abuse, forced labor, slavery, servitude, the commission of criminal offenses, or trafficking in organs, human tissues, or blood, buys, takes possession of, houses, transports, sells, hands over, or otherwise deals with another person, or recruits, exchanges, or transfers control over such a person, or facilitates any of these actions, shall be punished by imprisonment of one to ten years and a fine, regardless of any consent by the victim.
2. If the offense described in the previous paragraph is committed against a minor, or through the use of force, threat, deception, abduction, abuse of a position of subordination or dependency, or through giving or receiving payments or benefits to obtain the consent of a person who has control over another person, or with the intention of forcing pregnancy or artificial insemination, the perpetrator shall be punished by imprisonment of three to fifteen years.
3. Anyone who, with the intent to commit acts described in paragraphs one or two, withholds, confiscates, hides, damages, or destroys a public document that identifies the victim, shall be punished by up to three years of imprisonment and a fine.
4. Anyone who knowingly uses the services of a victim of human trafficking, as described in paragraphs one and two, shall be punished by up to three years of imprisonment and a fine.
5. If acts from paragraphs one, two, or three are committed as part of a criminal organization dedicated to such activities, or if a large financial gain is achieved through these acts, the perpetrator shall be punished by imprisonment of three to fifteen years and a fine.

There are various forms of human trafficking focused on acquiring and selling labor, whether in the form of harsh physical work or the exploitation of sexual services, such as prostitution and pornography. Human trafficking is often closely linked with the illegal trade in human organs and drugs. Human traffickers are indiscriminate, dealing in men, women, and children alike. This represents modern-day slavery, a practice that has persisted since prehistoric times.

Human trafficking constitutes a violation of fundamental human rights, involving crimes such as unlawful and callous exploitation, physical and psychological abuse, murder, violence, fraud, and life-threatening injuries. The primary cause of this social anomaly lies in the fact that legally and technologically advanced countries have allowed extreme poverty to spread across much of the world. It is estimated that about 90% of the global population lives in extreme poverty. Such an alarming figure, along with the inability of more developed nations to address the issue, is unsurprising, as poverty remains intense and widespread even within these nations.

Thus, the best strategic prevention would involve influential international organizations and world powers striving to establish appropriate political regimes based on democracy and human rights within these critically poor countries. A second step would involve a more rational and meaningful distribution of wealth. However, the main obstacle to achieving this lies in the raw and egocentric material and positional interests that prevent optimal cooperation and effective communication. Other preventive measures are certainly welcome but, in reality, they merely represent attempts to plug a leaking vessel. The outcome is therefore predictable — the vessel can never be filled even halfway, remaining forever empty.

The motives of human traffickers and criminal organizations are clear: a drive for dominance, the satisfaction of excessive hedonistic desires, and profit. Meanwhile, the consumers satisfy their excessive need for inexpensive services of various kinds.

Human trafficking not only causes social problems but also serious health and biological risks. Human traffickers do not care for the hygiene, nutrition, or health of the people they exploit, which can lead to the spread of harmful microorganisms that can even endanger consumers, further contributing to the spread of pandemics.

Regarding the influence of microorganisms, especially gut bacteria, on the emergence of criminal behavior associated with human trafficking and the formation of such personalities, no studies have been found. Therefore, we can only speculate that certain influences might exist. However, the impact of macrocosmic factors, such as natural disasters and unfavorable climate conditions, appears more tangible, as they, combined with poor social conditions, can further intensify this social anomaly.

NT drug trafficking is a criminal offense committed by individuals and/or organized criminal groups who illegally sell harmful substances such as narcotics, depressants, hallucinogens, and stimulants, creating addiction and causing serious health issues, social problems, and even death. The Slovenian Criminal Code addresses this under Article 186, which defines it as the unauthorized production and trafficking of prohibited drugs. It states the following:

1. Anyone who unlawfully produces, processes, sells, offers for sale, purchases, stores, transports, acts as an intermediary in the sale or purchase, or otherwise unlawfully distributes plants or

substances classified as prohibited drugs or illegal substances in sports, or precursor chemicals used in the manufacture of prohibited drugs, shall be punished by imprisonment of one to ten years.
2. Anyone who sells, offers for sale, or distributes for free a prohibited drug, an illegal substance used in sports, or a precursor chemical for manufacturing prohibited drugs to a minor, a mentally ill person, a person with a temporary mental disorder, a person with severe mental disability, or someone undergoing addiction treatment or rehabilitation, or commits such acts in educational or training institutions or their immediate vicinity, in prisons, military units, public venues, or at public events, or if the act is committed by a public official, a priest, a doctor, a social worker, a teacher, or an educator who exploits their position, or anyone who uses minors to commit these acts, shall be punished by imprisonment of three to fifteen years.
3. If the acts described in the first or second paragraphs are committed by a criminal organization, or if the perpetrator organizes a network of dealers or intermediaries, they shall be punished by imprisonment of five to fifteen years.
4. Anyone who, without authorization, manufactures, procures, possesses, or provides equipment, substances, or precursor chemicals intended for the production of prohibited drugs or illegal substances in sports, knowing their intended use, shall be punished by imprisonment of six months to five years.
5. Prohibited drugs, illegal substances in sports, and materials used for their production shall be confiscated. Vehicles used for the transport and storage of drugs or illegal substances in sports shall also be confiscated if they are specially adapted for such purposes or if the owner knew or should have known they would be used for such activities.
Organized criminal groups involved in drug trafficking are often closely linked to human trafficking organizations, and in some cases, they act as organizers and perpetrators of both social anomalies. These criminal organizations leave behind traces most visible in the form of blood (e.g., contract killings, blood feuds), disease (e.g., viruses, drug addiction), and money (e.g., bank transfers, money laundering on the dark web).
The motives of such criminals are similar to those involved in human trafficking. But what motivates drug users, who often end up becoming severely addicted or dependent? The motives of those who use illegal and harmful drugs can be traced to a spirit of adventure, the desire to enhance physical or mental abilities, or persistent, overwhelming feelings of discomfort or dissatisfaction.
In the case of hard drug users, factors such as gut bacteria, brain nerve cells, and the levels of happiness, satisfaction, and stress-resistance hormones are likely to play a significant role. It can be assumed that for victims of prohibited drugs, microcosmic factors exert a very intense and powerful

influence.[131] In fact, scientists in the fields of microbiology, neuroscience, medicine, and psychopharmacology have identified a close link between the tendency toward addiction and the abuse of various types of drugs.[132] If these biological predispositions are combined with various unfavorable social factors, such as negative social stress, an increase in the number of hard drug addicts or drug users can be expected. Regarding the influence of macrocosmic factors, additional effects on hard drug users could also be anticipated (e.g., excessive rainfall, insufficient sunlight, lunar phases, stronger electromagnetic fields). If favorable microcosmic, mesocosmic, and macrocosmic factors align in relation to drug addiction, we can state with near certainty that many potential and actual addicts will succumb to it.

As an interesting note, let's also calculate the annual energy loss in the form of thermal energy due to the consumption of tobacco, alcohol, and hard drugs. The number of deaths worldwide is estimated at around 11.8 million people per year.[133] This value can be multiplied (similarly to the previously discussed cases) by 2,500 kcal. As a result, we obtain 29,500,000,000 kcal, or 29,500 Gcal, of thermal energy loss on an annual basis. Once again, we are faced with a thermal energy loss equivalent to the output of several nuclear reactors. Many more people die from the abuse of various types of drugs than from cancer. The estimated loss of thermal energy can be considered an optimistic scenario, as many deaths related to drug abuse are not accounted for in this dark area of research. Moreover, drug abuse not only causes death but also leads to various severe diseases, such as viral infections (approximately 1.3 million hard drug users are believed to be infected with HIV) and bacterial infections (around 5.5 million hard drug users are thought to suffer from hepatitis C).[134] The trafficking and abuse of both certain legal and illegal drugs can be classified as serious social anomalies and outrageous systemic failures of societal hierarchical associative systems.

NT juvenile (youth) delinquency/crime also addresses criminal acts committed by minors. These may include all known forms of criminal offenses that can also be committed by adults (e.g., theft, murder, fraud, cyber intrusions, drug trafficking, bodily harm, bullying).

The Slovenian Criminal Code treats juvenile delinquency in a special section.

The motives that drive young individuals onto the path of criminal behavior are well understood by juvenile crime investigators and researchers. However, in my opinion, the greater problem lies in

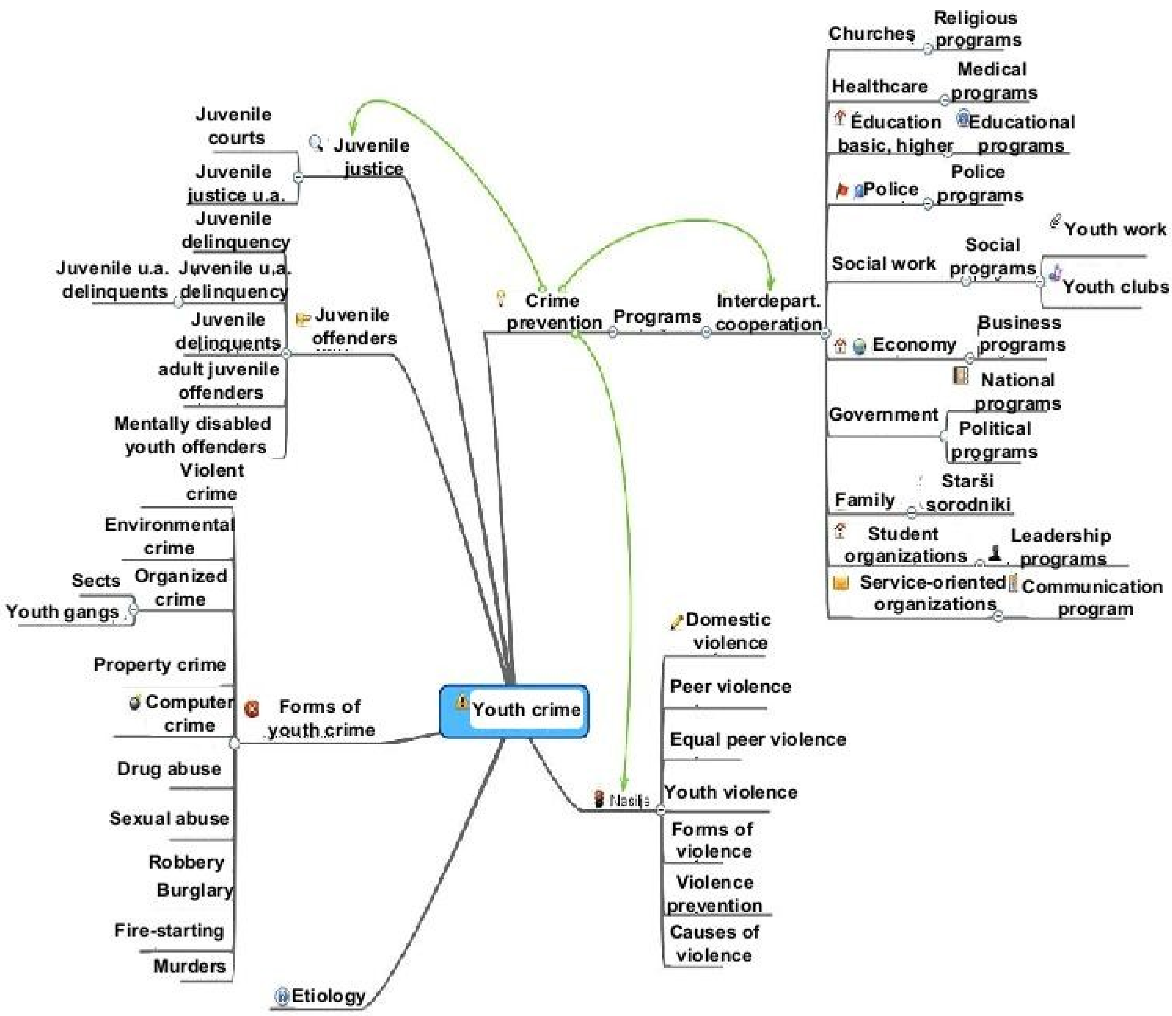
131 Ren, M., & Lotfipour, S. (2020). The role of the gut microbiome in opioid use. *Behavioural Pharmacology,* 31(2&3), 113-121.

132 Meckel, K. R., & Kiraly, D. D. (2019). A potential role for the gut microbiome in substance use disorders. *Psychopharmacology,* 1-18.
Weersma, R. K., Zhernakova, A., & Fu, J. (2020). Interaction between drugs and the gut microbiome. *Gut*. Available at URL: https://gut.bmj.com/content/gutjnl/69/8/1510.full.pdf (2020-08-22).

133 Ritchie, H., & Roser, M. (2019). *Drug use. Our World in Data*. Available at URL: https://ourworldindata.org/drug-use#total-deaths (2020-08-22).

134 Some facts related to drug abuse can be viewed at the URL: https://www.who.int/substance_abuse/facts/en/ (2020-08-22).

the following question: "How can this knowledge and understanding be applied even more effectively in everyday criminological, criminal, educational, social, and other practices?"
This question naturally leads to further ones that rightly highlight the issue of appropriate methods or approaches to preventing and/or suppressing juvenile delinquency.
We also cannot avoid another important question, which builds upon the previous ones: "How can we successfully, humanely, and fairly rehabilitate or redirect young offenders and provide them with a meaningful perspective for a structured life in society?"

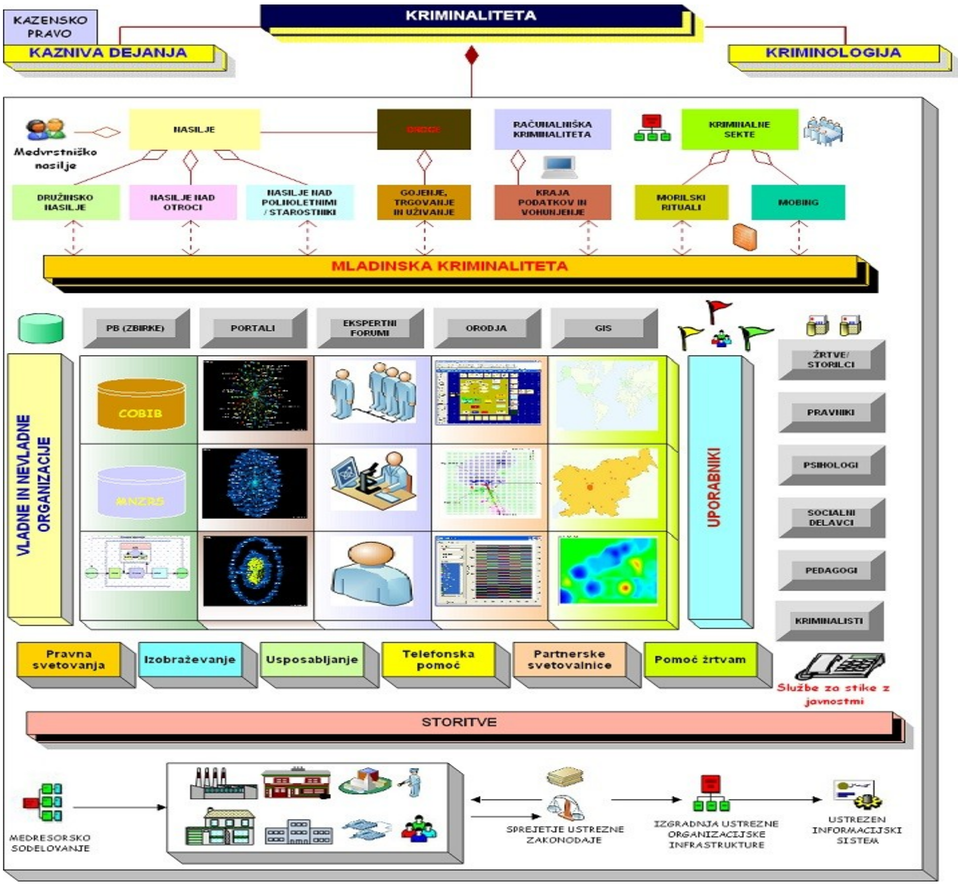


4.8.6.7 Figure 271: Mind map of juvenile/youth delinquency and crime

Figure 271 presents a mind map or content concepts related to the topic of juvenile delinquency and crime.
The content concepts include: youth crime, juvenile justice, juvenile courts, juvenile offenders, youth delinquency, juvenile delinquency, juvenile delinquents, youth offenses, juvenile offenses, juvenile offenders, crime prevention, programs, inter-agency cooperation, churches, religious programs, healthcare, medical programs, education, higher education, educational programs, police,

police programs, social work, social programs, youth work, youth clubs, economy, business programs, state/government, national programs, political programs, family, parents and/or close relatives, student organizations, leadership programs, service-oriented organizations, communication programs, forms of youth crime, violent crime, environmental crime, organized crime, sects, youth gangs, property crime, cybercrime, drug abuse, sexual abuse, robbery, burglary, arson, murder, etiology, violence, domestic violence, peer violence, interpersonal violence, juvenile violence, forms of violence, violence prevention, and causes of violence.

In order to further improve the prevention of juvenile delinquency and crime, a customized UML hierarchical associative diagram can be developed as a draft for the planning and later creation of an intelligent information system for juvenile/youth crime and delinquency.



4.8.6.8 Figure 272: Draft for an intelligent information system on juvenile/youth delinquency and crime

Figure 272 illustrates a draft for designing an intelligent information system on juvenile/youth delinquency and crime, presenting the content components related to juvenile/youth delinquency and crime and associated topics.

It includes various pre-prepared queries, access to databases, access to new resources (e.g., a compiled bibliography on youth crime), and other useful online links (e.g., to expert systems). The idea behind the presented draft moves toward the following efforts:

- Useful information gathered in one place (saving energy and time in searching),
- Clearly organized information,
- Fast information flow (e.g., exchange, notifications, good access to information, quick response to users),
- Bringing government and non-government organizations closer together,
- Opening new services that may benefit users (e.g., monitoring and analyzing user activities within the web information system),
- Inter-agency cooperation,
- Linking to appropriately related information systems (e.g., information system on domestic violence).

The description by content blocks follows:
- Top: Main dark blue-yellow block – emphasizes the link to the information system on domestic violence.
- Top: Main orange block – a title block (for pre-prepared Google search queries in different languages) aimed at educational purposes related to new findings on juvenile delinquency.
- Gray horizontal buttons define the information offerings on juvenile delinquency, e.g., databases (prepared search queries on youth crime on COBIB, a compiled bibliography (including indexes) on youth crime in the MNZRS local database, and a database on programs for violence and juvenile delinquency prevention), portals, experts (with a notable illustration of an expert with a microscope linking to an expert system, tools, and geographic information systems – GIS – for spatial monitoring and analysis). Within each field, there are icons representing the following content blocks:
- Vertical yellow block on the left contains a web link to pre-prepared queries in different languages on Google regarding juvenile delinquency prevention.
- Vertical light blue block on the right is intended for users and includes prepared queries in different languages about researchers, social workers, lawyers, and psychologists active in the field of juvenile delinquency. A small illustration of four people highlights the content of non-governmental and governmental organizations actively engaged in youth crime prevention and drug abuse prevention.
- Gray buttons on the right illustrate various types of users (e.g., victims/offenders, lawyers, psychologists, social workers, educators, and criminalists). Below this is an image of a phone representing public relations services focused on juvenile delinquency prevention.
- Horizontal pink block at the bottom represents services, including educational activities, effective partnership development, and group participation.

- Lastly, inter-agency cooperation is displayed (see bottom: inter-sector cooperation) between business sectors, schools, family communities, governments/ministries, media, church institutions, the police, and various social work centers. Strengthened cooperation across different sectors should enable more effective prevention of violence and juvenile delinquency.

The essential purpose of the proposed intelligent information system on juvenile delinquency would be to provide educational and informational content, enable free-of-charge contacts with various advisors (e.g., lawyers, social workers), support social networking, and analyze juvenile delinquency, ultimately aiming to prevent criminal acts committed by juvenile offenders.

Juveniles represent a crucial entity for the human population, as they preserve our lineage and advance the knowledge accumulated so far.

An increase in juvenile delinquency is a deeply alarming signal for society.

Young people, like adults, need respect and recognition. In my opinion, respect and recognition from adults improve their inner feelings. However, respect and recognition cannot have positive effects if ethical and moral values are absent. Young people learn these values directly or indirectly from adults.

Successful social behaviors must be connected with positive ethics and morality, not with aggression and excessive greed, but rather with empathy toward others and general societal and natural progress.

On successful behavioral patterns based on positive ethics and morality, future societies must build their developmental informational timelines, especially with the support of mass media.

New forms of criminal behavior (not only among youth) are constantly emerging, alongside an increasing diversity of their activities.

Today, minors can engage in types of crime that were not even possible a hundred years ago (e.g., cybercrime, hacking, financial fraud).

How do criminal careers of young people begin today?

What is the philosophical view of the meaning of life from the perspective of young people?

To what extent do young people react to environmental stimuli reflexively and/or rebelliously?

These are crucial questions requiring appropriate theoretical and practical cultural responses.

Mesocosmic influences on the emergence of juvenile delinquency seem crucial, as demonstrated by scientific and professional works from criminologists, criminalists, sociologists, and psychologists. They most often examine the factors of upbringing, social relationships, and psychological states among minors.

What about microcosmic influences on the emergence of juvenile delinquency and the development of criminal youth?

Connections between the information channels of gut bacteria and nerve cells in the brain, and hormones of happiness, satisfaction, and resilience to negative stress are still insufficiently researched. These factors could potentially have an even stronger influence on minors.
Similarly, macrocosmic influences remain largely unexplored.

NT murders are criminal acts where a person and/or a group of people take the life of another person and/or another group of people without invoking self-defense.

The Slovenian Criminal Code states the following in Article 116:

Whoever murders another by taking their life

1) in a cruel or treacherous manner;

2) due to actions taken in the course of official duties to protect public safety, during a pre-trial procedure, because of decisions made by public prosecutors, because of judicial proceedings or decisions made by judges, or because of reporting or testifying in court proceedings;

3) because of a violation of equality;

4) out of murderous intent, greed, in order to commit or conceal another criminal offense, out of ruthless revenge, or out of other base motives;

5) by an act committed within a criminal organization established to carry out such acts,

shall be punished with a prison sentence of no less than fifteen years.

There are different types of murders and different types of murderers.

A wide range of scientific and professional sources are available on this topic.

In this section, we will focus specifically on serial killers in connection with microcosmic, mesocosmic, and macrocosmic influences.

Based on various biographies of serial killers, we can observe that the triggers for their killing sprees are often linked to sexual abuse, fear of abandonment, poor family relationships, drug abuse, injuries, and illnesses.[135] Motives manifest in various forms, such as occult beliefs, the desire to acquire money and material goods, the calming of an excessive sexual drive, the pursuit of heroism or martyrdom, overcoming a loss of meaning in life, neutralizing external and internal conflicts, fighting against negative stress factors that cause constant discomfort and physical pain, the desire for control and dominance over both victims and one’s own emotions, betrayal by a loved one, ambition and the desire for attention, cannibalism, and others.

Motives are realized through actions accompanied by a modus operandi.

135 Philbin, T., & Philbin, M. (2009). *Killer Book of Serial Killers: Incredible stories, facts, and trivia from the world of serial killers*. Sourcebooks, Inc.

Serial killers often use deadly weapons such as pistols, rifles, knives, ropes, cables, pillows (for suffocation), various types of poison, occult and religious rituals involving the torture of the victim, and so forth.

It is extremely common for the victims of serial killers to be sexually abused and humiliated, indicating an explosive activation of sexual drive, which is believed to release large amounts of happiness and satisfaction hormones.

This represents an individual misuse of the body's biological "drugs," potentially triggering a state similar to addiction to hard and soft drugs.

At this point, we can connect the previous discussions on drug addiction with the microcosmic influences that originate within our bodies.

Research findings on addiction to hard and soft drugs have already shown a relatively strong link between the gut microbiological network, hormones, neurotransmitters, and nerve cells in the brain, all of which affect different patterns of eating, smoking, drinking, and even deviant behaviors.

It appears that the excessive abuse of biological "drugs" in combination with negative stress factors could have a similar effect on human behavioral patterns.

If we further account for the strong symbiosis between human genes and microbiological networks, the picture of microcosmic influence on human behavior becomes even more powerful.[136] To these influences, we can also add various macrocosmic factors (e.g., the sun, climate), which undoubtedly have a certain impact on our inner world.

It can be assumed that different exothermic and endothermic reactions occur among microcosmic, mesocosmic, and macrocosmic factors, resulting in the formation of more or less complex networked compounds.

These compounds operate on the principles of hierarchy and association, functioning either as stable or less stable formations.

The more stable formations of these networked compounds can become pathological behavioral patterns, which often do not change even over longer periods of time.

Some formations arising from the interplay between the micro-, meso-, and macrocosmos are more predictable and likely, while many others are not, as our scientific and research capabilities are significantly limited in comparison to the vast complexity of this "great trinity."

The emphasized anthropocentric dominance of the mesocosmos is more or less pathological, which, of course, is not surprising and should not be interpreted as a negative characteristic.

136 McDonald, D. ... [et al.]. (2018). American Gut: an open platform for citizen science microbiome research. *Msystems*, 3(3), e00031-18. Available at URL: https://msystems.asm.org/content/3/3/e00031-18 (2020-08-24).

Nevertheless, a deeper reflection is needed on the extent of influence that both microcosmic and macrocosmic factors have on the occurrence of murders and the emergence of serial killers.
Reality, in a broader sense, is not solely shaped by anthropocentrism and, consequently, the mesocosmic image formed within our minds.
NT state crime, or criminality committed by the state, can be defined from a systemic perspective — as a serious systemic flaw or defect that causes the state to suffer more or less severe losses in the form of material and/or moral goods.
We must ask ourselves whether such systemic flaws were caused intentionally or whether they arose as unintended side effects of legal, organizational, economic, or informational activities.
It can be stated with full certainty that state criminality is not the result of linear processes operating through small networks.
State criminality is predominantly the result of nonlinear processes (which are sometimes even systemically directed) that actually unfold through larger or extensive social networks in the form of negative outcomes (e.g., loss of large amounts of financial resources, loss of national reputation, loss of knowledge, promotion of violence through mass media).
The source of state criminality is certainly not located at the lower, middle, or even higher levels of the social hierarchy; rather, it must be traced at the very highest levels of the state.
In short, the social phenomenon of state criminality does not arise from the bottom up but rather from the top down.
The negative outcomes then often become visible even at the lowest levels of the social hierarchy.
But who are the actors executing such criminal outcomes (outputs)?
In cases of state criminality, there is always only one principal actor — the state itself!
And what elements constitute the state?
The state as a legal entity is composed of (citizens?!?), the legislative, executive, and judicial branches.
The state is an important part of society, yet criminality represents a negative social phenomenon.
Social activities, and thus state activities, can generally be segmented into negative, indifferent, and positive categories.
More precisely, social activities can be divided into the following: ECONOMIC, POLITICAL (e.g., ideology), LEGAL (e.g., human rights, social rights), EDUCATION, SCIENCE, CULTURE (e.g., art, museums, galleries, religion), SPORTS, HEALTHCARE, SOCIAL WELFARE, CHILDCARE, DISABILITY SERVICES, SOCIAL INSURANCE, and OTHERS (e.g., ecological or environmental).
These societal activities also operate at the state level.

Within these activities, alongside constructive efforts, destructive activities in the form of various types of criminality continually emerge.

If the perpetrator is the state itself, we may speak of state criminality, which, in all its anomaly, more or less distorts the previously mentioned social activities.[137]

Based on various activities, we can define systemic inputs and even name systemic outputs — for example, in the form of positive business outcomes or, in negative terms, as economic damage resulting from economic criminal activities.

The processes or different pathways that direct the inputs toward various outputs often escape the observers of the system unless they monitor them closely (the next stage would be analysis and synthesis, followed by regulatory systemic measures, such as amending outdated laws or changing inadequate organizational structures).

How can phenomena such as terrorism arise, and through which societal activities does it originate?

Societal activities, when driven by raw interests — or more mildly put, "hyperactive needs/desires/fears" — can represent the cause that subsequently triggers one or more negative effects or consequences.

It is interesting to note that the Slovenian Criminal Code does not explicitly address state criminality, which presents a relative paradox, since criminality stimulated from the highest branches of state power cannot be classified as a criminal offense.

This may imply that a particular state could actively support international terrorism without facing punishment under existing criminal codes.

Typically, other states — particularly superpowers — respond with other forms of punishment, such as the closure of business channels, cutting off the supply of raw materials, economic embargoes, or exclusion from various international organizations.

We will now continue by presenting the diverse content structure of state criminality through the visualization technique of a mind map.

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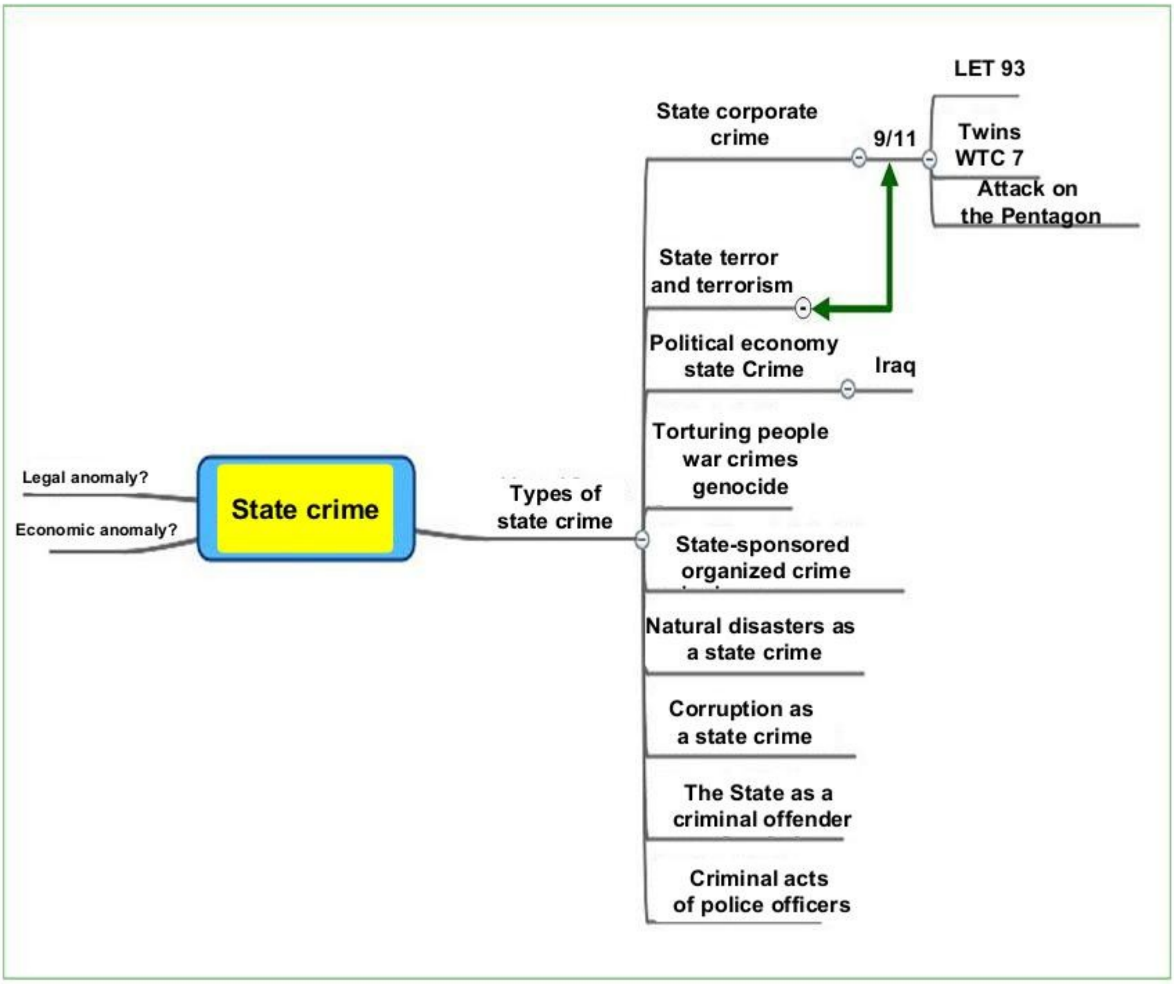
137 Friedrichs, D. O.(1998). *State crime*. Volume 1, Defining, delineating.
Bjørgo, T.(2005). *Root causes of terrorism : myths, reality and ways forward*. London, New York : Routledge.
Green, P. & Ward, T.(2004). *State crime : governments, violence and corruption*. London, Sterling (VA) : Pluto Press.



4.8.6.9 Figure 273: The content structure of state crime

Figure 273 presents a mind map or conceptual framework related to the topic of state crime or criminality.

The content concepts are as follows: types of state criminality; criminal acts committed by police officers; the state as the perpetrator of criminal offenses; corruption as a form of state criminality; natural disasters as state criminality; organized crime supported by the state; torture of individuals; war crimes; genocide; the political economy of state criminality (e.g., Iraq); state terror; terrorism (e.g., the year 1993, WTC7 in 2001, the attack on the Pentagon); and state corporate criminality. Based on these numerous content concepts, it is possible to create a structural diagram.

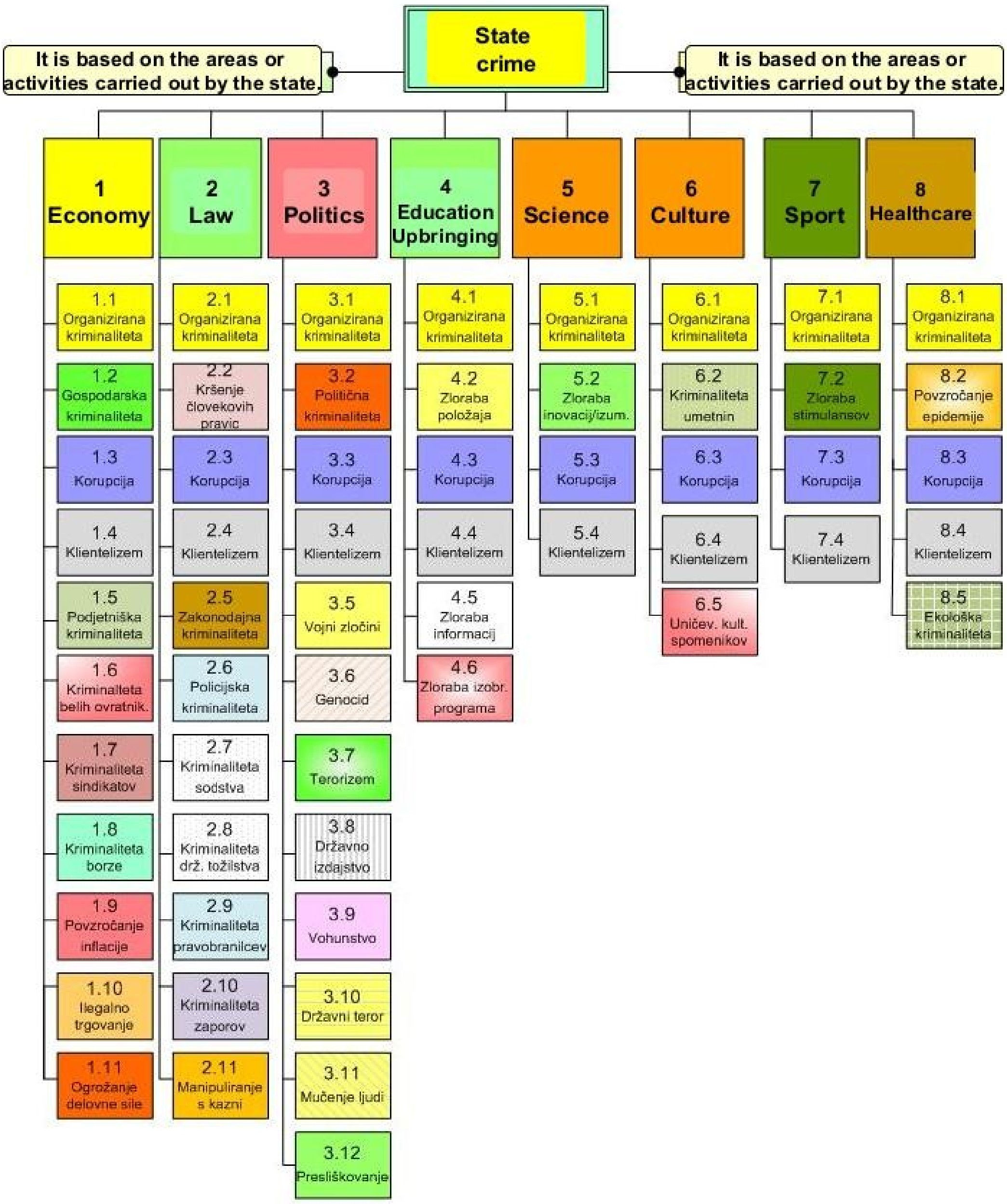
With the help of such a structural diagram, we can highlight the areas and activities that every civilized state covers or carries out.

In addition to lawful and proper operations, states also engage in irregularities and, in more severe forms, even various types of criminality.

The entity "STATE" can be viewed from legal (e.g., it has a lifelong population, its own legislation, administration, police, military, defined territory, government, and the capacity to engage with other states) and/or political, economic, geographic, cultural, sociological, and developmental perspectives.

From these various perspectives, we can reach the shared conclusion that the state carries out numerous and diverse activities — unfortunately, criminal ones must also be included.

More on this will follow.



4.8.6.9.1 Figure 274: Structural diagram of state domains and activities and various forms of crime or criminality

Figure 274 presents a structural diagram of the domains (very similar to a structural diagram of conspiracies) in which the state is involved, as well as various forms of crime or criminality.

Criminality or crime can be the result of different activities that the state (mostly) carries out in contradiction to the paradigm of social welfare and the rule of law.

By no means are all forms of criminal activity listed here.

The structural diagram in this case illustrates the broad spectrum of domains that a given state engages in, and consequently, as part of the systemic output, also displays the previously mentioned negative outcomes.

The domains and criminal activities are as follows:

- Point 1 to 1.11 → ECONOMY (e.g., organized crime, economic crime, corruption, clientelism, corporate crime, white-collar crime, union-related crime, stock market crime, causing inflation, illegal trade, endangering/sacrificing the labor force).
- Point 2 to 2.11 → LAW (e.g., organized crime, human rights violations, corruption, clientelism, legislative crime, police crime, judicial crime, prosecutorial crime, state attorney crime, prison-related crime – legislative aspect, manipulation of penalties).
- Point 3 to 3.12 → POLITICS (e.g., organized crime, political crime, corruption, clientelism, war crimes, genocide, terrorism, treason, espionage against national security, state terror, torture, wiretapping).
- Point 4 to 4.6 → EDUCATION (e.g., organized crime, abuse of authority, corruption, clientelism, misuse of information, manipulation of educational programs).
- Point 5 to 5.4 → SCIENCE (e.g., organized crime, misuse of innovations/inventions — causing natural disasters, corruption, clientelism).
- Point 6 to 6.5 → CULTURE (e.g., organized crime, art crime, corruption, clientelism, destruction/sale of cultural monuments).
- Point 7 to 7.4 → SPORT (e.g., organized crime, abuse of stimulants, corruption, clientelism).
- Point 8 to 8.5 → HEALTHCARE (e.g., organized crime, causing epidemics, corruption, clientelism, ecological crime).

Based on Figure 274, it can be observed that organized crime, corruption, and clientelism occur in all eight points, whereas other forms of criminality are too specific to be grouped under a common denominator.

The topic of state criminality is extremely diverse and therefore requires an interdisciplinary, holistic, and complex-systems approach (involving intricate networks).

The impact of state criminality on the population of a given state often remains hidden for a long time, only to suddenly erupt like a torrent — in the form of a major terrorist attack, an economic crisis, a war, an ecological disaster, etc.

State criminality or crime is comparable to a dangerous and insidious cancer, which in many cases cannot be detected in time and therefore cannot be prevented at an early stage.
Especially dangerous are the unconscious or semi-conscious actions of main actors who either pass or fail to pass certain laws, support or fail to support specific research projects, and so on.
Equally dangerous are the organized activities of key figures at the highest (visible and invisible) levels of state functions, since wars, social problems, economic difficulties, ecological collapse, etc., do not arise from sudden whims of nature and society, but are the result of long and persistent processes of numerous harmful irregularities.
Time and time again, humanity circles around the sun, and the problem of how to effectively and fairly distribute the "CAKE" (a metaphor for wealth or resources) among members of societal systems reappears — in order for these systems to function optimally.
Another problem, somewhat linked to the previous one, is that human civilizations struggle greatly with planning their own needs.
Somewhere within this tangled Gordian knot begins the worst form of all criminality: STATE (CRIME) CRIMINALITY!
This field is so complex and challenging that even using the mesocosmic level of analysis, it is difficult to explain it properly. It could become even more demanding and complex if the cosmic planes — namely the microcosm and the macrocosm — were also taken into account.
At the highest hierarchical levels, certain segments of visible and invisible power representatives simultaneously sustain the system and exploit systemic loopholes to satisfy their excessive needs for dominance and material wealth.
In our own bodies, certain organisms — such as parasitic bacteria and harmful viruses — operate in a similar way.
Bacteriophages are viruses that, on one hand, assist in defending the immune system by destroying harmful bacteria through social networks and mutual communication, but on the other hand, they also pursue their own interests by killing beneficial bacteria within our bodies.
This can be somewhat compared to certain branches of national defense and intelligence services, which, while meant to uphold national security, can drift away from the paradigm of a free and lawful state and instead pursue self-serving hedonistic and dominance-driven goals.
We must also not forget the greedy human brain, which appropriates the largest share of the body's nutrients, particularly in the form of sugar.
We can view these internal processes in the body as a more or less precise two-way reflection between the microcosm and the mesocosm, and vice versa.

Although the effects of the macrocosmic plane might seem weaker due to its greater distance, the two-way reflections among the macrocosmic, microcosmic, and mesocosmic planes cannot be excluded.

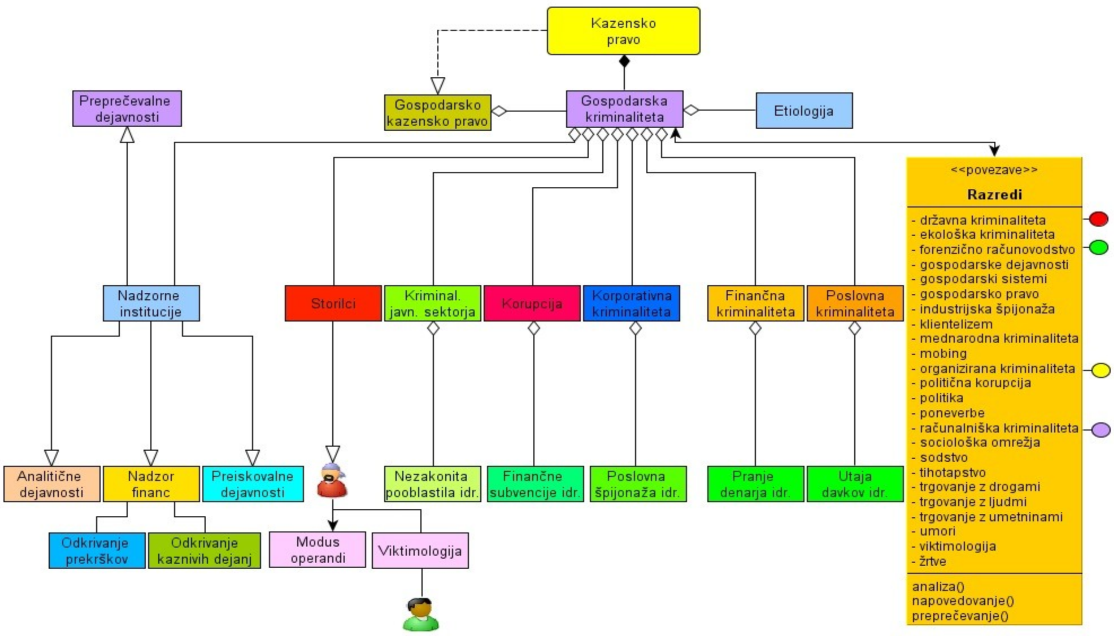
Thus, state criminality can be seen as the product of diverse and complex reactions, functioning also on the principle of mutual reflections between these three cosmic planes.

Similar reactions can occur in stages, and sometimes even simultaneously, across all three planes.

NT economic crime refers to criminal acts typically committed by organized groups of people and even by states within the sphere of economic activities (e.g., agriculture, forestry, fishing, hunting, industry, mining, construction, energy, trade, tourism, transport, banking, healthcare, education, public administration), which cause financial, material, and/or moral damage (e.g., loss of reputation of a company or the state) both to organized labor groups and to the state itself.

The Slovenian Criminal Code addresses economic crime as offenses against the economy (from Article 225 to Article 250).

This category includes various provisions and prescribed penalties for offenses such as restriction of competition, business fraud, money laundering, smuggling, tax evasion, misuse of non-cash payment instruments, forgery of securities, counterfeiting of money, illegal giving and receiving of gifts, abuse of position or trust in economic activities, manipulation of the financial instruments market, misuse of insider information, and abuse of information systems, among others.



4.8.7 Figure 275: Adapted hierarchical associative UML diagram of economic crime and related fields

Figure 275 shows an adapted hierarchical associative UML diagram of economic crime and its related fields. Criminal law is presented as a superior category in relation to economic crime, indicated by a connection with a black diamond. Criminal law includes economic criminal law (see the dashed connection with a triangle at the end), which is simultaneously subordinate to the field of economic crime (see the connection with a white diamond).

The etiology of economic crime is also subordinate to economic crime (see the connection with a white diamond), as it focuses on finding and researching the causes behind its emergence. Another subordinate category is perpetrators or "white-collar" criminals, whose modus operandi must be closely examined (see the connection with a white diamond). They are associatively linked (see the straight line) with the victims of economic crime. Victimology, within criminological science and criminalistics, deals with the study of these victims.

Economic crime can be divided into public sector crime (e.g., abuse of authority, unlawful authorizations), corruption (e.g., suspicious financial subsidies, approval of questionable loans to unprofitable companies), corporate crime (e.g., corporate espionage, social engineering), financial crime (e.g., money laundering, bank fraud), and business crime (e.g., criminal acts in agriculture and industry). These types are subordinate units of economic crime, as illustrated by the connections ending with a white diamond.

Economic crime can be an extremely effective tool for perpetrators connected to the state, making the boundary between the two types of crime often very thin.

On the right side of the adapted UML diagram, there is a two-way associative dependency between economic crime and other fields (e.g., forensic accounting, environmental crime, state crime, international crime).

The left side of the diagram suggests that preventing economic crime is reasonable, although often nearly impossible, especially when state authorities are involved in corrupt activities. Prevention should be pursued by supervisory institutions engaged in analytical, monitoring, and investigative work.

Perpetrators of economic crime or "white-collar" criminals typically have very high demands, needs, and desires for dominance, control, and profit, particularly in the form of money and material goods. To achieve their ambitious goals, they must invest significant energy, which leads to negative stress—mainly psychological, performance-related, and social—for themselves and the wider population.

Even after successful criminal endeavors, this vicious cycle does not end but repeats itself continuously.

Such perpetrators, driven by the lust for dominance, control, and wealth, must repeat these actions to maintain feelings of happiness and satisfaction. This dependency can be partly genetically conditioned, while at the same time fatal links strengthen between bacterial networks in the gut, hormones, neurotransmitters, and the brain. In this way, perpetrators are largely influenced by these microcosmic factors.

Mesocosmic factors then further reinforce this fatal dependence on "biological drugs" within the interpretation context of events.

Finally, macrocosmic factors—especially economic activities such as agriculture, forestry, and fishing—significantly influence the emergence of economic crime, as they provide both opportunities and threats for the execution of economic criminal scenarios.

It appears that the previously discussed DIHAM model could be effectively and comprehensively applied to explain economic crime.

NT computer crime is a negative social phenomenon involving criminal acts by individuals, groups, companies, and/or states through the use or abuse of computers and other information technology for the unlawful acquisition of monetary assets, material wealth (e.g., real estate, land), sensitive information (e.g., identity theft, concealment of important information), information dominance (e.g., manipulation of public information, information monopolies), and more.

Typically, systemic intrusions target other computer and/or information systems, where the perpetrator or perpetrators attempt to obtain information, gain control over the system, or damage or destroy it. This is carried out using programming tricks and modern information technologies.

Another form of intrusion is usually social engineering, where an organized group of people, often through personal contact, gathers information about a specific computer and/or information system. Employees in the IT field may be too trusting and knowingly or unknowingly divulge important system information, thereby enabling hackers to break into the system at a later stage.

The Slovenian Criminal Code addresses attacks on information systems in Article 221 and abuse of information systems in Article 237.

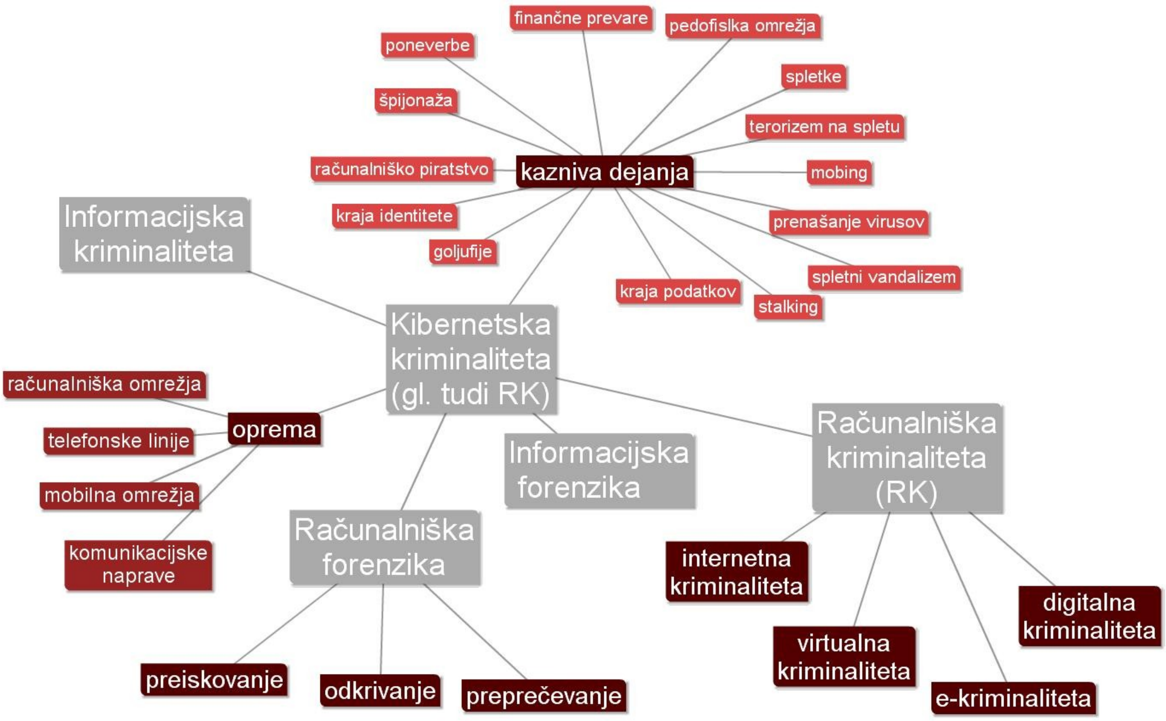
In the past twenty years, computer crime has grown dramatically, mainly because computers have permeated not only the business and academic spheres but also everyday life and activities. Even a basic conceptual analysis of computer crime reveals its extensive scope.

Today, it is nearly impossible to imagine the normal functioning of society and individuals without information technology.

Computers are complex machines that largely have a positive impact on society's functioning. However, it is crucial to also highlight the dark side of their use, especially in social spheres.

On one hand, networking computers has enabled faster communication between people; on the other hand, it has significantly increased the risks of systemic vulnerabilities that allow for various abuses of data (e.g., data theft, identity theft, cyber espionage, pedophile networks, terrorist networks, online social engineering).

Such abuses can be extremely serious and, although indirectly, can even endanger human lives. Another important negative consequence that must be highlighted is the reduction of social sensitivity toward others and the promotion of an unhealthy, physiologically passive lifestyle. Excessively socially isolated individuals can quickly become targets of experienced virtual criminals.

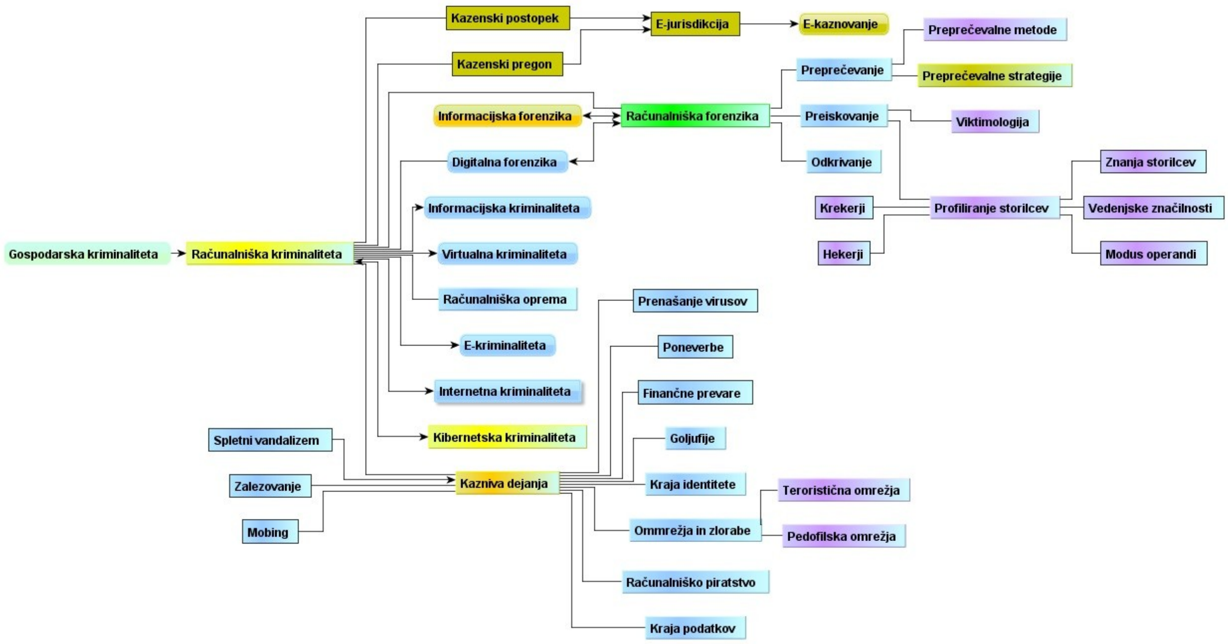


4.8.7.1 Figure 276: Mind map of computer crime

Figure 276 shows a mind map or conceptual framework of computer crime. The main concepts are as follows:

- Cybercrime (see also CC)
- Technical infrastructure: equipment, communication devices, mobile networks, telephone lines, computer networks
- Criminal offenses: fraud, data theft, identity theft, espionage, computer piracy, embezzlement, financial fraud, virus transmission
- Online dangers: pedophile networks, cyber terrorism, online schemes, mobbing, stalking, cyber vandalism
- Related terms: computer crime (CC), internet crime, digital crime, virtual crime, e-crime, information crime
- Computer forensics: detection, investigation, prevention

The next illustration will also be interesting, as it shows the connection between economic crime and computer crime.



4.8.7.2 Figure 277: The link between economic and computer crime

Figure 277 illustrates the connection between economic and computer crime, representing a highly organized form of criminal activity that stems from economic activities and is carried out through the use of computers and modern information technology.

Computer crime can be linked to information crime, virtual crime, misuse of computer equipment, e-crime, internet crime, and cybercrime.

Forms of known criminal offenses in the area of computer crime include: cyber vandalism, cyberstalking, online mobbing, virus transmission, embezzlement, financial fraud, business fraud, identity theft, abuses on social networks (e.g., terrorist networks, pedophile rings), computer piracy, data theft, and theft of financial assets, among others.

Computer forensic sciences—such as digital, information, and computer forensics—investigate and examine these offenses with the goal of collecting evidence. With undeniable evidence, a criminal procedure and prosecution can be initiated against the offender(s), leading to a court trial and sentencing.

Besides collecting evidence for court proceedings, computer forensics also focuses on preventing computer crime, studying and investigating victims (victimology), and profiling perpetrators (e.g., hackers, crackers), analyzing their modus operandi, behavioral traits, skills, and abilities.

One of the greatest challenges is computer crime on the dark web, where numerous criminal activities are conducted. These activities are relatively well known to the public but occur in different forms due to the use of digital media. They include drug trafficking, arms trafficking, human trafficking, money laundering, and contract killings.

In addition, there are lesser-known criminal activities, such as stock market manipulation, corporate and even state investments in suspicious and risky ventures, pedophile rings involving child sexual abuse, the sale of poisons, harmful bacteria and viruses, trafficking of unconventional weapons based on micro- and electromagnetic waves, and bionic products used for espionage or even assassination.

Various forms of online manipulation and mobbing against individuals, groups, companies, or states are also carried out on the dark web.

The problem lies in the fact that many forms of crime occurring on the dark web are still unknown. Moreover, they take place covertly and behind the scenes, making effective oversight extremely difficult.

As with other forms of crime, the question arises of how microcosmic, mesocosmic, and macrocosmic influences affect the emergence of computer crime and the formation of criminal personalities.

Computers and computer networks can, to some extent, be seen as reflections of the functioning of the human body, mental processes, social interactions, and even macroscopic networks such as networks of stars and planets.

This technological development is constantly evolving, increasingly mirroring the perception of reality across all three cosmic levels.

Based on this assumption, we can conclude that the microcosm had a significant influence on the creation of computers and computer networks. However, it is likely that the development of these technologies evolved as a synthesis of knowledge and insights from all three levels.

A similar assumption can be made regarding the emergence of computer crime and the formation of offenders, where microcosmic and macrocosmic influences operate primarily at the subconscious level, while mesocosmic influences are more the result of conscious thought and action.

The main triggers for the development of computers, computer networks, and computer crime are human desires and needs for hedonism and dominance. On one hand, it is about simplifying everyday activities, while on the other, the excessive need for pleasure and control brings additional complications, including the expansion of computer crime and other forms of criminality.

The DIHAM model could enable a more comprehensive study and investigation of computer crime and the formation of its perpetrators.

A similar hypothesis could also apply to computer and other technological forms of communication (e.g., telephone, mobile phone, tablet). In this context, we might recall the biological "telephone switchboard" in our brains, which existed long before the invention of the telephone and the later development of telephone exchanges at the mesocosmic level.

We continue with the subsection on lesser-known forms of crime, which could be described as fictional crimes, since their existence cannot yet be proven. This means they cannot yet be classified as criminal offenses.

4.8.7.3 Less known or fictional forms of crime

Before presenting the study on three cosmic influences on crime occurrence, a brief overview of less known or fictional types of crime will be provided.

A. Lesser-known or fictional crime related to deviant sexual orientations

We have already observed that the crimes committed by serial killers are often sexually motivated. Similarly, it can be inferred that crimes may also be committed by individuals or even organized groups with pronounced sexual deviations. In this critical group, we primarily include individuals with pedophilic and sadistic tendencies, as they frequently form social networks centered around sexually motivated content.

In contrast, individuals exhibiting other types of sexual deviations (such as exhibitionism, gerontophilia, voyeurism, excessive masturbation, and masochism) usually do not share their deviant sexual interests with like-minded others. However, in the case of some pedophiles and sadists, there is an extremely strong sexual motivation, expressed mainly through a need for dominance, creating favorable conditions for organized social networking.

Pedophilic and sadomasochistic social networks are most active on the so-called dark web, where effective monitoring is lacking, allowing them to fully realize their distorted sexual fantasies.

In most cases, these individuals are addicted to hormones related to happiness, satisfaction, and feelings of power. Due to these extreme needs, they often dedicate their entire lives to these obsessions, sometimes further intensified by an excessive desire for wealth. Such an environment fosters various forms of crime.

Much like some serial killers, these sexual offenders also tend to collect "trophies" from their victims, often by recording and distributing footage of sexual abuse on the dark web.

Pedophilic criminal organizations and social networks

1. Sadistically oriented criminal groups

These groups are extremely cruel and often involve children in dark scenarios of abuse. Sadistically oriented perpetrators often hide under the guise of occult sects or satanic cults. Based on available data, it can be assumed that victims of such groups are often subjected to occult rituals, which may involve sacrifices or training to become future "black priests" or slaves. Later, these individuals may develop their own criminal careers within organized occult groups.

2. Pedophilic criminal organizations ordering child abductions

Statistics on missing children around the world show alarmingly high numbers. It is important to note that official statistics only reflect a fraction of the actual number of missing children. Based on this data, it can be assumed that a well-organized criminal network is responsible for such high numbers.

To provide a better understanding, a table with data on missing children in certain countries on an annual basis (based on cautious estimates) will be presented later.[138]

4.8.7.3.1 Table 143: Estimated number of missing children by selected countries on an annual basis

Države	Estimated number of missing children per year
Avstralia	20000
Canada	45288
Germany	100000
India	96000
United States of America (USA)	460000

Table 143 presents a rough estimate of the number of missing children annually in several countries: Australia (20,000 children), Canada (45,288 children), Germany (100,000 children), India (96,000 children), and the United States (460,000 children). According to estimates for the year 2019, on average, one out of every six cases of missing children involved child trafficking for sexual exploitation.[139] Victims are often forced into prostitution, the recording of sexually explicit material, and the recruitment of new child victims. Their further development can follow various, typically dark, paths. In adulthood, some may find themselves assuming the role of their former abusers and adopting their methods, becoming victims of murder, becoming involved in drug trafficking, or falling into drug addiction themselves.

In cases involving both pedophilic and sadistic occult organized crime groups, victims most often face two main outcomes: death or a criminal career. This forms a sinister cycle that not only exists but is continually strengthening, evolving, and becoming increasingly dynamic, raising serious concerns.

Within these criminal organizations, influential individuals from sectors such as politics, mass media, the film industry, modeling, popular music, business, healthcare, national security, law enforcement, and others may be involved, further supporting and protecting the existence of these organized criminal structures.

138 Data obtained from URL: https://globalmissingkids.org/awareness/missing-children-statistics/ (2020-08-28).
139 Missing children statistics available at URL: https://www.missingkids.org/footer/media/keyfacts (2020-09-01).

This leads to the conclusion that child victims, as adults, can become tools for fulfilling the dominance needs of these powerful individuals, being involved in espionage, contract killings, organized drug trafficking, pimping, burglary and robbery, violent assaults, scheming, framing others, workplace bullying, stalking, and other illegal or borderline illegal activities.

Thus, children are not only victims of physical and sexual abuse, but their exploitation often continues into adulthood through involvement in criminal or suspicious activities, the full extent of which can only be speculated. At this point, we are approaching a more fictional level of study, as organized criminal groups often operate similarly to corporations or even states, with their activities frequently overlapping with those of legitimate businesses and government institutions at both national and international levels.

When influential individuals are involved in the abuse of children, it is possible to assume the existence of an entire chain of criminal activities that do not end with just one generation.

Child victims, especially those abducted from impoverished parts of the world, often do not report their abusers but instead accept their new reality, which may offer relatively better living conditions. Some even manage to achieve social advancement — a phenomenon known from documented cases involving traditional mafia operations.

B. Lesser-known or fictional crime related to the family

In this brief overview, we will focus on crime connected to families where criminal activities are passed down from generation to generation.

In fictional or lesser-known models of unlawful family structures (e.g., the pedophilic family model, the secret intelligence or espionage family model, the family organ-trafficking model) — as well as within legally recognized family models — various forms of crime can occur.

Even within legally established families, criminal activities sometimes take place, such as drug trafficking, the trade of illegally obtained goods, organizing illegal gambling, arranging illicit animal or human fights (e.g., cockfights, dog fights, human fights), organizing dangerous motorbike and car races, orchestrating theft rings, and trafficking their own children into sex tourism.

Parents, acting as mentors, often pass down criminal behavioral patterns to their children, who then adopt and transmit them to future generations.

In most cases, these criminal activities can be considered a way of life and survival.

In unlawful family models, however, survival is not necessarily the primary motive — more often, it is a pursuit of profitable prestige, aimed at hedonism, wealth, and dominance, with sexual motives often playing a central role.

Additionally, these criminal family structures are sometimes not based on blood relations.

In another context, one can encounter legal family models — such as extended families or families with adopted children — where, despite no visible criminal elements, the way they operate may still have a criminal nature.
Such anomalies often go unnoticed by the public and law enforcement because they operate covertly, behind the scenes.
A seemingly normal family with biological and adopted children can, in its functioning, closely resemble a pedophilic family model. Various forms of psychological and physical abuse are possible.
In very large countries, such as the United States, Australia, China, and Russia, true colonies of adopted children can arise within seemingly normal families — a phenomenon that could be described as modern-day slavery.
These vast countries have many isolated and inaccessible areas where it is difficult for law enforcement or the public to detect such colonies of enslaved adopted children.
In this context, we should not only think of sexual abuse but also consider even more horrific possibilities, such as farms harvesting children's organs.
When adding the kidnapping of children from poor regions of various societal hierarchies into the picture, the scenario becomes even more horrifying.
Poverty provides a favorable ground for the execution of such crimes against children.
In today's world, we are dealing with extremely high proportions of both very poor and very wealthy individuals, meaning that there could exist wealthy families who maintain child slave colonies.
Child victims could also be specially raised for espionage missions, contract killings, drug trafficking, and the smuggling of black-market goods, among other criminal purposes.
There are other possible forms of child exploitation that are difficult even to imagine — such as being subjected to illegal and risky psychological and genetic experiments, potentially at a state level, with very little chance that the public or authorities would ever notice.
A milder version of these crimes would be the careful upbringing and material support of adopted children, who would later, as adults, become loyal servants to the descendants of their criminal "parents."
This type of criminal activity would be the hardest to detect, as even the adopted or kidnapped children might not recognize the exploitation but would instead accept it as their reality.
One can recall historical monarchies, where servants lived to sacrifice themselves for their masters.

Until these possibilities become statistically significant, they remain, based on current knowledge and experiences of the modern world, purely fictional — the kind of material from which literary and film works could be developed.

C. Lesser-known or fictional criminality on the Dark Web

On the dark web, a large segment of society has developed an electronic form, encompassing entirely legal activities, those on the edge of legality, and outright criminal activities.

Hierarchical associative social systems encounter the latter daily.

These are familiar types of crime, such as drug trafficking, contract killings, the sale of black-market goods, arms trafficking, money laundering, illegal gambling operations, and more.

In the material world, law enforcement agencies have greater chances of detecting and prosecuting criminal acts; however, the same does not apply to the dark web.

There, numerous social networks of various criminal organizations operate, communicating and coordinating their illegal activities almost without interruption.

Tracking their communications on the dark web is extremely difficult, as even identifying these groups in the first place is nearly impossible.

The greatest problem arising from this situation is the destabilization of the hierarchical associative social systems, ultimately threatening the values of the rule of law.

Even citizens who appear to lead completely law-abiding lives in the material world can, on the dark web, be leaders or influential members of criminal networks.

They often find it difficult to resist the substantial profits that may far exceed their annual legitimate income.

This issue is even more critical among citizens living at or below the poverty line.

People do not merely want to survive; they strive for a decent and quality life.

Criminal social networks can become powerful magnets, particularly attracting the poorer segments of the population.

This is a strong reason why legally, socially, and technologically advanced countries around the world should intensify efforts to reduce poverty and excessive wealth accumulation.

There is a growing fear that if they do not, criminal social networks will gain even greater control over global affairs.

These criminal networks on the dark web are thriving in part due to the irrational distribution of wealth across social hierarchies.

With the further development and proliferation of humanoid intelligent robots, the situation could tilt even more in favor of dark web criminal networks. In certain respects, the dark web represents a blind spot for any country that strives to operate under principles of legal and social order.

On the dark web, various pyramid schemes using different cryptocurrencies can easily take place, beyond the control of national and international banking systems, making them difficult to monitor. Moreover, in the realm of money laundering, there is a lack of tools and mechanisms capable of detecting illegal financial transfers — particularly in the conversion of illicitly obtained money into cryptocurrencies and then back into traditional currencies. Even harder to control is the conversion of counterfeit money into cryptocurrencies, enabling the purchase of legitimate currencies, real estate, and land.

The same vulnerabilities apply to stock market speculation and investment activities carried out by individuals, organized social networks, and even at the state level.

It is even plausible that military-grade weaponry trafficked through the dark web could end up in the hands of entirely legitimate institutions involved in defense and national security.

We must be aware that hidden and almost untouchable mechanisms operate in the background of the dark web, seriously undermining the paradigm of a legal and social state and paving the way for the rise of criminal anarchy.

This could mean that while the legal and social order may continue to appear functional on the surface, it will increasingly rely on an underlying paradigm of criminal anarchy, fueled by vast dark web social networks.

D. Lesser-known or fictional criminality enabled by modern technology

In the realm of lesser-known or fictional criminal activities facilitated by modern technology, there are only vague assumptions about their existence.

In many cases, such actions are believed to be aimed at remote mind control, particularly targeting influential individuals, although illegal experiments on randomly selected victims are also suspected.

Another purpose of these modern technological weapons is to attempt to damage or even destroy the human bodily system, especially the nervous system within the brain.

Naturally, such criminal activities are extremely difficult to detect, research, or investigate.

The perpetrators could be individuals, but it is more likely that organized formations are behind them — either in the form of less obvious departments within entirely legal institutions or organized criminal groups. These involve weapons that are largely unknown to the public and operate using micro-, electromagnetic, sonic, and laser waves.[140]

140 SOLEILMAVIS, L. (2015). Mind control technology with electromagnetic frequency. "V: *"E-leader* (Fort Lee, N.J. Online). - ISSN 1935-4819. 10(1), 1-12. Available at URL: https://www.g-casa.com/conferences/shanghai/paper_pdf/Liu-mindcontrol.pdf (2020-01-06).
EARTH'S International Research Society. (2011). *Mind Weapon*. Available at URL: https://www.academia.edu/1934233/MIND_WEAPON (2020-01-06).

It is also worth mentioning the international organization for the protection of scientists, which, among other things, also deals with this area.[141] Modern technologies that enable the control of thought and damage to bodily organs often involve weapons incorporating implanted electronic microchips, various forms of nanotechnology, microwaves, and/or electromagnetic radiation.
When living beings, including humans, are intensely exposed to these technologies, they can affect people's behavioral patterns, emotional responses, sensory perceptions, as well as decision-making processes and, ultimately, their decisions themselves.
In cases of misuse, these modern technologies most often operate by targeting the human brain and nervous system.
Essentially, this represents the abuse of technologies or weapons — a practice that is not entirely new; the origins of such outrageous criminal activity can already be traced back to Nazi Germany, particularly during World War II.
Within numerous concentration camps, German scientists worked tirelessly on the possibility of controlling human thought. After the defeat of Nazi Germany, many of the German scientists responsible for numerous crimes — even direct atrocities within concentration camps — were allegedly taken over by certain intelligence agencies in the United States. The aim was to acquire their knowledge of thought control in order to grant the Western powers a prestigious tactical and strategic advantage over the Eastern powers. Based on this ambition, various scientific research projects aimed at human mind control began to emerge in the U.S. (for example, CIA Human Behavior Control – Project Bluebird in 1947, Project MK-Ultra, etc.). Let us now take a brief look at a small excerpt regarding modern technologies that can be used as weapons for the purpose of torture, information extraction, and thought control over individuals.[142]
1. Implanted or fluid-injected electronic chips:
These chips can enable the control of an individual's movements, causing them to react incorrectly in dangerous situations (for example, suffering a serious injury while operating machinery, or causing a major traffic accident because they were unable to properly steer and gradually veered off to the right side of the road).
Abuse of this technology is possible but cannot be proven.
2. Voice-to-Skull Technology (V2K):
This technology can be abused for torture and extracting critical information from individuals.

141 EARTH'S International Research Society Available at URL: https://internationalresearchsociety.wordpress.com/ (2020-09-02)
142 You can read much more about this in the work: EARTH'S International Research Society. (2011). Mind Weapon. Available at URL: https://www.academia.edu/1934233/MIND_WEAPON (2020-01-06).

People experience persistent auditory phenomena not caused by normal external stimuli; rather, sounds are generated directly within the brain using special external devices such as neuro-electromagnetic emitters that combine microwave radiation with silent sound devices transmitting ultrasound into the human brain.
Numerous cases have been reported where individuals suffered from constant auditory hallucinations, yet most of them ended up hospitalized in psychiatric institutions.
Despite strong medication, the sounds did not cease.
In many cases, the sounds suddenly stopped altogether, suggesting that the individuals were no longer being exposed to microwave and ultrasound radiation.
As with the previously mentioned technology, proving the misuse of this method for the purpose of human torture is not possible, since EEG, radiological equipment, and similar devices cannot detect either the microwave signals or the ultrasonic transmissions into the human brain.
3. Thought-reading technology:
This operates by measuring brain activity and stimulating sensory responses without any normal external stimuli.
The term "psychotronics" was coined to describe the influence of electromagnetic waves on the human psyche.
With the help of this technology, it is possible to extract critical information, manipulate dreams, and induce various scents.
In the previously cited work Mind Weapon, numerous cases were reported of mass shooters who claimed they heard voices commanding them to commit violent acts.
Abuse of this technology for mind manipulation and torture likewise cannot be proven.
There are also many other technologies described in Mind Weapon, including lasers, neurophones (devices that allow hearing other people's voices directly in the brain), biomagnetic fields, satellite systems, and internet-based external interfaces.
It is also important to mention the potential misuse of humanoid intelligent robots for committing the most severe crimes, such as murder, grievous bodily harm, financial fraud, and more.
It is likely that the future will bring more information about the abuse of artificial intelligence technology.
The category of AI-related technologies also includes remarkable products in the field of bionics, such as devices that mimic insects — for example, artificial flies, mosquitoes, or moths — that can be used for gathering information through eavesdropping or even committing assassinations by releasing lethal poison or dangerous viruses through an extremely small nozzle in a confined space.

While the last example may sound like pure fiction, this does not rule out the possibility that such abuses of bionic technology already exist. Once again, the fundamental issue is the near impossibility of proving these kinds of criminal acts.

5. Lesser-known or alleged criminal activity in the field of pharmaceuticals and healthcare

An extremely taboo topic appears to be the alleged criminal activity within the pharmaceutical industry, in cooperation with the healthcare sector, especially considering that there have never been as many users of various medications as in the past 25 years. It is claimed that as many as 25% of children are subjected to a range of powerful medications (see the previously cited work Mind Weapon).

The problem lies in the fact that a significant portion of the human population has become dependent on medication, which consequently promotes passivity and compliance.

At the same time, we observe extraordinarily lucrative profits from the sale of numerous pharmaceuticals, many of which do not provide sufficient guarantees of positive effects.

In psychiatry alone, there is a large number of available medications, reflecting the wide range of psychological disorders encountered.

From a profitability perspective, it seems logical that for every mental disorder, there should be an appropriate medication.

The classification of mental disorders is relatively complex, encompassing numerous subcategories.

Abuse and criminal activities within the pharmaceutical sector, particularly in connection with psychiatry, are possible but difficult to prove.

On one hand, this involves highly lucrative profits; on the other, it can also involve mental manipulation and poisoning of certain segments of the population — actions that could even be described as genocidal.

As with previous examples of lesser-known or alleged forms of crime, there is a lack of statistically significant data to definitively confirm the existence of pharmaceutical and healthcare collusion aimed at committing genocide against specific groups.

It is well known that the pharmaceutical industry strongly follows the logic of profit, while healthcare is expected to uphold a humanistic mission focused on healing people and preventing disease.

Statistically significant data support the existence of healthcare's humanitarian and medical efforts; however, evidence of organized criminal activities or even genocidal actions is far less prevalent.

Throughout human history, there have been isolated cases of individuals in the medical field who murdered their own patients, but organized forms of criminal activity in healthcare are much less known.

Nevertheless, the possibility of organized criminal operations within healthcare undeniably exists, and therefore, the possibility of organized genocide against certain vulnerable groups cannot be completely ruled out.
Vulnerable groups that could potentially be targeted include people with mental illnesses, individuals with incurable diseases, the homeless, the unemployed with little or no education, retirees, and elderly individuals with little or no financial means, especially those living in lower-quality nursing homes.
From an economic perspective, these groups are seen as unproductive and a significant financial burden to the state.
In the future, particularly under intensified economic and social crises, this could lead to hidden genocide against these vulnerable social groups, possibly even orchestrated covertly by the state.
One could imagine that para-intelligence units operating within the legal national security sector might organize and, with the assistance of certain healthcare and pharmaceutical professionals, carry out covert killings.
If such actions were to occur, the state's official stance as a lawful and free society would be undermined, shifting toward an unofficial criminal policy — one that prioritizes the acquisition of financial resources at any cost, even at the expense of human lives.
This alleged scenario has historical precedents, most notably in Nazi Germany between 1933 and 1945.
During that dark period, the Nazi regime not only advocated for the extermination of vulnerable groups but actively carried it out.
A large number of mentally ill individuals became victims of deadly medical experiments.
Law enforcement agencies and human rights defenders must remain vigilant to ensure that such a grim, fictional scenario does not materialize in the future.

6. Less-known or fictitious crime in a broader sense (Internal communities within the Ccity, Crime of social agreements, e.g., Art crime)

In this section, we have already learned that our reality is a construct based on numerous social agreements. These agreements appear in various fields such as science, art, economy, politics, the political monetary system, law, and also at the level of everyday interpersonal relations. A certain leading group of people in urban and/or rural communities can essentially dictate or guide other members of the community to accept a certain reality, often through different social habits. On one hand, we have an organized community of people, which is positive, but on the other hand, strong social colloids can form, which are excessively exclusionary towards certain groups of people, to the extent that they are even willing to break the law or adapt it for their own purposes.

This is not such a rare phenomenon, as history teaches us that injustices have often occurred to people who did not meet certain criteria for equal treatment. In more developed legal, social, democratic, and technological communities, exclusion processes are less visible, but processes on the edge of legality or even within the framework of criminality can still occur. The most dangerous for the course of these processes are certainly strong social colloids, which vehemently impose certain rules on other members that are not in accordance with the law.

A good example can be found in the field of mobbing, where these strong social colloids exert psychosocial violence on groups of people who do not meet all the conditions to follow their unofficial rules (for example, people who do not have the appropriate religion, do not have the right political beliefs, or have a speech impediment). This is merely a milder example of the criminality of a certain social agreement. Again, we can state that it is difficult to prove this type of crime, which is also confirmed by the relatively modest statistical data on mobbing.

Furthermore, we can move to the field of artworks, which, based on social agreements, have extremely high monetary and artistic value. Important criteria for determining the artistic and monetary value of a particular artwork are especially rarity, author, age, place, message, and the original style of the piece. If these criteria are optimally met, special experts in art and economics, as well as influential wealthy individuals in the art market, can determine the monetary value of an artwork. This is a specialized internal social agreement, over which 99% of people in the world have no influence. In short, the assessed value of a particular artwork is a complete construct that becomes a fact when the aforementioned social agreement is reached.

In this floating correlate of our reality, there is a lot of empty space, which enables numerous manipulations and consequently various forms of criminal activity (e.g., fraud, corruption, commissioned art thefts, forgery, murders). A certain group of people, among them appraisers or experts in art, economists in the field of art, lawyers, and wealthy influential people, can agree that the original artwork is not in a certain museum or gallery, but in a completely different, remote place, while another original finds its place in the museum. It even goes so far that a highly valued artwork has several originals, which is unknown to the general and professional public. In fact, it was a relatively serial artistic product from the Middle Ages, which specialized internal groups of people labeled as a unique example, which can be described as outrageous fraud. Certainly, many other examples of criminal activity in the field of art could be found, but their description would exceed the scope of this section.

Regarding the discussion on lesser-known or fictitious forms of criminality, it could be argued that the influence of the microcosm on the emergence of crime and criminal personalities is greater than commonly acknowledged. Many criminal acts are hormonally, gut-bacterially, and neuronally driven (e.g., excessive hedonism, dominance-seeking, addiction). Modern weaponized technology could theoretically incentivize criminal behavior by leveraging waves and energy fields that directly impact the human body, particularly the central nervous system at the microcosmic level. These technological distortions mirror macrocosmic-scale wave patterns observed in nature, suggesting a fractal relationship between micro- and macro-level influences.

Crime generates immense negative stress in hierarchical social systems, significant financial costs, and energy losses-even at nuclear infrastructure levels-though these represent only a fraction of total societal depletion. When accounting for losses tied to obscure or fictionalized criminal activities, the cumulative impact may approach magnitudes beyond conventional quantification.

This analysis extends to an ongoing opinion survey examining crime's intersection with 3M cosmic influences (micro-, meso-, and macrocosmic dynamics), further exploring how multi-scale environmental and biological factors shape criminal phenomena.

4.9 Research on crime and 3M cosmic influences

This study addresses topics previously explored in earlier subsections. On one hand, it examines the interdisciplinary collaboration of various scientific fields in criminology. On the other, it synthesizes opinions about influential factors driving crime prevalence through both quantitative assessments and qualitative descriptions. By analyzing these perspectives, the research evaluates the conceptual breadth of experts across disciplines as an indicator of favorable or unfavorable starting points for interdisciplinary crime research.

A distinctive feature of this survey was its emphasis on three interconnected cosmic dimensions: microcosm (individual/small-scale systems), mesocosmos (community/regional systems), and macrocosm (global/cosmic systems)-collectively termed 3M. The framework explores how phenomena at these scales-from biological and social dynamics to astronomical influences-might intersect with criminal behavior and systemic crime patterns.[143]

4.9.1 Research objective

The main goals of this study were to determine the level of interdisciplinary cooperation among various fields of study in Slovenia (including humanities, social sciences, intermediate sciences, natural sciences, applied sciences, and marginal sciences) and to gather opinions to assess the conceptual range of representatives from these fields. This range would indicate whether the conditions are favorable or unfavorable for interdisciplinary scientific research in the field of criminology.

143 Petrič, K. (2024). An empirical study of Interdisciplinary Crime Research. *European Journal of Economics, Law and Social Sciences*, 8(1), 1–21. https://doi.org/10.2478/ejels-2024-0001.

4.9.2 Research hypotheses

1. There is significant interdisciplinary cooperation among humanities, social sciences, intermediate sciences, natural sciences, applied sciences, and marginal sciences in criminology research in Slovenia.
2. There is very little interdisciplinary cooperation among these fields in criminology research in Slovenia.
3. The collective awareness of representatives from different fields regarding their scientific research and evaluation of crime is strongly focused on the mesocosm level.
4. Representatives from various fields believe that mesocosmic influences are the most important factors in the occurrence of crime, while microcosmic and macrocosmic influences are negligible.
5. The conceptual range of representatives from different fields regarding the understanding of crime is relatively narrow, which is an unfavorable starting point for interdisciplinary scientific research in criminology.

4.9.2.1 Research questions

1. Which fields have contributed the most research on crime in Slovenia?
2. Have natural sciences, applied sciences, intermediate sciences, humanities, and marginal sciences also frequently researched crime in Slovenia?
3. What is the strength and intensity of interdisciplinary cooperation among different fields in criminology research in Slovenia?
4. At which cosmic level do representatives of various fields in Slovenia most actively conduct research?
5. To which cosmic level is the collective awareness of representatives from different fields in Slovenia most strongly oriented?
6. According to representatives from various fields, which cosmic influences are the most important regarding the occurrence of crime in Slovenia?
7. What is the conceptual range of representatives from different fields regarding the understanding of crime?
8. Is the conceptual range of representatives from different fields wide and favorable enough for interdisciplinary scientific research in criminology?

4.9.2.2 Methodology

The research sample included representatives from various fields in Slovenia, mainly from different faculties, research institutes, libraries, and ministries. Opinions from representatives of marginal sciences were also collected. The sample size consisted of 200 valid respondents.

4.9.2.3 Tools

An online survey questionnaire was used to test the hypotheses. Various software tools for data pattern analysis were employed to analyze the collected data.

4.9.2.4 Procedure

The study included 200 valid respondents from various fields in Slovenia. A total of 5,125 email invitations to participate in the online survey on crime and 3M cosmic influences were sent to faculties, research institutes, libraries, and ministries across Slovenia. The sample included representatives from humanities, social sciences, intermediate sciences, natural sciences, applied sciences, and marginal sciences. Institutions involved included numerous universities, faculties, research institutes, libraries, and clinics across Slovenia. Additionally, representatives from astrology responded to 50 invitations sent.

Out of 5,125 invitations, 634 respondents (12.37%) replied. Of these, 205 (32.33%) completed the survey fully, with 5 responses excluded due to unusable answers. Data collection took place from June 21 to July 21, 2020.

Data collected included:

a. Information on gender, age, relationship status, and scientific field of activity.

b. Information on research and/or collaboration in criminology by representatives of various fields in Slovenia.

c. Ratings and opinions on the most influential factors causing crime.

d. Ratings and opinions on active research in the three cosmic levels.

e. Ratings and opinions on the influence strength of the three cosmic levels on crime occurrence.

f. Descriptive opinions on crime in a broader sense (the final question was intentionally open-ended).

Scientists were categorized into humanities (philosophy, theology, linguistics, library science, pedagogy), social sciences (sociology, law, economics, public administration, political science, demography, statistics, history), natural sciences (mathematics, astronomy, physics, chemistry, geology, biology, physical anthropology), applied sciences (computer science, civil engineering, mechanical engineering, electrical engineering, medicine), intermediate sciences (management, organizational science, psychology, cybernetics, kinesiology, geography, ecology), and marginal sciences (only three representatives from astrology were included). Classification was based primarily on the universal decimal classification system and experience in scientific systematics. The largest number of valid respondents (200 in total, or 100%) came from the fields of applied sciences (56 or 28%), natural sciences (45 or 22.5%), social sciences (37 or 18.5%), humanities (34 or 17%), intermediate sciences (25 or 12.5%), and finally marginal sciences (3 or 1.5%).

4.9.3 Statistical data analysis and interpretation

In addition to demographic data, the online survey tool also collected information about the respondents' technological equipment, which will be presented in the introductory highlights.

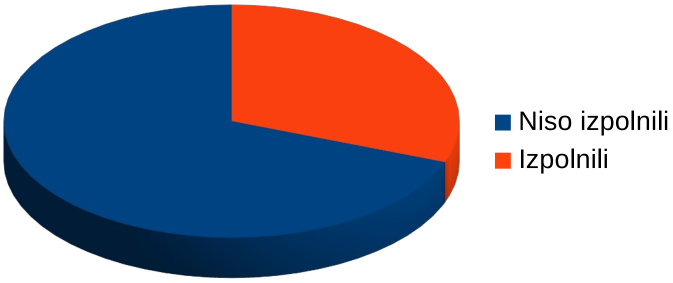
4.9.3.1 Introductory highlights

The majority of valid respondents accessed the online survey using a computer (178 respondents), followed by mobile phones (22 respondents). All valid respondents had JavaScript enabled. The most commonly used browser was Google Chrome (95 users), followed by Firefox (55), Internet Explorer 11 (23), Edge (15), Safari (11), and others (1).

Regarding operating systems, Windows 10 was the most frequently used (137 users), followed by Windows 7 (17), Android (16), MacOSX (11), iOS (6), Windows 8.1 (5), Linux (4), Windows 64-bit (3), and others (1). From a technological standpoint, the respondents used modern equipment!

4.9.3.2 Table 144: Number and percentage of respondents

	Number of respondents	Percentage (%)
Did not complete (niso izpolnili)	451	69.28
Completed (Izpolnili)	200	30.72
Total (Skupaj)	651	100

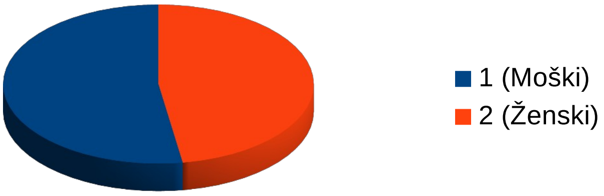


4.9.3.2.1 Figure 278: Percentage of online survey respondents

Table 144 and Figure 278 show the number and percentage of respondents to the online survey. Out of 651 respondents to the survey on crime and 3M cosmic influences, 200 (or 30.72%) completed the questionnaire in full (data as of July 26, 2020). On average, completing the survey took four minutes and 40 seconds. The highest number of respondents (23) completed the survey in full on July 8, 2020.

4.9.3.3 Table 145: Gender composition

Odgovori (Responses)	Frekvenca (Frequency)	Odstotek (Percentage)
1 (Moški) Male	105	52.5
2 (Ženski) Female	95	47.5
Skupaj (Total)	200	100

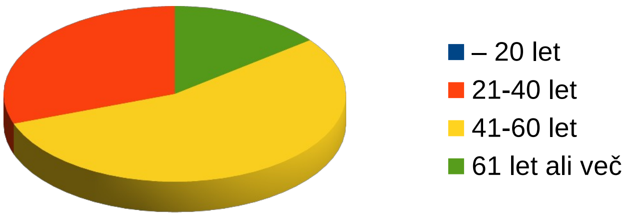


4.9.3.3.1 Figure 279: Gender composition

Table 145 presents the gender composition of respondents who completed the survey, while Figure 279 shows the same data in a pie chart for 200 respondents. The majority of respondents were male scientists (105; 52.5%), with slightly fewer female scientists (95; 47.5%). No respondent selected the "other" gender option. The results indicate a relatively balanced gender distribution.

4.9.3.4 Table 146: Age groups

Odgovori (Responses)	Frekvenca (Frequency)	Odstotek (Percentage)
– 20 let (years)	0	0
21-40 let (years)	61	30.5
41-60 let (years)	110	55
61 let ali več (years or more)	29	14.5
Skupaj (Total)	200	100

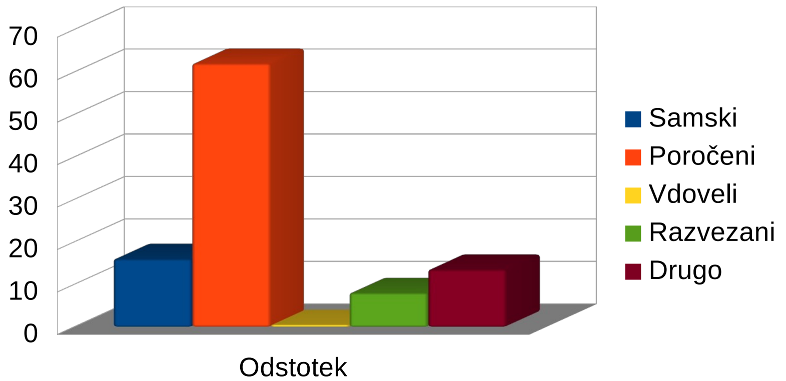


4.9.3.4.1 Figure 280: Age groups

Table 146 and Figure 280 show the age groups of respondents: under 20 years (0; 0%), 21 to 40 years (61; 30.5%), 41 to 60 years (110; 55.0%), and 61 years or older (29; 14.5%). As shown, the age structure of the surveyed representatives from various scientific fields is relatively advanced. Most scientists fall into the second and especially the third age groups. Based on this observation, it could be concluded that there is a shortage of younger scientists, which is somewhat concerning for the future development of science in Slovenia.

4.9.3.5 Table 147: Relationship

Odgovori (Responses)	Frekvenca (Frequency)	Odstotek (Percentage)
Samski (Single)	32	16
Poročeni (Married)	124	62
Vdoveli (Widow)	1	0.5
Razvezani (Divorced)	16	8
Drugo (Other)	27	13.5
Skupaj (Total)	200	100

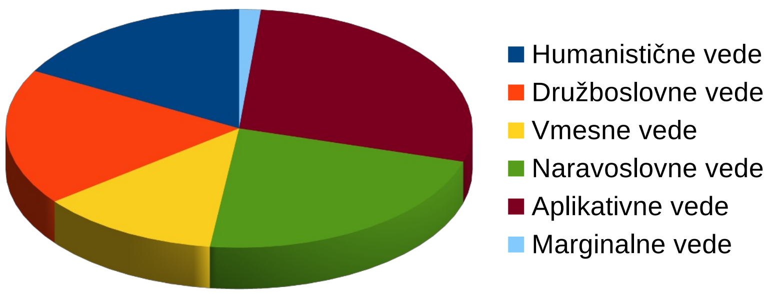


4.9.3.5.1 Figure 281: Relationship status composition

Table 147 and Figure 281 show the composition of relationship statuses as follows: single (32; 16.0%), married (124; 62.0%), widowed (1; 0.5%), divorced (16; 8.0%), and other (27; 13.5%). The "other" category includes various forms of partnerships such as cohabitation (the most common), engagement, and domestic partnerships.

4.9.3.6 Table 148: Composition of representatives of disciplines

Odgovori (Responses)	Frekvenca (Frequency)	Odstotek (Percentage)
Humanistične vede (Humanities)	34	17
Družboslovne vede (Social sciences)	37	18.5
Vmesne vede (Intermediate sciences)	25	12.5
Naravoslovne vede (Natural sciences)	45	22.5
Aplikativne vede (Applied sciences)	56	28
Marginalne vede (Marginal sciences)	3	1.5
Skupaj (Total)	200	100

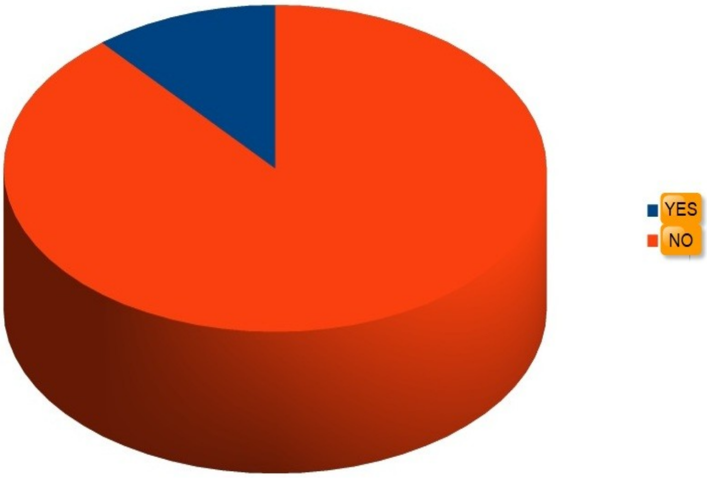


4.9.3.6.1 Figure 282: Composition of representatives by field

Table 148 and Figure 282 show the composition of representatives from various scientific fields. Among the 200 respondents (100%), the largest group came from applied sciences (56; 28%), followed by natural sciences (45; 22.5%), social sciences (37; 18.5%), humanities (34; 17%), intermediate sciences (25; 12.5%), and finally marginal sciences (3; 1.5%). The composition of representatives from different fields is relatively balanced, except for marginal sciences, which is favorable for analyzing diverse yet related perspectives on crime.

4.9.3.7 Table 149: Scientists who have already researched or participated in any research on crime

Scientists	Frequency	Percentage
Yes	22	11
No	178	89
Celota	200	100

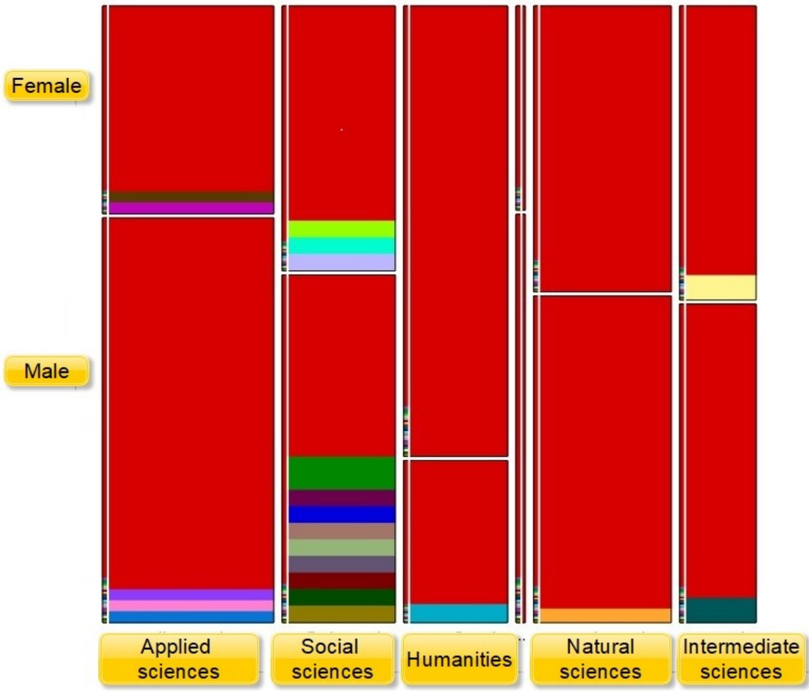


4.9.3.7.1 Figure 283: Scientists who have researched or participated in crime research

Table 149 and Figure 283 show the frequencies and percentages of scientists who have researched or participated in crime-related studies. Out of 200 surveyed scientists (100%), only 22 (11%) reported having conducted or at least participated in crime research, while 178 scientists (89%) have never been involved in such research. Based on the collected data, it can be concluded that there is little active interdisciplinary collaboration among scientific fields in the area of crime research. This statement can be further confirmed through additional data analysis.

4.9.3.8 Table 150: Representatives of sciences in connection with crime research

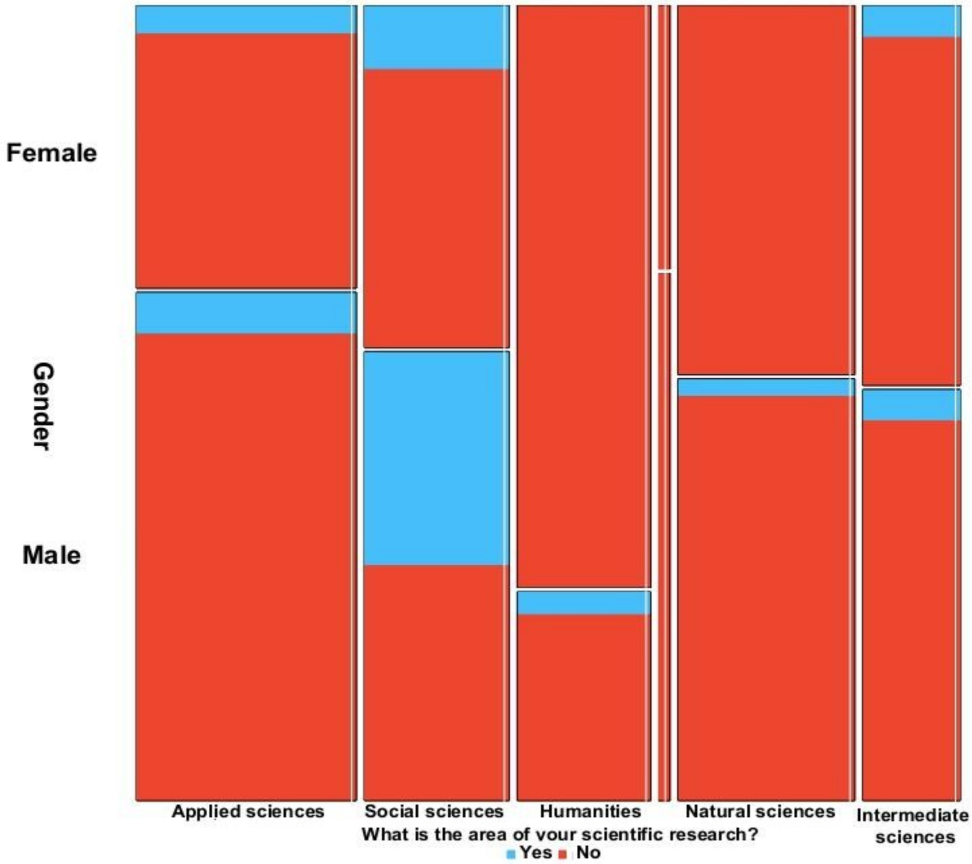
Sciences representatives	Frequency	Percentage
Humanities	1	0.5
Social sciences	13	6.5
Intermediate sciences	2	1
Natural sciences	1	0.5
Applied sciences	5	2.5
Marginal sciences	0	0
Sample size	200	11



4.9.3.8.1 Figure 284: Mosaic diagram of crime research by field and gender

Table 150 presents statistical data on crime research by scientific discipline, while Figure 284 illustrates a mosaic diagram showing crime research activity by both field and gender.

Based on the collected data (200 respondents), it was found that, outside of criminology, criminal law, and police science (13 respondents, 6.5%), very few other scientific disciplines (9 respondents, 4.5%) have engaged in crime research. Although there are a few isolated cases, their overall contribution is negligible (for example, one respondent from the field of agriculture and forestry served as a court expert). This indicates a lack of comprehensive knowledge synthesis and highlights the need for a more intensive interdisciplinary approach to crime research in Slovenia. A larger sample would certainly provide a more complete picture, so conclusions can only be drawn from the data of these 200 scientists from various disciplines. The analysis of scientific activity in crime research by gender will be of particular interest in the following section.



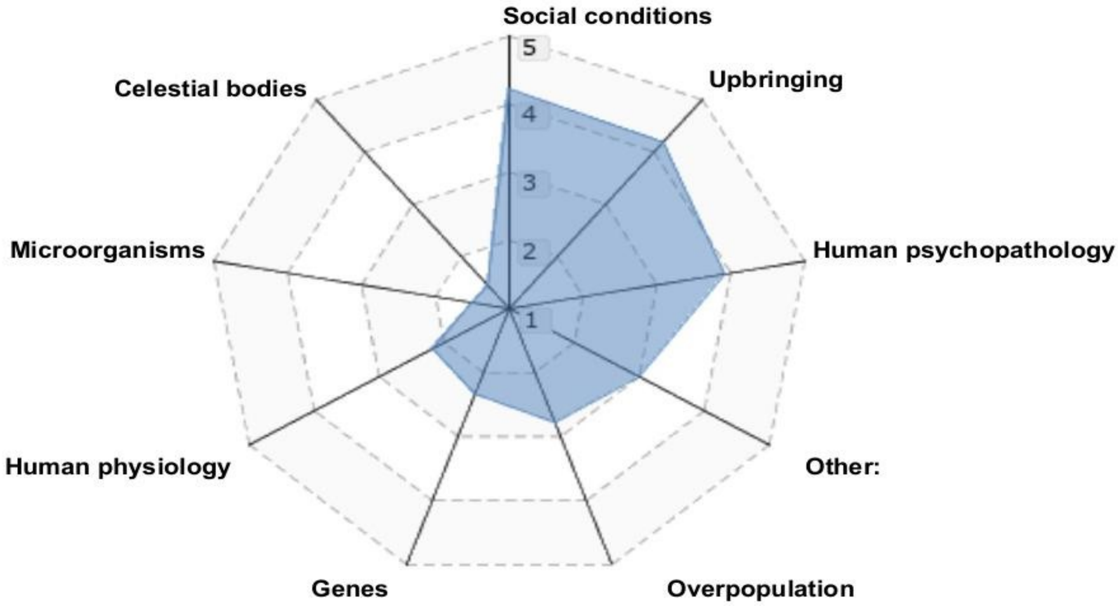
4.9.3.8.2 Figure 285: Mosaic diagram of crime research by gender

Figure 285 presents a mosaic diagram of crime research activity by gender. The data shows that male representatives from various fields contributed more to crime research (15.24% of 105 male respondents) than female representatives (6.32% of 95 female respondents).

The contribution of the social sciences to crime research was 9.52% (10 male representatives) and 3.16% (three female representatives). In applied sciences, the share was 2.86% (three male representatives) and 2.10% (two female representatives). For intermediate sciences, the figures were 0.95% (one male representative) and 1.05% (one female representative). In the humanities, 0.95% (one male representative) contributed, while there were no female representatives (0%). In the natural sciences, the contribution was 0.95% (one male representative), with no female representatives (0%). There were no representatives from marginal sciences, either male or female. A slight predominance of female representatives was observed only in the intermediate sciences, while in all other fields (except marginal sciences), male representatives prevailed. These results address the first, second, and third research questions and confirm the second research hypothesis: that interdisciplinary cooperation among the humanities, social sciences, intermediate sciences, natural sciences, applied sciences, and marginal sciences in Slovenia is extremely limited.

4.9.3.9 Table 151: Estimates (ratings) of impacts on the occurrence of crime

Impacts/influences	Responses						Sample	Average	Std. deviation
	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5	Total			
Upbringing	0,00%	3,00%	17,00%	40,00%	41,00%	100,00%	200	4.2	0.8
Social conditions	0,00%	6,00%	13,00%	35,00%	47,00%	100,00%	200	4.2	0.9
Genes	25,00%	31,00%	34,00%	9,00%	3,00%	100,00%	200	2.3	1
Mikroorganisms	64,00%	25,00%	9,00%	2,00%	1,00%	100,00%	200	1.5	0.8
Celestial bodies	72,00%	16,00%	10,00%	3,00%	1,00%	100,00%	200	1.4	0.8
Human psychopathology	1,00%	6,00%	26,00%	38,00%	31,00%	100,00%	200	3.9	0.9
Human physiology	30,00%	36,00%	23,00%	12,00%	1,00%	100,00%	200	2.2	1
Overpopulation	14,00%	23,00%	39,00%	19,00%	5,00%	100,00%	200	2.8	1.1
Other:	31,00%	4,00%	23,00%	19,00%	23,00%	100,00%	26	3	1.6



4.9.3.9.1 Figure 286: Polar diagram of assessed influences on crime occurrence

Table 151 presents statistical data on the factors influencing crime, as assessed by 200 respondents. These factors include social conditions, upbringing, psychopathological traits, overpopulation, genes, physiological characteristics, microorganisms, celestial bodies, and others. The table shows percentages, calculated average ratings, and standard deviations. Figure 286 visually represents these assessed influences on crime using a polar diagram.

The results indicate that respondents gave the highest ratings to the following influences:

- Social conditions (average rating 4.2; standard deviation 0.8)
- Upbringing (average rating 4.2; standard deviation 0.9)
- Psychopathological traits (average rating 3.9; standard deviation 0.9)
- Overpopulation (average rating 2.8; standard deviation 1.1)

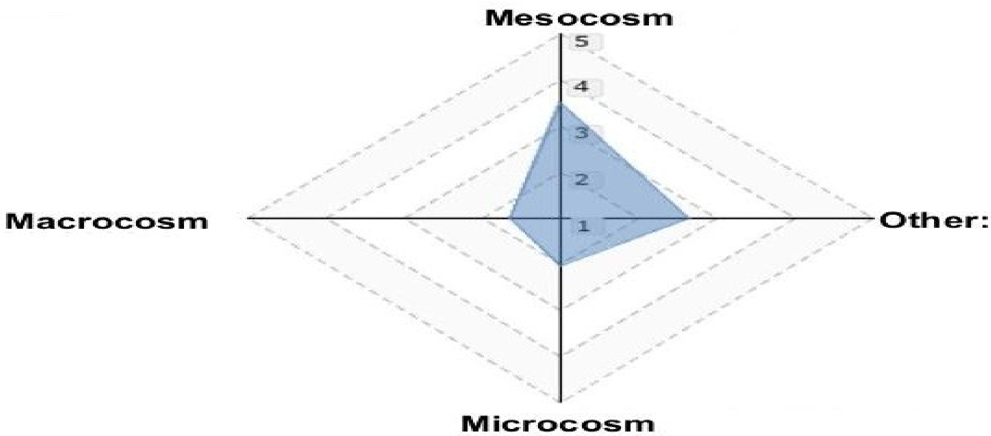
Lower ratings were given to:

- Genes (average rating 2.3; standard deviation 1.0)
- Physiological characteristics (average rating 2.2; standard deviation 1.0)
- Microorganisms (average rating 1.5; standard deviation 0.8)
- Celestial bodies (average rating 1.4; standard deviation 0.8)

Under the "Other" option, 26 respondents identified additional influences, which they rated with an average of 3.0 (standard deviation 1.6). These included: society, role models, climate, system dysfunction, weak institutions, ideology, the rate of offender detection, gender, social climate, personal hardship, opportunity, crowd psychology, moral values, social influence, and empathy (or its absence). The analysis of the ratings for individual influences showed no statistically significant differences between genders.

4.9.3.8.3 Table 152: Levels (planes) of scientific research work of scientists/researchers

Planes	Responses						Valid	Sample	Average	St. Deviation
	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5	Total				
Microcosm	60.00%	12.00%	8.00%	10.00%	12.00%	100.00%	200	200	2	1.5
Mesocosm	17.00%	8.00%	21.00%	18.00%	37.00%	100.00%	200	200	3.5	1.5
Macrocosm	67.00%	15.00%	10.00%	4.00%	5.00%	100.00%	200	200	1.7	1.1
Other:	46.00%	4.00%	14.00%	11.00%	25.00%	100.00%	28	200	2.6	1.7



4.9.3.8.3.1 Figure 287: Polar diagram of scientific research work across three cosmic planes

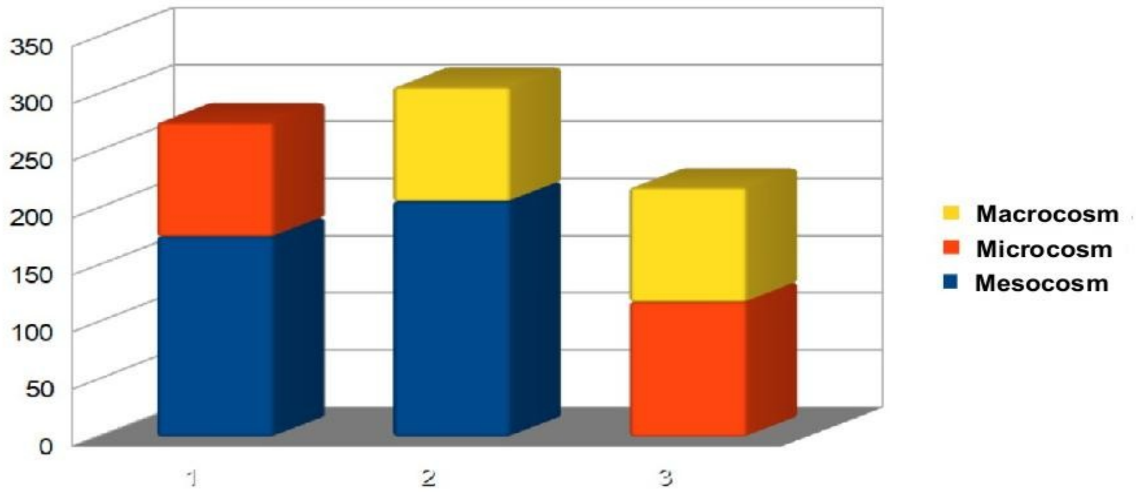
Table 152 presents statistical data on the scientific research fields of 200 scientists or researchers, while Figure 287 illustrates the same data in the form of a polar diagram.

Based on the collected data, we can conclude that the largest proportion of scientists are active in the field of mesocosmic research (average score 3.5), followed by the category "other" (average score 2.6), then microcosmic research (average score 2.0), and lastly macrocosmic research (average score 1.7).

The results show a clear scientific focus on the mesocosmic level, which aligns closely with an anthropocentric view of the world, and is therefore unsurprising. The relationships between the three levels of scientific research are also noteworthy:

- the ratio between mesocosmic and microcosmic research is 1.75, or 175:100,
- the ratio between mesocosmic and macrocosmic research is 2.06, or 206:100,
- the ratio between microcosmic and macrocosmic research is 1.18, or 118:100.

The visualization of these ratios further enhances the understanding of the scientific research orientations of the surveyed respondents.



4.9.3.8.3.2 Figure 288: Scientific research focus of respondents by cosmic plane

Figure 288 shows the scientific research focus of the respondents according to the cosmic planes, clearly highlighting the dominance of the mesocosmic level (see the blue column) compared to the other two levels. The third column shows a slight predominance of the microcosmic over the macrocosmic level.

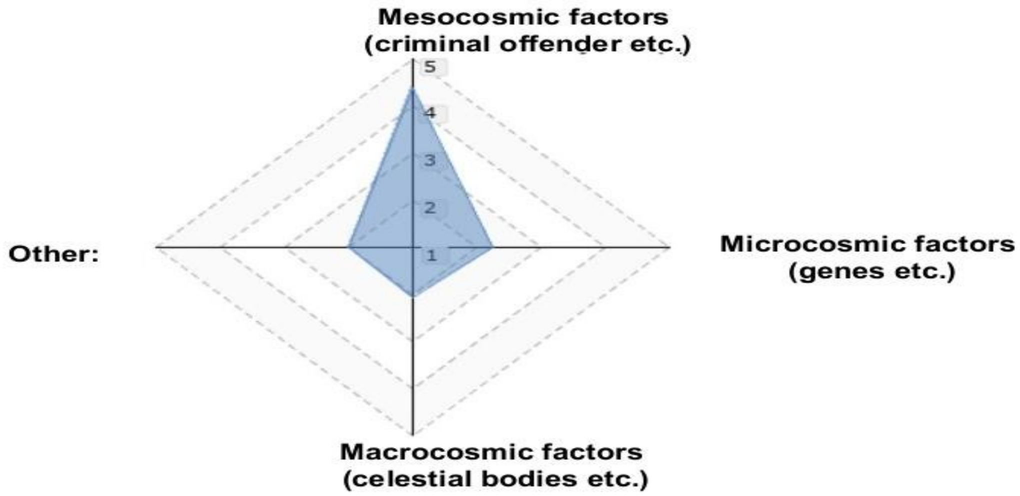
These ratios reflect the collective scientific consciousness of a particular group of people, fundamentally shaping their worldview and subsequently influencing their perception of key factors, causes, conditions, influences, methods of data analysis, synthesis of findings and insights, and decision-making processes.

This approach is distinctly anthropocentric in orientation. Based on the interpretation and analysis of the data, the third research hypothesis was confirmed, and the fourth and fifth research questions were answered.

Under the "other" option, several intermediate levels were listed that can occur across all three or at least two cosmic planes (e.g., Earth, communication, information, signals, mechanical and electrical energy, the sea, consciousness, experience, mathematics, computer science, theoretical sciences, history, society in a broader sense).
Meanwhile, the nanocosmos is classified within the microcosmic plane (according to the established division of the three planes).
The "other" category essentially refers to connecting elements (e.g., communication, which can be found on various planes, such as communication between space satellites, between people, or between nerve cells) and different perspectives (e.g., history, which may refer to the history of the universe, the history of society, or the history of a particular science).

4.9.3.8.4 Table 153: Influence of 3~M cosmic factors on the occurrence of crime

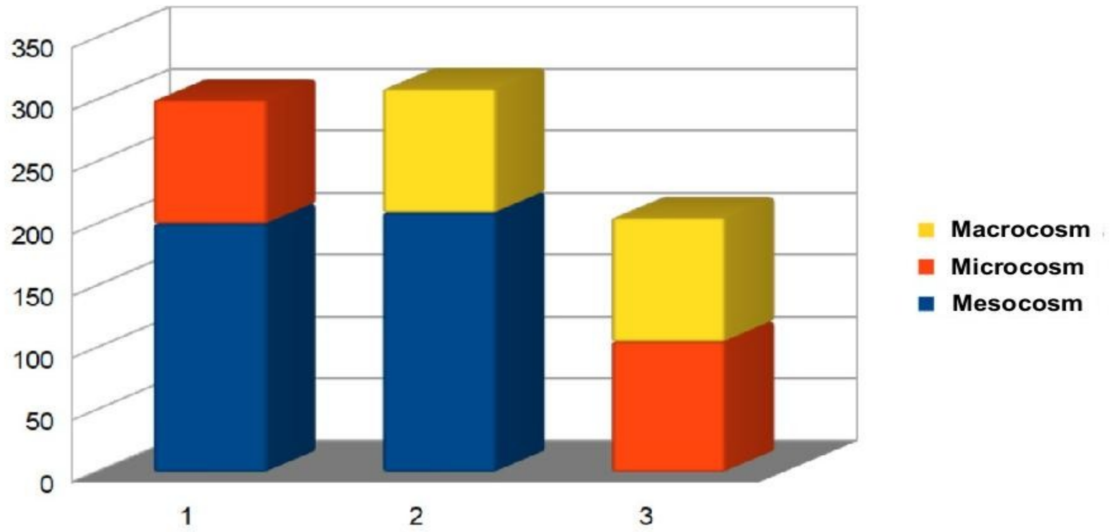
Plane influence	Ratings						Valid	Sample	Average	Std. deviation
	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5	Total				
Microcosmic factors	31.00%	32.00%	24.00%	0,00%	4.00%	100.00%	200	200	2.2	1.1
Mesocosmic factors	1.00%	1.00%	9.00%	38,00%	52.00%	100.00%	200	200	4.4	0.8
Macrocosmic factors	36.00%	34.00%	22.00%	8,00%	2.00%	100.00%	200	200	2.1	1.0
Other:	57.00%	13.00%	17.00%	0,00%	13.00%	100.00%	23	200	2.0	1.4



4.9.3.8.4.1 Figure 289: Assessed impact of 3~M cosmic factors on the occurrence of crime

Table 153 presents statistical data on the assessed impacts, averages, and standard deviations of the evaluations of 3~M cosmic factors, while Figure 289 illustrates the average evaluations using a polar chart.

Under the "other" option, some respondents added and assessed the influence of factors such as personal character, the combination of various factors, the femto-cosmos, and the interweaving of 3~M cosmic planes.
Similarly to the previous case, we can also calculate here the ratios between mesocosmic and microcosmic influences, mesocosmic and macrocosmic influences, and microcosmic and macrocosmic influences, which will be shown in bar charts.
The ratio between the influences of mesocosmic and microcosmic factors on the occurrence of crime is 2.00, or 200:100. The ratio between mesocosmic and macrocosmic factors is 2.09, or 209:100, while the ratio between microcosmic and macrocosmic factors is 1.05, or 105:100.
This is an extremely simple calculation and visualization of the obtained results, clearly showing the focus of influential factors from the respondents' perspective.



4.9.3.8.4.2 Figure 290: Influence of 3~M cosmic plane factors on the occurrence of crime

Figure 290 shows the influence of 3~M cosmic plane factors on the occurrence of crime in the form of a visualized comparison of the calculated ratios between the mesocosm and microcosm, the mesocosm and macrocosm, and the microcosm and macrocosm.
It can be observed that Figure 290 is very similar to Figure 288. According to 200 respondents, the influences of mesocosmic factors on the occurrence of crime strongly outweigh the influences of microcosmic and macrocosmic factors, while the assessed influence between microcosmic and macrocosmic factors slightly favors the microcosmic factors.
Once again, we encounter a strongly mesocosmic perspective on the occurrence of crime, which follows an anthropocentric orientation.
Under the "Other" option, the factors are those whose influence can be exerted across all three or at

least two cosmic planes (for example, personal character is the product of genes, microorganisms, upbringing, education, interpersonal relationships, environment—a combination and intertwining of factors from all three cosmic planes—while femto-cosmos (similar to nano-cosmos, e.g., at the level of atoms and electrons) can be classified as a factor from the microcosmic plane).

It can be concluded that the answers under the "Other" option are less anthropocentrically oriented and allow more flexibility in determining the influence of cosmic factors on the occurrence of crime.

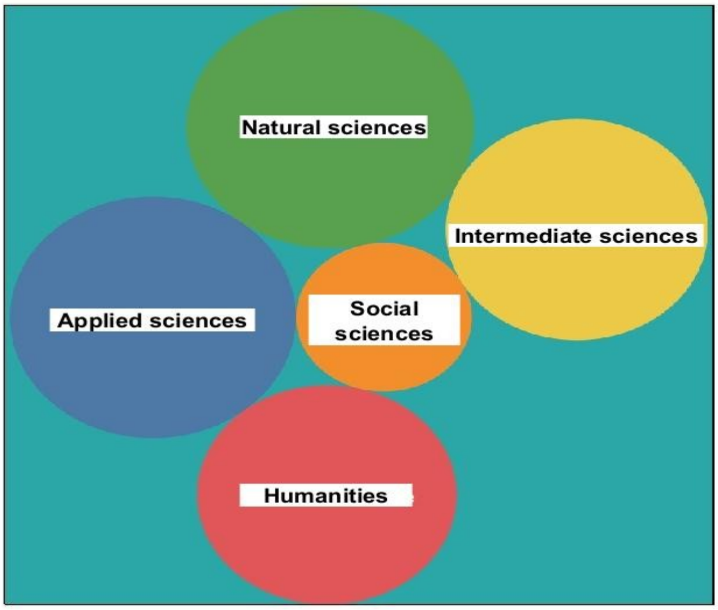
Based on the results of the analysis, the sixth research question was answered and the fourth research hypothesis confirmed: namely, that mesocosmic factors are the most crucial in regard to the occurrence of crime, while the influence of factors from the other two worlds is negligible.

4.9.3.9 Word analysis of opinions from the final question

Before proceeding to the word analysis of opinions, we will first present the productivity of responses to the final question of the survey questionnaire by representatives of different fields. Out of 200 respondents, 153 usable opinions were obtained, while 47 respondents did not provide an opinion.

4.9.3.9.1 Table 154: Productivity of opinions conveyed by researchers of disciplines

Science/scientists	No opinion F	No opinion %	Useful opinions	All opinions
Humanities	8	23,53	26	34
Social sciences	4	12,12	33	37
Interm. sciences	6	24	19	25
Natural sciences	13	28,89	32	45
Applied sciences	16	28,57	40	56
Marginal sciences	0	0	3	3
Total	47	11	153	200



4.9.3.9.3 Figure 291: Bubble chart of the productivity of submitted opinions by fields

Table 154 presents data on the productivity of submitted opinions by representatives of different fields, while Figure 291 illustrates the same subject based on calculated percentages between the frequencies of no opinions and all opinions in the form of a bubble chart.

It can be observed that representatives of the social sciences were the most productive in providing opinions for the final question of the survey questionnaire, as only four representatives from the social sciences (or 12.12%) did not submit an opinion (see orange circle). For representatives of other fields (excluding marginal fields – only three representatives), considerably lower productivity was observed among representatives of the natural sciences (see green circle, 13, 28.89%), applied sciences (see blue circle, 16, 28.57%), intermediate sciences (see yellow circle, 6, 24%), and the humanities (see red circle, 8, 23.53%).

This may suggest that these representatives thought much less about crime and that they encounter this topic less frequently in their scientific research work. Based on the results obtained, it appears that crime in Slovenia is primarily studied more intensively by social scientists.

We now continue with the word analysis.

The word analysis of opinions first involved the process of preparing, processing, and cleaning the data. Initially, the 47 responses without opinions were excluded. Then, the 153 opinions were transcribed and saved into a .txt file. A list of stopwords and a list of different word forms (e.g., education → educating, to educate, educates) and semantic fields of words (e.g., conceptually related terms were assigned to appropriate conceptual categories, such as education → school, education, learning) were prepared. After all necessary data were prepared, the data processing began using the software tool AntConc. First, the .txt file containing the 153 opinions was imported, followed by the import of the lists of stopwords, different word forms, and semantic fields under the word list option. By initiating the "Start" command, AntConc calculated the frequency of word occurrences within the 153 opinions. The results obtained were initially in a raw form, so a data cleaning process followed, including the merging of different word forms and semantic fields. Simultaneously, the list of stopwords was further refined. After completing the cleaning and organizing of the data, the "Start" command was triggered again. A small portion of the results from the word analysis of the 153 opinions is shown in the following table.

4.9.3.9.4 Table 155: Result of word analysis by frequency of occurrence of a certain word / word category

Rank	Frequency	Word	Word form / Word category
1	140	sociality	society, societies, social …
2	139	crime	criminal, collar, illegally …
3	95	influence	influences, influential, affect …
4	50	people	peoples, human, humans …
5	48	factor	factors, driver, agent …
6	45	parenting	upbringing, foster, childcare …

Table 155 shows a snapshot of a window from the AntConc software tool with results on the ranks and frequency of occurrence of a particular word / word category within 153 opinions. It can be noted that the most used word category is ‘sociality’ and related words (rank 1, frequency 140) and the second most used word category is ‘crime’ and related words (rank 2, frequency 139), which was otherwise the central topic of this last question from the questionnaire. More on the results below. After the data preparation for analysis,

the process of word classification followed, using the previously applied universal classification (see the subchapter on symbols) of verbal and non-verbal symbols/words, but in a slightly adapted form.
Words were grouped into categories such as attentional physical property (UKBS 1), performance-related property (UKBS 2), individual psychological property (UKBS 3), social property (UKBS 4), inanimate natural property (UKBS 5), living natural property (UKBS 6), health-related biological property (UKBS 7), material and intellectual products of humans (UKBS 8), institutions and their parts (UKBS 9), periods (UKBS 10), and an open group (UKBS 11).
After the classification of words was completed, evaluations were made regarding the strength of the connection (using a rating scale from 1 to 10, where 1 represents the weakest connection and 10 the strongest) between the central theme of crime and the words based on their frequency of occurrence.
As a result, a table of data was compiled.

4.9.3.9.5 Table 156: Part of composite data for word analysis

PR	MP	F	UKB	UKBS
crime	10	140	sociality	4
crime	10	139	crime	4
crime	9	95	influence	11
crime	8	48	factor	11
crime	7	37	individuality	3
crime	8	50	people	6

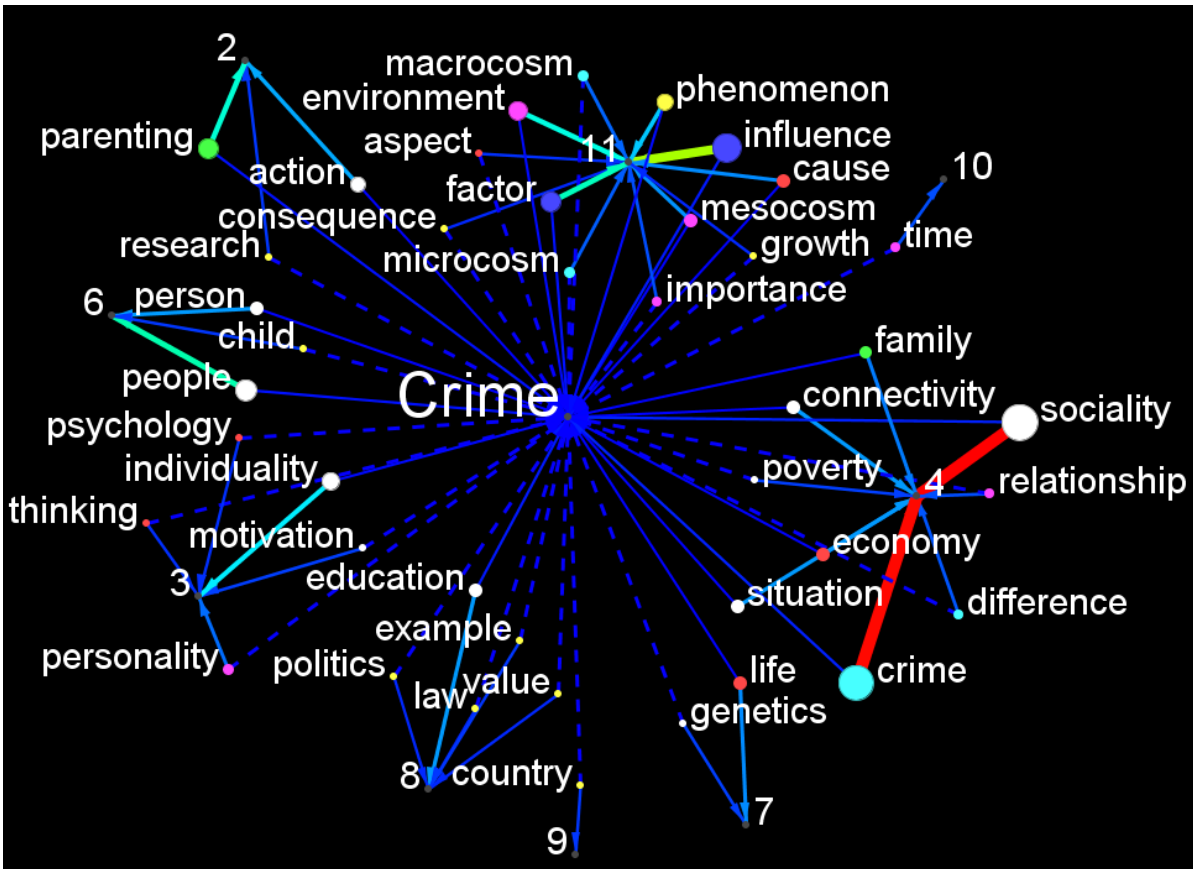
Table 156 shows a portion of the compiled data for the word analysis, where the far-left column displays the subject of interest or the central theme (PR: crime).
The second column (MP – strength of connection) provides data on the assessed strength of connection between crime and the words found in the 153 respondents' opinions.
The third column contains data on the frequency of occurrence of each word.
The fourth column lists the words themselves (UKB), while the fifth column shows their classifications (UKBS from 1 to 11).
The data, saved as a .txt file, were then imported into the Ora Casos software tool for social and conceptual network analysis using the command "Create a meta network from table data."
Afterward, it was necessary to label the column headers according to the type of data: the central theme was defined as the resource, the strength of connection as belief (this is the option available in the program), the frequency of a specific word also as belief, the words themselves as knowledge, and finally, the word classifications as organization.

The next step involved creating links between the different categories (PR, UKB, and UKBS) and attributes (MP and F) from the table.

Once the links between categories and attributes were created, the command to visualize the conceptual network was triggered.

In the conceptual network, it was necessary to set the color and strength of the links as well as the color and size of the nodes.

The size and colors of the nodes were determined based on the attribute of the frequency of a specific word, while the color and strength of the links were determined using the attribute of the strength of connection (MP). The result is shown in the following figure.



4.9.3.9.5.1 Figure 292: Conceptual network of crime and classified words with filter

Figure 292 shows the conceptual network of crime and classified words, applying a filter that excludes all words with a node size smaller than 5.0.

An additional range was set for node size, excluding nodes smaller than 6.1 but larger than 5.1, which within the network is represented by dashed connections between the central theme of crime and smaller nodes (e.g., dashed links from crime to words such as motivation, personality, genetics, differences, relationships, research, etc.).

The thematic connection strength of these words with the central topic is weaker or less frequent. Scientists and researchers were less focused on these concepts when sharing their opinions.
The final survey question was very open-ended, allowing respondents to share personal opinions about the causes, influences, connections, consequences, effects, preventive measures, or future visions regarding the central topic of crime.
Respondents had the option of giving complex answers, meaning they could discuss causes, influences, and preventive measures simultaneously. However, few respondents chose to provide such comprehensive responses.
Additionally, respondents had the option to adopt the offered model of the three cosmic planes (3~M model) for interpreting crime, which they did relatively frequently (27 out of 153 opinions, or 17.65%, referred to the 3~M cosmic planes model).
Respondents generally wrote more about the influences on crime occurrence and focused less on the causes and preventive measures.
Word categories within classification groups UKBS 1 and UKBS 5 did not make it into the narrower selection for further analysis due to the set filter.
What follows is a detailed description of the conceptual network according to classified groups UKBS 2, 3, 4, 6, 7, 8, 9, 10, and 11.
UKBS 2:
This group included words denoting performance-related characteristics or contents.
- Action ("dejanje" → actions, acts, to act, behavior, etc.) appeared 28 times across different forms and close semantic connections (strength of connection to the central theme: 7.0; strength of connection to UKBS 2 – see blue link: 29.0). This value also represents the node size.
Contributions by field:
  - Humanities: 26 useful opinions; "action" category appeared 3 times.
  - Social Sciences: 33 useful opinions; "action" category appeared 3 times.
  - Interdisciplinary Fields: 19 useful opinions; "action" category appeared 9 times.
  - Natural Sciences: 32 useful opinions; "action" category appeared 7 times.
  - Applied Sciences: 40 useful opinions; "action" category appeared 6 times.
  - Marginal Fields: 3 useful opinions; "action" did not appear.
- Research ("raziskava" → researched, investigations, studies, etc.) appeared 13 times within the 153 opinions (strength of connection to the central theme: 6.0; strength of connection to UKBS 2 – see dark blue link: 14.0). This also represents the node size.
Contributions by field:
  - Humanities: 26 useful opinions; "research" appeared 3 times.

- Social Sciences: 33 useful opinions; "research" appeared 4 times.
- Interdisciplinary Fields: 19 useful opinions; "research" appeared 2 times.
- Natural Sciences: 32 useful opinions; "research" appeared 2 times.
- Applied Sciences: 40 useful opinions; "research" appeared 2 times.
- Marginal Fields: 3 useful opinions; "research" did not appear.

We can conclude that categories like "violence," "prevention," and "research" did not hold high thematic importance in the shared opinions.

The "action" category, however, appeared slightly more significantly among respondents from interdisciplinary fields.

- Education ("vzgoja" → upbringing, educating, education, educational, etc.) appeared 45 times within the 153 opinions (strength of connection to the central theme: 9.0; strength of connection to UKBS 2 – see light green link: 46.0). This value also represents the largest node size within group UKBS 2.

Contributions by field:

- Humanities: 26 useful opinions; "education" appeared 4 times.
- Social Sciences: 33 useful opinions; "education" appeared 11 times.
- Interdisciplinary Fields: 19 useful opinions; "education" appeared 8 times.
- Natural Sciences: 32 useful opinions; "education" appeared 10 times.
- Applied Sciences: 40 useful opinions; "education" appeared 12 times.
- Marginal Fields: 3 useful opinions; "education" did not appear.

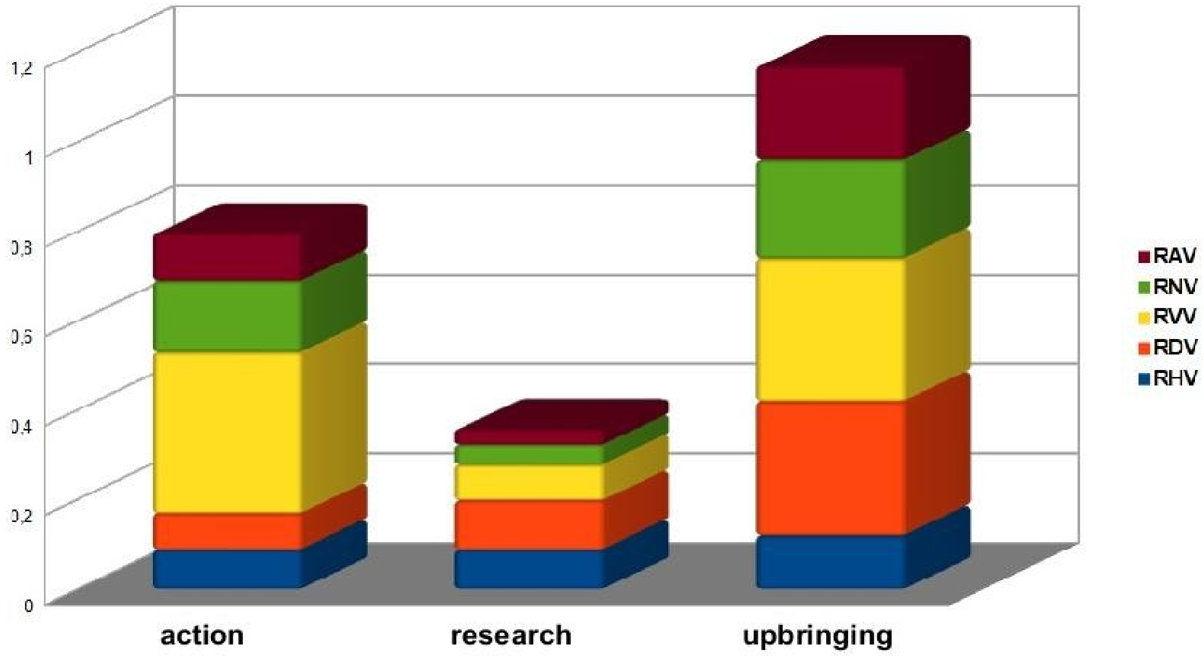
In the next step, ratios between the frequency of a particular word category and the total number of useful opinions within each scientific field will be calculated.

These ratios will be presented in a table and an accompanying stacked bar chart for all word categories and representatives of each field (excluding marginal fields due to the small number of representatives).

This methodology will apply to all classification groups whose word categories were selected for detailed data analysis.

4.9.3.9.5.2 Table 157: Calculated ratios for word categories within UKBS 2

UKB	RHV	RDV	RVV	RNV	RAV	Vsota V	UKBS
action	0.09	0.08	0.36	0.16	0.11	0.8	2
research	0.09	0.11	0.08	0.04	0.04	0.36	2
upbringing	0.12	0.3	0.32	0.22	0.21	1.17	2
Total S	0.3	0.49	0.76	0.42	0.36	2.33	2
No. of .opinions	34	37	25	45	56	197	2



4.9.3.9.5.2.1 Figure 293: Stacked bar chart of ratios by field

Table 157 presents the calculated ratios for each academic field (Humanities [RHV], Social Sciences [RDV], Interdisciplinary Fields [RVV], Natural Sciences [RNV], and Applied Sciences [RAV]) along with the totals of these ratios by row (Total V) and by column (Total S).

Figure 293 illustrates a stacked bar chart based on the calculated ratios across specific word categories ("action," "research," "education") that denote performance-related characteristics or content (UKBS 2) and by field.

For representatives of the humanities, it is evident that the thematic emphasis within their opinions on the word categories "action" (ratio value 0.09), "research" (ratio value 0.09), and "education" (ratio value 0.12) is relatively minor.

Among social sciences representatives, there is a stronger thematic emphasis on "education" (ratio value 0.30), whereas the word categories "action" and "research" are less prominent (ratio values 0.08 and 0.11, respectively).

It is important to note that social science representatives, compared to other fields, most frequently used the word category "research" in their opinions.

Representatives from interdisciplinary fields placed greater emphasis on "action" (ratio value 0.36) and "education" (ratio value 0.32), while the use of "research" was significantly less important in content (ratio value 0.08).

Natural sciences representatives placed slightly more thematic emphasis on "education" (ratio value 0.22) and "action" (ratio value 0.16), while the word category "research" was thematically insignificant (ratio value 0.04).

Finally, representatives of applied sciences, similar to those from natural sciences, more frequently used "action" (ratio value 0.11) and "education" (ratio value 0.21), while the word category "research" again proved to be of little thematic significance (ratio value 0.04).

Based on the total sum of ratio values by column, we can highlight the leading role of representatives from interdisciplinary fields (ratio value 0.76), followed by representatives from social sciences (0.49), natural sciences (0.42), applied sciences (0.36), and lastly humanities (0.30).

When summing the ratios by row, the greatest thematic significance was assigned to the word category "education" (ratio value 1.17), followed by "action" (0.80), with "research" ranking last (0.36).

Overall, opinions on crime from representatives of various fields were not primarily focused on the scientific investigation of crime but rather on unlawful acts, often seen as consequences of inadequate education.

If education meets high ethical standards, the likelihood of a rise in criminal activity is significantly reduced.

However, practical criminology has often demonstrated that while appropriate education is important, it does not provide an absolute guarantee against the rise of crime, as many other factors are involved (e.g., violent social environments, social hardship, opportunity, financial difficulties, illness).

It is somewhat surprising that the word category "research" had such a low result, considering that the survey participants were scientists and researchers from various disciplines whose core mission typically includes conducting scientific research. Through research, we can better understand certain phenomena and thus prevent negative outcomes more effectively.

UKBS 3: This group includes words that refer to individual psychological traits or content.

a. Individuality (individual, individualism, individual, individuals, individuality, person, person's, persons, individual's, individualistic, individualistic) appeared 37 times through various forms and

closely related content (the connection strength to the central theme is 8.0; the connection strength to UKBS 3, shown by the light blue link, is 38.0). This value also represents the size of the node.
- Representatives from the humanities contributed 26 usable opinions, with the word category "individuality" appearing 8 times.
- Representatives from the social sciences contributed 33 usable opinions, using words from the "individuality" category 10 times.
- Representatives from interdisciplinary fields contributed 19 usable opinions, using words from "individuality" 3 times.
- Representatives from the natural sciences contributed 32 usable opinions, with "individuality" and related words appearing 8 times.
- Representatives from the applied sciences contributed 40 usable opinions, with "individuality" and related words appearing 7 times.
- Lastly, three representatives from marginal fields contributed 3 usable opinions, with the "individuality" category appearing once.
b. Thinking (thinking → thought processes, mentality, foolishness, intelligence, consider, thinking about, reflections, reflection, pondering) appeared 12 times through various forms and closely related content (connection strength to the central theme is 6.0; connection strength to UKBS 3, shown by the dark blue link, is 13.0). This value also represents the node size.
- Humanities representatives contributed 26 usable opinions; the "thinking" category appeared once.
- Social sciences representatives contributed 33 usable opinions, using "thinking" words twice.
- Interdisciplinary fields representatives contributed 19 usable opinions, using "thinking" words 4 times.
- Natural sciences representatives contributed 32 usable opinions, with "thinking" appearing 4 times.
- Applied sciences representatives contributed 40 usable opinions, with "thinking" appearing once.
- Marginal fields representatives contributed 3 usable opinions; the "thinking" category did not appear.
c. Motivation (motivation → motivate, encouragement, encourages, encouraging, encouragements, encourage, stimulation) appeared 14 times across various forms and closely related content (connection strength to the central theme is 6.0; connection strength to UKBS 3, shown by the dark blue link, is 15.0). This value also represents the node size.
- Humanities representatives contributed 26 usable opinions; "motivation" appeared 4 times.
- Social sciences representatives contributed 33 usable opinions; "motivation" appeared twice.

- Interdisciplinary fields representatives contributed 19 usable opinions, using "motivation" words twice.
- Natural sciences representatives contributed 32 usable opinions, with "motivation" appearing 3 times.
- Applied sciences representatives contributed 40 usable opinions, with "motivation" appearing 3 times.
- Marginal fields representatives contributed 3 usable opinions; the "motivation" category did not appear.

d. Personality (personality → identity, character, personal, individual, individuality, personal nature) appeared 20 times across various forms and closely related content (connection strength to the central theme is 6.0; connection strength to UKBS 3, shown by the dark blue link, is 21.0). This value also represents the node size.

- Humanities representatives contributed 26 usable opinions; "personality" appeared 3 times.
- Social sciences representatives contributed 33 usable opinions; "personality" words appeared 8 times.
- Interdisciplinary fields representatives contributed 19 usable opinions, using "personality" words 6 times.
- Natural sciences representatives contributed 32 usable opinions, with "personality" appearing 2 times.
- Applied sciences representatives contributed 40 usable opinions, with "personality" appearing once.
- Marginal fields representatives contributed 3 usable opinions; the "personality" category did not appear.

e. Psychology (psychology → instability, psyche, psychiatric, psycho, psychophysical, psycholability, psychology, psychological, psychosocial) appeared 12 times across various forms and closely related content (connection strength to the central theme is 5.0; connection strength to UKBS 3, shown by the dark blue link, is 13.0). This value also represents the node size.

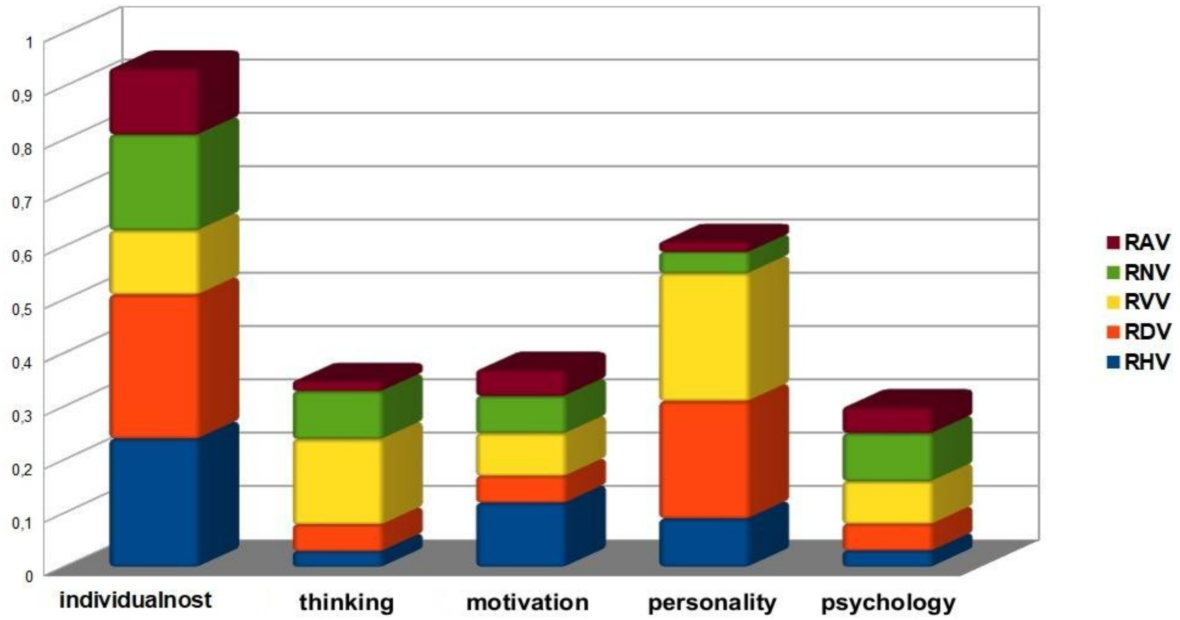
- Humanities representatives contributed 26 usable opinions; "psychology" appeared once.
- Social sciences representatives contributed 33 usable opinions; "psychology" words appeared twice.
- Interdisciplinary fields representatives contributed 19 usable opinions, using "psychology" words twice.
- Natural sciences representatives contributed 32 usable opinions, with "psychology" appearing 4 times.

- Applied sciences representatives contributed 40 usable opinions, with "psychology" appearing 3 times.

- Marginal fields representatives contributed 3 usable opinions; the "psychology" category did not appear.

4.9.3.9.5.3 Table 158: Calculated ratios for word categories within UKBS 3

UKB	RHV	RDV	RVV	RNV	RAV	Total V	UKBS
individuality	0.24	0.27	0.12	0.18	0.13	0.94	3
thinking	0.03	0.05	0.16	0.09	0.02	0.35	3
motivation	0.12	0.05	0.08	0.22	0.05	0.37	3
personality	0.09	0.22	0.24	0.07	0.02	0.61	3
psychology	0.03	0.05	0.08	0.04	0.05	0.3	3
Total S	0.51	0.64	0.68	0.47	0.27	2.57	3
No. of opinions	34	37	25	45	56	197	



4.9.3.9.5.4 Figure 294: Stacked bar chart of ratios by disciplines

Table 158 presents the calculated ratios for each academic field (humanities, social sciences, intermediate sciences, natural sciences, and applied sciences), along with the totals by rows (Total V) and by columns (Total S). Figure 294 illustrates a stacked bar chart showing the calculated ratios across individual word categories (individuality, thinking, motivation, personality, and psychology) that represent individual psychological traits or contents (UKBS 3) and the academic disciplines. Among the representatives of the humanities, it can be observed that the content emphasis within their statements for the word categories "thinking" (value 0.03), "psychology" (value 0.03), and

"personality" (value 0.09) is relatively low. Greater content weight is found in the word categories "motivation" (value 0.12) and "individuality" (value 0.24).
Representatives from the social sciences place a stronger content emphasis on the word categories "individuality" (value 0.27) and "personality" (value 0.22), whereas other word categories such as "thinking" (value 0.05), "motivation" (value 0.05), and "psychology" (value 0.05) are less prominent.
Representatives of the intermediate sciences emphasized the word categories "individuality" (value 0.12), "thinking" (value 0.16), and "personality" (value 0.24), while the remaining two word categories, "motivation" (value 0.08) and "psychology" (value 0.08), were substantially less important in terms of content within their statements.
Representatives from the natural sciences placed slightly more emphasis on "individuality" (value 0.18), while the other word categories were less important content-wise (with values ranging from 0.09 to 0.04).
Finally, representatives from the applied sciences, similar to those from the natural sciences, more frequently used the word category "individuality" (value 0.13), while the other word categories had lower values (ranging from 0.05 to 0.02).
Based on the sum of the ratios by columns, we can highlight the leading role of the representatives from the intermediate sciences (value 0.68), followed by the social sciences (value 0.64), humanities (value 0.51), natural sciences (value 0.47), and finally the applied sciences (value 0.27).
Looking at the sums of the ratios by rows, "individuality" (value 0.94) has the highest content significance, followed by "personality" (value 0.61), "motivation" (value 0.37), "thinking" (value 0.35), and lastly "psychology" (value 0.30). It is noteworthy that the values for the less important content emphases are relatively close together.
Opinions on criminality, particularly from representatives of the humanities, social sciences, and intermediate sciences, emphasized contents related to individuality and personality. For representatives of the natural and applied sciences, from an individual psychological perspective, no strongly prominent word category other than "individuality" can be highlighted.
For representatives of the humanities and social sciences, the word category "individuality" and related terms appear to be relatively important in relation to criminality. Interestingly, the representatives of the intermediate sciences seem to consider this word category less important in reflecting on criminality, despite the fact that psychologists' opinions were also included.
Regarding the word category "thinking" and related terms, a slight content importance can be noted based on the opinions of intermediate sciences representatives, while among other fields, this content unit is not particularly significant.

Regarding "motivation" and its related terms, it can be concluded that, from the perspective of representatives of the humanities, this content unit is more important in connection with criminality compared to other fields. This outcome is not surprising, as educators, in particular, often deal with motivational factors in learning.

For the largest node, "personality," representatives from the social sciences and intermediate sciences can be highlighted, as the "personality" content unit is significant in relation to criminality. This cannot be claimed for representatives of other fields due to their low scores.

For the word category "psychology" and its related terms, no greater content significance in connection with criminality could be established. Personality is an important content unit when thinking about criminality, especially in the context of criminal psychology. Therefore, the low values obtained from the representatives of the discussed fields are somewhat surprising, as a stronger content correlation between "personality" and "thinking" could have been expected.

A stronger content correlation can be pointed out between the categories "individuality" and "personality." Based on this, it could be concluded that representatives from the social sciences and intermediate sciences, in particular, believe that individual traits of certain personalities have a significant impact on the occurrence of criminality and may even constitute an important cause.

Based on the obtained results, it can be asserted that representatives of the humanities, natural sciences, and applied sciences are less focused on psychological influences and causes in connection with the occurrence of criminality.

UKBS 4: This group includes words that refer to individual social/sociological characteristics or contents.

a. Family

The word "family" (family -> in families, families, to family, family-related, of the family, in the family, family-based, among families) appeared 22 times in connection with various forms and closely related contents (link strength to the main topic: 7.0; link strength to UKBS 4 via the dark blue link: 23.0). This number also represents the size of the node.

- Representatives from the humanities contributed 26 useful opinions. Within these, the word category "family" appeared four times.
- Representatives from the social sciences contributed 33 useful opinions, mentioning "family" nine times.
- Representatives from interdisciplinary sciences contributed 19 useful opinions, using the "family" word category three times.
- Representatives from the natural sciences contributed 32 useful opinions, with "family" appearing once.

- Representatives from applied sciences contributed 40 useful opinions, mentioning "family" four times.

- Finally, three representatives from marginal sciences contributed three useful opinions, in which "family" appeared once.

b. Economy

The word "economy" (economy -> stocks, economic, economic-related, financially, financial, macroeconomic, business, etc.) appeared 24 times in relation to various forms and closely related content (link strength to the main topic: 7.0; link strength to UKBS 4 via the dark blue link: 25.0). This also represents the size of the node.

- Humanities: 26 opinions, "economy" appeared six times.
- Social sciences: 33 opinions, "economy" mentioned five times.
- Interdisciplinary sciences: 19 opinions, "economy" mentioned three times.
- Natural sciences: 32 opinions, "economy" appeared three times.
- Applied sciences: 40 opinions, "economy" mentioned seven times.
- Marginal sciences: 3 opinions, no mention of "economy".

c. Crime

The word "crime" (crime -> criminal, crime-related, offenses, suicides, tax evasion, white-collar crime, etc.) appeared 139 times in related forms and closely linked content (link strength to the main topic: 11.0; link strength to UKBS 4 via the bold red link: 140.0), also representing the node size.

- Humanities: 26 opinions, "crime" appeared 40 times.
- Social sciences: 33 opinions, "crime" mentioned 18 times.
- Interdisciplinary sciences: 19 opinions, "crime" mentioned 26 times.
- Natural sciences: 32 opinions, "crime" mentioned 24 times.
- Applied sciences: 40 opinions, "crime" mentioned 30 times.
- Marginal sciences: 3 opinions, "crime" appeared once.

d. Relationships

The word "relationships" (relationships -> relationship, relationships, relational) appeared 16 times (link strength to main topic: 6.0; to UKBS 4 via the dark blue link: 23.0), representing the node size.

- Humanities: 26 opinions, "relationships" appeared four times.
- Social sciences: 33 opinions, mentioned three times.
- Interdisciplinary sciences: 19 opinions, mentioned four times.
- Natural sciences: 32 opinions, mentioned four times.

- Applied sciences: 40 opinions, no mentions.
- Marginal sciences: 3 opinions, "relationships" mentioned once.

e. Connectedness

The word "connectedness" (connectedness -> interaction, correlation, networking, connected, linkage, interdependence, kinship, etc.) appeared 26 times (link strength to the main topic: 7.0; link strength to UKBS 4 via dark blue link: 27.0).

- Humanities: 26 opinions, "connectedness" appeared three times.
- Social sciences: 33 opinions, mentioned eight times.
- Interdisciplinary sciences: 19 opinions, no mentions.
- Natural sciences: 32 opinions, mentioned seven times.
- Applied sciences: 40 opinions, mentioned six times.
- Marginal sciences: 3 opinions, "connectedness" mentioned twice.

f. Differences

The word "differences" (differences -> different, various, differently, etc.) appeared 26 times (link strength to main topic: 6.0; to UKBS 4 via dark blue link: 18.0).

- Humanities: 26 opinions, "differences" appeared four times.
- Social sciences: 33 opinions, mentioned three times.
- Interdisciplinary sciences: 19 opinions, mentioned three times.
- Natural sciences: 32 opinions, mentioned three times.
- Applied sciences: 40 opinions, mentioned four times.
- Marginal sciences: 3 opinions, no mentions.

g. Conditions

The word "conditions" (conditions -> situation, circumstances, etc.) appeared 27 times (link strength to the main topic: 7.0; to UKBS 4 via dark blue link: 27.0).

- Humanities: 26 opinions, "conditions" appeared six times.
- Social sciences: 33 opinions, mentioned seven times.
- Interdisciplinary sciences: 19 opinions, mentioned four times.
- Natural sciences: 32 opinions, mentioned four times.
- Applied sciences: 40 opinions, mentioned six times.
- Marginal sciences: 3 opinions, no mentions.

h. Poverty

The word "poverty" (poverty -> hunger, lack, shortage, poor people, impoverished, etc.) appeared 27 times (link strength to main topic: 6.0; to UKBS 4 via dark blue link: 15.0).

- Humanities: 26 opinions, "poverty" appeared three times.

- Social sciences: 33 opinions, mentioned six times.
- Interdisciplinary sciences: 19 opinions, mentioned twice.
- Natural sciences: 32 opinions, mentioned once.
- Applied sciences: 40 opinions, mentioned three times.
- Marginal sciences: 3 opinions, no mentions.

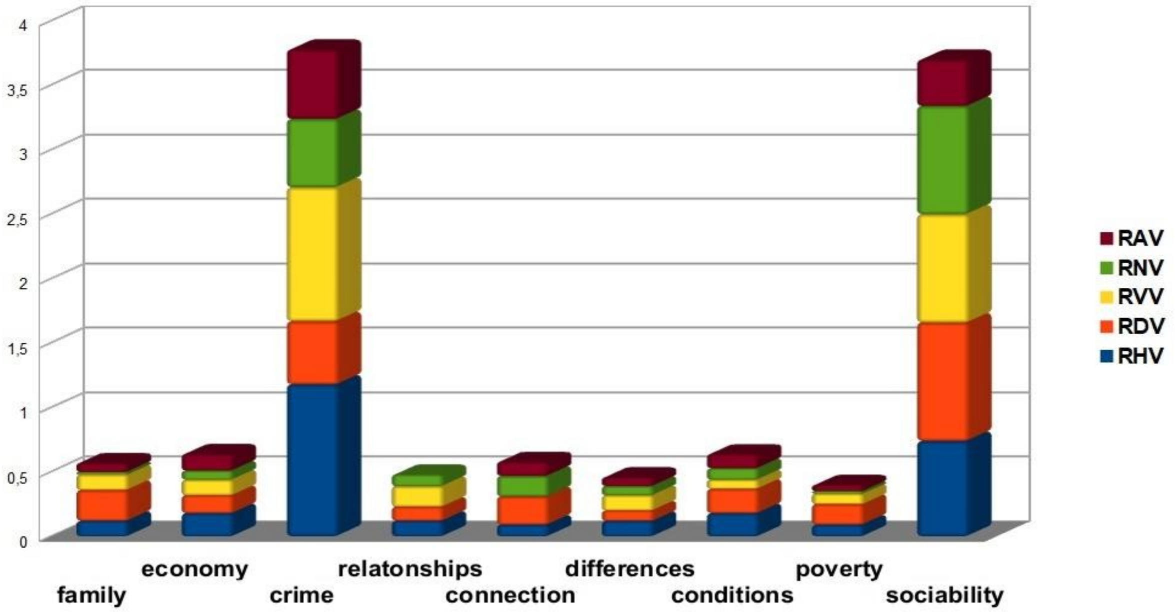
i. Sociality

The word "sociality" (sociality -> society, social, sociological, sociology, groups, socialization, globalization, mechanisms, etc.) appeared 140 times (link strength to the main topic: 11.0; to UKBS 4 via bold red link: 141.0).

- Humanities: 26 opinions, "sociality" appeared 25 times.
- Interdisciplinary sciences: 19 opinions, mentioned 21 times.
- Natural sciences: 32 opinions, mentioned 38 times.
- Applied sciences: 40 opinions, mentioned 20 times.
- Marginal sciences: 3 opinions, "sociality" mentioned twice.

4.9.3.9.5.5 Table 159: Calculated ratios for word categories within UKBS 4

UKB	RHV	RDV	RVV	RNV	RAV	Total V	UKBS
family	0.12	0.24	0.12	0.02	0.07	0.57	4
economy	0.18	0.14	0.12	0.07	0.13	0.64	4
crime	1.18	0.49	1.04	0.53	0.54	3.78	4
relationships	0.12	0.11	0.16	0.09	0.00	0.48	4
connection	0.09	0.22	0.00	0.16	0.11	0.58	4
differences	0.12	0.08	0.12	0.07	0.07	0.46	4
conditions	0.18	0.19	0.07	0.09	0.11	0.64	4
poverty	0.09	0.16	0.08	0.02	0.05	0.40	4
sociability	0.74	0.92	0.84	0.84	0.36	3.70	4
Total S	2.82	2.55	2.55	1.89	1.44	11.25	4
No. of opinions	34	37	25	45	56	197	4



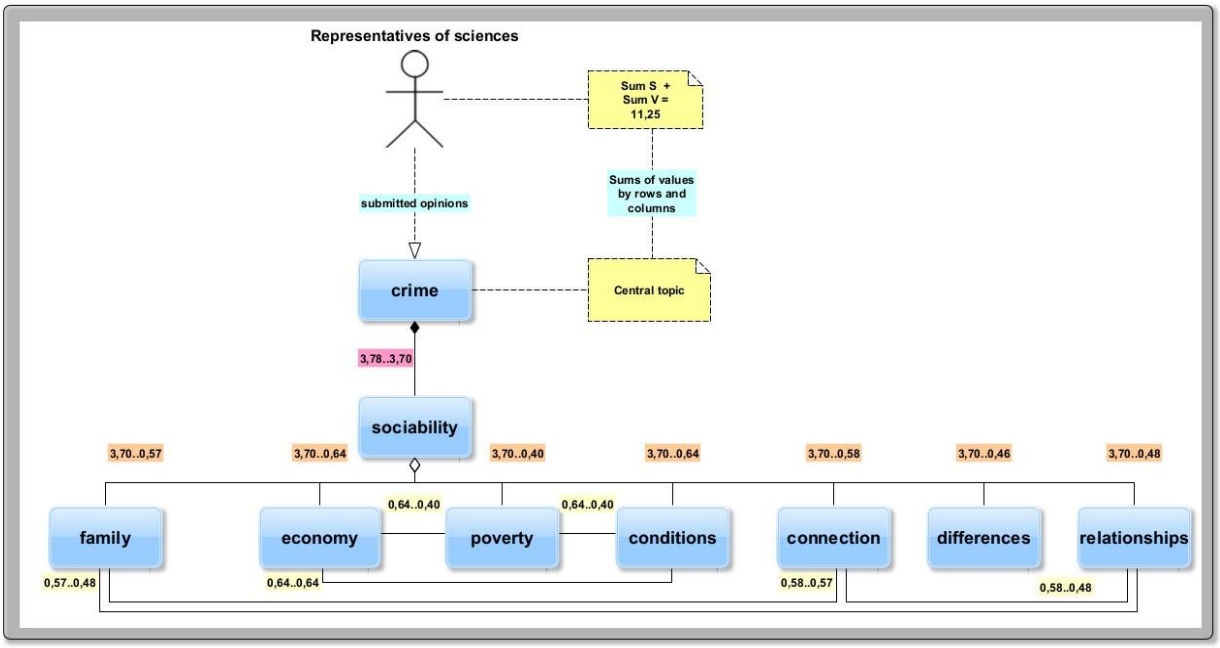
4.9.3.9.5.6 Figure 295: Stacked column chart of ratios by academic fields

Representatives of the social sciences contributed 33 useful opinions. Within these, the word from the lexical category “sociality” was used 34 times.

Table 159 shows the calculated ratios for individual academic fields (RHV, RDV, RVV, RNV, and RAV) and the totals of these ratios by rows (Sum/Total V) and columns (Sum/Total S). Meanwhile, Figure 297 illustrates a stacked column chart depicting the calculated ratios for individual lexical categories (family, economy, crime, relationships, connectedness, differences, conditions, poverty,

and sociality) that represent social characteristics or contents (UKBS 4) across different academic fields.
Among representatives of the humanities, it was found that the content emphasis within their opinions was lower for the lexical categories “connectedness” (value 0.09) and “poverty” (value 0.09). Greater content emphasis was observed in categories such as “crime” (value 1.18), “sociality” (value 0.74), “economy” (value 0.18), “conditions” (value 0.18), “relationships” (value 0.12), and “differences” (value 0.12).
Among representatives of the social sciences, a stronger content emphasis was observed in the lexical categories “sociality” (value 0.92), “crime” (value 0.49), “family” (value 0.24), “connectedness” (value 0.22), “conditions” (value 0.19), “poverty” (value 0.16), “economy” (value 0.14), and “relationships” (value 0.11), while the category “differences” (value 0.08) was less emphasized content-wise.
Representatives of the intermediate sciences placed greater emphasis on the categories “crime” (value 1.04), “sociality” (value 0.84), and “relationships” (value 0.16), as well as “family,” “economy,” and “differences” (each with a value of 0.12). Meanwhile, the use of other categories such as “poverty” (value 0.08), “conditions” (value 0.07), and “connectedness” (value 0) was significantly less meaningful. For “connectedness,” a zero content emphasis was recorded.
Representatives of the natural sciences placed greater content emphasis on “crime” (value 0.53), “sociality” (value 0.84), and “connectedness” (value 0.16), while other lexical categories were less emphasized (values between 0.09 and 0.02).
Finally, representatives of the applied sciences more frequently used the categories “crime” (value 0.54), “sociality” (value 0.36), “economy” (value 0.13), and “connectedness” and “conditions” (each with a value of 0.11), while the other categories scored lower (values between 0.07 and 0). The “relationships” category even reached a value of zero.
Based on the sum of ratios by columns, the leading role is held by representatives of the humanities (value 2.82), followed by representatives of the social sciences and intermediate sciences (both at 2.55), then the natural sciences (1.89), and finally the applied sciences (1.44).
Looking at the sums of ratios by rows, the greatest content importance is attributed to the lexical category “crime” (value 3.78), followed by “sociality” (value 3.70), “economy” and “conditions” (both 0.64), “connectedness” (0.58), “family” (0.57), “relationships” (0.48), “differences” (0.46), and lastly “poverty” (0.40). It is important to highlight that the values of less emphasized categories are relatively close together.
Opinions on crime from representatives of all academic fields showed a strong content emphasis on sociality (e.g., social influences, groups, socializing, society). Representatives of all fields,

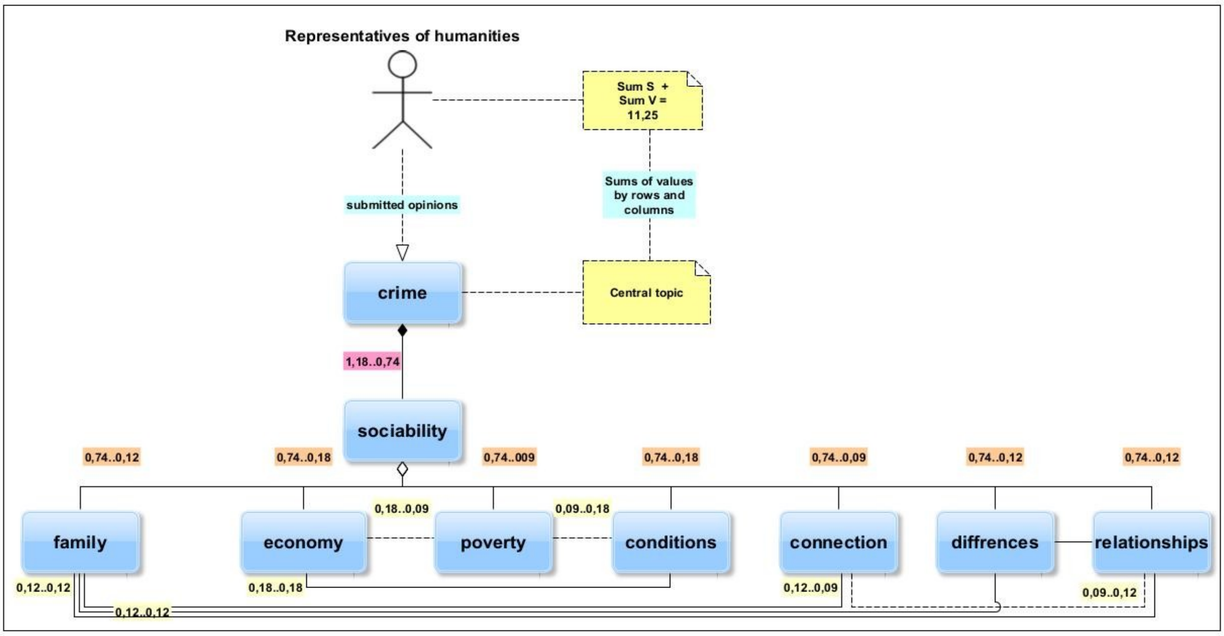
especially those from the humanities and intermediate sciences, also very frequently used the lexical category “crime,” which was the central topic of this final question in the survey questionnaire.
For a clearer view of the connections between lexical categories within the classification group UKBS 4, a hierarchical associative diagram was created.



4.9.3.9.5.7 Figure 296: Hierarchical associative diagram of lexical categories and academic field representatives

Figure 296 presents a hierarchical associative diagram of lexical categories and academic field representatives.
The representatives provided their opinions (see the realization or dashed connection with a triangle) on the central topic of crime, which is a parent category (see connection with a black diamond) to all the lexical categories.
The lexical category “sociality” plays a subordinate role in connection with crime but serves as a parent category (see connection with a white diamond) to other lexical categories, such as family, economy, poverty, conditions, connectedness, differences, and relationships.
Considering the variation between values (see values in the yellow field – the smaller the variation, the stronger the connection), a stronger associative link (see connections with a solid line) can be observed between the lexical categories “family,” “connectedness,” and “relationships.”
Another strong associative connection is visible among the categories “economy,” “poverty,” and “conditions.”
An additional associative link can be observed between “connectedness” and “relationships.”
Based on the analysis, a pronounced emphasis on social factors in the explanation of crime can be identified.

To better explore the content emphases of representatives of individual academic fields, it would be necessary to create hierarchical associative diagrams for each major field separately, since the previous diagram (see values) reflects the combined data for all field representatives.

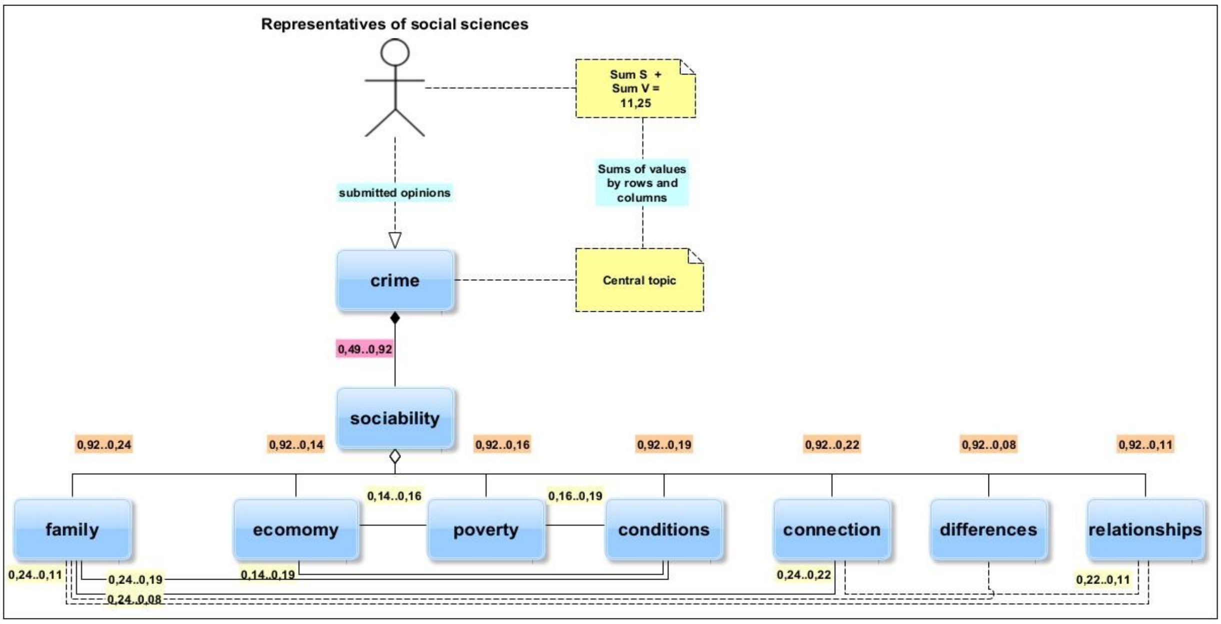


4.9.3.9.5.8 Figure 297: Hierarchical associative diagram of word categories according to representatives of the humanities

Figure 297 presents a hierarchical associative diagram of word categories based on the views of representatives from the humanities. The diagram reveals certain changes, especially when considering the variation ranges between values (see the values within the pink, orange, and yellow fields). These variations have altered the strength of hierarchical and associative links between the word categories. In this context, associative links are particularly important due to the shift in thematic emphasis.

According to representatives of the humanities, the strongest influences on the occurrence of crime are social or sociological factors. They see secondary-level influences and causes primarily in unfavorable social and economic conditions, family relationships, stronger and more quality-based connections among family members, and differences in upbringing. The associative links between the word categories “economy” and “poverty” (with a variation range from 0.18 to 0.09) and between “poverty” and “conditions” (with a variation range from 0.09 to 0.18) are weaker, as indicated by dashed lines. There is also a weaker associative link between “connection” and “relationships” (variation range from 0.09 to 0.12).

In summary, representatives of the humanities identified the economy, social conditions, interpersonal connections, and the family as having a stronger influence at the secondary level in explaining the occurrence of crime. They primarily support sociological interpretations of crime and do not emphasize strong roles for mass media, religion, ethnic background, poverty, political systems, or unemployment. Their sociological explanations can be summarized as focusing on the influence and causes stemming from the enhanced role of the family and the economy, in connection with the financial state of the country and many families. This represents the thematic scope of the positions held by representatives of the humanities regarding the emergence of crime.

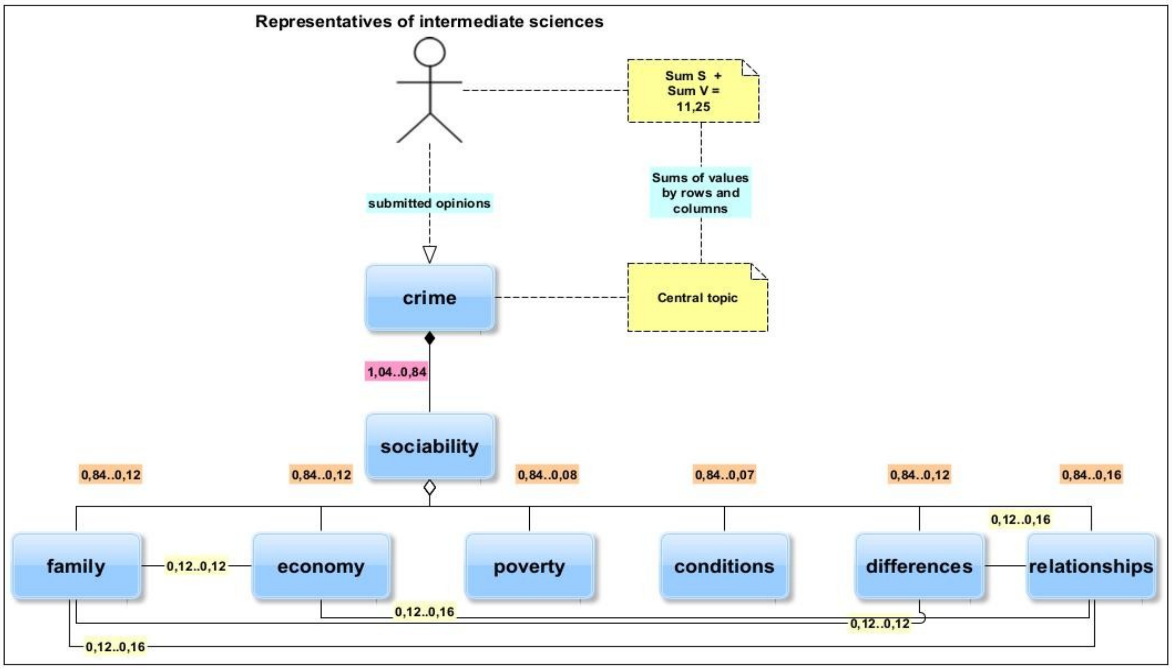


4.9.3.9.5.9 Figure 298: Hierarchical associative diagram of word categories according to representatives of the social sciences

Figure 298 presents a hierarchical associative diagram of word categories based on the views of representatives from the social sciences, within which certain changes can once again be observed. Considering the variation ranges between values (see the values within the pink, orange, and yellow fields), the strength of hierarchical and associative links between word categories has shifted.

One noticeable aspect is that the value associated with the word category “sociality” is higher (0.92) than the value associated with “crime” (0.49), even though crime is the central topic of the final question in the survey. Overall, it can be observed that representatives of the social sciences responded in a different manner than those from the humanities or other fields. They used fewer words from the “crime” category and focused more on social and sociological content, which they use to explain all social phenomena, including crime. The largest variation ranges are generally found between the category “sociality” and other word categories, suggesting that social science representatives provided the most diverse responses. However, to avoid drawing premature conclusions, further content-based analysis will be required. As with the humanities, it is also useful here to examine associative connections in relation to shifts in thematic emphasis.

Representatives of the social sciences expressed even stronger views about the influence of social and sociological factors on the occurrence of crime. At the secondary level, they primarily identified causes in existing family circumstances (see the associative link between “family” and “conditions” with a variation range from 0.24 to 0.19) and the nature of relationships among family members (see the associative link between “family” and “connection” with a variation range from 0.24 to 0.22). In addition, there are stronger associative links between the categories “economy,” “poverty,” and “conditions” (see variation ranges from 0.14 to 0.16, 0.19 to 0.16, and 0.14 to 0.19), indicating that poverty is a consequence of unfavorable economic conditions and that such economic and social conditions significantly impact the functioning of the family, the most fundamental social unit. Social science representatives placed less thematic emphasis on social and economic disparities expressed through interpersonal relations. In summary, based on the presented results, the mindset of social science representatives regarding the emergence of crime can be described as focused on the family and broader social connections, which are in turn influenced by other social factors such as economic and financial conditions. As for the response showing the greatest variability among social science representatives, more detailed conclusions will be provided after analyzing the extent and diversity of opinions across academic fields.



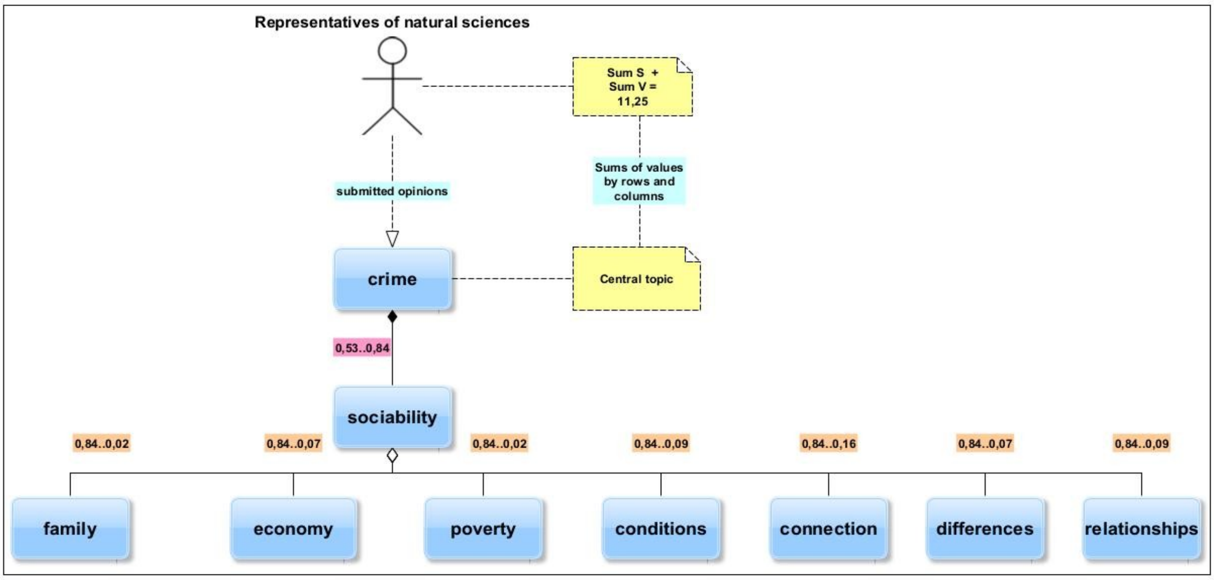
4.9.3.9.6 Figure 299: Hierarchical associative diagram of word categories according to representatives of the intermediate sciences

Figure 299 shows a hierarchical associative diagram of word categories based on the views of representatives from intermediate sciences. A strong emphasis on the word category “sociality” is again noticeable (see value 0.84), though slightly lower than among representatives of the social sciences. The category “crime” was used very frequently (see value 1.04).

At the secondary level of content relevance, the link to the category “connection” disappears, as this thematic emphasis is not present among representatives of interdisciplinary fields (value 0). Instead, the categories “relationships,” “differences,” “family,” and “economy” are more emphasized, while the thematic focus on “poverty” and “conditions” is considerably lower (see respective values 0.08 and 0.07).

From this, we can highlight stronger associative links between the word categories “relationships” and “differences” (see variation range from 0.12 to 0.16), “family” and “relationships” (0.12 to 0.16), “economy” and “relationships” (0.12 to 0.16), “family” and “differences” (0.12 to 0.12), and “family” and “economy” (0.12 to 0.12).

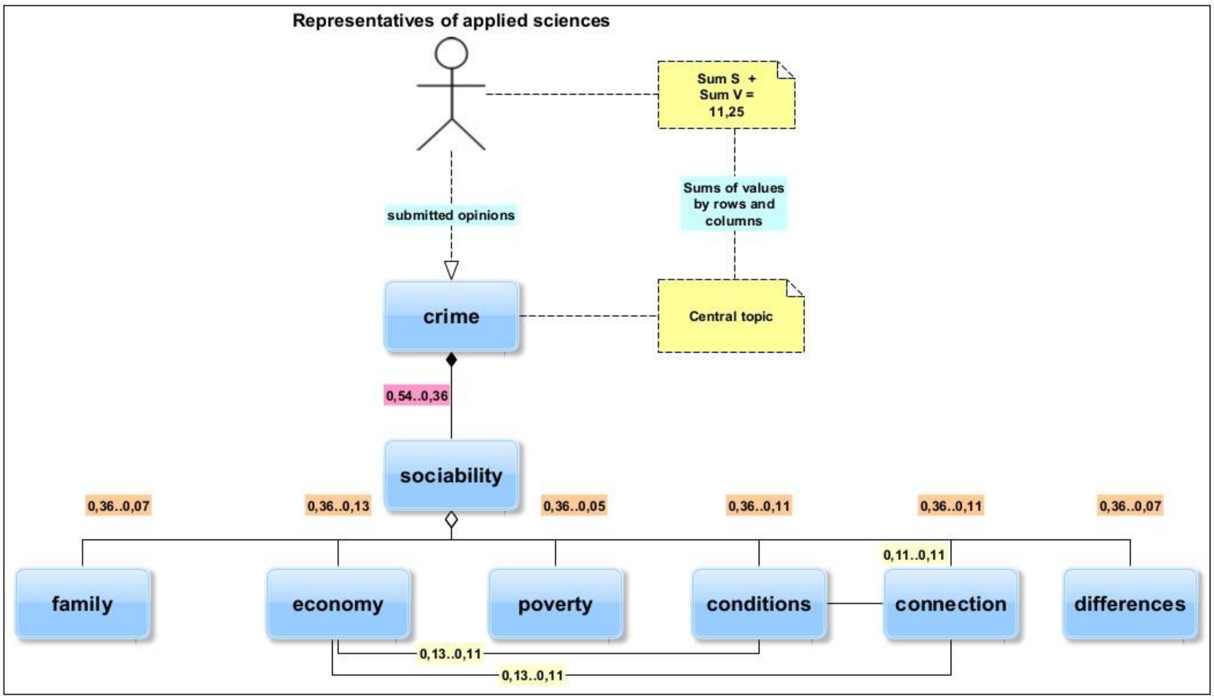
Regarding the influences and causes of crime, representatives of intermediate sciences are strong proponents of social and sociological factors. Within this overarching view, they place greater emphasis on relationships within the family, differences in interpersonal relationships in a broader sense, and relationships within economic and financial activities. This forms the core conceptual framework of representatives from the intermediate sciences based on the obtained results.



4.9.3.9.6.1 Figure 300: Hierarchical associative diagram of word categories according to representatives of the natural Sciences

Figure 300 presents a hierarchical associative diagram of word categories based on the views of representatives from the natural sciences. Similar to the representatives of the social sciences, we observe a more frequent use of the word category “sociality” compared to “crime” (see variation range from 0.53 to 0.84). However, in this case, the variation range is smaller than that observed among the social science representatives (0.49 to 0.92).

Representatives of the natural sciences also strongly emphasize social and sociological factors as influences and causes of crime. At the secondary level of thematic relevance, no strong associative links between word categories are observed. The content emphasis for categories such as “family,” “economy,” “poverty,” “conditions,” “differences,” and “relationships” is very low (ranging from 0.02 to 0.09), while the category “connection” stands out with a higher value (see value 0.16). Natural science representatives believe that the influences and causes of crime can be attributed to social or sociological factors, within which various variations and combinations of connections may be identified. This framework defines the conceptual scope of natural science representatives in explaining the phenomenon of crime.



4.9.3.9.6.2 Figure 301: Hierarchical associative diagram of word categories according to representatives of the applied sciences

Figure 301 shows the hierarchical associative diagram of word categories based on the views of representatives from the applied sciences. Similar to representatives from other disciplines, those from the applied sciences also emphasize the importance of social and sociological factors in the occurrence of crime.

At the secondary level, stronger associative links can be observed between the word categories “economy” and “conditions” (see associative link with a variation range from 0.13 to 0.11), between “economy” and “connection” (0.13 to 0.11), and between “conditions” and “connection” (0.11 to 0.11). Other categories, such as “family,” “poverty,” and “differences,” carry significantly less thematic emphasis (see values ranging from 0.07 to 0.05). A notable feature among representatives of the applied sciences is the absence of the word category “relationships” (value 0).

In summary, their view on the influence of social and sociological factors in crime occurrence is closely tied to the causes and effects related to economic and financial activities, where harmful negative interconnections contribute to poor social and economic conditions. This defines the conceptual scope of representatives from the applied sciences. Across all disciplines, social and sociological factors were strongly emphasized as key to understanding crime, though subtle differences in associative connections revealed variations in their perspectives.

UKBS 5: This group includes words that represent non-living natural properties or phenomena. Due to the applied filter, not a single word was classified into this group.

UKBS 6: This group includes words representing living natural properties or phenomena.

a. People (e.g., people → about people, to people, people (acc.), people (nom.), person, of the person, to the person).

This word appeared 50 times across various forms and closely related contexts (connection strength to the central theme is 9.0; connection strength to UKBS 6 – see stronger green link – is 51.0). This value also represents the size of the node.

- Representatives from the humanities contributed 26 valid responses, in which the word category "people" appeared 9 times.
- Representatives from the social sciences contributed 33 valid responses; "people" was used 7 times.
- Representatives from the intermediate sciences contributed 19 valid responses; "people" appeared 7 times.
- Representatives from the natural sciences contributed 32 valid responses; the word category "people" and related terms appeared 12 times.
- Representatives from the applied sciences contributed 40 valid responses; "people" and related words appeared 12 times.
- Three representatives from marginal sciences provided 3 valid responses, in which "people" appeared 3 times.

b. Individuals (e.g., individuals → actors, citizens, physicist, economists, person, Pickett, Plečnik, Refugijev, Rejnikov, Richard, peers, Wilkinson, advocates, athletes, mayors).

This word appeared 26 times in various forms and closely related contexts (connection strength to the central theme is 7.0; connection strength to UKBS 6 – see blue link – is 27.0). This value also represents the node size.

- Humanities: 26 valid responses; "individuals" appeared 4 times.
- Social sciences: 33 valid responses; "individuals" appeared 5 times.
- Intermediate sciences: 19 valid responses; "individuals" appeared 6 times.

- Natural sciences: 32 valid responses; “individuals” appeared 5 times.
- Applied sciences: 40 valid responses; “individuals” appeared 6 times.
- Marginal sciences: 3 valid responses; “individuals” did not appear.

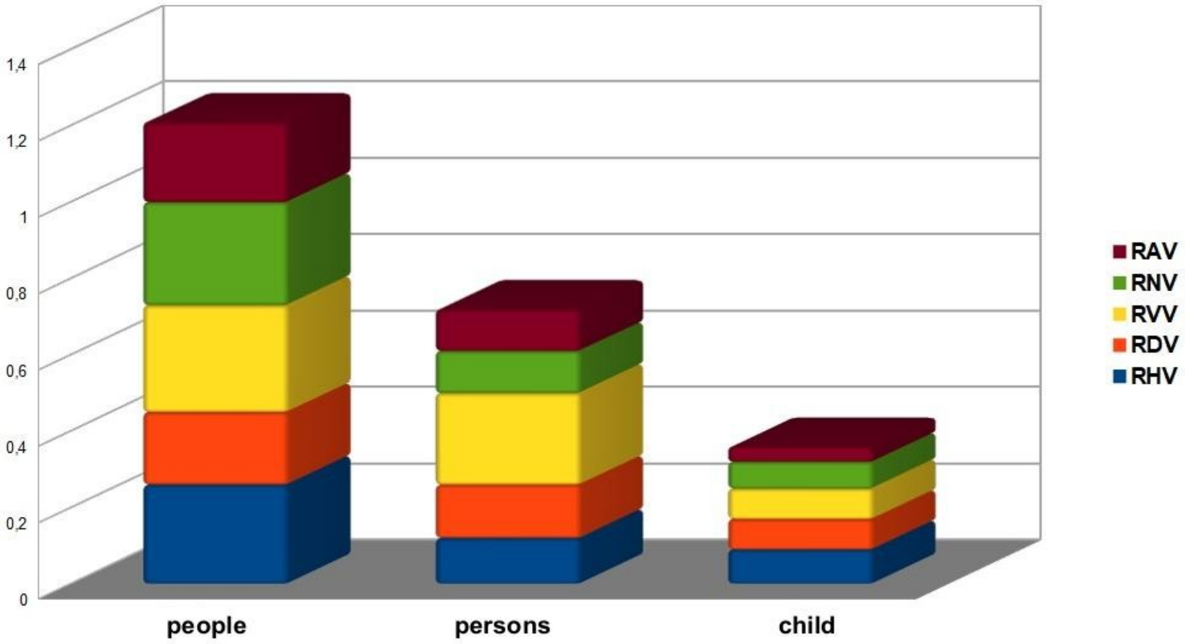
c. Child (e.g., child → child (acc.), to child, childhood (gen.), childhood (nom.), in childhood). This word appeared 13 times across its forms and in closely related contexts (connection strength to the central theme is 6.0; connection strength to UKBS 6 – see dark blue link – is 14.0). This value also represents the node size.

- Humanities: 26 valid responses; “child” appeared 3 times.
- Social sciences: 33 valid responses; “child” appeared 3 times.
- Intermediate sciences: 19 valid responses; “child” appeared 2 times.
- Natural sciences: 32 valid responses; “child” appeared 3 times.
- Applied sciences: 40 valid responses; “child” appeared 2 times.
- Marginal sciences: 3 valid responses; “child” did not appear.

In the following section, we will present the calculated ratios indicating the content-based influence strength of each word category across the various academic fields within classification group UKBS 6.

4.9.3.9.6.3 Table 160: Calculated ratios for word categories within UKBS 6

UKB	RHV	RDV	RVV	RNV	RAV	Sum V	UKBS
people	0.26	0.19	0.28	0.27	0.21	1.21	6
persons	0.12	0.14	0.24	0.11	0.11	0.72	6
child	0.09	0.08	0.08	0.07	0.04	0.36	6
Sum S	0.47	0.41	0.6	0.45	0.36	2.29	6
No. of opinions	34	37	25	45	56	197	6



4.9.3.9.6.4 Figure 302: Stacked bar chart of ratios by discipline

Table 160 presents the calculated ratios for each academic field (Humanities – RHV, Social Sciences – RDV, Intermediate Sciences – RVV, Natural Sciences – RNV, and Applied Sciences – RAV), as well as the total values by rows (Total R) and columns (Total C). Figure 302 illustrates a stacked bar chart based on the calculated ratios for individual word categories (people, individuals, child), which represent living natural properties or phenomena (UKBS 6), across different disciplines.

Among representatives of the humanities, the thematic emphasis on the word category child is relatively low (value: 0.09), whereas the categories individuals (value: 0.12) and people (value: 0.26) carry greater content significance. In the social sciences, there is a stronger emphasis on people (value: 0.19) and individuals (value: 0.14), while child is less prominent (value: 0.08). Representatives of the intermediate sciences placed the greatest emphasis on people (value: 0.28) and individuals (value: 0.24), with child receiving less attention (value: 0.08). In the natural sciences, the categories people (value: 0.27) and individuals (value: 0.11) were emphasized more, while child remained less significant (value: 0.07).

Finally, representatives of the applied sciences, like those in other fields, more frequently used the categories people (value: 0.21) and individuals (value: 0.11), while child had even lower thematic importance (value: 0.04).

Based on the sum of column values (ratios by discipline), the intermediate sciences stand out the most (total: 0.60), followed by the humanities (0.47), natural sciences (0.45), social sciences (0.41), and applied sciences (0.36). Regarding the sum of row values (ratios by word category), the most significant category is people (1.21), followed by individuals (0.72), and child (0.36).

Overall, representatives of various disciplines tend to focus primarily on actors involved in criminal offenses in the form of people and individuals in a general sense, while the emphasis on children is comparatively smaller. The classification group UKBS 6 serves as a connecting element between UKBS 2, UKBS 3, and especially UKBS 4, which contributes relatively little to the broader conceptual framework across the disciplines.

UKBS 7:

This group includes words that refer to health-related, biological, and natural characteristics or contents.

a. Genetics

(genetics → heredity, hereditary, genetic, genetics, genes, genetic traits, inherited, predispositions)

The word, in various forms and with closely related content, appeared 14 times (connection strength with the central theme: 6.0; connection strength with UKBS 7 via dark blue link: 15.0). This value also represents the size of the node.

- Representatives of the humanities contributed 26 usable responses, in which the word category genetics appeared twice.
- Representatives of the social sciences contributed 33 usable responses, using words from the genetics category four times.
- Representatives of intermediate sciences contributed 19 usable responses, using words from this category twice.
- Representatives of the natural sciences contributed 32 usable responses, with the genetics category and its related terms appearing three times.
- Representatives of applied sciences contributed 40 usable responses, with the genetics category and related words appearing three times.
- Representatives of marginal sciences contributed three usable responses, but the genetics category was not mentioned.

b. Life

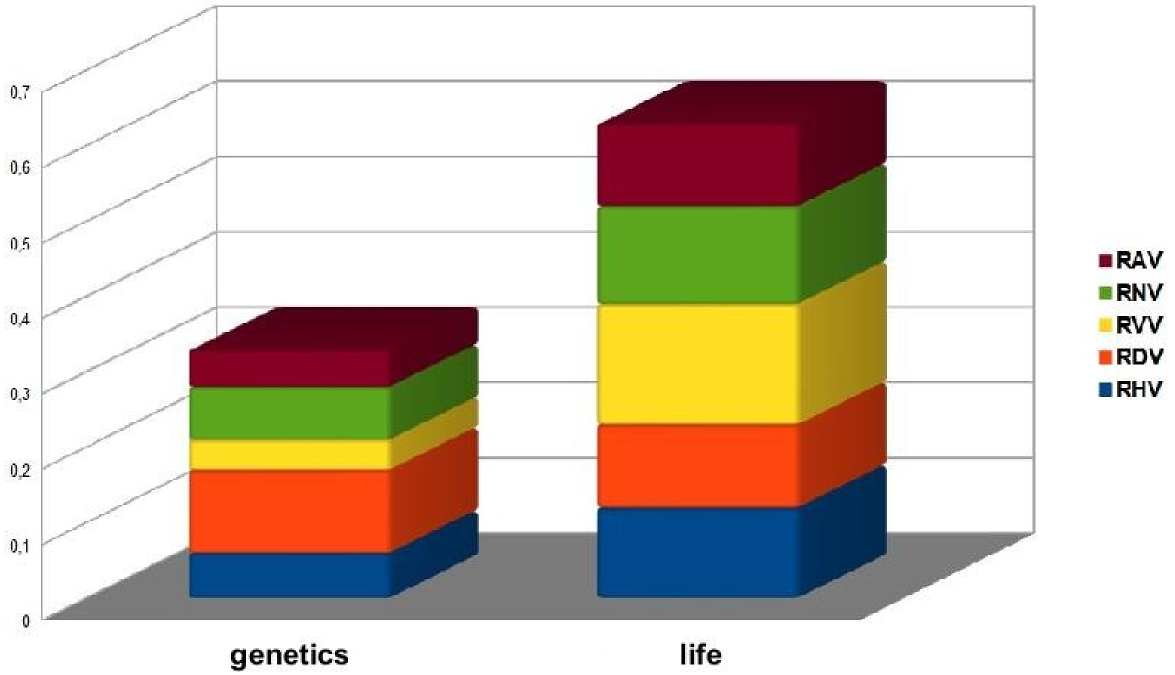
(life → bio, biological, biologically, living, alive, they live, lives, life-related, life aspects, in life)

The word, in various forms and with closely related content, appeared 24 times (connection strength with the central theme: 7.0; connection strength with UKBS 7 via blue link: 25.0). This value also represents the size of the node.

- Representatives of the humanities contributed 26 usable responses, with the life category mentioned four times.
- Representatives of the social sciences contributed 33 usable responses, also using words from the life category four times.
- Representatives of intermediate sciences contributed 19 usable responses, using terms from this category four times.
- Representatives of the natural sciences contributed 32 usable responses, where the life category and related terms appeared six times.
- Representatives of applied sciences contributed 40 usable responses, with the life category and related words appearing six times.
- Representatives of marginal sciences contributed three usable responses, but the life category was not mentioned.

4.9.3.9.6.5 Table 161: Calculated ratios for word categories within UKBS 7

UKB	RHV	RDV	RVV	RNV	RAV	Vsota V	UKBS
genetika	0,06	0,11	0,04	0,07	0,05	0,33	7
življenje	0,12	0,11	0,16	0,13	0,11	0,63	7
Vsota S	0,18	0,22	0,2	0,2	0,16	0,96	7
Št. mnenj	34	37	25	45	56	197	7



4.9.3.9.6.6 Figure 303: Stacked column chart of ratios by fields of study

Table 161 presents the calculated ratios for specific fields of study (RHV, RDV, RVV, RNV, and RAV), as well as the row (Total V) and column (Total S) sums. Figure 303 illustrates a stacked column chart showing the calculated ratios of two lexical categories—genetics and life—which represent health-related biological concepts (UKBS 7), broken down by academic disciplines. Among representatives of the humanities, the lexical category genetics (value: 0.06) has a weaker content emphasis, while life (value: 0.12) is more prominently emphasized. In the social sciences, both categories—life and genetics—are equally emphasized (value: 0.11 each). Representatives of the intermediate sciences placed greater content emphasis on life (value: 0.16), with genetics being significantly less emphasized (value: 0.04). In the natural sciences, life (value: 0.13) again received more emphasis than genetics (value: 0.07). Finally, in the applied sciences, as with the natural sciences, life (value: 0.11) was more frequently emphasized than genetics (value: 0.05).

Looking at the column totals, social sciences lead with a total ratio of 0.22, followed by humanities, intermediate sciences, and natural sciences, each at 0.20, and finally applied sciences at 0.16. In terms of row totals, life (value: 0.63) is the more emphasized concept, followed by genetics (value: 0.33).

In conclusion, representatives of various fields do not assign significant importance to biological explanations for the occurrence of crime. This suggests that such influences and causes—especially in comparison to social, sociological, or psychological factors—are considered less relevant. The data also reflects the cognitive range of representatives from different disciplines.

UKBS 8: This group includes words referring to intellectual and/or material products created by humans.

a. Education

(words related to education: reading, education, teaching, school, pedagogical, degree, learning, etc.)

The word education appeared 26 times in contextually related usage (connection strength to core topic: 10.0; connection strength to UKBS 8: 27.0), which also represents the node size.

- Humanities: 26 valid statements; "education" used 6 times.
- Social sciences: 33 statements; "education" used 3 times.
- Intermediate sciences: 19 statements; "education" used 4 times.
- Natural sciences: 32 statements; "education" used 5 times.
- Applied sciences: 40 statements; "education" used 8 times.
- Marginal sciences: 3 statements; "education" not used.

b. Politics

(words related to politics: democracy, political, capitalist, policy, etc.)

The word politics appeared 11 times (core topic: 6.0; UKBS 8: 12.0).

- Humanities: 26 statements; "politics" used 2 times.
- Social sciences: 33 statements; "politics" used 1 time.
- Intermediate sciences: 19 statements; "politics" used 2 times.
- Natural sciences: 32 statements; "politics" used 3 times.
- Applied sciences: 40 statements; "politics" used 3 times.
- Marginal sciences: 3 statements; "politics" not used.

c. Value

(words related to values: welfare, value, values, etc.)

The word value appeared 11 times (core topic: 6.0; UKBS 8: 12.0).

- Humanities: 26 statements; "value" used 2 times.
- Social sciences: 33 statements; "value" used 1 time.
- Intermediate sciences: 19 statements; "value" used 3 times.

- Natural sciences: 32 statements; "value" used 4 times.
- Applied sciences: 40 statements; "value" used 2 times.
- Marginal sciences: 3 statements; "value" not used.

d. Law

(words related to law: illegal, decree, legality, law, etc.)

The word law appeared 11 times (core topic: 6.0; UKBS 8: 12.0).

- Humanities: 26 statements; "law" used 1 time.
- Social sciences: 33 statements; "law" not used.
- Intermediate sciences: 19 statements; "law" used 1 time.
- Natural sciences: 32 statements; "law" used 7 times.
- Applied sciences: 40 statements; "law" used 2 times.
- Marginal sciences: 3 statements; "law" not used.

e. Role model

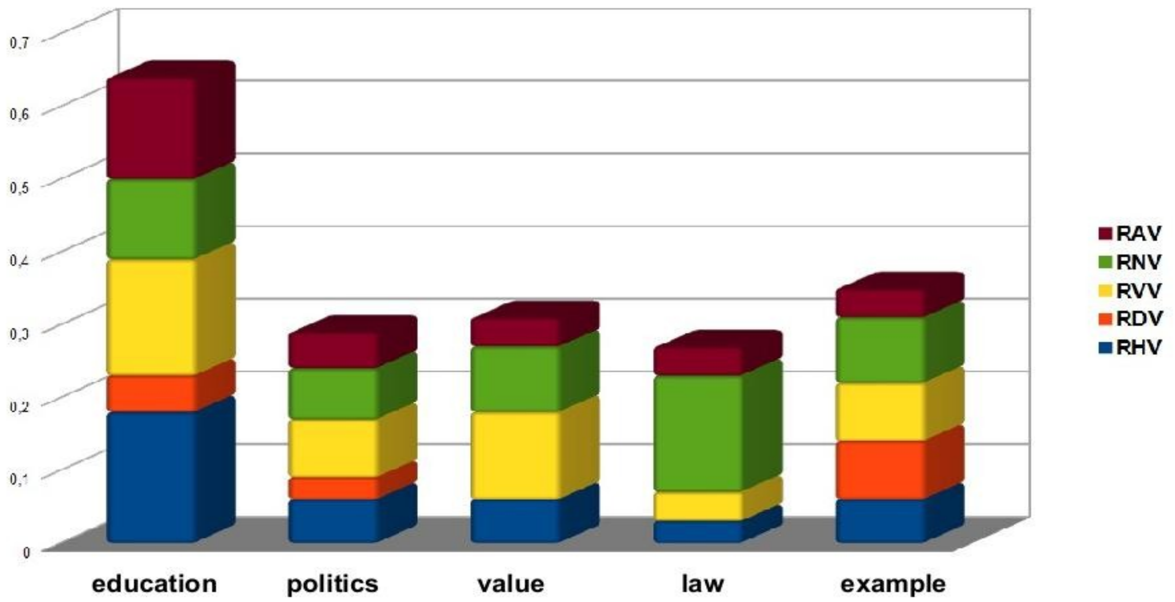
(words related to role model: example, idol, role models, etc.)

The word role model appeared 13 times (core topic: 6.0; UKBS 8: 14.0).

- Humanities: 26 statements; "role model" used 2 times.
- Social sciences: 33 statements; "role model" used 2 times.
- Intermediate sciences: 19 statements; "role model" used 2 times.
- Natural sciences: 32 statements; "role model" used 4 times.
- Applied sciences: 40 statements; "role model" used 2 times.
- Marginal sciences: 3 statements; "role model" not used.

4.9.3.9.6.7 Table 162: Calculated ratios for word categories within UKBS 8

UKB	RHV	RDV	RVV	RNV	RAV	Total V	UKBS
education	0,18	0,05	0,16	0,11	0,14	0,64	8
politics	0,06	0,03	0,08	0,07	0,05	0,29	8
value	0,06	0	0,12	0,09	0,04	0,31	8
law	0,03	0	0,04	0,16	0,04	0,27	8
example	0,06	0,08	0,08	0,09	0,04	0,35	8
Total S	0,39	0,16	0,48	0,52	0,31	1,86	8
No. of opinions	34	37	25	45	56	197	8



4.9.3.9.6.8 Figure 304: Stacked column chart of ratios by discipline

Table 162 presents the calculated ratios by academic disciplines (RHV, RDV, RVV, RNV, and RAV), along with the totals of these ratios by rows (Total V) and columns (Total S). Figure 304 illustrates a stacked column chart based on the calculated ratios of word categories ("education", "politics", "value", "law", and "role model") that represent the material and/or intellectual products of human activity (UKBS 8) across various disciplines.

Among representatives of the humanities, the strongest thematic emphasis is placed on the word category "education" (value: 0.18), while the other categories — "politics", "value", "law", and "role model" — show very weak thematic presence (values ranging from 0.03 to 0.06).

For representatives of the social sciences, all word categories exhibit very weak thematic emphasis (values ranging from 0 to 0.08), with "value" and "law" not appearing at all (value: 0 for both).

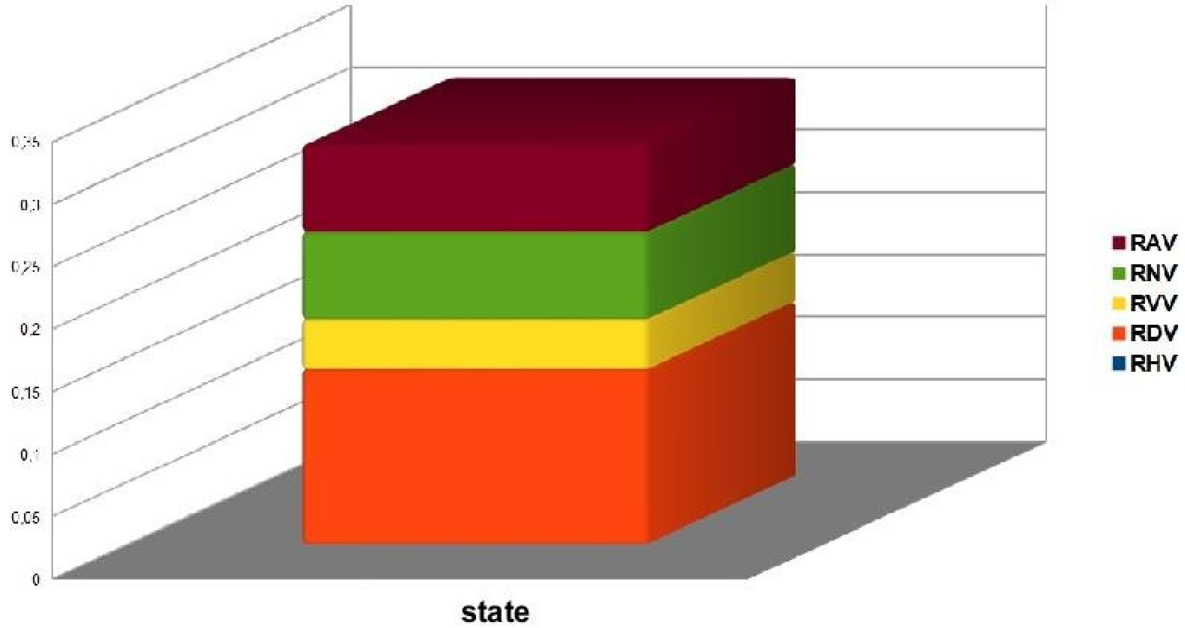
Representatives of intermediate sciences place the greatest emphasis on "education" (value: 0.16) and "value" (value: 0.12), while the other categories are much less frequently used (values from 0.04 to 0.08).

Among natural sciences representatives, the strongest emphasis is placed on "education" (value: 0.11) and especially "law" (value: 0.16), with the remaining categories showing lower values (from 0.07 to 0.09).
Applied sciences representatives most frequently used the category "education" (value: 0.14), with the other categories trailing significantly (values from 0.04 to 0.05).
Based on the sum of column values, natural sciences take the leading role (value: 0.52), followed by intermediate sciences (0.48), humanities (0.39), applied sciences (0.31), and lastly social sciences (0.16).
When examining the sum of row values, the word category "education" stands out with the highest thematic relevance (value: 0.64), followed by "role model" (0.35), "value" (0.31), and "politics" (0.29), with "law" ranking lowest (0.27).
Overall, representatives of different disciplines do not assign significant weight to the material or intellectual products of humans in connection with the occurrence of crime. Only "education" stands out — and even then, mostly outside of social sciences — as being assigned relatively high thematic importance. A higher level of education is assumed to be an indicator of greater social, legal, and technological development of a country, which could in turn lead to reduced crime rates. However, this assumption cannot be consistently confirmed in practice: while higher education may reduce petty crime, it does not appear to have the same effect on economic crime or workplace bullying.
In summary, representatives of various academic fields do not regard material and/or intellectual human products as major factors in explaining the occurrence of crime. Instead, the focus tends to lie more with social, sociological, and performance-based factors, reflecting the broader conceptual frameworks of these disciplines.
UKBS 9: This category includes words that denote institutions and/or their parts.
a. The State
Examples of this word category include: state → Austria, state’s, states, to the state, citizens, governmental, Slovenia, in Slovenia. The word appeared 13 times in various forms and within a narrow thematic context (strength of connection to the central topic: 6.0; strength of connection to UKBS 9, see dark blue link: 14.0). This value also represents the size of the node in the visual diagram.
Breakdown by academic discipline:
- Humanities: Representatives contributed 26 useful statements, but the word category “state” did not appear in any of them.

- Social Sciences: Representatives contributed 33 useful statements, in which the word category “state” was used five times.
- Intermediate Sciences: From 19 useful statements, the word category “state” was used once.
- Natural Sciences: From 32 useful statements, the word category “state” appeared three times.
- Applied Sciences: From 40 useful statements, the word category “state” was used four times.
- Marginal Sciences: Three representatives contributed three useful statements. The word category “state” did not appear in any of these.

4.9.3.9.6.9 Table 163: Calculated ratios for word categories within UKBS 9

UKB	RHV	RDV	RVV	RNV	RAV	Total V	UKBS
state	0	0,14	0,04	0,07	0,07	0,32	9
Total S	0	0,14	0,04	0,07	0,07	0,32	9
No. of opinions	34	37	25	45	56	197	9



4.9.3.9.7 Figure 305: Stacked bar chart of ratios by discipline

Table 163 presents the calculated ratios by individual disciplines (RHV, RDV, RVV, RNV, and RAV), along with the row totals (Total V) and column totals (Total S). Figure 305 illustrates a stacked bar chart showing the calculated ratio for the word category “state,” which was the only representative of institutions and/or their parts to be included in the UKBS 9 classification group and selected for detailed analysis.

Among representatives of the humanities, the emphasis on the word category “state” is entirely absent (main value: 0). Representatives of intermediate, natural, and applied sciences show a weak emphasis on this word category (main values range from 0.04 to 0.07). The social sciences are an exception, where the word "state" is given significantly more emphasis (main value: 0.14).

Based on the sum of the column values, the leading role is held by representatives of the social sciences (main value: 0.52), followed by natural and applied sciences (both at 0.07), intermediate sciences (0.04), and finally humanities (0). When summing the values by row, the word category "state" holds the greatest thematic importance (main value: 0.32).

Overall, representatives of different disciplines do not attribute significant influence to institutions or their components in terms of reducing or increasing criminality. The only exception is the social sciences, which placed somewhat more emphasis on the role of the state and its citizens in addressing and mitigating crime—particularly through improved interagency cooperation among governmental institutions.

Surprisingly, the word category relating to institutions and/or their parts received only weak thematic emphasis. Even among social science representatives, one might have expected stronger focus on this topic, especially in relation to economic, business, financial, corporate, and governmental crime. The described findings reflect the cognitive perspectives typical of representatives from the respective academic fields.

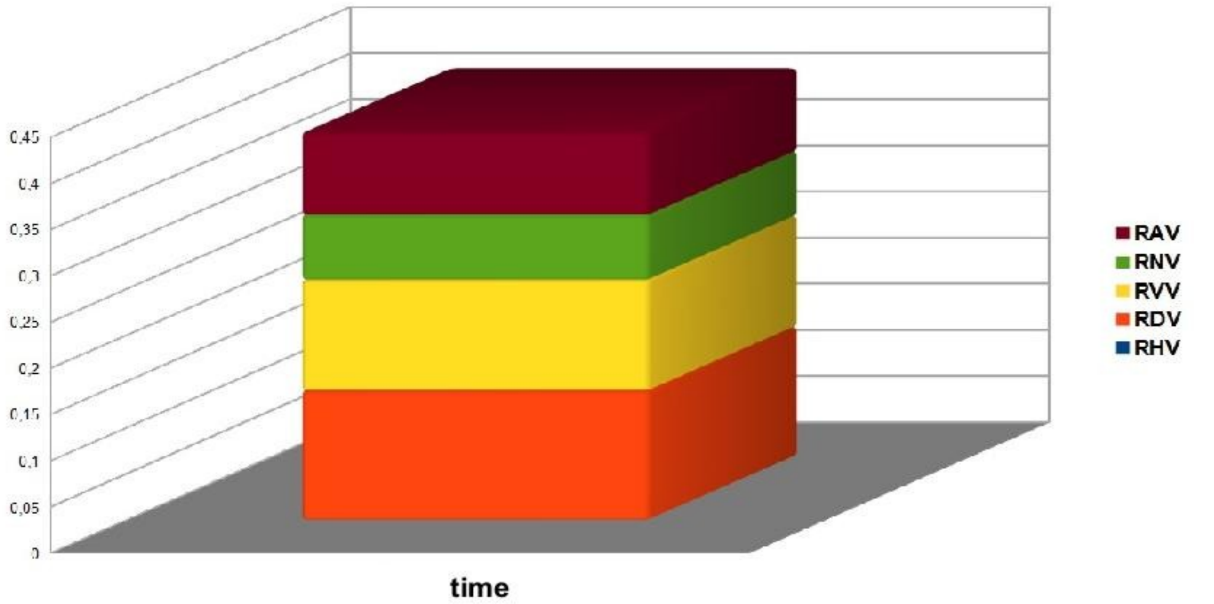
UKBS 10: This group includes words that refer to time and/or time periods.

a. Time ("čas" → years, transience, period, periods, deadline, simultaneous, time-related, etc.). The word appeared 16 times in various forms and in close thematic connection with other words (strength of connection with the central theme: 6.0; strength of connection with UKBS 10, see dark blue link: 17.0). This value also represents the node size.

- Representatives of the humanities contributed 26 usable statements. The word category "time" did not appear in any of them.
- Representatives of the social sciences contributed 33 usable statements. They used a word from the "time" category five times.
- Representatives of intermediate sciences contributed 19 usable statements, using words from the "time" category three times.
- Representatives of the natural sciences contributed 32 usable statements. Words from the "time" category appeared three times in their responses.
- Representatives of applied sciences contributed 40 usable statements. Words from the "time" category appeared five times.
- Finally, representatives of marginal sciences contributed three usable statements. The "time" category did not appear in their responses.

4.9.3.9.7.1 Table 164: Calculated ratios for word categories within UKBS 10

UKB	RHV	RDV	RVV	RNV	RAV	Total V	UKBS
time	0	0,14	0,12	0,07	0,09	0,42	10
Total S	0	0,14	0,12	0,07	0,09	0,42	10
No. of opinions	34	37	25	45	56	197	10



4.9.3.9.7.2 Figure 306: Stacked bar chart of ratios by discipline

Table 164 presents the calculated ratios by individual disciplines (RHV, RDV, RVV, RNV, and RAV), as well as the sums of these ratios by rows (Row Total) and columns (Column Total). Figure 306 illustrates a stacked bar chart based on the calculated ratio of the word category “time.”

Among representatives of the humanities, there is no thematic emphasis on the word category “time” (main value: 0). Representatives of the natural and applied sciences show a weak emphasis on this category (main values ranging from 0.07 to 0.09), whereas representatives of the social sciences and intermediate sciences place somewhat greater emphasis on it (main values of 0.14 and 0.12, respectively).

Based on the column total values, social science representatives have the leading role (main value: 0.14), followed by intermediate sciences (0.12), applied sciences (0.09), natural sciences (0.07), and lastly, humanities (0). The sum of ratios by rows indicates that the word category “time” holds the highest thematic significance overall (main value: 0.42).

Representatives of different disciplines do not attribute significant influence to time or historical periods in relation to the occurrence of crime, which is somewhat surprising. Historical insights show that time or era is an important factor in the emergence of various social phenomena, including crime. Naturalists, in particular, have strongly emphasized the impact of factors such as time, genetics, and environment on personality development and, consequently, criminal behavior. However, this perspective is hardly reflected in the conceptual framework of representatives from the various disciplines.

UKBS 11: This group includes words that cover an exceptionally broad range of meanings and were not suitable for classification into any other group.

a. Factor

(Forms include: factor, factors, facto, faktor, etc.)

The word appeared 48 times in various forms and in close semantic connection with other words (connection strength with the central theme: 9.0; connection strength with UKBS 11, see bold green link: 49.0). This number also represents the node size.

- Humanities representatives contributed 26 relevant statements, using the word category "factor" 11 times.
- Social sciences: 33 statements, with 16 instances.
- Interdisciplinary fields: 19 statements, 7 instances.
- Natural sciences: 32 statements, 4 instances.
- Applied sciences: 40 statements, 10 instances.
- Marginal fields: 3 statements, 0 instances.

b. Macrocosm

(Forms include: macro, macrocosmic, macro-environment, etc.)

Appeared 19 times (central theme link: 6.0; UKBS 11 link: 20.0).

- Humanities: 26 statements, 4 instances.
- Social sciences: 33 statements, 3 instances.
- Interdisciplinary fields: 19 statements, 0 instances.
- Natural sciences: 32 statements, 3 instances.
- Applied sciences: 40 statements, 8 instances.
- Marginal fields: 3 statements, 1 instance.

c. Mesocosm

(Forms include: meso, mesocosmic, etc.)

Appeared 25 times (central theme link: 7.0; UKBS 11 link: 26.0).

- Humanities: 26 statements, 3 instances.
- Social sciences: 33 statements, 3 instances.
- Interdisciplinary fields: 19 statements, 2 instances.
- Natural sciences: 32 statements, 6 instances.

- Applied sciences: 40 statements, 11 instances.
- Marginal fields: 3 statements, 0 instances.

d. Microcosm

(Forms include: micro, microcosmic, microorganisms, etc.)

Appeared 18 times (central theme link: 6.0; UKBS 11 link: 19.0).

- Humanities: 26 statements, 2 instances.
- Social sciences: 33 statements, 3 instances.
- Interdisciplinary fields: 19 statements, 1 instance.
- Natural sciences: 32 statements, 3 instances.
- Applied sciences: 40 statements, 9 instances.
- Marginal fields: 3 statements, 0 instances.

e. Environment

(Forms include: environment, environmental, surroundings, etc.)

Appeared 43 times (central theme link: 8.0; UKBS 11 link: 44.0).

- Humanities: 26 statements, 6 instances.
- Social sciences: 33 statements, 12 instances.
- Interdisciplinary fields: 19 statements, 2 instances.
- Natural sciences: 32 statements, 8 instances.
- Applied sciences: 40 statements, 14 instances.
- Marginal fields: 3 statements, 1 instance.

f. Phenomenon

(Forms include: phenomena, appearing, manifestation, etc.)

Appeared 32 times (central theme link: 8.0; UKBS 11 link: 33.0).

- Humanities: 26 statements, 10 instances.
- Social sciences: 33 statements, 5 instances.
- Interdisciplinary fields: 19 statements, 4 instances.
- Natural sciences: 32 statements, 8 instances.
- Applied sciences: 40 statements, 5 instances.
- Marginal fields: 3 statements, 0 instances.

g. Importance

(Forms include: important, significance, most important, etc.)

Appeared 16 times (central theme link: 6.0; UKBS 11 link: 17.0).

- Humanities: 26 statements, 2 instances.
- Social sciences: 33 statements, 2 instances.

- Interdisciplinary fields: 19 statements, 3 instances.
- Natural sciences: 32 statements, 6 instances.
- Applied sciences: 40 statements, 3 instances.
- Marginal fields: 3 statements, 0 instances.

h. Consequence

(Forms include: consequences, consequential, etc.)

Appeared 11 times (central theme link: 6.0; UKBS 11 link: 12.0).

- Humanities: 26 statements, 5 instances.
- Social sciences: 33 statements, 0 instances.
- Interdisciplinary fields: 19 statements, 1 instance.
- Natural sciences: 32 statements, 2 instances.
- Applied sciences: 40 statements, 3 instances.
- Marginal fields: 3 statements, 0 instances.

i. Perspective

(Forms include: viewpoint, perspective, etc.)

Appeared 12 times (central theme link: 6.0; UKBS 11 link: 13.0).

- Humanities: 26 statements, 1 instance.
- Social sciences: 33 statements, 2 instances.
- Interdisciplinary fields: 19 statements, 0 instances.
- Natural sciences: 32 statements, 6 instances.
- Applied sciences: 40 statements, 2 instances.
- Marginal fields: 3 statements, 1 instance.

j. Influence

(Forms include: influence, affect, influenced, etc.)

Appeared 95 times (central theme link: 10.0; UKBS 11 link: 96.0).

- Humanities: 26 statements, 22 instances.
- Social sciences: 33 statements, 18 instances.
- Interdisciplinary fields: 19 statements, 9 instances.
- Natural sciences: 32 statements, 21 instances.
- Applied sciences: 40 statements, 22 instances.
- Marginal fields: 3 statements, 3 instances.

k. Cause

(Forms include: cause, causes, causes something, etc.)

Appeared 24 times (central theme link: 7.0; UKBS 11 link: 25.0).

- Humanities: 26 statements, 3 instances.

- Social sciences: 33 statements, 4 instances.

- Interdisciplinary fields: 19 statements, 2 instances.

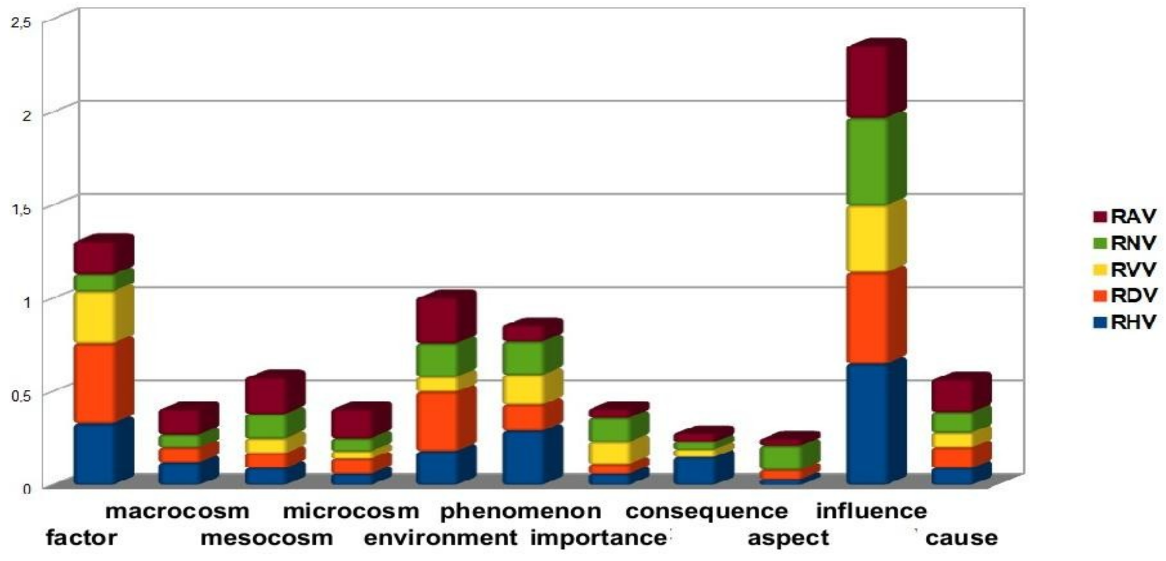
- Natural sciences: 32 statements, 5 instances.

- Applied sciences: 40 statements, 10 instances.

- Marginal fields: 3 statements, [incomplete – likely continues with 0 or similar].

4.9.3.9.7.3 Table 165: Calculated ratios for word categories within UKBS 11

UKB	RHV	RDV	RVV	RNV	RAV	Total V	UKBS
factor	0,33	0,43	0,28	0,09	0,18	1,31	11
macrocosm	0,12	0,08	0	0,07	0,14	0,41	11
mesocosm	0,09	0,08	0,08	0,13	0,2	0,58	11
microcosm	0,06	0,08	0,04	0,07	0,16	0,41	11
environment	0,18	0,32	0,08	0,18	0,25	1,01	11
phenomenon	0,29	0,14	0,16	0,18	0,09	0,86	11
importance	0,06	0,05	0,12	0,13	0,05	0,41	11
consequence	0,15	0	0,04	0,04	0,05	0,28	11
aspect	0,03	0,05	0	0,13	0,04	0,25	11
influence	0,65	0,49	0,36	0,47	0,39	2,36	11
cause	0,09	0,11	0,08	0,11	0,18	0,57	11
Total S	2,05	1,83	1,24	1,6	1,73	8,45	11
No. of opinions	34	37	25	45	56	197	



4.9.3.9.7.4 Figure 307: Stacked bar chart of ratios by disciplines

Table 165 presents the calculated ratios for individual disciplines (Humanities, Social Sciences, Interdisciplinary Sciences, Natural Sciences, and Applied Sciences), along with the sums of these ratios by rows (Total V) and columns (Total S). Figure 307 illustrates a stacked bar chart based on the calculated ratios of lexical categories such as “factor,” “macrocosm,” “mesocosm,” “microcosm,” “environment,” “phenomenon,” “importance,” “consequence,” “aspect,” “influence,” and “cause.”

These lexical categories, taken from the classification group UKBS 11, express a broad thematic range, are highly general, and may represent universal components of any scientific communication. This means they can be linked with all other lexical categories from other classification groups. In short, they are extremely important categories, without which the descriptive form of scientific publications would be hard to imagine.

In the Humanities, certain categories stand out more prominently, such as “influence” (value: 0.65), “factor” (0.33), and “phenomenon” (0.29). The medium-emphasis group includes “environment” (0.18), “consequence” (0.15), and “macrocosm” (0.12). The lowest-emphasis group includes “mesocosm” (0.09), “cause” (0.09), “microcosm” (0.06), “importance” (0.06), and “aspect” (0.03).

In the Social Sciences, similar emphasis is placed on “influence” (0.49), “factor” (0.43), and “environment” (0.32). Medium-emphasis categories are “phenomenon” (0.14) and “cause” (0.11). Low-emphasis categories include “macrocosm,” “mesocosm,” and “microcosm” (each 0.08), “importance” and “aspect” (each 0.05), while “consequence” has a value of 0.

In Interdisciplinary Sciences, the most emphasized categories are “influence” (0.36) and “factor” (0.28). Medium-emphasis categories include “phenomenon” (0.16) and “importance” (0.12). The remaining categories fall into the low-emphasis group (values between 0.08 and 0.04), with “macrocosm” and “aspect” having values of 0.

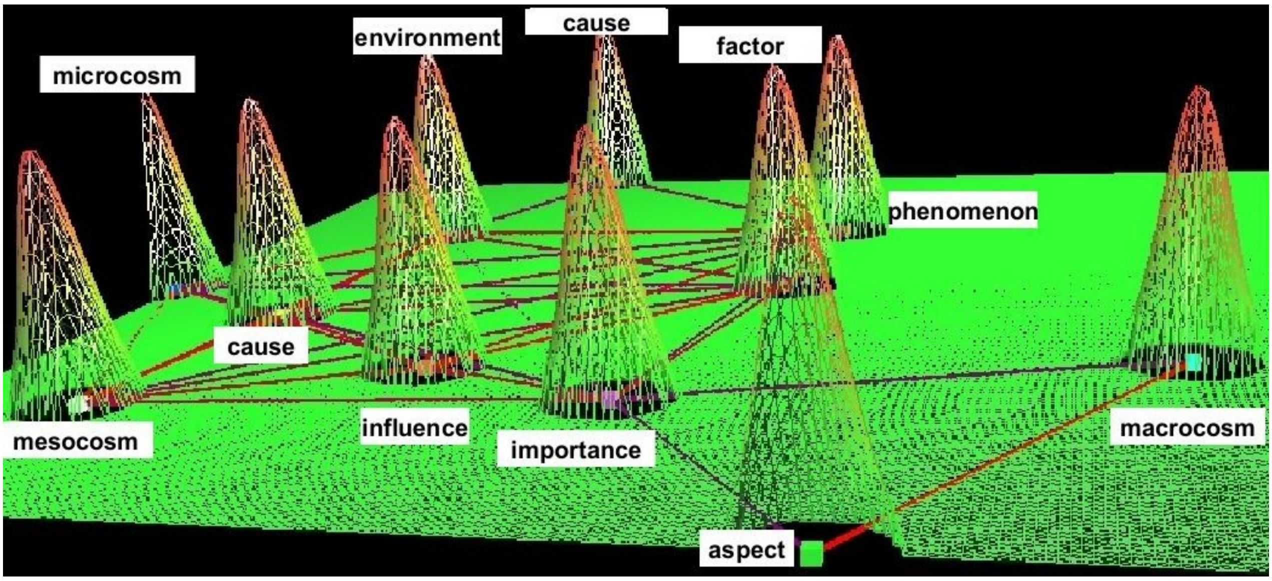
For Natural Sciences, only “influence” stands out with a high emphasis (0.47). Medium-emphasis categories include “environment” (0.18), “phenomenon” (0.18), “mesocosm” (0.13), “importance” (0.13), “aspect” (0.13), and “cause” (0.11). The low-emphasis group includes “factor” (0.09), “macrocosm” (0.07), “microcosm” (0.07), and “consequence” (0.04).

In Applied Sciences, two categories are emphasized: “influence” (0.39) and “environment” (0.25). Medium-emphasis categories include “factor” (0.18), “cause” (0.18), “mesocosm” (0.20), “microcosm” (0.16), and “macrocosm” (0.14). The lowest emphasis is given to “phenomenon,” “importance,” “consequence,” and “aspect” (values between 0.09 and 0.04).

Based on the total column values, the leading role belongs to the Humanities (total value: 2.05), followed by the Social Sciences (1.83), Applied Sciences (1.73), Natural Sciences (1.60), and finally Interdisciplinary Sciences (1.24).

Row totals highlight the most prominent lexical category as “influence” (2.36), followed by “factor” (1.31), “environment” (1.01), “phenomenon” (0.86), “mesocosm” (0.58), “cause” (0.57), “macrocosm,” “microcosm,” and “importance” (each 0.41), “consequence” (0.28), and lastly “aspect” (0.25).

Before moving on to hierarchical associative diagrams by discipline, we first present the overall lexical category data landscape across all disciplines.



4.9.3.9.7.5 Figure 308: Data landscape of lexical categories from group UKBS 11

Figure 308 presents the data landscape of lexical categories from the UKBS 11 group, which was generated using imported data from Table 163 in the form of a .txt file (with the column labeled "UKBS" previously removed), processed in the TmeV software tool.[144] Then the data was visualized using the visualization technique called an "expression terrain map." Lexical categories (e.g., influence, cause, mesocosm) are depicted as cones or hills positioned on a green platform or meadow. These data hills are connected by links of varying strength, represented by red (strong connections), purple (moderate connections), and blue (weak connections) lines. A threshold value of 0.5 was set as the minimum for inclusion. The Pearson squared distance algorithm was used to measure distances, combining positive and negative correlations within a range from 0 to 1.

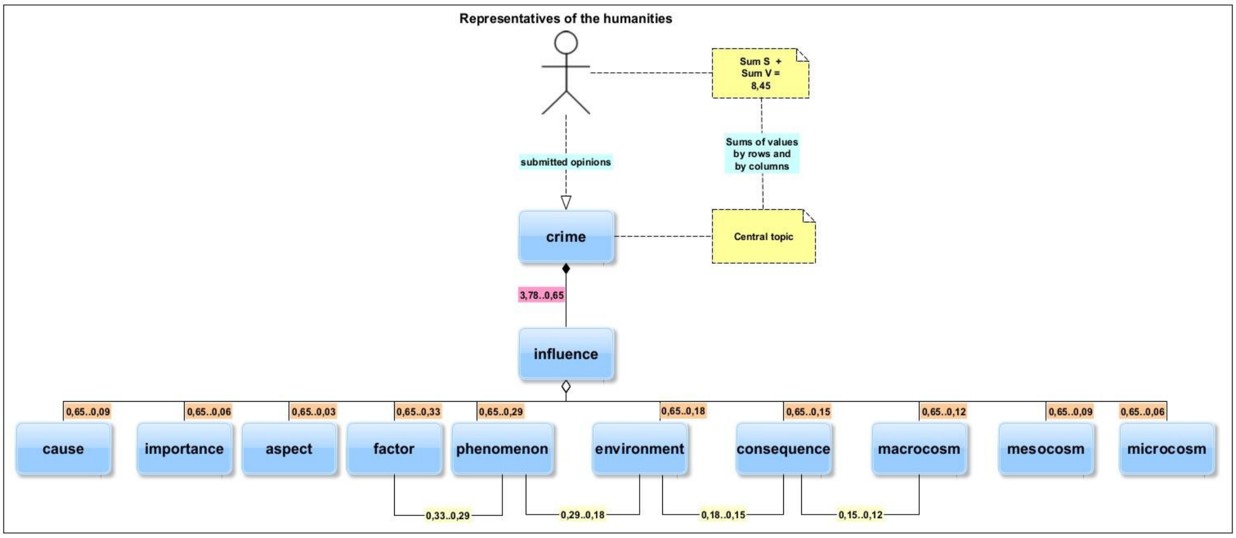
The strongest connections are observed among lexical categories such as influence, cause, mesocosm, microcosm, environment, phenomenon, and factor, which form the conceptual core of the UKBS 11 group. Somewhat distant from this core, on the right side of the map, a strong connection is also visible between perspective and macrocosm. All other connections—such as those involving consequence, importance, and macrocosm—are weaker.

This leads to an important insight: test participants tended to focus more on citing influences related to the occurrence of criminal behavior, while engaging less deeply with its causes. The proposed

144 Howe, E., Holton, K., Nair, S., Schlauch, D., Sinha, R., & Quackenbush, J. (2010). MeV: Multiexperiment Viewer. *Biomedical Informatics for Cancer Research*, 267–277. https://doi.org/10.1007/978-1-4419-5714-6_15.

3~M model of cosmic levels leaned more toward the mesocosm, with macrocosm and microcosm being less emphasized. The clear dominance of lexical categories like influence, environment, factor, and phenomenon within the UKBS 11 classification group can be considered both logical and expected.

Based on the presented data landscape, we can describe a typical cognitive scenario of the test participants: they frequently emphasized universal lexical categories such as influence, environment, factor, and phenomenon, either independently or in connection with lexical categories from other classification groups—particularly UKBS 4. Occasionally, these were also linked with cause, mesocosm, and microcosm. This represents the average conceptual range of participants from various academic fields. Naturally, subtle differences in content emphasis exist between the disciplines, as already seen with classification group UKBS 4.



4.9.3.9.7.6 Figure 309: Hierarchical associative diagram of UKBS 11 lexical categories according to representatives of the humanities

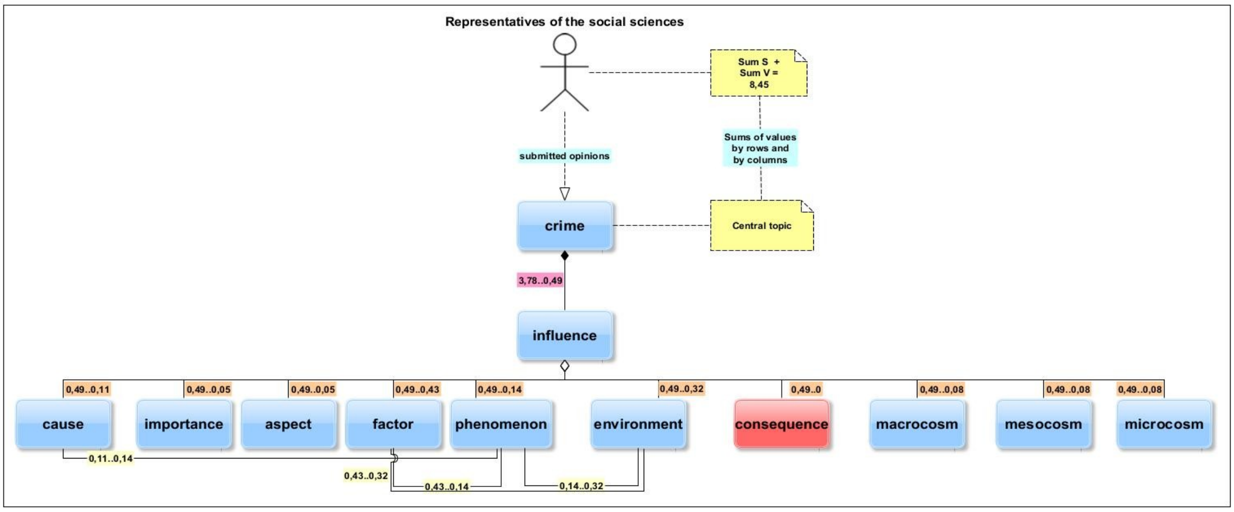
Figure 309 presents a hierarchical associative diagram of lexical categories from UKBS 11, based on responses from representatives of the humanities. In answering the final question of the survey, these participants most frequently focused on influences related to the occurrence of criminality, which is why the lexical category influence has the highest value (value: 0.65). This established a hierarchy between influence and other lexical categories, as illustrated by connections to the white diamond symbol. Similar patterns can also be observed in the diagrams for other academic disciplines.

In this diagram, attention should be drawn to the stronger associative links between the lexical categories factor and phenomenon, with a variation range from 0.33 to 0.29. The next strongest associative connection appears between phenomenon and environment, with a range from 0.29 to 0.18. A somewhat weaker connection is observed between environment and consequence (range:

0.18 to 0.15), followed by a weaker link between consequence and macrocosm (range: 0.15 to 0.12).

Other lexical categories such as cause, perspective, importance, mesocosm, and microcosm scored lower (values between 0.09 and 0.03), which made it unfeasible to establish stronger associative connections. Based on these findings, representatives of the humanities generally did not focus on identifying causes or on the potential influence of the microcosm.

In the analysis of the UKBS 4 group, it was noted that respondents very frequently used words from the lexical category criminality, which explains the relatively high values of categories such as influence, factor, phenomenon, and environment (e.g., in phrases like “environmental and social factors influence the occurrence of criminality,” “criminality is a phenomenon influenced by environment and upbringing,” and “environmental, psychological, and social factors affect the emergence of criminality”).



4.9.3.9.7.7 Figure 310: Hierarchical associative diagram of word categories in UKBS 11 according to representatives of the social sciences

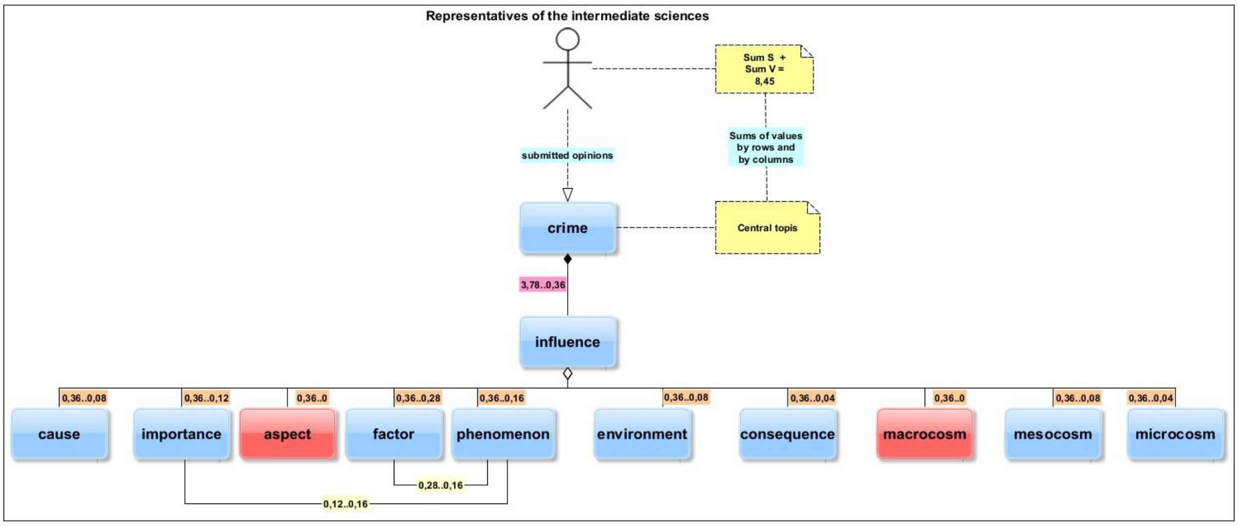
Figure 310 shows a hierarchical associative diagram of word categories from UKBS 11, based on responses from representatives of the social sciences. Similar to the representatives of the humanities, they most often focused their responses to the final survey question on the factors influencing the occurrence of crime. As a result, the word category “influence” has the highest value (see value 0.49). It is worth noting that the ratio value for the category “influence” is significantly lower than before (a drop from 0.65 to 0.49).

In this diagram, stronger associative connections are noticeable between the word categories “factor” and “environment,” with a variation range from 0.43 to 0.32. Another strong associative connection can be observed between “factor” and “phenomenon,” ranging from 0.43 to 0.14. A similarly strong connection appears between “phenomenon” and “environment,” with a range from

0.14 to 0.32. Lastly, there is a notable associative connection between “cause” and “phenomenon,” with a variation range from 0.11 to 0.14.

Other word categories such as “aspect,” “importance,” “macrocosm,” “mesocosm,” and “microcosm” received lower values (see values from 0.08 to 0.05). The word category “consequence” even reached a value of zero (see the reddish unit with a value of 0).

According to the results, representatives of the social sciences more frequently focused on identifying causes of crime occurrence. They also placed slightly more emphasis on environmental aspects or factors related to the occurrence of crime. In the analysis of the UKBS 4 group, it was found that respondents less frequently used words from the category “crime” and more often used words from the categories “factor” and “environment,” resulting in higher values for these two categories compared to representatives of the humanities. The slightly lower value for the category “influence” may be explained by the higher value for the category “cause.”

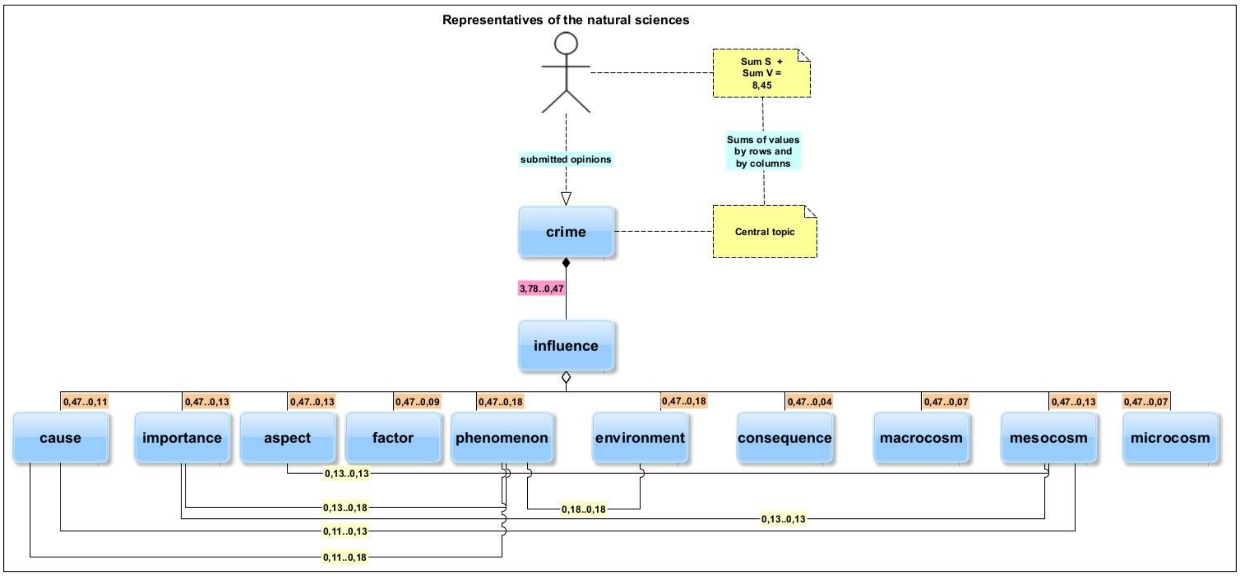


4.9.3.9.7.8 Figure 311: Hierarchical associative diagram of word categories in UKBS 11 according to representatives of the intermediate sciences

Figure 311 presents a hierarchical associative diagram of word categories from UKBS 11, based on responses from representatives of the intermediate sciences. The first notable observation is the zero value for the word categories “aspect” and “macrocosm.” Another equally important finding is the significant drop in the value of the category “environment” (see value 0.08).

According to the results, stronger associative connections can be identified between the word categories “factor” and “phenomenon” (see variation range from 0.28 to 0.16), as well as between “importance” and “phenomenon” (see variation range from 0.12 to 0.16). Due to the low values of the remaining word categories—such as “cause,” “environment,” “consequence,” “macrocosm,” “mesocosm,” and “microcosm”—it is not meaningful to determine associative connections for them (see values ranging from 0.08 to 0.04).

Representatives of the intermediate sciences focused more on the phenomenological aspects of the factors contributing to crime, and rarely sought out causes or possible means of preventing these negative factors. Already in the analysis of the UKBS 4 classification group, it became clear that these respondents very frequently used words from the “crime” category when expressing their views, further reinforcing the phenomenological orientation of intermediate sciences representatives toward the central theme of criminality.



4.9.3.9.7.9 Figure 312: Hierarchical associative diagram of word categories in UKBS 11 according to representatives of the natural sciences

Figure 312 presents a hierarchical associative diagram of word categories from UKBS 11, based on responses from representatives of the natural sciences. The first noticeable feature is the greater number of associative connections between various word categories and the significantly lower value of the word category “factor” (see value 0.09). There is also a greater thematic emphasis on the categories “mesocosm” and “aspect.”

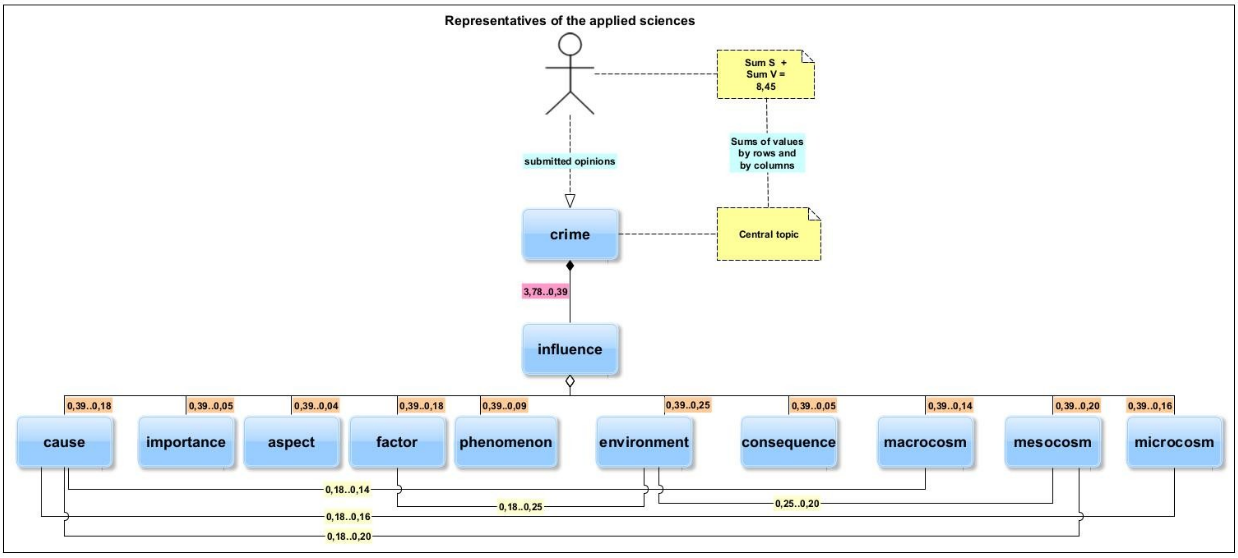
Stronger associative connections, based on the results, can be observed between the following word categories:

- “phenomenon” and “environment” (variation range 0.18 to 0.18),
- “importance” and “phenomenon” (variation range 0.13 to 0.18),
- “cause” and “phenomenon” (variation range 0.11 to 0.18),
- “cause” and “mesocosm” (variation range 0.11 to 0.13),
- “importance” and “mesocosm” (variation range 0.13 to 0.13),

- “aspect” and “phenomenon” (variation range 0.13 to 0.18).

Other word categories, such as “microcosm,” “macrocosm,” “consequence,” and “factor,” showed lower values (see values ranging from 0.09 to 0.04).

Representatives of the natural sciences focused their responses more on the occurrence of criminality within a specific environment, and they more frequently searched for causes and referred to the mesocosmic level. Interestingly, the word category “factor” appeared less frequently in their responses, even though it was commonly used by representatives of other fields to explain or describe certain influences contributing to the occurrence of criminality.



4.9.3.9.8 Figure 313: Hierarchical associative diagram of word categories in UKBS 11 according to representatives of applied sciences

Figure 313 presents a hierarchical associative diagram of word categories from UKBS 11, based on responses from representatives of the applied sciences. One of the first things to note is the greater number of associative connections between various word categories, particularly “factor” (see value 0.18). There is also a notable thematic emphasis on the categories “macrocosm” (value 0.14), “mesocosm” (value 0.20), and “microcosm” (value 0.16).

According to the results, stronger associative connections can be observed between:

- “factor” and “environment” (variation range from 0.18 to 0.25),

- “cause” and the cosmic levels (variation ranges from 0.18 to 0.14, 0.18 to 0.20, and 0.18 to 0.16), among others.

Representatives of the applied sciences focused more on the occurrence of criminality within a specific environment and more frequently searched for causes, often referring to the different cosmic levels. Interestingly, the word category “phenomenon” appeared less frequently in their responses (see value 0.09), even though it was more commonly used by representatives of other fields to explain or describe certain influences contributing to the occurrence of crime.

4.9.4 Analysis of opinion density and diversity by representatives of different sciences

By analyzing the density and diversity of opinions from the final question of the survey across representatives of different academic fields, it will be possible to identify the most productive and varied contributors within each discipline. Word counts for each set of opinions will be conducted according to the field of the respondents, along with an analysis of word frequency and diversity using the software tool AntConc.

For this purpose, five .txt files were prepared, each containing the opinions of representatives from the humanities, social sciences, interdisciplinary fields, natural sciences, and applied sciences. Due to an insufficient number of responses from representatives of marginal fields, that group will be excluded from further analysis. The results of these data sets are shown in the following table.

4.9.4.1 Table 166: Analysis of the density and diversity of opinions

Representatives	Fb	Fm	B/m	Rb	Rb/Fm
Humanities	1004	34	29.52	390	11.47
Social sciences	870	37	23.51	360	9.7
Intermediate sciences	816	25	32.64	351	14.04
Natural sciences	1267	45	28.16	492	10.9
Applied sciences	1276	56	22.79	525	9.4
Average	1046.6	39.4	27.3	423.6	11.1

Table 166 presents statistical data on the density and diversity of opinions. The highest total number of words (average 1,046.6) was contributed by representatives of the applied sciences (see value 1,276), followed by representatives of the natural sciences (1,267), then the humanities (1,004), social sciences (870), and finally the intermediate sciences (816).

However, the highest number of words does not necessarily indicate the highest opinion density. Therefore, the total number of words (Fb) was divided by the number of opinions (Fm) for each group to calculate the word density per opinion (B/m).

The highest word density was observed among representatives of the intermediate sciences (32.64 words per opinion), followed by the humanities (29.52), natural sciences (28.16), social sciences (23.51), and lastly the applied sciences (22.79).

Taking into account both the number of words and the number of opinions per discipline, we get a very different ranking.

Next, the values for the diversity of words within opinions were calculated (Rb/Fm), by dividing the number of unique words (Rb) by the number of opinions (Fm) for each field.
Based on the calculated values, representatives of the intermediate sciences showed the highest diversity (14.04 unique words per opinion), followed by the humanities (11.47), natural sciences (10.9), social sciences (9.7), and applied sciences (9.4).
However, the number of unique words alone does not reflect the importance of these words or categories.
In the next step of the analysis, words or word categories that appeared fewer than three times were excluded. After this filtering, the following results by discipline were obtained:
- a. Humanities: 35 words or categories
- b. Social sciences: 40 words or categories
- c. Intermediate sciences: 31 words or categories
- d. Natural sciences: 53 words or categories
- e. Applied sciences: 56 words or categories
Subsequently, ratios were calculated between the number of frequently occurring words/categories and the number of opinions per field.
Based on these ratios, the results show that:
- Representatives of intermediate sciences contributed 1.24 significant words or categories per opinion,
- Natural sciences: 1.18,
- Social sciences: 1.08,
- Humanities: 1.03,
- Applied sciences: 1.00 (lowest).
It can be confidently stated that representatives of intermediate sciences contributed the highest density of words per opinion, the greatest diversity of words per opinion, and the highest density of significant words or categories per opinion.
In contrast, social sciences ranked second to last, and applied sciences had the lowest overall values. The ranking between the humanities and natural sciences is somewhat less clear. To resolve this, a simple calculation will be performed for the total scope, diversity, and strength of opinions, using the following mathematical formula:

$$\boxed{\sum \rho = \rho_{rb} + \rho_{Bm} + \rho_{rbm}}$$

The meaning of the symbols is as follows:
$\Sigma\rho$ – the sum of scope, diversity, and strength of opinions

ρ_{bm} – number of words per opinion

ρ_{rbm} – number of unique (diverse) words per opinion

ρ_{rb} – number of significant words per opinion

The significance of ρrb lies in its role as a key indicator, representing the contribution of each scientific field in terms of delivering more important words or word categories.

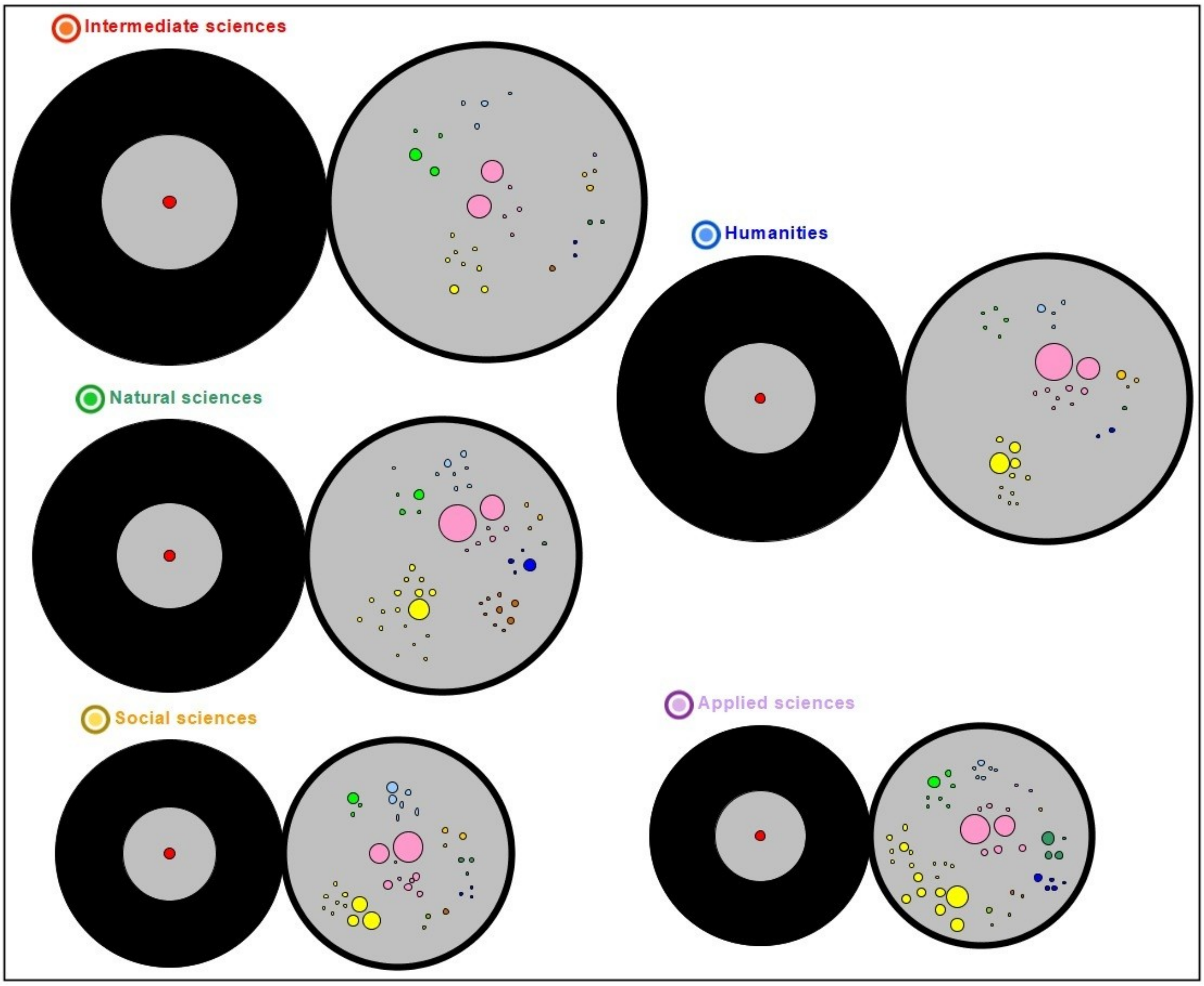
By summing the relevant values for each field, we obtain the following results:

1. 1st place: Intermediate sciences – $\Sigma\rho = 47.92$
2. 2nd place: Humanities – $\Sigma\rho = 42.02$
3. 3rd place: Natural sciences – $\Sigma\rho = 40.24$
4. 4th place: Social sciences – $\Sigma\rho = 34.29$
5. 5th place: Applied sciences – $\Sigma\rho = 33.19$

Based on these results, we can more clearly identify the fields that contributed a proportionally higher share in terms of expressed opinions. A clear gap is noticeable in the case of the intermediate sciences, while the difference between the natural and humanities disciplines is very small and statistically less significant.

Greater statistical significance in the differences would be achieved by focusing more closely on the contrast between the top three disciplines and the social and applied sciences. When comparing the values between the social and applied sciences, we again observe an extremely small difference, which implies minimal statistical significance.

For better clarity, this will also be visualized using a circle model.



4.9.4.2 Figure 314: Circle model of opinion scope, diversity, and strength

Figure 314 presents a circle model that further illustrates the more or less significant contributions of individual scientific fields to the expressed opinions. Based on this visualization, the relative sizes of the previously calculated values are clearly visible.

The model also features circles containing colored bubbles (e.g., pink bubbles belong to the UKBS 4 group, yellow bubbles to UKBS 11), which represent key words or word categories classified under the UKBS system. The size of these bubbles depends on how frequently a particular classified word or word category appears.

It is particularly evident that words or categories from classification group UKBS 4 stand out—these include social attributes/contents such as criminality, sociality, connectedness, economy, and conditions—as well as from UKBS 11, which consists of universal terms like factor, influence, cause, microcosm, macrocosm, mesocosm, consequence, significance, phenomenon, form, level, pattern, type, etc.

Less prominently represented are words from UKBS 2 (productive attributes/contents), although this group includes some strong terms such as education and action. All other classification groups appear less prominently in the opinions, meaning they have less influence on the main thematic emphases highlighted by the various scientific fields.

These thematic emphases form the core conceptual framework for the understanding of criminality. This main conceptual framework emphasizes social/sociological factors, described using universal words or categories. Within this framework, productive factors like education and action could also be included. The circle model (see the pink, yellow, and green bubbles) effectively illustrates this core conceptual understanding of criminality.

The word analysis with statistical emphasis showed that, regarding this main conceptual framework, there is no significant difference among the disciplines. Criminality is generally understood as a consequence of societal influences and causes. The results also point to additional, though less prominent, influences and causes related to productive and psychological factors.

Environmental factors (in terms of climate change or ecological disasters), as well as media, technological, institutional, and biological factors (e.g., genetic foundations, viral illnesses, cooperation between gut bacteria and brain neurons, interactions between genes and bacteria), are even less emphasized.

The preventive aspect of criminality is also extremely underrepresented. Given the dominant conceptual framework across disciplines, this is unsurprising: we are all aware that large-scale social realities can be extremely rigid and unresponsive to positive changes. Although the individual, as the more flexible part of society, may offer proposals for preventing various negative phenomena, they remain painfully aware of their powerlessness against the inertia and rigidity of societal systems that often follow the raw interests of positional and material profit.

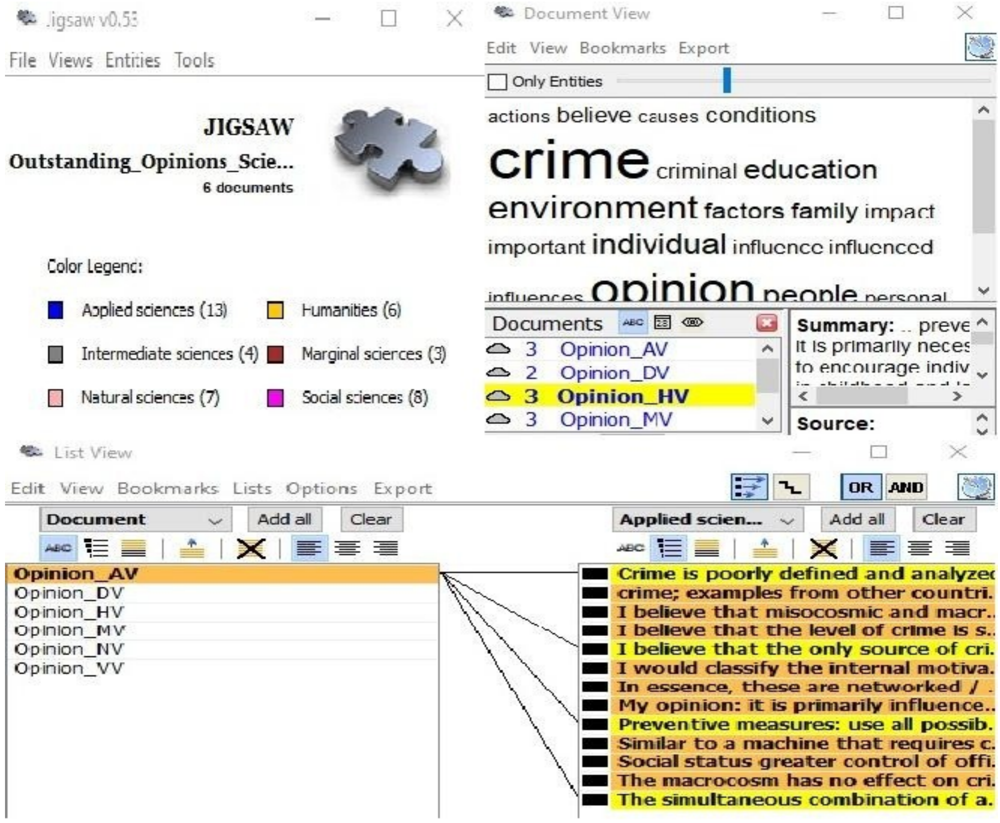
The word analysis with statistical emphasis clearly illustrated the dominant conceptual framework among the various disciplines. It also made it possible to determine a ranking based on the combined scope, diversity, and strength of opinions from each field.

It would be misleading to claim that representatives from applied and social sciences were the least original or productive—this cannot be inferred from a statistical word analysis of opinions.

An intellectual review of the opinions across fields reveals original and high-quality contributions from all disciplines. For this reason, an additional analysis was carried out to identify deviations in opinions from the strict sociological interpretation of criminality.

Six .txt files (for humanities, social sciences, intermediate, natural sciences, applied sciences, and marginal sciences) were prepared, each containing opinions by field. These files were then imported into the JigSaw software tool, which is suitable for analyzing diverse texts.

Within each file, or set of opinions from each field, intellectually determined entities were identified that diverged from the main conceptual framework. These entities were categorized by field: humanities, social sciences, intermediate sciences, natural sciences, applied sciences, and marginal sciences. To better illustrate this process, a screenshot of the JigSaw environment is provided.



4.9.4.3 Figure 315: Screenshot of the JigSaw software environment

Figure 315 shows a screenshot of the JigSaw software environment, where opinions deviating from the highlighted sociological conceptual framework were identified across different academic fields. The results are displayed in the upper left part of the image, showing numerical values for each discipline.

The number of outlying opinions was recalculated relative to the total number of opinions contributed by representatives of each field. To improve clarity, a table was created containing relevant data on the number of outlying opinions, the total number of opinions by discipline, and the calculated percentages indicating deviation from the main conceptual framework.

The screenshot also displays a portion of the opinions contributed by representatives of the applied sciences, using the document review technique and a visual column list.

Similar visualizations were created for the humanities, social sciences, intermediate sciences, natural sciences, and marginal sciences, although these are not shown in this particular screenshot.

4.9.4.4 Table 167: Calculated percentages of outstanding opinions according to the main content concept

Representatives	Fim	Fm	Percentage of outstanding opinions
Humanities	6	34	17.6
Social sciences	8	37	21.62
Intermediate sciences	4	25	16
Natural sciences	7	45	15.6
Applied sciences	13	56	23.2
Marginal sciences	3	3	100

Table 167 presents data on the number of outlying opinions, total number of opinions, and the calculated percentages of outlying opinions by academic discipline, based on the main conceptual framework.

The highest percentage of outlying opinions relative to the main conceptual framework was observed among representatives of the applied sciences (13 opinions or 23.2%), followed by representatives of the social sciences (8 opinions or 21.62%). Next are the humanities (6 opinions or 17.6%), then the intermediate sciences (4 opinions or 16%), and lastly, the natural sciences (7 opinions or 15.6%). Due to the insufficient number of representatives and responses from the marginal sciences, this group was excluded from the ranking.

Had a larger number of representatives from marginal sciences been included in this study, one could have expected a much greater deviation from the main conceptual framework, which is relatively strictly sociological and anthropocentric in orientation.

In short, established and well-anchored positions are generally welcome, as they provide effective orientation in life and contribute to a degree of social stability. However, these same positions can also hinder innovative scientific ideas and significantly impede communication and collaboration with groups that hold alternative views. This tendency is particularly disadvantageous for interdisciplinary cooperation across different scientific domains, including the study of crime.

The views of the participating scientists and researchers were largely rooted in a relatively strict mesocosmic and anthropocentric mindset. With such a programmed cognitive framework, it is very difficult to remain open to fields that fall outside of this mindset.

Crime is known to be a highly complex phenomenon and cannot be adequately explained solely through sociological, psychological, environmental, biological, media-related, or other isolated perspectives. For research into such complex domains, a multidisciplinary and/or interdisciplinary approach is typically required. This means that research on crime is not exclusively the domain of criminologists, psychologists, and sociologists, but also includes contributions from natural sciences, applied sciences, and even marginal scientific fields.

Based on the sample of scientists/researchers and the analysis of the questionnaire data, it can be stated with confidence that there is no effective interdisciplinary collaboration between different scientific disciplines in Slovenia. Furthermore, the findings indicate that representatives of different fields have a very narrow conceptual or cognitive range when it comes to understanding crime, which is a highly unfavorable foundation for any interdisciplinary scientific research. This finding answers the seventh and eighth research questions and confirms the fifth research hypothesis.

4.9.5 Conclusion

Interdisciplinarity in science essentially means the ability to synthesize and apply knowledge from various scientific disciplines. In Slovenia, there is a lack of a more comprehensive and effective interdisciplinary approach to researching crime, as different scientific fields tend to remain closed off and focused on their traditional subjects of inquiry—making crime feel distant and irrelevant to them. This social climate, in itself, hinders the possibility of synthesizing and applying knowledge from various domains.

Given the growing need for a better understanding of crime, there is a need for a scientific climate that is not excessively closed to other types of knowledge and perspectives. It is often the case that a particular scientific discipline already holds a solution to pressing social or environmental problems but is not explicitly aware of it. In such cases, we can speak of hidden, unconscious clusters of knowledge that fail to reach the right person or scientist, blocked by a relatively closed scientific social climate.

Studying crime requires an interdisciplinary approach, as only this enables a more effective synthesis of knowledge from various research areas. Furthermore, this increases the likelihood of uncovering so-called hidden knowledge, which—when combined with existing knowledge—can lead to synthesis or advancement. This could result in a deeper understanding of crime and potentially improve its prevention.

We must not ignore the mesocosmic level and its influences, but for a truly interdisciplinary approach to crime, we must also remain open to influences from the macrocosmic and microcosmic levels.

It is surprising how unaware some representatives of different disciplines—especially biologists and microbiologists—are of the significant influence that bacterial and viral cultures can have on human behavior. When combined with unfavorable social factors, these biological influences can increase the likelihood of deviant and criminal behaviors. Numerous respected studies have demonstrated the powerful impact of microorganisms on humans and other living beings.

The same applies to macrocosmic influences: one might expect, for example, that physicists or astronomers would show more interest in the potential effects of strong electromagnetic or other fields on human behavior. It is no shame if they have never heard of or considered these influences —after all, the production of knowledge in every field is growing rapidly, and no single scientist can keep up with even a fraction of new discoveries.

Similarly, it is no shame that criminologists struggle—or fail entirely—to follow publications that approach crime from alternative perspectives. This gap could be addressed by actively collaborating with specialized libraries and/or information centers that could investigate such publications and attempt to extract or uncover hidden knowledge. Perhaps they could even synthesize this knowledge? Unfortunately, such efforts are rare, as libraries are often stuck in a stereotypical view of their services, limited to lending, information literacy training, and maintaining researchers' bibliographies (mainly for point-scoring purposes). Yet even this last task could serve additional valuable functions.

Ultimately, through more effective knowledge synthesis, criminology—as well as related disciplines (such as police science)—could develop new perspectives that might enhance our ability to predict and prevent crime, thereby improving parts of the world.

The difficulty of keeping up with human knowledge is not unique to criminology; it's a "David vs. Goliath" situation across the sciences. For example, geneticists struggle to follow developments in bacteriology and vice versa. This is especially relevant because human genes interact with vast bacterial networks inside our bodies from birth to death—these bacteria outnumber human cells by at least ten to one, with estimates reaching 100 trillion. When this cooperation is optimal, both the human body and bacterial networks benefit (e.g., strengthened immunity, improved reproduction, production of vitamins such as B, B12, and K). But there is also a darker scenario, in which bacterial networks can easily manipulate our genes—activating or deactivating them at will.

In short, the mesocosm plays a central role—it is the layer of the universe we understand and feel most clearly. However, when fatal overlaps occur across all three levels (e.g., harmful bacterial activity, intensified electromagnetic fields, and adverse social conditions), the tendency toward criminal behavior may even increase exponentially.

The official, traditional explanations of crime are well known and documented. But in studying crime, we must not underestimate other, more hidden or lesser-known factors—such as microorganisms or electromagnetic fields—which indirectly give rise to mesocosmic influences.

History constantly teaches us not to forget: official views (laws, classification systems, dominant scientific paradigms, theories, and models) are often outdated. This is not surprising, given how difficult it is to keep up with the pace of change in our environment—and within ourselves.

4.9.6 Simulated model of criminality in a broader or natural sense

Based on an intriguing comment made by a respondent—namely, that there is essentially no crime if there is no law—we can derive a slightly modified assertion:

“If there is no law, there are no criminal offenses, yet criminality can still exist.”

This statement can be interpreted by examining the meaning of criminality from its Latin origin (crimen), which can be roughly translated as realized error (or offense, fault). From a broader perspective, we could interpret criminality as the violation of natural laws by living beings within a natural hierarchical associative system.[145]

The natural laws within this hierarchical associative system—which also apply to social systems—can include:

a. the law of hierarchy (or the law of the stronger/more capable),

b. the law of cooperation (relatively equal associations, symbiosis, etc.),

c. the law of survival,

d. the law of genetic transmission,

e. the law of habitat,

f. the law of mobility and diversity (e.g., adaptability, wide dietary range),

g. the law of proportional conservation of mass and energy (e.g., the energy consumption of a living being or social network should not endanger existence; energy intake should support optimal usage),

h. the law of opportunity (a living being uses an available opportunity to its own advantage, e.g., parasites),

i. the law of induction (e.g., long-distance communication among ants).

There are likely additional natural laws not listed here, but those mentioned are sufficient to illustrate the idea of criminality or realized errors committed by living beings in the natural world.

According to this model, perpetrators of criminality are not limited to humans—they can also include other living organisms such as bacteria, plants, mammals, reptiles, amphibians, and insects.

When and how? When these beings violate natural laws and negatively affect environmental balance, they are effectively committing realized errors—or criminality in the broader or natural sense.

Criminality, under this model, can also exist in the animal kingdom (in fact, in ancient Greece and the Middle Ages, animals were even put on trial and sentenced). While plant-based “criminality” is less emphasized, plants too can make “errors” and disrupt natural laws.

145 Petrič, K. (2020). Crime in a broad or natural sense [preprint]. https://www.doi.org/10.13140/RG.2.2.23980.85128.

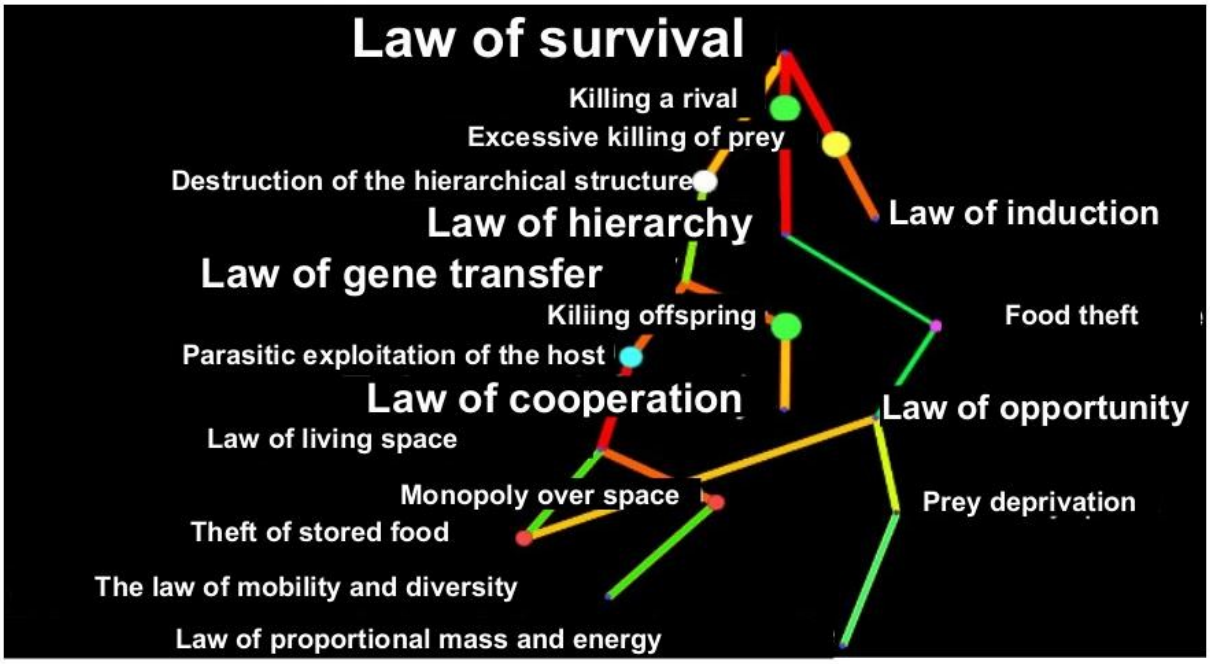
This model also invites the question of whether animals act consciously. While we might claim that animals lack true consciousness and act only on instinct, from a broader perspective we can assume that all living beings possess some form of consciousness—albeit varying in nature and degree compared to humans. Likewise, all living beings can act both responsibly and irresponsibly.
The main goal of this model of “realized errors” or “criminality in a broader or natural sense” is twofold:

1. To abstract and better understand the complex causes and influences behind human criminality within social systems.
2. To identify the most basic (or atomic) causes and influences behind criminal-like behaviors in other living beings within the natural world.

This model is based on the fundamental assumption that there are no essential differences in the core cognitive structures of humans and other living organisms.
To develop this idea, data were simulated on selected natural laws and realized errors in nature. Both categories were rated on a scale from 1 to 10, with 10 indicating the strongest and 1 the weakest. These ratings were compiled into a table and then imported into the software tool Ora Casos to generate a network diagram, visually representing the strength of realized errors in relation to the significance of different natural laws.
Based on this, it becomes possible to simulate the severity of a given violation of a natural law and to hypothesize about possible negative outcomes and scenarios.

4.9.6.1 Table 168: Part of the simulated data on estimated realized errors and the importance of natural laws

Errors commited	Error assessments	Natural laws	Importance assessments
Killing a rival	10	Law of hierarchy	8
Killing offspring	10	Law of cooperation	8
Parasitic exploitation	7	Law of gene transfer	9
Theft of stored ...	5	Law of living space	8
Monopoly over space	5	Law of mobility and ...	8
Predation of food	4	Law of opportunity	5
Prey deprivation	3	Law of proportional ...	7
Excessive killing ...	9	Law of induction	6
Destruction of hierarchies ...	8	Law of survival	10



4.9.6.2 Figure 316: A possible network of natural laws and actualized errors

Table 168 presents simulated statistical data evaluating actualized errors and the importance of natural laws, while Figure 316 illustrates a potential network connecting those errors and laws based on the data. Within the natural hierarchical associative system—which also encompasses human societal systems—we can identify the “law of survival” as the most dominant of all natural laws. This law, aimed at maintaining existence and life, underpins all others. Other powerful natural laws include the “law of gene transfer,” the “law of hierarchy,” and the “law of association or proportionate cooperation.”

Additional laws, while not as dominant, are still essential for the survival of all living beings. These include the “law of proportional conservation of mass and energy,” the “law of mobility and diversity,” the “law of habitat,” the “law of opportunity,” and the “law of induction.” When these laws are violated by living beings within nature, significant negative consequences can arise in the environmental system—potentially even leading to the gradual extinction of certain animal or plant species. The depicted actualized errors represent violations of natural laws, which can trigger negative outcomes.

For instance, consider the scenario of a challenger lion that kills the dominant male and his six offspring. Many might see this as normal, a basic example of the natural law of the stronger prevailing. Up to that point, this may seem acceptable. However, when the victorious lion mates with the lioness, no new offspring are produced, thereby violating the natural law of gene transfer. Over time, the pride ages and dies out, leaving a void in the ecosystem that creates imbalance. Other predators, such as hyenas and wild dogs, multiply rapidly. This exponential growth increases pressure on prey populations, which become severely threatened by the overly aggressive and gluttonous predators.

Thus, the challenger lion commits a significant error—or “crime” in the broader natural sense—by violating the law of gene transfer. This violation sets off a domino effect: a sudden increase in the number of lawbreakers in the ecosystem leads to further environmental imbalance, particularly among predators, prey, and plant systems. What began as a minor ecological disruption grows into a major imbalance due to excessive killing and resource depletion.

The potential for various forms of “criminality” in nature—i.e., violations of natural laws by different organisms—is difficult to quantify. However, the causes are more easily identified and generally stem from violations of natural laws committed in pursuit of better survival conditions or prestige. These include enhanced gene propagation, larger habitats, better access to food and water, etc. Such “prestige” can be interpreted as the desire to dominate the environment. Survival ensures the continuation of life, while dominance serves as a tool for achieving survival with status.

Although nature’s hierarchical associative system is self-organizing and self-regulating, these same attributes exist within individual organisms. Natural systems include both automated dynamics and conscious responses, with the drive for survival often functioning as a pathological automatism. Every such automatism contains memory, though this memory alone does not prove the existence of conscious will to live.

The entire system, composed of distributed memory and awareness, reacts automatically to movements and stimuli from both living and non-living components. All living units are driven by survival instincts as well as threats to their survival, which manifest as feelings of inadequacy or helplessness—leading to energy loss (distress) in the broadest biological sense. Fundamental responses to this distress are fight, flight, or freeze. In the case of flight or fight, semi-automatic movements or rapid decisions emerge to eliminate threats or deficiencies. A positive outcome of such reactions is survival and life continuation.

The natural system thus operates like a conductor of all natural processes, yet is also a nonlinear sum of countless rapid decisions made by living beings based on their will to survive. This automatism results in recurring behavioral patterns embedded in living organisms (e.g., weather cycles, planetary orbits, seasons). These repeating processes form a kind of algorithm of dynamics—approximating past processes, yet constantly altered by changing conditions, which affect future outcomes.

Each repeated cycle consists of a starting point, an action, and a goal. The expected outcome often differs from the actual result, creating a basis for new cycles to unfold, often differently than before. The survival instinct sets rules that shape behavioral responses. This thinking framework includes reproductive processes that aim to repeat prior outcomes, though the results often vary in fidelity.

As an example, bees typically live in highly organized eusocial colonies with a strict hierarchy. The queen bee represents the highest level, responsible for reproduction and ensuring the colony's future. Sometimes, worker bees attempt to reproduce, which the "bee police" do not allow—destroying the unauthorized eggs and punishing the offending workers. This strict hierarchy maintains order and population size, enhancing survival prospects. If all bees attempted to become queens and reproduce, the colony would fragment into smaller units with reduced survival chances. The long-evolved bee hierarchy has proven highly effective. Workers who undermine this structure by violating the laws of survival and gene transfer can be seen as committing "natural crimes" because they threaten the entire species' existence. Bees play a crucial ecological role—not just in honey production, but in pollination, which supports plant life, and in turn, sustains other organisms. Thus, bees contribute significantly to the systemic balance of the entire natural associative hierarchy.

In summary, the root cause of "natural crime" or criminal behavior in living organisms can be traced to the instinct for survival and the pursuit of prestige—closely tied to various cosmic dimensions that guide life dynamics and distribute energy across systems. These interactions inevitably create imbalances, but the system as a whole tends toward proportional balance. This balance is deeply linked to the law of proportional conservation of mass and energy—both for individual living units and the overall system.

Energy is not distributed based on equality, but based on losses and gains through repeated natural processes. Therefore, understanding crime and criminal organisms cannot be limited to the

mesocosmic level (human society); it also involves micro- and macrocosmic influences affecting energy distribution in the whole natural system.
Translating this to human society implies that criminal behavior and criminal personalities stem from energy imbalances, often shaped by pathological survival and prestige mechanisms—which go beyond just societal influences. The source of this “criminal energy” lies not only within human social structures but also in the deeper interconnections with macro- and microcosmic levels. The next subchapter will address a social anomaly often referred to as environmental pollution.

4.9.7 Pollution of nature

There is another fundamental characteristic that significantly distinguishes the legal, social, and technological aspects of civilized human society from all other living beings on planet Earth. This part of the human species is, in fact, the greatest polluter of nature. Over the past 150 years, it has violently disrupted the original purity of our environmental system, and these actions have even contributed to the extinction of certain animal and plant species. It has gradually altered the climate to such an extent that the protective ozone layer in the atmosphere has thinned, which in turn leads to the gradual warming of the planet. This will have negative consequences not only for the survival of many animal and plant species but also for humanity itself.
This societal anomaly can be closely linked to environmental crime, which constitutes only a small portion of the criminal activities carried out by humans. The largest processes of environmental pollution often take place entirely legally, as they primarily serve the profit-driven interests of acquiring material and/or social advantages. These interests can be narrow or broad, even extending to national and international levels. From a strict perspective, virtually all business processes that pollute nature could be considered criminal acts, though they are not legally punishable. From this, one could conclude that the legal, social, and technological aspects of civilized humanity are the greatest violators of natural laws, and thus the worst "criminals" in the evolutionary process. No other species shows such a powerful drive for survival tied to prestige and status.
This subchapter, on one hand, neatly connects with the previous subchapter on criminality, and on the other hand, serves as a soft transition into the next chapter on natural nature. In this section, the focus will not be so much on the various types and methods of nature pollution, but rather on the energetic aspect of social hierarchical associative systems. Due to other social anomalies discussed in previous subchapters, these systems waste large amounts of energy, which in turn exponentially increases excessive environmental pollution.
The factor of environmental pollution can cause severe health problems for both humans and other living beings. Fatalities due to the poisoning of air, water, and soil are not uncommon. Cities with

higher levels of air pollution report increased rates of crime, particularly in the form of violent robberies, thefts, burglaries, and domestic violence.[146] A particularly important factor to highlight is the impact of increased smoke levels in the atmosphere and the rise in temperature. Due to human activity, various emissions are released into the atmosphere, including carbon dioxide, hydrofluorocarbons, nitrogen oxides, methane, and gases produced by forest burning and other processes. These contribute to the greenhouse effect and consequently weaken the ozone layer, which protects living beings from harmful UV rays and cosmic radiation.

In this context, we are dealing with effects that move from the mesocosmic to the macrocosmic level, as both the oxygen content in the atmosphere and the climate itself are gradually changing. This creates a feedback loop that negatively impacts the mesocosmic level and, therefore, life on our planet.

In addition, there is a massive loss of various forms of energy, resulting simply from the large amounts of diverse waste that modern legal-social-technological societies are no longer able to manage effectively. A significant portion of this waste from developed countries is exported to less developed nations in Africa, Asia, and South America. As a result, these countries are also overwhelmed by waste, which causes serious health problems for populations living near these massive dumping sites.

Food systems consume around 30% of total energy, and a large portion of that energy ends up as waste. Research in the United States has shown that approximately 60 billion kilograms of food are discarded annually, representing a tremendous waste of energy. This issue is further intensified by the decomposition of food, which releases additional emissions of various gases and fine toxic particles into the atmosphere.[147]

The problem is not only the emission of various gases and toxic particles into the atmosphere, but also an equally serious issue: water pollution caused by extremely small plastic particles at the nanoscale, which flow from rivers into seas and oceans. These are primarily plastic products with long decomposition periods. The threat affects not only marine organisms that ingest these particles, but also humans who consume fish.

Another major issue is the widespread use of synthetic fertilizers and insecticides on agricultural land. These chemicals poison the soil and plants used as feed for livestock and for human consumption. This is closely tied to the meat industry, whose production has reached astronomical levels and has harmful effects on human health.

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146 Burkhardt, J. et al. (2019). The effect of pollution on crime: Evidence from data on particulate matter and ozone. *Journal of Environmental Economics and Management*, 98, 102267.

147 Bloom, J. (2010). *American wasteland: how America throws away nearly half of its food (and what we can do about it)*. Cambridge, MA: Da Capo Press.

Environmental pollution has led to the exponential spread of various bacteria and viruses. Some of these microorganisms contribute to the production of oxygen in the atmosphere, while others have harmful effects on living beings, including mammals and humans.

Many inventions for generating thermal and electrical energy—developed mainly over the past 150 years—have, on one hand, enabled relatively comfortable living, but on the other hand, have exhausted natural energy resources, which are not available in unlimited quantities. Furthermore, energy production from these sources has generated massive amounts of waste and environmental pollution. In the long term, this has led to global warming, climate change, and increasing hunger, forcing affected populations to migrate to more favorable environments.

This creates an organizational challenge for developed societies, which are already struggling with overpopulation. As a result, mass migration from poorer parts of the world is often viewed as undesirable and problematic. Energy consumption continues to rise across all sectors—industry, transportation, households, and other economic areas such as commerce and agriculture.

In this context, the legal-social-technological aspect of the more developed part of the human species becomes especially important, as it faces the urgent need to find solutions to energy and environmental challenges. Technological innovation alone is not enough—there must also be coordinated action in organization, law, communication, social services, project collaboration, software and procedural implementation, and business operations.

So far, there has been no effective coordination among these types of innovation. Some modern technologies have indeed improved energy efficiency and enhanced quality of life, but they have also brought new challenges, such as increased unemployment, complex administrative procedures, reduced interpersonal communication, more complicated legislation, and extreme business models. Moreover, the amount of waste has not decreased—on the contrary, it has increased.

The more technologically advanced part of the human species, particularly from a business and political perspective, has promoted the adoption of modern technologies to increase thermal and electrical energy production. However, due to the narrow focus of key decision-makers, potential problems associated with these technologies have not been adequately considered. In this area, interdisciplinary cooperation between various scientific and professional fields would be especially meaningful.

Energy consumption, particularly through the burning of fossil fuels (oil, gas, coal), has risen sharply over the past 20 years. Currently, global energy consumption ranges from 40,000 to 1,400,000 TWh (343,938,091.14 to 120,378,331,900 Gcal).[148] The combustion of fossil fuels releases large amounts of toxic gases into the atmosphere, with emission levels reaching gigaton

148 Data obtained from the online source: https://ourworldindata.org/fossil-fuels (2020-11-03).

(Gt) scales. In 2018 alone, fossil fuel combustion in China resulted in carbon dioxide emissions totaling 37.5 billion (bn) tons.[149] In short, the technologically advanced segment of humanity continuously harms our atmosphere and the health of living beings. An excessive desire for survival, combined with a craving for prestige, drives humans toward irrational and unreasonable behavior, which in turn causes serious systemic failures in both social and natural hierarchical associative systems.

For decades, energy and technological alternatives capable of reducing various types of gas emissions into the atmosphere have existed, but they have yet to gain traction in commercial markets. Large corporate conglomerates and their top executives continue to rely on fossil energy sources despite the damage caused, and they are consistently supported by political systems.

Forensic ecology, or environmental forensics, is a field that investigates environmental crimes under criminal law. It uses specialized methods to gather evidence of offenses and seeks to identify the individuals, groups, corporations, or other entities responsible. However, environmental forensics does not operate outside the scope of criminal law to investigate or address such acts.

In essence, whenever and wherever the law allows harmful environmental pollution, environmental forensics plays no role in investigating or preventing environmental or ecological crime. In general, forensic sciences (similar to criminology) are not primarily preventive in nature; instead, they function in a repressive manner, aiming to identify perpetrators through collected evidence so they may be held accountable and punished accordingly.

Criminal codes worldwide often allow severe environmental pollution and harm to the health of living beings, including humans, as long as it occurs within legal and profitable business operations of heavy industry. Environmental sciences, some of which focus on the damaging impacts of pollution, highlight environmental crime and the outdated nature of criminal codes in their research. However, it often takes decades before significant changes are made to criminal legislation.

Transnational environmental crime, such as poaching and illegal logging, results in massive global costs, estimated between 91 and 259 billion U.S. dollars annually.[150] In addition to financial costs, transnational environmental crime significantly contributes to serious threats in various forms, such as public health issues, violent crime, the expansion of drug plantations (involving deforestation and

149 Data obtained using the following online source: https://www.carbonbrief.org/analysis-fossil-fuel-emissions-in-2018-increasing-at-fastest-rate-for-seven-years (2020-11-03).

150 Gore, M.L. et al. (2019). Transnational environmental crime threatens sustainable development. *Nature Sustainability*, 2, 784–786. Available at URL: https://www.ecohealthalliance.org/wp-content/uploads/2019/09/Transnational-environmental-crime-threatens-sustainable-development.pdf (2020-11-08).
Another German online article relies on the aforementioned research: https://www.umweltdialog.de/de/management/Compliance/2019/Umweltkriminalitaet-kostet-Weltwirtschaft Milliarden.php (2020-11-08).

the use of harmful insecticides), human and arms trafficking, endangerment of animal species, depletion of the ozone layer, and other negative consequences.

Effective reforms in criminal legislation, better organization of law enforcement agencies, and innovative strategies for predicting and preventing such crimes are essential for successfully limiting and combating transnational environmental crime. Compared to the loss of various forms of energy, the financial costs—even if astronomically high—are relatively insignificant, as these threats undermine energy systems and thereby affect the functioning of entire societal hierarchical associative systems.

Even without the impact of transnational environmental crime, the environment is already heavily burdened by the production and consumption of thermal and electrical energy, which leads to the release of harmful gas emissions. Therefore, it is crucial to consider new or at least improved energy systems that would reduce energy consumption, increase energy production, and utilize sources that either do not produce emissions or emit them only in minimal amounts.

Natural hierarchical associative systems—those not involving human societies—also generate gas emissions in various forms, such as from the droppings of large herds of antelope, gazelles, and African buffalo, the decomposition of carcasses (much of which is handled by scavengers), and the decay of plants. In this context, various types of insects, which humans often consider pests, are among the least polluting creatures in nature. The same applies to microorganisms, some of which even contribute to the production of oxygen in the atmosphere.

Human behavior, influenced by minority interest groups and an excessive desire for comfort and prestige, often leads to irrational decisions. While the use of natural energy sources appears vital for maintaining the balance of natural ecosystems, it is generally less profitable. Nevertheless, many alternative energy sources have long been known, such as geothermal springs, water, wind, sunlight, biomass, and geothermal heat. Forecasts suggest that the cost of using these sources will, in the future, be significantly lower than the costs associated with the exploitation of fossil fuels.[151] In Germany, in 2019, one billion kWh—or 860,050,647,427.0199 kcal—of energy was produced using alternative energy sources. Both energy consumption and environmental pollution from gas emissions into the atmosphere were significantly lower that year.[152] Wind energy has been in use for quite some time, as it is free and seemingly available in unlimited quantities for our needs. Its operation is simple—it relies on a rotor that captures the wind's kinetic energy and converts it into

151 Hühn, S. (2020). Alternative Energie : Mit diesen Quellen kann die Energiewende gelingen. V: *Ingeneur.de* (26. 03. 2020). Available at: https://www.ingenieur.de/technik/fachbereiche/energie/alternative-energiequellen/ (2020-11-08).

152 Umwelt Bundesamt. (2020). *Erneuerbare Energien in Zahlen*. Available at URL: https://www.umweltbundesamt.de/themen/klima-energie/erneuerbare-energien/erneuerbare-energien-in-zahlen#uberblick (2020-11-08).

mechanical energy. A special generator then transforms this mechanical energy into electricity. From a legal perspective, the use of wind energy is also relatively well regulated.

In the case of solar energy, electricity is generated directly using solar collectors. Similarly, the conversion of water energy also involves a generator, like in wind energy, which ultimately produces electricity. The use of bioenergy for electricity generation is still under development, as it does not yet provide complete safety for humans and other living beings. Many consider the use of environmental heat for thermal energy production to be environmentally friendly and thus beneficial to living organisms.

Thermal energy is obtained through a process that operates in reverse to a refrigeration system—a heat pump draws heat from the ground and transfers it into a heating system, which can then supply an entire building. Like wind energy, these other briefly described alternative energy sources are also adequately regulated from a legal standpoint.

From both a technological and legal standpoint, the continued use of fossil energy sources no longer appears necessary. The main challenge lies in reorganizing large energy corporations, which should gradually shift toward the production of alternative energy sources. This transition may involve relatively high initial costs, and future profits may not reach the same levels. On the other hand, it is also a social issue—workers employed in these large energy corporations would need to adapt to new processes and procedures, which would require significant restructuring.

In this context, it will likely be necessary for business elites to accept lower profits in favor of protecting the environment and the health of humans and other living beings. At present, it is primarily possible to reduce the damage already done, most of which has been caused by large industrial corporations through the extraction and use of fossil energy sources and chemical-metallurgical processes (e.g., plastic production, extraction of pure metals from heterogeneous raw materials).

Changes in energy use will need to occur rapidly, as it is essential to reduce the strain on the natural ecosystem before we reach a point where environmental protection is no longer possible. This leads us into a vast chapter on natural hierarchical systems, which will be examined from the perspective of the 3~M cosmological planes. This research will be extremely complex and can only be carried out through empirical experiments and the application of the hierarchological or hierarchographic concept.

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5 Natural hierarchical associative systems

First, it is necessary to define natural hierarchical associative systems. Subsequently, we will address the important and influential natural process of induction, followed by entities such as water, earth, air, and light, which form the foundation of our natural system and life in general. This will serve as a smooth transition to both non-living nature (e.g., rocks, minerals, crystals, chemical compounds) and living nature (e.g., microorganisms, insects, amphibians, reptiles, birds, mammals, plants, algae).

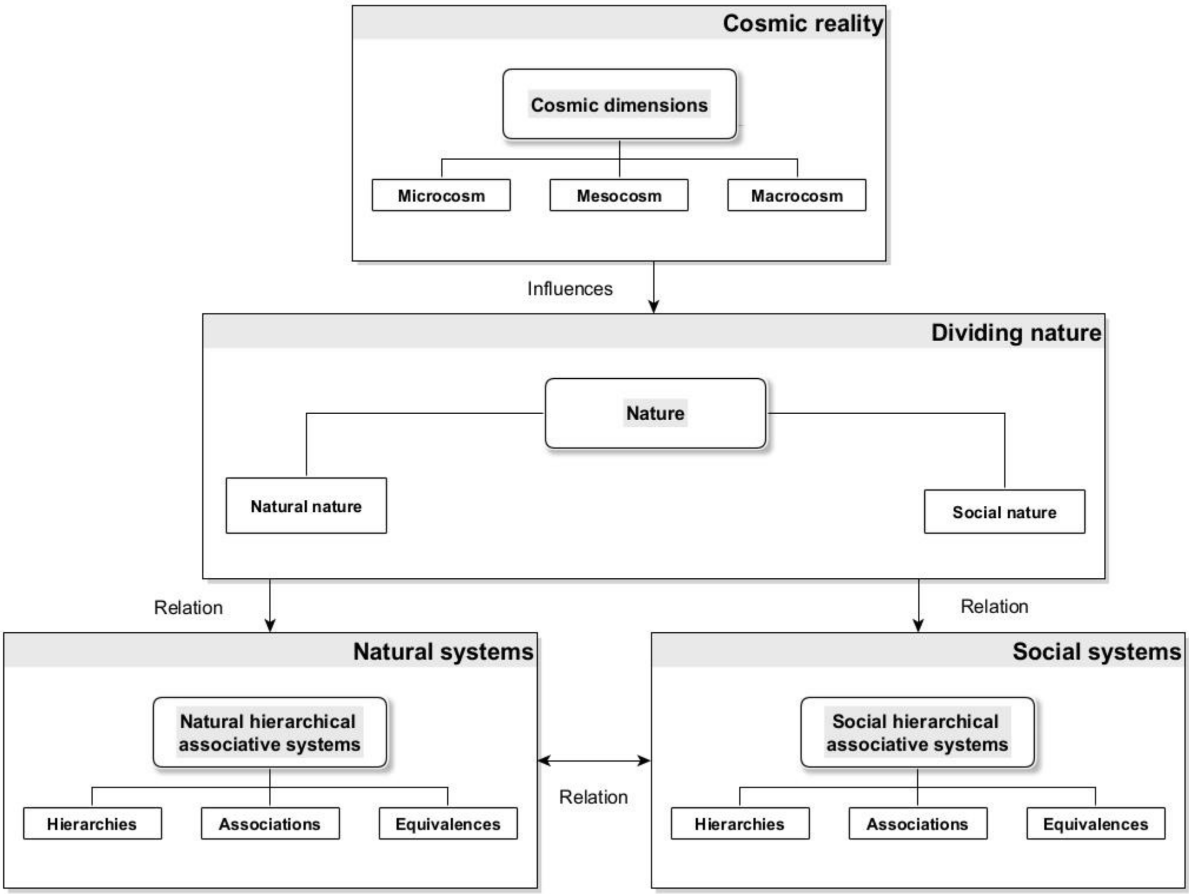
5.1 Definition of natural hierarchical associative systems and their distinction from social systems

As previously mentioned, social hierarchical associative systems represent only a small part of the natural hierarchical associative system. Similar to other disciplines (e.g., anthropology), there is a need for a conditional distinction between the natural and social domains, within which the human species resides, driven by its need to emphasize its own identity. Additionally, the socially, legally, and technologically more advanced segment of humanity continuously influences natural environments and, consequently, natural systems. These influences blur the boundaries between the social and natural, as this segment increasingly encroaches on untouched natural landscapes and reshapes them.

To a far lesser extent, the socially, legally, and technologically less developed segments of humanity also impact the natural environment. However, their activities largely align with those of other animal species, as they predominantly coexist with their surroundings. From this perspective, this segment can at least partially be viewed as part of natural hierarchical associative systems. It is crucial to recognize that many indigenous communities have already experienced the influence of the so-called civilized world. The boundary between social and natural is not as clear-cut as it initially appears-it is fluid and intertwined with varying degrees of intensity.

From the standpoint of the world's origins and the subsequent emergence of humanity, it may not even be meaningful to strictly separate natural and social realms. Instead, it is more appropriate to consider the entire natural hierarchical associative system, which, through prolonged evolution and numerous chemical, physical, electromagnetic, and biological reactions, gave rise to living beings. Incorporating micro-, meso-, and macrocosmic scales further complicates this distinction, as interconnections between levels are exceptionally strong. For example, microorganisms inhabiting the human body could be classified as part of humans and thus social hierarchical associative systems, while external microorganisms belong to natural environmental units existing at meso- or macrocosmic levels (e.g., airborne bacteria in the atmosphere).

As inferred from this brief overview, the division between social and natural is largely artificial and rooted in subjective perception, making it inconsistently defined. Introducing an updated anthropological demarcation of social and natural environments could reduce conceptual ambiguity. Anthropologists might oppose this idea, as the traditional social-natural dichotomy is already established. Hierarchology and hierarchography face two options: either adopt the anthropological division or adapt it. This text primarily employs the anthropological division but will later present an alternative framework that diverges from it, enabling a clearer systemic perspective.



5.1.1 Figure 317: Demarcation of nature and society

Figure 317 illustrates the demarcation between nature and society from a systemic perspective. Cosmic reality, as we interpret it, is omnipresent, with influences from cosmic dimensions (micro-, meso-, and macrocosmos) acting on our natural environment. According to the anthropological division of nature into natural and social, these cosmic influences consequently affect both natural and social realms. Within natural nature lie natural hierarchical associative systems, while social hierarchical associative systems-centered on humans-reside within social nature.

As shown in Figure 317, there is no clear boundary between natural and social hierarchical associative systems; only relational connections exist between them. This chapter will focus on natural hierarchical associative systems through the lens of three cosmic planes, with less emphasis on humans and social systems.

Natural hierarchical associative systems operate across all three cosmic planes, from which their influences originate. Studying these systems requires capturing causality within and between these planes, including interactions involving microorganisms, mid-level organisms, crystals, rocks, celestial bodies, climate, and more.

A distinct category comprises air, earth, water, and light, which form the basis of all known existence and appear across all cosmic planes:

- Air: A heterogeneous mixture of gases.
- Earth: Composed of minerals, microorganisms, and compounds of calcium, magnesium, iron, and others.
- Water: A hydrogen-oxygen compound infused with microorganisms.
- Light: Photons (massless particles) that contribute to mass formation in subsequent processes.

This demarcation between natural and social systems is highly conditional and synthetic. It represents an abstraction method to temporarily exclude the influence of the legally, socially, and technologically advanced segments of humanity. Natural hierarchical associative systems can thus be defined as domains where human impact is minimal or absent.

Example: Nature reserves aim to preserve and develop animal and plant species by controlling specific processes. Their goals include preventing species extinction (which could harm entire ecosystems), protecting against poachers trafficking valuable animal parts, and promoting profitable tourism. They also serve as research areas for studying natural systems.

Human influence on natural systems often manifests as conflict rather than collaboration:

- Pollution from waste.
- Offshore oil drilling.
- Nuclear bomb testing.

These activities highlight how social hierarchical associative systems frequently disrupt natural systems rather than coexist with them.

Natural reserves, large parks, botanical gardens, terrariums, aquariums, and zoos cannot be classified as natural hierarchical associative systems. A natural hierarchical associative system is one where hierarchical and associative causal processes-rooted in physical, chemical, and biological reactions-occur without significant human influence. These processes lead to the formation of more or less recognizable organized structures of hierarchies and associations.

Hierarchy is a form of collaboration emphasizing distinctions between superior and subordinate elements, whereas association is not inherently tied to dominance-submission relationships, even if associative interactions may exist within hierarchical structures. The most well-known and significant forms of association include symbiosis, assimilation, accommodation, and adaptation among diverse natural entities.

Symbiotic relationships can vary: they may involve positive mutualism between at least two living organisms or forced symbiosis (parasitism). Assimilation-the incorporation of environmental characteristics or other organisms-resembles accommodation and adaptation. These processes emphasize collaboration rather than rigid hierarchical structures.

Importantly, there is no strict boundary between hierarchical and associative structures; hierarchies are not always the central element of a system. Similar to social hierarchical associative systems, natural systems often rely on induction, which enables the operation of informational, communicative, organizational, and even material infrastructure.

In natural hierarchical associative systems, induction forms the foundation for hierarchical, associative, and hybrid structures, allowing the creation of complex networks.[153] Before we move on to studying air, water, earth, and light, we will once again focus on the process of induction, this time emphasizing its occurrence and functioning within natural hierarchical associative systems.

5.2 Induction in natural hierarchical associative systems

Even in the functioning of the human body system, we can observe that numerous processes occur at self-regulative and self-organizational levels, where the system strives to achieve an optimally efficient network structure. This structure aims to prevent unnecessary energy consumption and enable optimal functioning of all bodily organs.

Similarly, in natural hierarchical associative systems, self-regulative and self-organizational processes occur, where various types of induction create relatively homogeneous, direct network structures that operate according to the principle of optimal system efficiency. As a result, similar network structures emerge that can cooperate and thus exist as a specific species.

Induction processes occur not only in living nature (e.g., neural networks where neurons exchange information with each other) but also in non-living nature (e.g., lightning when two clouds approach each other).

Let's examine different types of induction in natural hierarchical associative systems in more detail:

1. Magnetic induction: This occurs when an electric voltage is created in a magnetic field, resulting from the presence of a magnet or magnetic substance and the movement of a conductor within the magnetic field (e.g., magnetization of materials). Electrons accumulate on the lower side of the

153 The idea was based on the following work: Wang, R., Fan, Y. & Wu, Y (2019). Spontaneous electromagnetic induction promotes the formation of economical neuronal network structure via self-organization process. *Scientific Reports*, 9(1), 1-13. https://doi.org/10.1038/s41598-019-46104-z (2021-01-30).

conductor, causing induced voltage and consequently induced current that flows in the opposite direction of electron movement.

Magnetic induction is present throughout the entire magnetic field, not just at its poles (north/south). It is often encountered in combination with electric forces, hence the more established term electromagnetic induction. While magnetism is a permanent natural phenomenon, electric charge is established through friction but is later lost.

2. Electromagnetic induction: Electromagnetic induction is a phenomenon in which electromotive force is generated in an electrical conductor due to changes in the magnetic field. It was first discovered in 1831 by English scientist Michael Faraday. Electromagnetic induction occurs when magnets or magnetic substances are used in combination with electrical circuits. It combines magnetic and electrical forces which, under the influence of media movement through a conductor or coil (e.g., electric cable, bar magnet), causes electrical voltage and current. This phenomenon can be measured with a multimeter (e.g., voltmeter or ammeter).

3. Geomagnetic induction: Earth's magnetic field, located in its inner and outer layers, is in constant interaction with solar winds, causing the geodynamo phenomenon. Electric currents in the highly conductive liquid iron in Earth's core create magnetic fields through electromagnetic induction, protecting our planet from harmful effects of solar winds. Earth acts as a negatively charged body, while the atmosphere is positively charged due to bombardment by cosmic rays. Earth's magnetic properties originate from the presence of iron, nickel, and cobalt in its interior. Induced voltages and currents have higher values when Earth's rotation speed is greater.

4. Fluid magnetic induction: This occurs when the movement of a fluid within a magnetic field generates electric currents. This applies to water, various homogeneous and heterogeneous solutions, as well as liquid gases and metals. Liquid metals inside the Earth’s interior and other fluids (e.g., water, oil) are ubiquitous in nature, making fluid magnetic induction a common phenomenon.

5. Air induction: This refers to the phenomenon where incoming air displaces or moves the existing air. This principle is mainly used in ventilation and heating systems.

6. Heat and cold induction: This phenomenon is very common in nature and is related to air, electromagnetic, and geomagnetic induction. Air masses consist of particles that mostly move through magnetic fields. More frequent collisions between particles cause temperature increases, while less frequent collisions lead to cooling.

There are likely many other types of induction in natural hierarchical associative systems that could be described in detail, which would be a topic for future monographic studies. It is important to emphasize that induced voltages and currents primarily arise due to magnetic fields, the magnetic properties of substances, and the movement of the medium.

From the study of geomagnetism, we know that the Earth carries an excess of electrons, while the atmosphere is positively charged. Additionally, magnetic materials exist within the Earth's interior. These findings apply to both non-living and living nature on Earth's surface.

Particularly noteworthy are living beings-plants, semi-plants, microorganisms, insects, birds, fish, reptiles, amphibians, and mammals-which contain magnetic substances in their bodies, including magnetite (Fe_3O_4, a form of iron oxide). Research has shown that magnetic substances in the form of magnetite are also present in the human brain.[154] Based on Faraday's model of electromagnetic induction, we can now assume that living beings, including humans, move through the Earth's magnetic field, generating extremely small values of induced voltage and current on an individual level. Of course, this does not apply to the combined total of all individual living beings. Currently, our devices are not precise and powerful enough to measure these types of induced voltages and currents. Furthermore, Faraday's theory is too simplified to fully describe the natural processes of various types of induction that affect all living beings in natural hierarchical associative systems. When a person moves, numerous factors come into play that are not limited to magnetism and electricity; the influences of fluid (especially water) and air movement are also extremely strong, but have not yet been accurately measured.

In short, it is not only about electromagnetic induction, but also about other types of induction that have been briefly described in this section. Despite this complexity, we will conduct an experiment to visually represent the electromagnetic induction of an individual and a group of people moving through a homogeneous magnetic field, thereby creating electrical voltage and current. This current is extremely difficult to measure, as measurements under specially prepared conditions and with state-of-the-art equipment have so far only allowed detection of currents in the pico-ampere range ($1\ pA = 10^{-12}\ A$).

154 Kirschvink, J. L., Kobayashi-Kirschvink, A., & Woodford, B. J. (1992). Magnetite biomineralization in the human brain. *Proceedings of the National Academy of Sciences of the United States of America*, 89(16), 7683–7687. https://doi.org/10.1073/pnas.89.16.7683.
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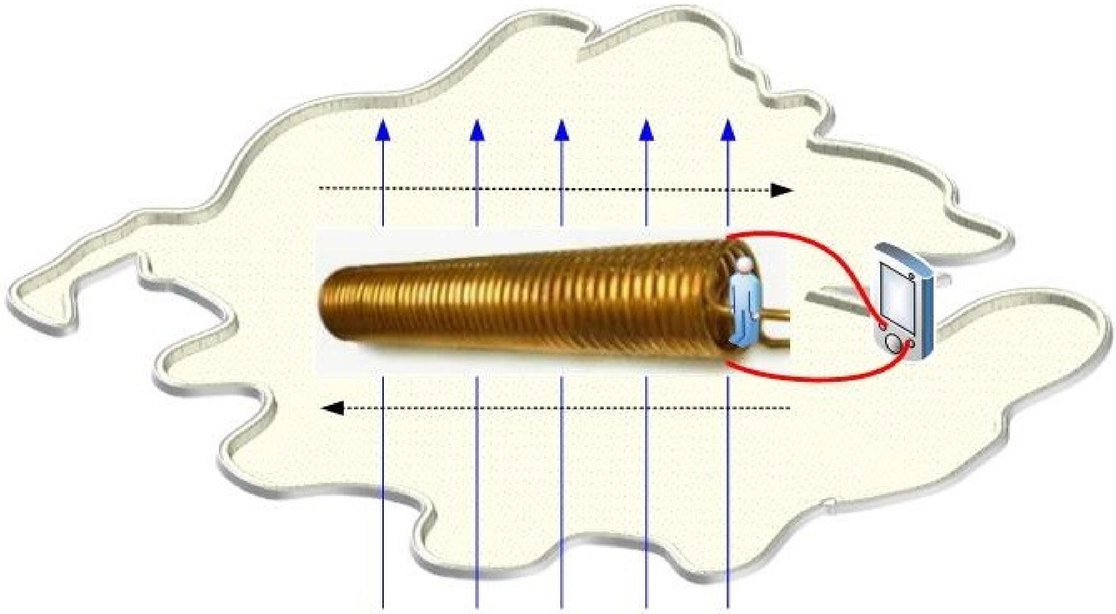
Guilder, S. A. et al. (2018). Distribution of magnetic remanence carriers in the human brain. *Sci Rep*, 8(11363). https://doi.org/10.1038/s41598-018-29766-z.
Duncombe, J. (2019), Human brains have tiny bits of magnetic material, *Eos*, 100. https://doi.org/10.1029/2019EO137782.
Kletetschka, G. et al. (2021). Magnetic domains oscillation in the brain with neurodegenerative disease. *Sci Rep*, 11(714). https://doi.org/10.1038/s41598-020-80212-5.

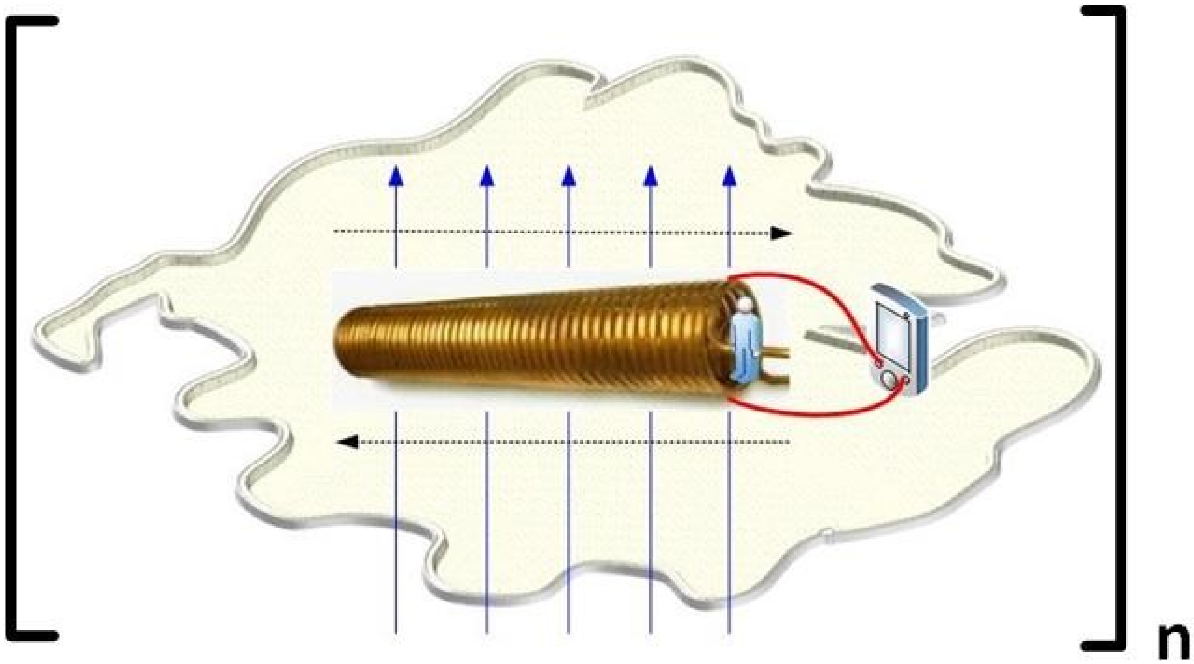
More precise measurements would likely require instruments capable of detecting currents in the femto-ampere range (1 fA = 10^{-15} A), atto-ampere range (1 aA = 10^{-18} A), perhaps even zepto-ampere (1 zA = 10^{-21} A) and yocto-ampere (1 yA = 10^{-24} A) ranges.
Before we begin visualizing the movement of an individual and a group of people through a homogeneous magnetic field, let's define the predicted value of the measured current in femto-amperes (fA), which corresponds to the measurement level of atoms, protons, and electrons.



5.2.1 Figure 318: Movement of an individual through a coil of air and moisture in a homogeneous magnetic field

Figure 318 illustrates the movement of a person through a coil of air and moisture in a homogeneous magnetic field, where the individual acts as a magnet that generates induced voltage and current at the femto-level. This could potentially be measured with an extremely precise device under specially prepared conditions.
The first requirement for such a measurement would be a device capable of detecting values in the femtoampere (fA) range. The second requirement would be a suitably prepared coil made from air and moisture with sufficiently dense windings. Since it would be extremely difficult to connect a measuring device to a coil of air and moisture using conventional wired connections, the device would need to enable wireless measurement of voltage and current.
It has long been known that planet Earth possesses magnetic properties and generates a geomagnetic field. Humans also have weak magnetic properties, as the body-especially the brain-contains small amounts of magnetite and other magnetic substances. Nevertheless, both air (0.3 to $0.8 \cdot 10^{-14}$ S/m) and moisture or water (0.05 S/m) have extremely weak conductive properties compared to copper ($57–60 \cdot 10^{6}$ S/m).

The induced current generated by an individual most likely exists, but its value is negligible for our perception and understanding. In natural hierarchical associative systems, we generally do not consider individual units, but rather their collectives, which form more or less extensive networks. Both non-living and living nature generate induced voltages and currents, but we are not yet able to visualize the networks of all living beings with their hierarchical and associative connections. We are somewhat more successful in visualizing human social networks.
It could be expected that a crowd of people with the same motivation (e.g., watching a football match) generates much stronger induced voltages and currents than an individual. Imagine a group of people holding hands and moving in sequence (other formations are also possible) through a suitably prepared coil of air and moisture to its end.



5.2.2 Figure 319: Movement of a crowd through a coil of air and moisture in a homogeneous magnetic field

Figure 319 illustrates the movement of a crowd of people through a coil of air and moisture in a homogeneous magnetic field. The crowd represents a value "n," which in this case is defined as 11 individuals. In reality, there is no precisely defined value for a crowd, as it is determined by the size of the space (e.g., 10 people in 5 m² can constitute a crowd).
Even based on the movement of a specific group of people through the mentioned coil, we could expect higher measured values of induced current. If we further increased the number of participants (e.g., to 1000 people), which would be much more difficult to implement, would we be able to detect values in the pico-ampere (pA) range?

As has already been pointed out, we know of different types of induction and magnetic fields that operate within natural hierarchical associative systems, which means a complex process intertwined with various factors. We can assume that a crowd of people connected in a network with the same mental concentration or common motive contains enough magnetite and other substances with magnetic properties to generate electrical voltages and currents.

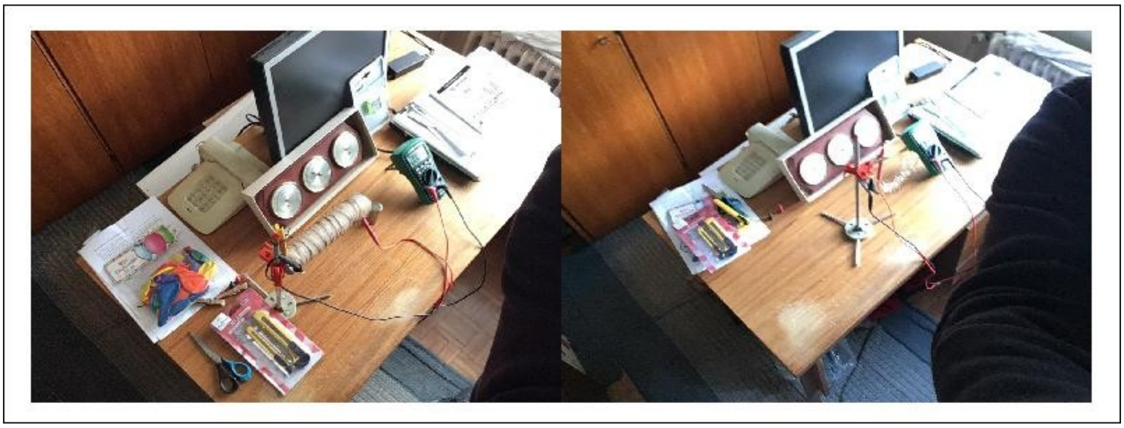
The purpose of these voltages and currents is not to light a light bulb, but something else that is not yet known to us. We can only assume that natural processes of various types of induction contribute to effective communication between species and thus to the establishment of optimal organizational structures, learning practical patterns of thinking and acting, pragmatic decision-making, more efficient flow of biochemical and physical reactions, protection of planet Earth, establishing a relative balance of energy and mass in the universe, etc.

It is known that electrical current is produced in the human body, which is transmitted with the help of cells and enables the functioning of the nervous system. This system must send appropriate signals throughout the body and to the brain, which enables movement, sensation, and thought. The human body acts as a capacitor and has conductive properties. In isolated conditions, it can store an electrical charge, with higher or lower capacitance depending on the environment.

In short, a crowd of people in connection with the environment can act as a highly charged capacitor. In the vicinity of any conductive object connected to the earth, this can cause electrostatics, even in the form of a spark.

Natural processes of various types of induction, in interdependence with the potentials of both inanimate and living nature, create energy for the optimal functioning of the Earth and, consequently, of our solar system. What is the connection to parallel worlds remains an unexplored universal enigma.

The study of induction represents an extremely demanding and important research area for hierarchology and hierarchography, as inductions of various types influence the acquisition and loss of different types of energies. The following will present some experiments related to inductions, starting with two experiments related to magnetic induction.



5.2.3. Figure 320: Tests of magnetic induction with copper coils of 13 and 17 turns

Figure 320 shows a recording of a magnetic induction test using copper coils with 13 and 17 turns, through which a neodymium magnetic stack (composed of 10 neodymium magnetic discs) with a lifting capacity of eight kilograms (the total lifting capacity of the magnetic stack would be approximately 80 kg) and a diameter of 25 mm was rapidly moved.

One end of the coil was connected to a positive red electrode, and the other end to a negative black electrode. Both electrodes were connected to a multimeter, with the measuring range set to milliamperes.

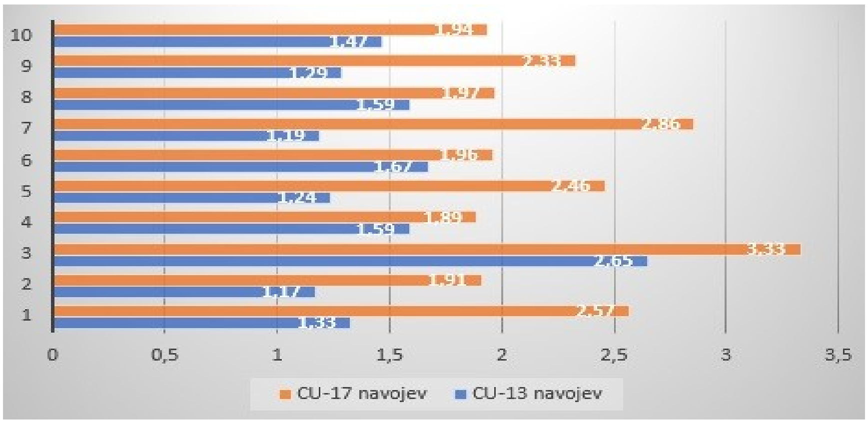
Neodymium magnets are significantly stronger than conventional ferrite magnets, as they are composed of an alloy of neodymium, iron, and boron. The magnetic stack was rapidly moved in and out of the copper coils with 13 and 17 turns. Measurements showed slightly higher values for the copper coil with 17 turns, with fluctuating current values between 3.33 and most frequently between 2.57 and 1.89 milliamperes. For the copper coil with 13 turns, the values ranged between 2.65 and most frequently between 1.67 and 1.17 milliamperes.

The measurement results will be presented separately for the copper coils with 13 and 17 turns.

This experiment demonstrates Faraday's law of electromagnetic induction, where the movement of a magnetic field through a coil generates an electric current. The greater number of turns in the coil resulted in higher induced current values, which aligns with the principle that the induced voltage is proportional to the number of turns in the coil.

5.2.3.1 Table 169: Measurement results with 13 and 17 turns

No. of measure	CU-13 turns in mA	CU-17 turns in mA
1	1.33	2.57
2	1.17	1.91
3	2.65	3.33
4	1.59	1.89
5	1.24	2.46
6	1.67	1.96
7	1.19	2.86
8	1.59	1.97
9	1.29	2.33
10	1.47	1.94
Total	15.19	23.22
Average	1.52	2.32



5.2.3.2 Figure 321: Bar chart of measurements with 13 and 17 turns

Table 169 and figure 321 show the measurement results with 13 and 17 turns in milliamperes (mA). As can be seen, a greater number of turns increases the current values, but these values disappear immediately when the magnet stops. In both tests, we observed alternating higher and lower current values.

Observations:

- A magnet reduces the power of a battery.

- Highly conductive metals reduce the power of a magnet.

- A magnet can create an electric field, and electricity can create a magnetic field.

- In combination, they can cause strong currents and generate a lot of energy, but only if the magnet is moving.

- Magnetism is a permanent natural phenomenon, while electricity is not permanent and often arises as a result of friction, then disappears from the natural environment.

- Electricity can create magnetic and electric fields and cause chemical changes (e.g., electrolysis of water). Magnetism, under conditions known to us, cannot cause chemical changes.
- Magnetism and electricity can combine, but this combination is less likely without the movement of a magnetic body and/or the effect of friction between two or more substances.

The following is a demonstration of a magnetic induction experiment with a coil in the form of a chain.

5.2.3.3 Figure 322: Test of magnetic induction with a coil in the form of a copper chain

Figure 322 shows a test of magnetic induction with a coil in the form of a copper chain. The same copper wire was used as in the previous tests. When 14 neodymium magnets were moved through the loop of the coil (see stand, attached copper chain, and electrodes), the multimeter detected current values. Based on the measurement results, we will observe that the values in mA are considerably lower.

5.2.3.4 Table 170: Results of three tests

No. of measure	CU-13 turns in mA	CU-17 turns in mA	CU – chain mA
1	1,33	2,57	0,42
2	1,17	1,91	0,44
3	2,65	3,33	0,41
4	1,59	1,89	0,48
5	1,24	2,46	0,6
6	1,67	1,96	0,36
7	1,19	2,86	0,48
8	1,59	1,97	0,45
9	1,29	2,33	0,39
10	1,47	1,94	0,56
Total	15,19	23,22	4,59
Average	1,52	2,322	0,459

Table 170 presents the results of three magnetic induction tests based on three different coil shapes, all created using the same two-meter length of copper wire. Without unnecessary additional visualization, it can be concluded that the measured values in the third test were noticeably lower. Although the coil shaped like a copper chain had many turns, the neodymium magnet moved through only one turn in the middle. In the previous tests, the magnet moved through coils with 13 and 17 turns.

In short, higher induced current values primarily result from the number of coil turns and the speed at which the 14 neodymium magnets (disk-shaped magnets stacked to form a tower) move through it. When a coil is made from the same wire in the form of a spiral with three turns, higher induced current values ranging from 0.94 to 1.30 mA are obtained. Similar results are achieved with a coil shaped like a radar.

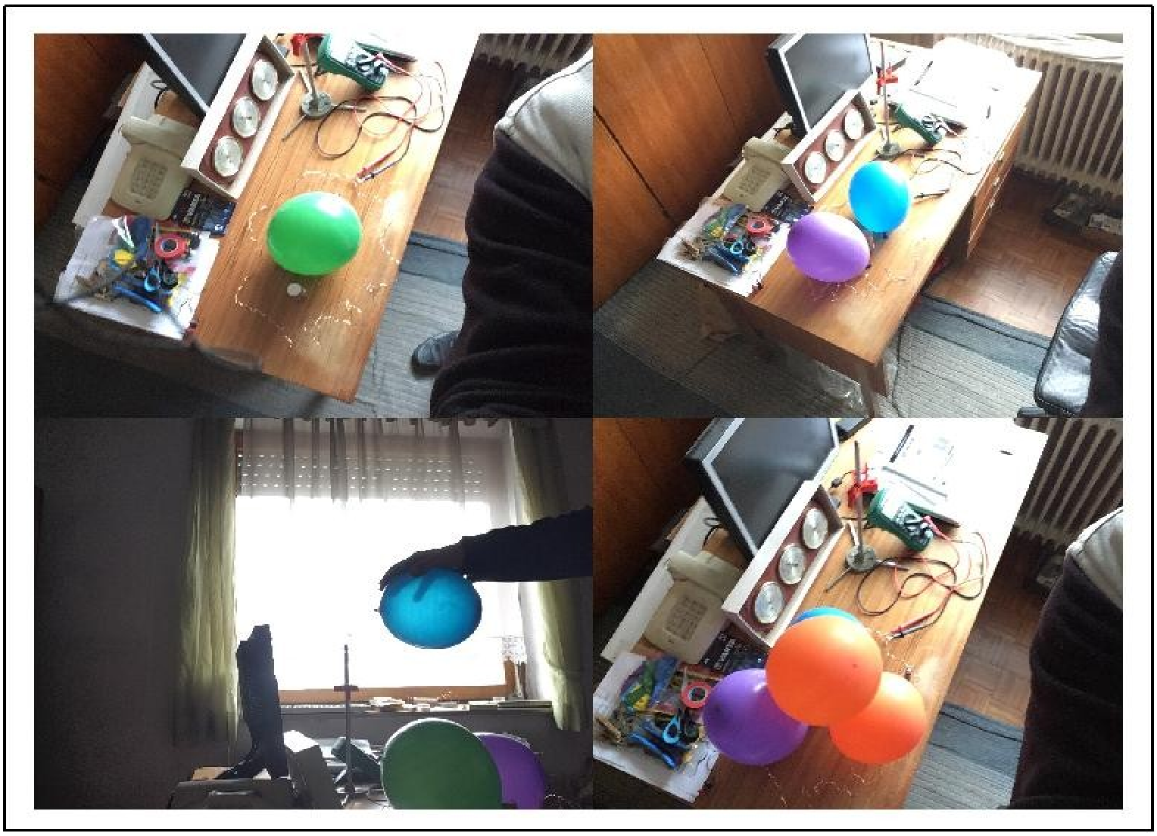
It is important to emphasize again that the higher measured induced current values were influenced not by the coil’s shape but by the number of turns. Next, we will examine an interesting induction test involving balloons, a magnet, and a battery.

5.2.3.5 Figure 323: Balloon induction test using a magnet and a battery

Figure 323 shows a balloon induction test using a magnet and a battery. The yellow balloon was connected to a 1.5 V battery via a copper tube, while the orange balloon was similarly connected through a copper tube to 14 neodymium magnets. It was then possible to push the yellow balloon away by hand without direct physical contact, while the orange balloon literally stuck to an open palm.

The same effect could be achieved by pressing both palms on the yellow or orange balloon, as both balloons adhered to the right palm as if the hand were a magnet. However, it was difficult to get the balloons to stick to both palms simultaneously. This effect was very short-lived.

For better understanding of the described phenomenon, the following test with balloons, a copper conductor, 14 neodymium magnets, and a 1.5 V battery will be presented. In this test, measurements of current as well as direct and alternating voltages of the copper conductor alone and in connection with the balloons, magnets, and battery were also conducted.



5.2.3.6 Figure 324: Balloon induction experiments and measurements using a magnet, battery, and copper conductor

Figure 324 shows experiments and measurements of balloon induction using 14 neodymium magnets, a 1.5 V battery, and a copper conductor. When measuring the current and both direct and alternating voltage of the copper conductor-inside which were a stack of neodymium magnets, one balloon, and a 1.5 V battery (see Figure 324, top left)-the multimeter displayed values of 0.0000 μA, 0.0000 V (DC voltage), and 0.0000 V (AC voltage).

When the stack of neodymium magnets was placed in the center of the copper conductor, with two balloons on the left and right sides of the magnet (see Figure 324, top right), it was again not possible to measure any current or DC voltage. However, when a third balloon was moved above the stack of neodymium magnets and the two balloons, after some time the multimeter detected 0.040 V of alternating voltage.

Under the influence of the two balloons and the stack of neodymium magnets, the third, blue balloon (see Figure 324, bottom left) stuck to the open palm. The blue balloon was then moved away from the copper conductor and brought close to the positive pole of the 1.5 V battery. After a few moments, the blue balloon, which had a negative charge, detached from the palm and stuck to the positive pole of the battery. This means the blue balloon was negatively charged, the palm was positively charged, and the 1.5 V battery was even more positively charged than the palm to which the balloon was initially attached. These results illustrate the interplay between static electricity, magnetism, and induced voltages, and are consistent with the principles of electromagnetic induction. The balloons usually repel each other due to having the same charge. However, this does not happen if the balloons have different charges (see Figure 324, bottom right), as they are interconnected within the copper conductor. Charges can change rapidly under the influence of sudden and uneven movement, different materials, temperature, surface area, and pressure, and are therefore not as stable in complex circumstances as they are in chemical compounds.

When a balloon is placed between a magnet and a battery, it begins to oscillate slightly and then adheres to the stronger field, whether magnetic or electric. In our test, the balloon adhered to the stack of neodymium magnets. However, if the balloon was moved closer to the 1.5 V battery, it adhered to its positive pole.

Birthday balloons, which are typically made of latex and plastics, are usually negatively charged due to an excess of electrons. This is conducive to the formation of static electricity, especially if they come into contact with positively charged materials such as human hair, aluminum, paper, silk, cat fur, or dry human skin. When rubbing a balloon against a synthetic fabric (e.g., pants), a quiet crackling sound can be heard when the balloon is brought close to a copper conductor or another balloon. This is a phenomenon of static electricity, which can be measured with a specially adapted voltmeter.

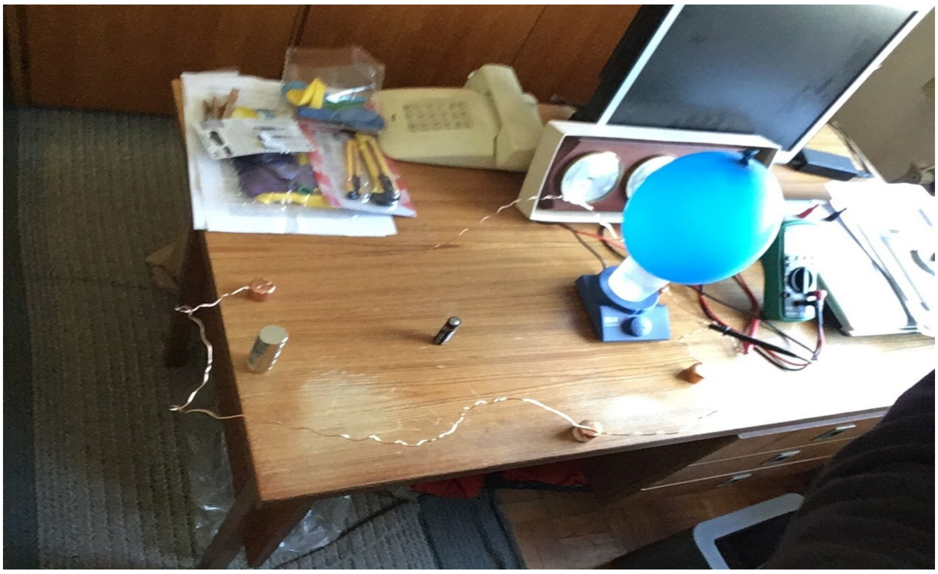
We continue with an experiment in which we do not examine the induction of current or voltage, but rather the induction of resistance. For this purpose, the two-meter copper conductor was used again, with the positive and negative electrodes of the multimeter connected to it. The device did not detect any resistance value in ohms (Ω), as the specific electrical resistance of copper (Cu) at 20 °C is around $1.68 \cdot 10^{-8}$ Ω·m, while its conductivity is $5.96 \cdot 10^{7}$ S/m (Siemens per meter). Copper is an extremely conductive metal, surpassed in conductivity only by silver (Ag).

Subsequently, a magnetic stirrer, a beaker of plain water, a magnet, a 1.5 V battery, and a stack of 14 neodymium magnetic discs were placed in the center of the copper conductor. The beaker of water with a magnet was placed on a magnetic stirrer, and a balloon was placed on top of it to prevent water from splashing. A magnet was placed inside the beaker of water, and it started to rotate when the magnetic stirrer was turned on, achieving a stirring effect.

A short distance from the magnetic stirrer and the beaker of water, a 1.5 V battery was placed, and a little further away, the neodymium magnet stack. After switching on the multimeter, the unit for measuring resistance was set. This time, the measured resistance value was no longer 0 Ω, but 3.4 Ω. This value increased linearly by 0.1 Ω in a time span of approximately 40 to 60 seconds. After 17 measurements, a value of 5 Ω was reached. After completing the measurements, the multimeter was switched off for approximately 15 minutes. When switched back on, it showed a significantly higher resistance value of 218 Ω, which continued to increase. After a second switch-off and switch-on, a value of 6 Ω was measured, which also continued to increase. With the third switch-off and switch-on, the values fluctuated greatly, ranging from 11.4 to 19.7 Ω, then jumped to 37.1 Ω, dropped to 15 Ω, and rose again to 25.6 Ω.

Upon further repetitions of the procedure, the measured resistance values were considerably lower, namely 11.4 Ω, 5.8 Ω, 4.6 Ω, and 2.4 Ω. For easier understanding of the experiment, a visual representation of the experiment follows.

This series of observations indicates that the presence and movement of magnetic fields and electric currents can influence the measured resistance of a conductive material in complex and time-dependent ways, likely due to a combination of electromagnetic induction, temperature variations, and other factors that affect the conductivity of the material.



5.2.3.7 Figure 325: Induced resistance on a copper conductor

Figure 325 shows an experiment in which, without direct physical contact between mixed water, a magnetic stirrer, a neodymium magnet, a 1.5 V battery, and an ordinary latex balloon, induced resistance occurred in a copper conductor. This experiment is interesting because it partially simulates our environment, where we are surrounded by copper conductors, water, synthetic materials, and magnetic and electric fields.

In this context, the significant impact of water stirring can be clearly highlighted, as it contributed most strongly to the effect of induced resistance in the copper conductor. It is important to note that the conductivity of copper was substantially reduced by this-by several million S/m. Induced resistance in the copper conductor causes a long-term loss of a large amount of electrical energy, which consequently reduces the system’s efficiency. An alternative scenario might also be possible: if we could store electrical energy in a capacitor and then supply it through the copper conductor to the battery in precisely the amount needed for optimal operation, without excess, we could improve the system’s efficiency. When the battery discharges, the capacitor could take over, releasing the stored electrical energy gained from induced resistance as needed. Could the battery in such a system operate significantly longer?[155] In short, the induced resistance in the copper conductor was primarily caused by the movement of water, while the other factors had only a potential influence since they remained stationary. When the neodymium magnet stack or the 1.5 V battery was moved, a slight effect was detected, as the values on the multimeter fluctuated slightly. We can assume that this resistance induction was a relatively superficial phenomenon.

After removing all the elements and reshaping the copper conductor, the resistance measurement was repeated. The result was expected but also somewhat surprising, as the resistance of the copper conductor again registered as 0 Ω on the multimeter. In this sense, we could conclude that the shape of the copper conductor influenced the value of the induced resistance. Apparently, the water stirring created a certain field that encompassed the copper conductor. As long as a certain shape was maintained, resistance was detected; after disrupting the existing shape, the resistance disappeared or became undetectable by the multimeter.

This experiment highlights the need to study induction processes in natural hierarchical and associative systems holistically. Electromagnetic forces certainly play a crucial role, but we must not overlook other types of induction that are constantly present and, combined with electromagnetic effects, strongly determine the functioning of systems. The presented experiment was repeated several times, including with alligator clips and in a different room. The final conclusion could be that this is an unstable surface phenomenon, a sort of emulation of resistance induction. It is therefore a case of electromagnetic induction, which manifests as an unstable "induced" resistance. In fact, this is not true resistance, but rather an effective impedance, which can be observed as an unstable reading on the multimeter.

Much more could be written about induction in natural hierarchical and associative systems, but these processes are often very complex and difficult to measure, leading to many hypotheses that we cannot yet prove. For this reason, the chapter on induction in natural hierarchical and associative systems will conclude here. The following chapters will present additional examples from living and non-living nature, such as long-distance ant communication or the phenomenon of the aurora borealis.

155 The idea was based on the following article: Liao, C. (2021). Persistent Induction Battery. *Project: Energy and Environment* [Preprint].

5.3 Water, earth, air, and light

This subsection will address the fundamental building blocks of life-water, earth, air, and light-echoing themes from ancient Greek philosophy. Ancient philosophers attributed great significance to these elements, although they emphasized fire instead of light. In the following sections, basic knowledge about these life components will be presented, with a greater focus on conducting biological, physical, chemical, and hybrid experiments.

The order in which these elements are studied mainly serves practical purposes, as appropriate measuring instruments must be prepared before examining air and light. For this reason, air and light will be discussed last. From a strictly materialistic perspective, light and air would typically be studied first, followed by water and earth. Despite this content gap, it will still be possible to synthesize insights from theory and, especially, from practical experiments.

5.3.1 Water or hydrogen oxide (H_2O)

Water is a fundamental component of diverse living organisms and plays a crucial role in nutrition and, consequently, their continued existence. Completely pure or deionized water does not naturally occur; the purest form of water is considered to be rainwater in non-industrial environments. Chemically, water is a compound of two hydrogen atoms and one oxygen atom. It is a polar molecule that carries no net electrical charge, but the oxygen atom is more negatively charged than the hydrogen atoms. This characteristic allows the entire molecule to attract other water molecules, enabling the formation of numerous hydrogen bonds.

This property is responsible for two important anomalies of water: its boiling point (hydrogen bonds cause a higher boiling temperature) and its density (water reaches maximum density at 3.98 °C, then decreases at 0 °C, which is why ice is lighter than liquid water). The formation of many hydrogen bonds allows the angle between the oxygen and hydrogen atoms to be 104.45°. In nature, water exists in all three states of matter: solid (ice), liquid, and gas. Under special conditions known as the critical point, water can exist simultaneously in all three states.

In liquid water, numerous attractive and repulsive forces act between molecules, with the greatest potential energy stored at the surface, causing surface tension. Water acts as a solvent due to its ability to dissolve many substances. Water covers 71% of the Earth’s surface and constitutes a large proportion of many living organisms. The human body contains approximately 70% water, and the brain about 85%.

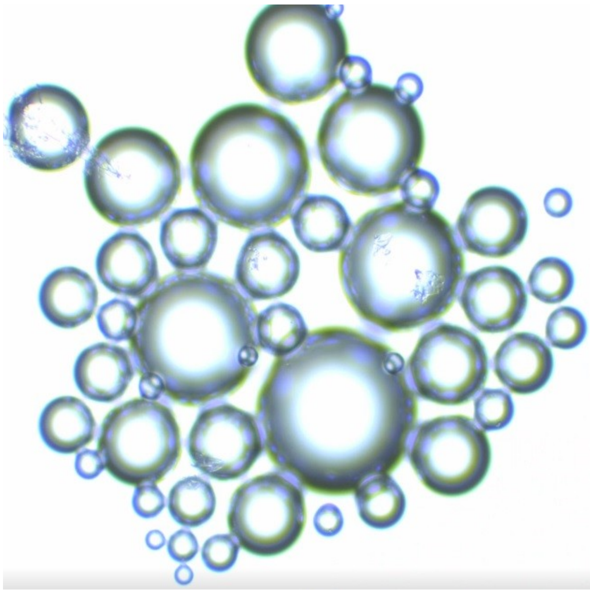
Recent research in the field of water suggests that water may have memory and the ability to store information. As evident from this brief introduction, water can be studied from various perspectives, including biological, chemical, physical, sociological, psychological, and geographical. In this subsection, water will be examined through the lens of the frequently used model of three cosmic planes, further broadening diverse viewpoints and their interconnections.

5.3.2 Hierarchical associative structure of water molecules

Water is one of the most important substances in biological and ecological systems in the broadest sense, as diverse forms of life and environments as we know them would not be possible without it. The hierarchical associative structure of water molecules, which are constantly forming and breaking associations in the liquid state, is strongly influenced by the polarity of the oxygen and hydrogen charges. Each oxygen atom is bonded to two hydrogen atoms at an angle of 104.5°, which is only slightly less than the ideal tetrahedral angle of 109.5°. This structural feature enables the development of polarity, with one side of the molecule being negatively charged and the other positively charged.

Because of the higher electronegativity of the oxygen atom, the bonds in water are polar covalent, meaning the oxygen atom attracts the shared electrons of the covalent bonds more strongly than the hydrogen atoms. As a result, the oxygen atom acquires a partial negative charge, while the hydrogen atoms each acquire a partial positive charge, making water a dipolar molecule. This allows the oxygen atom to play a dominant role relative to the hydrogen atoms, supporting a hierarchical model of the water molecule's structure. Another aspect supporting this hierarchical understanding is the relative atomic mass: oxygen's atomic mass (~16 units) is much greater than that of hydrogen (1 unit). In summary, the oxygen atom contributes more to the molecule's polarity, but without the positive charge of hydrogen, the known polarity of water would not be possible.

If this polarity did not exist, many characteristic properties of water would disappear, such as its solvent ability, density anomaly, boiling point anomaly, ability to form associations, and characteristic surface tension. Each water molecule has a strong tendency to associate with others, a feature most pronounced in the solid state, where water molecules form stable tetrahedral and hexagonal structures (as in ice). This illustrates a model of the hierarchical associative structure of water molecules, where not only hierarchy but also relatively balanced cooperation is present. For better illustration, see the accompanying figure.



5.3.2.1 Figure 326: Image of ice shavings

Figure 326 shows an image of ice shavings from a household freezer at 100x magnification, revealing the bonding of water molecules during the melting process. The water molecules strive to maintain their existing structure through bonding, but due to the higher ambient temperature, this is only temporarily successful.[156] The phenomenon of polarity in the first phase allows the establishment of hierarchical relationships, and then also of relatively equal connections that extend into smaller and larger networks. In the case of water, this depends primarily on external factors such as air pressure and temperature. Elevated temperature causes a change in the existing structure and thus also in the way water molecules connect.

They adapt to environmental influences, but their basic tendency to connect remains. In addition, there is another tendency that can be described as a tendency to disassociate. Both processes occur continuously, promoting both hierarchical and relatively equal associative relationships. The great importance of water for biological and environmental systems in the broadest sense has already been emphasized. Next, let's take a closer look at the properties of both elements that make up water.

156 The image was taken using a Zeiss Primostar 3 microscope (10x objective) and an Axiolab 208 color camera.

5.3.2.2 Table 171: Properties and importance of hydrogen and oxygen

Hydrogen (H_2)	Oxygen (O_2)	Notes
Colorless, tasteless, and odorless gas	Colorless, tasteless, and odorless gas	Same
Burns with a blue flame	Only promotes combustion	Not the same
Smaller mass	Larger mass	Not the same
Tendency to be positively charged	Tendency to be negatively charged	Not the same
In the atmosphere in traces	Approximately 21%	Not the same
Space contains 75%	Space contains little oxygen	Not the same
In many compounds	In many compounds	Same
In all organic compounds	Not in all organic compounds	Not the same
Constituent of the sun/stars	May be only in traces?	Not the same
Harmful in large quantities	Harmful in large quantities	Same
Is explosive	Not explosive	Not the same
Flammable	Not flammable	Not the same
Contained by all acids	Not	Not the same
Contained by all bases	Contained by all bases	Same
Contained by some salts	Contained by many salts	Not the same
Not necessary for breathing	Very necessary for breathing	Not the same
Not found in the body in pure form	Found in the body in pure form	Not the same
Three isotopes are known	Three isotopes are known	Same
Poorly soluble in water	Slightly more soluble in water	Not the same
Low melting point	Low melting point	Same
Low boiling point	Low boiling point	Same
Hexagonal crystals	Dark blue crystals	Not the same
Density is low (0,089 g/l)	Density is low (1,43 g/l)	Same

Table 171 presents some characteristics and the significance of hydrogen and oxygen, along with qualitative comparative notes.

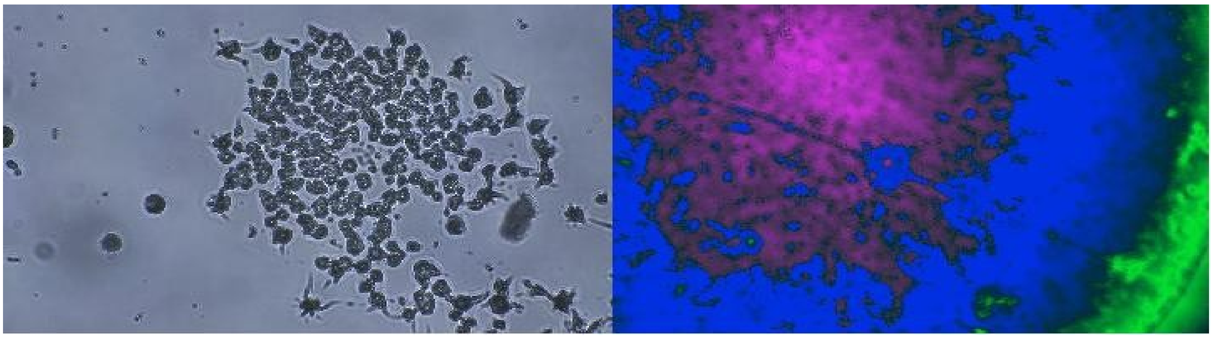
These notes show that hydrogen and oxygen differ significantly from each other, although they also share some common properties. From a mesocosmic and microcosmic perspective, free oxygen is considerably more important than free hydrogen, both for our atmosphere and for all known living organisms. However, this picture changes when we consider the macrocosm, as it contains approximately 75% hydrogen.

Moreover, we must not forget our Sun and many distant stars, where fusion processes take place. In these processes, oxygen is not required, as hydrogen fuses into helium, releasing vast amounts of heat and light energy—energy that makes life on Earth possible. From a macrocosmic viewpoint, one could therefore argue that hydrogen is more important than oxygen.

In natural hierarchical associative systems, complex processes occur that cannot be confined to individual cosmic levels; rather, these processes are often interconnected.

This involves not just the efficient use of energy but also the influence of forces and phenomena such as gravity, induction, polarity, attraction, repulsion, radioactivity, magnetism, and electricity. These phenomena can act in various combinations (e.g., polarity, induction, and gravity, or electricity, magnetism, induction, and gravity).
Natural sciences attempt to measure these effects and determine the causes that influence various outcomes, with a particular emphasis on the mesocosmic perspective.
However, we must not overlook the microcosmic viewpoint, especially the strong influence of water molecules on the behavior of many living organisms. The polarity of water molecules affects our perception of the world, since many living beings have a high water content in their bodies—especially in the brain. Therefore, water could be seen as a fundamental component of our polarized sensory system.
Even though cognitive processes are much more complex and not solely limited to the influence of water molecules, these molecules still provide an important basis for the thinking processes of various living beings. Water molecules have the ability to adapt to other structures and also to influence them. They can even develop spontaneous movement, particularly when resisting gravity. Water constantly alternates between adapting to and influencing its environment (e.g., during the dissolution of salt), which suggests it has the property of polar alternation. Water molecules can also be directionally polarized and move in specific directions, with opposing flows constantly occurring.
In nature, water acts as a memory of events, unlike deionized water, whose hydronium ions are not strong enough to cause significant bonding and dissociation.
Certain impurities in water (such as minerals, salts, and microorganisms) contribute to the development of the aforementioned properties in water molecules.
Under the right conditions (pressure, temperature, air speed, and the structure of air masses), water molecules can develop immense destructive power.
For example, during vortex formation and high-speed air movement, excessive associative potentials of water molecules may develop, potentially triggering tsunamis. These phenomena are also evident at low temperatures, when water transitions from liquid to solid. Ice crystals at very low temperatures can even cause rocks to crack, as water molecules continuously strive to bond. Above freezing temperatures, separating forces also begin to act.
Many scientists who study the properties of water use microscopic techniques to examine its alleged ability to store information.
They use a method involving the observation of dried water droplets under a microscope, where patterns supposedly vary depending on the person who prepared the sample. Although the results

are intriguing, the evidential strength of these experiments remains questionable. Possible influencing factors—such as the organization of water molecules in the sample, the presence of microorganisms, or dust particles—can affect the final results.
Despite potential doubts, these experiments are interesting and encourage further research.
To better illustrate this, a recording is provided of such an experiment, carried out using a Zeiss Primostar 3 microscope and an Axio Cam Color 208 camera.



5.3.2.3 Figure 327: Sample of a dried water droplet under a microscope

Figure 327 shows part of a sample of a dried water droplet observed under a microscope using two different color techniques: dark field and phase contrast. A certain structure can be seen forming, which resembles an association of water molecules.
It is extremely difficult to determine the influence of the researcher on the resulting structure. The experiment was carried out with the available resources, which means the results may also reflect experimental limitations. Given that the human body is composed of approximately 73% water, one can hypothesize the existence of an induction effect between water molecules in the body and those in the environment. This would suggest that a person might potentially influence the way water molecules bond outside the body.
The beneficial effects of water—especially from lakes, rivers, and streams—have long been recognized, as water acts as a natural stress-reliever. It's not only the water itself that matters, but also the accompanying sounds, such as the gentle murmur of flowing water. This phenomenon could be described as a combination of fluid and sound-based induction.
Water has the ability to influence both living and non-living nature, while also being affected by various external factors. The concept of natural water as a carrier of diverse information and memories is intriguing, but currently lacks reliable scientific proof or practical application.
It is still not entirely clear how two different substances can, through a chemical reaction, produce an entirely new substance—like water—that has completely different properties and functions across all three levels of cosmic reality. A similar example is the formation of sodium chloride (table salt) from sodium and chlorine ($2Na + Cl_2 = 2NaCl$), where two toxic substances create a compound essential for life.

Perhaps a more comprehensive explanation could be found through the hierarchical associative concept and the idea of induced properties?

5.3.3 Bodily fluids in humans

Human bodily fluids are typically quite complex in composition, but they all share the common feature of containing water. The most well-known bodily fluids include sweat, saliva, tears, urine, blood, semen, and in women, breast milk.

5.3.3.1 Sweat

Sweat consists of approximately 99% water and 1% sodium chloride (NaCl). It also contains trace amounts of glucose, amino acids, ammonia, lactic acid, urea, and other substances. The pH value of sweat varies depending on the part of the body (e.g., feet, palms, armpits, face) and typically ranges from 4.5 to 7.0. The sweating process helps regulate body temperature, facilitates the elimination of waste and toxic substances, and contributes to the production of pheromones.[157] There are three main types of sweat glands: eccrine (which regulate body temperature), apocrine, and apoeccrine. Excessive or insufficient sweating can lead to serious health complications. The sweating process is closely connected to the thermoregulatory center in the brain, which, upon detecting excessive body heat, triggers sweating to enable cooling. Without sweating, a person could suffer from heat stroke, which may lead to physical shock and, in extreme cases, even death. Based on this, we can once again emphasize the vital importance of water for life.

5.3.3.2 Saliva

Saliva is a bodily fluid composed of various chemical compounds, including 98.5% water, as well as sodium, potassium, magnesium, calcium, and phosphate ions, along with enzymes (such as maltase and amylase), cholesterol, free fatty acids, hormones, and other substances. Saliva performs important functions such as softening hard food, cleansing the oral mucosa, and cleaning the teeth. When the optimal composition of saliva changes significantly, it can increase the risk of dental diseases and more severe digestive issues. The process of salivation is controlled by the autonomic nervous system. A reduced amount of saliva can result from various fears, stressful situations, or dehydration. During sleep, the salivation process may even stop entirely.

Salivation typically increases in response to pleasant tastes and smells. The normal pH level of saliva usually ranges between 6.2 and 7.6. However, it can drop below 5.5, which may happen when a person consumes too many acidic soft drinks. A low saliva pH can lead to dental disease.

157 Lindsay B. Baker (2019) Physiology of sweat gland function: The roles of sweating and sweat composition in human health, *Temperature*, 6:3, 211-259. https://doi.org/10.1080/23328940.2019.1632145.

5.3.3.3 Tears

In medicine, three types of tears are recognized: basal, reflex, and emotional tears. Basal tears primarily serve to moisturize the eye; reflex tears are triggered by physical stimuli from the environment (e.g., onion vapors, smoke, dust, wind, or pain caused by impact or injury); emotional tears result from the expression of various emotions (e.g., joy, sadness, anger, or psychological pain).

Their functions include eye lubrication (basal tears), removal of irritants (reflex tears), and immune system support. Emotional tears may help reduce the intensity of stress factors. Tears are composed mostly of water (around 98%). Other components may include NaCl, KCl, manganese ions, zinc ions, glucose, and various enzymes that protect the eyes from infections. The pH of tears ranges between 6.5 and 7.6. Very low (around 4) or very high (around 10) pH values can cause eye damage.

5.3.3.4 Urine

Urine is a bodily fluid excreted by the kidneys through the urinary tract. Urine production is an important physiological process that regulates the volume and composition of body fluids and enables the elimination of waste products. Healthy urine contains about 95% water, along with urea, sodium, potassium, and chloride ions, creatinine, inorganic sulfur, and trace amounts of phosphorus, citric acid, ammonia, and other substances.

Normal urine pH ranges from 5.5 to 7.0, and its density ranges from 1003 kg/m^3 to 1035 kg/m^3. A healthy indicator of bodily function is the yellow color of urine. If urine appears orange, it may suggest an excessive intake of beta-carotene or insufficient water consumption. Other colors, such as green or red, can indicate more serious health issues or simply reflect the consumption of certain foods like beets or asparagus. Urine is typically clear, and cloudiness may indicate the presence of bacteria or excess proteins.

5.3.3.5 Blood

Blood consists of 56% blood serum (plasma and the protein fibrinogen) and 44% blood cells (erythrocytes, leukocytes, and thrombocytes). Blood serum has a diverse composition, including approximately 92% water, 6–8% proteins, around 0.8% salts, 0.6% lipids, 0.1% glucose, and trace amounts of various minerals, hormones, and vitamins.

An average adult has about 5 to 6 liters of blood circulating throughout the body. Blood is a vital life fluid that supplies every cell in the body with nutrients and oxygen, supporting normal bodily function. Erythrocytes (red blood cells) are considered living cells, while thrombocytes (platelets)

are fragments of living cells. Leukocytes (white blood cells) differ from other cells in the body as they function like independent, living single-celled organisms—they can move on their own, engulf other cells and bacteria, and carry DNA on their outer membranes.
Most leukocytes do not divide within the bloodstream, but some retain this ability. The lifespan of blood cells ranges from a few hours to 120 days. An exception is the memory cell, a type of leukocyte, which can live for several years. Most blood cells are produced in the bone marrow. Thrombocytes are primarily responsible for wound healing, erythrocytes for transporting nutrients and oxygen, and leukocytes for defensive immune functions.

5.3.3.6 Semen

Sperm cells exhibit nearly all characteristics of living organisms, such as DNA, independent movement, a specific purpose, orientation, sensory perception, and nutrition, and in favorable conditions, they can temporarily survive independently of the host. However, they lack the ability to reproduce or self-replicate, meaning they cannot have offspring on their own. For this reason, semen is currently classified as a living cell according to standard biological definitions.
Liquid semen contains approximately 99% water and about 1% of other substances, including calcium, magnesium, zinc, fructose, proteins, enzymes, minerals, and amino acids. The pH of human semen ranges between 7.2 and 8.0, indicating that sperm cells thrive in alkaline environments. It is believed that sperm cells possess a form of non-cognitive memory and may communicate with each other in ways not yet fully understood.[158] They are also believed to form various social groups to more easily overcome obstacles along the way and thus achieve their goal more effectively.[159] It is not merely a matter of raw competition among them. Moreover, it has been discovered that sperm cells even possess an olfactory receptor, which suggests that they likely use this ability on their complex journey toward the egg.[160]

5.3.3.7 Breast milk

Finally, we can briefly report on a bodily fluid typically found only in female individuals—breast milk. It contains approximately 80% water, along with fats, proteins, carbohydrates, and minerals. The pH value of breast milk ranges from 7.0 to 7.4, and its density is approximately 1.03 g/cm³. Breast milk also contains a large number of specific and beneficial bacteria that differ from those

158 Graham-Rowe, D. (2002). Smart human sperm have memory. *NewScientist*, 28. August. URL: https://www.newscientist.com/article/dn2729-smart-human-sperm-have-memory/ (2021-07-10).
159 Foster, K. R. & Pizzari, T.(2010). Cooperation: The Secret Society of Sperm. *Current biology*, 20(7), str. R314-R316. URL: https://www.sciencedirect.com/science/article/pii/S0960982210001582 (2021-07-11).
160 American Association For The Advancement Of Science. (2003, March 28). Human Sperm May 'Smell' Their Way To The Egg, Science Study Suggests. *ScienceDaily*. URL: http://www.sciencedaily.com/releases/2003/03/030328073214.htm (2021-07-11).

found elsewhere in the human body. Through breastfeeding, an infant receives around 800,000 bacteria per day, which help strengthen the immune system. Transgender and intersex individuals are also capable of producing breast milk.

This brief overview of human bodily fluids clearly demonstrates their vital importance to life and highlights the essential role of water—without which humans would not exist in the form and substance we know today.

Bodily fluids in humans should not contain harmful microorganisms. However, various pathways allow such microorganisms to enter the human body, potentially leading to the contamination of bodily fluids. This can occur through drinking water from different household sources such as domestic plumbing systems, wells, cisterns, and similar sources, as well as through food products, interpersonal contact, objects, airborne transmission, or droplets. Entry points for harmful microorganisms into the human body include the eyes, nose, mouth, bloodstream, respiratory system, open wounds, intestines, and genitals.

Given the broad scope of this topic, we will illustrate it by focusing only on potentially harmful microorganisms found in drinking water. Substances such as abiotic and biotic food chains, food webs, and food pyramids will be discussed in more detail in the following sections.

5.3.3.8 Harmful microorganisms in drinking water

There are various types of water sources, such as streams, springs, torrents, rivers, lakes, seas, and oceans. A vast number of different microorganisms live in these water sources. Drinking water from the tap may contain microorganisms, which can be divided into three groups:

a. Environmentally related microorganisms (e.g., nitrobacteria, coliform bacteria);

b. Waterborne microorganisms (e.g., Pseudomonas, Legionella);

c. Fecal microorganisms (e.g., Citrobacter, E. coli).

Most microorganisms in drinking water do not pose a significant threat to human health. However, some microorganisms—such as bacteria (e.g., Legionella), viruses (e.g., poliovirus), and protozoa (e.g., Giardia lamblia)—can be extremely dangerous to humans.[161]

5.4 Natural hierarchical associative feeding systems with an emphasis on water

Abiotic and biotic factors together form a complete ecological system. A key component of this system is the feeding systems of living nature. To better understand natural hierarchical associative systems, it is essential to study food chains, which serve as the basis for the creation of food webs

161 Botzenhart, K.(1996). Mikroorganismen im Trinkwasser. *Das Ärzteblatt*, 93(34-35): A-2142–2144. URL: https://www.aerzteblatt.de/archiv/2518/Mikroorganismen-im-Trinkwasser (2021-07-12).

and pyramids. In this section, we focus on hierarchical associative feeding systems, particularly in relation to water. But what does this really mean?

The simplest explanation lies in the connection between abiotic and biotic factors. Food chains, webs, and pyramids are often explained primarily from a biotic perspective, with little attention given to the influence of abiotic elements.

The construction of food chains begins by identifying producers, followed by primary, secondary, and tertiary consumers. Producers are living organisms such as plants, algae, and plankton that provide food for herbivores—the primary consumers. Secondary and tertiary consumers are mostly carnivores, though some may be omnivores. Primary consumers typically serve as prey, while secondary, tertiary, and higher-order consumers act as predators.

A special group not to be overlooked is the decomposers (e.g., fungi, bacteria, earthworms), which break down and clean up organic waste.

At the end of the food chain is the top predator, which usually has no natural enemies and is rarely preyed upon. These consumers occupy the highest position in the food pyramid. The food pyramid illustrates the hierarchical relationships between predators and prey, while the food web consists of multiple interconnected food chains, showing the complexity of relationships among different species.

When analyzing these relationships, it is important to consider various types of symbiosis, such as parasitism, commensalism, and mutualism:

- Parasitism involves an exploitative relationship where the parasite weakens the host, possibly leading to the host's death. This can be seen as a predator-prey dynamic, although the parasite does not kill the host immediately.
- Commensalism is a more balanced relationship, where one organism benefits while the other is neither harmed nor helped.
- Mutualism is the most balanced, where both organisms benefit and can be seen as "winners" in the relationship.

In defining relatively balanced associative relationships, only commensalism and mutualism are considered, while parasitic symbiosis is treated as a predator-prey interaction.

When visualizing hierarchical feeding systems, it is important to consider the levels of microcosm, mesocosm, and macrocosm. Why? Take a simple example: at the top of the food system is the human, who has no natural enemies at the mesocosmic level (except possibly themselves, though that doesn't fully apply here). However, humans do have significant natural enemies at the microcosmic level—namely harmful bacteria, viruses, and fungi.

One could argue that harmful microorganisms are at the top of the food chain. However, even they have predators within the microcosmic world. In fact, identifying the top predator at the micro level and determining whether it poses a threat to humans is a complex task, as many microorganisms remain poorly understood. This suggests that humans also have natural enemies in the form of microorganisms that, by mesocosmic standards, are unintelligent and microscopic.

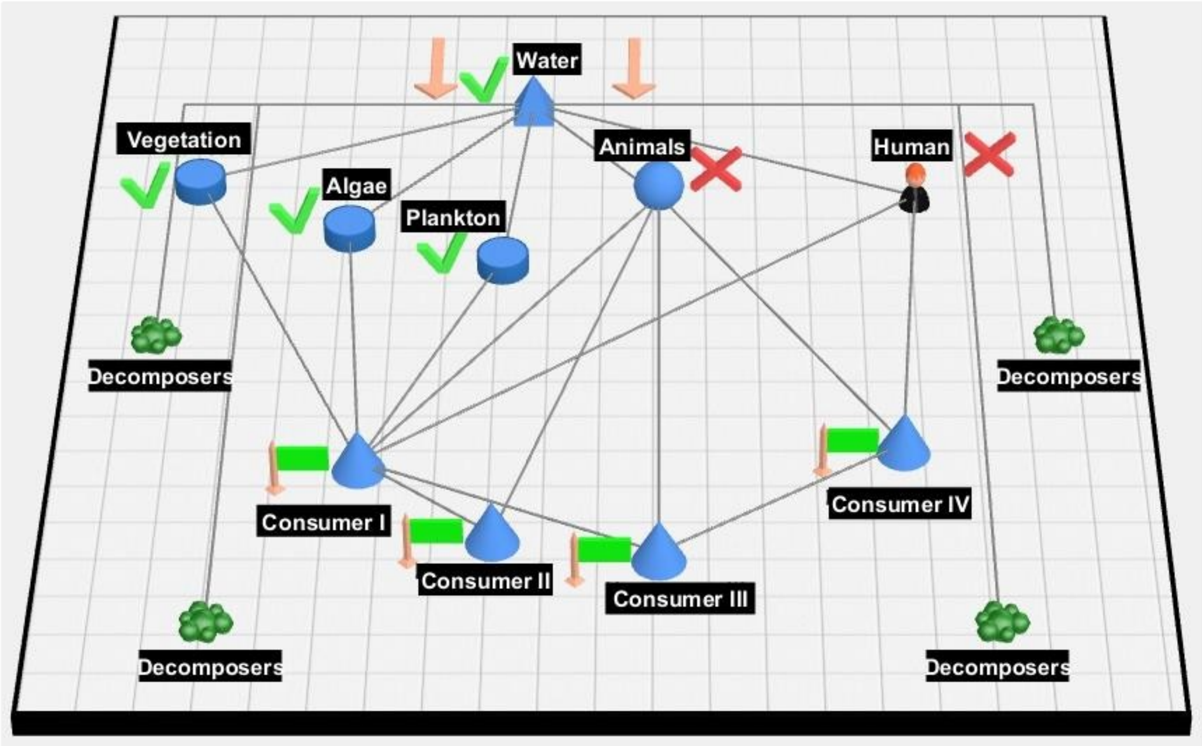
Moreover, it is extremely difficult to design and visualize the human natural feeding system due to its diversity. Many people are omnivores, while a smaller portion consumes only meat or plant-based food. Plant-based humans (primary consumers) also lack natural predators at the mesocosmic level—again, except for harmful microorganisms such as bacteria, protozoa, and viruses.

Most people in developed societies are passive predators—they do not hunt, but instead purchase pre-prepared or processed foods. Likewise, consider the dog, often referred to as "man's best friend," which also has no natural predators and is not an active predator, as it receives its food from its owner. This can be viewed as a successful form of symbiosis—sometimes even a relatively balanced relationship. Nevertheless, it remains a hierarchical interaction between the two entities.

To connect biotic and abiotic factors, we return to producers—living organisms like plants, algae, and plankton. In the realm of abiotic factors, we define superproducers as water, soil, air, and light. These are non-living elements, but without them, biotic producers could not exist. Water is an especially important superproducer in the living world, as both producers and consumers depend on it. Water enables life for all organisms in the food system, acting as both input and output within the system.

Water and other abiotic superproducers form the foundation of hierarchical and associative relationships in nature. All living beings are strongly influenced by these abiotic superproducers, which are vital components of the non-living world. Even biotic producers are, within this broader system, also consumers.

Before the creation of a micro-thesaurus as a data basis for visualizing the feeding system, a general three-dimensional model will be presented.



5.4.1 Figure 328: General conceptual model of the food web

Figure 328 illustrates a general conceptual model of the food web, which emphasizes the role of a superproducer—namely, water. Water is essential for all living beings, including producers (e.g., plants, algae, plankton), animals (e.g., dolphins, elephants, lions), humans, and decomposers (e.g., earthworms, microorganisms, fungi), as it provides the basic nourishment required for life. Water supports growth and development and is therefore classified as an abiotic superproducer.

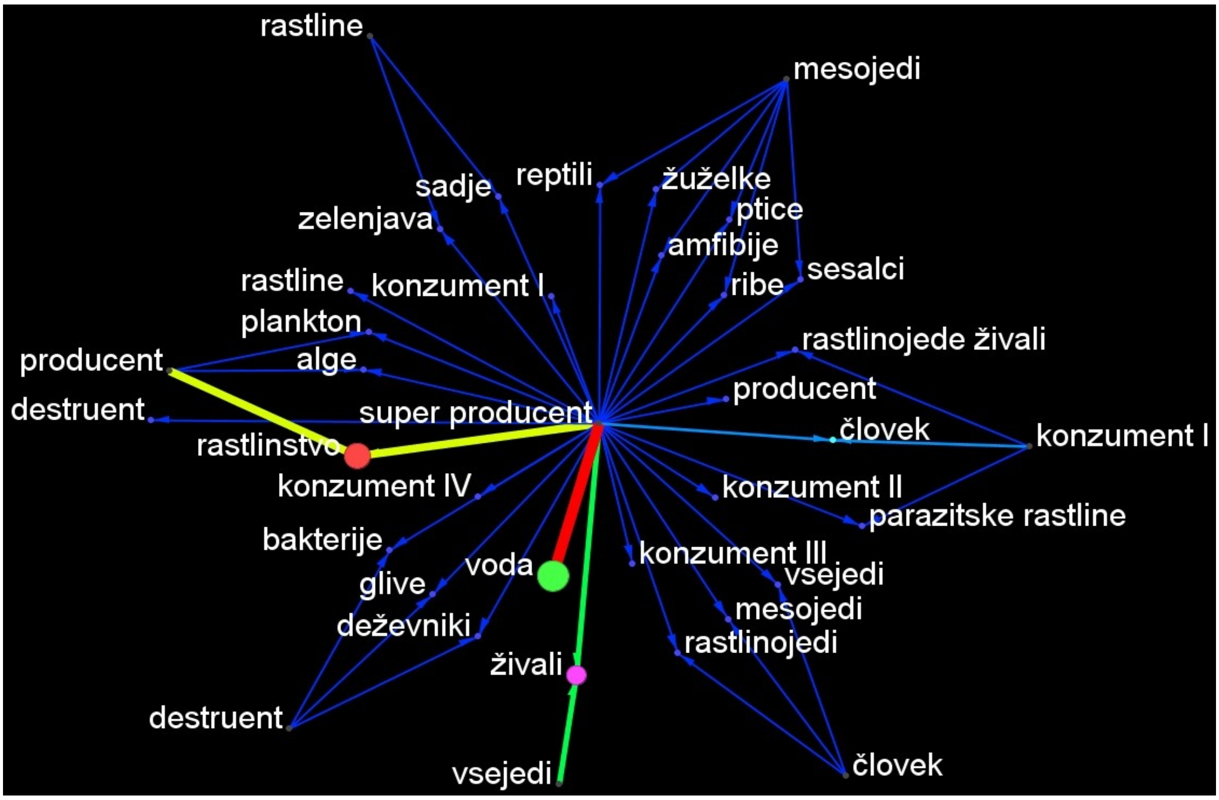
The animal kingdom is divided into:

- Primary consumers (e.g., herbivores that eat only plants, similar to vegetarian humans),
- Secondary consumers (e.g., animals that primarily eat other animals),
- Tertiary consumers (e.g., predators that feed exclusively on the meat of other animals), and
- Quaternary consumers (e.g., apex predators like humans who eat other animals and have no natural predators at the mesocosmic level).

Also included are decomposers, which clean the environment of organic waste (e.g., dead plants, animals, and humans).

Within the plant kingdom, there are a few notable exceptions—carnivorous and parasitic plants. Typically, these plants (e.g., the common butterwort and dodder) are not classified as producers because, in addition to using water and photosynthesis, they also consume other living organisms such as insects or other plants.

The total mass of our planet is estimated at 5.972 × 10^{24} kg, with water accounting for only about 0.05% of this mass, despite covering around 70% of the Earth's surface. The total biomass on Earth is estimated to be approximately 550 gigatons (GT). Plants dominate this biomass with about 450 GT, followed by bacteria at 70 GT, and fungi at 12 GT. The biomass of all animals is relatively small—around 2 GT, and human biomass is even smaller, estimated at just 0.06 GT.[162] In the food pyramid, there is a rule that both mass and energy transfer from lower levels to higher levels. The previously stated biomass values clearly confirm this rule.



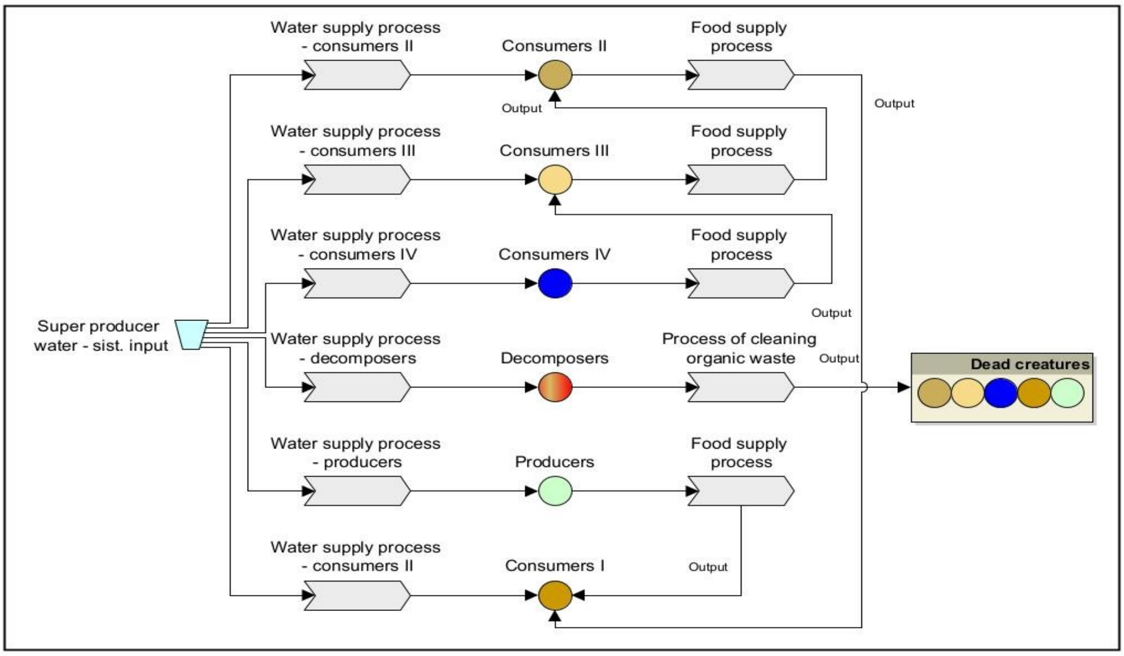
5.4.2 Figure 329: The network of water as a super producer in relation to producers and consumers

Figure 329 illustrates the network of water as a super producer in relation to producers and consumers, taking into account estimated masses. Water has the greatest mass because it covers around 70% of the Earth's surface and constitutes a vital component of all life on the planet (e.g., humans, dolphins, chimpanzees). In Figure 329, the estimated mass of water is depicted with the largest green node, connected to the super producer by a bold red line. Plant life ranks second, followed by animals, and then humans.

In the mass estimates, bacteria were not included—even though their total biomass greatly exceeds that of animals and humans combined (see 70 GT vs. 2.06 GT)—because they were considered decomposers in this context. However, it is well established that bacteria in natural hierarchical

162 Data obtained from the article: Bar-On, Y. M., Phillips, R., & Milo, R. (2018). The biomass distribution on Earth. *Proceedings of the National Academy of Sciences*, 115(25), 6506–6511. https://doi.org/10.1073/pnas.1711842115.

associative systems are not merely decomposers. They also perform numerous other functions, such as producing atmospheric oxygen, strengthening the immune systems of animals and humans, and improving soil quality for better plant growth.
In short, producers, consumers, and decomposers are all significantly subordinate to the super producer—water. This means that on the mesocosmic level (alongside earth and air, while the source of light such as the sun belongs to the macrocosmic level), water is one of the key pillars of the natural hierarchical associative system of our planet. Without super producers, it is not possible to comprehensively interpret our natural hierarchical associative system on the mesocosmic level. This system is not limited to simple linear inputs and outputs, but can be better understood as heterogeneous networks rather than homogeneous ones. In other words, a given system input may serve as a system output for another process, and vice versa. This systems perspective is admittedly synthetic, as human capabilities to interpret complex processes are limited. Nonetheless, we need some orientation to better understand at least fragments of this complex reality.
To enhance our understanding of the natural hierarchical associative system and its internal processes, a hierarchical associative cosmic network concept is introduced. As a first step, a visual model at the mesocosmic level will be developed, with water as the central pillar. In later chapters on earth, air, and light, we will return to these insights in order to synthesize and expand the model.



5.4.3 Figure 330: A systems perspective on water as an abiotic super producer

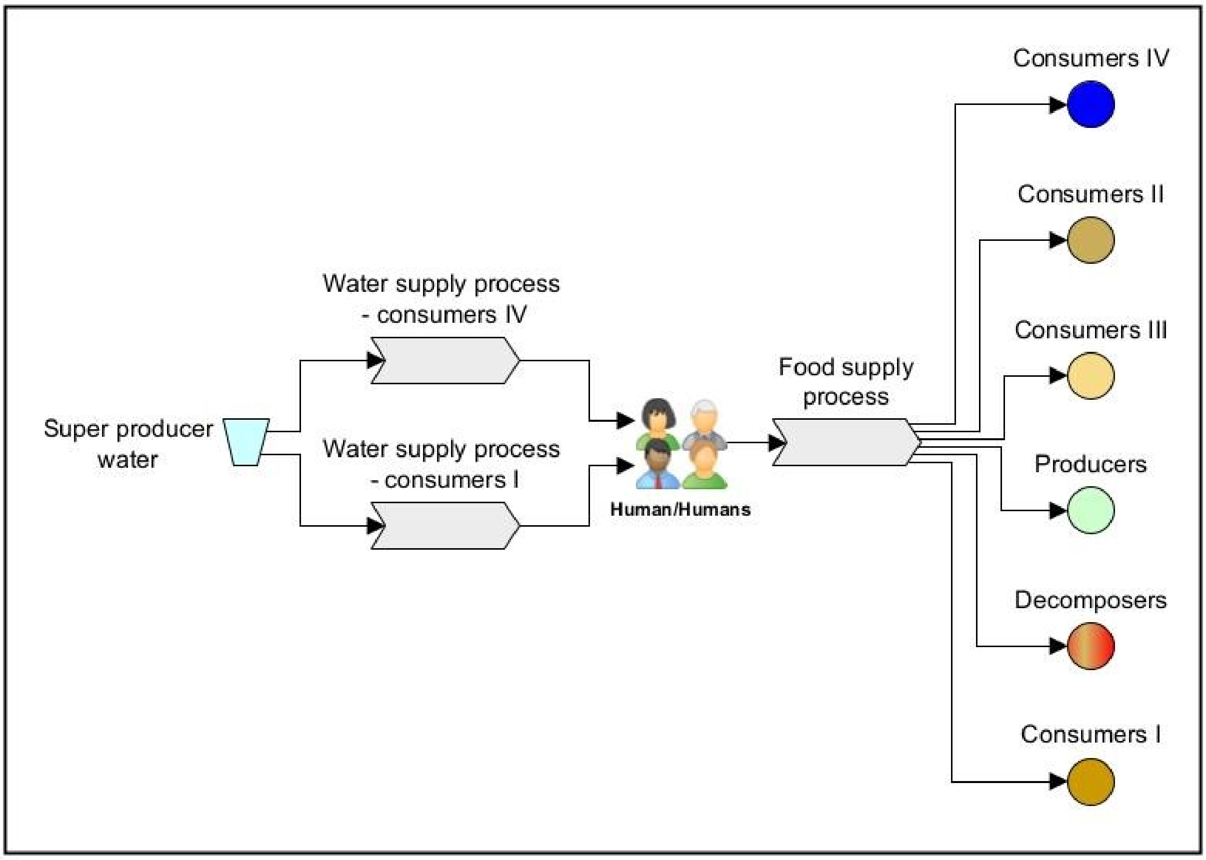
Figure 330 presents a systems perspective on water as an abiotic super producer. Water supplies basic sustenance for life to producers, consumers of various orders, and decomposers through different processes. Only after this foundation is in place can the various food chain processes, as we know them, unfold: producers provide food to primary consumers and, less frequently, to secondary and higher-level consumers.

Primary consumers typically serve as food for secondary consumers, and less commonly for tertiary consumers, while secondary consumers are often prey for tertiary consumers and occasionally for quaternary consumers. Tertiary consumers, in turn, often fall victim to apex predators—quaternary consumers.

In this framework, humans can be classified both as primary consumers (e.g., vegetarians) and as consumers spanning from the first to the fourth order simultaneously. Most people on Earth belong to a group that consumes an extremely wide range of sources, including plants, insects, fish, reptiles, amphibians, birds, and mammals. Some types of decomposers, such as fungi and earthworms—which primarily play a role in decomposing organic waste in the soil—can also be included in the human diet.

As seen in Figure 330, the diagram shows simplified connections between producers and consumers of various orders. This makes the presented model quite general, emphasizing the most common linear connections: producers feed primary consumers, who in turn feed secondary consumers, and so on. However, for a model that captures nonlinear relationships—where specific producers or consumers are subordinate to a super producer such as water—a new model is needed.

It would be worthwhile to attempt modeling the human food system with a hierarchical focus on water.



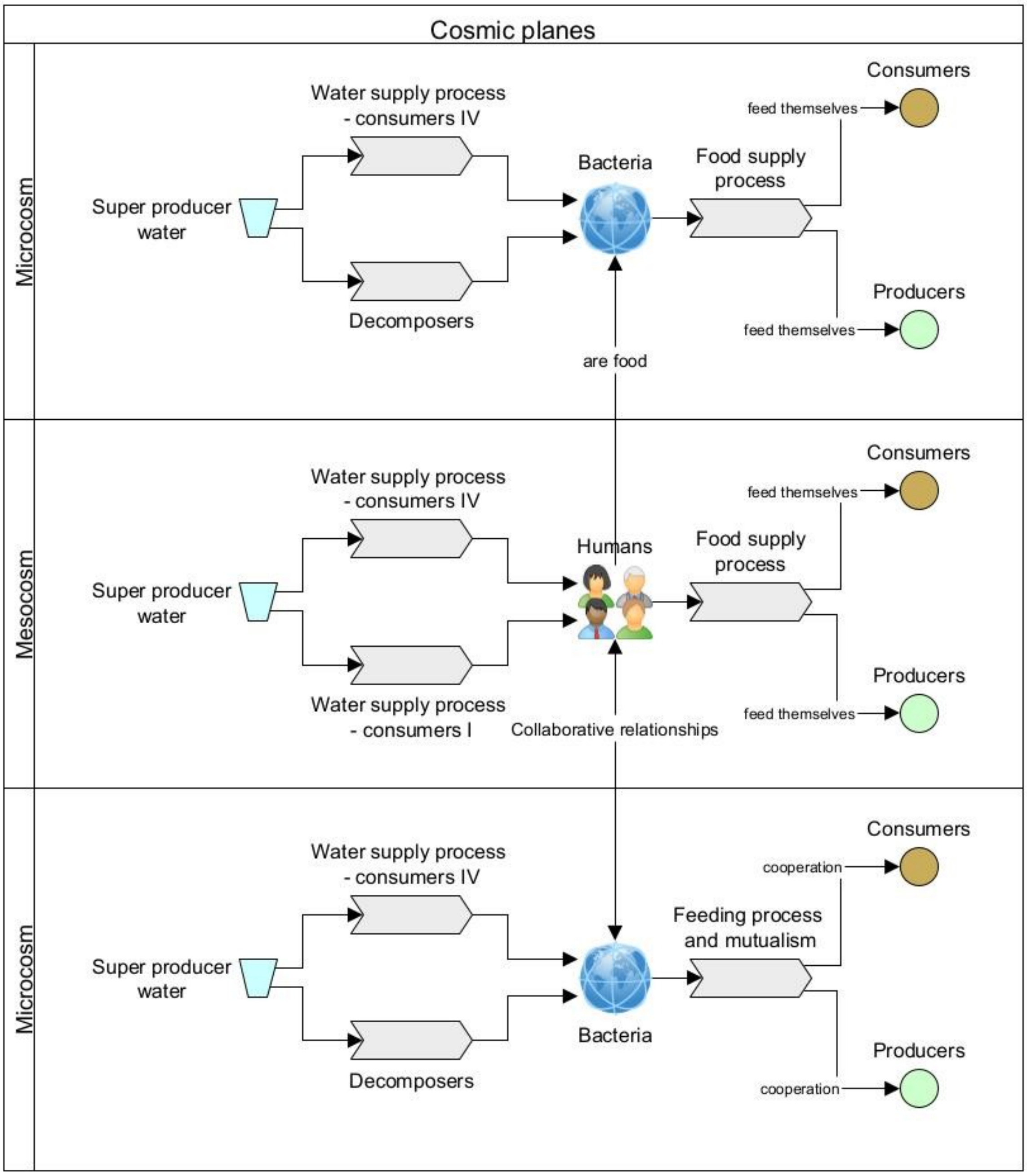
5.4.4 Figure 331: The human food system with emphasis on water

Figure 331 illustrates the human food system with a hierarchical emphasis on water as a super producer. The most fundamental source of nourishment for human life is water, with humans functioning as either primary consumers (e.g., vegetarians) or as fourth-order consumers or apex predators (omnivores and carnivores).

From there, the process of food supply continues. The range of dietary possibilities for humans is exceptionally broad. One could argue that, on the mesocosmic level, humans have no true peer in this regard—perhaps only certain decomposer scavengers, which feed on the remains of dead plants, animals, and humans, come close.

The human diet includes decomposers (e.g., earthworms, centipedes, beetles), producers (e.g., vegetables, fruit, leaves, flowers, roots), primary consumers (e.g., insects), secondary consumers (e.g., birds, amphibians), tertiary consumers (e.g., wolves, foxes), and even other apex predators (e.g., sharks, large reptiles). This list remains extensive even when limited to Europe.

In terms of biomass, the human species is extremely small compared to plants, bacteria, fungi, and animals—but its appetite and consumption of food resources are extraordinary. Generally speaking, or from an average perspective, the human food chain mainly includes three types of living beings: producers (e.g., vegetables, fruit), primary consumers (e.g., herbivores), and secondary consumers (e.g., wild boars). Tertiary and quaternary consumers are more rarely part of the human diet. This means that omnivores and other apex predators appear less frequently on the human menu.



5.4.5 Figure 332: The hierarchical associative feeding system between humans and bacteria

Figure 332 depicts the hierarchical associative feeding system between humans and bacteria, illustrating an interweaving of two cosmic levels. Both humans and bacteria are highly dependent on the abiotic super producer—water—since provisioning processes occur at both the mesocosmic and microcosmic levels.

The relationships between bacteria and humans are extremely complex and span both cosmic planes. On one hand, there are cooperative relationships involving mutualism; on the other hand, bacteria may act as predators with humans as prey. In such cases, harmful bacteria can weaken the human body or even cause death. Even in mutualistic interactions, feeding processes are present—bacteria inside the human body receive nourishment while simultaneously enhancing the human immune system.

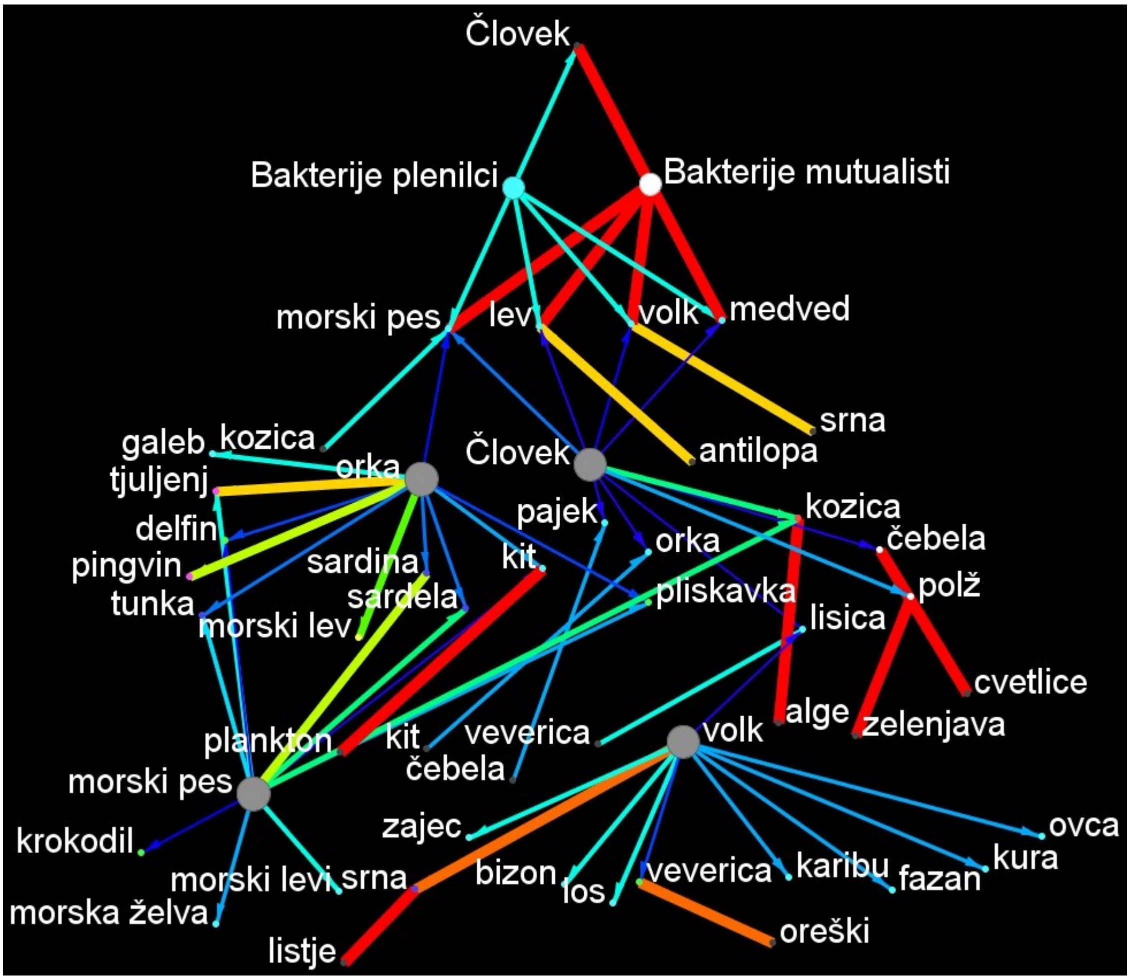
This model applies not only to humans but is transferable to many other living species on our planet. The natural hierarchical associative feeding system operates through the interconnection of two cosmic levels and forms the foundation of various existing food chains or networks. Apex predators are strongly influenced by bacterial networks, which shape their feeding behaviors, including that of humans. In a seemingly magical way, this influence helps prevent a natural catastrophe in which apex predators would frequently prey on one another.

The biomass of apex predators is relatively small compared to plants and first-, second-, and third-level consumers. Therefore, the feeding behavior of apex predators is inherently regulated to avoid frequent consumption of other top predators. Maintaining a relatively constant number of apex predators helps preserve biomass and energy within our natural hierarchical associative system on the mesocosmic level. This balance is regulated by countless microorganisms, with bacteria at the forefront.

Modeling this hierarchical associative feeding system is a highly challenging endeavor, as any detailed view can only capture a small part of the whole. The task becomes even more complex when multiple cosmic planes are involved. Despite this complexity, such work is essential. It's understood that this cannot be accomplished with a single model; instead, it would require a comic-strip-like or film-based approach—something beyond the scope of this work. A dedicated monograph with visual illustrations and detailed descriptions of interconnected feeding systems would be recommended. Such a publication should also include estimates of biomass, bioenergy, and the frequency of predator-prey interactions.

In any case, this would be a task that exceeds the capabilities of a single individual. A compelling documentary once simulated our natural hierarchical associative system on the mesocosmic level. Its conclusion suggested that, in the absence of humans, nature would recover dramatically—implying that human existence on this planet may not be essential.[163] Perhaps it could generally be said that our natural world would continue to function in a relatively rational manner even in the absence of apex predators? In any case, the following page will present a fragment of the hierarchical associative feeding network model, with a focus on humans and bacteria in their roles as both predators and collaborators.

163 Video: https://www.youtube.com/watch?v=l11zPNb-MFg (2021-08-04).



5.4.6 Figure 333: Fragment of the hierarchical associative model of apex predators and bacteria network

Figure 333 presents a fragment of the hierarchical associative model of the network between apex predators and bacteria. At the top of the hierarchy are bacteria, functioning both as predators and, more importantly, as partners in a productive symbiosis, such as mutualism. This type of relationship is characteristic of many living beings on the mesocosmic level (e.g., humans, lions, sharks, bears, wolves). It is more a relationship of constructive cooperation than a rigid hierarchy. More rigid hierarchical relationships are observed between apex predators and their prey (e.g., wolf → deer, sheep, moose, rabbit, bison; shark → sea lion, sea turtle, sardines; human → shrimp). The hierarchical associative feeding system (excluding the abiotic superproducer – water) is primarily based on productive symbiosis at its input, while subsequent processes proceed through increasingly pronounced hierarchical relationships. The overall systemic output can be summarized as the result of proportionate preservation of biomass and bioenergy. While individual subsystems may have differing outputs, the prevailing trend is usually toward a relative balance among all participants. Hierarchies within feeding systems emerge only after cooperative relationships have been established, with rigid hierarchies being present to a lesser extent. The system is dynamic:

rigid hierarchical relations may initially dominate and override mutualistic cooperation. In such negative scenarios, mesocosmic-level organisms may be significantly endangered.

As previously noted, the main drivers of the food system hierarchy are neither apex predators nor microorganisms, but rather abiotic superproducers like water. The peak of the hierarchy is thus occupied by abiotic, non-living factors, not by brains or sentience. In short, the inorganic world dominates the organic one, and our natural hierarchical associative feeding system is subject to this principle.

This system also adheres to another important law, which could be called the need for energy and actual energy efficiency, as energy determines the system's capacity for performing various functions. Basic functions of living beings include temperature regulation, digestion, and nutrient supply to the brain. Living beings differ in the type and amount of food they consume and in how they obtain it. The length of the digestive tract already reflects this adaptation: it is typically longer in herbivores, shorter in carnivores, and intermediate in omnivores. Energy expenditure for digestion is highest in herbivores, medium in omnivores, and lowest in carnivores.

Another key indicator is the quantitative need for food in certain species—some require near-continuous intake to function optimally (e.g., the mole). Also important is the method of acquiring food: herbivores expend a lot of energy digesting but obtain food relatively easily, while carnivores have faster digestion but invest significant energy into searching for, chasing, and hunting prey. Unsuccessful hunts are common in predator feeding systems, which also results in energy loss. The energy transfer efficiency from producers to primary consumers, from primary to secondary consumers, and so on, is only about 10%, meaning the system operates with a very low, roughly 10% efficiency rate.[164] The diversity and abundance of plant species enhance the functionality—and thereby the energy efficiency—of the natural hierarchical associative feeding system.[165] This does not only imply more favorable conditions for primary consumers, but also for the entire food web, including humans and their agricultural activities. Furthermore, promoting the diversity and abundance of plant life could potentially prevent the extinction of certain living species that are vital for the improved functioning of the whole system.

The ratio between inorganic matter and biomass has continuously changed throughout Earth's history. Prior to significant human technological influence on nature—around 5000 BCE—biomass

164 Mehner, T., Lischke, B., Scharnweber, K., Attermeyer, K., Brothers, S., Gaedke, U., Hilt, S., & Brucet, S. (2018). Empirical correspondence between trophic transfer efficiency in freshwater food webs and the slope of their size spectra. *Ecology*, 99(6), 1463–1472. https://doi.org/10.1002/ecy.2347.

165 Buzhdygan, O. Y., Meyer, S. T., Weisser, W. W., Eisenhauer, N., Ebeling, A., Borrett, S. R., Buchmann, N., Cortois, R., De Deyn, G. B., de Kroon, H., Gleixner, G., Hertzog, L. R., Hines, J., Lange, M., Mommer, L., Ravenek, J., Scherber, C., Scherer-Lorenzen, M., Scheu, S., … Petermann, J. S. (2020). Biodiversity increases multitrophic energy use efficiency, flow and storage in Grasslands. *Nature Ecology & Evolution*, 4(3), 393–405. https://doi.org/10.1038/s41559-020-1123-8.

is estimated to have totaled approximately 1000 gigatons (GT). Today, that biomass has decreased by nearly 50%. Meanwhile, Earth's mass is estimated to decrease by 40,000 to 50,000 tons annually, which can be understood as a decline in inorganic mass. At the same time, the human population has generated so much inorganic material that it now exceeds the estimated existing biomass, which stands at around 550 GT.[166] These data give rise to an unusual question: does humanity's hyperproduction of inorganic matter on Earth contribute to replacing the planet's lost inorganic mass? The amount of metals, concrete, plastic, clothing, and similar materials is increasing exponentially every year. It seems as though we are gradually entering a new geological era, which could have negative consequences for existing biomass. With this question, we will temporarily conclude this subchapter. We will return to the topic of hierarchical associative food systems in later subchapters focused on soil, air, and light. The next subchapter will address microorganisms that live in water.

5.4.7 Water and the microcosm

Determining the boundary between the micro-, meso-, and macrocosm can be particularly challenging and, in practice, is largely a matter of convention. On the one hand, we deal with concepts like electrons, nuclei, and atoms, which are fundamental components of both non-living and living nature across the mesocosmic and macrocosmic levels. In short, these three levels are deeply intertwined. Distinguishing between them can make their explanation somewhat easier. This subchapter will not deal with atoms or other smaller particles that science has already identified, but rather with microorganisms that live in water. In this realm, we encounter an extraordinary diversity of living beings that science seeks to interpret—especially through the use of powerful microscopes, which may be either light or electron microscopes. Light microscopes function by bending light that passes through the specimen being studied, whereas electron microscopes use a beam of electrons that passes through the substance being examined.

In any case, the observable phenomena we perceive through magnification by light or electron microscopes reveal only certain outlines or perspectives, which scientific taxonomy then attempts to interpret. It is important to emphasize that even the best electron microscopes do not offer a complete view of objective reality. Over the centuries, scientific communities have come to accept interpretations of the microcosm as reality based on agreed-upon conventions.

As such, the descriptions of various aquatic microorganisms presented here are based on visualizations through microscopes and accepted scientific taxonomy. Before introducing examples of known aquatic microorganisms, we will outline their classification. The main groups of

166 Elhacham, E., et al. (2020). Global human-made mass exceeds all living biomass. *Nature*, 588(7838), 442–444. https://doi.org/10.1038/s41586-020-3010-5.

microorganisms in water can be classified as bacteria, viruses, archaea, protozoa, algae, and fungi (e.g., yeasts, molds). These differ in their DNA, shape, structure, size, method of movement, and metabolism. Based on these distinguishing features, classifications have developed over the centuries and continue to be refined.

5.4.7.1 Bacteria

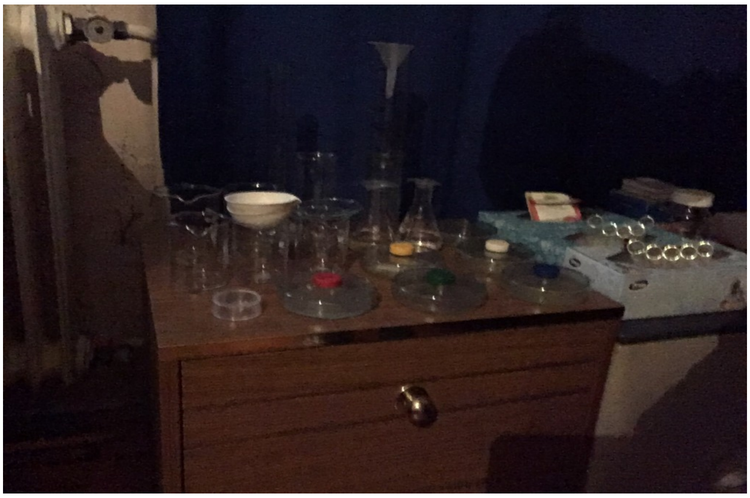
Bacteria are simple, single-celled organisms without a cell nucleus and, with rare exceptions, are very small, measuring between 0.5 and 5 micrometers (μm). They have cell walls, often move using flagella, and reproduce asexually. Their reproduction occurs in three stages: adaptation to the environment, exponential growth when food is abundant, and dormancy, when bacterial colonies stop growing.

Bacteria most commonly appear in round, oval, rod-like, or spiral shapes. They may form clusters, chains, pores, tetrahedrons, or octahedrons. They also have their own genetic material, which they can exchange with one another. As previously mentioned, bacteria can influence the human genetic code by switching certain genes on or off. Lateral gene transfer is also possible—from a bacterium to the living cell of another species, or even another organism entirely.

From this line of thinking, it is not a far leap to consider the creation of new bacteria or even entirely new organisms, perhaps based on human DNA.[167] Despite numerous and intensive scientific research efforts, a great deal has been written about bacteria, but relatively little is actually known.

This subchapter will present experiments involving the cultivation of bacterial cultures using soil filtrate (10 grams of soil and 90 milliliters of water with a pH value of 7.1), human saliva (10 milliliters with a pH value of 7.19), and semen (with a pH value of 7.7). The samples were then exposed to a weak magnetic field, with an ordinary button magnet placed on the lid of each Petri dish.

167 Scientists Created Bacteria With a Synthetic Genome. Is This Artificial Life? (2019). *The New York Times*, 21st May 2019, 1-4. URL: https://www.nytimes.com/2019/05/15/science/synthetic-genome-bacteria.html (2021-08-19).



5.4.7.1.1 Figure 334: Prepared samples in Petri dishes

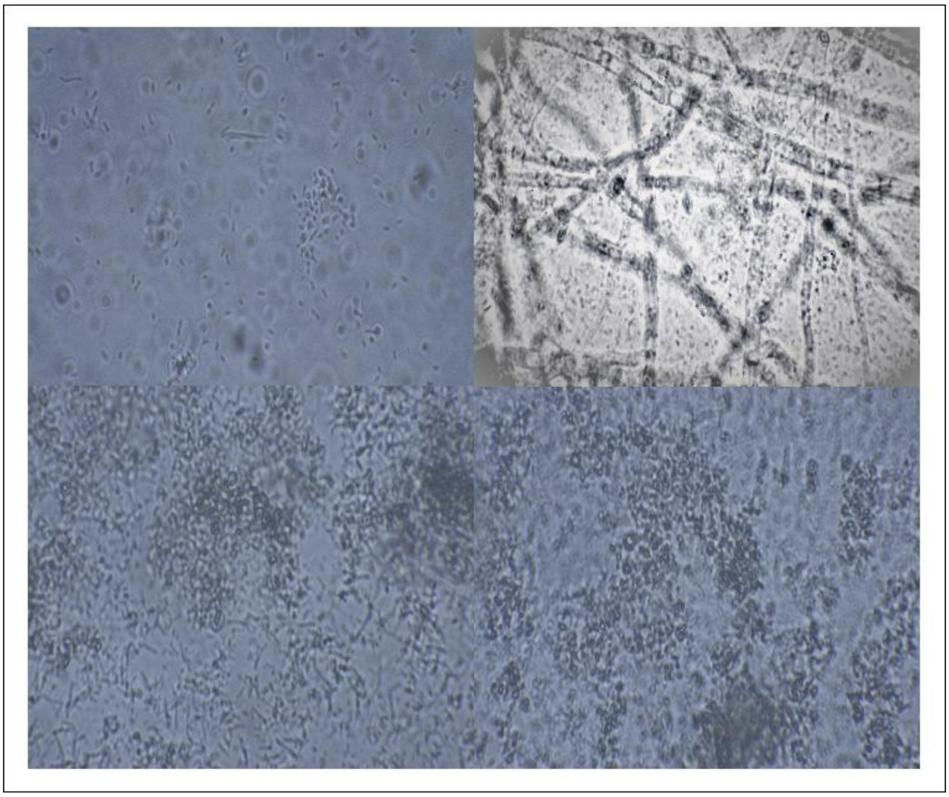
Figure 334 shows the prepared samples in Petri dishes, with ordinary ferrite button magnets placed on their lids.

In general, the presence of bacteria is not expected in soil and semen filtrates, whereas this does not apply to human saliva. Saliva contains a large number of bacteria, with total counts reaching several billion. These include, for example, Prevotella, Streptococcus oralis, Propionibacterium, Fusobacterium, and Lactobacillus.[168] In two of the samples, 50 mg of the enzyme Lallzyme HC was added, which is used for clarifying white and red must.

Enzymes have the ability to promote the growth of both bacterial and fungal cultures. Human saliva also contains the enzyme amylase, which is responsible for the initial breakdown of starch and for regulating blood sugar levels in the mouth. The prepared samples were then examined under a microscope. Some of the results are shown in the following image.[169]

168 Conrads, G. (2020). Das orale Mikrobiom und seine kariogenen Spezies. *zm online*, Hft. 23-24, (1. 12. 2020). URL: https://www.zm-online.de/archiv/2020/23_24/zahnmedizin/das-orale-mikrobiom-und-seine-kariogenen-spezies/seite/alle/ (2021-08-21).

169 A Zeiss Primostar 3 light microscope with an Axio 208 color camera was used.



5.4.7.1.2 Figure 335: Selection of microscopic images of bacteria and fungi within the examined samples

Figure 335 shows a small selection of microscopic images of bacteria and fungi from the examined samples. The first image in the upper left corner displays a partially prepared sample of the soil and semen filtrate. It can be observed that the number of bacteria is relatively small, and their presence is mainly the result of the added soil filtrate (no bacteria were detected during the examination of semen alone).

The second image in the upper right corner shows network-like fungal structures separating different bacterial colonies. This structure resulted from the reaction between soil filtrate, semen, saliva, and the enzyme Lallzyme HC. A completely different structure appears (see the image in the lower left corner) when only soil filtrate, semen, and saliva are combined. In this case, fungi are not observed, but rather more extensive bacterial networks.

With the addition of semen (see the image in the lower right corner), a denser network structure can be observed. This is due to the higher number of sperm "tadpoles," which some bacteria use as a source of nutrients and/or as an organic substrate for forming biofilms. This raises an interesting question: can bacteria exchange genes with sperm tadpoles? Bacteria are known to exchange genes with plant and even animal cells through the process of conjugation, though whether this occurs in humans is still not entirely clear.[170] This intriguing question has sparked intense and passionate

170 Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., Stahl, D. A., & Brock, T. D. (2022). *Brock Biology of Microorganisms*. Pearson Education.

debate. In short, the idea that bacteria, over the course of long historical development, may have co-created entirely new, both simple and complex, living organisms seems entirely plausible. Of course, the possible combinations are immense, and only a few bacterial reaction combinations lead to the creation of entirely new living organisms. An example is the conducted experiment involving fungi (see the previous image, top right). In the first sample, the reactive substances were added in small quantities, while in the second sample the same substances were added in excessive amounts. The final outcome differs significantly as a result. Interestingly, both samples also received an additional 10 ml of a 4% sugar solution.

5.4.7.1.3 Figure 336: Formation of different fungi from the reaction of the same reagents

Figure 336 shows the formation of different fungi after the reaction of the same reagents in a Petri dish. In the first sample (see left side), the reagents added were: 10 ml of soil filtrate, 10 ml of human saliva, 5 ml of human semen, 50 mg of the enzyme Lallzym HC, and 10 ml of a 4% sugar solution. In the second sample, the same reagents were added, but with at least 15 times more Lallzym HC enzyme. The difference is striking.

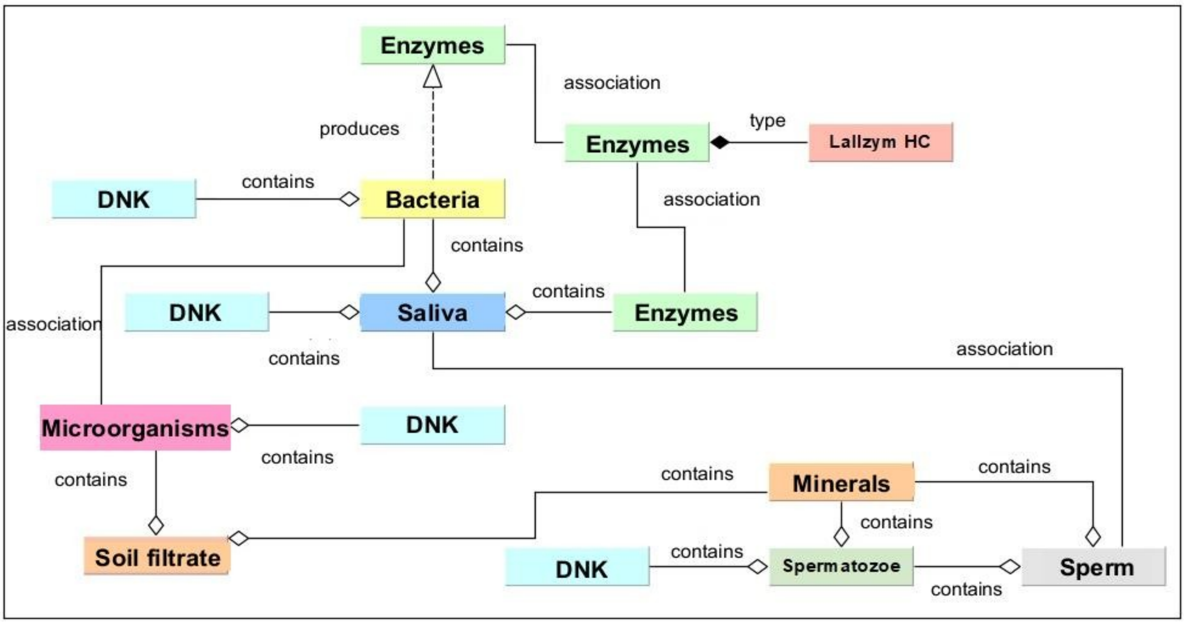
The formation of a certain new, relatively stable living species requires the right proportions of different reagents and catalysts within biological, chemical, electromagnetic, and other reactions. If a particular reagent is in excess, the formation of new life cannot occur. Finding the correct ratios is very much like a lottery, except that the number of possible combinations is much greater. We can use intuition, knowledge, and experience to assume that the catalyst Lallzym HC enzyme will accelerate the reaction, that sugar at lower concentrations will be well accepted by fungi as a food source, that the soil filtrate may contain substances favorable for the formation of, for example, white fungi, that human saliva contains its own DNA and bacterial DNA, and that human semen contains DNA fragments, etc. We can assume that certain substances, due to enhanced properties, are favorable for diverse reactions, but we cannot predict the final outcome of a particular reaction, which is not merely chemical but of a composite nature.

Another problem we face is time. Complex living beings, such as mammals, evolved over millions of years, while human existence is just a fleeting moment. This means that even if we hit the right reagents and determine the correct ratios, we would not be able to fully observe the final outcome of these multidimensional and diverse reactions.

At the microcosmic level, there are multiple possibilities for success in creating new beings. It is possible to create a new or previously unknown bacterium, a new or unknown protozoan, or to create a known protozoan from certain reagents. The experiment with the Lallzym HC enzyme and other reagents showed that not only fungi were formed, but also protozoa that were previously not visible within the given reagents.

LHC + Saliva + Semen + Soil filtrate + Sugar + Bacteria + DNA → Protozoa + White fungi + Reorganized bacteria

The reaction indicates a change in the original composition, resulting in microorganisms such as protozoa and white fungi, while it is not entirely clear whether the bacteria represent a new bacterial species or merely a reorganized bacterial culture.



5.4.7.1.4 Figure 337: Hierarchical associative diagram of reagents

Figure 337 shows a hierarchical associative diagram of the reagents involved in the biochemical and magnetic reaction. Human saliva contains DNA and includes both bacteria and enzymes (see the white diamond with a line indicating a superior relationship). Bacteria also contain DNA (again shown via a white diamond and line) and produce enzymes as byproducts (indicated by a dashed line to a triangle, representing realization). Enzymes are associatively linked to one another (shown by a line connection). The enzyme Lallzyme HC is specifically highlighted as a superior element (see the line with a black diamond).

Soil filtrate contains minerals and microorganisms, though in smaller quantities, as shown by a superior relationship (white diamond with a line). Microorganisms—such as many bacteria, protozoa, and fungi—contain DNA (white diamond with a line). Human sperm is associatively connected with human saliva since both are bodily fluids (line connection). Sperm contains both minerals (white diamond relationship) and living cells (white diamond connected to spermatozoa). Spermatozoa also contain DNA (again shown by a white diamond and line).

From these various interrelations among classes, we can infer that human saliva and spermatozoa contain the same DNA, while the DNA of bacteria and other microorganisms is not identical. Furthermore, the soil filtrate and the Lallzyme HC enzyme do not contain DNA. The soil filtrate includes small amounts of both organic substances (e.g., leaf fragments) and inorganic substances (e.g., minerals). Lallzyme HC is classified as an enzyme that accelerates the clarification of must (juice used in winemaking).

In short, the complex reaction studied here involves multiple types of DNA and enzymes. These enzymes have the ability to accelerate certain biochemical reactions. Similarly, magnets may stimulate the growth of bacterial cultures. A weak magnetic field can act as an inorganic catalyst. Essentially, we are dealing with substances that are inherently fairly reactive.

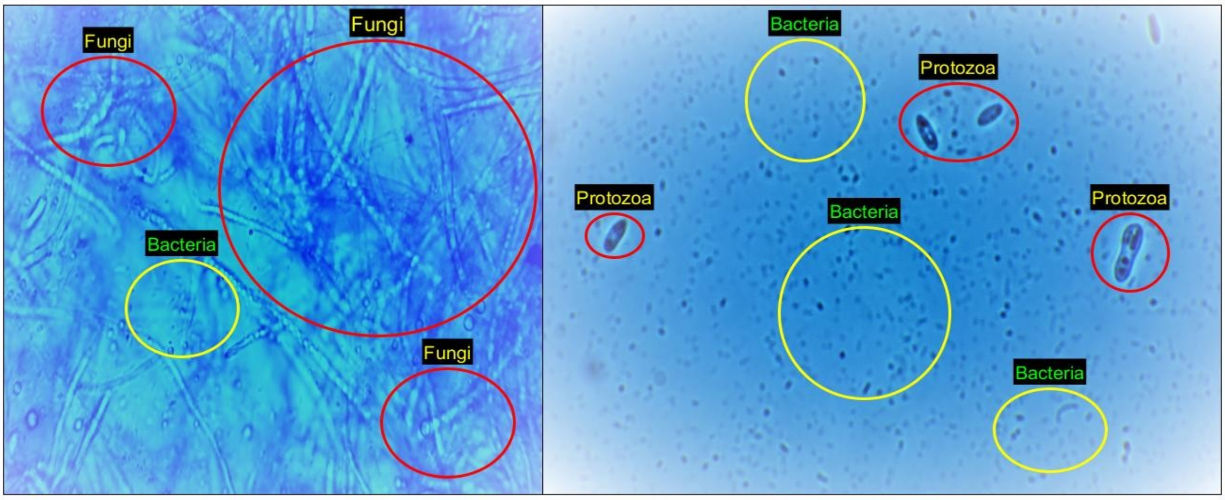
How, then, could white fungi and protozoa have emerged from these reagents? Due to the lack of understanding of the actual processes involved in complex reactions, it might seem as though white fungi and protozoa appeared out of nothing. However, this explanation can immediately be ruled out, as specific reagents and enzymes must have contributed to the formation of both white fungi and protozoa.

It can be assumed that bacteria from human saliva, spermatozoa, soil filtrate, and the Lallzyme HC enzyme triggered reactions that led to the emergence of white fungi. Protozoa may have originated from DNA traces of protozoa already present in the soil filtrate, although this is less likely. A more complex explanation seems probable: under the influence of bacteria and their tendency to exchange genes with white fungi, protozoa may have developed, while spermatozoa initially served merely as a nutrient source for the bacteria and later also for the white fungi, creating a robust symbiosis.

This idea is surprising, since fungi are typically food for bacteria—fungi and bacteria are natural enemies. In this case, however, the absence of competition or natural enemies due to food abundance may have led to the overproliferation of white fungal networks. One might speculate that bacteria played a crucial role by exchanging DNA and supplying waste products to the fungi, which could have stimulated the emergence of protozoa.

Most protozoa feed on bacteria, but one type of amoeba (see Vampyrellids) feeds on fungi. Microscopic images revealed that the protozoa were not found inside the fungi but near bacteria, suggesting that bacteria might have regulated their own population growth by indirectly creating a natural enemy—protozoa—through fungi.

This hypothesis sounds rather implausible and remains unproven. Perhaps the most credible explanation is that the conditions for protozoa formation were already present, though undetectable by the available light microscope. It is true that enzymes can accelerate certain biochemical reactions and that weak magnetic fields can stimulate the growth of bacterial and fungal cultures—but it still seems highly unlikely that entirely new lifeforms emerged from these reagents alone.



5.4.7.1.5 Figure 338: Distribution of fungi, bacteria, and protozoa within the same sample

Figure 338 shows the distribution of fungi, bacteria, and protozoa within the same sample. It can be observed that on the western side (see the left side of the image), fungal colonies strongly dominate, while smaller bacterial networks coexist within the center of the fungal cultures. On the eastern side (see the right side of the image), bacteria are clearly dominant, accompanied by a few representatives from the protozoan group.[171] Both on the left and right sides of the image, no large bacterial networks are visible.

Generally, bacteria feed on fungi and use them to form biofilms, although fungi possess sharp defensive mechanisms that can destroy bacteria. It is still not entirely clear whether certain types of fungi also feed on bacteria. Most types of protozoa are known to feed on bacteria, as protozoa are typically much larger and have a more complex genetic structure. Whether fungi and bacteria

171 The image was taken using a Zeiss Primostar 3 microscope and an Axio 256 color camera. The sample was stained with methylene blue. It is a 1000x magnification (100x oil immersion objective).

actually created protozoa through gene exchange remains an unresolved question. What is known is the outcome: a diluted population of bacterial species and a proliferation of fungi. Protozoa seem to play a role in further reducing the bacterial population, or at least in exerting some kind of control over it.
To what extent bacteria were able to create a biofilm with the help of fungi cannot be clearly determined from the microscope images with 1000x magnification. Based on the images, only sparse bacterial colonies are visible, a few scattered protozoa, and large, intertwined fungal networks. Fungi can easily survive without bacteria and require only water and oxygen for their continued existence.
The final scenario within the Petri dish could be predicted: without a sufficient number of bacteria, the protozoa, as shown in the image, would not be able to survive. The ultimate winner in this small ecosystem is therefore the fungus—not the other two microbial representatives. It is also clear that the available light microscope cannot be used to study the possible influence of viruses on the dynamics within this small ecosystem.

5.4.7.2 Viruses

Viruses are essentially not living cells, and even less so living beings, but they carry the potential to become living cells when they successfully integrate into a host. Viruses contain their own DNA or RNA, which can be either single- or double-stranded. It is known that different organic molecules of DNA and RNA across various living organisms are relatively similar in both structure and composition. Likewise, the DNA/RNA of viruses does not differ significantly in basic structure or composition from that of other known living beings. This is, in every sense, a strong prerequisite for viruses to be able—through a host—to either destroy a living being (a living cell) or potentially even contribute to the creation of a new type of living being (a living cell).
There are theories suggesting that viruses might be descendants—or perhaps more accurately, offshoots—of previously free-living organisms that adopted a parasitic reproductive strategy. Intense debates are ongoing about the origin and age of viruses. Some scientists believe that viruses are the creators of all known life forms and that their presence on Earth predates the existence of protozoa, archaea, bacteria, fungi, or even algae. Other common views propose that viruses are merely byproducts of extinct living cells and other more complex microorganisms. The truth likely lies somewhere in between.
Most viruses are much smaller than bacteria, typically ranging in size from 0.02 to 0.3 µm. However, there are also viruses that can reach diameters of 0.5 to 0.7 µm, and in length, they may exceed 1 µm (e.g., mimivirus). In terms of shape, viruses are predominantly filamentous, rod-like,

or spiral, often wrapped in proteins and consisting of a head and a tail. The structure of viruses often includes a membrane envelope, membrane proteins, glycoproteins, nucleoproteins, capsomeres, a capsid, and DNA or RNA (the genome).[172] Viruses appear to function as intelligent compounds that use their own DNA or RNA to deceive living cells, bacteria, macroviruses (such as virophages), and others. Moreover, certain segments within many viral DNA and RNA chains are similar to those found in humans, as researchers have discovered key similarities in the way genetic codes are determined. This allows the virus to evade our cellular defenses.[173] It may also be a matter of attractive and repulsive forces created by nature, where numerous complex reactions take place under the influence of gravitational, electromagnetic (inductive), and nuclear forces. Viruses are also believed to possess a form of social behavior and to communicate with one another, suggesting that they are not merely passive participants in attacking hosts such as bacteria.[174] This kind of thinking significantly changes the conventional views on viruses. Most viruses are highly specialized in terms of their choice of host, meaning they infect only humans, animals, bacteria, macroviruses, algae, plants, or fungi. However, there are also viruses that can infect both animals and bacteria. Could it be that some viruses have an even broader range of hosts?

Although viruses pose challenges to living organisms, it is important to emphasize that they actually play a beneficial role in the natural hierarchical associative system. Without them, many living species would have gone extinct. From the perspective of their broader contribution, viruses are especially important for the adaptive mechanisms of natural hierarchical associative systems. Future challenges—such as climate change, air pollution, and water contamination—will be difficult to overcome without the involvement of viruses.

In terms of biomass, viruses are relatively minor players compared to bacteria, accounting for only about 0.2 gigatons. Technically, viruses represent a transition between living and non-living matter and are not classified as either living beings or living cells. Some studies have also reported that viruses can exist in water.[175] Viruses cannot exist without a living host cell and will disintegrate within a relatively short time. Primarily, their protein coat breaks down, while the viral DNA or RNA does not degrade. Therefore, a virus becomes a "naked" virus before it is fully broken down. DNA essentially contains the codes for making proteins—so why couldn't a "naked" virus inside a host use its existing DNA to rebuild its protein coat?

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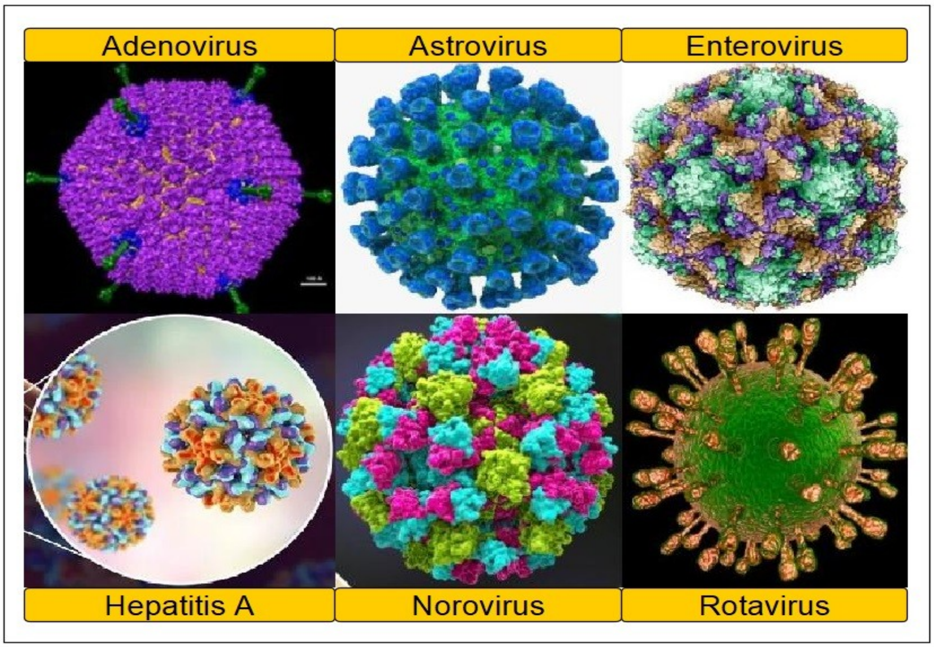
172 Modrow, S., Falke, D., Schätzl, H., & Truyen, U. (2010). *Molekulare Virologie*. Spektrum Akademischer Verlag.

173 Takata, M. A., Gonçalves-Carneiro, D., Zang, T. M., Soll, S. J., York, A., Blanco-Melo, D., & Bieniasz, P. D. (2017). Cg dinucleotide suppression enables antiviral defence targeting non-self rna. *Nature*, 550(7674), 124–127. https://doi.org/10.1038/nature24039.

174 Dolgin, E. (2019). The secret social lives of viruses. *Nature*, 570(7761), 290–292. https://doi.org/10.1038/d41586-019-01880-6.

175 Pinon, A., & Vialette, M. (2018). Survival of viruses in water. *Intervirology*, 61(5), 214–222. https://doi.org/10.1159/000484899.

When we talk about viruses, we usually imagine them as coming from outside the living organism, rather than considering the possibility that they might also be products of dissociative reactions within living cells, bacteria, or fungi. For example, a bacterium may lose a portion of its DNA instead of replicating. Similarly, the DNA or RNA of a virus, without its protective envelope, can enter a living organism and, through further reactions with living cells, bacteria, or fungi within the host, reassemble into a virus with a new envelope and altered properties.
If we adhere to the hypothesis that viruses are pioneers in the origin of living organisms, this could explain their relatively small biomass on Earth. Linked to this reduced biomass is the observation that virus structures are becoming increasingly simple, while bacterial structures are growing more complex. This leads us to seriously question whether the primary role of viruses is merely to destroy their host, or if they might also contribute to the formation of new combinations—such as increasingly complex bacterial forms.
Previous findings have noted the magnetic properties of certain bacteria, which invites speculation about the possible magnetic properties of viruses as well. With the aid of magnets, the movement of both viruses and living cells can be influenced. This opens up further thought paths suggesting that viruses may be by-products of the breakdown of living cells, bacteria, and fungi.
In general, we might conceive of viruses as organic compounds with an envelope, often equipped with appendages, participating in advanced stages of complex biochemical, electromagnetic, inductive, and mechanical processes—where attractive and repulsive forces or fields are at play. In short, self-organizing reactions of either exothermic or endothermic nature occur due to compound causes (analogous to simple exothermic chemical reactions between two reagents, such as sodium and water, HCl and $CaCO_3$, or H_2SO_4 and magnesium).
It is estimated that a single drop of seawater contains around 10 million viruses, of which only a few are harmful to fish or mammals. Most marine viruses are bacteriophages, which kill marine bacteria. Various types of viruses can also be found in drinking water, including adenovirus, astrovirus, enterovirus, hepatitis A, norovirus, and rotavirus. All of these are extremely harmful to human health, primarily targeting the digestive system. The most effective method for destroying such viruses is to boil the water for one to three minutes.
Let’s now take a closer look at these viruses.



5.4.7.2.1 Figure 339: Waterborne viruses harmful to human health

Figure 339 shows viruses that can be present in water sources. These viruses are harmful to human health, cause severe pain, and primarily affect the digestive system.

The adenovirus (top left of the image), with a diameter of 80 to 110 nm, has icosahedral symmetry. Its DNA is a linear double helix with a genome length of 30 to 45 KB.

The astrovirus (top center), with a diameter of 28 to 35 nm, also has icosahedral symmetry and a star-like structure (as seen under an electron microscope). Its RNA is a single-stranded helix with a genome length of 6.8 to 7.9 KB.

The enterovirus (top right) has a diameter of 25 to 30 nm and a similar symmetry to the adenovirus and astrovirus. Its RNA is single-stranded, with a genome length of 7.2 to 8.5 KB.

The hepatitis A virus (bottom left) has a diameter of 27 to 32 nm and icosahedral symmetry. Its RNA is single-stranded and approximately 7.5 KB in length.

The norovirus (bottom center) has a diameter of 38 to 40 nm and icosahedral symmetry. Its RNA is also single-stranded, around 7.5 KB long.

The last selected example is the rotavirus, with a diameter of 55 to 80 nm and icosahedral symmetry. Its RNA is double-stranded with a genome length of about 18.5 KB.

All of these viruses are extremely small, have similar symmetry, and relatively short genomes—either DNA or RNA. Essentially, they are very simple molecules that carry a small amount of information (for comparison, the human genome contains around 700 MB), meaning they are highly specialized for certain living cells.

Within a host organism, viruses participate in both strictly hierarchical, deterministic complex processes and in associative, stochastic ones. After mRNA is released from the cell nucleus, various attractive and repulsive forces guide both the mRNA and ribosomes. A single living cell may contain up to 10 million ribosomes, composed of ribosomal RNA and ribosomal proteins. The ribosome's main task is to absorb specific RNA building blocks (adenine, thymine, cytosine, and guanine) in a precisely determined sequence (e.g., AUG). Through this strict, deterministic process, ribosomes synthesize complex proteins from the acquired materials. After completing this organic algorithm, the ribosome releases the protein into the cell's internal solution. From this point onward, based on our current understanding, the processes no longer follow a strictly deterministic hierarchy but instead shift into associative, stochastic behavior.

This means that free-floating proteins no longer follow an obvious algorithm but rather interact based on probabilistic attraction and repulsion among other cellular components. In the case of a virus, this might mean that it penetrates a cell membrane, where its protein coat breaks down and releases its DNA or RNA. Ribosomes are structured to read any DNA or RNA strand that contains a favorable sequence of materials for building proteins. The viral DNA or RNA passes through a ribosome, which then manufactures viral proteins. These proteins then self-assemble into geometrical structures, often with icosahedral symmetry. This is one way in which viruses can replicate.

If we assume that DNA or RNA are composed of strictly defined building blocks, then the entry of a virus with its own genetic material into a host cell can be viewed as a semi-random, associative-stochastic event. Likewise, the interaction between a virus and a ribosome is relatively random but highly probable due to the virus's specific genetic composition. Once the ribosome begins reading the viral genome, the process returns to a deterministic, hierarchical mode. After the ribosome expels the viral proteins, the process again momentarily enters a stochastic phase. The produced viral protein components attract one another and self-organize into a symmetrical structure.

This part of the process is hard to define strictly as stochastic or deterministic—it's better understood as a hierarchical-associative process, meaning it's driven by both structured determinism and random probability. The outcome is a relatively symmetrical body tailored to its environment.

Clearly, the human mind finds it easier to interpret deterministic processes than stochastic ones. In this current model of viral protein synthesis based on RNA, many complex interactions remain invisible to us—and thus beyond our current understanding. We still lack the ability to observe or define the roles of induction, polarization, attraction, repulsion, and various wave interactions.

Viruses cannot be classified as living organisms because they do not require water for survival in a direct sense. All other known living beings are, to varying degrees, dependent on water. This independence is more characteristic of inanimate materials, such as chemical elements and compounds. The rule that "there are always exceptions" also applies here (e.g., crystals or

compounds that contain water like acids, bases, ethanol). Yet these compounds are not directly dependent on water to exist.
For this reason, viruses can be viewed as intelligent compounds that contain a simple program and a short DNA or RNA molecule. Both function in relation to the attractive and repulsive forces within a living host. If additional wave phenomena or inductive properties are involved, the future may provide more answers. Despite all this, it is astonishing what viruses are capable of. They are able to mimic life—resembling intelligent organic nanorobots created by nature and, in a way, its automated mechanisms.

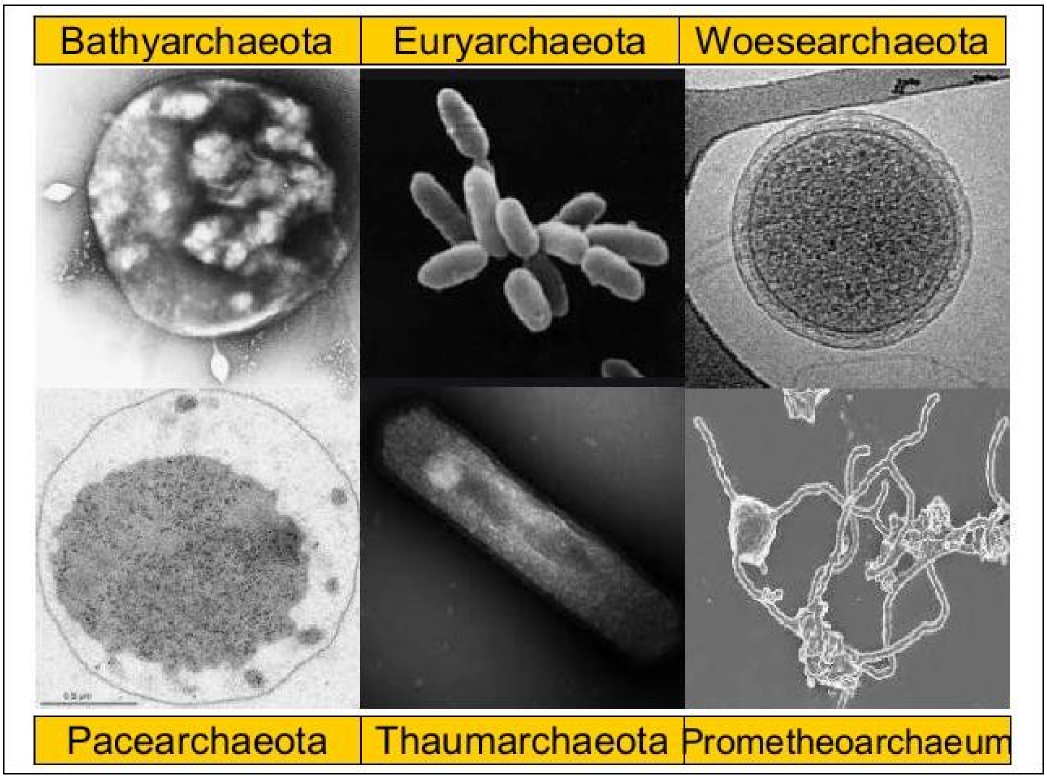
5.4.7.3 Archaea

Archaea were once classified as bacteria, but further scientific developments have shown that they are fundamentally different. While bacteria have only prokaryotic characteristics, archaea possess both prokaryotic and eukaryotic features. Although archaea and bacteria share a similar structural appearance, they differ in their chemical composition.
Archaea can have various shapes, including spherical, rod-shaped, spiral, paddle-shaped, rectangular, or irregular forms. They are known to be widespread and capable of surviving in the most extreme natural environments—such as hot springs, methane-rich areas, highly saline environments, and the deep sea.
Based on their method of obtaining energy, archaea can be categorized into:
- Phototrophs: which require sunlight to live and feed,
- Lithotrophs: which utilize chemical substances like methane for survival and nourishment,
- Organotrophs: which consume organic substances, similar to humans and animals.

The impact of archaea on living nature is believed to be extremely positive (with a few rare exceptions still under investigation). They are also actively used in industry, particularly for methane production.
Many archaea can survive without oxygen, but they still require water to live—even if only in very small amounts. Key indicators for the presence of different types of archaea include certain chemical elements or compounds (such as sulfur, iron, and methane), temperature (e.g., very high, like 130 °C, or very low, like –70 °C), and pH levels (ranging from very acidic, around 1, to very alkaline, around 10).
There are prominent hypotheses suggesting that archaea were the first living organisms on Earth. These claims are supported by convincing arguments, especially considering archaea's adaptability to the extreme conditions of early Earth (e.g., high temperatures, lack of atmosphere and oxygen). Fossil evidence suggests that the first such organisms appeared around 3.5 billion years ago.

Archaea can be found in both animal and human feces. The most common archaeal species in human gut microbiota is Methanobrevibacter smithii, which plays a crucial role in efficiently digesting polysaccharides.

Archaea are also found in hot springs, deep-sea environments, soil, and even drinking water. Some notable archaeal groups found in aquatic environments include Bathyarchaeota, Euryarchaeota, Woesearchaeota, Pacearchaeota, Thaumarchaeota, Prometheoarchaeum, and others.



5.4.7.3.1 Figure 340: Archaea living in water sources

Figure 340 shows examples of classified groups of archaea that also live in water sources. Their size ranges from 0.1 to 15 µm, while the genome length is between 0.5 and 5.5 MB. Similar to bacteria, archaea have their own DNA, but their DNA is not contained within a nucleus, as it is not surrounded by a membrane, unlike in the cells of plants, animals, fungi, algae, and protozoa. Some of these archaea do not only live in water, but can also be found in soil and within various complex living organisms (e.g., cows, humans). All archaea have epithelial-bound lipids, a lack of peptidoglycan in their cell walls, and structurally complex RNA polymerases that are more similar to those in animals and humans than in bacteria.[176]

176 Madigan, M. T., et al. (2021). *Brock biology of microorganisms*. Pearson.

5.4.7.4 Protozoa or Protozoans

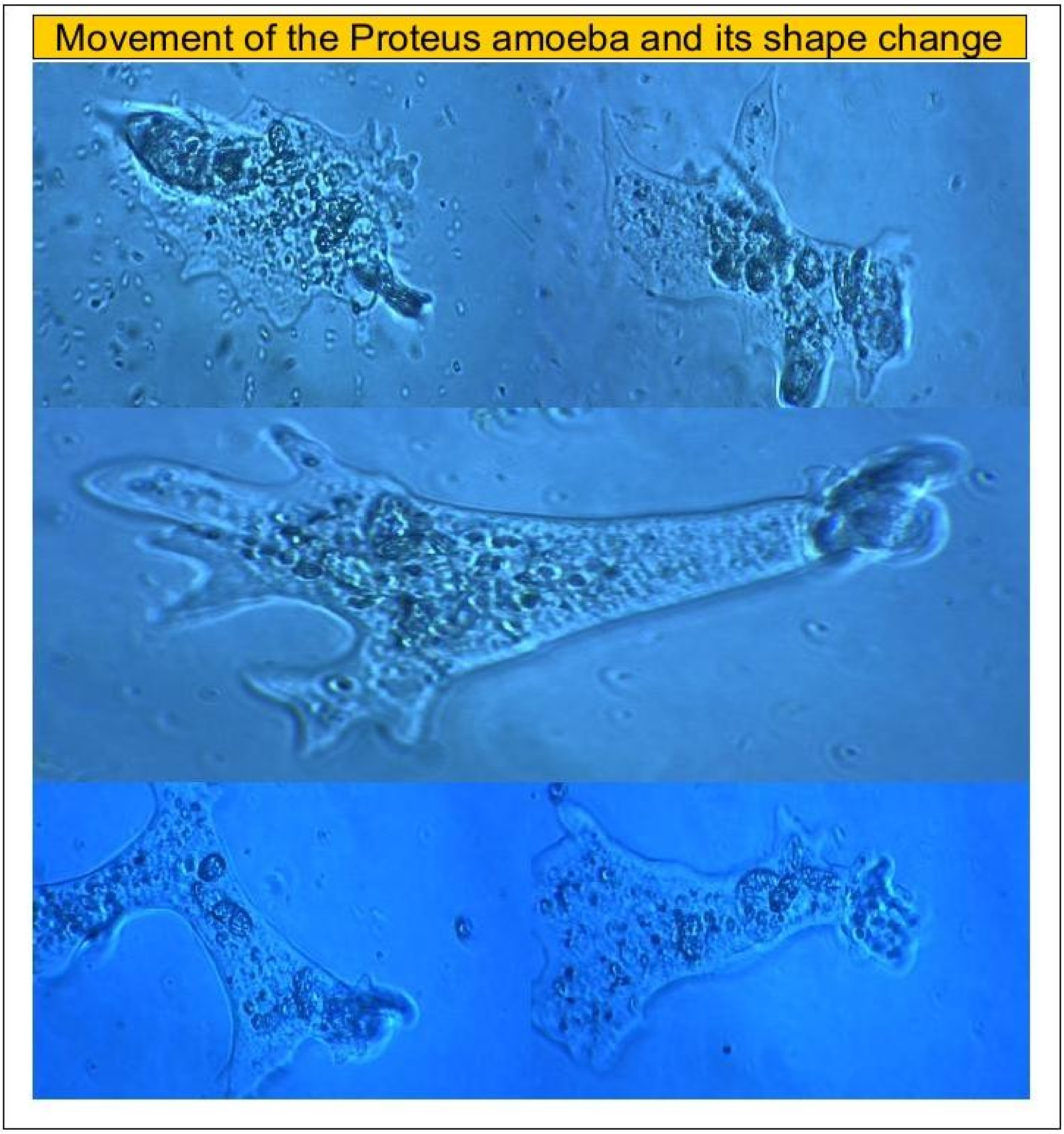
Protozoans are mostly single-celled microorganisms that belong to the group of eukaryotes, and some of them reproduce sexually.[177] They appear in various shapes and sizes, ranging from amoebas, which can change their shape, to paramecia, which have a fixed shape. They can be found in different habitats, such as seawater, drinking water, and soil. Free-living protozoa are most commonly found in fresh, mineral, and saline waters, while there are also species that live in soil, moss, and even in hot springs. All protozoa are dependent on water and cannot survive without it. Some protozoa or protozoans can be parasites that exploit the hospitality of plants, animals, and humans, causing serious diseases (such as Plasmodium, which causes malaria). The feeding method of protozoa is heterotrophic, meaning they feed on other living organisms. Certain species of protozoa can form symbiosis with algae, which, through photosynthesis, provide an additional source of nutrition. Most protozoa lack a rigid external cell wall. Protozoa are mobile, using various methods of movement. Ciliates have tiny hair-like structures covering the exterior of the microorganism. They move by using these, which resembles rowing. Flagellates have flagella that allow them to move like a whip, creating waves that facilitate movement. The third most common and well-known technique is amoeboid movement. An organism like an amoeba moves by extending temporary protrusions, filled with cytoplasm that flows from the cell body. In this way, the amoeba can change its shape as needed. The size of protozoa is estimated to range from 1 µm (such as Plasmodium falciparum) to 20 cm (such as the foraminifera amoeba). The genome length also has an exceptionally wide range, from 100 KB to 200,000 MB (such as the amoeba). The following will present some representatives of protozoa that live in water.

5.4.7.4.1 Amoebas

Amoebas are single-celled organisms capable of changing their shape by extending and retracting pseudopodia. Amoeboid cells are not found only in protozoa but also in animals, fungi, and algae. This indicates that there are several different types of amoebas. Amoebas do not have a cell wall, which allows them to move freely using cytoplasmic extensions, similar to legs, called pseudopodia. Amoebas reproduce asexually by simple cell division. The size of amoebas typically ranges from 0.01 to 0.5 mm, although there are much larger ones (such as Syringammina fragilissima, which can reach a diameter of 20 cm). They mainly feed on bacteria, algae, and other protozoa (such as paramecia). Essentially, they consume anything that comes their way. The genome size of Proteus amoeba is 1,000 times larger than the human genome, and there are even

177 According to many scientific experts in the field of microbiology, the term protozoa is outdated and has been replaced by the term protists. This defines such microorganisms as single-celled organisms that cannot be classified as animals, plants, or fungi.

amoebas with much larger genomes (such as Amoeba dubia). This raises the legitimate question of why amoebas need such an extensive genome. Amoebas essentially perform various functions, such as movement, metabolism, reproduction, etc., and are not highly specialized but have a broad feeding range. Furthermore, they can (as already mentioned) change their size and shape quite freely, which likely explains why they have such an extensive genome. Amoebas can even survive without oxygen.



5.4.7.4.2 Figure 341: Shape and size changes of the Proteus amoeba during movement

Figure 341 shows the shape and size changes of the Proteus amoeba during movement and prey capture, which primarily consists of bacteria, algae, and other protozoa.[178] The movement of the

178 The images were taken using a Zeiss Primostar 3 light microscope and an Axio 208 color camera. An oil immersion 100x objective was used for magnification. The phase contrast technique was employed.

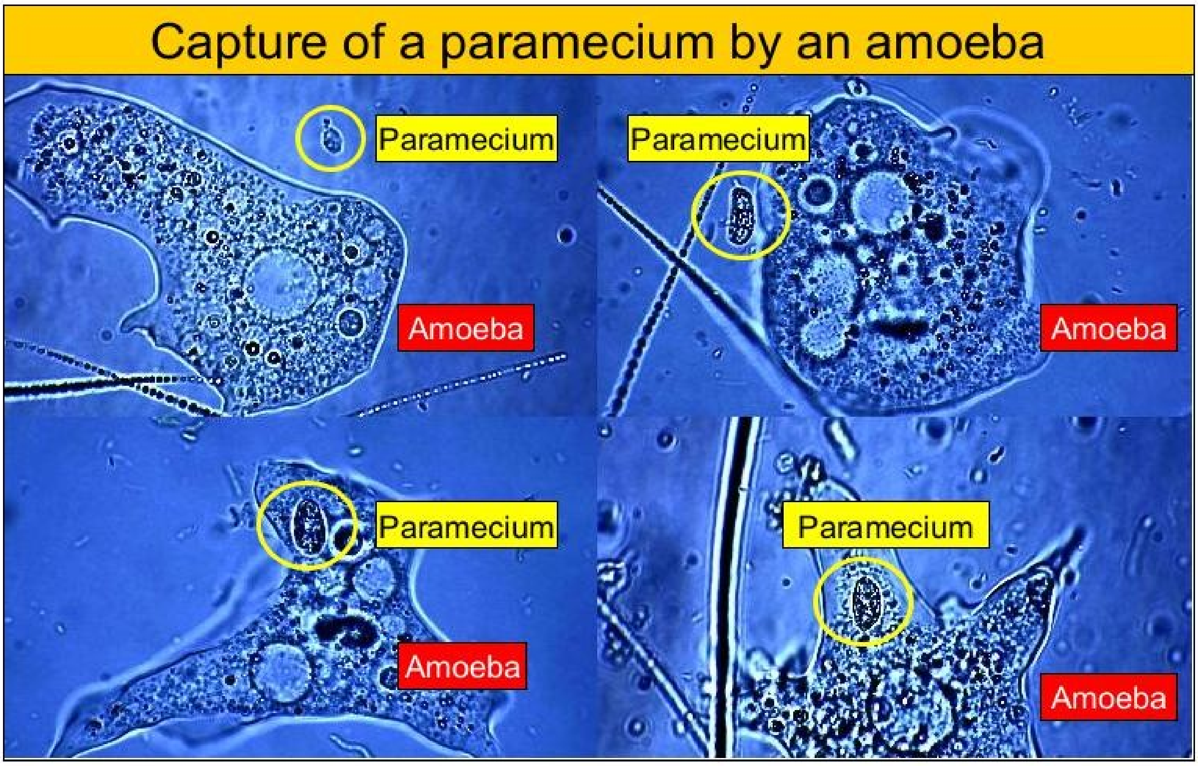
amoeba is primarily determined by attractive and repulsive forces, as it tends to move towards the negative electrode and generally avoids the positive one. This means that amoebas are mostly negatively charged, and the electric field influences their movement. Similarly, this could apply to magnetic and electromagnetic fields. A significant factor in the movement of the amoeba is the light intensity. They avoid excessive light and darkness. The third important factor affecting their movement is the temperature of the water they are in. Similar to light intensity, they also avoid extreme cold and warm environments, preferring a temperature range of 20 to 25°C. A very important factor influencing the movement of the amoeba is the pH of the water, which is most favorable for amoebas in the range of 6.50 to 7.50. The movement of the amoeba is also influenced by various obstacles (such as sharp objects, toxic substances, predators like fish, small crustaceans, and certain bacteria) present in the water. All of the factors mentioned, and likely many others, not only affect the movement of the amoeba but also its shape-changing ability, which in turn impacts its feeding behavior. As a food source, they capture living organisms that do not live in extreme conditions and do not predominantly move in environments with sharp objects, dense fungal networks, or toxic substances, as the amoeba requires relatively more space to move. As seen in the images, the shape of the amoeba constantly changes under the influence of the factors described above. The changes in the shape and size of the amoeba also represent its adaptation to the existing environment, where there are more and less favorable conditions, particularly in terms of nutrients.

5.4.7.4.2 Paramecium

Paramecium is a single-celled microorganism that contains two nuclei in its cytoplasm. The size of a paramecium ranges from 50 to 350 µm, while its genome size may be up to twice the size of the human genome.[179] The reproduction of paramecia depends on the amount of food available. If food is scarce, they typically reproduce sexually through conjugation. Under favorable conditions, when food is abundant or at least sufficient, they reproduce asexually (by binary fission). There are about 15 different species of paramecia. Paramecia move using cilia, which classifies them as ciliates. Paramecia are microorganisms that live exclusively in water and are generally not found in the human body. While paramecia can have the potential to harm human health, they also have the potential to benefit it. They primarily feed on bacteria, algae, and yeasts, while their predators include amoebas, dinoflagellates, and water fleas. Some species of paramecia can serve as hosts to bacteria, archaea, and algae. In particular, they can form a beneficial symbiosis with algae, aiding in additional food acquisition through photosynthesis. Paramecia avoid excessive light, low temperatures, and overly acidic or alkaline environments. While they can adapt to lower

179 Madigan, M. T., et al. (2021). *Brock biology of microorganisms*. Pearson.

temperatures, they cannot survive in waters with a pH range of 1 to 4.7 or from 10.7 to 14. The most favorable pH range for the life of paramecia is between 4.7 and 6.7.[180] The aforementioned conditions create favorable circumstances for paramecia and amoebas to frequently encounter each other, with paramecia being a popular food source for amoebas.

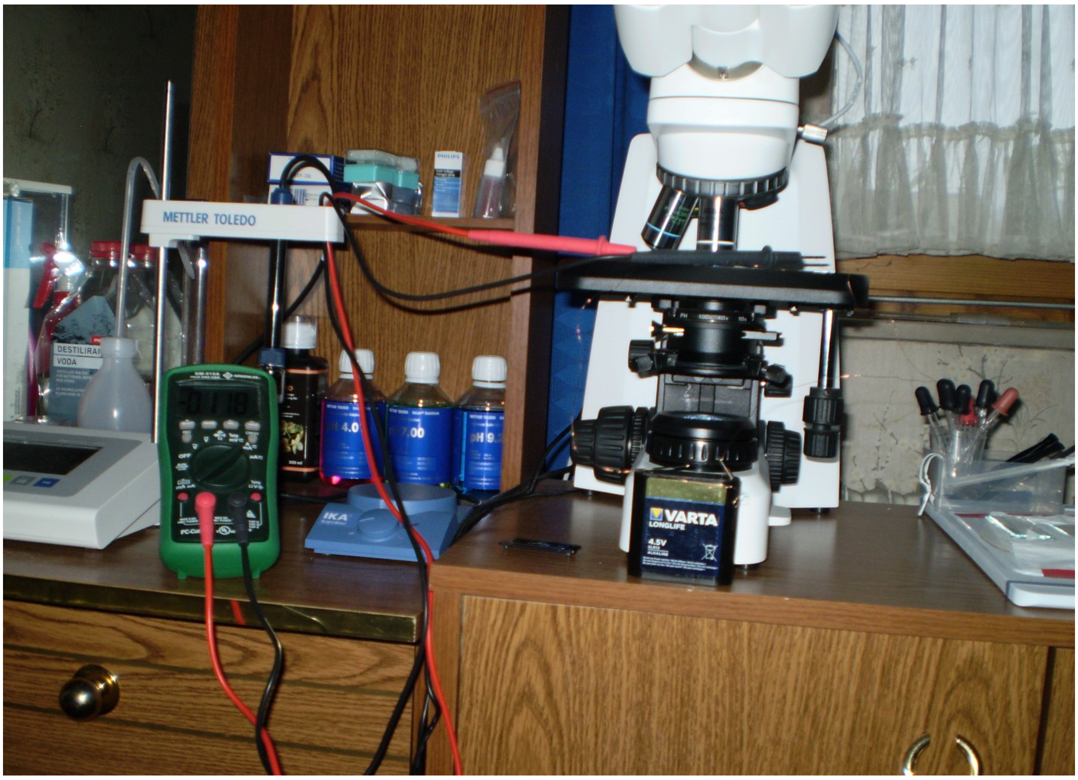


5.4.7.4.2.1 Figure 342: Paramecium as prey to an amoeba

Figure 342 shows a part of the predatory event between an amoeba and a paramecium, where the former consumes the latter. In fresh water, the probability of an encounter between these two species is very high, as both organisms prefer a relatively mild environment with suitable temperature and pH levels. Paramecia are more commonly found in denser areas of aquatic plants and algae, where bacteria are also abundant, while amoebas require more space for movement, which is not optimally possible in a densely vegetated environment. Nevertheless, amoebas and paramecia frequently encounter each other. Amoebas contain large amounts of ingested food in the form of bacteria, algae, and other microorganisms, which acts as a magnet for paramecia, as they also feed in a similar way. In short, paramecia seek an entrance to access the inside of the amoeba and obtain food, particularly bacteria and algae, which are abundant in the amoeba's body. The amoeba allows this entrance but simultaneously creates a chamber from which the paramecium cannot escape. The outcome is well known, as the prey in the form of the paramecium is gradually

180 Heydarneja, M. S. (2008). Survival of paramecium caudatum at various ph values and under normoxic and hypoxic conditions. *Pakistan Journal of Biological Sciences*, 11(3), 392–397. https://doi.org/10.3923/pjbs.2008.392.397.

digested within the amoeba. This provides the amoeba with an exceptionally rich diet, as paramecia also contain ingested bacteria, algae, and other microorganisms. For this reason, paramecia are a popular food source for amoebas. As observed, the food chain is effectively carried out even at the level of the aquatic microcosm, with both food pyramids and food networks existing. The hierarchical and associative connections between predators, prey, and various symbioses are not always strictly linear, as they also involve very complex and intertwined relationships, much like at the mesocosmic level. Using the available resources, an experiment was conducted to observe the movement of paramecia and bacteria under the influence of an electric current or field. Under the influence of the electric current or field, paramecia typically (similar to amoebas) orient themselves towards the negatively charged electrode or cathode.[181] The following will describe the experiment along with its results.

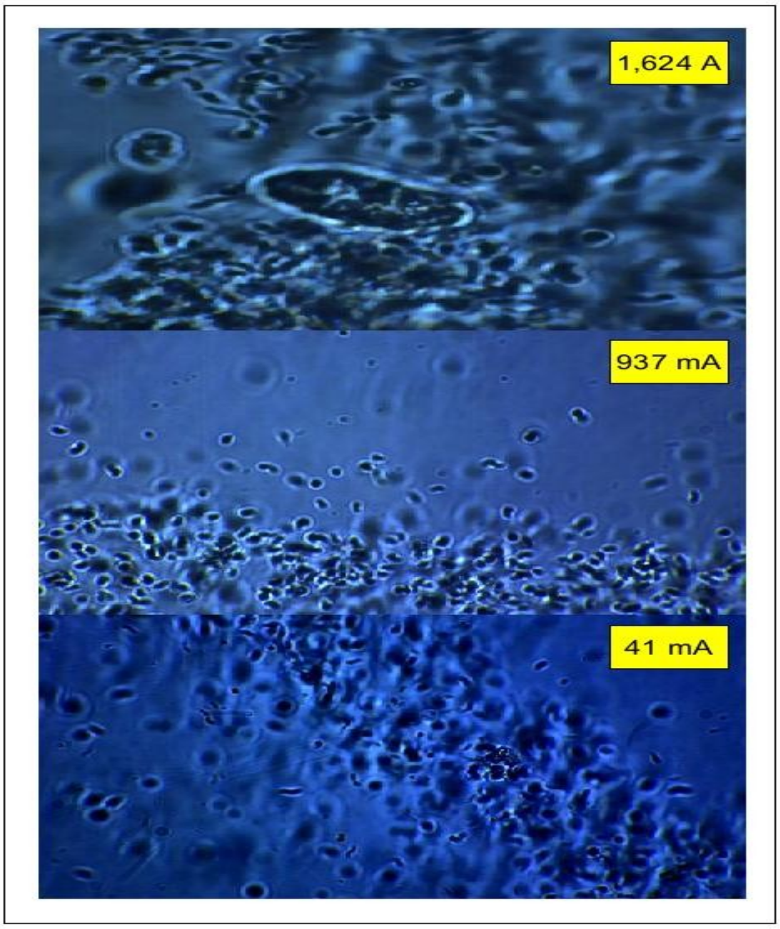


5.4.7.4.2.2 Figure 343: Image of the experiment on the effect of electric field on paramecia

Figure 343 shows an image of the experiment testing the effect of an electric field on paramecia and other microorganisms. A droplet of river water, enriched with algae, was placed on a microscope slide, which was then covered with a cover slip. On the left and right sides of the cover slip, two thin layers of modeling clay were placed to attach wires from both the positive and negative voltage sources (4.5 V battery). Additionally, the current was measured with a multimeter in amperes and

181 Ogawa, N., Oku, H., Hashimoto, K., & Ishikawa, M. (2006). A physical model for Galvanotaxis of Paramecium Cell. *Journal of Theoretical Biology*, 242(2), 314–328. https://doi.org/10.1016/j.jtbi.2006.02.021.

milliamperes. The sample was then focused using objectives such as 4x, 10x, 40x, and 100x (oil immersion). Initially, the current was 1.624 A, but it gradually decreased to 39.64 mA. At higher current values, the movement of both the paramecia and bacteria was much more directed towards horizontal swarms at the southern pole of the cover slip. After a noticeable drop in the electric current, the horizontal swarm initially shifted more towards the center of the sample under the cover slip, becoming more diagonal and smaller in size.



5.4.7.4.2.3 Figure 344: Images of paramecium and bacteria formations under the influence of electric current

Figure 344 shows images depicting the outcome of the effect of electric current on the formations of paramecia and bacteria within a sample of river water enriched with algae. The top image shows a dense formation of paramecia and bacteria with a horizontal orientation at a current value of 1.624 A. At a lower current value of 937 mA (see the middle image), it can be observed that the horizontal formation of bacteria is less dense, with occasional paramecia moving quickly north and south within the formation, similar to dolphins (this is not shown in the image at 100x magnification with oil immersion). In the bottom image, at an even lower current strength, it can be seen that the bacteria's orientation has changed to a diagonal formation, shifting more or less towards the center of the sample, while paramecia are nearly absent. In addition to galvanotaxis, there is also magnetotaxis, which refers to the movement response of a specific organism or living cell to a magnetic field. In this experiment, a neodymium magnetic tower (11 neodymium magnets in the form of discs) was used in motion through an electric conductor, but no changes in the formation of bacteria or paramecia were observed. Some international experiments report on the impact of gravitational (gravitaxis), electric, and magnetic fields on the movement of paramecia in water samples.[182]

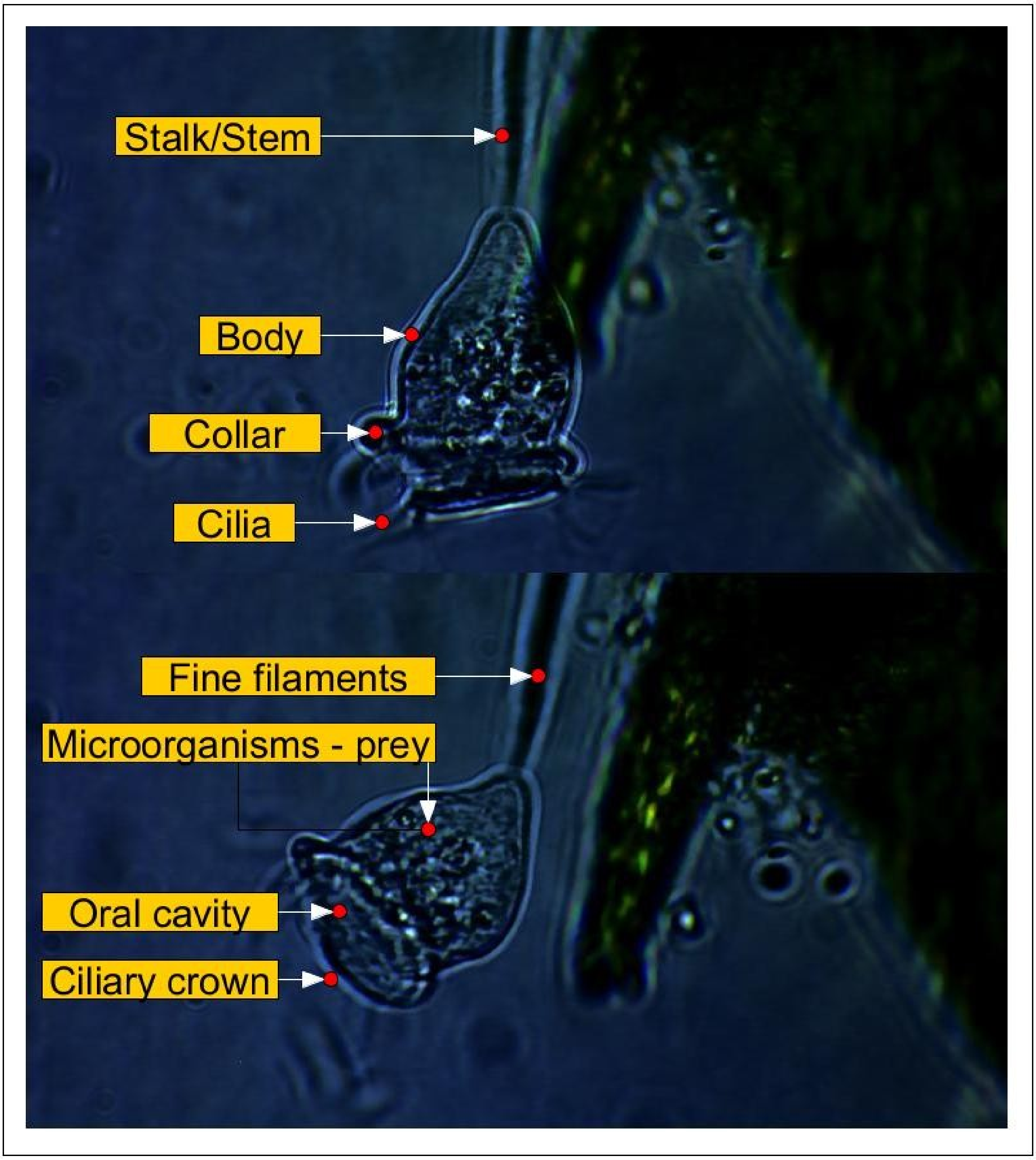
5.4.7.5 Vorticella

Vorticella is a genus of bell-shaped ciliates with a stalk that allows them to attach to a suitable surface. The stalk forms after the free-swimming phase. Vorticella primarily feeds on bacteria and smaller protozoa using moving cilia that function like a sort of suction device. The prey is literally sucked into the interior of the vorticella, where it is processed or metabolized. Vorticella can be found in both fresh and saltwater sources. They often appear singly, but can also be found in groups that resemble networks, with each vorticella's stalk being individually attached and not sharing a common node. They can reproduce asexually by fission or sexually through conjugation. Around 150 different species of vorticella are known to benefit aquatic environments and, consequently, humans. Their bodies typically range from 30 to 40 µm in size, while their stalks can be up to 100 µm long. Vorticella has two nuclei in its cell, containing DNA. The micronucleus is diploid, meaning it contains (like in humans) two copies of each chromosome. Genes in the macronucleus are actively transcribed into mRNA (similar to humans) and then translated or processed into proteins. The genome size is estimated to be between 70 to 130 MB. This value applies to various species of vorticella, such as C. ceramicola, Vaginicola sp., Zoothamnium, and Convallaria.[183] They thrive best in moderate conditions, such as a pH around 7.5 and temperatures around 25 °C. In their younger stages, they are free-swimming organisms, which, in their mature stages, attach to aquatic plants, algae, or inorganic substrates using their stalk. Their movement strongly resembles a spring, which can be triggered reflexively upon detecting prey. Typically, vorticellae are too long to be attacked by predators in the microcosm, with the exception of rotifers, which can tear off small parts. Potential threats to vorticellae can come from mosquito larvae, which can infect them. This information indicates that vorticellae are at the top of the food pyramid within the microcosm. Some green algae can live inside the bell of the vorticella, where mutualistic symbiosis occurs. The

182 Ogawa, N., Oku, H., Hashimoto, K., & Ishikawa, M. (2006). A physical model for Galvanotaxis of Paramecium Cell. *Journal of Theoretical Biology*, 242(2), 314–328. https://doi.org/10.1016/j.jtbi.2006.02.021
Swenson, J. E. (1975). *Magnetotactic behavior of Paramecium caudatum*. Fairleigh Dickinson University.

183 These are approximate estimates of values taken from the following article: Chen, X., Wang, C., Pan, B., Lu, B., Li, C., Shen, Z., Warren, A., & Li, L. (2020). Single-cell genomic sequencing of three peritrichs (Protista, Ciliophora) reveals less biased stop codon usage and more prevalent programmed ribosomal frameshifting than in other ciliates. *Frontiers in Marine Science*, 7. https://doi.org/10.3389/fmars.2020.602323.

vorticella provides the algae with a safe environment for survival, while the algae supplies the vorticella with an additional food source. The movement of vorticellae can be controlled by phototaxis, galvanotaxis, and magnetotaxis. Vorticella Convallaria can be used as a linear actuator or sensor for temperature, speed, and acceleration. Let’s also take a look at the general structure of vorticella.



5.4.7.5.1 Figure 345: Basic structure of vorticella

Figure 345 illustrates the basic or approximate structure of a vorticella, which strongly resembles a bell—hence its common name "bell animalcule." The vorticella consists of a bell-shaped body and a long stalk, which is typically attached to an organic or inorganic surface. Inside the stalk are fine filaments. At the top of the vorticella's body are the collar and the ciliary crown. The ciliary crown is lined with numerous moving cilia, which generate a suction-like pressure. Prey such as bacteria, algae, and smaller protozoa are easily drawn into the oral cavity, where they are subsequently digested (see the lower part of the image, labeled "microorganisms – prey").

5.4.7.6 Didinium

Didinium is a genus of single-celled ciliates and free-living predatory protozoa most commonly found in marine and freshwater environments. Most species of Didinium feed exclusively on paramecia, though they will also consume smaller ciliates. They have an oval shape and typically measure between 50 and 150 µm in size. Their genome is relatively small, ranging from 350 to 1,650 base pairs.[184] They contain primarily linear DNA or RNA. Similar to paramecia and amoebae, they avoid extreme values of both temperature and pH. Didinia are highly specialized predators that primarily feed on paramecia by injecting them with a toxin and slowly digesting them.

5.4.7.6.1 Figure 346: Shape and structure of Didinium

Figure 346 shows the shape and structure of a Didinium. The cell body is surrounded by two ciliary bands—an upper and a lower band. These bands are used to propel the Didinium through the water by rotating the cell around its axis. At the front end, there is a cone-shaped part of the body used to detect and capture prey. The contractile vacuole and anal opening are located at the rear end of the cell. Like other types of ciliates, Didinia can reproduce asexually through binary fission or sexually through conjugation. We have briefly introduced some representatives of protozoa. We will now continue with a short presentation of algae.

184 Data obtained from a source: https://www.ncbi.nlm.nih.gov/nuccore/?term=txid5996[Organism:exp] (2021-11-07).

5.4.7.7 Algae

Algae are thallophytes, meaning they lack true organs such as stems, leaves, and roots, and instead possess a simple body structure called a thallus. Algae are important producers of food for living organisms at both the microcosmic and mesocosmic levels. They also play a key role in forming beneficial symbiotic relationships with other living organisms (e.g., algae and protozoa). Algae can be unicellular or multicellular and exhibit a wide range of structural diversity. Their size also varies greatly—some species are visible only under a microscope, while others can be seen with the naked eye.

Classifying algae can be somewhat problematic, as they exhibit both animal-like and plant-like characteristics, making them best understood as something in between—not strictly animals or plants. Algae are commonly found in saltwater sources, but also occur in freshwater environments and even on land where humidity levels are high or very high.

Based on the shape of the thallus, algae can be categorized as:

- Unicellular flagellates (capable of independent movement and forming associations),
- Spherical forms (capable of forming groups but unable to move independently),
- Multicellular filaments (which may exist independently or in clusters),
- Tissue-like thalli (e.g., highly developed brown algae),
- Tubular forms (large enough to be visible to the naked eye).

Using chloroplasts that contain DNA, algae perform photosynthesis. They thrive best at temperatures between 17 and 20 °C and at pH levels from 8.2 to 8.7. Their growth decreases in pH ranges from 6 to 7 and drops significantly at extremely low or high pH values. Many algae species require lower light conditions for efficient photosynthesis, as excessive light reduces photosynthetic efficiency.[185] The genome size of algae varies greatly, ranging from 16.5 Mb and 1,500 Mb all the way up to 185 Gb.[186] Algae are generally extremely beneficial to both ecosystems and many living organisms, including humans, as they produce oxygen and, as previously mentioned, serve as a rich source of nourishment for numerous microorganisms and more complex life forms. Algae are used across many areas of our societal activities, including medicine, cosmetics, plastic production, food technology, biofuels, and more. The coloration of algae is highly diverse, with brown, red, yellow, orange, blue, and green varieties known. Some algae are capable of moving independently, while others are anchored to solid surfaces or rely on wind and water currents for movement.

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185 Singh, S. P., & Singh, P. (2015). Effect of temperature and light on the growth of algae species: A Review. *Renewable and Sustainable Energy Reviews*, 50, 431–444. https://doi.org/10.1016/j.rser.2015.05.024.

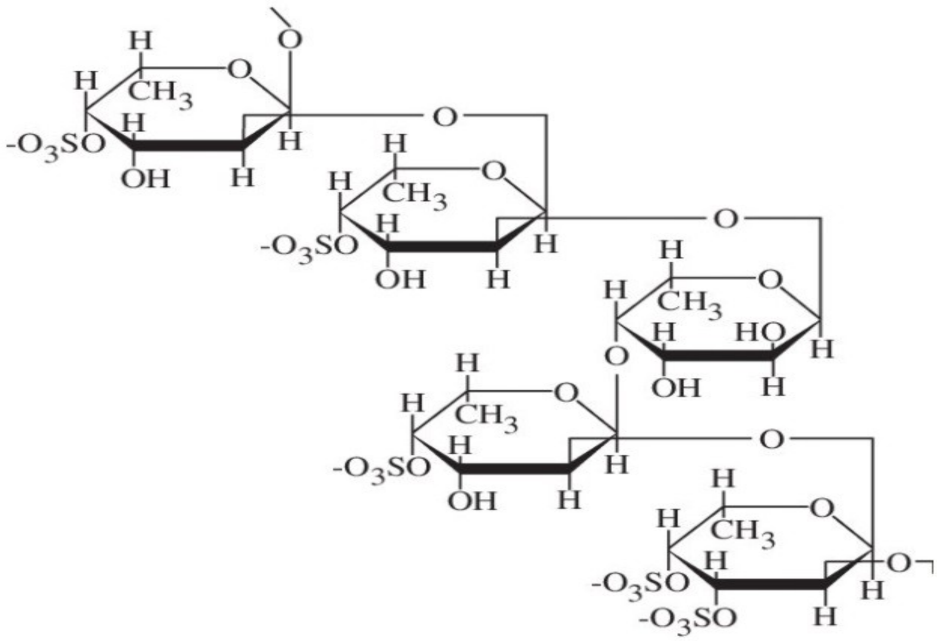
186 Blaby, C. E. (2003). Comparative and Functional Genomics. *Comparative and Functional Genomics*, 4(5), 515–515. https://doi.org/10.1002/cfg.321.

Algae are particularly fascinating due to their many shapes and structures, as their formations can create geometric patterns that appear precisely arranged from our point of view. What is perhaps most impressive is their ability to engage in mutualistic relationships with other organisms in beneficial or positive interactions, offering additional food sources or serving as visual shields against predators. In such mutualistic processes, algae also benefit by creating a safer and more favorable living environment either inside or around another organism.

Algae are primarily composed of approximately 50% carbon, 10% nitrogen, and 2% phosphorus. For effective photosynthesis and nourishment, they require a combination of carbon dioxide, water, and sunlight, which supports their growth. Through photosynthesis, algae produce oxygen and various sugars, which they primarily consume themselves. In certain cases, algae can also produce hydrogen during photosynthesis—for example, blue-green algae or cyanobacteria.[187] This could be important for future energy production and utilization, particularly in the development of new fuels that do not pollute our atmosphere. Genetic crossbreeding of different algae species is a less explored field compared to that of plants; however, it has been proven that there are algae which are the result of gene hybridization between two distinct algae species (e.g., Carpophyllum maschalocarpum and Carpophyllum angustifolium).[188] Let us now devote a few more words to brown algae in connection with the experiments. The chemical composition of brown algae in their dry state can range from 46% to 63% protein, 8% to 14% carbohydrates, 4% to 9% lipids, and 2% to 5% nucleic acids. The cell walls of brown algae contain a special sugar, such as sulfated polysaccharide, which includes SO_3 groups, as shown in the following structural formula.

187 Sharma, A., Arya, S. K. (2017). Hydrogen from algal biomass: A review of production process. *Biotechnology Reports,* 15, 63–69. https://doi.org/10.1016/j.btre.2017.06.001.

188 Hodge, F. J., Buchanan, J., & Zuccarello, G. C. (2010). Hybridization between the endemic brown algae carpophyllum maschalocarpum and Carpophyllum angustifolium (Fucales): Genetic and morphological evidence. *Phycological Research,* 58(4), 239–247. https://doi.org/10.1111/j.1440-1835.2010.00583.x.



5.4.7.7.1 Figure 349: Polysaccharide with a sulfate IV group

Figure 349 illustrates a portion of the structural formula of a polysaccharide containing a sulfate IV group, where an SO_3 group is observed on the left side instead of an OH group. Such saccharides can be extracted from brown algae and subsequently used for nutritional and medical purposes.[189] The mentioned sulfate polysaccharide within the cell walls of algae represents an interesting starting point for physicochemical tests. In this context, tests were carried out based on the electrolysis of brown algae and a 1% solution of sucrose. A 4.5 V battery and two copper electrodes in the form of very thin wires were used for the electrolysis. A test was conducted with two 4.5 V batteries, one providing a current of 3 A and the other providing 0.6 A. The reaction proceeded relatively slowly, but after about an hour, it was observed that oxygen bubbles were likely released at the anode, while a light blue substance formed at the cathode. The initial association was that the final product of electrolysis at the cathode was copper (VI) sulfate pentahydrate ($CuSO_4 \cdot 5H_2O$). The basic assumption, which was not confirmed, was that electrolysis with copper electrodes could lead to the breakdown of the cell walls of brown algae (based on SO_3 in the sugar, copper, and oxygen, copper (VI) sulfate could have formed). Further electrolysis tests using only solutions of various concentrations (1%, 2%, 3%, 4%, and 5%) of sucrose without algae showed that a light blue substance also formed at the cathode. This light blue substance is therefore not copper sulfate, as measurements of the pH values (around pH 6.59 to 7.23) demonstrated, since a copper sulfate solution or blue vitriol has a much more acidic value (in our case, 3.31). Given the higher pH values of the substance formed after electrolysis, it could be concluded that copper (II) hydroxide

189 Je, J.-G., Lee, H.-G., Fernando, K. H., Jeon, Y.-J., Ryu, B. (2021). Purification and structural characterization of sulfated polysaccharides derived from brown algae, Sargassum binderi: Inhibitory mechanism of inos and COX-2 pathway interaction. *Antioxidants*, 10(6), 822. https://doi.org/10.3390/antiox10060822.

($Cu(OH)_2$), which is also light blue, was formed. To provide more clarity, the tests will be presented.

5.4.7.4.2 Figure 348: Electrolysis tests of sugar solution with and without brown algae

Figure 348 shows some electrolysis tests with stronger and weaker currents using a sugar solution with and without brown algae. The stronger current during the electrolysis caused a faster formation of a light blue substance. As mentioned earlier, when electrolyzing the sugar solution with and without algae, the same result was obtained in the form of copper (II) hydroxide. These tests were relatively unsuccessful in relation to the initial assumption that SO_3 ions from the sugar would influence the formation of copper (VI) sulfate, leading to the breakdown of the cell walls of brown algae. Therefore, it was decided to conduct another electrolysis test using river and distilled water with brown algae. River water and brown algae were added to the first 100 ml beaker, while distilled water and brown algae were added to the second 100 ml beaker. The electrolysis was then carried out using two 4.5 V batteries providing 3 A of current and two connected copper wires. It was important to ensure that each copper wire touched the bottom of the container and the brown algae. During the electrolysis of river water with brown algae, effects were visible after about an hour, as a white substance precipitated at the cathode, while a light blue, slightly greenish substance precipitated at the anode. The first substance is likely copper (I) chloride ($CuCl$), while the second substance, similar to the previous test, is most likely $Cu(OH)_2$. When using distilled water and brown algae, the first effect was visible only after ten hours. Light blue colloids of $Cu(OH)_2$ and white to gray colloids of $CuCl$ were visible at the bottom of the solution. At the end of both electrodes, it was observed that part of the copper wires had blackened. This could indicate that the copper oxidized to copper (II) oxide due to the release of oxygen. Let's look at some images from both tests.

5.4.7.4.3 Figure 349: Electrolysis tests of brown algae in river and distilled water

Figure 349 shows electrolysis tests of brown algae in river and distilled water. The upper part of the image shows the electrolysis of both samples, where the formation of a light blue, slightly greenish substance can be observed. The pH of both samples was measured, and it ranged from 6.61 to 6.79 (the universal pH paper strip, shown in the middle right part of the image, indicates a value between 6.5 and 6.7).

Later, a confirmatory test for hydroxyl ions was carried out using phenolphthalein, as both solutions turned purple. The lower part of the image shows an oily layer that was visible from a certain angle and under moderate lighting. This oily layer was visible, although to a much lesser extent, in the sample of algae in distilled water, which is not clearly visible due to lower resolution in the image. The so-called oily layer, when viewed from a certain angle, displayed a range of colors, from yellow, gold, purple, blue, to red. What actually happened in both electrochemical reactions? This is a question worth attempting to find a credible explanation for.

Algae in general, including brown algae, contain ions (SO_4^{2-}, NO_3^-, Cl^-, CO_3^{2-}, Ca^{2+}, Mg^{2+}, Na^+, K^+, etc.) in their cell walls, which could be released by electrolysis, potentially causing chemical reactions with the copper electrodes.[190] This could mean that the ions released due to electrolysis within the cell walls of brown algae may travel towards the cathode or anode.[191] Let's return to the observation of the oily layer, as algae, including brown algae, contain lipid oils.[192] This could explain the formation of the multicolored oily layer on the surface of the solution (see the lower part of the image). Based on the recorded indicators, various chemical reactions occurred under the influence of the electric current. Especially in the experiment with river water and brown algae, we can assume the formation of sulfate, carbonate, nitrate, phosphate, oxide, and oily substances. In the experiment with distilled water and brown algae, fewer diverse chemical reactions occurred, which can be limited to the formation of oily, hydroxyl, oxide, and sulfate substances.

Additionally, in the experiment with river water and brown algae, oxygen and hydrogen were observed to form, which was much less pronounced in the second experiment. In the first experiment, a white substance, likely in the form of carbonates, precipitated at the cathode, while a light blue substance, in the form of sulfates and copper hydroxide, precipitated at the anode. Furthermore, a black layer appeared on both electrodes, indicating oxidation and the formation of copper oxide.

In the second experiment, neither a white nor light blue layer could be observed on either the cathode or the anode, as only a thin black layer, likely in the form of copper oxide, formed on both electrodes. Electrolysis of a certain substance is generally only possible in the presence of ions, so we can conclude that algae contain ions, which is further confirmed by the experiment with distilled water and brown algae. Electrolysis with distilled water is difficult to perform, as it requires high voltage and strong current. Despite the strong presence of distilled water, brown algae allowed

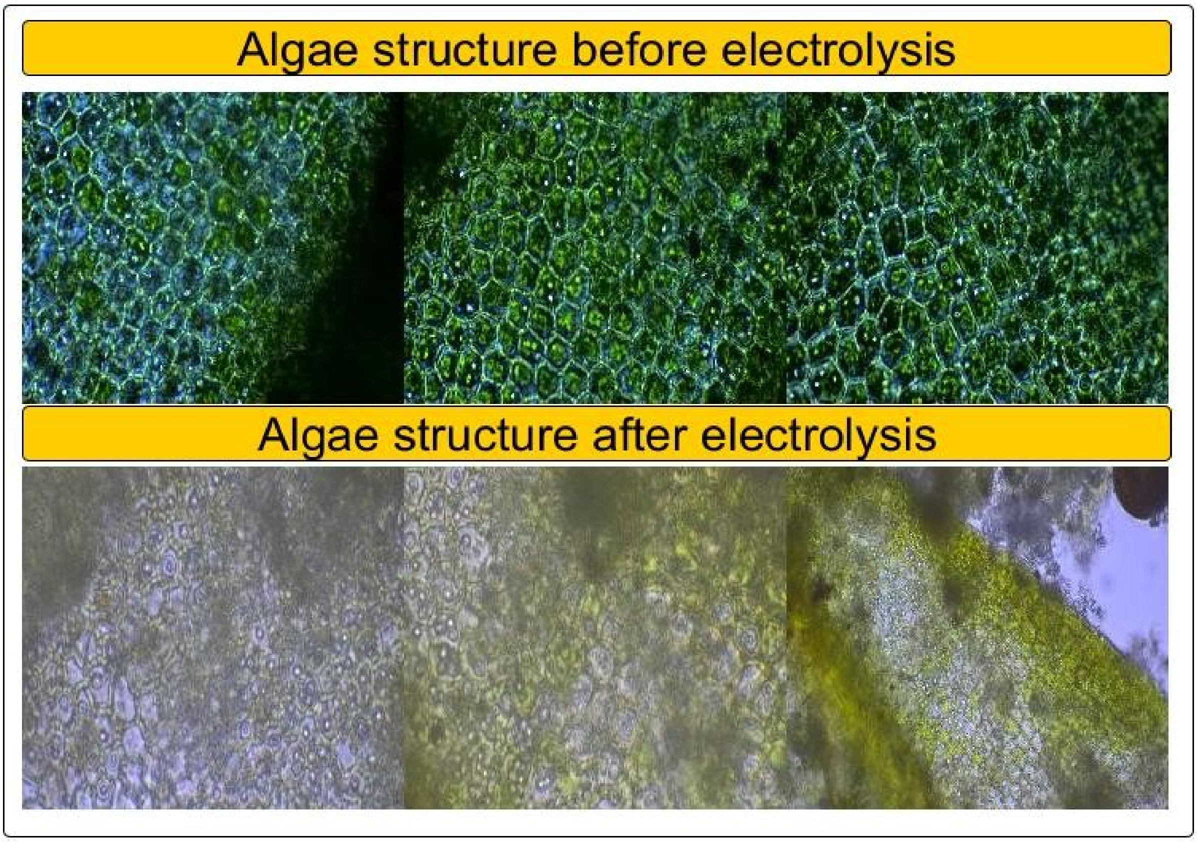
190 Sasaki, H., Kataoka, H., Murakami, A., & Kawai, H. (2004). Inorganic ion compositions in brown algae, with special reference to sulfuric acid ion accumulations. *Hydrobiologia*, 512(1-3), 255–262. https://doi.org/10.1023/b:hydr.0000020334.08794.0a.

191 Pearsall, R., Connelly, R., Fountain, M., Hearn, C., Werst, M., Hebner, R., & Kelley, E. (2011). Electrically dewatering microalgae. *IEEE Transactions on Dielectrics and Electrical Insulation*, 18(5), 1578–1583. https://doi.org/10.1109/tdei.2011.6032827.

192 Valizadeh Derakhshan, M., Nasernejad, B., Abbaspour-Aghdam, F., & Hamidi, M. (2014). Oil extraction from algae: A comparative approach. *Biotechnology and Applied Biochemistry*, 62(3), 375–382. https://doi.org/10.1002/bab.1270.

electrolysis to occur at a voltage of 4.5 V and a current of 3 A, triggering various chemical reactions both within the algae particles and on both copper electrodes.

In the electrolysis of brown algae, we can speak of composite processes of extraction (lipid oils), oxidation (copper oxide), reduction (copper hydroxide), and substitution (salts in the form of carbonates, sulfates, etc.). The structure and composition of the brown algae certainly changed at certain points, but it is difficult to conclude that a new or different type of algae was formed (e.g., the conversion of brown algae to green through electrolysis). This hypothesis can be partially confirmed by the following microscopic images of brown algae.



5.4.7.4.4 Figure 350: Structure of brown algae before and after electrolysis

Figure 350 shows microscopic images of the structure of brown algae before and after electrolysis. At first glance, it is evident that the basic structure of the polygonal cells of the brown algae has been preserved; however, the cells appear significantly less filled. A change in color is also noticeable, as the microscopic images of the algae taken before electrolysis show much more intense colors, while the images taken after electrolysis reveal paler shades. This may indicate the degradation of a certain amount of chlorophyll, which acts as a catalyst in photosynthesis for the production of oxygen and glucose.

However, electrolysis alone likely cannot produce a different type of algae. The section briefly introduced algae, which are key food producers in aquatic microecosystems. Some algae species can also appear at the mesocosmic level.

We now continue with an overview of fungi in the aquatic microecosystem. It should be noted that some types of fungi, such as mushrooms, also occur at the mesocosmic level.

5.4.7.5 Fungi

Fungi form an independent kingdom of living organisms and are heterotrophs that live saprophytically, parasitically, or in symbiosis. They can be found in freshwater sources, on land, and occasionally even in saltwater. Some types of fungi are extremely harmful to human health, while others do not pose health risks under normal conditions.

Fungi do not contain chlorophyll, but they have a thallus that is not structured like that of plants. All known species of fungi are highly dependent on water, while they are less dependent on sunlight. They feed on living organisms such as plants, and mostly on dead animals. As a result, they are most commonly found in areas rich in organic material, such as compost and dense forests.

Certain species of fungi live in symbiosis with plants, while others can be parasitic or even predatory. They can reproduce sexually or asexually through complex processes. The size of their genome ranges from 8.97 Mb to 178 Mb. Fungi have a complex cellular organization and possess their own DNA, which is wrapped around histone proteins.

They thrive best at temperatures between 25 °C and 35 °C and in environments with a pH between 5 and 7.[193] The size of most microscopic fungi ranges from 2 to 10 μm in width and from 5 to 50 μm in length, while fungi at the mesocosmic level can reach sizes of 30 cm or more.

Most types of fungi can be classified as primary consumers, as they do not use sunlight as their main energy source but instead feed on other living organisms, while also serving as a food source for higher-level consumers. The cell wall of fungi is typically composed of mannoproteins, GPI anchors (glycosylphosphatidylinositol), β-1,6-glucan, β-1,3-glucan, and chitin.[194] Fungi contain various ions, including phosphorus, nitrogen, calcium, magnesium, potassium, and selenium. An interesting experiment will be conducted involving the electrolysis of white fungi in distilled water. The experiment will use laboratory-grown fungi (see the subsection on bacteria and protozoa), obtained from human bodily fluids (saliva, semen), the enzyme Lallzyme, and a sugar solution. Several pieces of the cultured white fungus were placed in a 100-milliliter beaker, followed by the addition of approximately 30 milliliters of distilled water. Two thin copper wires, connected to a 4.5

193 Jaitly, A. K. (2019). Effect of ph and temperature on growth of fungi from city waste of bareilly. *Biotech Today*, 9(2), 82–87. https://doi.org/10.5958/2322-0996.2019.00027.9.

194 Watkinson, S. C., Boddy, L., Money, N. P., & Carlile, M. J. (2016). *The Fungi*. Elsevier, Academic Press.

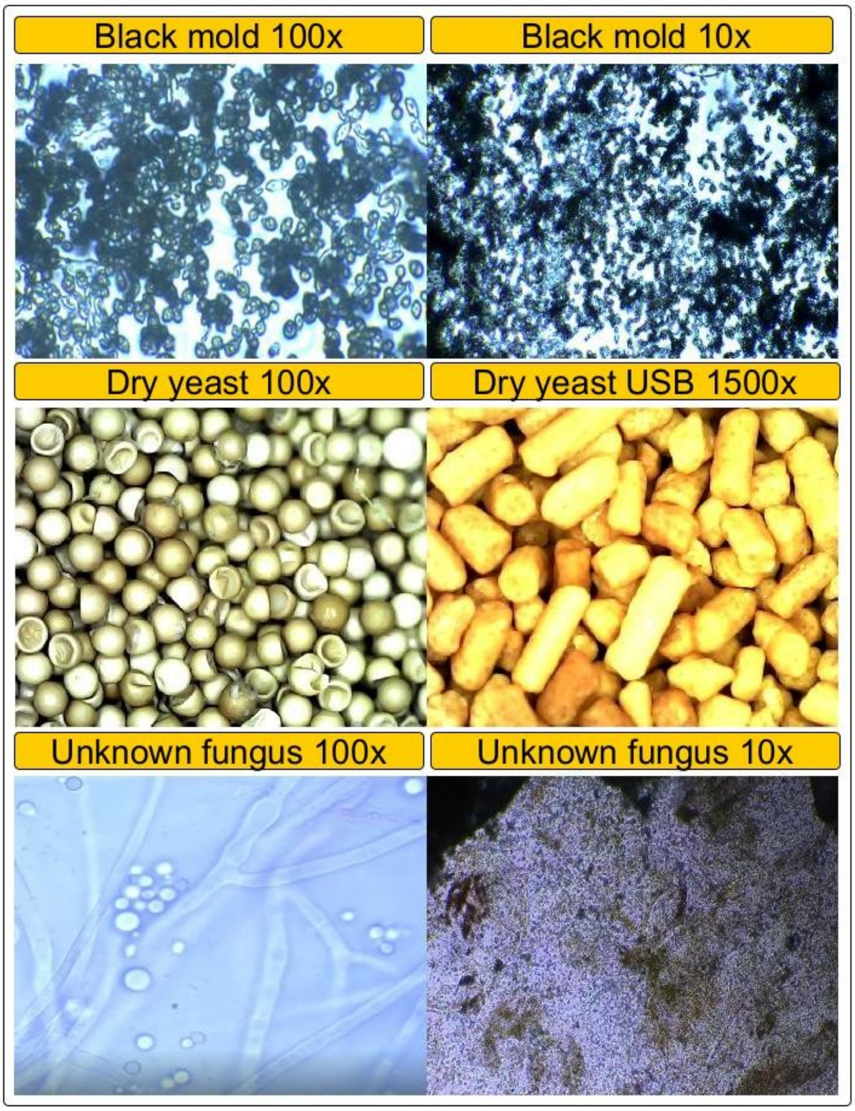
V battery with a current of 3 A, were used as electrodes. The wires were immersed in the distilled water so that their ends were in contact with the pieces of fungus. To prevent the possible spread of harmful spores into the air, the entire electrolysis setup was covered with a 1-liter beaker.
Compared to the algae, the effects of electrolysis were noticeable relatively quickly. After ten hours, a white and light blue substance with a slightly greenish tint appeared at the anode near the fungus, while the copper wire at the cathode had completely blackened. A similar effect was observed as in the electrolysis of brown algae.
Since distilled water does not contain ions on its own, electrolysis under the given voltage and current conditions would normally not be possible. However, the fungi used contained ions, which enabled the electrolysis to take place. Oxidation of the copper wire occurred at the cathode, resulting in the formation of copper(II) oxide (CuO), which is somewhat unexpected. Oxygen should typically be released at the cathode and then form two negative anions at the anode, but this effect was not visibly observed. As previously mentioned, white and light blue, slightly greenish chemical compounds appeared at the anode, while no visible blackening was observed on the copper wire. The reduction of hydrogen should have taken place at the cathode, but this evidently did not occur, as oxidation of the copper wire was observed instead.

5.4.7.5.1 Figure 351: White fungi and electrolysis

Figure 351 shows a sample of white fungi (white mold – see the upper part of the image) in a petri dish, as well as the electrolysis of distilled water and fungi (see the lower part of the image). Similar to the electrolysis of brown algae, this process also involved fairly complex oxidation, reduction, and substitution reactions.

There is no visible evidence of oil extraction in the form of an oily sheen. Although it is known that yeasts can produce oil, this cannot be confirmed for the specific, unidentified species of fungus used in this case. The pH value of the solution after electrolysis was 7.67, which is higher than that observed in algae (pH around 6.70). Just like algae, fungi also contain ions, which made the electrolysis of distilled water with fungi possible under the given conditions.

The fungal kingdom is incredibly diverse, with approximately 200,000 species discovered to date. A common feature of all fungi is their highly branched mycelial structure, which can be observed in yeasts, molds, and other types such as mushrooms. Some species of fungi pose no significant threat to human health, while others can be extremely harmful—such as the well-known blue mold, often seen on fruit, vegetables, and bread. The fungi themselves are not the primary concern; rather, it is the toxins they release during growth that can cause poisoning in the human body. Fungi can act as decomposers (detritivores), but they also serve as an additional food source for many organisms, including humans. To conclude this subsection, let's take a look at some images of various types of fungi.



5.4.7.5.2 Figure 352: Microscopic images of various fungal species

Figure 352 shows microscopic images of various fungal species at different magnifications—from black mold (see the upper part of the image) and dried yeast (see the middle part) to unidentified fungal species formed through a biochemical reaction involving human bodily fluids, soil filter, the enzyme Lallzyme HC, and a 4% sucrose solution (see the lower part of the image). Fungi have the ability to create highly complex networks using their mycelium, which can connect with the root systems of various plants.

They can also form symbiotic relationships with different types of algae, such as in the case of lichens.

Although fungi share some characteristics with animals and others with plants, they are so unique that they cannot be classified strictly as either. Based on current estimates, fungi are believed to have appeared before algae.

5.4.7.6 Water and the mesocosm

It is sometimes difficult to clearly distinguish water in the microcosmic and mesocosmic contexts, as certain substances and living organisms—such as plankton, algae, fungi, and crystals—can be found in both micro- and mesoscale forms.

The human eye typically perceives objects ranging from 80 to 100 μm in size, which can conditionally be categorized within the mesocosmic scale. Within the mesocosmos, various water sources are known to exist, and they can differ significantly in terms of chemical composition, pH level, density, and total hardness.

In general, density is closely related to total hardness, as higher water density usually indicates higher total water hardness, measured in ppm (parts per million). Total water hardness, expressed in ppm, refers to the content of both inorganic and organic substances dissolved in the water.

Total water hardness can be determined by evaporating the water and weighing the remaining residue in an evaporating dish. However, this method is quite time-consuming, so using a TDS (Total Dissolved Solids) meter is often more practical, even if it is slightly less accurate than direct weighing. Measurements of pH and total hardness from various water sources will be presented.

5.4.7.6.1 Figure 353: Measuring total water hardness with a TDS meter

Figure 353 shows the measurement of total water hardness in ppm using a TDS meter. Water sources including tap water, two streams, two rivers, a lake, and simulated seawater were tested for pH value, temperature, and total hardness. The results are presented in the following table. It will become evident that the pH and total hardness values vary significantly and deviate considerably from the ideal range. The ideal total water hardness ranges from 5 to 40 ppm. Water with values between 26 and 100 ppm can also be considered high-quality. When values exceed 100 ppm, the water is classified as hard. Water with values exceeding 180 to 200 ppm is referred to as very hard water.

5.4.7.6.2 Table 172: Ph and total hardness measurements of different water sources

Water source	Ph	Hardness	Temperature
Domestic water	6.94	271	16.8
Stream A	7.19	196	15.3
Stream B	6.38	199	15.9
River A	6.2	312	16.6
River B	6.78	188	15.5
Lake	6.67	468	15.8
Simulated sea water	6.94	>15000	24.1

Table 172 presents the pH and total hardness measurements of various water sources. The pH values range from 6.20 (slightly acidic) to 7.19 (slightly alkaline), while the total water hardness values range from 188 ppm (River B) to 468 ppm (the lake). The hardness of domestic tap water (271 ppm) indicates that it is hard and less suitable for drinking. The quality of drinking water can be significantly improved using BWT filters, which, after double filtration, can reduce total hardness to below 100 ppm. The table also includes data on simulated seawater, which contains high concentrations of sodium, potassium, calcium, chloride, and iodide ions, resulting in a total hardness of over 15,000 ppm. Naturally, such water is not drinkable and, in large quantities, can be harmful to health.

As observed with aquatic microorganisms, both pH and temperature values are crucial for their survival and reproduction. Unfavorable pH or temperature conditions in a water environment can lead to stagnation or even death of certain species. Total water hardness may also influence the movement speed of different microorganisms, as water hardness is closely related to density. Based on these findings, it can be concluded that similar principles apply to aquatic life at the mesocosmic level, where extremely low or high values of these parameters can reduce biodiversity. Furthermore, the existing structure of the natural hierarchical associative system for mesocosmic aquatic life is disrupted. This also affects food webs, as lower diversity among predators and producers means less food for survival.

Aquatic organisms at the mesocosmic level are extremely numerous and cannot all be described here. Therefore, only a small selection of various aquatic species from a broader mesocosmic perspective will be covered—primarily species such as aquatic plants, insects, fish, aquatic reptiles, amphibians, waterfowl, and aquatic mammals, which may function as producers, prey, or predators. Many species from these groups inhabit different water sources.

Before presenting aquatic life from a broader perspective, it's important to highlight a key distinction between the microcosm and mesocosm of water. Many aquatic microorganisms do not exist at the mesocosmic level or within the range of our visual perception. These are unique organisms (e.g., Vorticella, Paramecium, ciliates, rotifers, Didinium, bacteria), which primarily reproduce asexually. In the aquatic mesocosm, there is a greater emphasis on sexual reproduction among living organisms.

Natural hierarchical associative systems tend to expand when food and water are abundant. Otherwise, they shrink and may eventually collapse into a new form and structure. Currently, the universe is expanding, which means entropy is increasing. Some predictions suggest that entropy will continue to increase until a black hole forms. According to another possible scenario, the expansion could reach a critical point, after which the universe would collapse back into a cosmic seed.

When we observe different living beings, including humans, we see that all function within a certain rhythm influenced by external conditions (e.g., sun, water, climate, magnetic forces, gravitational forces) and internal biomechanical properties (e.g., heartbeat, breathing rhythm, digestion, excretion of waste). Their bodies constantly expand and contract throughout life (e.g., inhalation and exhalation, body growth in youth, shrinkage in old age).

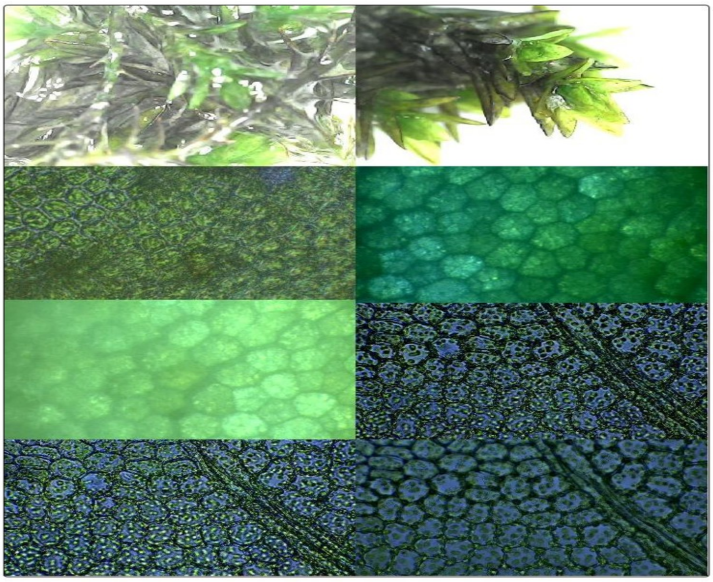
5.4.7.6.3 Aquatic plants

The term "aquatic plants" primarily refers to plants that live in, on, or near water. This includes a highly diverse range of species in freshwater and/or saltwater environments (e.g., amaranth, valerian, moss, lotus, seaweed). Water sources can include streams, rivers, pools, lakes, seas, and oceans. Aquatic plants are crucial for their habitat as they help limit the growth of undesirable algae and keep the water clean with an optimal amount of oxygen. Additionally, aquatic plants (87 families, 1,022 different species) can be an important source for bioenergy production.[195] The genome size ranges from 60 Mbp to 150,000 Mbp.[196] All aquatic plants have evolved from terrestrial plants, meaning they share many morphological and genetic characteristics with them. Aquatic plants typically lack a cuticle layer to avoid excessive dryness. They do not have xylem, as their leaves perform all the necessary functions, and they have few stomata. Aquatic plants have leaves that either protrude from the water or float on the surface with access to air and sunlight, although their roots are always located at the bottom of the water body. The most favorable temperature for the growth of aquatic plants ranges from about 16.5°C to 22.5°C. In this temperature range, the water is neither too cold nor too warm, allowing the aquatic plant to maintain

195 Hu, S., Li, G., Yang, J., & Hou, H. (2017). Aquatic Plant Genomics: Advances, applications, and prospects. *International Journal of Genomics*, 2017, 1–9. https://doi.org/10.1155/2017/6347874.

196 Heslop-Harrison, J. S. P., & Schmidt, T. (2012). *Plant Nuclear Genome Composition*. ELS. https://doi.org/10.1002/9780470015902.a0002014.pub2.

an optimal amount of dissolved oxygen. The pH value of the water also influences the effective growth of aquatic plants, as excessively acidic or alkaline water can significantly limit growth and reproduction. In swamps, extremely acidic pH values between 2 and 4 can be measured, but some swamp plants, like the swamp lily, can survive in this acidic environment. Additionally, water that is either too hard or too soft can negatively affect the growth of aquatic plants, especially when the concentration of calcium and magnesium ions is too high. Marine aquatic plants have evolved to break down saltwater into sodium and chloride ions (e.g., phytoplankton, seagrass, and sea lilies).[197] This enables osmosis, which means that water molecules can diffuse through a selectively permeable membrane. Ordinary terrestrial plants would not be able to survive in salty water because the membrane would become clogged due to the higher concentration of various minerals, which would prevent the formation of optimal osmotic pressure. We can understand that without the proper external physical-chemical conditions, living organisms cannot survive, including aquatic plants. This insight applies to all three cosmic planes. External physical-chemical conditions represent the peak of the natural hierarchical associative system and are essentially a prerequisite for processes such as adaptation, assimilation, symbiosis, etc. Aquatic plants must adapt to the physical-chemical conditions and form an appropriate morphological structure with optimal biomechanical properties. As an example, we can present moss on rocks along and within a stream.



5.4.7.6.3.1 Figure 354: Images of stream moss with USB and light microscope

Figure 354 shows images of stream moss captured with a USB camera (top two images) and a light microscope.[198] We can observe that the density of the leafy part is exceptionally high, indicating a

197 Rae, K. (2018). What Type of Plants Grow in Salt Water? *Sciencing* (19. april) https://sciencing.com/type-plants-grow-salt-water-5527311.html.

198 Digital USB microscope 1500x magnification. Zeiss Primostar 3 magnification 100x (immersion oil).

strong interconnection between the structures (similar to ivy). The images taken under the light microscope show polygon-shaped cells that are interconnected in a way that resembles solar panels. Because of this structure, moss does not require a large amount of sunlight or heat to carry out efficient photosynthesis—it primarily needs a constant water supply to prevent drying out. A similar cell structure containing chlorophyll can also be observed in algae.

All aquatic plants can do is turn external physico-chemical conditions to their advantage by adapting to them. Aquatic plants depend on a balance of sunlight/light, water, soil, and air—with a specific order of importance. The primary factor for aquatic plants is water, followed by sunlight/light, while soil and air are considered tertiary factors. Because aquatic plants are highly susceptible to drying out, they require a continuous and abundant supply of water molecules.

Many aquatic plants, as demonstrated with moss, are capable of utilizing light very efficiently, particularly in low-light environments, and can perform photosynthesis without needing intense sunlight or heat. Among aquatic plants, different tolerance thresholds exist depending on their resistance to environmental factors. Some species can even thrive beneath frozen surfaces, while others are more sensitive to temperature fluctuations.

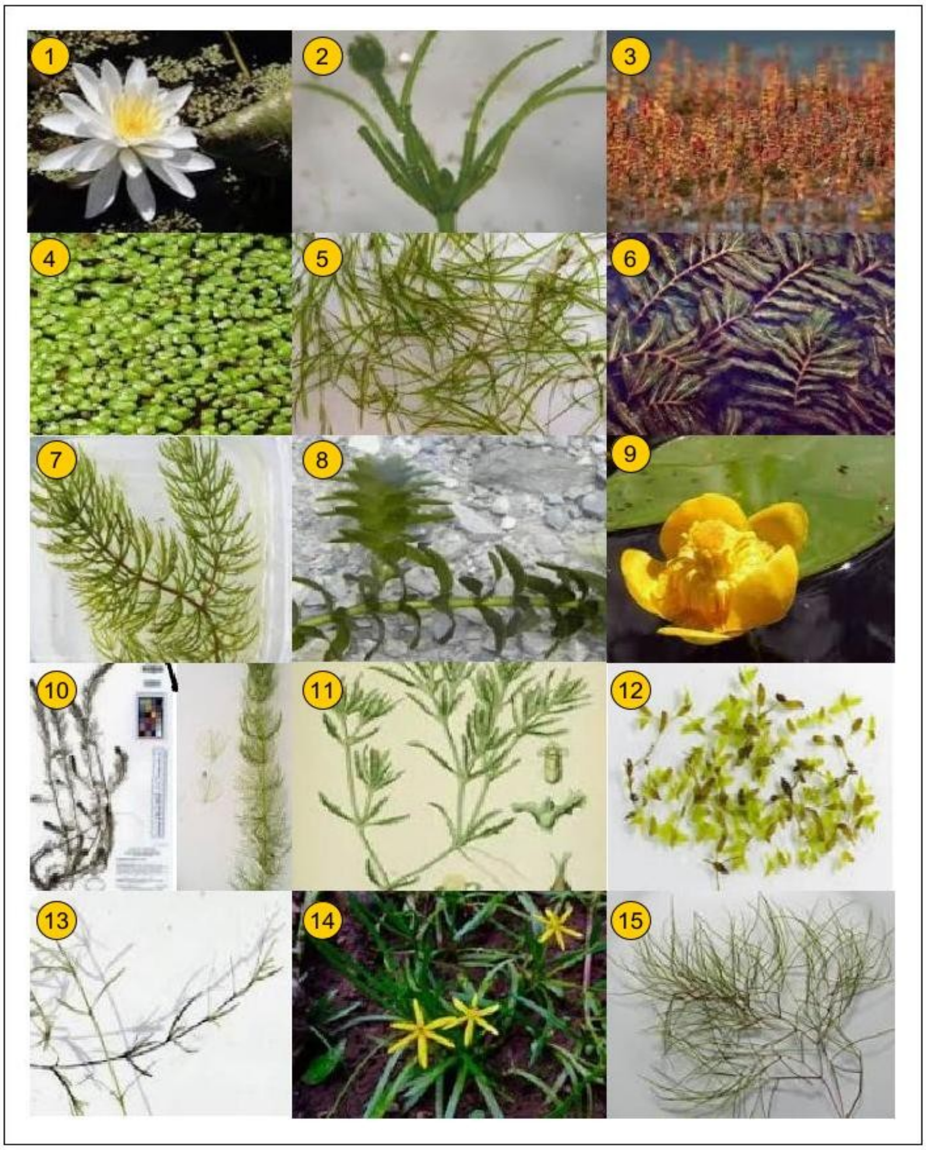
In terms of the hierarchical associative relationship between external conditions and the successful proliferation of aquatic plants, temperature, pressure, water hardness, density, and pH levels are dominant. These are followed by water supply, sunlight, and mineral-rich soil. Only at the base of this hierarchical associative structure are the biomechanical properties of aquatic plants found. This offers a more hierarchical perspective.

The associative aspect, however, provides another viewpoint. Despite the dominance of external factors like water inflow, sunlight, and nutrient-rich soil, the associative perspective shows that without the interplay between these factors, aquatic plants cannot thrive. While there are relatively frequent cases in which aquatic plants do not need much sunlight or mineral-rich soil, the complete absence of light and nutrients would prevent their nourishment. In short, this hierarchy is deeply influenced by the optimal balance among all the contributing factors, even those considered subordinate from a hierarchical perspective.

This points to a chain-like and network-based causality and conditionality within the hierarchical associative network of factors. It closely resembles how biological systems function, where it is often difficult to determine a clear hierarchy.

Each aquatic plant often serves a primary role as a producer in its ecosystem, contributing both food and oxygen. This represents a hierarchical associative system composed of numerous interdependencies, as already discussed in the subchapter on the aquatic microcosm. We will return to these and similar reflections later in order to synthesize the three levels of the aquatic cosmos.

To conclude this subchapter, we will briefly describe a few aquatic plants to highlight their various forms, characteristics, and roles in food chains. This will be a highly limited selection of aquatic plants from lake ecosystems; a more comprehensive view would require descriptions of numerous other aquatic species found in streams, pools, seas, and oceans.



5.4.7.6.3.2 Figure 355: Aquatic plants in a lake

Figure 355 shows a small selection of aquatic plants that inhabit a lake environment. These will be briefly described based on the numbered images.[199]

1. American white water lily (*Latin: Nymphaea odorata / tuberosa*)

This aquatic plant thrives best in waters with moderate alkalinity and conductivity. It grows at medium depths, approximately 91 to 106 cm. The leaves and stems are rounded, with most of the

199 Lall, N. (2021). *Aquatic plants*: *Pharmaceutical and cosmetic applications*. CRC Press, Taylor & Francis Group.Lucas, J. S., Southgate, P. C., & Tucker, C. S. (2018). *Aquaculture*: *Farming aquatic animals and plants*. John Wiley & Sons. Parker, R. O. (2012). *Aquaculture science*. Delmar Cengage Learning.

leaves floating on the water's surface. It is most commonly found in calm and relatively ecologically clean environments such as ponds and lakes. This water lily is a rich food source for birds that feed on its seeds. Additionally, deer, beavers, moose, and other terrestrial mammals feed on its roots. Its sturdy leaves provide shade and shelter for fish, allowing them to more easily hide from potential predators both from the air and underwater.

The bulb of this plant is used in the production of remedies for diarrhea, vaginal, throat, and mouth ailments. The white water lily is a free-floating aquatic plant with a rhizome that supplies the plant and its flower with necessary nutrients. It is most commonly found in the United States and Canada. While climate change does not have a direct impact on this plant, it has several indirect effects (e.g., mitigating greenhouse effects, contributing to biodiversity, improving water quality, regulating water temperature, storing large amounts of organic matter, and preserving wetlands).

The energy content of American water lilies is estimated to range from 10 kJ/g to 20 kJ/g (approximately 2.4 kcal/g to 4.8 kcal/g). No genome size data was found in the NCBI database, but based on a related species, Nymphaea colorata, the genome size is estimated to be around 400 Mb.

2. Muskgrass (*Latin: Chara vulgaris*)

This plant is actually a less typical type of algae that resembles a plant and is conditionally classified among higher plants. Its structure is very simple – it has no true roots but rather a rhizoid. It can grow up to approximately 50 cm and develops beneath the water's surface. Its main branches have ridges that are often coated with a crust of calcium carbonate. It is most commonly found in hard, deeper waters, preferring muddy or sandy bottoms.

Its dense growth covers the entire lakebed and brings numerous environmental benefits, serving as an important food source for aquatic birds. It also provides nourishment for algae and certain invertebrates. Muskgrass beds offer a favorable habitat for fish, especially sea bass. Furthermore, it improves water quality and slows down the movement of suspended solids. It rapidly spreads across open areas or lake bottoms, acting as a stabilizer. It softens water by removing lime and carbon dioxide. In short, it is highly beneficial for creating better-quality habitats and food webs.

The most common geographic regions where it thrives include the USA, Canada, Germany, and Hungary. Muskgrass does not directly impact climate change but has several indirect effects – it mitigates the greenhouse effect, produces oxygen, stabilizes sediments, contributes to biodiversity, improves water quality, regulates water temperature, stores large amounts of organic matter, and preserves wetlands.

Its energy content is estimated to be between 10 kJ/g and 20 kJ/g (2.4 kcal/g to 4.8 kcal/g). No genome size data was available in the NCBI database, but based on a related species, Chara braunii, the genome size is estimated to be around 1.70 Gb.

3. Eurasian watermilfoil (*Latin: Myriophyllum spicatum*)

This aquatic plant is often regarded as a weed. It can grow to a depth of around four meters and is found in waters with moderate conductivity and higher pH levels. It thrives best in environments with low light and higher temperatures. Due to its aggressive growth, it can displace other beneficial aquatic plants.

This plant appears to have limited environmental value, as it can disrupt efficient food webs and negatively impact habitats. It is widespread across Europe, Asia, and North America. It can influence climate change both positively and negatively—it may mitigate the greenhouse effect, lower carbon dioxide concentrations in the atmosphere, reduce nutrient pollution, and contribute to biodiversity. However, as an invasive species, it can alter water flow patterns and reduce biodiversity.

Its energy value is estimated at 10 to 20 kJ/g (2.4 to 4.8 kcal/g). Its genome size is not listed in the NCBI database but is estimated to be around 260 Mb.

4. Common duckweed (*Latin: Lemna minor*)

This is a small, free-floating aquatic plant typically found in bays and calm, wind-protected areas. It is not dependent on water depth or substrate, and is commonly found in waters with moderate alkalinity and conductivity. In stagnant waters, it can cause issues, but otherwise, it is a valuable food source for waterfowl, beavers, and fish. It offers less effective shelter for fish and invertebrates.

It is geographically widespread in North, Central, and South America, as well as Europe and Asia. It can directly influence climate change by mitigating the greenhouse effect, supporting biodiversity, improving water quality, and promoting efficient nutrient cycling, though it may also contribute to the warming of water bodies.

Its energy value is estimated at 10 to 20 kJ/g (2.4 to 4.8 kcal/g). Its genome size is not available in the NCBI database, but it is estimated to be around 360 Mb.

5. Sago pondweed (*Latin: Potamogeton pectinatus*)

It grows at depths of up to four meters, most commonly between one and three meters. It can survive in very turbid, moderately alkaline, and conductive waters. Its flowers and fruits grow on slender stalks, which may be submerged or floating. It is considered a highly expansive aquatic plant and is tolerant of pollution. It is well-rooted and has slender, branching stems with narrow, grass-like leaves. It provides habitat for insects, which are important food sources for fish and waterfowl. Its fruits and tubers are food for certain bird species.

This plant is widespread in Europe, Asia, Africa, and Central and North America. It can influence climate change by mitigating the greenhouse effect, maintaining healthy nutrient balance, and supporting biodiversity.

Its energy value is estimated at 10 to 20 kJ/g (2.4 to 4.8 kcal/g). Its genome size is not listed in the NCBI database but is estimated at around 351 Mb.

6. Curly pondweed (*Latin: Potamogeton crispus*)

This plant typically grows in shallow waters up to 3.5 meters deep and prefers soft substrates. It tolerates low temperatures and low light well, and is not sensitive to turbid water. It thrives in moderately alkaline and conductive waters.

It provides food and shelter for some fish and invertebrates, particularly in winter and spring. However, it may be less environmentally beneficial, especially due to decomposition processes that can lower oxygen levels and promote harmful algal blooms.

Geographically, it is widespread in Europe, Asia, Africa, and North and Central America. It can impact climate change by mitigating the greenhouse effect, maintaining nutrient balance, and contributing to biodiversity.

Its energy value is estimated at 10 to 20 kJ/g (2.4 to 4.8 kcal/g). Genome size is not listed in the NCBI database but is estimated at about 400 Mb.

7. Coontail (*Latin: Ceratophyllum demersum*)

This plant primarily grows in clean waters up to five meters deep. It is found in a variety of chemical conditions but prefers soft substrates. It can also thrive in less clear waters.

It has long stems and no true roots but can loosely anchor in sediments. It tolerates low temperatures and light, allowing it to remain evergreen and photosynthetically active even in winter. Although not highly valued, it provides good habitat for fish and invertebrates and food for some bird species. It also removes phosphorus from the water.

It grows in various regions, including the USA, Canada, and Norway. It can affect climate change directly and indirectly—mitigating the greenhouse effect, enhancing biodiversity, producing oxygen, and improving water quality. As an invasive species, it may lead to the extinction of native aquatic plants.

Its energy value is estimated at 10 to 20 kJ/g (2.4 to 4.8 kcal/g). Estimated genome size is around 725 Mb.

8. Canadian waterweed (*Latin: Elodea canadensis*)

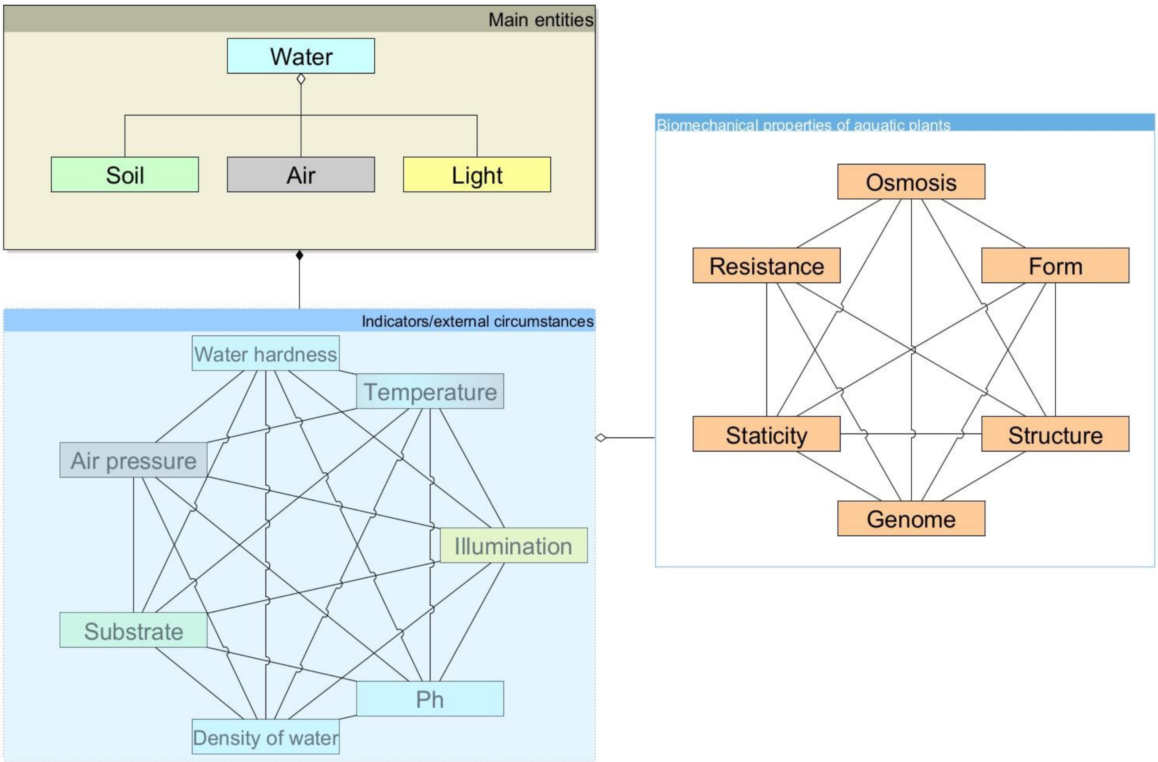
This plant requires soft substrate, is tolerant of turbid and low-light environments, and mostly grows submerged except for small white flowers. It thrives in cold, mineral-rich, alkaline waters.

Being evergreen, it can photosynthesize even under ice in winter. It provides excellent habitat for fish and invertebrates and is consumed by muskrats and waterfowl.
It is found in regions such as the USA, Canada, and Sweden. It influences climate change directly and indirectly—mitigating the greenhouse effect, supporting biodiversity, producing oxygen, and improving water quality. It can contribute to the extinction of native plants when invasive.
Estimated energy value: 10 to 20 kJ/g (2.4 to 4.8 kcal/g). Estimated genome size: 245 Mb.
9. Spatterdock (*Latin: Nuphar advena*)
It commonly grows in shallow waters with soft substrates in lakes, ponds, and slow-moving streams, up to 2.5 meters deep. Its floating leaves reach above the water surface and thrive in both sun and shade, though its flowers prefer full sunlight.
It offers excellent habitat for fish and invertebrates. Insects often gather under its leaves and serve as fish food. Birds feed on its seeds, while mammals like beavers, deer, and muskrats eat its leaves, flowers, and stems.
It is most commonly found in the USA and Canada. It mitigates climate change, supports biodiversity, produces oxygen, and improves water quality. Invasive populations can threaten native species.
Estimated energy value: 10 to 20 kJ/g (2.4 to 4.8 kcal/g). Genome size: ~464 Mb.
10. Northern watermilfoil (*Latin: Myriophyllum sibiricum*)
This plant grows more than four meters deep and thrives in undisturbed waters with soft substrates. It prefers waters with moderate alkalinity and conductivity. Stems and flower shoots appear in spring and summer, with flower shoots often protruding above the surface.
Its leaves and fruits are an important food source for waterfowl, and its foliage provides refuge for fish and invertebrates.
It is found in the USA, Canada, and Russia. It can mitigate climate change, enhance biodiversity, produce oxygen, and improve water quality—but as an invasive species, it may cause local extinctions.
Estimated energy value: 10 to 20 kJ/g (2.4 to 4.8 kcal/g). Estimated genome size: ~350 Mb.
11. Spiny naiad (*Latin: Najas marina*)
This plant grows up to three meters deep, tolerates high pH and conductivity, and resists high chloride levels. It offers refuge to fish and serves as an important food source for waterfowl, especially ducks.
It is widespread across Europe, North America, Asia, Africa, and oceanic islands. It can affect climate change by mitigating the greenhouse effect, improving water quality, and enhancing biodiversity—but can be ecologically disruptive if invasive.

Estimated energy value: 10 to 20 kJ/g (2.4 to 4.8 kcal/g). Genome size estimated at ~220 Mb.
12. Star duckweed (*Latin: Lemna trisulca*)
Unlike related species, this floating plant has petiole-like leaves and is usually found just below the surface in calm waters. It is not dependent on water depth or clarity but requires nutrient-rich waters. It thrives in temperate climates.
It provides food for waterfowl and habitat for invertebrates and fish. Found in Europe, North America, and Asia. It can mitigate climate change, support biodiversity, and improve water quality, though it may become ecologically disruptive when invasive.
Estimated energy value: 10 to 20 kJ/g (2.4 to 4.8 kcal/g). Estimated genome size: ~360 Mb.
13. Slender naiad (*Latin: Najas flexilis*)
This plant grows at various depths and prefers hard substrates like sand and gravel. It tolerates turbid, alkaline, and conductive waters and is well-rooted.
It is vital for waterfowl and muskrats, which eat its stems, seeds, and leaves. Fish also feed on it and use its leaves for shelter.
It is not highly invasive and is mostly found in Europe and North America. It mitigates climate change and supports aquatic ecosystems.
Estimated energy value: 10 to 20 kJ/g (2.4 to 4.8 kcal/g). Genome size estimated at ~250 Mb.
14. Water stargrass (*Latin: Heteranthera/Zosterella dubia*)
It grows up to three meters deep and is not sensitive to turbidity or substrate. It prefers waters with moderate alkalinity and conductivity.
It provides food and shelter for fish and birds. It is mostly found in North and Central America. It can mitigate climate change and improve water quality, but may cause imbalance if invasive.
Estimated energy value: 10 to 20 kJ/g (2.4 to 4.8 kcal/g). Estimated genome size: ~571 Mb.
15. Leafy pondweed (*Latin: Potamogeton foliosus*)
This plant is commonly found in shallow waters with soft substrates. It tolerates high salt content and low oxygen levels. It provides a food source for waterfowl, deer, moose, beavers, and muskrats. Its bushy shape offers excellent shelter for fish and invertebrates.
It is primarily found in North and Central America. It influences climate change positively and may cause ecological imbalance if invasive.
Estimated energy value: 10 to 20 kJ/g (2.4 to 4.8 kcal/g). Estimated genome size: ~420 Mb.
As we could observe from these brief descriptions, most aquatic plants are beneficial both to the environment and as a food source for many animals. However, there are also certain types of aquatic plants that do not provide significant benefits or may even have harmful effects on the ecosystem. These kinds of aquatic plants are often highly adaptable to various environmental

conditions, where they encounter a relatively wide range of temperature, pressure, water hardness, and pH levels. They are frequently species introduced by human interference with nature.

To conclude this subsection, let us summarize in a diagram the hierarchical associative arrangement among the key entities (water, light/sun, soil, and air), the external conditions (pressure, temperature, density, hardness, illumination, substrate, and pH), and the biomechanical properties of aquatic plants (form, structure, resistance, stability, osmosis, and genome).



5.4.7.6.3.3 Figure 356: Package-based hierarchical associative diagram of key entities, external conditions, and biomechanical properties of aquatic plants

Figure 356 illustrates a package-based hierarchical associative diagram showing the key entities, external conditions, and biomechanical properties of aquatic plants. In this diagram, water is represented as the central entity (see the connection from the white diamond to earth, air, and light), playing a crucial role in the growth of aquatic plants in specific environments, where various external conditions are present (such as water hardness, temperature, light exposure, pH, water density, substrate, and air pressure).

The first package is hierarchically superior to the second package (indicated by the black diamond connected to the second package), while the second package is superior to the third package (see the white diamond connected to the third package). Inside the second and third packages, associative connections are shown (indicated by lines), representing external conditions and biomechanical properties.

External conditions can significantly affect the biomechanical properties of aquatic plants. An unsuitable substrate, excessive density, too low or too high pH levels, excessive water hardness, and similar factors can influence osmosis—specifically, the plant's ability to absorb water molecules and nutrients through a semipermeable membrane—as well as resistance, structural stability, shape, internal structure, and even its genome over time. In excessively unfavorable conditions, an aquatic plant may simply perish.

One external condition missing from the diagram is space. If enough space is available, highly expansive plant species can spread rapidly and grow optimally. Certain aquatic plants may possess excellent biomechanical properties that allow them to temporarily withstand adverse external conditions such as low pH levels, low temperatures, high densities, extremely low or high pressures, and unsuitable lighting or substrate. However, they cannot withstand a severe lack of space, even temporarily. For this reason, space was not included in the diagram.

In essence, space represents a specific plane that can be divided into three cosmic dimensions: the microcosm, mesocosm, and macrocosm. More about this will be explained later when the synthesis of all three planes of the aquatic cosmos is presented.

5.4.7.6.4 Aquatic insects

This section discusses several types of insects that live near, in, or on water. People often view insects in the broadest sense as harmful and annoying creatures, especially when mosquitoes and horseflies aggressively attack us and suck our blood. However, there is another side to this story: insects can make an extraordinary contribution to ecosystems and food webs. In addition to contributing to biodiversity, they also serve as a food source for many animals. Furthermore, they play an important role in forensic entomology by helping to determine the time and place of a person's death. It is estimated that in North America alone, there are over 10,000 species of aquatic and semi-aquatic insects, which have ruled our planet for more than 400 million years.[200] The vast majority of insect species undergo complete metamorphosis during their life cycle, which includes four main developmental stages: egg, wingless larva, pupa (the transformation stage), and the final stage (winged insect).

During the larval phase, insects focus on feeding and growing, while the adult insects primarily engage in reproduction. Insects have animal-like physiology, meaning they possess the same basic physiological systems as other animals—digestive, excretory, circulatory, immune, muscular, nervous, and reproductive systems.

200 Waldbauer, G. (2008). *A walk around the pond*: Insects in and over the water. Harvard University Press.

When it comes to growth, all known insects have a certain size limitation, especially in terms of body width, which generally does not exceed one centimeter. The main reason for this limitation is their small tracheae, which are spread throughout their bodies and used to draw in an optimal amount of oxygen. If an insect's body were two or three centimeters wide, the airflow would slow down significantly, making it impossible for the tiny tracheae to supply enough oxygen—causing the insect to quickly suffocate.

Insects make their greatest contribution to ecosystems by serving as a food source for fish, birds, amphibians, and mammals. Large insect populations are necessary to sustain numerous other species that are essential for maintaining a healthy ecosystem. Additionally, certain insects help control pests that damage plants and crops—for example, ladybugs feed on aphids.

Insects also form three types of mutualistic symbioses with aquatic and other plants: protection, pollination, and seed dispersal. Their role in ecosystems is significant not only because of their abundance but also due to their total biomass on Earth, which is crucial for the flow of biological energy.[201] In short, insects represent top organisms within the natural hierarchical associative system in the mesocosm, as they promote plant growth, influence nutrient flow, and alter the rate and direction of ecological succession. Insects play a crucial role in the processing of organic detritus (fragments of decayed plants and animals) in both terrestrial and aquatic ecosystems, and they impact soil fertility and water quality. Insects are highly dependent on water temperature, although their tolerance range is extremely wide, as they can survive both extremely low temperatures (-50°C) and high temperatures (50°C).[202] Moreover, they are highly dependent on oxygen intake and pH levels, as certain chemical changes (e.g., the formation of nitrogen and sulfur compounds) can have harmful effects on some insect species. Aquatic insects, in particular, are quite sensitive to water levels and flow, which in turn affect water quality. Light also has a strong impact on (aquatic) insects, as even those that typically avoid light can become dependent on it when oxygen levels are low. As you have probably noticed, these dependencies on external conditions are similar to those of aquatic microorganisms and plants at the mesocosmic level, with the key difference being that some insect species are exceptionally resistant to even extreme changes in external conditions.

Aquatic insects, like other living organisms, manage energy consumption and acquisition, which can be expressed with a simple mathematical formula:[203]

$$I = P + R + E$$

201 Schowalter, T. D. (2022). *Insect ecology.* Elsevier Academic Press.
202 Schowalter, T. D. (2022). *Insect ecology.* Elsevier Academic Press.
203 Schowalter, T. D. (2022). *Insect ecology.* Elsevier Academic Press.

Energy consumption (I) depends on the sum of the energy required for production (growth, reproduction), respiration (R), and excretion (E). During food digestion, unnecessary or excess substances are excreted, while the remaining substances are used as biofuel for the insects. The final outcome of the assimilation process of nutrients is determined by the efficiency or effectiveness of assimilation. This efficiency also depends on the optimal functional metabolism of not only insects but all living organisms. The main energy and nutrient needs include activities such as foraging, mating, reproduction, competition, and defensive behavior.

Based on current scientific knowledge, it could be argued that the majority of biomass and bioenergy is located at the mesocosmic level, followed by biomass and bioenergy at the microcosmic level. The macrocosmic level, limited by our solar system, comes last. We do not know the macrocosmic level due to its unfathomable vastness, so we cannot estimate its biomass or bioenergy. However, the macrocosmic level does yield the greatest mass and energy in various forms such as thermal, light, nuclear, and kinetic energy, and in this broad perspective, both the microcosm and mesocosm play subordinate roles. We can reiterate the established understanding that the inorganic world dominates over the organic one. From this perspective, living organisms are essentially byproducts of complex physical-chemical processes, which, from our viewpoint, have their functionality and usefulness.

This raises an interesting question: do living beings have any meaning in the grand scheme or larger scenario? From the perspective of belief in God or positive cosmic energy, we can immediately state that living beings represent the noble pinnacle of all that exists. This is a belief that people are encouraged to hold, but on the other hand, we have full freedom in this regard. Ultimately, our decision to believe in the importance of living beings is the result of a mixture of strict determinism and free will. The latter may approach strict stochasticity, filled with randomness and uncertainty.

A more detailed discussion of insects, particularly eusocial ones, will follow in the subsection on terrestrial insects at the mesocosmic level. We will now continue with descriptions of some species of aquatic insects.[204]

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204 Waldbauer, G. (2008). *A walk around the pond*: *Insects in and over the water.* Harvard University Press.

5.4.7.6.4.1 Figure 357: Aquatic insects and their larvae

Figure 357 shows numbered examples of aquatic insects and some of their larvae that live in the aquatic mesocosm.

1. Water strider (*Latin: Order Hemiptera; Gerridae*)

There are many species of these insects in the Hemiptera order. With the exception of the water boatman, all water striders are predators and thus consumers.

They most commonly feed on small insects that have fallen into the water and are unable to escape. They also feed on mosquito larvae, which helps prevent their overgrowth, making them beneficial insects. To move across the water, water striders use their long, thin legs, which are coated with a hydrophobic wax, and they take advantage of the surface tension of the water.

Thanks to the high surface tension, these insects can run across the water's surface. Water striders also have wings, allowing them to fly and find another habitat on the water if necessary. Similarly, water striders can be poisoned by mercury if the water source contains even small amounts of it.

They are most commonly found in lakes, ponds, and calm rivers and streams. Among the insects that live on the water's surface are also the water striders in lakes. Unlike water striders in calm streams and rivers, they prefer to stay in dense riparian vegetation, where they primarily hunt weaker insects, such as aphids, mosquitoes, and midges.

In winter, water striders move away from the water and seek shelter to hibernate. It has been proven that they are sensitive to waters that contain an excessive amount of dissolved oxygen.[205] Water striders can also be poisoned by mercury if the water source contains even small amounts of it.[206] As mentioned earlier, the impact of temperature on water striders is significant even in the early stages of their development. At cooler temperatures, around 10°C or lower, their reproductive capacity is severely hindered, as egg formation does not occur, let alone the development of larvae. It has been found that temperatures between approximately 20°C and 22°C are most favorable for egg production and, consequently, the development of larvae.[207] Lowered pH levels in a water source polluted with metals from industrial activities also have a highly negative impact on the life and development of water striders.[208] The hardness of water likely also affects the movement of water striders. Measurements have shown that increased temperature lowers surface tension, which could slow their movement. Additionally, colloidal particles in the water and pollution from detergents can significantly reduce surface tension, which in turn affects the life dynamics of these organisms.[209] As you have probably noticed, external physicochemical conditions are also crucial for the water strider, influencing its growth and development. Their impact on climate change is indirect, primarily through the optimal cycling of nutrients, creation of biodiversity, and maintenance of a healthy environment.

Water striders inhabit geographical regions across Europe, Asia, Africa, North and South America, and Australia. The size of their genome is estimated to be approximately 1000 Mb.[210] This genome

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205 Hirayama, H., & Kasuya, E. (2008). Factors affecting submerged oviposition in a water strider: Level of dissolved oxygen and male presence. *Animal Behaviour,* 76(6), 1919–1926. https://doi.org/10.1016/j.anbehav.2008.08.013.

206 Jardine, T. D., Kidd, K. A., Cunjak, R. A., & Arp, P. A. (2009). Factors affecting water strider (Hemiptera: Gerridae) Mercury concentrations in Lotic Systems. *Environmental Toxicology and Chemistry*, 28(7), 1480. https://doi.org/10.1897/08-478.1.

207 Spence, J. R., Spence, D. H., & Scudder, G. G. (1980). The effects of temperature on growth and development of water strider species (Heteroptera: Gerridae) of Central British columbia and implications for species packing. *Canadian Journal of Zoology*, 58(10), 1813–1820. https://doi.org/10.1139/z80-248.

208 Drover, S., Leung, B., Forbes, M. R., Mallory, M. L., & McNicol, D. K. (1999). Lake ph and aluminum concentration: Consequences for developmental stability of the water strider rheumatobates rileyi (Hemiptera: Gerridae). *Canadian Journal of Zoology,* 77(1), 157–161. https://doi.org/10.1139/z98-205.

209 Cho, Y. I., & Lee, S.-H. (2005). Reduction in the surface tension of water due to physical water treatment for fouling control in heat exchangers. *International Communications in Heat and Mass Transfer,* 32(1-2), 1–9. https://doi.org/10.1016/j.icheatmasstransfer.2004.03.019.

210 Armisén, D., Rajakumar, R., Friedrich, M., Benoit, J. B., Robertson, H. M., Panfilio, K. A., & et al. (2018). The genome of the water strider Gerris Buenoi reveals expansions of gene repertoires associated with adaptations to life on the water. *BMC Genomics,* 19(1). https://doi.org/10.1186/s12864-018-5163-2.

is relatively large for such a small organism, as the size of the human genome is around 3000 Mb. The large size of the water strider's genome may be related to its ability to fly through the air and run on water, making it essential for its survival. The energy content of these insects is roughly estimated at 16.72 kJ/g or 4 kcal/g.

2. Dragonfly larva and dragonfly (*Latin: Order Odonata*)

Dragonflies undergo similar developmental stages to butterflies. The dragonfly, which often lives near water, lays its eggs in the water, from which larvae develop. These larvae mostly live beneath the water's surface and breathe through tracheal gills. They feed on aquatic microorganisms, smaller invertebrates, and some species even feed on tadpoles and small fish. In the absence of food, they may resort to cannibalism.

After a successful feeding cycle, the larvae form a cocoon and, after some time, undergo metamorphosis into adult insects with genitalia and wings (see 2a and 2b). Unlike the larvae, adult dragonflies do not live in the water but near it, most often near lakes, ponds, fish ponds, streams, and rivers. Like the larvae, adults are predators and primarily feed on flies and mosquitoes, helping to control their population and thus positively impacting the environment.

Dragonflies thrive better at higher temperatures and in sunny, well-lit environments. They have many natural enemies, including ants, spiders, and birds. Their larvae are highly dependent on the temperature, pH level, and pollution of the water. Their impact on climate change is indirect, as they contribute to carbon storage, reduce the greenhouse effect, regulate the population of various insects, promote biodiversity, and maintain a healthy environment.

Dragonflies inhabit geographical regions in Europe, Asia, Africa, North and South America, and Australia. Their genome size ranges from approximately 590 Mb to 750 Mb, which is somewhat smaller than that of the water strider.[211] The energy content of these insects can be roughly estimated at 16.72 kJ/g or 4 kcal/g.

3. Mosquitoes (*Latin: Order Diptera; Family Culicidae*)

Mosquito larvae live in a variety of aquatic environments. Males feed on plant sap, while females of most species consume the blood of other organisms, although blood is not directly necessary for their survival. They ingest blood primarily for the optimal development of their eggs, and consequently, their offspring.

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211 Ardila-Garcia, A. M., & Gregory, T. R. (2009). An exploration of genome size diversity in dragonflies and damselflies (Insecta: Odonata). *Journal of Zoology,* 278(3), 163–173. https://doi.org/10.1111/j.1469-7998.2009.00557.x.

Their lifespan is approximately one month, and they mostly inhabit warmer climates. Mosquito larvae typically feed on various microorganisms, especially bacteria. Some species are not selective and suck blood from various animals, while others are specialized to a single host species.

In ecosystems, mosquitoes are beneficial mainly as a rich food source for fish, birds, dragonflies, frogs, and other predators. However, they are generally harmful to humans, as they transmit numerous diseases. Mosquitoes are typically resistant to waters with a pH range of 4 to 12, but their larvae develop best in slightly alkaline environments, close to a neutral pH.

The hardness of the water also significantly affects the development of mosquito larvae. If the water is excessively hard due to a high concentration of calcium and carbonate ions, their growth can be severely hindered. Their impact on climate change is indirect, as they contribute to biodiversity, changes in ecological balance, and the transmission of dangerous diseases.

The genome size of mosquitoes is estimated to range from 210 Mb to 1380 Mb (e.g., Aedes aegypti), with the highest value representing a relatively large genome.[212] Currently, 3,500 different species of mosquitoes are known to inhabit various geographical locations such as Africa, Asia, Europe, North, Central, and South America, etc. The energy content of these insects can be roughly estimated at 16.72 kJ/g or 4 kcal/g.

4. True bugs (*Latin: Class Hemiptera*)

There are around 80,000 different species of beetles that belong to the class Hemiptera due to the characteristics of their wings. Some species exclusively feed on plants and plant juices, while others are true predators that feed on invertebrates and other insects. One well-known representative of true beetles is the water beetle (Nepomorpha), which is found worldwide.

Water beetles live in freshwater environments such as rivers, streams, and lakes, and are therefore indicators of water quality. Certain species of true water beetles are harmful to humans (e.g., they eat the larvae of valuable fish), while others can be beneficial.

They are very important in regulating mosquito populations. In addition, they serve as a food source for various fish, amphibians, birds, and even bats.[213] They thrive best in waters with moderate conductivity, hardness, temperature, and alkalinity. Their impact on climate change is indirect, as they contribute to the creation of biological diversity, changes in ecological balance, and the pollination of flowers.

212 Wiegmann, B. M., & Richards, S. (2018). Genomes of Diptera. *Current Opinion in Insect Science*, 25, 116–124. https://doi.org/10.1016/j.cois.2018.01.007.

213 Schaefer, C. W., & Panizzi Antônio Ricardo. (2000). *Heteroptera of economic importance*. CRC Press.

They are found in geographical regions of Europe, Asia, Africa, North and South America, and Australia. The genome size of insects from the Hemiptera class ranges from 407 Mb to 7000 Mb.[214] The energy content of these insects can be roughly estimated at 16.72 kJ/g or 4 kcal/g.

5. Caddisflies (*Latin: Order Trichoptera*)

Their larvae live in various aquatic environments such as lakes, rivers, pools, ponds, and streams. They are primarily known for constructing small homes made of silk, which is similar to spider webs, or small stones. Their pupae are, in contrast to moths, quite active, and the transition to the fully formed adult insect is relatively faster.

Adult caddisflies range in size from approximately 3.5 mm to 40 mm in length. They closely resemble moths and nocturnal butterflies, and typically live for only a few weeks.

They are beneficial to the environment, providing a rich food source for fish, birds, amphibians, bats, and others. They are highly dependent on the optimal concentration of oxygen in the water and the purity of the water itself, meaning they thrive in waters with moderate levels of conductivity, pH, temperature, and hardness.

Their impact on climate change is indirect, as they contribute to creating biological diversity, altering ecological balance, nutrient cycling, reducing the greenhouse effect, and maintaining ecosystem health.

They are found in geographical regions of Europe, Asia, Africa, North and South America, and Australia. The genome size of insects from the Order Trichoptera ranges from approximately 230 Mb to 1.4 Gb, which is somewhat smaller than that of insects from the Order Hemiptera.[215] The energy content of these insects can be roughly estimated at 16.72 kJ/g or 4 kcal/g.

6. Beetles (*Latin: Order Coleoptera*)

They represent the most numerous animal order, with around 350,000 different species currently known. Their larvae live in a wide range of aquatic environments, such as seas, hot springs, lakes, streams, pools, and more. For humans, both the larvae and adult beetles often pose a significant nuisance, as they attack and threaten numerous plant species.

However, in a broader environmental context, they provide a rich food source for amphibians, bats, birds, spiders, and others. Beetles, and especially their larvae, are quite resistant to large

214 Hanrahan, S. J., & Johnston, J. S. (2011). New genome size estimates of 134 species of arthropods. *Chromosome Research*, 19(6), 809–823. https://doi.org/10.1007/s10577-011-9231-6.

215 Heckenhauer, J., Frandsen, P. B., Sproul, J. S., Li, Z., Paule, J., Larracuente, A. M., Maughan, P. J., Barker, M. S., Schneider, J. V., Stewart, R. J., & Pauls, S. U. (2022). Genome size evolution in the diverse insect order Trichoptera. *GigaScience*, 11. https://doi.org/10.1093/gigascience/giac011.

fluctuations in temperature, pressure, pH, water hardness, and oxygen concentration, but they thrive best in warmer conditions and in waters with moderate conductivity and alkalinity.

They are found in geographical regions across Europe, Asia, Africa, North and South America, and Australia.

Their impact on climate change is indirect, as they contribute to the creation of biological diversity, changes in ecological balance, nutrient cycling, reduction of the greenhouse effect, pollination of flowers, decomposition of organic matter, and maintaining ecosystem health.

The average genome size of this insect order is approximately 760 Mb (ranging from 160 Mb to 5020 Mb).[216] The energy content of these insects can be roughly estimated at 16.72 kJ/g or 4 kcal/g.

7. Dobsonflies (*Latin: Order Megaloptera*)

The larvae have an elongated body and jaws and, after hatching from the eggs, crawl into the water, where they feed on smaller arthropods. They primarily live in calm waters such as small streams, pools, ponds, and more. The development speed of dobsonfly larvae depends on the temperature, pH of the water, water hardness, and the number of prey. They thrive best in waters with moderate conductivity and alkalinity.

The larvae have tracheal gills, allowing them to breathe underwater. Before transformation, they return to land, where they pupate in the soil.

The lifespan of adult dobsonflies is generally very short, as, despite having well-developed jaws, they feed very little or not at all.

They are important for the environment as they provide a rich food source for fish. Geographically, they are widespread and can be found worldwide, except in the tropical regions of Africa and Antarctica. Their impact on climate change is indirect, as they contribute to the creation of biological diversity, changes in ecological balance, nutrient cycling, reduction of the greenhouse effect, and maintaining ecosystem health. The genome size of dobsonflies ranges from approximately 481 to 767.8 Mb. The energy content of these insects can be roughly estimated at 16.72 kJ/g or 4 kcal/g.[217]

8. Mayfly (*Latin: Order Ephemeroptera*)

216 Schoville, S.D., Chen, Y.H., Andersson, M.N., & et al. (2018). A model species for agricultural pest genomics: the genome of the Colorado potato beetle, Leptinotarsa decemlineata (Coleoptera: Chrysomelidae). *Sci Rep 8*, 1931. https://doi.org/10.1038/s41598-018-20154-1.

217 Genome Dataset: https://www.ncbi.nlm.nih.gov/genome/?term=Megaloptera (2022-02-09).

Female mayflies lay up to 8,000 eggs on the surface of the water. The larvae live in streams and rivers, usually under rocks or among aquatic plants. Most species from the order Ephemeroptera feed on plants, but there are also predatory species. The larvae live from a few months to several years, while the adult mayflies live only a few hours to a few days. Adult mayflies have a clear purpose – mating, during which they reproduce in large numbers. The larvae are highly dependent on the optimal concentration of dissolved oxygen in the water and moderate water temperature. They thrive best in waters with moderate conductivity and alkalinity. They are quite sensitive to excessively hard and polluted waters, so the presence of these larvae in the water indicates that the water quality is good. Both larvae and adult mayflies are an important food source for fish, birds, amphibians, and others. Their impact on climate change is indirect, as they contribute to the creation of biological diversity, changes in ecological balance, nutrient cycling, reduction of the greenhouse effect, and maintaining ecosystem health. They are found in geographical locations in Europe, Asia, Africa, North America, South America, and Australia. The genome size of the mayfly is similarly small as in the previously discussed class of aquatic insects, ranging from approximately 174.1 Mb to 474.3 Mb.[218] The energy content of these insects can be roughly estimated at 16.72 kJ/g or 4 kcal/g.

9. True lacewings (*Latin: Order Neuroptera*)

True lacewings are recognizable by their net-like wings and greenish or brownish coloration. The larvae are predatory and live both on land and in freshwater environments. They thrive best in temperate climates, in waters with moderate values of temperature, pH, hardness, and conductivity. The larvae can serve as an additional food source for fish. Adult lacewings feed very little or not at all. They perform best in moderate climates.

Their impact on climate change is indirect, contributing to biological diversity, changes in ecological balance, nutrient cycling, reduction of the greenhouse effect, pollination of flowers, and the maintenance of ecosystem health.

They are found in geographical regions of Europe, Asia, Africa, North America, South America, and Australia. The size of their genome is approximately 550 Mb.[219] The energy content of these insects can be roughly estimated at 16.72 kJ/g or 4 kcal/g.

10. Common backswimmer (*Latin: Notonecta glauca*)

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218 Genome Dataset: https://www.ncbi.nlm.nih.gov/datasets/genomes/?taxon=30073&utm_source=data-hub (2022-02-09).

219 Data obtained using Genomes – NCBI Datasets: https://www.ncbi.nlm.nih.gov/datasets/genomes/?taxon=7516&utm_source=data-hub (2022-02-09).

This aquatic insect is easily recognizable by its red eyes and its unique habit of swimming on its back. It is an exceptional predator, feeding not only on other insects but also on tadpoles and fish. It lays its eggs beneath the water surface. This species is geographically widespread and can be found in Europe and Asia. It thrives best in calm waters such as small lakes, ponds, pools, and unpolluted streams with moderate levels of temperature, dissolved oxygen, pH, hardness, conductivity, and alkalinity.

It poses no environmental threat to humans and can instead be considered a regulator of populations of other insects, small fish, and tadpoles.

Its impact on climate change is indirect, contributing to the creation of biodiversity, shifts in ecological balance, nutrient cycling, reduction of the greenhouse effect, and the maintenance of ecosystem health. No precise data on genome size (in Mb) could be found, though it is estimated to be around 1.2 Gb. The energy content of these insects can be roughly estimated at 16.72 kJ/g or 4 kcal/g.

11. Stoneflies (*Latin: Order Plectoptera*)

Adult stoneflies lay their eggs on the surface of the water, which then sink to the bottom. From these eggs, nymphs hatch that already resemble the adults, except they lack wings. Nymphs primarily breathe through gas exchange across their body surface. Some species of stonefly nymphs also breathe using gills located on their legs or neck. They feed mainly on moss and algae, though some are predatory and consume the larvae of other aquatic insects. As they grow, the nymphs eventually migrate to land and transform into adults. Adult stoneflies of certain species do not feed at all, while others feed on terrestrial algae and pollen. Their lifespan is approximately three weeks. Stonefly nymphs thrive in cold, clean water with high levels of dissolved oxygen. The water should have moderate conductivity, hardness, and alkalinity. Since stonefly nymphs are not found in polluted waters, they serve as reliable indicators of water quality. Both nymphs and adults are an important food source for fish. Geographically, stoneflies are widespread and are found almost everywhere except Antarctica and oceanic islands. Their impact on climate change is indirect, as they contribute to biodiversity, shifts in ecological balance, nutrient cycling, greenhouse gas reduction, and ecosystem health. Their genome size is estimated to be around 510 Mb.[220] The energy content of these insects can be roughly estimated at 16.72 kJ/g or 4 kcal/g.

12. Wasps near water sources (*Latin: Order Hymenoptera*)

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220 Hotaling, S., Kelley, J. L., & Weisrock, D. W. (2019). Nuclear and mitochondrial genomic resources for the meltwater stonefly (Plecoptera: Nemouridae), Lednia Tumana (Ricker, 1952). *Aquatic Insects*, 40(4), 362–369. https://doi.org/10.1080/01650424.2019.1639764.

This group includes a highly diverse family of wasp species, most of which are considered eusocial creatures. The vast majority of wasps are terrestrial animals, laying their eggs on land, where their larvae develop and grow. However, there are also species such as Polistes erythrocephalus that build their nests near water sources. The larvae of these wasps primarily feed on other aquatic insects, and in cases of food scarcity, they may even resort to cannibalism.

Their main natural predators near aquatic environments are ants. The larvae are sensitive to excessive light and high temperatures. These wasps do not pose any environmental threats. They are predominantly found in Central and South America. Their impact on climate change is indirect, as they contribute to biodiversity, the alteration of ecological balance, nutrient cycling, the reduction of greenhouse gas effects, pollination, and the maintenance of ecosystem health. The estimated genome size ranges between approximately 300 Mb and 400 Mb.[221] The energy content of these insects can be roughly estimated at 16.72 kJ/g or 4 kcal/g.

13. Aquatic moths/butterflies (Latin: Order Lepidoptera)

The public is generally more familiar with terrestrial species of moths and butterflies. However, there are also lesser-known species whose larvae or caterpillars live in aquatic environments—for example, Bellura gortynoides.[222] Most of these caterpillars feed on aquatic plants, though there are also species that live as predators and/or parasites. Their developmental stage from caterpillar to butterfly is similar to that of dragonflies, except that aquatic caterpillars differ significantly from the adult moths or butterflies. These aquatic caterpillars thrive best at higher temperatures and in waters with moderate levels of hardness, conductivity, pH, and dissolved oxygen concentration.

In general, they are highly beneficial to the environment, serving as a rich food source for other organisms, while the adult insects are excellent pollinators and seed dispersers. Aquatic moths and butterflies can be found in regions of North America, Europe, and on oceanic islands. Their impact on climate change is indirect, contributing to biodiversity, ecological balance, nutrient cycling, greenhouse gas reduction, flower pollination, and ecosystem health. The estimated genome size ranges from approximately 200 Mb to 850 Mb. Their energy content is roughly estimated at 16.72 kJ/g or 4 kcal/g.

Terrestrial wasps and butterflies will be discussed in more detail in the subchapter on the terrestrial mesocosm. Similar to the section on aquatic plants, this subchapter will include a diagram

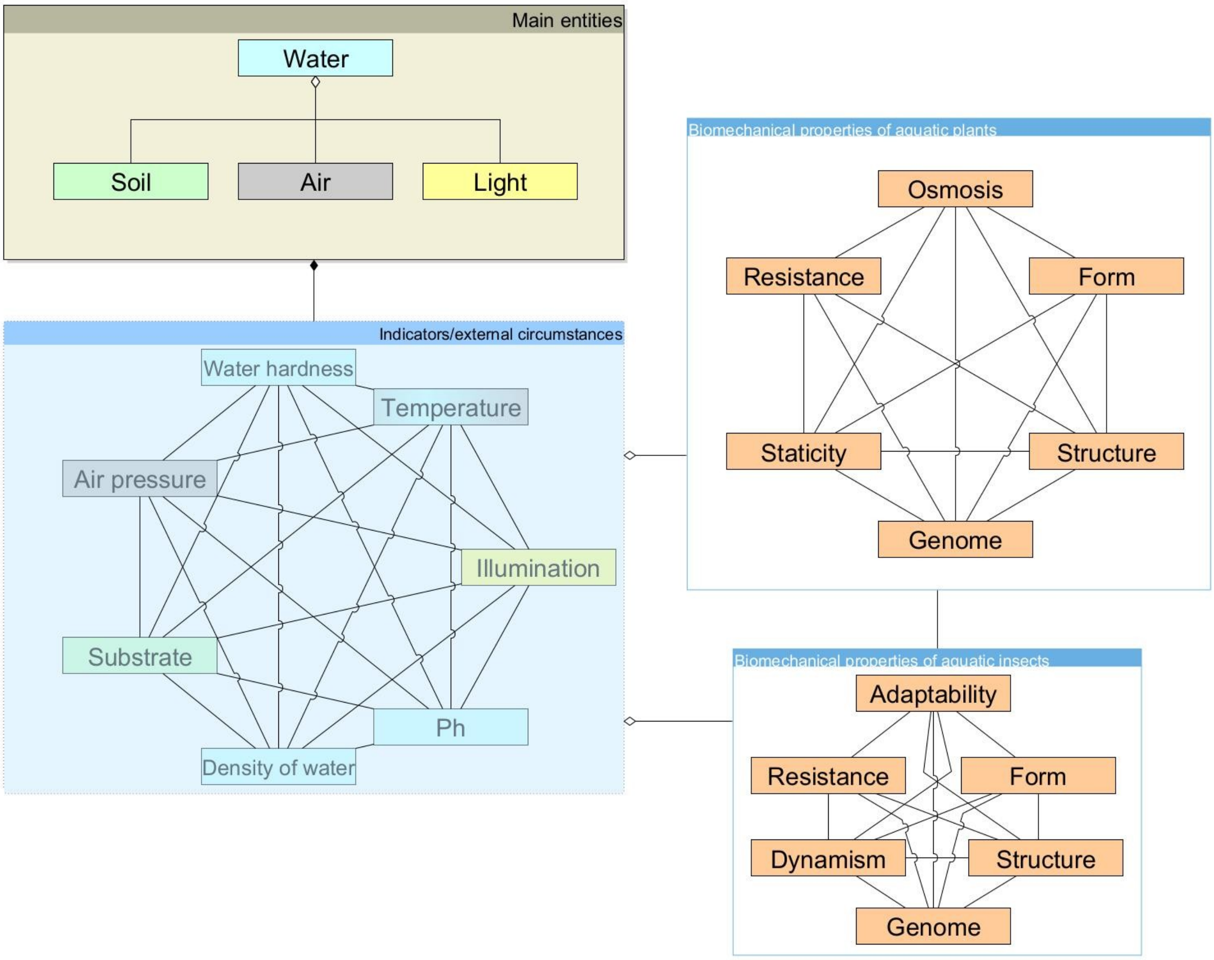
221 Zhang, X., Wang, G., Zhang, S., Chen, S., Wang, Y., Wen, P., Ma, X., Shi, Y., Qi, R., Yang, Y., Liao, Z., Lin, J., Lin, J., Xu, X., Chen, X., Xu, X., Deng, F., Zhao, L., Lee, Y.-lun, & et al. (2020). Genomes of the banyan tree and pollinator wasp provide insights into fig-wasp coevolution. *Cell*, 183(4). https://doi.org/10.1016/j.cell.2020.09.043.

222 Ricciuti, E. (2021). The Lepidopteran Life Aquatic. *Entomology today*, (February 12). https://entomologytoday.org/2021/02/12/the-lepidopteran-life-aquatic/ (2022-02-10).

summarizing the hierarchical associative relationships among key entities (water, light/sun, soil, and air) and external conditions (pressure, temperature, density, hardness, illumination, biodiversity, and pH), as well as the biomechanical characteristics of aquatic insects (shape, structure, resilience, mobility, adaptability, and genome).

Aquatic insects and plants are living organisms interconnected in various ways. Some aquatic plants serve as a rich food source and offer shelter for aquatic insects from excessive heat and larger predators such as water birds, amphibians, and aquatic reptiles. Conversely, aquatic insects can act as pollinators and seed dispersers of aquatic plants. In both cases, a symbiotic relationship exists between aquatic plants and insects. These positive symbioses enhance ecosystem fertility, diversity, and biomass—particularly important in an era where human interference has drastically reduced global biomass.

Such cooperation between these two groups of organisms serves as a valuable reminder to technologically and legally advanced societies of the urgent need to strengthen the positive symbiosis between humans and nature. This requires a significant shift in both political and economic decision-making models.



5.4.7.6.4.2 Figure 358: Modular hierarchical associative diagram of key entities, external conditions, and biomechanical properties of aquatic plants and aquatic insects

Figure 358 illustrates a modular hierarchical associative diagram depicting key entities, external conditions, and the biomechanical properties of aquatic plants and aquatic insects. In this diagram, water is again presented as a central entity (see the connection of the white diamond to soil, air, and light), highlighting its importance for the success of aquatic plants in a given environment, where various external factors prevail (such as water hardness, temperature, light exposure, pH, water density, substrate type, and air pressure).

The first module is a superordinate element to the second module (see black diamond connected to the second module), while the second module is hierarchically above the third and fourth modules (see white diamond connected to the third module). Within the second, third, and fourth modules, associative connections are shown (represented by lines), depicting relationships between external conditions and biomechanical properties.

External conditions can significantly affect the biomechanical traits of both aquatic plants and insects. Inadequate substrate, excessive density, too low or high pH levels, and high water hardness can impair the osmosis capacity of aquatic plants and hinder the mobility and development of aquatic insects. Without diverse symbiotic relationships and interactions (such as consumption) between aquatic plants and insects, the ecosystem cannot function optimally (see the associative link between the third and fourth modules).

The biomechanical characteristics of aquatic insects differ from those of aquatic plants and are defined in this diagram as adaptability, resilience, mobility, genome, structure, and shape. Effective development of aquatic plants supports the development of aquatic insects by providing either food or shelter. Strong biomechanical traits in both aquatic plants and insects contribute to a more stable ecosystem, which is more resistant to adverse external conditions.

Notably, spatial dimensions have not yet been included in this diagram—they will be considered during the synthesis of all three cosmic planes.

5.4.7.6.5 Fish

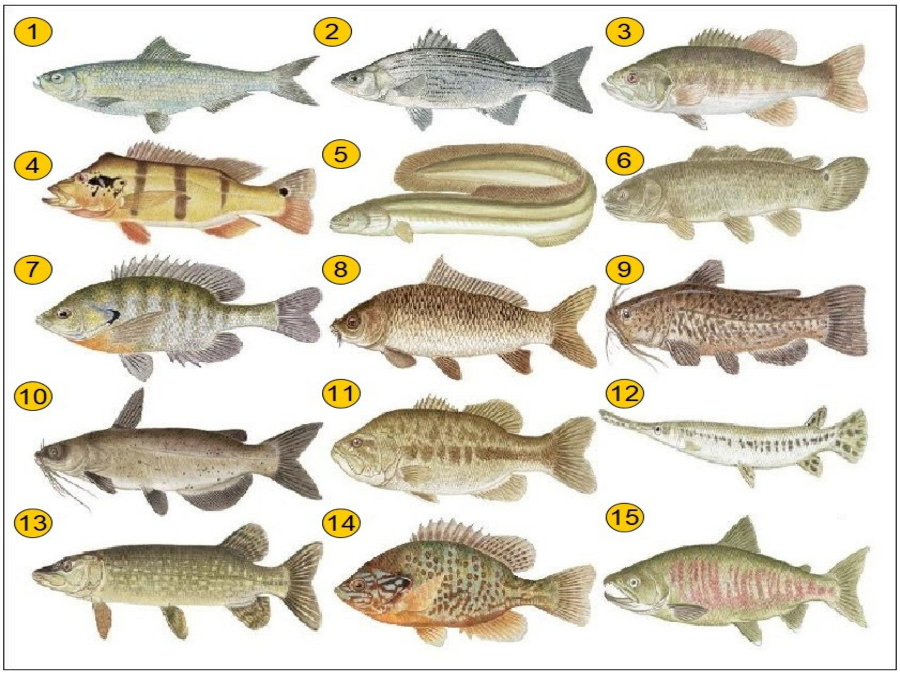
Fish are a special class of living beings found in various aquatic environments such as streams, ponds, pools, lakes, rivers, seas, and oceans. More than 21,000 different species are known to exist in freshwater, saltwater, or mixed aquatic habitats.[223] Fish are predominantly cold-blooded animals (for example, tuna is an exception as it is warm-blooded) that have backbones and breathe through gills (an exception is the lungfish, which breathes using lungs), meaning they do not take in oxygen from the air. The basic structure of a fish includes a long spine, fins, scales, muscles, and gills. With this biological equipment, fish can move quickly, are protected, and can breathe—forming the foundation for effective feeding.

Fish come in a wide variety of shapes, mostly adapted to aquatic environments. We find elongated, flat, tubular, and even round fish. These shapes help them avoid obstacles, move faster, and defend themselves more effectively. This incredible diversity is not only seen in their shapes but also in their colors. Fish use their body coloration for camouflage, mimicry, mating, warning, and other purposes.

As for sensory abilities, fish generally have excellent hearing and smell, and they can see colors well at short distances. Taste appears to be a less developed and less important sense for most fish. They also possess a special sense that detects weak vibrations, from electromagnetic waves to temperature changes. This additional sense helps many fish locate prey, avoid predators, and migrate to warmer or cooler waters.

223 Schultz, K. (2004). *Ken Schultz's Field Guide to Freshwater Fish*. John Wiley & Sons.

Fish reproduce sexually, with a variety of reproductive methods. Most species lay eggs, but some give birth to live young. In terms of diet, fish range from strictly herbivorous to carnivorous. Some species feed on plankton. There are also highly aggressive, predatory fish known for their hunting abilities. Many feed on other fish, insects, and invertebrates. Some fish are scavengers, feeding exclusively on dead aquatic animals or their remains. Fish, which are the most widespread vertebrates on our planet, can live in waters with temperatures ranging from about 37°C down to -4°C.[224] As in the previous two subchapters, this section will focus on a narrow selection of freshwater fish that inhabit water sources such as streams, pools, ponds, lakes, and rivers. This narrowed focus will make it easier to study a small part of the natural aquatic hierarchical associative system at the mesocosmic level.



5.4.7.6.5.1 Figure 359: A small selection of predominantly freshwater fish

Figure 359 shows a small, numbered selection of (predominantly) freshwater fish, labeled from 1 to 15.[225]

1. Alewife (*Latin: Alosa pseudoharengus*)

Alewives can be found in both saltwater coastal areas and freshwater habitats such as rivers, ponds, pools, and lakes. In saltwater, they tend to grow larger than their freshwater counterparts. Alewives prefer to move in large schools. From late April to June, some saltwater alewives migrate into freshwater environments—especially rivers and lakes—to spawn. This spawning occurs at water

224 Schultz, K. (2004). *Ken Schultz's Field Guide to Freshwater Fish*. John Wiley & Sons.
225 The following monographic work served as an aid in the descriptions: Schultz, K. (2004). *Ken Schultz's Field Guide to Freshwater Fish*. John Wiley & Sons.

temperatures between approximately 11°C and 21°C. Freshwater females lay between 10,000 and 12,000 eggs during this period. Alewives thrive best within this spawning temperature range.

They are highly sensitive to high alkaline pH levels in the water, which can be an indicator of pollution. Additionally, water hardness should not exceed 200 ppm, as excessively hard water may elevate pH levels and signal contamination. Broadly speaking, alewives play an important role in the ecosystem as a rich food source for eagles, other waterbirds, fish, and humans. However, in some lakes, they can become problematic because they feed on the same plankton as native fish species. This species of alewife is geographically limited to regions in North America.

Their impact on climate change is indirect, contributing through nutrient cycling, greenhouse gas mitigation, carbon storage, maintaining ecosystem balance, and—due to human industrial fishing activities—increasing harmful gas emissions into the atmosphere. The genome size of these fish ranges from approximately 600 to 900 Mb. Their energy content is around 25 kJ/g or 6 kcal/g.

2. White bass (*Latin: Morone chrysops*)

This fish is relatively strongly built but not particularly large, typically measuring between 25 cm and 44 cm in length and weighing between half a kilogram and one kilogram. It is a fierce predator, feeding on smaller fish, crustaceans, insects, and tiny invertebrates. White bass primarily inhabit freshwater sources such as rivers, lakes, pools, and ponds. They thrive in water temperatures ranging from 13°C to 24°C; beyond this range, their reproductive success decreases, and mortality rates increase.[226] Spawning is most effective at a temperature of around 14°C. The pH level of the water is also important and should ideally be between 6.9 and 7.5. White bass are particularly sensitive to highly alkaline waters. Likewise, excessively hard water—above 200 ppm—can negatively affect their growth and development, as overly hard and alkaline waters often indicate pollution, especially from nitrates. These fish are highly beneficial to the ecosystem, serving as a food source for many other fish species, waterbirds, and even humans. As efficient predators, they also help maintain population balance among smaller fish, invertebrates, and insects. White bass are especially common in North America.

Their impact on climate change is indirect, contributing through nutrient cycling, greenhouse gas mitigation, carbon storage, maintaining ecological balance, and increased emissions of harmful gases into the atmosphere due to industrial human activity in the fishing sector. The genome size of white bass is approximately 640 Mb. Their energy content is around 25 kJ/g or 6 kcal/g.

226 Person-Le Ruyet, J., Mahé, K., Le Bayon, N., & Le Delliou, H. (2004). Effects of temperature on growth and metabolism in a Mediterranean population of European Sea Bass, Dicentrarchus labrax. *Aquaculture*, 237(1-4), 269–280. https://doi.org/10.1016/j.aquaculture.2004.04.021.

3. Largemouth bass (*Latin: Micropterus salmoides*)

This fish is a freshwater predator that primarily feeds on other fish, but its diet can also include animals such as snakes, frogs, salamanders, mice, and others. It can grow to a size of 40 cm to 97 cm. It thrives best in water temperatures ranging from approximately 18°C to 29°C, with an optimal temperature for growth and development around 21°C. For successful reproduction, this species does well in water with a pH range from 5 to 10, meaning it is not highly sensitive to moderately acidic or more alkaline conditions. It can even tolerate harder waters, with 400 ppm of water hardness being optimal.

The water must contain a high concentration of dissolved oxygen, especially when the temperature exceeds 25°C. Like most fish, the largemouth bass is sensitive to water pollution. However, overall, it is a fairly resilient species. As a top predator, it plays an important role in maintaining the balance of other fish populations and serves as a rich food source for larger predators, including humans. It is most commonly found in parts of North and Central America but also lives in Europe, South Africa, and Japan.

Its impact on climate change is indirect and is reflected through nutrient cycling, greenhouse gas mitigation, carbon storage, maintaining ecosystem balance, and increased emissions of harmful gases due to industrial fishing activities. The genome size of this species is approximately 920 Mb. The energy content of these fish is about 25 kJ/g or 6 kcal/g.

4. Speckled peacock bass (*Latin: Cichla temensis*)

The speckled peacock bass can reach a weight of 14 kg and a length of up to 98 cm. It most commonly inhabits warm tropical regions, preferring water temperatures between 27°C and 29°C and a pH range of 5.5 to 6.5. It can survive in waters with a hardness ranging from 85 to 267 ppm. It typically lives in riverine lagoons with sandy and rocky bottoms.

This fish primarily feeds on smaller fish and the eggs of other fish. It adapts relatively easily to new environments and is well-suited for aquariums. However, when introduced to a new natural habitat, it can become overly invasive and expansive, which may pose a threat to local ecosystems.[227] In South America, this fish is farmed for commercial sport fishing. It is most commonly found in South America, particularly in regions of Venezuela and Brazil. Its impact on climate change is indirect and is reflected in nutrient cycling, greenhouse gas mitigation, carbon storage, and

227 Sastraprawira, S. M., Abd. Razak, I. H., Shahimi, S., Pati, S., Edinur, H. A., John, A. B., Ahmad, A., Kumaran, J. V., Martin, M. B., Chong, J. L., Chowdhury, A. J., & Nelson, B. R. (2020). A review on introduced Cichla spp. and emerging concerns. *Heliyon*, 6(11). https://doi.org/10.1016/j.heliyon.2020.e05370.

maintaining ecological balance. The genome size is estimated to be approximately 900 Mb. The energy content of these fish is around 25 kJ/g or 6 kcal/g.

5. American eel (*Latin: Anguilla rostrata*)

The American eel resembles a snake in shape and can grow from approximately 37 cm to 100 cm, though it may reach lengths up to 152 cm and weigh up to 7 kilograms. It is found in both saltwater and freshwater environments with temperatures ranging from 4°C to 25°C, tolerating a wide range of pH levels and water hardness. It can survive in both acidic and saline waters and is less sensitive to low levels of dissolved oxygen. Its diet is highly varied, including carrion, frogs, fish, insects, invertebrates, fish eggs, larvae, crabs, and more. As a top predator, it plays a vital role in regulating populations of insects, invertebrates, amphibians, etc. It also serves as a rich food source for turtles, larger fish, aquatic birds, mammals, and humans. It is predominantly found in North and Central America. The species influences climate change indirectly by contributing to nutrient cycling, reducing greenhouse effects, carbon storage, and maintaining ecosystem balance. The estimated genome size is between 975 Mb and 1,413 Mb. Its energy content is about 25 kJ/g or 6 kcal/g.

6. Bowfin (*Latin: Amia calva*)

This fish is commonly found in warmer lakes and rivers with abundant aquatic vegetation. It thrives in water temperatures between 15°C and 25°C, with pH ranging from 6.0 to 7.5 and water hardness between 54 ppm and 268 ppm. It grows between 53 cm and 109 cm long and can weigh over 9 kilograms. Bowfin can survive without water for nearly 21 days, making it less dependent on dissolved oxygen. It preys on fish, aquatic insects, night spiders, frogs, snakes, lizards, salamanders, and various aquatic invertebrates, marking it as a versatile apex predator. Its only natural predators are mainly alligators. It is primarily found in North America. Its indirect impact on climate includes nutrient cycling, greenhouse gas mitigation, carbon storage, and ecosystem balance. Its genome size is estimated between 831 Mb and 897 Mb. Energy content is about 25 kJ/g or 6 kcal/g.

7. Bluegill (*Latin: Lepomis macrochirus*)

This species lives in rivers and large lakes with water temperatures ranging from 1°C to 36°C, a pH between 7.0 and 7.5, and water hardness from 178 ppm to 267 ppm. It is sensitive to pollution and low dissolved oxygen levels. It can weigh up to 2.2 kg and grow between 19 cm and 41 cm in length. Bluegill feeds on small fish, snails, aquatic insects, and invertebrates. It is important in controlling populations of other species and is a food source for predators like the largemouth bass. It is found across North, Central, and South America, as well as in Asia, Africa, and oceanic islands.

It influences climate indirectly via nutrient cycling, carbon storage, and maintaining ecosystem balance. Its genome is about 889 Mb in size. Energy content is approximately 25 kJ/g or 6 kcal/g.

8. Common carp (*Latin: Cyprinus carpio*)

These resilient fish inhabit the bottoms of calm waters like smaller rivers and lakes with soft substrates and dense vegetation. They can tolerate low oxygen levels, temperature extremes from 3°C to 35°C, pH between 6.5 and 9.0, and water hardness from 178 ppm to 267 ppm. Spawning occurs best between 15°C and 20°C. Although mainly herbivorous, they also feed on snails, aquatic insects, invertebrates, small crustaceans, and algae, helping regulate plant and animal populations. They are a food source for larger fish like pike and for humans. In non-native areas, they can become invasive, harming ecosystems. They are found in North America, Europe, and Asia. Their climate impact is indirect and includes nutrient cycling, carbon storage, and emissions related to fisheries. Genome size ranges from 1.415 Gb to 1.714 Gb. Energy content is around 25 kJ/g or 6 kcal/g.

9. Brown bullhead (*Latin: Ameiurus nebulosus*)

Highly adaptable to water temperature fluctuations (0°C to 37°C), the brown bullhead tolerates low oxygen and can survive out of water temporarily. It lives in both freshwater and saltwater and tolerates hard, acidic, or alkaline waters. Typically, it grows to about 55 cm and weighs just over 1 kg. As a top predator, it eats aquatic plants, fish, insects, invertebrates, fish eggs, larvae, etc. It is preyed upon by water snakes, pike, turtles, and lungfish. Though beneficial to ecosystems, it may become invasive in non-native areas. It is found in North America, Europe, Asia, and oceanic islands. It indirectly affects climate via nutrient cycling and carbon storage. Genome size is approximately 840 Mb. Energy content is around 23 kJ/g or 5 kcal/g.

10. Channel catfish (*Latin: Ictalurus punctatus*)

Mostly found in lakes and pools but also in rivers, it prefers water temperatures between 10°C and 32°C, pH 6.0–8.0, and hardness from 71.2 ppm to 534 ppm. It is tolerant of low oxygen levels. It can grow from 54 cm to 132 cm and weigh up to 26.3 kg. Its diet includes small fish, crustaceans, snails, aquatic insects, and small mammals. It is prey to birds of prey, snakes, alligators, otters, and humans. Some freshwater mussels use it to host their larvae. It can be invasive outside its native range. Found in Canada, the U.S., and Mexico. It influences climate indirectly through nutrient cycling and ecosystem stability. Genome size ranges from 783.3 Mb to 1.037 Gb. Energy content is around 23 kJ/g or 5 kcal/g.

11. Florida largemouth bass (*Latin: Micropterus salmoides floridanus*)

Native to Florida, this fish lives in lakes, ponds, and rivers. It grows faster due to the warmer climate, reaching lengths of 46 cm to 67 cm and up to 11 kg in weight. Prefers water temperatures from 20°C to 30°C, pH above 6.0, and hardness between 200 ppm and 400 ppm. It feeds on smaller fish, aquatic insects, and invertebrates and is prey to pike, eels, herons, and alligators. Important for ecosystem balance, it is found primarily in Florida. Climate impact is indirect through nutrient cycling, carbon storage, and biodiversity. Estimated genome size is about 1.0 Gb. Energy content is around 23 kJ/g or 5 kcal/g.

12. Longnose gar (*Latin: Lepisosteus osseus*)

Lives in lakes, rivers, and ponds with water temperatures from 12°C to 20°C, pH between 7.0 and 7.7, and hardness of 178–267 ppm. It can tolerate low oxygen levels and brackish water. It typically grows 66–80 cm but can reach up to 200 cm and 22.8 kg. It preys mainly on fish and crustaceans. In southern Florida, it is a food source for alligators. It helps control populations of smaller predatory fish. Found mostly in the U.S. and Mexico. It has an indirect climate impact through nutrient cycling, biodiversity, and carbon storage. Genome size is about 940 Mb. Energy content is around 23 kJ/g or 5 kcal/g.

13. Northern pike (*Latin: Esox lucius*)

This predator grows from 25 cm up to 150 cm and can weigh up to 28.4 kg. Found in clean lakes and rivers with rich vegetation, at temperatures of 10°C to 28°C. Tolerant of pH 5.0 to 9.0 and hard water (200–400 ppm), as well as low oxygen levels. Feeds mainly on fish, but also on birds, mice, frogs, reptiles, and invertebrates. It sits at the top of the food chain with few natural predators besides humans and other pike. It is found in North America, Asia, and Europe. Indirectly influences climate by supporting nutrient cycling and biodiversity. Genome size is about 919 Mb. Energy content is around 25 kJ/g or 6 kcal/g.

14. Pumpkinseed sunfish (*Latin: Lepomis gibbosus*)

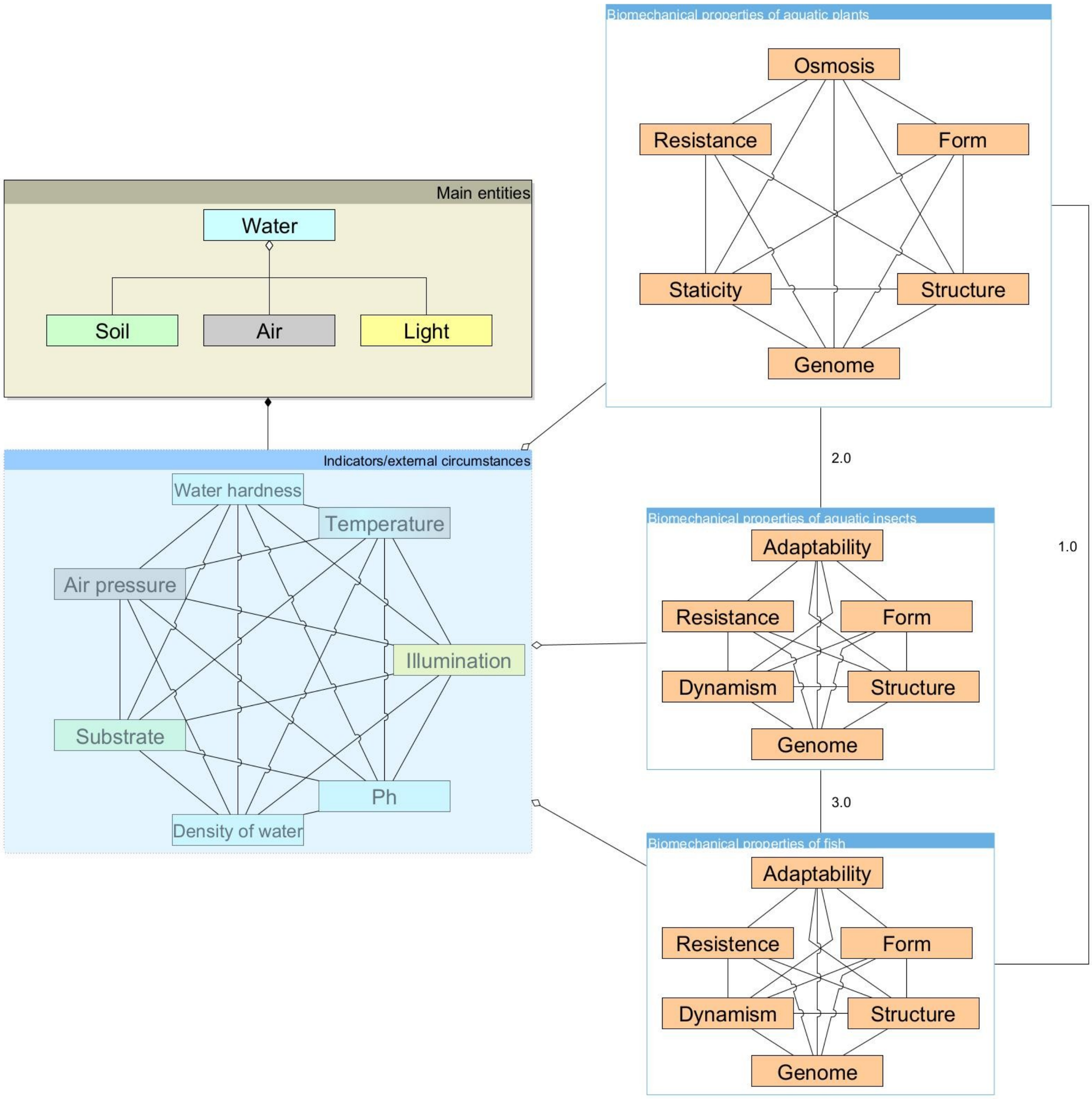
Grows from 9.9 cm to 40 cm and weighs between 171 g and 630 g. Inhabits lakes, ponds, and small rivers at temperatures from 4°C to 30°C, with pH 7.0–7.5 and water hardness from 178–267 ppm. Tolerates low oxygen levels. Eats small fish, aquatic invertebrates, insects, spiders, and fish eggs. Preyed upon by larger fish like bass and pike, and humans. While helpful in balancing populations, it can disrupt ecosystems when introduced elsewhere. Found mainly in North America. It indirectly contributes to climate stability through ecosystem functions. Genome size is about 773 Mb. Energy content is about 23 kJ/g or 4 kcal/g.

15. Chum salmon (*Latin: Oncorhynchus keta*)

This species migrates between saltwater (oceans) and freshwater (rivers), living in temperatures from 0°C to 24°C and pH 6.5–8.0. Tolerates hard water but is sensitive to low oxygen levels (must exceed 6.3 mg/L). It can grow from 58 cm to 100 cm and weigh nearly 16 kg. Feeds primarily on marine and freshwater fish (e.g., squid, sprat, sand eel), aquatic insects, and plankton. It is a major food source for larger fish, birds, mammals (e.g., orcas, seals, bears, humans). After death, its body enriches the river ecosystem with nutrients. It is ecologically vital and indirectly influences climate through nutrient recycling and carbon storage. The size of their genome can be estimated at approximately 2.20 Gb. The energy content of these fish is about 25 kJ/g or 6 kcal/g.

As with the subsections on aquatic plants and insects, this subsection will also summarize in a diagram the hierarchical associative layout among key entities (water, light/sun, soil, and air), external conditions (pressure, temperature, density, hardness, light availability, biodiversity, and pH), and the biomechanical properties of fish (shape, structure, resistance, mobility, adaptability, and genome). Fish, aquatic insects, and aquatic plants are living organisms that are interconnected in various ways. Some aquatic plants and insects are a rich food source for fish, although it is worth noting that there is a stronger connection between fish and aquatic insects, as relatively few fish species consume aquatic plants. On the other hand, aquatic plants offer shelter to fish from high temperatures and larger predators such as water birds and aquatic reptiles. It is important to emphasize the symbiotic relationship between aquatic plants and certain fish species. Despite the struggle for survival among different species, the focus is not solely on raw competition, but also on the less obvious cooperation between them. Raw competition can, from a narrow perspective, be seen as extremely hierarchical, but a broader, big-picture view reveals the simultaneous presence of mutual and balanced cooperation. Ego-driven motives, when viewed in the larger context, cannot override a hidden awareness of the common good, which contributes to a more fruitful, diverse, biomass-rich, and balanced ecosystem.

It appears that, in many cases, the human species stands apart from this cooperative framework, having drastically reduced the planet’s biomass in just 10,000 years. It remains unclear why humans act this way from the perspective of the natural hierarchical associative system or whether there is any functional or rational explanation for this behavior.



5.4.7.6.5.2 Figure 360: Packet-based hierarchical associative diagram of key entities, external conditions, and biomechanical properties of aquatic plants, aquatic insects, and fish

Figure 360 presents a packet-based hierarchical associative diagram of key entities, external environmental conditions, and biomechanical properties of aquatic plants, aquatic insects, and fish. We can observe that the packet network is already more extensive and inclusive, reflecting the strength of associative connections between the biomechanical property packets of these organisms.

Given that most fish are carnivorous and use aquatic plants primarily as shelter rather than as a food source, the associative link between the biomechanical properties of aquatic plants and fish is relatively weak (see the figure: the strength of the associative link is marked as 1.0 and is less pronounced). A moderately strong associative connection is observed between the biomechanical properties of aquatic insects and aquatic plants, as many insect species—including their larvae—feed not only on other animals but also on plants, which serve not just as shelter from predators (see the figure: the strength of the associative link is marked as 2.0 and is somewhat stronger).

Finally, the strongest associative connection is found between the biomechanical properties of aquatic insects and fish (see the figure: the strongest associative link is marked with a value of 3.0). These varying levels of associative strength between biomechanical properties of different living species are primarily the result of genomic potential and adaptation, but they are also shaped by external environmental conditions. The genome essentially determines the potential for traits such as size, shape, structure, resistance, and adaptability. These traits, in turn, define which organisms become producers or consumers within the food web, heavily influenced by the physical and chemical properties of the aquatic environment, such as pH, temperature, density, and hardness.

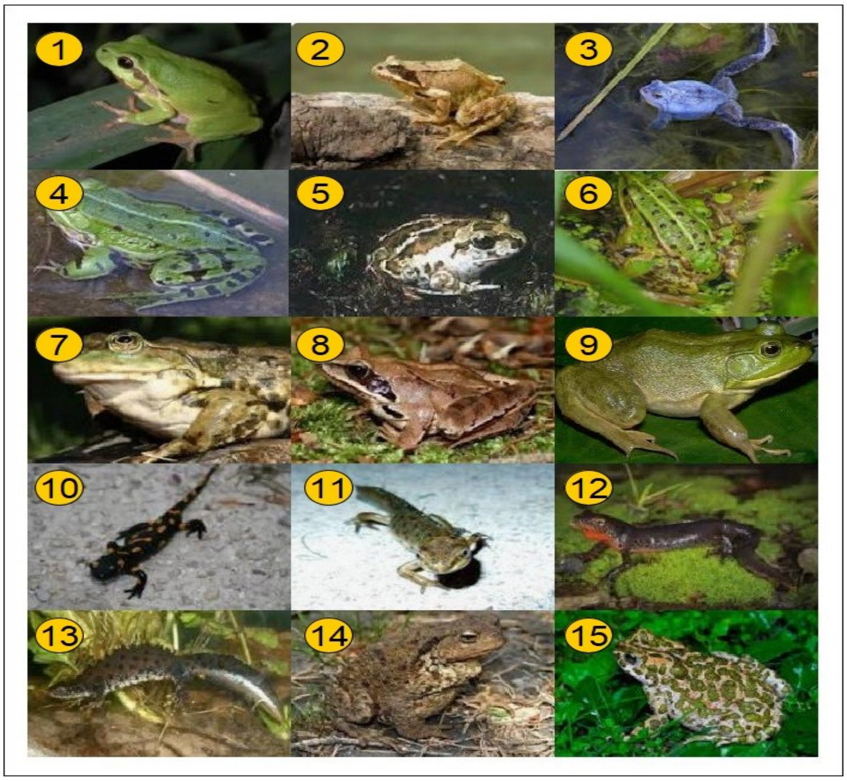
Water is not an isolated element; it is generically interconnected with soil (substrate and nutrients, minerals), light (sunlight and heat), and air (air pressure, pollution). Without these primary physical and chemical properties, the conditions required for critical encounters between species would not exist. As a result, the genetic potentials of organisms could not be realized. Based on this understanding, the genome can be seen as the overarching element within the packet of biomechanical properties. However, combinations of suppositions, positions, situations, and events within the mesocosm can significantly reduce the importance of the genome.

5.4.7.6.6 Amphibians

Amphibians are cold-blooded animals and, in most cases, are not fully adapted to life on land. They spend a large portion of their lives in or near various water sources such as springs, streams, ponds, rivers, lakes, and wetlands. A smaller percentage live in forests and moist agricultural areas, while a very small number can survive in saltwater (e.g., frogs that feed on crabs). Most amphibian larvae breathe through gills, while adults breathe through lungs and their skin. Amphibians represent a transitional form between fish and reptiles.

A key characteristic of amphibians is that they have four legs instead of fins. Additionally, they have eyelids, a tongue, and well-developed senses of smell and taste. Some amphibians lay their eggs in water, while others are viviparous, meaning their eggs develop inside the mother’s body. Amphibians have excellent hearing due to the unique structure of their middle ear, which is connected to the throat via the Eustachian tube. Water is vital for amphibians because it keeps their skin moist, which is essential for breathing and movement. Amphibians rarely drink water directly; instead, they absorb it through the prey they consume.

Occasionally, especially during hot summer days, amphibians may eat plant material, but they primarily feed on meat. Their diet includes insects, slugs, other frogs, small fish, spiders, worms, and, if large enough, even birds, bats, and mice. Most amphibian larvae prefer a plant-based diet. Due to numerous natural predators, some amphibian species have developed poisonous glands that make them unpalatable. Others use different defense mechanisms, such as visually deceiving predators or mimicking other animal species to surprise and deter attackers. In addition to the five basic senses, amphibians can detect ultraviolet and infrared light, and even magnetic fields.[228] Amphibians are broadly classified into frogs, toads, salamanders, newts, and caecilians. What follows is a description of a very limited selection of different amphibian species.[229] Given that frogs make up 90% of all amphibians, most of the descriptions will focus on them.



5.4.7.6.6.1 Figure 361: Selection of frogs, salamanders, and toads

1. European tree frog (*Latin: Hyla arborea*)

They grow to about 4–5 cm in length and have a bright green coloration, while the tadpoles are yellowish. They are commonly found on forest edges, meadows with other vegetation, and near water sources such as ponds, small pools, or ditches, where they lay their eggs attached to aquatic plants. They typically avoid waters with fish, which can pose a threat to both their eggs and the tadpoles that hatch after about ten days. Tadpoles and adult frogs thrive best in water temperatures between 15–20°C, pH between 6.5 and 7.5, and soft to moderately hard water (80–200 ppm).

228 Clarke, B., Brightling, G., & Greenaway, F. (2005). *Amphibian*. DK Pub.

229 The following monographic work served as additional assistance in the description: Wells, K. D. (2007). *The Ecology & Behavior of Amphibians*. The University of Chicago Press.

Dissolved oxygen levels should be above 7 mg/L. Tadpoles feed mainly on plant material, while adults consume various small invertebrates, making them beneficial for maintaining ecosystem balance. They are widespread across Europe. This species will also be discussed later as a terrestrial organism. Genome size is approximately 3.6 Gb.

2. Common frog (*Latin: Rana temporaria*)

These frogs grow to 6–9 cm in length and vary in color, typically with dark spots. Tadpoles are dark brown. Outside of the breeding season, they are mostly found in moist areas near ponds, marshes, or tall grass meadows. In winter, they hibernate in still waters, lakes, or muddy burrows. Optimal water temperature for tadpoles and adults is 20–23°C, with pH 6.5–7.5 and water hardness between 80–200 ppm. Dissolved oxygen should exceed 7 mg/L. Tadpoles initially feed on algae and aquatic plants, later switching to smaller aquatic animals and invertebrates. Adults feed on various insects, spiders, woodlice, snails, and worms. Both life stages face predators like water birds, raptors, snakes, magpies, and weasels. They play an important role in insect population control and are widespread throughout Europe and much of Asia. Genome size: \~4.11 Gb. Energy content: \~12 kJ/g or 3 kcal/g.

3. Moor frog (*Latin: Rana arvalis*)

They grow to 5–7 cm, with males turning blue during breeding season. Tadpoles are brown. Found in marshes and forest edges. They thrive in 15–20°C waters with pH 4.5–7.5 and tolerate harder water (over 200 ppm). They are less sensitive to low oxygen concentrations (<7 mg/L). Tadpoles feed on algae and small invertebrates; adults eat insects and other invertebrates. Common throughout Europe and much of Asia. Genome size: \~3.2 Gb. Energy content: \~12 kJ/g or 3 kcal/g.

4. Edible frog (*Latin: Pelophylax kl. esculentus*)

They reach 5–11 cm in length, green with dark spots. A hybrid between the pool frog and marsh frog. Found in lakes, ponds, canals, ditches, etc. They thrive in 15–20°C water, pH 6.5–7.5, and hardness 120–200 ppm. Oxygen concentration should be above 7 mg/L. Tadpoles eat algae and small insects; adults consume insects, invertebrates, spiders, and even fish, other frogs, and small birds. Widely distributed in Europe. Genome size: \~4.0 Gb. Energy content: \~8 kJ/g or 2 kcal/g.

5. Common spadefoot (*Latin: Pelobates fuscus*)

They grow to 4–9 cm, brownish to white, tadpoles are olive-colored with black patterns and may grow up to 10 cm. Adults mostly live on land, except during mating, near calm rivers, ponds, lakes, and pools. Tadpoles feed on algae and microorganisms; adults eat insects and invertebrates. Natural predators include owls, crows, herons, and coyotes. They are sensitive to water quality: temperature 18–20°C, pH 6.5–7.5, hardness 100–200 ppm, oxygen >7 mg/L, and should not be polluted with ammonia or nitrate ions. Common throughout Europe. Genome size: \~4.0 Gb. Energy content: \~8 kJ/g or 2 kcal/g.

6. Marsh (colorful) frog (*Latin: Pelophylax ridibundus*)

They grow to 4.5–6.5 cm, grass-green with dark spots. Closely related to the pool and edible frogs. Shares similar characteristics to the edible frog. No genome size data available in NCBI.

7. Marsh (fathead minnow) frog (alternate/common name for Rana ridibunda)

These are the largest true frogs in Europe, growing up to 17 cm. Green with black patterns. Primarily feed on insects (especially dragonflies) but also worms, slugs, small fish, amphibians, and even small mammals. Prey for small mammals, lizards, snakes, shrews, otters, and large birds like herons. Optimal water temperature: \~15°C, with moderate pH, hardness, and oxygen levels. Found across Europe and Asia. Genome size: \~4.0 Gb. Energy content: \~8 kJ/g or 2 kcal/g.

8. Agile frog (*Latin: Rana dalmatina*)

Grows 5–9 cm, light brown with black spots. Terrestrial outside breeding season, found near moist grasses, forest edges, calm rivers, and ponds. Feeds mainly on terrestrial insects, earthworms, and spiders. Prey for birds, snakes, and mammals like foxes. Tadpoles feed on aquatic vegetation and carrion. Thrive at moderate water quality values. Found across Europe. Genome size: \~4.0 Gb. Energy content: \~8 kJ/g or 2 kcal/g.

9. American bullfrog (*Latin: Lithobates catesbeianus*)

Can grow up to 20 cm; olive-green to brown. Tadpoles are dark brown, 9–10 cm long. Found in lakes, calm rivers, pools, and ponds. Adults are opportunistic predators eating anything they can catch—bugs, invertebrates, fish, small mammals, snakes, lizards. Tadpoles feed on algae and organic material, with few natural enemies. Adults face predators like foxes, raccoons, large birds, snakes, turtles, and humans. Beneficial but potentially harmful due to overpredation. Optimal water temperature: 15–20°C; breeding requires over 25°C. pH 7.0–7.5, hardness 80–250 ppm, low oxygen tolerance. Found in Europe and North America. Genome size: \~6.25 Gb. Energy content: \~12 kJ/g or 3 kcal/g.

10. Fire salamander (*Latin: Salamandra salamandra*)

Grows 20–25 cm; black with yellow spots. Found near springs and small streams. Few predators due to toxic skin glands. Larvae develop internally and are born with limbs. They live in water and breathe via gills until adulthood. Capable of regenerating limbs and some organs. Feed on insects, spiders, worms, and larvae. Not sensitive to water temperatures below 15°C; prefer 80–300 ppm hardness and oxygen >7 mg/L. Common in Europe. Genome size: \~20.0 Gb. Energy content: \~8 kJ/g or 2 kcal/g.

11. Smooth newt (*Latin: Lissotriton vulgaris*)

Smooth newts grow up to about 10 cm in length and are brownish-olive green in color. They spend most of their time on land, except during the breeding season. During this period, adult smooth newts inhabit calm water bodies such as springs, lakes, slow-moving rivers, quiet streams, and ponds. Their larvae remain in water until metamorphosis, feeding mostly on aquatic plants. In their aquatic stage, adult newts primarily feed on aquatic invertebrates, water fleas, and insect larvae, while on land, they mostly prey on earthworms and slugs. They are an important food source for water birds, snakes, and some frogs. These animals play a crucial and beneficial role in the ecosystem. They are not highly sensitive to water temperatures below 15°C, pH values between 4 and 9, or water hardness levels above 300 ppm. They also tolerate lower levels of dissolved oxygen in water. Smooth newts are most commonly found throughout Europe. Their impact on climate change is indirect—contributing to nutrient cycling, greenhouse gas mitigation, carbon storage, biodiversity creation, and maintaining ecosystem balance. Their genome size is estimated at about 20.0 Gb. Their energy content is approximately 8 kJ/g or 2 kcal/g.

12. Alpine newt (*Latin: Ichthyosaura alpestris*)

These newts can grow up to 12 cm long and are black in color. They are adapted to live in environments with temperatures below 10°C. Females lay their eggs on moist grass or the leaves of aquatic plants, from which fully developed young hatch. For reproduction, they only need small water bodies such as puddles, ponds, or small lakes. Both larvae and adults primarily feed on plankton, insect larvae, and small aquatic crustaceans. They are a rich food source for snakes, fish, birds, aquatic beetles, and mammals such as hedgehogs. Alpine newts are beneficial for ecosystem balance. Their larvae are sensitive to water temperatures above 20°C, acidic pH levels below 6.5, soft water (below 100 ppm), and dissolved oxygen levels below 6.5 mg/L. They are most commonly found in Europe. Their contribution to climate change is indirect, as they support nutrient cycling, reduce greenhouse effects, store carbon, enhance biodiversity, and help maintain ecological balance. Their genome size is estimated at approximately 20.0 Gb. Their energy content is about 8 kJ/g or 2 kcal/g.

13. Great crested newt (*Latin: Triturus cristatus*)

These newts can reach up to 16 cm in length. They have dark brown backs and yellowish bellies. They spend most of their time on land but return to various aquatic habitats—such as lakes, large ponds, pools, and sometimes even rivers—for breeding. On land, they mainly feed on invertebrates; in water, they consume insects, other animal larvae, and aquatic invertebrates. They are a key food source for water birds, snakes, and mammals such as hedgehogs, badgers, and shrews. Great crested newts are highly beneficial in both terrestrial and aquatic ecosystems. Their larvae, which can grow up to 7 cm, feed mostly on aquatic plants and decaying organic matter. Their optimal water environment includes temperatures below 25°C, pH between 6.84 and 8.70, and hardness between 36 ppm and a maximum of 215 ppm. They can survive in waters with low dissolved oxygen levels (as low as 6.0 mg/L). Found throughout various parts of Europe, they contribute indirectly to climate change mitigation through nutrient cycling, carbon storage, biodiversity maintenance, and ecosystem stability. Their genome size is around 20.0 Gb. Their energy content is about 8 kJ/g or 2 kcal/g.

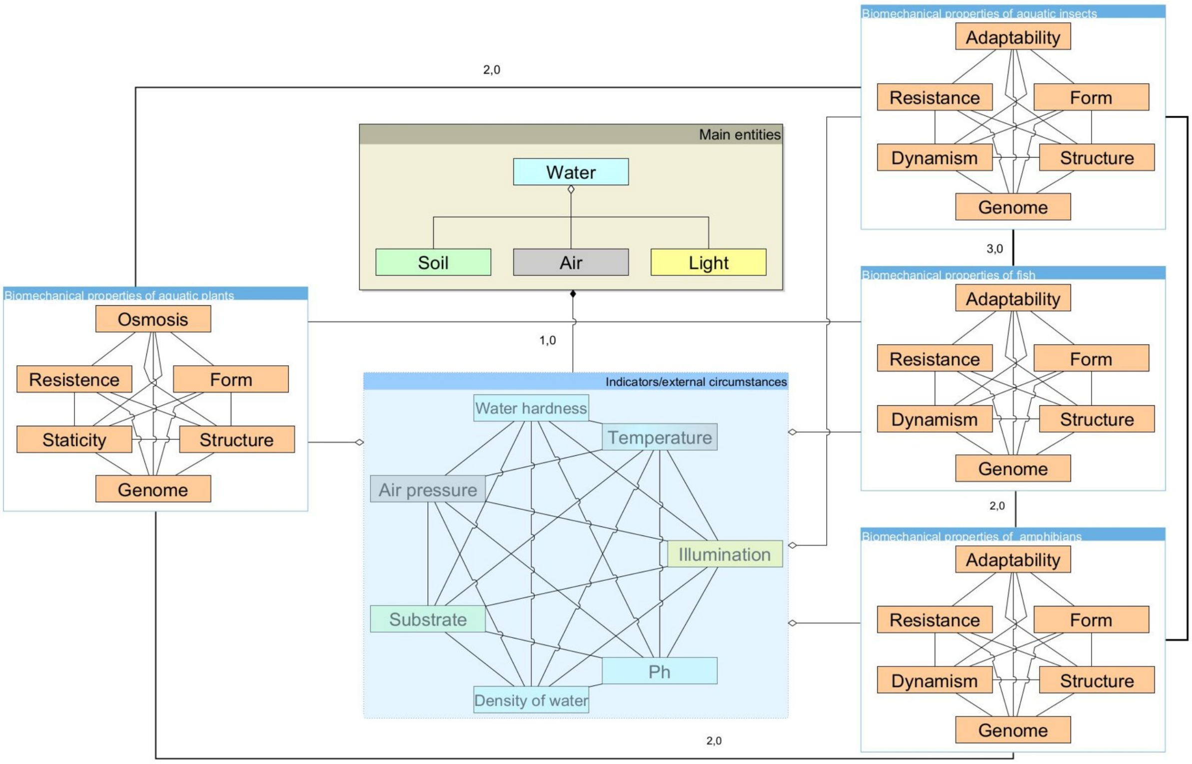
14. Common toad (*Latin: Bufo bufo*)

Common toads grow between 10 cm and 18 cm long and are yellowish-brown with dark patterns. They live primarily on land and become aquatic only during spring breeding. During this time, they lay thousands of eggs, which hatch into tadpoles that mostly feed on algae and aquatic plants. Adult toads eat insects, small mice, smaller snakes, worms, and even other toads. Both adults and tadpoles thrive best in waters with temperatures between 17°C and 21°C. They tolerate a wide pH range from 4.7 to 9.9, hardness from 86 ppm to 500 ppm, and dissolved oxygen levels below 7 mg/L. These animals are generally beneficial for maintaining ecosystem balance, though they can become a nuisance if populations grow excessively. They are found across Europe, Asia, and Africa. Their impact on climate change is indirect—supporting nutrient cycles, reducing greenhouse gas effects, storing carbon, fostering biodiversity, and preserving ecological equilibrium. Their genome is estimated at about 4.39 Gb. Their energy value is about 12 kJ/g or 3 kcal/g.

15. Green toad (*Latin: Bufotes viridis*)

Green toads grow between 8 cm and 10 cm long and are grayish-white to brownish with green spots on their backs. They are mainly terrestrial, spending time in water only during the spring breeding season, where they lay between 9,000 and 15,000 eggs around submerged vegetation. Their tadpoles are lighter in color than those of the common toad and feed mainly on algae and aquatic plants. They are an important food source for aquatic insects and their larvae, snakes, newts, water birds, and small mammals. Adult green toads eat insects (such as ants), terrestrial invertebrates, and occasionally small mammals. They play a vital role in both land and aquatic ecosystems. Green toads are extremely resilient and can survive extreme conditions—from intense heat to low temperatures, and even in saline water. However, their tadpoles are more sensitive, depending on specific conditions: water temperatures between 18°C and 21°C, pH between 6.75 and 7.12, hardness from 80 ppm to 300 ppm, and dissolved oxygen between 7.2 and 7.8 mg/L. They are primarily found in Europe, Asia, and Africa. While genome data is unavailable in the NCBI database, it is estimated to be around 3.70 Gb. Their indirect role in climate change includes nutrient cycling, greenhouse effect reduction, carbon storage, biodiversity maintenance, and ecological balance. Their energy content is around 12 kJ/g or 3 kcal/g.

After these brief species descriptions, we continue with a hierarchical associative diagram of key entities (water, light/sun, soil, and air) and external factors (pressure, temperature, density, hardness, illumination, biodiversity, and pH), alongside biomechanical properties of amphibians (shape, structure, resilience, mobility, adaptability, and genome), and their relationship with aquatic plants, insects, and fish.



5.4.7.6.6.2 Figure 362: Packaged hierarchical associative diagram of key entities, external factors, and biomechanical characteristics of amphibians in relation to aquatic plants, insects, and fish

Figure 362 presents a packaged hierarchical associative diagram that maps the key entities, external environmental conditions, and biomechanical characteristics of amphibians in relation to aquatic plants, aquatic insects, and fish. The inclusion of biomechanical properties makes the associative network more extensive, but conceptually, it remains relatively straightforward. It illustrates the essential interconnections between all components within the network. For example, if a predator exhibits strong traits such as resilience, adaptability, and agility, it is likely that its prey will exhibit similar traits. Conversely, if a prey species is highly sensitive to environmental conditions (such as very low pH or high water hardness), less resilient, and lacking in mobility, it is less likely that the predator and prey will ever encounter each other.

Within this food web hierarchy, associative or symbiotic relationships also occur. Aquatic plants, for instance, are not only food producers but also provide shelter for many animals, protecting them

from predators and extreme temperatures. In return, these animals supply the plants with additional minerals. This mutualistic symbiosis results in a win-win situation for all parties involved.
Amphibian larvae often feed on aquatic plants and algae, while adult amphibians tend to prey on other animals—including, in some cases, members of their own species (e.g., cannibalism). The same applies to aquatic insects, many of whose larvae (such as dragonfly larvae) feed on smaller animals, while adult insects consume aquatic plants and other organisms. Fish and their larvae also adopt various feeding strategies, as very few fish species are strictly herbivorous.
From the associative connections—each assigned a numerical weight—we can deduce that the strongest links exist between insects and both fish and amphibians (with a biomechanical connection strength of 3.0). The link between amphibians and fish is somewhat weaker (weight 2.0), and the weakest connection is between fish and aquatic plants (weight 1.0).
This packaged hierarchical associative diagram is based on a limited selection of species, but the core principles are depicted with reasonable accuracy. Most amphibians spend the majority of their lives on land and migrate to water only during breeding periods. As a result, females often lay their eggs on suitable aquatic plants, from which larvae emerge that, in some species (particularly frogs), are fully adapted to aquatic life. These key patterns of connection are consistent and tend to recur with precise timing each year. In the next section, we will explore aquatic reptiles. While they may share some dietary habits with amphibians, they typically belong to a higher predator class and are exclusively carnivorous.

5.4.7.6.7 Aquatic reptiles

Like fish and amphibians, reptiles are vertebrates. Their main characteristics are that they are cold-blooded and breathe with lungs throughout their entire lives, which means they do not undergo metamorphosis like amphibians do. Reptiles come in various shapes—some resemble large worms, while others have legs and more rounded bodies. Some reptiles lay eggs, while others give birth to live young.
Reptiles can be broadly categorized into four main groups:
- Crocodylia (crocodiles, gharials, caimans, and alligators),
- Sphenodontia (e.g., tuatara),
- Squamata (lizards, snakes, and amphisbaenians), and
- Testudines (turtles and tortoises).

They form an incredibly diverse group of animals inhabiting a wide range of terrestrial and aquatic environments. For example, there are sea snakes that spend most of their lives in the ocean, as well as snakes that live in deserts and even in colder regions of the world. Some crocodiles inhabit both freshwater and saltwater environments. A notable example is the Galápagos marine iguana, which lives along the coast and feeds on algae scraped from the ocean surface. On the Indonesian islands, we find very large lizards such as the Komodo dragon, which is strictly carnivorous and can be deadly to humans due to its venomous saliva—it can even kill a water buffalo.

The following section will focus on a small selection of European reptiles, with an emphasis on aquatic habitats. It will describe species of semi-aquatic or aquatic snakes, lizards, and turtles.[230]

5.4.7.6.7.1 Figure 363: A small selection of (semi-)aquatic reptiles

Figure 363 shows a small, numbered selection of (semi-)aquatic reptiles, including one species of lizard, three different species of turtles, and five different species of snakes that live either partially or entirely in aquatic environments.

1. Viviparous lizard (*Latin: Zootoca vivipara*)

These lizards grow up to 16 cm in length and are brown in color. In colder climates, they give birth to live young, while in warmer regions, they lay eggs. Although primarily terrestrial, they may occasionally use water sources and aquatic vegetation for shelter from predators.

They feed on spiders and various insects such as grasshoppers, flies, and butterfly larvae.

230 The following sources were helpful in describing the limited selection of reptiles: Vitt, L. J., & Caldwell, J. P. (2014). *Herpetology an introductory biology of amphibians and reptiles*. Academic Press. Green, J., Green, J., Spilsbury, R., & Taylor, B. (2009). *Exploring the world of reptiles and Amphibians*. Chelsea House. Cox, N. A., & Temple, H. J. (2009). *European red list of reptiles*. Office for Official Publications of of the European Communities. Speybroeck, J., Beukema, W., Bok, B., & Van Der Voort, J. (2016). *Field guide to the amphibians and reptiles of Britain and Europe*. Christopher Helm.

Ecologically, they help control insect and spider populations and serve as an important food source for predators like foxes, cats, falcons, magpies, and larger reptiles. Found across Europe and Asia, their genome size is estimated at approximately 1,464 Mb.

A more detailed description, including their response to climate change and energy content (in kJ/g and kcal/g), will be provided later in the section on terrestrial animals.

2. European pond turtle (*Latin: Emys orbicularis*)

These turtles are 25–30 cm long with a dark shell and a black body speckled with yellow spots. They live in calm aquatic habitats like streams, ponds, lakes, and canals.

They are sensitive to temperatures below 10°C and prefer water temperatures above 20°C. They can tolerate a pH range from 5.0 to 7.5 and water hardness from 150 to 300 ppm, thriving best in harder waters.

Their diet includes fish, small snakes, tadpoles, insects, earthworms, and snails. They are an important food source for larger water birds, fish, mammals, snakes, and even humans.

They contribute indirectly to climate stability by supporting nutrient cycling, carbon storage, biodiversity, and ecosystem health.

They are found in Europe, Asia, and Africa, with an estimated genome size of about 2.30 Gb and an energy content of around 17.9 kJ/g (4.3 kcal/g).

3. Red-eared slider (*Latin: Trachemys scripta elegans*)

Measuring 20–30 cm long, these turtles have a dark shell with white edges and a distinctive red marking around the neck. They prefer temperatures between 24–30°C and live in lush aquatic environments like lakes, ponds, and pools.

Optimal water pH is 6.5 to 7.6, with moderate hardness below 300 ppm. Clean water is essential, free of chloride and nitrate pollutants.

They are omnivorous, feeding on aquatic plants, algae, snails, insects, tadpoles, fish, carrion, and decaying plant matter.

They need sunlight for digestion and safety.

Red-eared sliders play a key role in maintaining ecosystem balance and are common in North and Central America, Europe, Africa, and Asia.

Their genome size is about 2.13 Gb, and their energy content is approximately 17.9 kJ/g (4.3 kcal/g).

4. Yellow-bellied slider (*Latin: Trachemys scripta scripta*)

These turtles are 15–35 cm long, with a lighter shell and dark edges and a yellow pattern from neck to jaw. Similar to red-eared sliders in appearance and behavior, they thrive in water temperatures of 24–28°C, and up to 30°C.

They prefer slow-moving waters like rivers, lakes, ponds, and vegetated wetlands.
They are beneficial to ecosystems and are mainly found in North America and Europe.
They share the same genome size (~2.13 Gb) and energy content (17.9 kJ/g or 4.3 kcal/g) as red-eared sliders, with similar ecological contributions.
5. Grass snake (*Latin: Natrix natrix*)
They typically grow 90–110 cm long, though some individuals exceed 200 cm. Their dark back and light spots behind the head are distinguishing features.
They prefer moist, vegetated environments near slow-moving waters such as streams and ponds.
Their diet includes adult amphibians, tadpoles, aquatic invertebrates, and occasionally fish.
They help control amphibian populations and are prey for foxes, hedgehogs, cats, and large birds.
They require clean water with moderate temperature (20–25°C), pH (6.5–7.5), and hardness (80–200 ppm).
Grass snakes are found throughout Europe. Their genome size is ~1.73 Gb, with an energy value of 17.9 kJ/g (4.3 kcal/g).
6. Dice snake (*Latin: Natrix tessellata*)
These snakes grow to about 100 cm and are dark gray or olive green. They typically live in freshwater, but can tolerate slightly saline waters.
They favor calm habitats like ponds and small lakes with rich vegetation. Their diet includes fish, tadpoles, frogs, and salamanders.
They are an important food source for large birds, other snakes, and mammals.
Best suited to warmer waters (26–28°C), with a pH of 6.8–7.9, they tolerate moderately hard and slightly saline waters.
Dice snakes are found in North Africa, Europe, and Asia. Genome size is ~1.60 Gb, energy content ~17.9 kJ/g (4.3 kcal/g).
7. Common european adder (*Latin: Vipera berus*)
These snakes measure 60–85 cm and are grayish or brownish with a zigzag pattern along the back.
Though mainly terrestrial, they can be found near wetlands and calm rivers.
They prey on small mammals, birds, and amphibians and are a food source for larger mammals and birds of prey.
They are not dependent on water but may inhabit areas with very low (<5.0) or high (>7.5) pH and tolerate water hardness above 300 ppm and varying temperatures.
Common adders are widespread across Europe. Genome size is ~1.53 Gb, with energy content ~17.9 kJ/g (4.3 kcal/g).
8. Viperine water snake (*Latin: Natrix maura*)

Growing up to 85 cm, these snakes are gray-green or brownish and feed on fish, frogs, and other small aquatic animals.

They are preyed upon by beavers and large birds of prey and are beneficial to ecosystem balance.

They are active hunters in rivers, lakes, and brackish waters. Most effective in waters at 20–26°C, they prefer slightly alkaline water with moderate to high hardness.

They are found in Europe, North Africa, and North America. Genome size ~1.60 Gb; energy value ~17.9 kJ/g (4.3 kcal/g).

9. Four-lined snake (*Latin: Elaphe quatuorlineata*)

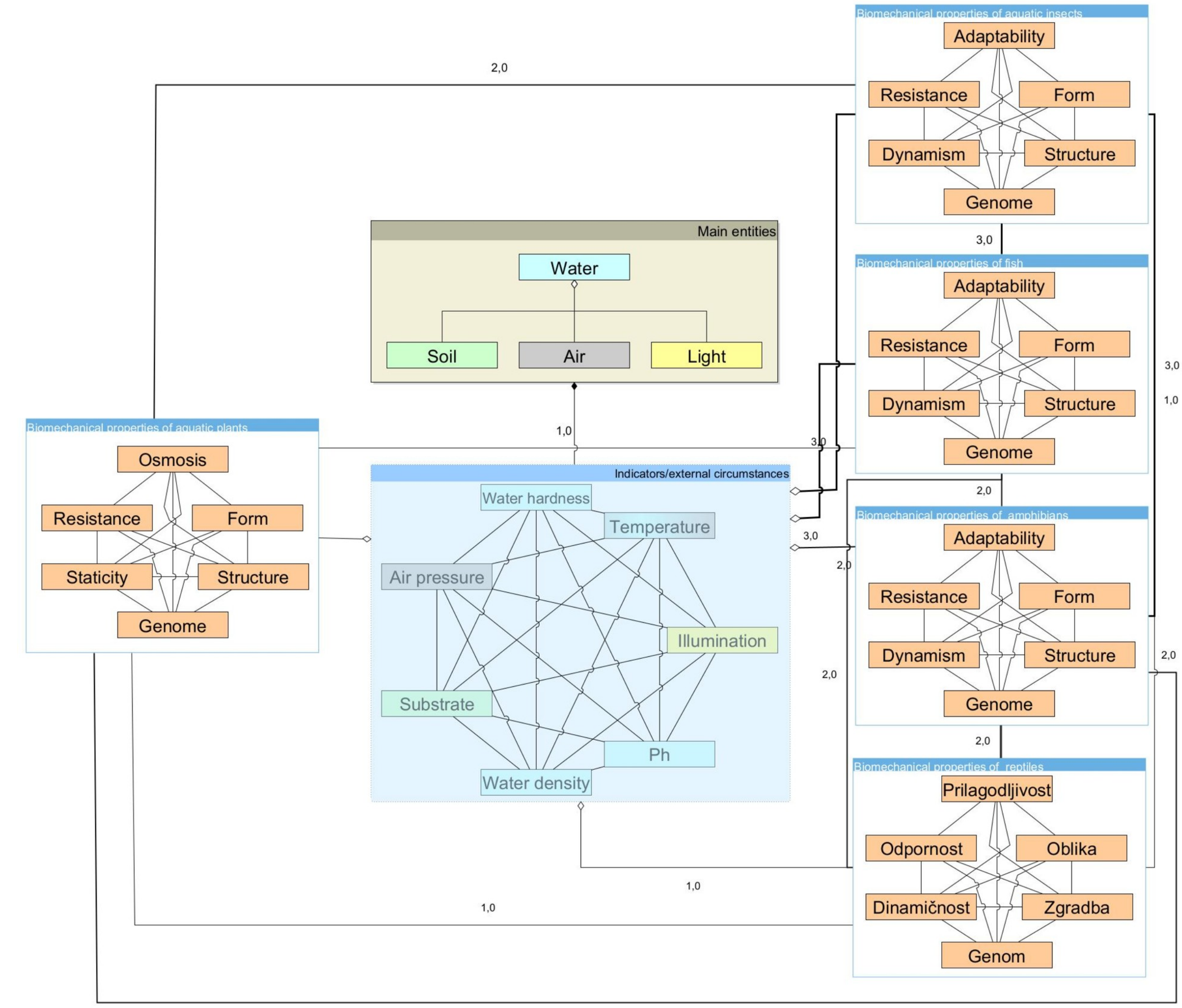
Reaching 185–225 cm, these snakes are brown with black stripes. They are mainly terrestrial, found in grassy riverbanks where prey is abundant.

They prefer warm climates and are not dependent on water quality. Their diet includes small rodents, lizards, birds, and eggs.

They help control rodent populations and are prey for cats, wildcats, coyotes, and foxes.

Common in Europe and parts of western Asia, their genome size is ~1.60 Gb and energy content ~17.9 kJ/g (4.3 kcal/g).

A hierarchical associative diagram will be updated later to include these reptiles, focusing on those least dependent on aquatic environments.



5.4.7.6.7.2 Figure 364: Package hierarchical associative diagram of reptiles in relation to aquatic plants, insects, fish, and amphibians

Figure 364 presents a package hierarchical associative diagram showing the relationships between reptiles and aquatic plants, insects, fish, and amphibians. In addition to the weights indicating the strength of associative links, weights for hierarchical dependence have also been included, which represent the degree of reliance on aquatic environments. Aquatic reptiles, in the broader sense, are significantly less dependent on water than the previously described species. As such, the hierarchical dependence is rated only at a value of 1.0, represented by a thin line and a white diamond.

Most aquatic reptiles are carnivorous and, from a dietary standpoint, are less dependent on aquatic plants. This is illustrated in the diagram by a weaker associative link with aquatic plants, also rated at 1.0. The same applies to their relationship with insects. Reptiles have the strongest associative links with fish and amphibians, which are both important food sources. These links are therefore rated at 2.0 and depicted with slightly thicker lines.

This suggests that reptiles are at the top of this food web, despite being predominantly terrestrial animals in most cases. Except for those reptiles more frequently found in aquatic environments, they are also less influenced by the physical-chemical properties of water, such as pH, temperature, hardness, and pollution levels. Instead, reptiles are far more dependent on air temperature, atmospheric pressure, and sunlight—although they also require ample shade to regulate their body temperature.

This description does not include top reptilian predators that inhabit marine environments (e.g., sea snakes, sea turtles) or tropical freshwater ecosystems (e.g., anacondas, crocodiles, caimans). For these animals, water's physical and chemical factors play a much more significant role, as they spend a substantial part of their lives in the water, where they feed and reproduce. However, their offspring are born from eggs laid on land, making them somewhat less dependent on aquatic environments in that regard. The same applies to body temperature regulation, as these reptiles need land to fully bask in the sun.

Reptiles such as crocodiles, giant lizards (e.g., Komodo dragons), and large snakes have few natural enemies and are generally not threatened by aquatic birds once they reach adulthood—these birds will be discussed in a later section.

5.4.7.6.8 Water birds

Water birds include species that primarily inhabit areas near flowing and still waters, and often have feet that closely resemble flippers. Most water birds are omnivores, feeding on both plant matter and other animals such as fish, insects, invertebrates, reptiles, and amphibians. This suggests that water birds play a crucial role in maintaining the population balance of both plant and animal species, unlike reptiles and fish, which are primarily carnivorous.

Despite the wide variety of water bird species, they share several common characteristics. These include slightly rear-positioned legs that facilitate swimming, a highly developed uropygial gland responsible for feather maintenance and waterproofing, and—among seabirds—salt glands that allow them to excrete excess salt from their bodies. The main defining trait of water birds is their adaptation to aquatic environments, which is evident in the various morphological forms of their bodies, heads, and especially their beaks. These physical traits often determine how the birds obtain and consume their food.

The presence of water birds in a particular habitat largely depends on the diversity and biomass of aquatic vegetation, favorable water and air temperatures during certain seasons, and the size and weight of the birds themselves. The relationship between the ecological role of water birds and aquatic surfaces is extremely important, as it influences their food consumption, production of beneficial organic substances for the environment, adaptability, and the creation of safe refuges for survival. Due to the vast diversity among the approximately 212 species of water birds, this subsection will present only a small selection of those that live in or around freshwater habitats.[231]

5.4.7.6.8.1 Figure 365: A small selection of water birds

Figure 365 presents a small selection of water birds, including swans, ducks, geese, herons, storks, dippers, kingfishers, rails, gulls, and others. What follows is a brief description of these water birds, numbered from one to fifteen.

1. Swan (*Latin: Cygnus*)

Swans are very large water birds that can reach a length of 120 to 180 cm. They inhabit freshwater bodies with lush vegetation. Their primary diet consists of aquatic plants such as green algae and

231 The following source served as an aid in the descriptions: Hammonds, H. (2004). *Water birds*. Thomson Nelson.

pondweed, but they may occasionally eat small fish, worms, insects, and frogs. They also use aquatic vegetation to build floating nests.

Adult swans have few natural predators, but their young are vulnerable to raccoons and foxes. They live in environments like lakes, ponds, and calm rivers, thriving in moderate temperatures and balanced pH and water hardness, conditions that support aquatic plant life.

Swans play an important role in the ecosystem by helping maintain the balance of aquatic vegetation and acting as bioindicators of water and air pollution. They are found almost worldwide, except in Africa. Their impact on climate change is indirect, as they contribute to nutrient cycling, carbon storage, biodiversity, and ecosystem stability. Their genome size is estimated at around 1.12 Gb. Their energy value is approximately 22 kJ/g or 5.3 kcal/g.

2. Mallard duck (*Latin: Anas platyrhynchos*)

Mallards grow to 50–60 cm in length and inhabit both still and flowing waters. Their diet is mostly aquatic plants, but they also eat frogs, tadpoles, and various insects.

They are highly adaptable water birds, best suited to environments with moderate temperatures and balanced pH and water hardness. Their main natural predators include foxes, herons, falcons, and humans.

Mallards play a vital ecological role by maintaining aquatic plant populations and serving as bioindicators of pollution. They are also a food source for many predators, including humans. They are widespread across Europe, Asia, North and South America, Australia, and North Africa.

Their impact on climate change is indirect and involves nutrient cycling, carbon storage, biodiversity support, and ecosystem health. Their genome is about 1.18 Gb in size. Their energy value is approximately 22 kJ/g or 5.3 kcal/g.

3. Gadwall (*Latin: Anas strepera*)

Gadwalls reach 46–57 cm in length and prefer marshes, muddy waters, ponds, and small lakes. Their diet consists mostly of aquatic plants, but they also eat aquatic invertebrates, frogs, fish, insects, and seeds.

They are highly adaptable, thriving in moderate conditions with balanced pH and water hardness. Their predators include foxes, raccoons, falcons, weasels, crows, martens, badgers, coyotes, and humans. Gadwalls help balance aquatic vegetation and are bioindicators of pollution. They are also a key food source for predators. They inhabit parts of Europe, and North and Central America. They indirectly impact climate change by contributing to nutrient cycling, carbon storage, biodiversity, and ecosystem balance. Their genome size is about 1.12 Gb. Energy content: 22 kJ/g or 5.3 kcal/g.

4. Common pochard (*Latin: Aythya ferina*)

Common pochards grow to 42–50 cm and prefer marshes and lakes up to about one meter deep. They mainly eat aquatic plants but also consume aquatic invertebrates, insects, and small fish. They thrive in moderate conditions and balanced water chemistry. Natural predators include red foxes, raccoons, falcons, weasels, martens, and humans.

They are important for regulating aquatic vegetation and serve as bioindicators. They are widespread in Europe, Asia, and North Africa. They indirectly support climate balance through ecological contributions. Genome size: ~1.12 Gb. Energy value: 22 kJ/g or 5.3 kcal/g.

5. Goosander (*Latin: Mergus merganser*)

Goosanders are 58–72 cm long and live near rivers and lakes with rich vegetation, often near forests. They feed mainly on fish but also eat amphibians, crustaceans, mollusks, invertebrates, and occasionally plants. They adapt well to various aquatic environments, including brackish waters, especially where water chemistry is moderate. Predators include large fish, eagles, falcons, and owls. They maintain aquatic animal populations and serve as bioindicators. Found in Europe, Asia, and North Africa, they also play a role in climate resilience via ecological services. Genome size: ~1.19 Gb. Energy value: 22 kJ/g or 5.3 kcal/g.

6. Greylag goose (*Latin: Anser anser*)

Greylag geese grow to 76–90 cm and live near rivers, lakes, ponds, and pools with vegetation, and sometimes in fields. They eat roots, grasses, grains, aquatic plants, and algae. They prefer moderate climates with balanced pH and water hardness. Predators include eagles, ravens, hawks, wild dogs, foxes, and humans.

They help control vegetation, serve as bioindicators, and are food for larger predators. Found in Europe, Asia, and parts of Australia, they contribute to ecosystem health and climate resilience. Genome size: ~1.21 Gb. Energy value: 22 kJ/g or 5.3 kcal/g.

7. Tundra bean goose (Latin: Anser fabalis)

These geese are 69–88 cm long and inhabit wetlands, fields, and marshes. They primarily eat grasses and seeds. Highly adaptable, they survive in moderate to cold environments with varying water chemistry. Predators include foxes and humans. They support vegetation balance near water sources, serve as bioindicators, and are prey for other species. They are mainly found in Europe and Asia. Genome size: ~1.21 Gb. Energy value: 22 kJ/g or 5.3 kcal/g.

8. Great egret (*Latin: Ardea alba*)

Great egrets measure 80–104 cm and are found near lakes and slow rivers. They eat fish, frogs, small mammals, reptiles, crustaceans, and insects. They prefer warmer climates with balanced water chemistry. Main predators include jays, hawks, and raccoons.

They regulate animal populations in aquatic ecosystems and provide food for predators. Found in southern Europe, Africa, the Americas, and Asia. Genome size: ~1.19 Gb. Energy value: 22 kJ/g or 5.3 kcal/g.

9. Grey heron (*Latin: Ardea cinerea*)

These herons are about 100 cm long and live near ponds, lakes, rivers, wetlands, and coasts. They mainly eat fish, frogs, small mammals, insects, and young water birds.

They tolerate a wide range of temperatures and water conditions. Adults have few natural predators; eggs and young are vulnerable to raptors and crows.

They help maintain aquatic animal populations and are a food source for predators. Found in Europe, Africa, and Asia. Genome size: ~1.19 Gb. Energy value: 22 kJ/g or 5.3 kcal/g.

10. Black stork (*Latin: Ciconia nigra*)

Black storks grow to 90–105 cm and live in moist forest habitats near rivers and swamps. They primarily feed on amphibians and insects near water.

They prefer humid, forested environments with moderate climates and broad water chemistry ranges. Few natural predators; young and eggs are vulnerable to raptors and primates. They regulate animal populations and support predators. Found across Europe, Africa, and Asia. Genome size: ~1.19 Gb. Energy value: 22 kJ/g or 5.3 kcal/g.

11. Spotted crake (*Latin: Porzana porzana*)

Spotted crakes are 19–23 cm long and inhabit rivers, lakes, ponds, pools, and flooded marshes. They feed mainly on amphibians, insects, small fish, snails, worms, and occasionally aquatic plants. They prefer moderate water temperatures and variable chemistry. Their main predators are birds of prey. They help maintain aquatic animal balance and are prey for raptors. Found across Europe, Africa, and Asia. Genome size: ~1.27 Gb. Energy value: 22 kJ/g or 5.3 kcal/g.

12. Water rail (*Latin: Rallus aquaticus*)

Water rails can grow to a length of 23 cm to 26 cm and inhabit various aquatic environments such as slow-moving rivers, gently flowing larger streams, and small lakes surrounded by dense vegetation. Their diet consists mainly of invertebrates and insects, though they occasionally feed on small birds, mammals, and fish.

Water rails thrive best in waters with moderate temperatures, balanced pH levels, and a wide range of water hardness. Their main natural predators include large birds of prey and some members of the dog and cat families. They play an important ecological role by maintaining population balance among aquatic animals and serve as a significant food source for larger birds of prey and certain mammals. They are distributed across various geographic regions, including Europe and Asia. Their impact on climate change is indirect—they contribute to nutrient cycling, carbon storage, biodiversity, and the overall health and balance of ecosystems. The size of their genome is estimated at approximately 1.23 Gb. Their energy value is about 22 kJ/g or 5.3 kcal/g.

13. Common kingfisher (*Latin: Alcedo atthis*)

Kingfishers grow to a length of 17 cm to 20 cm and live in various aquatic environments such as slow-moving rivers, calm streams, and small lakes surrounded by trees. They feed primarily on small fish, but occasionally also consume invertebrates and insects. Kingfishers thrive in waters with moderate temperatures, balanced pH levels, and appropriate water hardness. They have very few natural predators, but may occasionally fall prey to large birds of prey and snakes. They are ecologically important for maintaining the population balance of aquatic animal species.

Kingfishers are widespread across Europe, Africa, and Asia. Their influence on climate change is indirect—they help with nutrient cycling, carbon storage, biodiversity creation, and maintaining ecological balance and health. Their genome size is estimated at about 1.14 Gb. Their energy content is approximately 22 kJ/g or 5.3 kcal/g.

14. White-throated dipper (*Latin: Cinclus cinclus*)

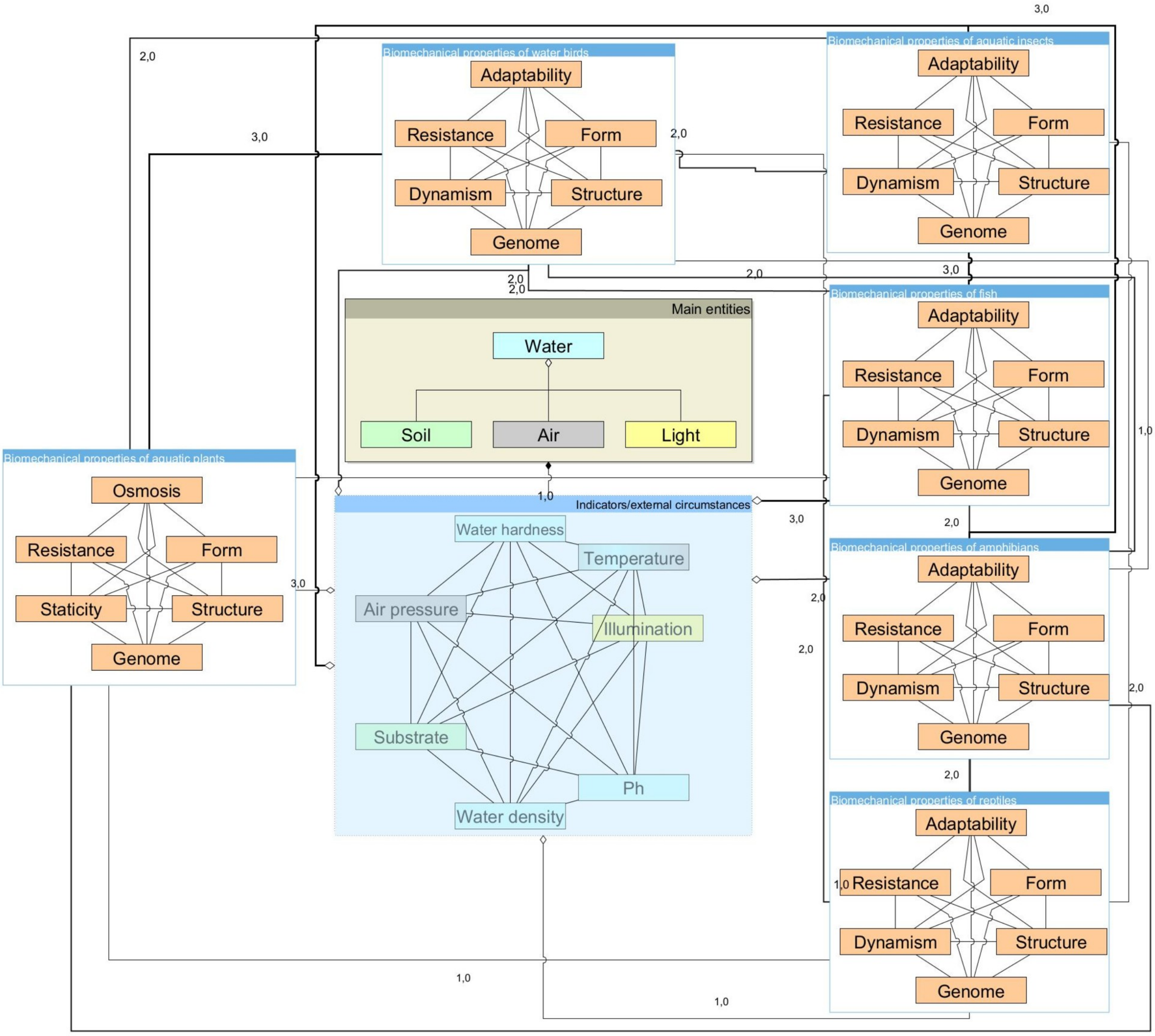
White-throated dippers grow to about 20 cm in length and inhabit aquatic environments such as slow-moving rivers, ponds, and lakes. Their diet consists mostly of insect larvae, insects, and small snails. They are bioindicators of clean water and thrive in habitats with moderate temperatures, balanced pH levels, and appropriate hardness. Their main natural predators include crows, ravens, and rats. Dippers are important for ecosystems as they help maintain the population balance of insects and invertebrates. They are found in a variety of geographical regions including Europe, Africa, and Asia. Their impact on climate change is indirect, contributing to nutrient cycling, carbon storage, biodiversity, and the maintenance of ecosystem balance and health. Their genome size is estimated at approximately 1.00 Gb. Their energy value is about 22 kJ/g or 5.3 kcal/g.

15. Black-headed gull (*Latin: Larus ridibundus*)

Black-headed gulls grow to a length of 37 cm to 44 cm and inhabit various aquatic environments such as rivers and lakes. Their diet consists primarily of insects, fish, invertebrates, and seeds. They thrive in water environments with moderate temperatures, pH, and hardness but can also survive in cooler aquatic habitats. Their main natural predators include birds from the falcon and crow families as well as larger gull species.

Black-headed gulls play an important role in ecosystems by maintaining the population balance of fish, aquatic and terrestrial insects, and invertebrates.

They are distributed across regions including Europe, Asia, and North America. Their effect on climate change is indirect—they contribute to nutrient cycling, carbon storage, biodiversity, and overall ecosystem health and stability. Their genome size is estimated at about 1.17 Gb. Their energy value is approximately 22 kJ/g or 5.3 kcal/g.



5.4.7.6.8.2 Figure 366: Hierarchical associative package diagram of water birds in relation to aquatic plants, insects, fish, amphibians, and reptiles

Figure 366 presents a hierarchical associative package diagram showing the relationships between water birds and aquatic plants, insects, fish, amphibians, and reptiles. As observed, the hierarchical associative network among the main entities, indicators of external conditions, and the biomechanical traits of living organisms has become increasingly complex.

Water birds are strongly linked to aquatic plants (the strength of the associative connection is 3.0), not only because aquatic plants serve as an important food source for many water birds, but also because they provide shelter and materials for nest construction.

Although many water birds can be classified as omnivores, those that feed exclusively on animal matter—such as fish, amphibians, reptiles, invertebrates, and insects—are relatively rare. From this, we can conclude that water birds are highly dependent on water quality (pH, hardness, pollution levels). Water quality has a significant influence on how effectively their biomechanical traits are expressed. Many water birds are considered reliable bioindicators of a clean environment.[232] In short, in locations where aquatic plants are present and the environment is unpolluted, water birds are also likely to appear. These two conditions are essential for the occurrence of generic interactions between producers and consumers of food, especially primary consumers.

The connection between the studied water birds and insects, fish, and amphibians is somewhat weaker, which is why a lower weight has been assigned to these associations (see the associative diagram with a value of 2.0). The weakest connection can be observed between water birds and (semi-)aquatic reptiles, as encounters between these groups are relatively rare (see the associative diagram with a value of 1.0). These connections, as with reptiles, do not account for water birds that inhabit saltwater environments, many of which are top predators (e.g., sea eagles, marine gulls). Water birds exhibit significant migratory behavior, influenced by seasonal changes—factors on which other aquatic organisms also heavily depend. They breed during periods when food availability is most favorable, which includes the flourishing of aquatic plants and the reproductive peaks of insects, fish, amphibians, and to a lesser extent, reptiles.

From a human-defined perspective of intelligence, water birds are considered the most intelligent of the aquatic organisms discussed so far. However, it is important to note that human criteria for measuring intelligence are not absolute truths. In the broader context of birds, there are intriguing theories about the evolutionary links between dinosaurs, reptiles, and birds.[233] This is primarily explained based on the evolutionary origin of species through phylogenetic classification. On the other hand, the older Linnaean classification system does not place birds in a close relationship with dinosaurs and reptiles, as it focuses more on how organisms live and on their observable traits. Naturally, different perspectives can produce quite different outcomes, which may encourage new viewpoints that attempt to synthesize existing thematic focuses.

Once again, we encounter the role of scientific consensus in shaping understanding, knowledge, and eventually, relative truths. The passage of time has often shown that many insights, pieces of knowledge, and relative truths may no longer hold in the future, as science makes mistakes that are corrected or replaced by new discoveries and knowledge—thus forming new relative truths. In the

232 Amat, J. A., & Green, A. J. (2009). Waterbirds as bioindicators of environmental conditions. *Biological Monitoring in Freshwater Habitats*, 45–52. https://doi.org/10.1007/978-1-4020-9278-7_5.

233 Feduccia, A. (2002). Birds are dinosaurs: Simple answer to a complex problem. *The Auk*, 119(4), 1187. https://doi.org/10.1642/0004-8038(2002)119[1187:badsat]2.0.co;2.
DVG Service. (2014). In Jahrestagung der Dvg-Fachgruppe Zier-, zoo- und wildvögel, Reptilien und Amphibien. Gießen: Deutsche Veterinärmedizinische Gesellschaft.

following section, we will explore certain aquatic mammals that are believed to surpass water birds in terms of intelligence.

5.4.7.6.9 Semi-aquatic and riparian mammals

In saltwater environments such as seas and oceans, there are mammals like whales and dolphins, which can undoubtedly be classified as aquatic mammals. In freshwater habitats—such as lakes, ponds, pools, streams, and rivers—there are no known mammals that live exclusively in the water. Therefore, this subsection will focus only on semi-aquatic and riparian mammals.

Beavers and otters can be classified as semi-aquatic mammals. Riparian mammals, on the other hand, generally refer to species that are primarily terrestrial but frequently visit the banks of water bodies—like lakes, ponds, pools, streams, and rivers—in search of food such as fish, amphibians, (semi-)aquatic reptiles, water birds, and, more rarely, insects.

The category of riparian mammals includes weasels, foxes, wolves, wild cats, jackals, bears, and even humans. These animals are essentially higher-order consumers and often top predators, and they are either omnivorous or exclusively carnivorous.[234]

234 Help source: Leigh-Pemberton, J. (1971). *European mammals*. Ladybird books Ltd.

5.4.7.6.9.1 Figure 367: A small selection of semi-aquatic and riparian mammals

Figure 367 shows a small, numbered selection of semi-aquatic and riparian mammals, including the beaver, otter, stoat, red fox, Eurasian jackal, wolf, wildcat, brown bear, and human.

1. Beaver (*Latin: Castor albicus*)

Beavers can grow from 74 cm to 90 cm in length, weigh up to 30 kg, and spend much of their lives in aquatic environments such as ponds, lakes, rivers, and larger streams. By building dams, beavers contribute to improving water quality. They are highly social animals with a well-structured family hierarchy. Beavers thrive in water with moderate temperature, pH, hardness, and optimal dissolved oxygen levels. They are strictly herbivorous, feeding on aquatic plants, grasses, herbs, and in summer, also on trees and shrubs. Their main natural predators include lynxes, coyotes, otters, bears, eagles, and large owls. Beavers are essential ecosystem engineers, creating habitats for many aquatic species and helping regulate plant populations. They are most commonly found in Europe, Asia, and North America. Their impact on climate change can be both positive (e.g., nutrient cycling, carbon storage, greenhouse gas reduction, biodiversity promotion) and negative (e.g., increased emissions, ecosystem imbalance). Their genome size is approximately 2.90 Gb, and their energy content is about 20 kJ/g or 4.8 kcal/g.

2. Otter (*Latin: Lutra lutra*)

Otters grow between 90 cm and 100 cm, weigh around 10 kg, and spend most of their time in a variety of water sources, including ponds, pools, lakes, rivers, seas, and swamps. They serve as bioindicators of water quality, though they can survive in lower-quality water. Otters thrive in waters with moderate temperature, pH, and dissolved oxygen—conditions favorable for the fish they primarily feed on. They also eat frogs, crustaceans, small mammals, young beavers, and aquatic plants. In saltwater, their predators include sharks, killer whales, and sea lions, while in freshwater, bears, large eagles, and coyotes pose threats. Otters play a key ecological role in balancing fish populations. Eurasian otters are common in Europe and Asia. Their influence on climate change is indirect but positive, aiding nutrient cycling and biodiversity. Genome size: ~1.76 Gb; energy content: ~20 kJ/g or 4.8 kcal/g.

3. Stoat (*Latin: Mustela erminea*)

Stoats grow from about 24 cm to 38 cm, weigh around 300 g, and are terrestrial and riparian, though they are excellent swimmers. They can be found near lakes, rivers, streams, ponds, and pools. They primarily eat mammals like rabbits and mice, but also occasionally birds, eggs, large insects, reptiles, crustaceans, fish, and frogs. Their main predators include red foxes, snakes, and wildcats. Stoats help control prey populations on land and contribute in aquatic environments as a food source for higher predators. Their climate impact is indirect but positive. Genome size: ~2.04 Gb; energy content: ~20 kJ/g or 4.8 kcal/g.

4. Red fox (*Latin: Vulpes vulpes*)

Red foxes can grow up to 140 cm long, weigh around 10 kg, and are mostly terrestrial and riparian. They are found near lakes, ponds, pools, streams, and rivers, occasionally feeding on reptiles, amphibians, fish, beavers, otters, and water birds, as they are strong swimmers. Their main diet includes rabbits, mice, squirrels, and stoats. Predators include eagles, owls, wolves, coyotes, jackals, lynxes, bears, mountain lions, and humans. They contribute more significantly to land ecosystems but also impact aquatic ones. Found in Europe, North America, North Africa, and Asia. Genome size: ~2.42 Gb; energy content: ~20 kJ/g or 4.8 kcal/g.

5. Eurasian jackal (*Latin: Canis aureus moreoticus*)

Eurasian jackals grow up to 120 cm, weigh between 10–15 kg, and are mainly terrestrial but occasionally found near lakes, rivers, and swamps. They are social animals with strict pack hierarchies. Their diet includes rabbits, rodents, pheasants, ducks, birds, reptiles, amphibians, fish, invertebrates, insects, and fruit. Predators include wolves, eagles, and large wild cats. They mainly impact terrestrial ecosystems but also contribute to aquatic ones. Found in Europe and Asia. Genome size: ~2.30 Gb; energy content: ~20 kJ/g or 4.8 kcal/g.

6. Wolf (*Latin: Canis lupus*)

Wolves can grow over 140 cm, weigh 23–80 kg, and are terrestrial, though excellent swimmers found near lakes, rivers, and streams. Like jackals, they have strict pack hierarchies. Their diet includes large herbivores (moose, deer, bison), smaller mammals (beavers, otters, mice, rabbits, foxes, jackals), and occasionally fish, amphibians, water birds, reptiles, insects, fruits, and vegetables. Predators include bears, large cats, coyotes, foxes, eagles, and humans. Found in Europe, North America, and Asia. Genome size: ~2.42 Gb; energy content: ~20 kJ/g or 4.8 kcal/g.

7. Wildcat (*Latin: Felis silvestris*)

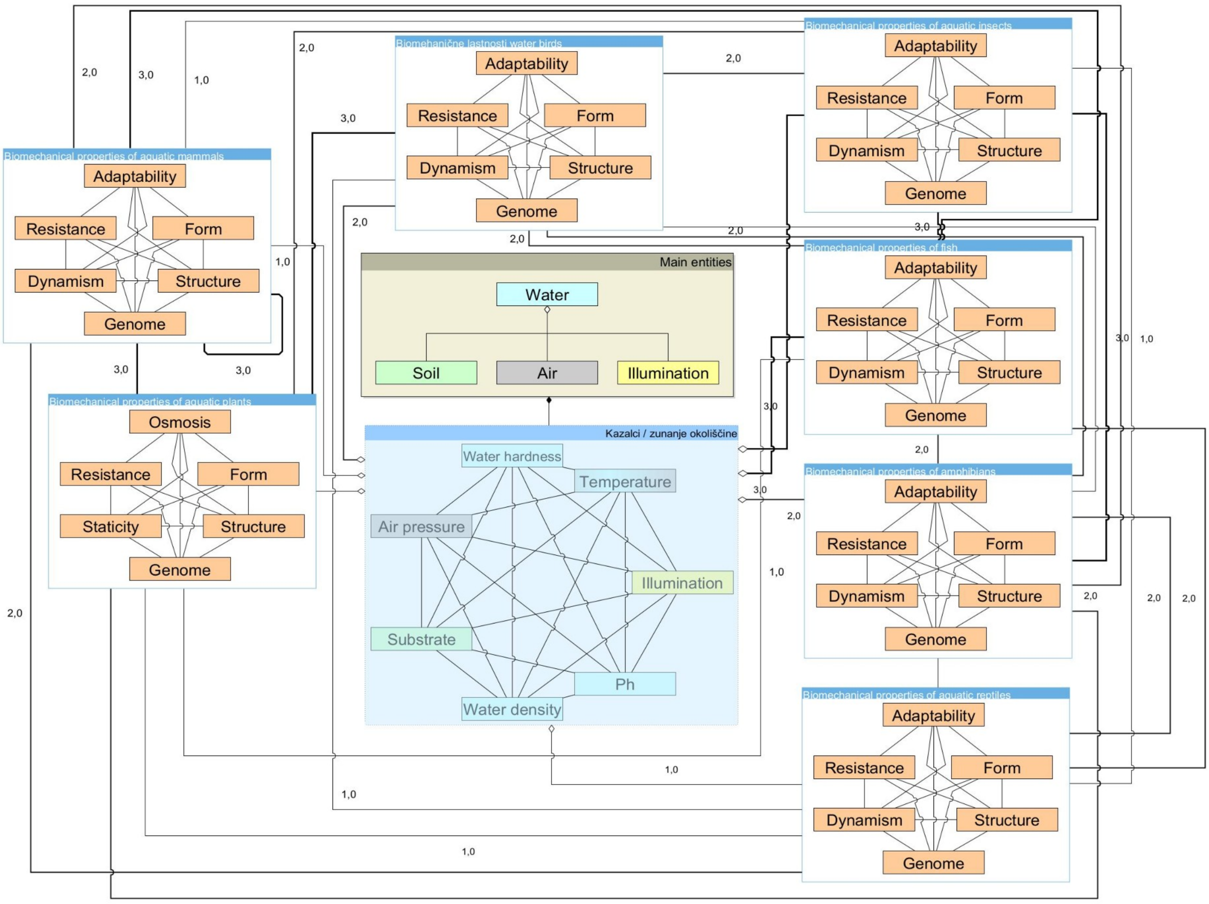
Wildcats grow from 80–100 cm, weigh 4–7 kg, and live mostly in forests but are occasionally near lakes, pools, rivers, and streams. They feed on rabbits, mice, forest hens, stoats, squirrels, fish, reptiles, amphibians, and water birds, and sometimes insects, fruits, and vegetables. Predators include wolves, foxes, large birds of prey, and larger cats. They help regulate prey populations and serve as food for larger predators. Found in Europe, Asia, and Africa. Genome size: ~2.42 Gb; energy content: ~20 kJ/g or 4.8 kcal/g.

8. Brown bear (*Latin: Ursus arctos*)

Brown bears grow from 120–260 cm, weigh 150–400 kg, and live mostly in forests but are found near lakes, pools, and rivers. They are apex predators and omnivores, feeding on fruit, vegetables, honey, mice, beavers, otters, foxes, wolves, deer, amphibians, fish, water birds, and carrion. They are essential to ecosystem balance and population control. Excellent swimmers, but not highly dependent on aquatic environments. Found in Europe, Asia, and North America. Genome size: ~2.40 Gb; energy content: ~20 kJ/g or 5 kcal/g.

9. Human (*Latin: Homo sapiens sapiens*)

Humans vary greatly in size (75–230 cm tall, 20–300 kg in weight) and inhabit all environments, from deserts to forests and urban areas near water. As apex predators, humans have no natural enemies except themselves. Their diet includes plants, fungi, algae, and meat. Humans heavily depend on water sources, modifying and exploiting them. They have a largely negative impact on biodiversity and climate—through deforestation, fossil fuel use, and habitat destruction—but also potential for positive change via renewable energy, technological innovation, and biodiversity conservation. Humans are found worldwide. Genome size: ~3.10 Gb; energy content: ~20 kJ/g or 5 kcal/g.



5.4.7.6.9.2 Figure 368: Packaged hierarchical associative diagram of aquatic/riparian mammals in relation to aquatic plants, insects, fish, amphibians, reptiles, and water birds

Figure 368 presents a packaged hierarchical associative diagram showing the relationships between aquatic/riparian mammals and aquatic plants, insects, fish, amphibians, reptiles, and water birds. Strong associative links can be observed between semi-aquatic/riparian mammals and aquatic plants and fish (see bold lines with a value of 3.0), as these mammals are frequent and intensive consumers of these organisms. Additionally, there is a strong internal associative connection among semi-aquatic/riparian mammals themselves, as many of them prey on other mammals (also indicated by a value of 3.0).

It is already known that riparian mammals, in terms of biomechanical traits, are less dependent on indicators of external environmental conditions that affect the state and quality of water, as they are mostly terrestrial creatures. They primarily consume terrestrial plants and animals, which is why the strength of their hierarchical connections is weaker (see the connection with a value of 1.0).

Most living organisms reproduce during specific seasons, often depending on the availability of food for their offspring. In this regard, the human species differs from other living beings on the mesocosmic level, as human reproduction occurs independently of the seasons. In some parts of the world, particularly economically underdeveloped regions, this can lead to an inability to feed

offspring, which exacerbates poverty. In contrast, among other living beings on the mesocosmic level, the ability to calculate food availability for offspring appears to be more appropriately aligned with reproduction timing.
We proceed with a synthesis of findings between the aquatic microcosmic and mesocosmic levels. For this purpose, data were prepared in the form of three tables.
The first table was created based on a micro-theosaur model, illustrating the relationships between the super-producer "water" (TT), producers (DE), and food consumers (DE). An evaluation of the strength of food production and predation by producers on a scale from 0 to 100 (MPROPIE) was also included.
The second table focused on food consumers and producers (ZB), with assessments of resistance and adaptability to physical-chemical environmental conditions based on the biomechanical characteristics of (semi-)aquatic organisms, also rated on a scale from 0 to 100 (FKOBL). This table also included the relationships between consumers and producers (K1 to K11) and predators or natural enemies (P1 to P11).
The third table presented data on mutualistic symbioses among (semi-)aquatic organisms (M1, V1), with strength ratings on a scale from 0 to 100 (OMS). These assessments were based on descriptions of organisms (e.g., pH tolerance, hardness, resistance, feeding behavior, natural enemies) at both the microcosmic and mesocosmic aquatic levels.
The data were imported into the Ora Casos software tool, where they underwent a data integration process. The result of this process was a unified food web, including mutualistic symbioses among living organisms. Due to the scope and complexity of the data assembly, technical details of the procedure are omitted.

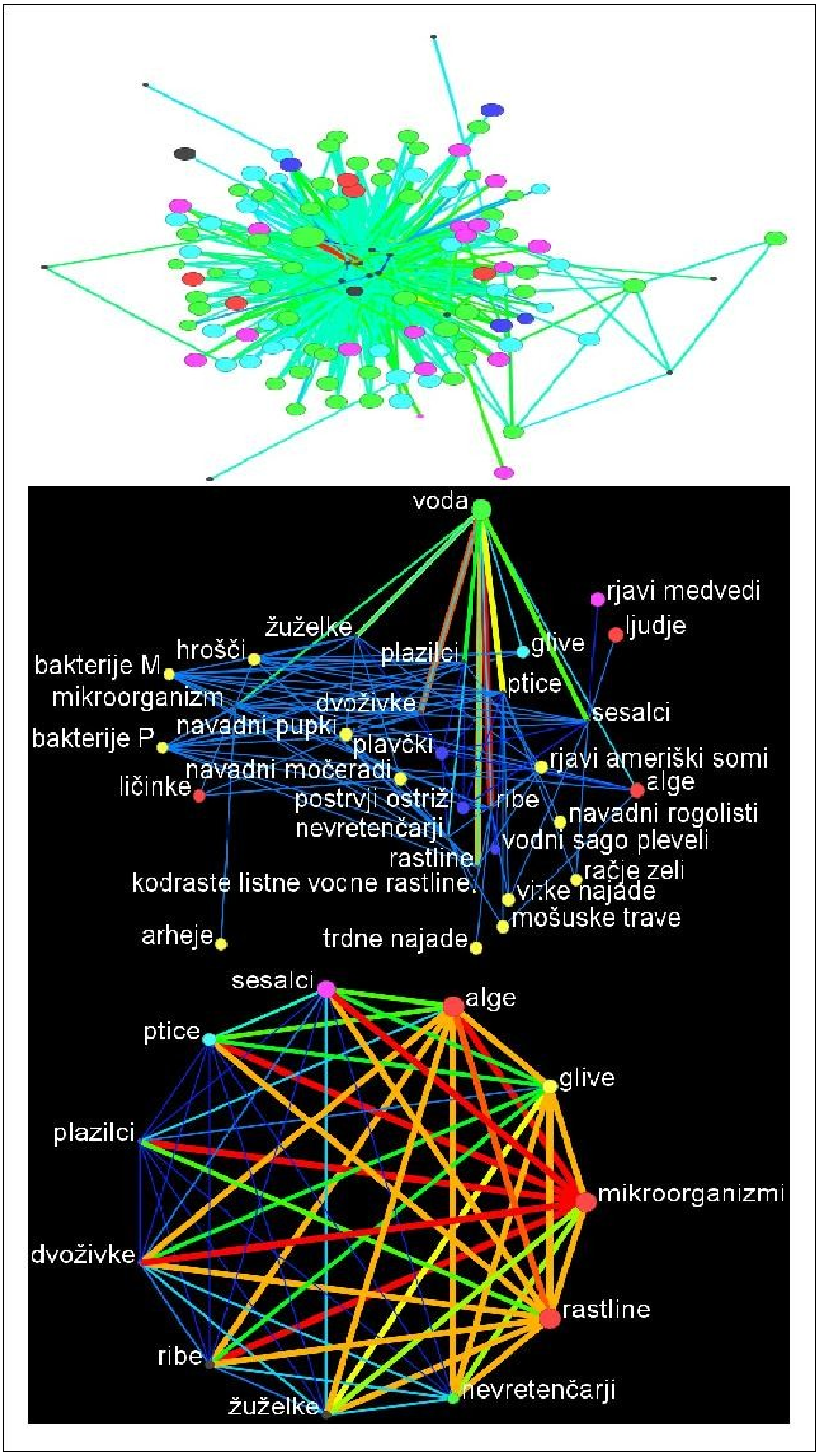
DE	MPROPIE	TT	CC	BT	NT
alge	90	voda	P	mikroorganizmi	
amebe	90	voda	K/Pl	protozoe	
ameriške jegulje	70	voda		ribe	
ameriške vodne lil	90	voda		rastline	
arheje	50	voda		mikroorganizmi	
bakterije M	50	voda	K/Pl	mikroorganizmi	
bakterije P	50	voda	K/Pl	mikroorganizmi	
beli brancini	70	voda		ribe	

ZB	FKOBL	K1	K2
alge	70		
amebe	90	alge	bakterije M
ameriške jegulje	90	dvoživke	nevretenčarji
ameriške vodne lilije	60		
arheje	100	mikroorganizmi	
bakterije M	100	alge	mikroorganizmi
bakterije P	100	alge	mikroorganizmi
beli brancini	60		nevretenčarji

M1	OMS	V1
mikroorganizmi	90	rastline
mikroorganizmi	80	nevretenčarji
mikroorganizmi	80	žuželke
mikroorganizmi	100	ribe
mikroorganizmi	100	dvoživke
mikroorganizmi	100	plazilci
mikroorganizmi	100	ptice
mikroorganizmi	100	sesalci
mikroorganizmi	100	alge
mikroorganizmi	90	glive
mikroorganizmi	70	mikroorganizmi
rastline	90	nevretenčarji
rastline	90	žuželke
rastline	90	ribe
rastline	90	dvoživke
rastline	70	plazilci

5.4.7.6.9.3 Figure 369: An extremely small portion of prepared data on living organisms

Figure 369 shows a very small portion of the prepared data on living organisms, intended for the analysis or assessment of feeding symbiotic networks at the aquatic micro- and mesocosmic level. The resulting networks will be presented in the following sections.



5.4.7.6.9.4 Figure 370: The Entire network, network of the strongest representatives of living organisms, and strength of mutualistic symbioses

Figure 370 presents the entire network, the network of the strongest representatives of living organisms (producers and consumers of food), and the strength of mutualistic symbioses among them. Based on a comprehensive network of microorganisms, plants, algae, fungi, and animals—including humans (see the upper part of the figure)—a network of the strongest representatives was extracted using a filter for scores above 90.1 (see the middle part of the figure). The lower part of the figure shows the network of mutualistic symbioses among living organisms with generic names (e.g., insects, mammals).

First, it is necessary to closely examine the extracted network of the strongest representatives of living organisms, which includes both food producers and consumers. The strongest producer is water, as it supplies all living beings with food in the form of liquid or water molecules (see the largest green node with a value of 200.0). From water, hierarchical connections lead to living organisms with generic names such as microorganisms, plants, insects, invertebrates, fish, amphibians, reptiles, birds, and mammals. From these, further hierarchical connections lead to specific strongest representatives, such as archaea, M bacteria, P bacteria (microorganisms), beetles (insects), sticklebacks, common salamanders, smooth newts (amphibians), perch trout, brown bullheads (fish), brown bears, and humans (mammals).

There are also associative links between (aquatic) plants—such as slender naiad, robust naiad, water sago pondweed, muskgrass, curled pondweed, hornwort, and duckweed—and animal species like fish, birds, invertebrates, and mammals. Additionally, there is an associative link between muskgrass, invertebrates, and algae, reflecting previously mentioned examples of the selected subset of living organisms, as muskgrass is a less typical type of algae that provides food for certain algae and invertebrates.

The following sections will offer systematic descriptions and findings by generic types, including their representatives that ranked among the strongest living organisms based on criteria such as food production, predation or consumption strength, resistance, and adaptability to physical-chemical conditions.

1. Microorganisms (*Slovenian: mikroorganizmi*)

At the microcosmic aquatic level, several top predators were identified, though not all are highly tolerant to a wide range of physical and chemical conditions. Typically, they require moderate water temperature, sufficient dissolved oxygen, moderate water hardness, lower light intensity, and a relatively narrow pH range. These include amoebae, archaea, paramecia, vorticellae, and didinia. Due to these specific requirements, they were not included in the narrower selection.

The least sensitive and most successful producers and/or consumers include archaea, M bacteria (mutualistic bacteria), P bacteria (parasitic bacteria), microalgae, and fungi, as their scores exceeded 90.1. Even within the microcosmic level, numerous mutualistic symbioses exist—between microalgae and fungi, paramecia and microalgae, M bacteria and fungi, and M bacteria and microalgae. Many microalgae and fungi fall under producers, whereas bacteria often act as food consumers. Archaea, which can only metabolize inorganic substances and convert them into organic compounds, form a special category and can also be seen as indirect food producers.

Particularly interesting are mutualistic symbioses between specific paramecia and microalgae: microalgae supply nutrients to paramecia, while paramecia provide mobility and shelter for microalgae within their bodies. Only a few microorganisms become prey to much larger mesocosmic creatures (e.g., amoebae consumed as part of plankton by water birds or by insect and amphibian larvae), so such cases are rare.

It appears there are many more mutualistic symbioses between the microcosmic and mesocosmic levels. Microorganisms, especially M bacteria and some fungi, cooperate effectively with nearly all other living beings—such as aquatic plants, invertebrates, fish, amphibians, (semi-)aquatic reptiles, water birds, macroalgae, macrofungi, and (semi-)aquatic mammals. By studying the lower part of the figure, we can identify the most active mutualistic symbionts across the two cosmic levels, potentially crowning microorganisms as the ultimate champions of mutual cooperation. These collaborations support healthy and fruitful life at the mesocosmic level by strengthening immune systems and enhancing species reproduction.

2. Aquatic Plants (*Slovenian: Vodne rastline*)

Many aquatic plant species actively participate in both food production and mutualistic symbioses with other living beings, offering them shelter and shade from intense sunlight. In return, various animal species, algae, and fungi supply the plants with nutrients and help disperse their seeds across locations.

From the food production perspective, no aquatic plant ranked in the top tier. However, in terms of associative value, seven species made the narrow selection: robust naiad, slender naiad, hornwort, duckweed, muskgrass, water sago pondweed, and curled pondweed. These provide food, safe shelter, and construction material for various animal species. Though not top producers, they share a common trait: they are relatively resistant to harder water, broader temperature ranges, and low-light conditions.

From a human perspective, aquatic plants are not key food sources like terrestrial plants but play vital roles in promoting biodiversity and environmental homeostasis. Their somewhat expansive nature can make them invasive, sometimes even considered a nuisance.

In terms of frequency and intensity of mutualistic symbioses with other living beings, aquatic plants rival microorganisms. They maintain cooperative interactions with microorganisms, algae, fungi, invertebrates, amphibians, reptiles, birds, and mammals. The lowest level of association is found with reptiles, especially snakes, which are strict carnivores and thus only form commensal, not mutualistic, relationships with aquatic plants.

Compared to land plants, aquatic plants are less important to human nutrition but contribute significantly to biodiversity and ecosystem stability. Most mutualistic relationships with aquatic plants are found among fish, invertebrates, amphibians, water birds, and mammals such as beavers and otters.

3. Insects and other invertebrates (*Slovenian: Žuželke in drugi nevretenčarji*)

Similar to aquatic plants, no representatives of (semi-)aquatic insects or other invertebrates were included in the narrow selection. Insects and other invertebrates often serve as food consumers and as prey for a wide range of animal species. Regarding mutualistic symbiosis, the most prominent cooperative relationships occur between (semi-)aquatic insects, other invertebrates, aquatic plants, and microorganisms. Mutualistic symbioses between these invertebrates and other animal species are less well-documented—not because they don't exist, but because they are less frequent than those found in microorganisms and aquatic plants. Insects are often more associated with parasitic relationships toward other living beings. Their main ecological function appears to be rapid reproduction, which in turn supports the diets of more complex organisms and contributes to biodiversity.

4. Fish (*Slovenian: Ribe*)

Two fish species made it into the narrow selection: the brown bullhead (Ameiurus nebulosus) and the perch trout (likely referring to a predatory perch species). Both are top predators and share characteristics such as resilience to broader pH ranges, water hardness, and temperature variations. Fish primarily function as both predators and prey in natural hierarchical and associative systems, where mutualistic symbioses with other animal species are relatively rare. The most significant and common mutualistic relationships occur between fish, aquatic plants, and microorganisms. These include "cleaner fish" that form symbiotic relationships with larger predatory fish. Additionally, mutualistic interactions exist between fish and algae, and to a lesser extent, fungi.

5. Amphibians (Sloveninan: Dvoživke)

Included in the selection were the fire salamander, the smooth newt, and the moor frog. These amphibians are relatively resilient to harder water, lower temperatures, and broader pH ranges. Amphibians play a key role in maintaining population balance among insects and other invertebrates. Their most frequent mutualistic relationships are with microorganisms, aquatic plants, and algae. Cooperative relationships with other types of living beings are less common.

6. Reptiles (*Slovenian: Plazilci*)

Reptiles are estimated to have the fewest mutualistic symbioses with other (semi-)aquatic lifeforms—though some do exist, such as birds cleaning crocodiles of parasites in exchange for food and protection from other predators. As with other lifeforms, the most common mutualistic relationships involve microorganisms, as shown in the lower part of the image. Reptiles are generally governed more by predatory-prey dynamics than mutual cooperation. They are extremely hardy and resilient even under unfavorable conditions, making them true survival experts. No reptile species was included among the top predators in the narrowed selection.

7. Aquatic Birds (*Slovenian: Vodne ptice*)

No aquatic bird species made it into the narrow selection, primarily because they are quite sensitive to water and air pollution. Additionally, many species feed on plants or small prey such as small fish, larvae, insects, and invertebrates. Apart from the swan (which is part of the limited selection), most aquatic birds have numerous natural predators—including large fish, reptiles, and predatory mammals, including humans. The most frequent mutualistic relationships with aquatic birds involve microorganisms, aquatic plants, and algae.

8. Mammals (*Slovenian: Sesalci*)

Mammals—including humans—are considered the most advanced and intelligent animals, appearing relatively late in Earth's biological history. Two top predators were included in the selection: the brown bear and the human. Both have almost no natural predators and possess extremely broad diets, ranging from plants to other animals. In terms of mutualistic relationships, mammals rank third—after microorganisms and aquatic plants. Mammals are primarily social and cooperative animals capable of effective communication and teamwork. Humans, in particular, have developed many beneficial symbioses with other lifeforms through technological progress, but at the same time, have contributed to the reduction of planetary biomass. This duality makes it difficult to view humans as stewards of natural hierarchical associative systems.

Based on the analysis of the narrow selection of living organisms in terms of food consumption and cooperation, it can be concluded that the struggle for survival is only a small part of the broader picture. Cooperative relationships are just as essential for survival. No species benefits from completely eliminating others, as there are self-regulating mechanisms in natural hierarchical associative systems that prevent this—partly due to natural forces like electromagnetism, magnetism, gravity, and others. A kind of unconscious collective awareness exists within the system. Therefore, the dominance of the "law of the strongest" would be devastating for the survival of various species. Without laws—and especially without cooperative relationships between species—there can be no survival. Natural hierarchical associative systems are not solely based on the binary of winners and losers; instead, they uphold the idea that all living beings can be winners in their own way, enhancing the survival potential of Earth's entire biomass. In short, to improve the chances of survival for all life on the planet, the balance must shift from the dominance of the strongest toward constructive interspecies cooperation. Humans, through optimal political, legal, and economic decisions, could play a significant role in this process. Every armed conflict or war presents a dark scenario in which there are mostly only losers. A good example of such a negative course of events and irresponsible political decisions can be seen in the current military conflict between Russia and Ukraine. On one hand, there are criticisms of Russia that NATO expanded too far east; on the other hand, Russia initiated the war to prevent further NATO expansion. The Russian government demands a return to the state of affairs as it was in 1997. A cooperative solution to this societal catastrophe—which also negatively affects our natural hierarchical associative system—would be possible, but implementing such a solution would require a high level of communication and mental rationality, especially from politicians and diplomats.

We no longer live in the era of two dominant military blocs, and in fact, the existence of NATO in its current form and purpose is arguably unnecessary. It would make sense to rename and reorganize NATO (including various intelligence networks and military units) into a Human Alliance for Survival (HAS), incorporating all countries of the world—including Russia, Ukraine, and others—to address future global challenges such as mass migration, Darknet crime, excessive psychological stress, viral diseases, climate change, environmental pollution, and the depletion of the planet's biomass. Furthermore, it would be meaningful to establish an international legal agreement declaring that any war is a crime against humanity and other living beings. Wars further reduce the Earth's biomass, and this recognition could serve as a tool for war prevention. These upcoming challenges could seriously threaten the continued existence of the human race and other life forms. In short, this is not a time for enemies and displays of power, but a time for meaningful cooperation among nations and across religious divides. Future reasonable and responsible decisions made by politicians, legal experts, and economists could enable humanity, animals, plants, and other life to survive. Without productive cooperation and greater involvement of interdisciplinary scientific groups in political decision-making, humanity will struggle—or even fail—to solve current and far more complex future problems.

5.4.7.7 Water and the macrocosm

Where does the macrocosm actually begin? This boundary is defined by the Kármán line, which is located approximately 100 kilometers above the Earth's surface, as it is considered the point where our atmosphere effectively ceases to exist.[235] Based on this boundary, living organisms such as

235 McDowell, J. (2020). Where does outer space begin? *Physics Today*, 73(10), 70–71. https://doi.org/10.1063/pt.3.4599.

airborne bacteria cannot be classified as belonging to the macrocosmic plane. Recently, scientists have discovered that, from our perspective, water appears within the macrocosmic plane in large quantities or in massive blocks of cosmic ice.[236] It is assumed that water emerged at the very beginning of the formation of the entire universe. Combined with other factors, these massive blocks of cosmic ice may have contributed to the occurrence of the famous Big Bang. Through subsequent processes, numerous chemical elements may have formed as well. We cannot know this for certain, even though the Big Bang is continually presented as the fundamental explanation for the origin of the great cosmic Truth. Many people believe in it, and over time, this construct has become widely accepted within science, education systems, and popular discourse.

A chemical element like helium is believed to be produced through the radioactive decay of uranium and thorium. With a vast input of energy, hydrogen and carbon can be obtained from helium. Indirectly, oxygen can be derived from carbon and helium, and nitrogen may have formed in a similar way. These are the basic elements needed for the creation of inorganic and organic compounds.

In the cosmic ether, there is a far greater mass of inorganic than organic matter—a similar ratio applies to our planet, although Earth, relative to the rest of our solar system, is exceptionally rich in organic substances.

From these established facts, we can now turn to the core of this subsection: the various forms of life on a macrocosmic level in connection with water. Given that water exists in the cosmic ether primarily in the form of massive blocks of ice, it would be very difficult—based on our current understanding—to find any life forms in this vast part of the universe. However, organisms such as bacteria, fungi, and tardigrades (commonly known as water bears) are known to survive in these extreme, inhospitable conditions. In fact, it has been found that some fungi and bacteria can endure intense radiation and extremely low temperatures.[237] They were discovered during the Mir space station missions, as they contaminated the windows of the spacecraft and even damaged certain metal components. These spaceborne bacteria are believed to grow significantly larger than their counterparts on Earth. It is still not entirely known what these unknown life forms feed on. However, it is known that they reproduce and frequently mutate under the influence of cosmic radiation, leading to the emergence of new species.

A truly remarkable example are the tardigrades, or "water bears," which are capable of surviving extreme radiation, toxic gases, and both extremely low and high temperatures by entering a state of

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236 Piani, L., Marrocchi, Y., Rigaudier, T., Thomassin, D., Vacher, L., & Marty, B. (2021). *Earth's water may have been inherited from material similar to enstatite chondrite meteorites*. Goldschmidt2021 Abstracts. https://doi.org/10.7185/gold2021.4658.

237 Can germs live in outer space? https://www.wonderopolis.org/wonder/can-germs-live-in-outer-space (2022-04-19).

cryptobiosis. It has been documented that they survived more than 10 days in the vacuum of space and under dangerous unfiltered radiation. A large number of dehydrated tardigrades have even been found on the Moon, shriveled into dried organic pellets. These were brought back to Earth and revived with water—after some time, they returned to life as if nothing had happened. Let us now take a closer look at these creatures—tardigrades, or water bears.

5.4.7.7.1 Figure 371: Tardigrade in motion

Figure 373 shows a tardigrade, also known as a water bear, in motion as it feeds on the stem and leaves of moss.[238] They have a stout build, eight legs or suction pads, and are multicellular animals that primarily feed on plant material, although some species also consume bacteria and small soil-dwelling organisms. More than 1,000 species of these creatures are known, and they can be found all over the Earth—from Antarctica, deserts, and mountain heights to the Arctic. They live in both saltwater and freshwater environments, though the majority of species are considered terrestrial.

238 The image was taken from a moss sample with water using a Zeiss Primostar 3 microscope, an Axiocam color 208 camera, and a 10x objective (100x magnification).

All tardigrade species require a moist environment, as they cannot move, feed, excrete, or reproduce without water. Some species are hermaphroditic, similar to snails, while others have distinct male and female sexes. A female can lay up to 30 eggs, which are then fertilized by a male. Development is relatively rapid—within two weeks, a tardigrade becomes fully developed. Under favorable conditions, they can live up to three years. However, in cases of repeated harsh environmental conditions that force them into a state of cryptobiosis (a form of suspended animation), they may survive for 70 to 100 years.

Their size ranges from 0.5 mm to a maximum of 1.5 mm, with 0.5 mm being the most common. Water temperatures above the boiling point can kill tardigrades in less than a day. They have no lungs and breathe through their skin or cuticle, with their whole body functioning like a pump for fluid circulation. Tardigrades possess dorsal brains and a ventral nervous system that coordinates neural signaling between the brain and body, integrating sensory input with motor output. They also have a pair of simple eye spots located within the head, which act as intracerebral photoreceptors. Tardigrades are invertebrates distantly related to crustaceans, insects, and roundworms. One particularly surprising discovery is that tardigrades can acquire or even absorb genes from other organisms such as plants, bacteria, archaea, and fungi.[239] This animal species contains the highest number of foreign genes of all known living organisms (approximately 17.5% foreign genetic material, while humans and other animal species contain an exceptionally small percentage). Their genome size ranges from about 150 Mb to 360 Mb, which, considering their incredible abilities, is not very large. Tardigrades also have a high tolerance threshold regarding polluted environments, higher temperatures, and water hardness, but they poorly tolerate excessive acidic values (below pH = 4) and alkaline values (above pH = 10). This animal species has a considerable number of natural enemies, such as crustaceans, earthworms, nematodes, mites, spiders, and insect larvae. Additionally, various parasitic protozoa and fungi can infect a large number of tardigrades.

Regarding the boundary of the macrocosm at the Kármán line, no reports exist of other living organisms on this cosmic plane in relation to water. Before moving on to the subchapter about Earth, various chemical solutions containing water as a solvent will be described. Furthermore, some crystals formed through the process of hydration (water absorption) will also be discussed.

239 Boothby, T. C., Tenlen, J. R., Smith, F. W., Wang, J. R., Patanella, K. A., Osborne Nishimura, E., Tintori, S. C., Li, Q., Jones, C. D., Yandell, M., Messina, D. N., Glasscock, J., & Goldstein, B. (2015). Evidence for extensive horizontal gene transfer from the draft genome of a Tardigrade. *Proceedings of the National Academy of Sciences*, 112(52), 15976–15981. https://doi.org/10.1073/pnas.1510461112.

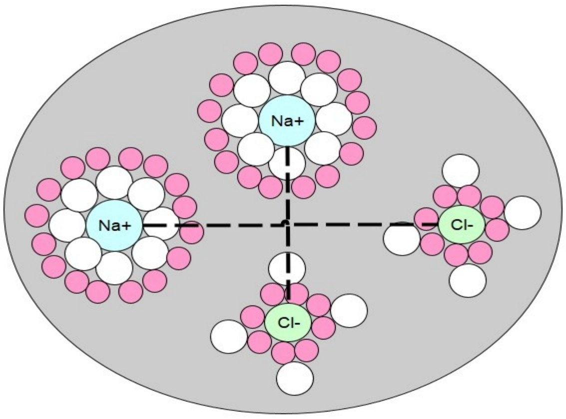
5.4.7.8 Water, chemical solutions, and crystals

In this subsection, we will focus on water from the perspective of chemical solutions and the growth of crystals based on the process of hydration or water absorption. This is important because within natural hierarchical associative systems, various chemical and physical reactions occur, which impact both the landscape and the lives of many living organisms. This subsection will mainly be dedicated to various tests using equipment such as microscopes (light, USB), pH meters, TDS meters, conductivity meters, multimeters, and assembled frameworks for performing electrolysis, modified paper chromatography, and hydration of certain chemicals, such as sodium chloride, potassium chloride, copper sulfate, calcium carbonate, etc.

5.4.7.8.1 Chemical solutions with emphasis on water in natural hierarchical associative systems

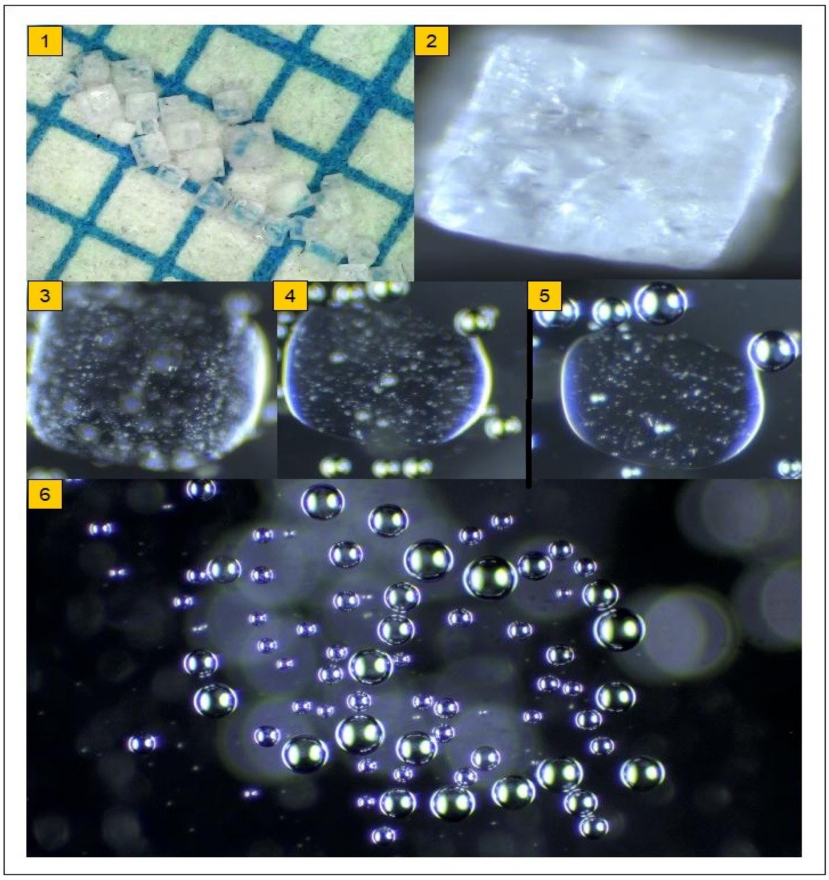
Chemical substances dissolved in water are of existential importance for the life of various living organisms, as numerous chemical reactions take place within them, without which many living beings, as we know them, would not exist. Furthermore, water with its solutions regulates the temperature of the Earth's surface, which creates conditions suitable for life. As mentioned earlier, water has a polar chemical bond, within which there is no distinct electrical charge. There are only two poles: a weaker positive charge from hydrogen (H_2) and a slightly stronger negative charge from oxygen (O_2). These are called electrostatic interactions. Due to the asymmetry of electronic charges, which favors negativity, water molecules can combine with each other and dissolve various chemical substances. In water, compounds with ionic bonds dissociate into negative and positive ions. During this dissociation process, the positive part of the water molecules surrounds the negative ion of the chemical substance, while the negatively charged part of the water molecules surrounds the positive ion. To illustrate this more clearly, we will demonstrate it with a reaction and an image (examples of various chemical substances will follow).

5.4.7.8.1.1 Sodium chloride (table salt) Na+ + Cl- + H2O → (Na+ H2O) + (Cl- H2O)



5.4.7.8.1.2 Slika 372: Surrounding of sodium and chloride ions by water molecules

Figure 372 shows the surrounding of sodium (Na^+) and chloride (Cl^-) ions by water molecules. Small NaCl crystals, typically cubic in shape, dissolve relatively quickly in water due to electrostatic attraction between the positively charged Na^+ cations and the partially negative oxygen atoms of water molecules, as well as between the negatively charged Cl^- anions and the partially positive hydrogen atoms of water molecules. During dissolution, water acts as a diverse molecular envelope, particularly for ionic compounds. To better visualize this process, an experiment dissolving NaCl crystals in two water droplets was observed using a light microscope and camera. While individual ions remain invisible, this method provides a clear illustration of the described phenomenon.



5.4.7.8.1.3 Figure 373: Dissolution of fine cubic NaCl crystals in water

Figure 375 shows fine NaCl crystals and the stages of their dissolution in two drops of water under a light microscope.[240] The following describes numbered observations from sample display to abstracted dissolution phases:

1. Sample preparation

As seen in the upper left of the image, NaCl crystals exhibit relatively regular cubic shapes. These crystals were placed on a glass slide and examined under a microscope using phase contrast technique. Initial focusing used a 4x magnification objective, later replaced with a 10x objective. A sharpening procedure followed.

2. Image sharpening

The microscope's adjustment knob was fine-tuned until the image was satisfactorily focused. Subsequent phases of NaCl dissolution in water were observed.

3. First dissolution phase

240 The images were taken using a USB microscope (1500x magnification) and a Zeiss Primostar 3 light microscope, Axiocam color 208 camera and 10x objective (100x magnification).

Upon adding two small droplets of distilled water, the cubic structure of the NaCl crystal began rapidly breaking down even in this initial stage.

4. Second dissolution phase

A pronounced structural change became clearly visible, now resembling an asymmetrical sphere.

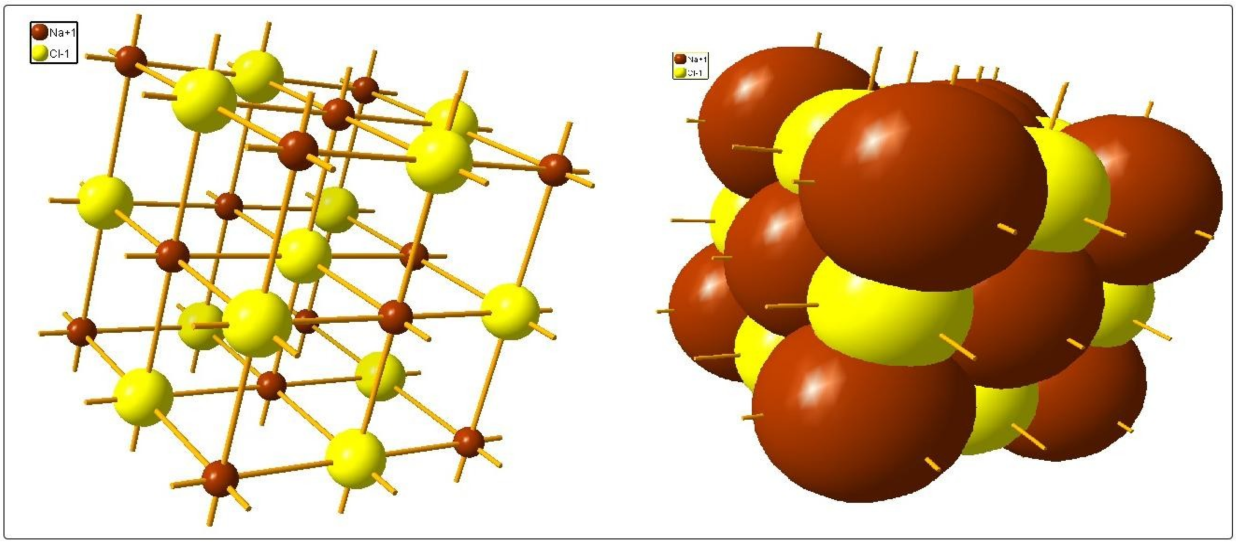
5. Third dissolution phase

The asymmetrical sphere gradually transitioned into a less asymmetrical shape.

6. Fourth dissolution phase

Numerous small, relatively uniform spherical droplets of NaCl solution were observed. While ions remained invisible, the effect of water molecules surrounding disintegrated cubic crystal fragments was evident. This implies water molecules indeed enveloped both Na^+ and Cl^- ions.

The process illustrates a hierarchy of charges and the association of water molecules, which contribute to electrical conductivity. Without water, NaCl cannot conduct electricity, as ions remain fixed in the crystal lattice. In water, ions gain mobility despite being encased in a hydration shell. For clarity, NaCl crystals are also shown in full and lattice structure representations.



5.4.7.8.1.4 Figure 374: Structure of the NaCl crystal

Figure 374 displays the NaCl crystal structure in both lattice and full forms. The symmetry of the crystal acts as a framework guiding the movement of atoms (or ions) and the electrons tightly bound within the cubic geometric arrangement. The increased mobility of ions arises primarily from electron migration due to spatial expansion and the influx of water molecules. Here, symmetry effectively functions as a tensor governing electrical conductivity.[241] In ionic bonds, the strength of the connection between Na^+ and Cl^- ions is significantly greater than when these ions are dissolved in water, where the interactions between them become much weaker. This means that the crystal lattice changes from a relatively rigid and spatially fixed structure into a more flexible form, due to the expansion of space caused by the action of water molecules on the ions.

The bonds between water molecules and ions are not very strong, although fairly regular symmetrical structures form around the ions, which are only loosely connected to each other. Nevertheless, these loose bonds between water molecules are stronger than the bonds between individual ions. Because of their polarity, water molecules disrupt the original symmetry of the ionic crystal lattice, leading to significant changes in properties such as increased entropy, higher surface tension, greater electrical conductivity, increased density, and greater hardness. In fact, ionic polar bonds form between water molecules and the Na^+ and Cl^- ions.

A hierarchical associative network of water molecules and NaCl ions emerges, where cooperative or associative bonds dominate over strictly hierarchical ones. Hierarchical bonds are weakest in highly diluted NaCl solutions but become stronger as the NaCl concentration increases. The strongest hierarchical bonds in the solution appear at saturation, while further excess NaCl causes the system to gradually return to the original symmetry of the NaCl crystal lattice.

In short, in NaCl solutions, hierarchical relationships are weaker and more prone to associative strength, resulting in a more cooperative nature. Strict hierarchies reduce entropy and increase determinability and predictability but limit variability and mobility. In natural hierarchical associative systems, following this chemical bonding model, both rigid, strictly hierarchical structures (such as crystal lattices) and freer associative relationships (such as solutions) can be observed. Due to natural variability, these rigid and freer structures often intertwine, leading to the formation of many new hierarchical and associative interactions.

Such patterns can be analyzed and interpreted to assess the balance between hierarchy and associativity. For this purpose, an appropriate scale would be needed to determine when a relationship is strictly hierarchical and when it is more associative. The NaCl crystal lattice with optimal symmetry could be placed high on the hierarchical scale, while relationships in homogeneous or heterogeneous solutions would rank higher on the associative scale. Although rating scales allow quick analysis, they are often insufficiently precise.

241 Graef, D. M., & McHenry, M. E. (2013). *Structure of materials: An introduction to crystallography, diffraction and symmetry.* Cambridge University Press.

How could the strength of hierarchical and/or associative relationships be quantified? Could various measuring devices such as multimeters, conductometers, polarimeters, densitometers, TDS meters, pH meters, chromatographs, etc., be used for this purpose? Conditionally, the answer could be yes, using water measurements as a reference. This way, the conductivity or resistance of the NaCl crystal lattice and NaCl solution could be measured and compared. Higher resistance would indicate stronger hierarchical bonds, while higher conductivity would suggest stronger freer associative interactions.

However, this approach could not be directly applied to metallic chemical bonds, as metallic crystal lattices are often extremely symmetrical, with delocalized electrons freely moving among positively charged metal ions. The structure of metallic bonds is highly hierarchical and achieves high conductivity values. When measuring the conductivity of NaCl solutions at different concentrations, the mobility of ions in the solution must also be considered. Saturated NaCl solutions are expected to have the highest conductivity, not only due to the high ion concentration but also because of optimal ion mobility. Adding excess ions to a saturated NaCl solution causes conductivity to decrease, as ions can no longer move freely and optimally.

Another criterion for determining the strength of hierarchical and/or associative bonds could be the distance between Na^+ and Cl^- ions. Measuring such distances would be more challenging and would require the use of an electron microscope. Density and hardness were also mentioned as criteria closely related to conductivity. The higher the density of the NaCl solution, the higher its hardness, which contributes to greater conductivity-but only up to the saturation concentration. Beyond saturation, density and hardness continue to increase while conductivity begins to decline.

The method of determining the strength of hierarchical and/or associative bonds between water molecules and Na^+ and Cl^- ions by measuring conductivity is feasible, although limited to chemical compounds with ionic bonds. The following sections will present measurements of conductivity, density, and hardness at lower NaCl solution concentrations of 0.1%, 0.2%, 0.3%, and 0.4%.

5.4.7.8.1.5 Table 173: Measurements of hardness, density and conductivity of NaCl solutions

Concentration in %	Hardness in ppm	Density in g/cm^3	Conductivity in μS
0.1	780	1.0010	1592
0.2	808	1.0020	3077
0.3	1998	1.0030	6995
0.4	2606	1.0040	8084

Table 173 shows measurements of hardness (ppm – parts per million), density (g/cm^3), and conductivity (μS – microsiemens) for NaCl solutions at low concentrations ranging from 0.1% to 0.4%. As the concentration of NaCl in water increases, the values for hardness, density, and conductivity also rise. The strength of hierarchical and associative bonds between ions and water molecules similarly increases in correlation with density, hardness, and especially conductivity. However, the hierarchical bonds between ions in solution are no longer as strong as in the crystal lattice, where associative bonds were e·tremely weak. Based on the measurements, it can be concluded that the strength of associative bonds between water molecules and ions has significantly increased in NaCl solutions.

Since these are low-concentration solutions, associative bonds dominate over hierarchical ones. Dissolving one mole of NaCl in distilled water releases about 3.9 kJ/mol of energy, indicating a slightly endothermic reaction. In the studied samples, the released energy is much lower: 0.0668 kJ/mol at 0.1% (0.01713 mol/L), 0.1337 kJ/mol at 0.2% (0.03429 mol/L), 0.2008 kJ/mol at 0.3% (0.05149 mol/L), and 0.2682 kJ/mol at 0.4% (0.06879 mol/L). The density of the NaCl crystal lattice is appro·imately 2.167 g/cm^3, while the densities of the studied solutions are much lower, ranging from 1.001 g/cm^3 to 1.004 g/cm^3.

One mole of NaCl contains about 1.204×10^{24} ions, consisting of appro·imately $6.022 \cdot 10^{23}$ Na^+ cations and $6.022 \cdot 10^{23}$ Cl^- anions. This is an e·tremely large number, which remains high even in diluted NaCl solutions where polarized water molecules predominate. This means water molecules in the solution have enough space to freely associate and dissociate. At locations where water molecules surround Na^+ ions (with a radius of about 102 pm) and Cl^- ions (with a radius of about 181 pm), their movement is no longer completely free, as the polarized charges are slightly bound to the NaCl ions.

In 100 ml of a 0.1% NaCl solution, there are appro·imately $3.3 \cdot 10^{23}$ water molecules and $3.426 \cdot 10^{20}$ ions ($1.713 \cdot 10^{20}$ Na^+ and $1.713 \cdot 10^{20}$ Cl^-). In solutions with higher concentrations, the number of ions increases slightly, while the number of water molecules decreases somewhat. A key question is where the greatest number of hydrated ions are located within the solution. Resistance measurements show that the highest resistance values are at the surface of the solution, the lowest at the bottom, with intermediate values in between. Lower resistance values indicate higher conductivity, while higher resistance values indicate lower conductivity.

This suggests that hydrated ions are not evenly distributed throughout the solution. This assumption can be tested with a multimeter in the Ohm range or alternatively in the mA/μA range, but these measurements are more qualitative than quantitative. Since anions have greater mass than cations, it can be assumed that the highest number of Cl^- ions is at the bottom of the solution. However, it should also be noted that connections between Na^+ and Cl^- ions still e·ist in solution, but the distances between them are greater (4.59 Å or $4.59 \cdot 10^{-10}$ m) than in the NaCl crystal lattice (2.81 Å or $2.81 \cdot 10^{-10}$ m).

In the solution, Cl^- anions are mostly located below the Na^+ cations, depending on the strength and dynamics of the water molecules. The mass of the ions differs slightly from that of neutral atoms, but these values remain extremely small (proton mass = $1.6726 \cdot 10^{-27}$ kg, electron mass = $9.109 \cdot 10^{-31}$ kg, neutron mass = $1.675 \cdot 10^{-27}$ kg). At the beginning of the hydration process of the NaCl crystal lattice, most Na^+ ions coordinate with water molecules, while nearly all Cl^- ions coordinate with both Na^+ ions and water molecules.[242] This means that Na^+ ions are positioned further from their original locations in the cubic crystal lattice than Cl^- ions, with the nearest Na^+ ion having a significant influence on the hydration shell surrounding each Cl^- ion. In this process, there is a simultaneous tendency toward both order and disorder among the ions and water molecules.

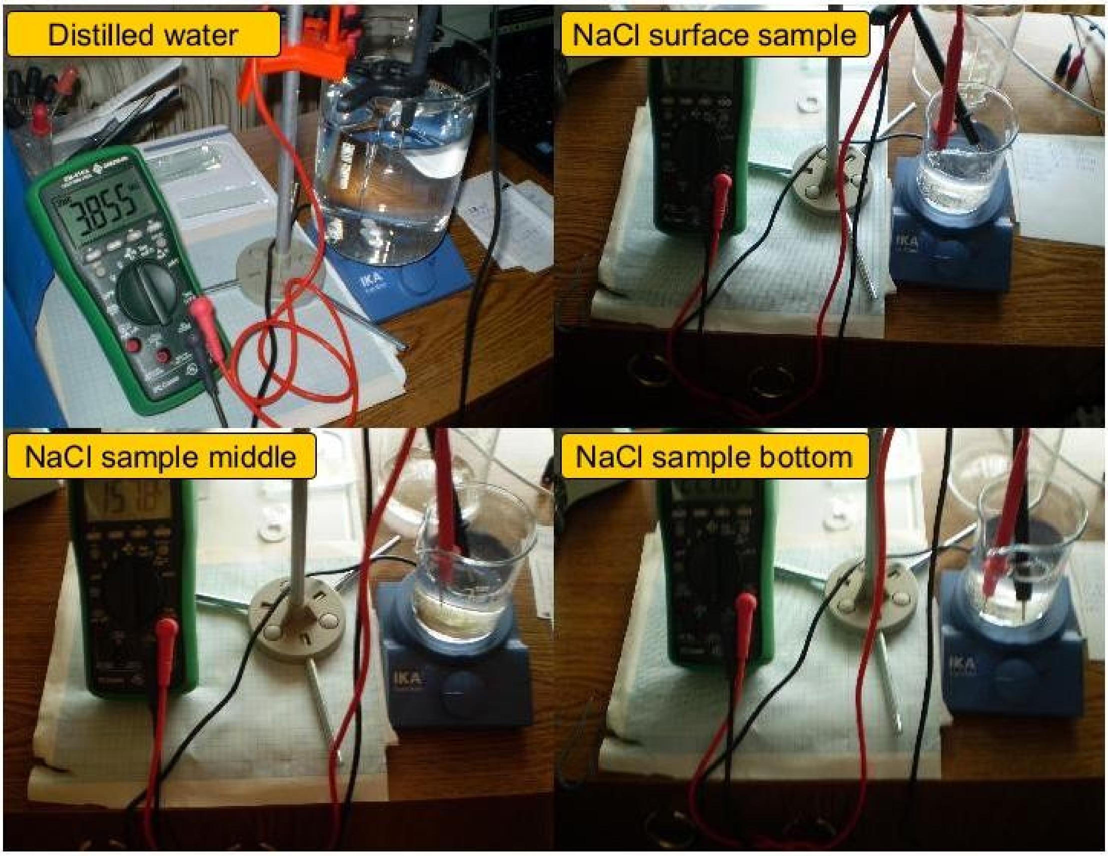
Increasing the concentration of NaCl in solution can alter the tetrahedral structure of some water molecules, and this effect is more pronounced in solutions with higher NaCl concentrations compared to those with lower concentrations.[243] When measuring the conductivity of NaCl solutions, it was found that they are conductive, although only within the range of microsiemens (μS) or lower millisiemens (mS) values. Using a multimeter set to measure resistance in ohms (Ω), resistance values can be measured at the surface, middle, and bottom of the solution. The purpose of these measurements is to determine where in the solution the greatest or smallest number of NaCl ions are located. It is important to note that these measurements are not highly precise but provide valuable information.

Based on the measured resistance values, the conductivity of different solutions can be calculated using the formula $\chi = 1/R$, where χ is conductivity and R is resistance. Tests were conducted

242 Liu, F., & Sun, D. (2019). Ion Distribution and hydration structure at solid–liquid interface between NaCl Crystal and its solution. *ACS Omega*, 4(20), 18692–18698. https://doi.org/10.1021/acsomega.9b02620.

243 El Hog, S., Rjiba, A., Jelassi, J., & Dorbez-Sridi, R. (2022). NaCl salt effect on water structure: A Monte Carlo Simulation Study. *Physics and Chemistry of Liquids*, 1–11. https://doi.org/10.1080/00319104.2022.2049776.

measuring the resistance of distilled water, a 1% NaCl solution, and a 0.4% NaCl solution. For all samples, resistance values were measured at the surface, middle, and bottom of the solution.
To perform the measurements, an appropriate stand and clamps were used to correctly position the electrodes at different heights within the solution. The greatest precision and difficulty were required when placing the multimeter electrodes on the surface of the solution, as both electrodes had to touch the surface only with their tips. For a better illustration of the tests, refer to the measurement photos.



5.4.7.8.1.6 Figure 375: Measuring the resistance of distilled water and NaCl solution

Figure 375 shows part of the resistance measurements for distilled water and a NaCl solution, where resistance was measured at the surface, in the middle, and at the bottom of the liquid or solution. In the upper right part of the image, the resistance measurement at the surface of the distilled water is shown. The remaining images display resistance measurements of the NaCl solution at the surface, in the middle, and at the bottom. Measurements were conducted for distilled water and two NaCl solutions with concentrations of 0.4% and 1%, respectively.

5.4.7.8.1.7 Table 174: Resistivity measurements of distilled water and two NaCl solutions

Samples	Rp (KΩ)	Rs (KΩ)	Rd (KΩ)
Distilled water	3600	1300.0000	1020
0.4 % NaCl	890	180.0000	60
1.0 % NaCl	386	82.0000	25

Table 174 shows resistance measurements for distilled water and two NaCl solutions with different concentrations. The values Rp, Rs, and Rd are expressed in kiloohms (kΩ) and represent the following:

- Rp: measurements at the surface,
- Rs: measurements in the middle, and
- Rd: measurements at the bottom of the solutions.

Clear differences between Rp, Rs, and Rd values are immediately noticeable, indicating that the solutions are not completely homogeneous. For distilled water, all measured resistance values are extremely high, in the megaohm (MΩ) range, while for the two NaCl solutions, resistance decreases significantly depending on the measurement location. This suggests that NaCl ions are unevenly distributed within the solution. Lower resistance means higher conductivity, so these solutions conduct electricity best at the bottom, less in the middle, and least at the surface.

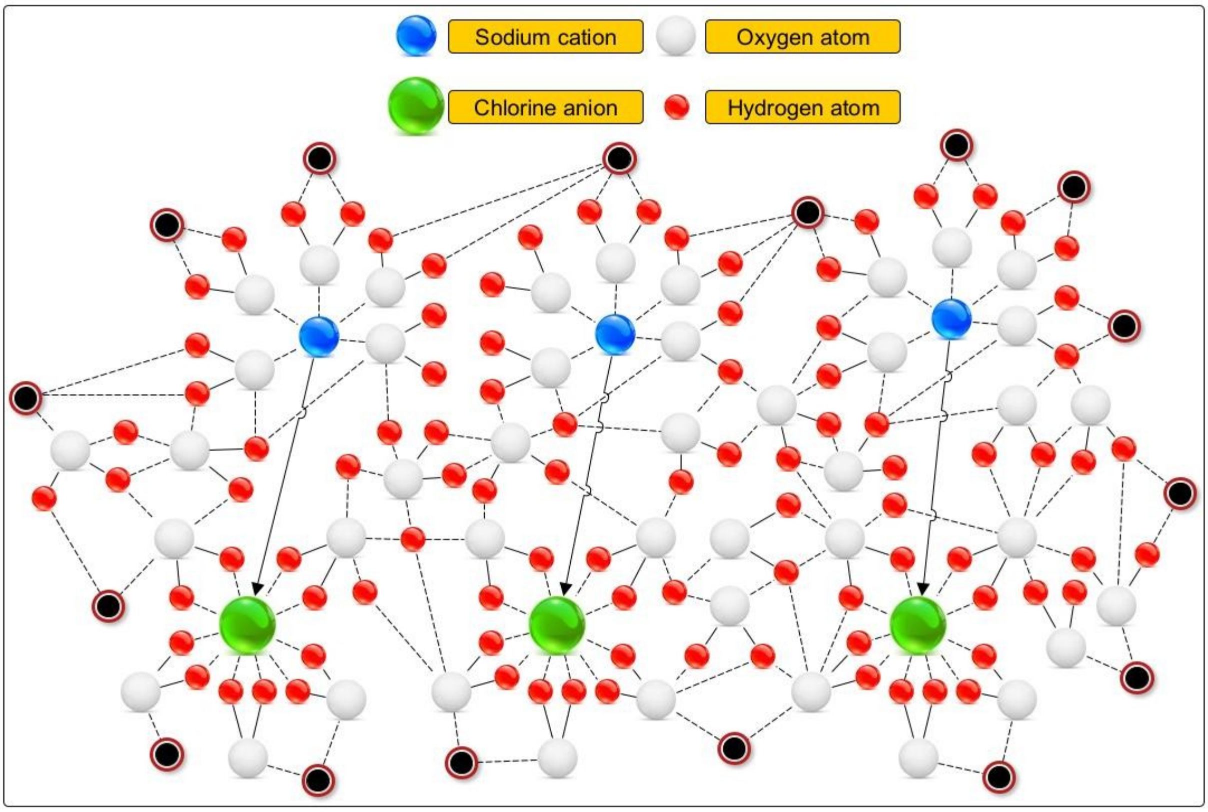
The distribution of ions is far from uniform or homogeneous, as it is in the crystal lattice. Additionally, the masses of the cations and anions differ. It has been noted that Cl^- anions are heavier than Na^+ cations and are connected at certain distances, which may mean that Cl^- ions, surrounded by hydration shells, tend to be located below Na^+ cations, which are also hydrated. These Na^+ cations significantly influence the hydration shell around Cl^- anions, potentially causing changes in the dynamics and structure of these water molecules.

Following this idea, Na^+ cations occupy a hierarchically superior position and dictate the dynamics of the hydration shell around Cl^- anions. Furthermore, Na^+ cations act as electron donors, while Cl^- anions are electron acceptors, making them highly dependent on Na^+ cations. Essentially, Na^+ cations have a more active role in bonding with Cl^- anions, which are more passive in this context. Water molecules in this relationship create greater distances between the two ions, meaning the chemical bond between them is weaker than in the crystal lattice. The basic structure of water molecules is best preserved at the solution’s surface, although surface tension increases due to NaCl ions. In this arrangement, a collective effect of both water molecules and NaCl ions emerges in the form of conductivity, enabling electrical current. This collective effect grows stronger with increasing NaCl concentration, up to a critical saturation point.

In summary, water molecules, due to their polarity, participate in an associative relationship with NaCl ions, while a mild hierarchical relationship exists between the ions themselves because of increased distance. As NaCl concentration in water rises, the organization of ions and surrounding water molecules becomes less asymmetric and conical, gradually resembling a more normal distribution, which leads to greater symmetry.

More asymmetric particle distributions occur in NaCl solutions with lower concentrations (from 0.1% to 1.9%), while from 2% to saturation, symmetry increases, resulting in a stronger collective conductivity effect of NaCl ions and their hydration shells. A more symmetrical distribution and optimal freedom of particle movement allow better conductivity utilization and thus greater efficiency in electrical energy transfer.

NaCl solution is considered a relatively strong electrolyte; for example, a 0.59% (0.1 M) solution can produce a current of 1.065 mA. It is known that NaCl ions have a spherical geometric shape, while water molecules form symmetrical tetrahedrons. Dissolving NaCl involves physical rather than chemical changes, meaning the geometric shapes of ions and water molecules remain relatively unchanged during dissociation. Ionic spheres are surrounded by polar symmetrical tetrahedrons. Ionic and polar bonds are strained due to attractive forces. Polar water molecules initiate this process, causing Na^+ and Cl^- ions to loosely position themselves among water molecules. This can be visualized as water molecules forming an environment for NaCl ions. Both cations and anions have their own hydration shells, which repeat continuously within the solution as a pattern.



5.4.7.8.1.8 Figure 376: Fragment of the network of water molecules and NaCl ions

Figure 376 shows a fragment (see black circles with red borders) of the network formed by water molecules and NaCl ions, featuring just six NaCl ions surrounded by thirty water molecules. Additional water molecules are present in the structure, which have not fundamentally changed their ability to form hydrogen bonds between hydrogen and oxygen atoms or their continuous association and dissociation. However, under the influence of NaCl ions, their structure has become slightly less symmetrical. This network of ionic polar bonds results from a NaCl solution with a lower concentration, between 0.1% and 2%. At higher concentrations (from 3% onward), the structure of water molecules may become even less symmetrical, leading to further changes in basic properties. In such cases, the ions would mainly be surrounded by three rather than five water molecules, and the space available for the movement of NaCl ions and water molecules would be somewhat reduced. However, this does not affect the increase in the collective effect of electrical conductivity up to the saturation point.

In low-concentration solutions, the arrangement of NaCl ions largely preserves the basic property of the cubic crystal lattice, but the distances between cations and anions become much greater. The highest amount of electrical energy can be extracted from NaCl solutions-both at low and high concentrations-at the bottom of the solution, where the ion concentration is greatest. At the surface, the concentration of NaCl ions drops sharply. This decrease depends mainly on the solution’s concentration: as the NaCl concentration increases above 3%, the number of ions at the surface also increases. Still, even at concentrations up to 35.7% at 25°C, there are fewer ions at the surface than in the middle or at the bottom. On the surface, the associative hierarchy of water molecules over NaCl ions is most dominant; otherwise, the water surface would be relatively rigid. This associative hierarchy also prevails in the middle and at the bottom, but NaCl ions are more influential there than at the surface. Therefore, the hierarchical relationship between sodium cations and chloride anions is stronger, as shown by the arrow from Na^+ to Cl^- in the network diagram. Sodium cations also influence the water molecules around chloride anions.

This arrangement of ions applies mainly to still solutions, as stirring redistributes the ions from the bottom to the middle and surface. In nature, mixing in seawater is caused by vibrations, wind, precipitation, and living organisms. Nevertheless, the lowest number of NaCl ions is always found at the surface of the solution or saltwater source.

The distribution of ions within NaCl solutions can be clearly demonstrated using a modified paper chromatography method. A filter paper of specific dimensions (e.g., width: 3 cm, length: 4.8 cm) is dipped 0.5 cm deep into the NaCl solution in a chromatography chamber, and the retention time of the solution's movement from the starting to the target line is measured. No dyes are used in this method. The filter paper with the adsorbed particles is then dried in a pre-weighed crucible and ignited at 900°C. After one hour of ignition and cooling in air, the crucible is placed in a desiccator to prevent moisture absorption by the NaCl. The crucible with its contents (the filter paper is burned to carbon dioxide) is weighed on an analytical balance to four or five decimal places. The result gives the amount of adsorbed NaCl, reflecting the movement of particles along the filter paper. This test can be repeated within one solution until none remains, and can also be performed for solutions of different NaCl concentrations. In this case, adsorption cycles were conducted for solutions of 1 g NaCl + 100 ml H_2O, 2 g NaCl + 100 ml H_2O, and 3 g NaCl + 100 ml H_2O. The filter papers used were measured and cut from Machery-Nagel MN 640 w (width 3 cm, length 4.8 cm). Before reviewing the results for these concentrations, a simple chromatography chamber setup is shown for clarity.

From a systemic perspective, there is a constant influx of Na^+ cations releasing electrons into the environment of Cl^- anions, forming loose but stable associations between these two different environments. The higher the NaCl concentration, the more symmetrical and collectively organized these loose, stable associations become. This also means hierarchical relationships within the solution strengthen, as optimal collective effects require both hierarchical and cooperative interactions. This structure can be illustrated for water and NaCl solutions with lower concentrations.

5.4.7.8.1.9 Figure 377: Simple chromatography chamber

Figure 377 shows a simple chromatography chamber containing a NaCl solution, into which a strip of filter paper of specific dimensions (without any color, as shown in the image) is dipped. The time it takes for the solution to travel from the starting line to the end line is measured. The rest of the procedure has been described earlier.

5.4.7.8.2 Adsorption of particles from NaCl solutions on filter strips

Using the described modified paper chromatography method and gravimetric analysis, the masses of NaCl adsorbed onto filter strips were determined from solutions of different concentrations (1 g/100 ml, 2 g/100 ml, and 3 g/100 ml). For each solution, the modified paper chromatography method was repeated until there was no more solution left in the chromatography chamber. For the 1 g/100 ml solution, 165 filter strips were used; for the 2 g/100 ml solution, 175 strips; and for the 3 g/100 ml solution, 170 strips. The main reason for these relatively small differences is water evaporation, since the experiments were conducted from June 21, 1993, to December 12, 1993. In summary, these measurements provided the distribution of NaCl particles in the solutions. The results for the adsorbed NaCl from the three different concentrations on filter strips, for some initial and final measurements, will be shown in a table.

5.4.7.8.2.1 Table 175: Small portion of NaCl adsorption data

Samples	Map (mg)	Mas (mg)	Mad (mg)
1 g NaCl /100 ml	1.45	1.85	2.2
2 g NaCl / 100 ml	2.4	3.2	5.05
3 g NaCl / 100 ml	6.3	6.1	8.95

Table 175 presents a very small portion of the data (only 510 data points on adsorbed masses) for the adsorption of NaCl onto filter paper strips from solutions of three different concentrations. It is immediately noticeable that the smallest amount of NaCl was adsorbed at the surface of the solution (see masses in mg – Map), somewhat larger amounts were found from the middle of the solutions, and the largest amounts came from the bottom. Based on all the data for the adsorbed masses, a simple statistical analysis was performed, calculating the arithmetic means, ranges, quartile deviations, mean absolute deviations, standard deviations, coefficients of variation, skewness, and kurtosis. Listing all the calculation steps is unnecessary, as the results are less precise, but they are still very informative. Therefore, only the final results of these numerous measurements will be presented.

For the 1 g NaCl / 100 ml H_2O solution, the arithmetic mean (M) was greater than the median (Me), which was greater than the mode (Mo), meaning: M > Me > Mo. Based on the coefficients of skewness and kurtosis, the distribution of NaCl particles in the solution was slightly skewed to the right and somewhat peaked, differing from a normal distribution.

For the 2 g NaCl / 100 ml H_2O solution, the mode (Mo) was greater than the median (Me), which was greater than the arithmetic mean (M), so: Mo > Me > M. According to the coefficients of skewness and kurtosis, the distribution was slightly skewed to the left and somewhat flattened, making it less different from a normal distribution.

For the 3 g NaCl / 100 ml H_2O solution, the median (Me) was greater than the arithmetic mean (M), which was greater than the mode (Mo), so: Me > M > Mo. The coefficients showed that the distribution was nearly normal and symmetric. The distribution of NaCl particles in the highest-concentration solution was already very similar to a Gaussian distribution curve.

From this, we can conclude that at even higher concentrations of NaCl solutions, the distributions would likely become increasingly normal, leading to better organization of NaCl particles or ions, which would ultimately result in a greater collective effect in terms of electrical energy output. Improved organization is mainly the result of stronger hierarchical and associative bonds between ions and water molecules. It is known that statistical analyses mostly explain mass phenomena, focusing less on important individual occurrences. Even with increasing concentrations of dissolved NaCl in water, the established distribution of NaCl ions would fundamentally remain asymmetric, with the largest number of ions at the bottom, fewer in the middle, and the least at the surface. However, a closer look at the adsorbed mass data shows that this earlier conclusion is not entirely accurate, as larger adsorbed NaCl masses on the filter paper are also found in the middle of the solution and just above the bottom.

On one hand, Van der Waals forces pull the ions downward, while in the middle of the solution, there are forces that push larger masses of particles toward the relative center. These are dispersion forces, which operate on the principle of attraction and repulsion. Additionally, there is induction, which occurs due to attractive dipole forces between molecules and atoms not in direct physical contact. It is worthwhile to study the frequency distributions of the adsorbed NaCl masses in more detail.

5.4.7.8.2.2 Table 176: Adsorption masses and frequency distribution

Ma 1g Nacl	f1	Ma 2g NaCl	f2	Ma 3g NaCl	f3
0.40 – 0.70	4	2.40 – 2.70	7	4.80 – 5.10	6
0.71 – 1.00	19	2.71 – 3.00	6	5.11 – 5.40	0
1.01 – 1.30	33	3.01 – 3.30	18	5.41 – 5.70	3
1.31 – 1.60	56	3.31 – 3.60	14	5.71 – 6.00	8
1.61 – 1.90	25	3.61 – 3.90	27	6.01 – 6.30	11
1.91 – 2.20	18	3.91 – 4.20	21	6.31 – 6.60	16
2.21 – 2.50	8	4.21 – 4.50	30	6.61 – 6.90	12
2,51 – 2,80	1	4.51 – 4.80	28	6.91 – 7.20	23
2.81 – 3.10	1	4.81 – 5.10	16	7.21 – 7.50	25
		5.11 – 5.40	2	7.51 – 7.80	17
		5.41 – 5.70	5	7.81 – 8.10	13
		5.71 – 6.00	1	8.11 – 8.40	15
				8.41 – 8.70	6
				8.71 – 9.00	6
				9.01 – 9.30	5
				9.31 – 9.60	3
				9.61 – 9.90	1

Table 176 shows the classes of NaCl adsorption masses on filter paper strips and the frequency distributions for solutions containing from 1 g NaCl/100 ml H_2O up to 3 g NaCl/100 ml H_2O. The solution with the highest concentration (3 g NaCl/100 ml H_2O) has the greatest number of adsorption mass classes (17 classes), followed by the 2 g NaCl/100 ml H_2O solution with 12 classes, while the solution with the lowest concentration has the fewest classes.
The lowest variability in adsorbed mass occurs at the lowest NaCl concentration, while the highest variability is observed at the highest concentration. For the lowest concentration solution, the most frequently occurring adsorption mass classes, from 1.01 to 1.30 mg (frequency = 33) and from 1.31

to 1.60 mg (frequency = 56), appear near or at the surface of the solution. The highest adsorbed masses, such as 2.50 mg and 2.85 mg, occur near the middle rather than near or at the bottom, although higher values like 2.20 mg, 2.30 mg, and 2.35 mg are also found in this region.

In the 2 g NaCl/100 ml H_2O solution, the most common adsorption mass class is from 4.21 mg to 4.50 mg (frequency = 30), observed near the surface, middle, and bottom of the solution. The highest adsorption masses, ranging from 4.80 mg to 5.95 mg, are found near or at the bottom.

For the highest concentration solution, the largest adsorption masses, from 9.00 mg to 9.90 mg, are found near and at the bottom of the solution. Less frequently, such masses are also found near the middle. Adsorption masses from 6.91 mg to 7.50 mg most commonly appear near the surface, middle, and bottom, as do masses from 7.51 mg to 8.40 mg.

These observations show that the distribution of particles or ions within NaCl solutions is complex. The smallest masses are found near the surface and middle of the solution, but higher adsorbed masses are always present within these zones. Similarly, lower adsorption masses are found near the bottom. Generally, the distribution of NaCl ions in water follows the pattern: mass at surface < mass at middle < mass at bottom. However, local or individual deviations from this rule occur.

What force could cause heavier NaCl particles surrounded by water molecules to repeatedly appear near the surface and middle, sometimes even heavier than some particles near the bottom? One possible force is osmosis, as water moves upward through the filter paper strip and can pull heavier particles upward due to osmotic pressure. Environmental factors such as humidity, air temperature, and air pressure also affect this process. At air pressures above 1000 mb, the speed of particle or solution movement along the filter paper increases, indicating stronger osmotic forces.

Considering these findings, we can reflect on the highest energy potentials within various NaCl solutions. When harvesting electrical energy from seas or large oceans containing over 4% NaCl, the greatest electrical energy would likely be obtained between the lower middle and bottom of the saltwater source. Sea water is not a perfectly homogeneous NaCl solution but contains many other salts, such as iodides, bromides, fluorides, and other chlorine compounds with alkaline earth metals.

The modified paper chromatography method highlights the tendency for particle organization in NaCl solutions. Water has the ability to defy gravity by moving upward, as seen in plants. Filter paper strips are networks of cellulose fibers that act as tiny interconnected capillaries. The movement of NaCl solution along the filter paper works on the principle that the lighter component, water, pulls NaCl particles or ions-surrounded by water molecules-upward due to osmotic forces. This suggests that free water molecules not surrounding NaCl ions travel first and reach the target line earlier, meaning the last third of the filter strip contains the smallest amount of NaCl ions. The middle third contains a somewhat larger number, while the largest number of ions is found in the first third of the travel path. This again reflects the general principle of NaCl ion distribution in solution: the greatest number of ions at the bottom, the least near the surface.

With this modified paper chromatography method, we initially capture content near the surface, not from the middle or bottom, and only through many trials do we gradually reach the bottom. It would be advisable to perform tests with filter paper strips designed to capture NaCl particles from the surface, middle, and bottom of the solution. We can expect to encounter the already known basic principle of NaCl particle distribution in solution.

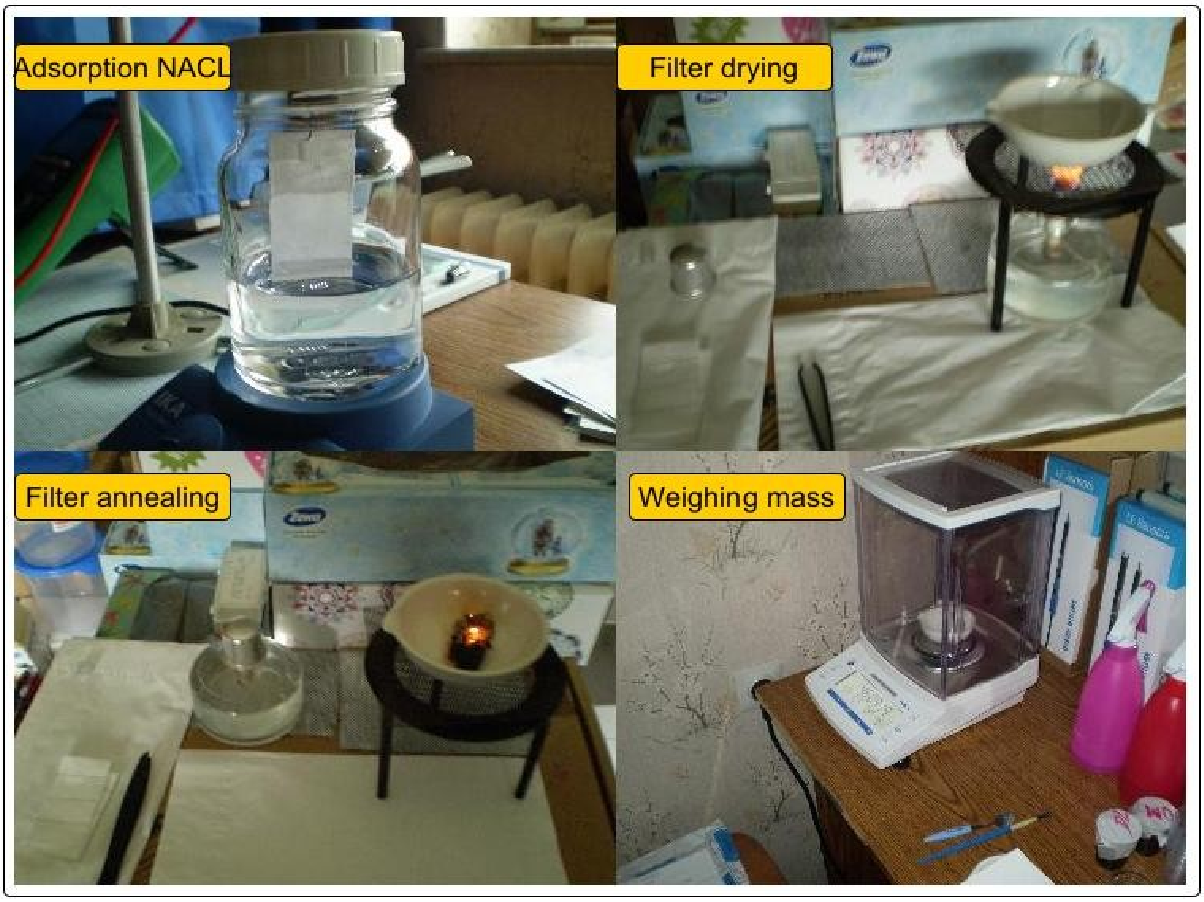
It is important to note the structure of the filter paper. The cellulose fiber network can be dense, medium dense, or less dense (fine to coarse filter paper). Coarser filter papers cause particles to spread more sideways, while finer papers direct particles more vertically or lengthwise. This does not change the basic tendency of NaCl particle distribution in solution but results in different patterns of particle or ion organization.

This can be illustrated by adding a color component, such as a fluorescent dye, to the center of the starting line. In finer filter paper immersed in NaCl solution, the dye travels lengthwise, while in coarser paper it spreads sideways.

It is also useful to observe NaCl particle adsorption results under USB and light microscopes. Although ions cannot yet be seen with available tools, small clusters of NaCl particles on the filter paper surface can be observed.

Water alters the physical properties of NaCl ions by changing the distances between cations and anions, enabling greater collective effects in conductivity and electrical energy generation. Additionally, density and hardness change. These are not one-way effects; NaCl ions also influence the physical properties of water, such as temperature, density, hardness, and especially surface tension. These are mutual changes in the physical properties of polar molecular and ionic bonds. The structures of both chemical compounds remain fundamentally unchanged; otherwise, chemical structure changes would occur. Tetrahedral water molecules and dispersed cubic crystal lattices remain separated by hydration shells.

Where on the filter paper strip will the greatest amount of NaCl adsorb? To answer this, a modified paper chromatography and gravimetric analysis experiment was conducted by dividing the filter strips into thirds. Machery-Nagel filter strips measuring 3 cm wide and 4.8 cm long were divided into three equal parts of 1.6 cm each, representing the initial, middle, and final thirds. The following description is supported by an illustration.



5.4.7.8.2.3 Figure 378: Adsorption of NaCl as a whole and by thirds

Figure 378 illustrates part of the procedure for determining the adsorbed mass of NaCl on filter paper strips, both as a whole and divided into thirds. First, a filter strip of known dimensions was immersed 0.5 cm into a chromatography chamber containing a NaCl solution (see the upper left part of the figure). The NaCl solution traveled upward along the filter paper, and once it reached the final or target line, the strip was removed from the chamber and placed in a pre-weighed ceramic evaporating dish (see the lower right part of the figure). The strip was then dried with a burner (see the upper right part of the figure), and afterwards, using tweezers and a gas burner, the dried filter strip was incinerated to ash (see the lower left part of the figure). Before this step, the mass of the charred filter strip of known dimensions was determined to be 0.0004 mg. The ceramic dish with its contents was cooled before weighing and then placed on an analytical balance. A simple calculation followed: from the measured mass of the ceramic dish, the mass of the ash and then the mass of the empty dish were subtracted. The result was 14.2 mg of adsorbed NaCl.

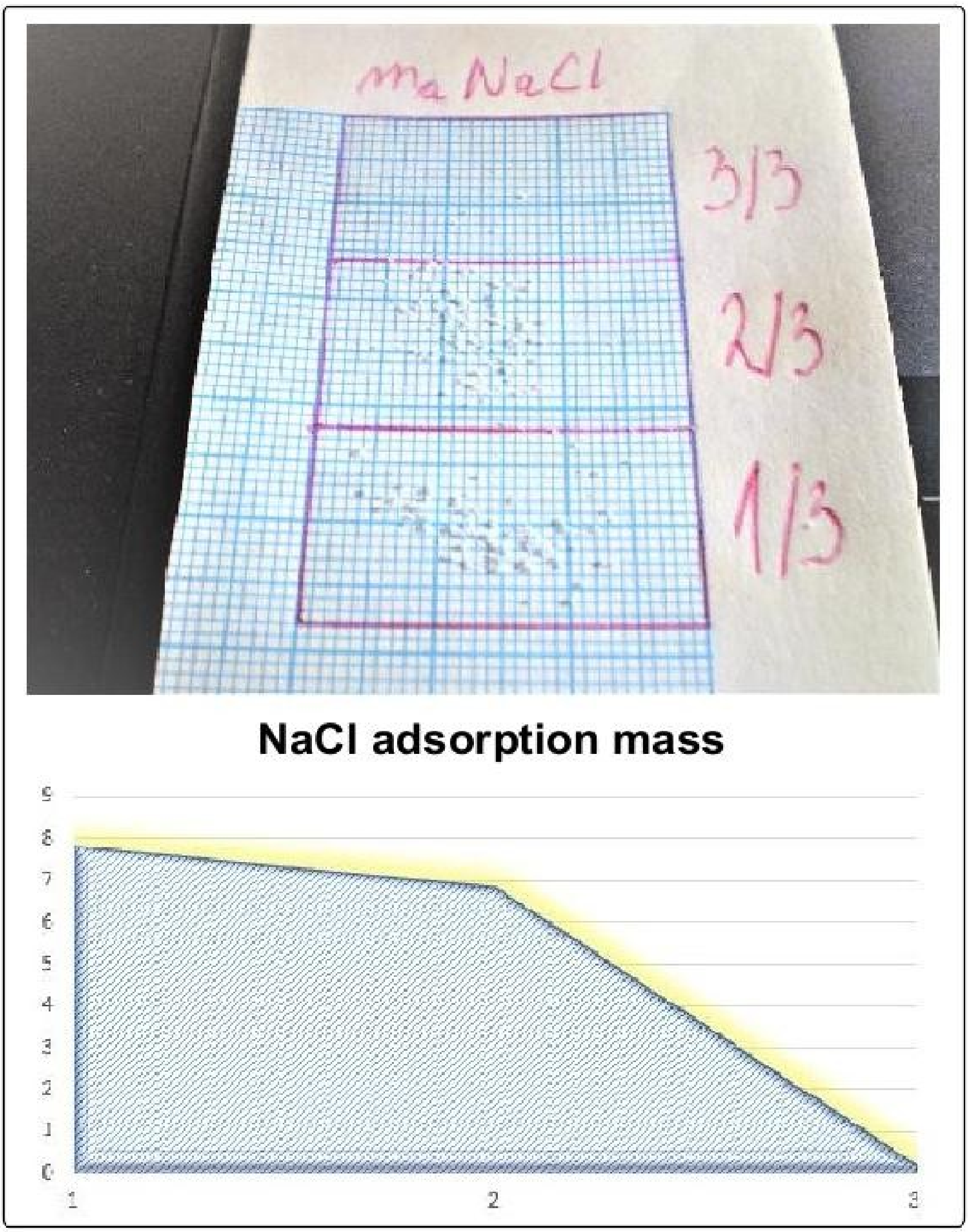
The procedure was then repeated, but with the key difference that the mass was first determined for the first third (when the solution traveled from the starting point to the end line of the first third) and later for the second third (when the solution traveled from the starting point to the end line of the second third). The mass of NaCl adsorbed in the first third was 7.8 mg, while in the second third it

was 14.0 mg. The largest amount of NaCl was adsorbed on the surface of the first third of the filter strip (m = 7.8 mg), followed by the surface of the second third (m = 6.2 mg), and finally the remainder, representing the mass adsorbed on the surface of the third third (m = 0.2 mg).
This process allowed us to determine where on the filter strip the largest and smallest amounts of NaCl ions were located. At the very beginning, the filter paper absorbs water molecules, which results in the fastest movement of the solution. After passing into the second third, the speed of the solution's movement decreases and remains roughly constant until the end line of the third third. As the NaCl solution travels along the filter strip, water molecules always take the lead, so NaCl ions do not reach the final end line. Although ions cannot be detected without an electron microscope, some NaCl microcrystals surrounded by water molecules can be observed with a light microscope.[244] Crystals become even more visible when a single drop of the studied NaCl solution is placed on a microscope slide and covered with a cover slip. The prepared sample is then examined under a light microscope using 10x and 40x objectives. After some time, the water beneath the cover slip evaporates, and white NaCl crystals form along the edges.

5.4.7.8.2.4 Figure 379: Microscope and NaCl crystallization

Figure 379 shows the formation of NaCl crystals at the edges of the cover slip (see the upper part of the image) and their asymmetric shapes (see the lower part of the image). The NaCl crystals form a chain of interconnected microcrystals. It is difficult to clearly recognize the familiar cubic structure of NaCl crystals. Let us return to the adsorbed NaCl masses from the solution by thirds.

244 Yakhno, T., & Yakhno, V. (2019). A study of the structural organization of water and aqueous solutions by means of optical microscopy. *Crystals*, 9(1), 52. https://doi.org/10.3390/cryst9010052.



5.4.7.8.2.5 Figure 380: Mass of NaCl adsorption by thirds

Figure 380 shows the masses of NaCl adsorbed from the solution on thirds of the surface area, each measuring 4.8 cm². The greatest adsorption mass is observed in the first third (7.8 mg), where particles surrounded by water molecules are more widely dispersed. This changes somewhat in the second third, as particles distribute less across the width and more along the length. Water molecules and the smallest crystals, surrounded by hydration shells, travel first along the filter strip, resulting in a higher travel speed. This tendency continues throughout the solution's movement. Measurements on the surface of the second third show the second highest adsorption mass of NaCl

(6.2 mg). The travel speed decreases slightly afterward, and the smallest adsorption mass (0.2 mg) is measured on the surface of the third third.

The resulting surface graph forms a trapezoid shape (see the lower part of the figure), indicating that the adsorbed mass value initially decreases relatively linearly and then exponentially. The ion distribution in the 5 g NaCl + 100 ml H_2O solution is far from uniform and homogeneous, as microcrystals surrounded by water molecules vary in weight and size. Osmotic force is initially stronger, leading to a faster travel speed of the solution. Later, osmotic force weakens, especially for more distant surfaces, and must transport heavier and larger microcrystals surrounded by water molecules. Among the heavier and larger hydrated microcrystals, smaller and lighter ones are still present. Generally, the rule is that larger and heavier hydrated microcrystals lie beneath layers of smaller and lighter hydrated microcrystals, although smaller layers of lighter microcrystals surrounded by water molecules can occasionally be observed. This phenomenon can be explained by larger and heavier hydrated microcrystals continuing to hydrate into a greater number of smaller and lighter microcrystals. This means the hydration process is ongoing. Due to the associative and dissociative nature of water molecules, some smaller and lighter microcrystals can combine into larger and heavier ones through ionic polar attractive forces. This is a continuously repeating dynamic pattern within NaCl solutions of varying concentrations. The experiment was repeated with a 0.4% NaCl solution, and the results were as expected. A total of 3.4 mg of NaCl was adsorbed: 1.9 mg in the first third (the most), 1.5 mg in the second third (slightly less), and zero in the third third (the least). In summary, this pattern of NaCl mass adsorption on the filter strip of precisely defined dimensions is similar to that observed with the 5 g NaCl + 100 ml H_2O solution.

In order to more accurately determine the locations of NaCl ions from solutions of different concentrations, such as 1 g NaCl + 100 ml H_2O, 2 g NaCl + 100 ml H2O, 3 g NaCl + 100 ml H_2O, 4 g NaCl + 100 ml H_2O, and 5 g NaCl + 100 ml H_2O, let’s examine the method for determining the specific (surface) adsorption of the aforementioned solutions, which is calculated using the following simple mathematical formula:

$$S_A = \frac{m_a}{S}$$

S_A ... specific adsorption; m_a ... mass of adsorption; S ... surface area of the filter paper strip

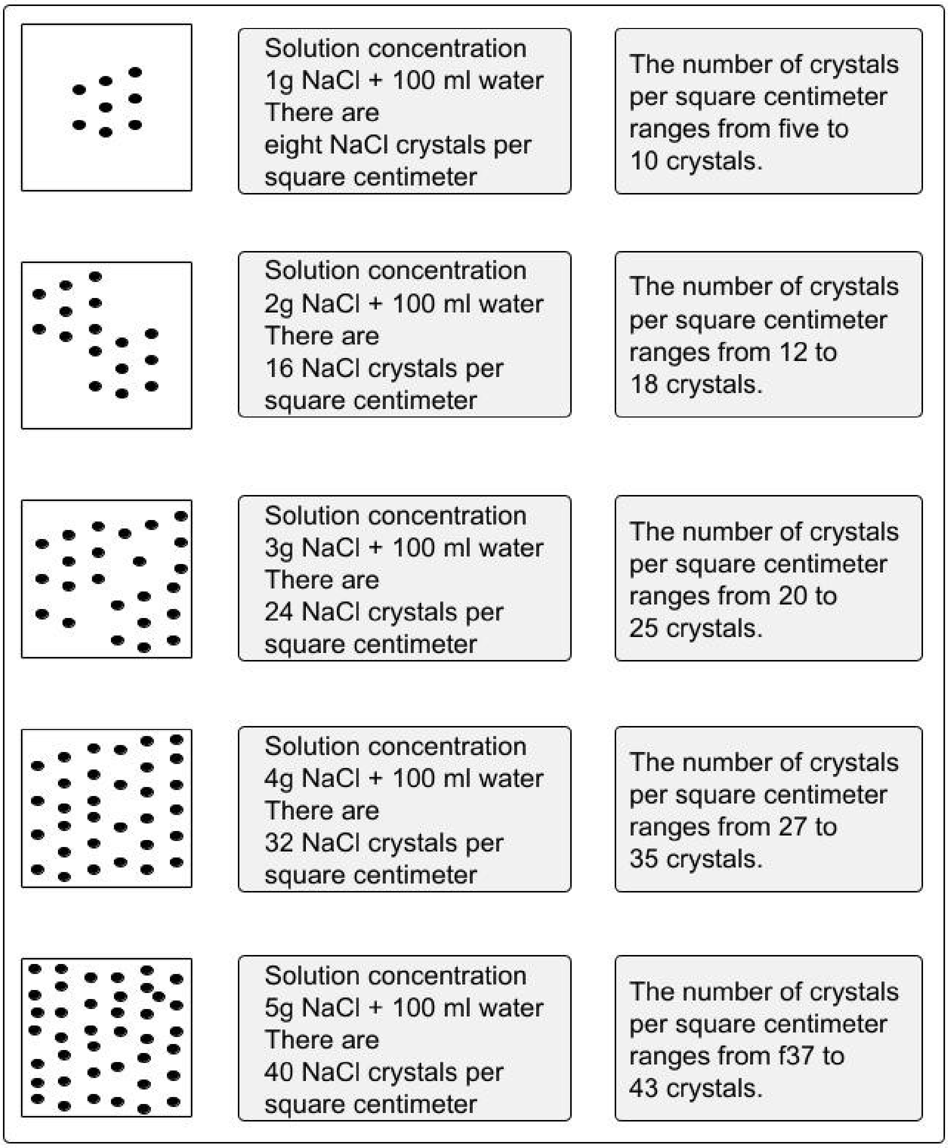
A small portion (34 series) of these already calculated S_A values in units of g/cm² based on the adsorbed masses (ma) and the constant surface area of the filter paper strip (S = 3 cm x 4.8 cm = 14.4 cm²) for the specified NaCl solution concentrations will be presented in the following table.[245]

245 The results of adsorbed NaCl masses are based on measurements from 1993.

5.4.7.8.2.6 Table 177: Specific adsorptions of NaCl solutions

S_a 1g Nacl	S_a 2g Nacl	S_a 3g Nacl	S_a 4g Nacl	S_a 5g Nacl
0.0001	0.0003	0.0005	0.0006	0.0009
0.0001	0.0003	0.0005	0.0008	0.0010
0.0001	0.0004	0.0005	0.0008	0.0010
0.0001	0.0003	0.0006	0.0008	0.0009
0.0001	0.0002	0.0005	0.0007	0.0009
0.0001	0.0003	0.0005	0.0007	0.0008
0.0001	0.0004	0.0004	0.0006	0.0009
0.0001	0.0003	0.0005	0.0007	0.0009

The table shows a small portion of the data on specific adsorption (Sa) in units of g/cm² for NaCl solutions of various concentrations, ranging from 1 g NaCl + 100 ml H_2O to 5 g NaCl + 100 ml H_2O. Using both the adsorbed masses and the specific adsorptions, it was possible to illustrate the number of grains or NaCl crystals, ranging from 0.1 mm to 0.2 mm, on a surface area of 1 cm². Additionally, with the help of an analytical balance, it was possible to determine the range of crystal numbers across different NaCl solution concentrations on a surface area of 1 cm².



5.4.7.8.2.7 Figure 381: Number of NaCl crystals at different concentrations

Figure 381 shows the number of NaCl crystals at different concentrations on a surface area of 1 cm^2. Additionally, it displays the range of crystal numbers (see the right side of the figure). It can be observed that the number of crystals increases linearly with higher concentrations of NaCl solutions, following a linear mathematical function $Y = 8x$. Slight deviations from linearity are possible (e.g., combinations of 10, 13, 21, 28, and 39 crystals).

This result was obtained through measurements of numerous adsorption masses and specific adsorptions (g/cm^2) at various NaCl solution concentrations (34 series, with five different concentrations each = 170 measurements), as well as weighing the crystals using an analytical balance. This provided a fairly good insight into the organization of NaCl particles, both within the solution and on the filter strip.

It was found that the greatest amount of NaCl is adsorbed in the first third of the filter strip (with an area of 4.8 cm^2), followed by the second third, and the least amount is adsorbed in the last third (each also 4.8 cm^2 in area). If we were to determine the specific adsorptions of NaCl for each third, we would gain even more detailed insight into the distribution of NaCl particles in solutions of varying concentrations.

First, using the analytical balance, we could indirectly determine the number of crystals adsorbed in each third. Then, through simple calculations, we could determine the number of ions in a single crystal with a size ranging from 0.100 mm to 0.200 mm. To do this, we need the mass of a single crystal (e.g., 0.100 mm in size), the known molecular mass (M = 58.4 g/mol), and Avogadro's number (Na = $6.023 \cdot 10^{23}$).

First, we calculate the number of moles by dividing the actual mass of the NaCl crystal by its molecular mass. The result is then multiplied by Avogadro's number to obtain the number of NaCl ions in a single crystal of 0.100 mm.

To illustrate this, we will use an example with a solution concentration of 5 g NaCl + 100 ml H_2O, where, using a modified paper chromatography method and gravimetric analysis, we measured the adsorption masses for individual thirds of the surface area (S = 4.8 g/cm^2).

$m_{a1/3}$ = 7,8 mg = 0,0078 g; S_{13} = 4,8 g/cm^2; $S_a=\frac{m_a}{S_{13}}=\frac{(0{,}0078\,g)}{(4{,}8\,cm^2)}=0{,}0016\frac{g}{cm^2}$

$m_{a2/3}$ = 6,2 mg = 0,0062 g; S_{23} = 4,8 g/cm^2; $S_a=\frac{m_a}{S_{23}}=\frac{(0{,}0062\,g)}{(4{,}8\,cm^2)}=0{,}0013\frac{g}{cm^2}$

$m_{a3/3}$ = 0,2 mg = 0,0002 g; S_{33} = 4,8 g/cm^2; $S_a=\frac{m_a}{S_{33}}=\frac{(0{,}0002\,g)}{(4{,}8\,cm^2)}=4{,}17\cdot 10^{-5}\frac{g}{cm^2}$

For a single crystal measuring 0.100 mm, let us assume that 40 crystals weigh 0.0010 g. This means the mass of one small NaCl crystal is 0.0004 g. Next, we simply divide this mass by the molecular mass of NaCl, which is 58.4 g/mol.

$$ML=\frac{m_{kNaCl}}{M_{Nacl}}=\frac{(0{,}0004\,g)}{(58{,}4\frac{g}{mol})}=6{,}85\cdot 10^{-6}\,moles$$

The result we obtained was $6.85 \cdot 10^{-6}$ moles. We simply multiply this value by Avogadro's number.

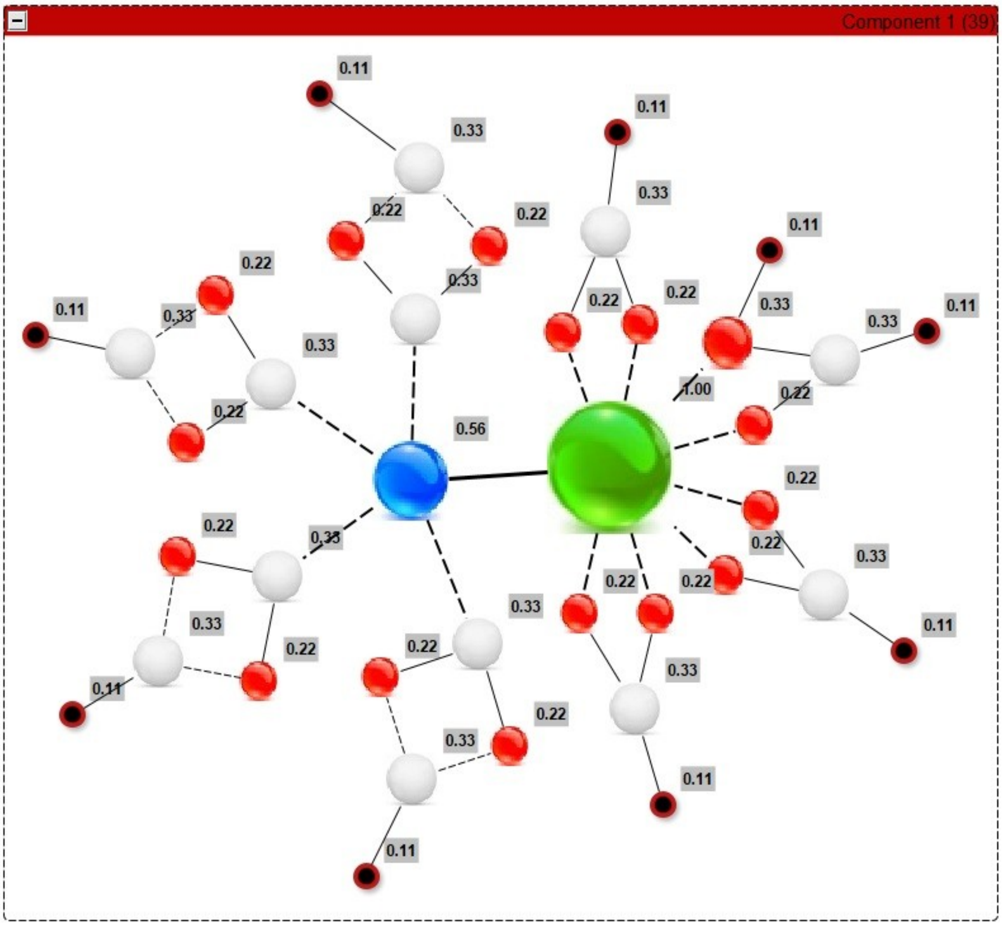
$$N_i=ML\cdot N_a=6{,}85\cdot 10^{-6}\cdot 6{,}023\cdot 10^{23}=41{,}36\cdot 10^{17}\,ions$$

A single NaCl crystal with a mass of 0.0004 g contains $41.36 \cdot 10^{17}$ ions, which means it includes approximately $20.63 \cdot 10^{17}$ Na^+ cations and $20.63 \cdot 10^{17}$ Cl^- anions. The third third of the surface contains the lowest number of ions, around $10.32 \cdot 10^{17}$ ions; the second third contains $31.98 \cdot 10^{18}$ ions; and the first third contains around $40.23 \cdot 10^{18}$ ions. These are extremely high numerical values that are difficult to model.

This can be simplified by abstracting the exponents and rounding the base numbers to values such as 2 ($20.63 \cdot 10^{17}$), 32 ($31.98 \cdot 10^{18}$), and 40 ($40.23 \cdot 10^{18}$). For better resolution and clarity, these ions can be placed on the surface of individually enlarged thirds, allowing us to clearly display or model the organization of the ions. Thus, on the surface of the first third there are 40 ions (20 cations and 20 anions), on the second third there are 32 ions (16 cations and 16 anions), and on the third third there are 2 ions (one cation and one anion).

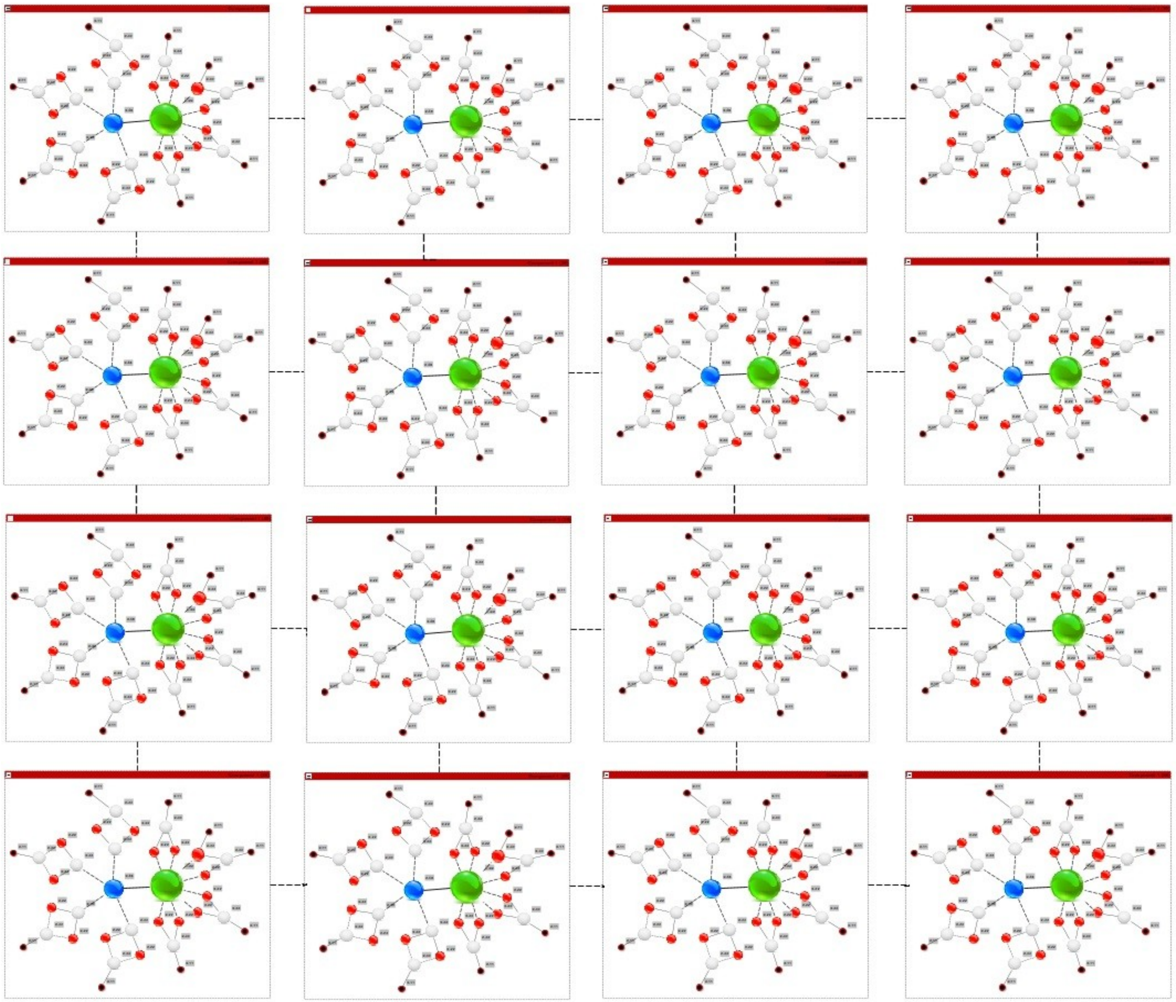
We base this on the previously mentioned assumption that the tendency of NaCl ions in solution to form a cubic structure generally does not change, as NaCl remains in the form of (elastic) microcrystals surrounded by water molecules. Furthermore, it has been found that the adsorbed masses of NaCl from solutions ranging from 1 g NaCl + 100 ml H_2O to 5 g NaCl + 100 ml H_2O increase almost linearly, or even linearly, following the function $Y = 8x$. This somewhat coincides with the number of vertices or nodes in a geometric cube (eight vertices, 12 edges, and six faces).

The structure of ion organization in NaCl solution and on the filter paper strip can therefore resemble a more or less deformed cubic structure. NaCl microcrystals—and consequently the ions surrounded by water molecules—expand and contract alternately, leading to processes of disintegration into smaller microcrystals and aggregation into larger ones. In short, there is a dynamic organization of both NaCl ions and water molecules, which would ideally be presented through a dynamic simulation. In this section, however, only static models will be shown. First, we will look at the organization of ions on the surface of the third third.



5.4.7.8.2.8 Figure 382: Organization of ions on the surface of the third third

Figure 382 shows the organization of ions on the surface of the third third of the filter paper strip, which also proportionally reflects the organization of these ions in the NaCl solution. The black circles outlined in red represent the endpoints (or terminations) of ionic polar bonds, as the connections between water molecules continue beyond these circles. The values between the connections indicate the number of linked edges. Based on this, we can proceed to model the ions in the second and first thirds of the filter paper strip.



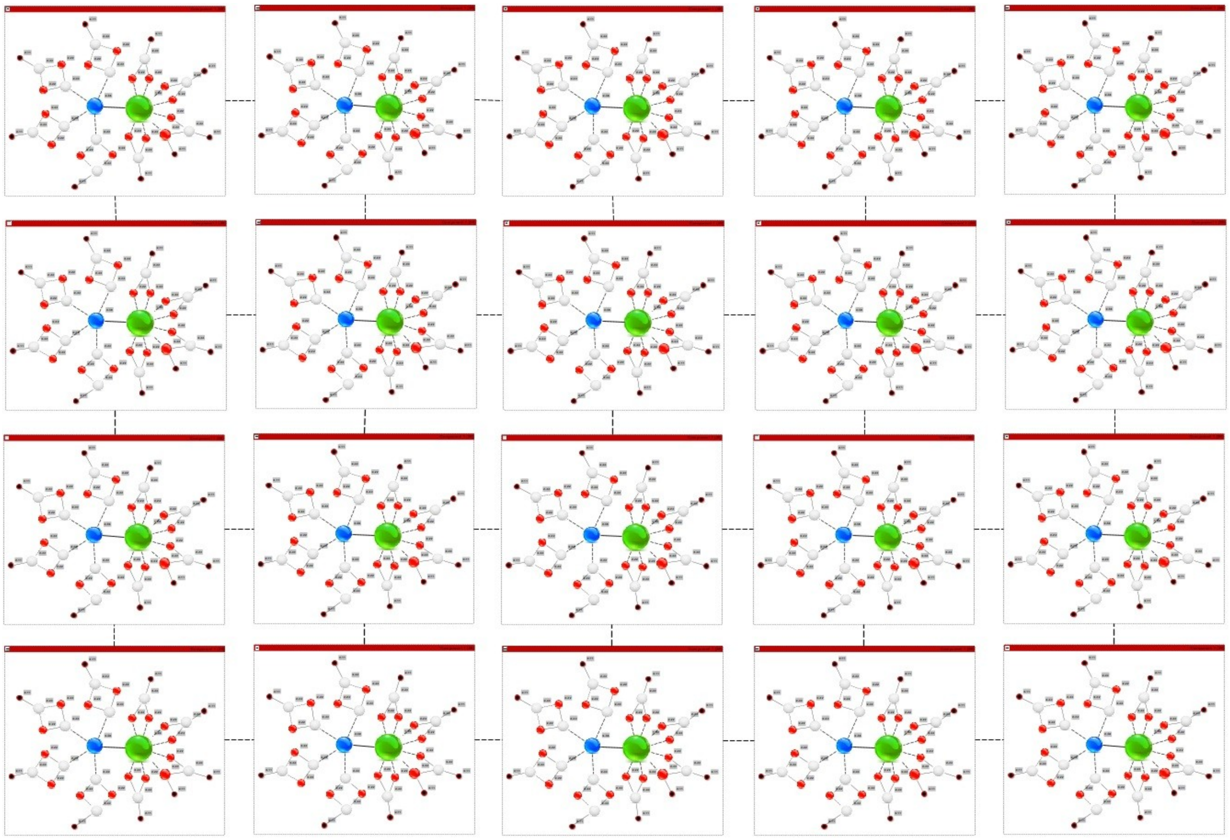
5.4.7.8.2.8.1 Figure 383: Organization of ions on the surface of the second third

Figure 383 shows the organization of NaCl ions on the surface of the second third of the filter paper strip. The ions are arranged in a cubic-like structure with 16 nodes (2 × 8). Each group of ions (see red-and-white clusters) is loosely connected via bridges formed by water molecules, which contributes to a collective conductivity effect and potentially to the generation of electrical energy.

It can be observed that the original cubic structures of solid NaCl crystals have been more or less preserved (see the clusters and ion arrangement), but we are now dealing with a heterogeneous network of NaCl ions and water molecules with a tetrahedral structure. This characteristic results in a new quality defined by quantitative collective effects.

The ions are generally distributed evenly across the entire surface, but with slight horizontal sinusoidal-like displacements, likely due to the uneven surface texture of the filter paper. The ions have considerable space, allowing for relative mobility, although they remain constrained by the paper substrate.

The ion distribution on the filter paper acts as a snapshot of the state within the chromatography chamber, where the solution contains NaCl ions and water molecules. As the solution travels along the filter paper, the initial layers of water molecules overlap with NaCl ions, which remain loosely associated with water molecules until the area of the third third is reached. There, water molecules dominate, and NaCl ions—relative to the surface area of 4.8 cm^2—appear only in trace amounts.



5.4.7.8.2.8.2 Figure 384: Organization of ions on the surface of the first third

Figure 384 shows the organization of ions on the surface of the first third of the filter paper strip, where we again observe numerous repeating patterns of NaCl ions surrounded by shells of water molecules. This loose yet stable assembly holds significantly greater potential for electrical energy generation, as the collective effects of the ionic polar bonds are much stronger here.

The higher the concentration of NaCl ions in water, the more frequently these basic motifs of loose yet stable assemblies of ionic polar cells repeat. These repeated patterns further enhance the collective effect in the direction of conductivity, and thus contribute to a greater potential for generating electrical energy.

This phenomenon can be conditionally compared to plants—such as various trees with numerous branches and leaves, or ivy. Ivy, in particular, is especially interesting in this context, as it utilizes solar energy very efficiently throughout all seasons. The secret lies in its leaves, which exchange nutrients in the form of minerals, water, and solar energy. Ivy also features many repeating motifs, which ultimately result in a powerful collective effect, enabling the plant to grow impressively fast —both vertically and across the ground. This plant is highly expansive, primarily due to the collective structure of its leaf cells or units. It represents a hierarchically associative and stable assembly that adapts well even to less favorable environmental conditions. Similar to crystals, it expands wherever there is enough space.

Based on this premise, the following section will present measurements of the conductivity of NaCl solutions of varying concentrations—from 1 g NaCl + 100 ml H_2O to 10 g NaCl + 100 ml H_2O— and finally the measurement of conductivity in a supersaturated NaCl solution.

5.4.7.8.2.9 Figure 385: Measurement of NaCl solution conductivity

Figure 385 shows the measurement of conductivity in NaCl solutions. Conductivity was measured for solutions with various concentrations, ranging from 1 g NaCl + 100 ml H_2O to 10 g NaCl + 100 ml H_2O. Finally, the conductivity of a supersaturated NaCl solution was also measured. The results are presented in the following table.

5.4.7.8.2.9.1 Table 178: Conductivities of different concentrations of NaCl solutions

Concentrations of solutions. NaCl (g+100 ml H_2O)	χ (mS)	T (°C)
1	17.85	20.5
2	33.9	20.5
3	48.5	21
4	62.2	20.9
5	75.6	20.4
6	87	22.2
7	99.3	22.4
8	111	21.8
9	121.7	22
10	132.3	21.8
Additional excess NaCl to a saturated solution	230	21.6

Table 178 shows the measured values of conductivity and temperature for NaCl solutions of varying concentrations, ranging from 1 g NaCl + 100 ml H_2O up to 10 g NaCl + 100 ml H_2O. An additional measurement was taken for a saturated NaCl solution (35.5%) with a slight excess (around 38%).

It is immediately noticeable that conductivity values increase almost linearly with concentration (Y = 12x + 15), measured in millisiemens (mS). This somewhat corresponds to the number of NaCl crystals per surface area (Y = 8x). However, for the saturated solution with excess NaCl, the measured conductivity (230 mS) is lower than what would be expected for a hypothetical 20 g NaCl + 100 ml H_2O solution. These results confirm that once a solution becomes saturated, additional salt reduces conductivity.

If the conductivity of the supersaturated solution is added to the dataset, the graph becomes no longer fully linear (Y = 29.47x + 102.9), which would apply only if we consider concentrations from 11 g + 100 ml H_2O and up to saturation. A saturated (or near-saturated) NaCl solution may offer the highest potential for generating electrical energy.

In this context, one cannot overlook the revolutionary invention of the battery by Italian physicist Alessandro Volta. He used copper and zinc plates arranged in a stack, with pieces of cloth soaked in saltwater placed between them. An aluminum plate was used as a base for the voltaic pile. In combination with metals, NaCl ions produced an electric current that increased as the height of the stack increased. Various alternative designs of batteries are possible.

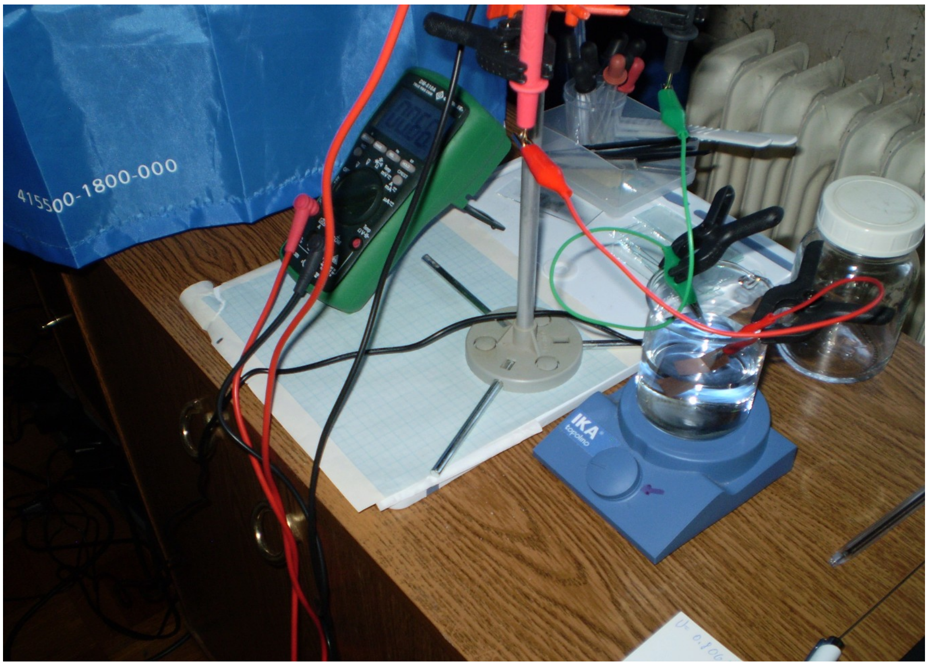
This section will also include conductivity measurements for seawater salt solutions from 1 g NaCl + 100 ml H_2O up to 5 g NaCl + 100 ml H_2O. Seawater salt is a heterogeneous mixture of different chemical compounds, primarily NaCl, but it also contains other strong electrolytes such as potassium chloride, calcium chloride, magnesium chloride, sulfates, borates, bromides, iodides, fluorides, and silicates. The hierarchical associative network of polar water molecules and ions in a seawater salt solution may differ significantly from that of table salt. This is because, in addition to NaCl ions and their hydration shells, other polar ionic bonds exist in the solution.

Does this imply a different ion organization and interaction with water molecules, potentially resulting in a distinct collective effect on conductivity and the ability to generate electricity? This question can only be answered through experimental measurements.

Based on the measured conductivity values for seawater salt solutions of various concentrations, the results appear almost identical to those obtained with table salt solutions. The dominant presence of NaCl ions in seawater seems to prevent significant deviations in conductivity compared to standard kitchen salt solutions. Thus, the hierarchical associative structure of water and ions in seawater salt behaves similarly in terms of conductivity.

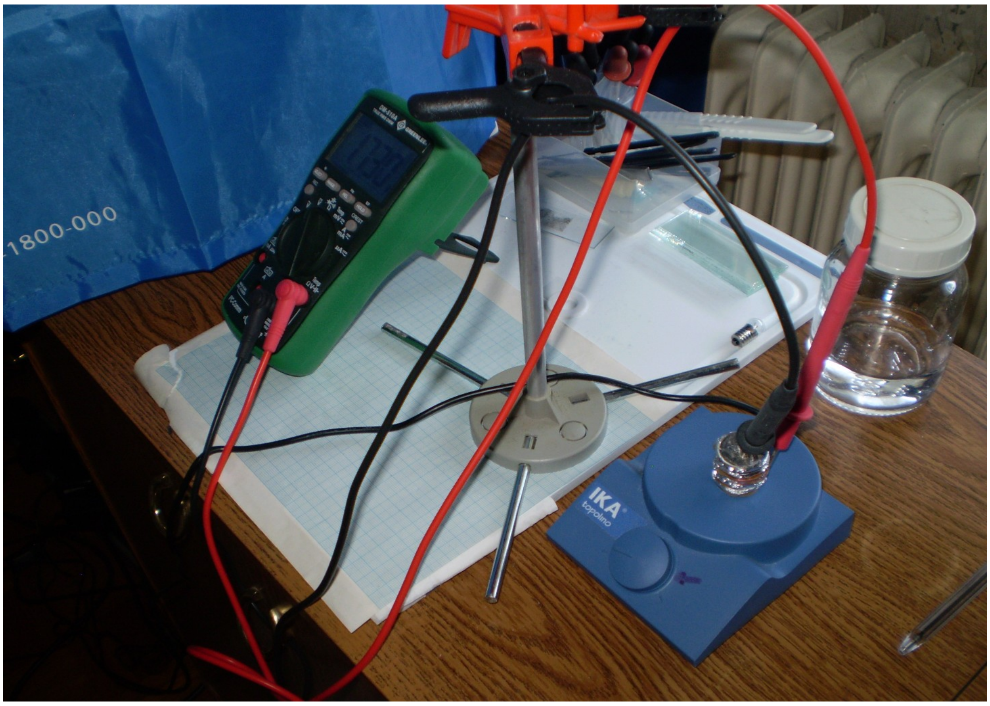
As a next step, a battery should be constructed using cloths soaked in a 5 g NaCl + 100 ml H_2O solution. The metallic parts of both batteries could be made from euro five-cent coins and aluminum coins, with aluminum foil serving as the base.[246] The intermediate paper layers will consist of coffee paper filters, which need to be cut to the appropriate circular size, matching the diameter of five-cent coins. Before this test, a simpler experiment will be conducted using a NaCl solution of the same concentration and copper and zinc electrodes. A multimeter will then be used to first measure the voltage, followed by the current.

246 A five-cent coin is composed of 75% copper, 20% nickel, and 5% zinc.



5.4.7.8.2.9.2 Figure 386: Measurement of voltage and current for NaCl solution

Figure 386 shows the measurement of resistance and current for a NaCl solution with a concentration of 5 g NaCl + 100 ml H_2O. The red crocodile clip cable was connected to the copper plate, while the green cable was connected to the zinc plate. The other ends of both crocodile clip cables were connected to the electrodes of the multimeter. The multimeter was first set to the voltage setting, and a value of 0.806 V was measured. After this measurement, the multimeter was switched to the milliampere (mA) setting. The device measured a weaker current of 0.54 mA. It is clear that a higher number of metal cells would result in higher values for both voltage and current. In the next experiment, the previously mentioned battery model will be tested. A paper soaked in saltwater was placed on a five-cent coin, followed by an aluminum coin, thus establishing the first battery cell. This procedure was repeated four more times, resulting in five battery cells. The black or COM electrode of the multimeter was placed on top of the aluminum coin, while the red electrode was placed on the bottom five-cent coin. First, the voltage was measured, which was around 2.083 V. Then, the current in milliamperes (mA) was measured, which was 1.50 mA. A figure illustrating this procedure follows for better clarity.



5.4.7.8.2.9.3 Figure 387: Measurement of voltage and current for a small battery stack

Figure 387 shows the measurement of voltage and current for a small battery stack, which was described on the previous page. As expected, the results were much better, as both the voltage and current increased significantly. If the concentration of the NaCl solution had been considerably higher, even greater values of voltage and especially current would have been obtained. Based on the conductivity data of the NaCl solution and the voltage, we can calculate the current using the known mathematical formula:

$$R=\frac{U}{I}=I=\frac{U}{R}=I=\frac{U}{\left(\frac{1}{\chi}\right)}=I=U\cdot\chi$$

Basically, we simply multiply the voltage (U) by the conductivity value (χ), which gives us the current in milliamps or amps. Indicators such as conductivity, resistance, voltage, and current are closely related, so it would be possible to estimate a certain hierarchical associative network of polar ionic bonds based on conductivity and resistance, in terms of the associative strength of collective effects. Higher values of conductivity would indicate greater associative strength of collective effects, while resistance values would indicate the hierarchical strength of polar ionic bonds. Conductivity represents the mobility of polar water molecules and ions, while resistance signifies a more fixed state, especially expected from polar water molecules in solutions of various concentrations (e.g., NaCl, KCl, $CaCl_2$, $CuSO_4 \cdot 5H_2O$, $FeSO_4 \cdot 7H_2O$). The conductivity of NaCl solutions is particularly dependent on ion concentration and temperature, as both higher ion concentration and higher temperature increase conductivity. However, at very low ion concentrations of NaCl in aqueous solutions, the effect of increased temperature is negligible. Increased conductivity should also be influenced by the dynamic electromagnetic field.[247] A similar effect is expected to be caused by a stronger magnetic field, which, in addition to increasing conductivity, also raises the pH of a given electrolyte solution.[248] The influence of the electromagnetic field on NaCl solutions with the aim of obtaining a greater amount of electrical energy is therefore possible. In short, it involves induced conductivity, which most likely does not have a permanent effect and is mainly dependent on the dynamics of the electromagnetic and/or magnetic field. This is a key characteristic of many types of induction: their strength gradually decreases and eventually disappears once the dynamics cease (for example, when a plastic rod is charged, it attracts hair, but if there is no recharging, this attractive effect fades relatively quickly). Without the continuous influence of the dynamics of the electromagnetic and/or magnetic field on a specific NaCl solution, it is not possible to achieve a permanent effect of increased conductivity. From these considerations, we move on to the vital importance of NaCl for many living organisms. NaCl is an essential nutrient that the body cannot produce on its own. It plays a crucial role in regulating many bodily functions and is found in bodily fluids that transport oxygen and nutrients. NaCl is also important for maintaining overall fluid balance in the body. If electrolyte levels are too low or too high, dehydration or excessive hydration can occur in many living beings, including humans. Sodium enables the transmission of nerve impulses throughout the body as an electrolyte, similar to potassium, calcium, and magnesium, which regulate the electric charges moving in and out of cells in the body. It controls our taste, smell, and tactile processes. The presence of sodium ions is essential for muscle contraction, including the heart. It is fundamental for the functioning of signals to and from the brain. Without sufficient sodium, senses and nerves would be highly dysfunctional. Chlorine is also important, as it is essential for good health and is a key element in the digestive process. It helps maintain acid-base balance in the body and assists in potassium absorption. It enables the existence of hydrochloric acid in gastric juices, which helps break down food. Additionally, it controls the level of bacteria in the stomach and strengthens the blood's ability to transport carbon dioxide from respiratory tissues to the lungs. Sodium plays a role in regulating blood pressure and volume in the body. Sodium (Na^+) and chloride (Cl^-) are the main ions in the extracellular space, which includes blood plasma, interstitial fluid (fluid between cells), and transcellular fluid (e.g., cerebrospinal fluid, synovial fluid). As such, they play a key role in many

247 Li, N., Chai, F., Chen, L., & Cheng, S. K. (2011). Effect of rotating electromagnetic field on the conductivity of aqueous NaCl solution. *Advanced Materials Research*, 391-392, 1080–1084. https://doi.org/10.4028/www.scientific.net/amr.391-392.1080.

248 Wu, T., & Brant, J. A. (2020). Magnetic field effects on ph and electrical conductivity: Implications for water and wastewater treatment. *Environmental Engineering Science*, 37(11), 717–727. https://doi.org/10.1089/ees.2020.0182.

processes that sustain life. Sodium and chloride are electrolytes that help maintain differences in concentration and charge across cell membranes. Potassium (K^+) is the main positively charged ion (cation) inside cells, while sodium is the main cation in extracellular fluid. Potassium concentrations inside cells are about 30 times higher than outside, while sodium concentrations inside cells are more than 10 times lower than outside cells. The concentration differences of potassium and sodium across cell membranes create an electrochemical membrane potential, which is maintained by ion pumps. Tight control of the membrane potential is crucial for nerve impulse transmission, muscle contraction, and heart function.[249] NaCl in humans accounts for approximately 0.4% of body weight, with levels in the blood ranging from 45 g to 50 g (approximately 9 g/l). Excessive or insufficient amounts of NaCl in the blood can lead to the undesired shortening of the lifespan of red blood cells.[250] Sodium chloride, dissolved in waters around the world, is also of crucial importance for oxygen production, without which most living organisms would not be able to survive. Furthermore, sodium chloride, dissolved in oceans and seas, contributes to the optimal mass balance of the Earth, as a sudden decrease in the mass of this substance could lead to an increase in the number of major natural disasters, such as volcanic eruptions, hurricanes, extreme temperature drops, and earthquakes. In short, without sodium chloride dissolved in water, our natural hierarchical associative system would not be what we know it to be. We will now continue with a subsection on the chemical compound potassium chloride (KCl), which has a similar structure and properties to sodium chloride (NaCl).

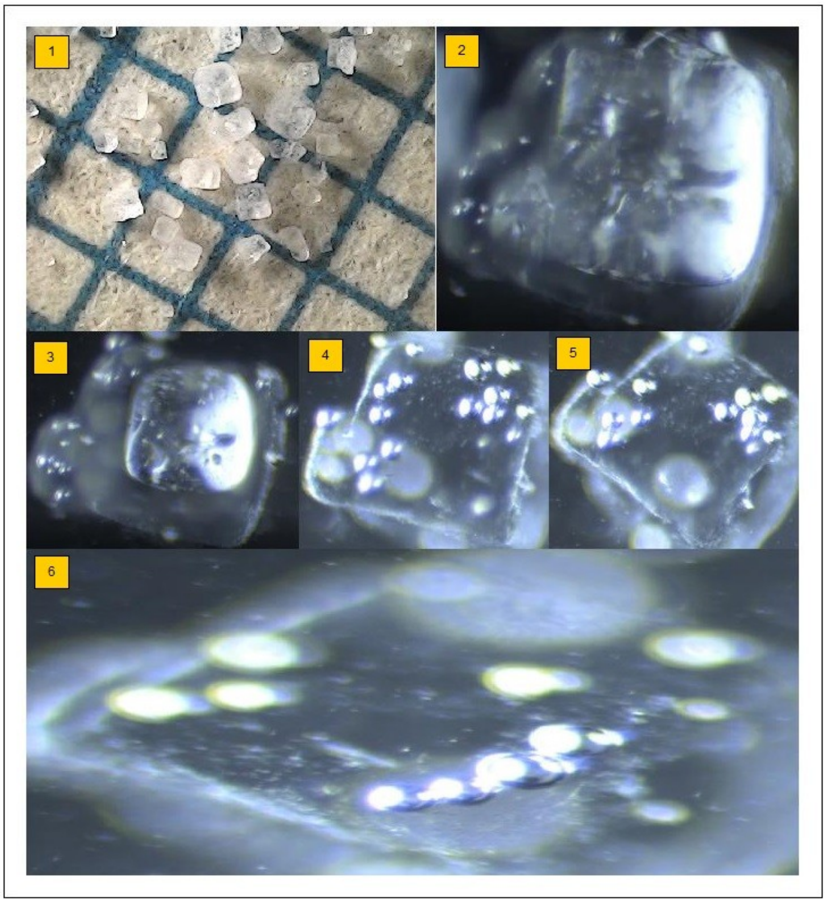
5.4.7.8.3 Potassium chloride

Potassium chloride, like sodium chloride, is a chemical compound with an ionic bond and a similar cubic crystal structure. The key difference between their crystal structures lies in the fact that potassium ions are larger than sodium ions, which can be explained based on atomic masses and electropositivity (the potassium ion is smaller than the chloride ion). Potassium chloride (74.55 g/mol) has a higher molar mass than sodium chloride (58.44 g/mol). This is also why KCl is highly soluble in water (344 g/l at 20 °C), although slightly less so than NaCl (359 g/l at 20 °C). The distances between potassium and chloride ions are greater (3.15 Å or $3.15 \cdot 10^{-10}$ m) than those between sodium and chloride ions (2.81 Å or $2.81 \cdot 10^{-10}$ m), which means that less energy is required to break the ionic bond in KCl. This is also evident in the melting points of the two

249 Part of the description about the importance of NaCl for life was prepared based on various online sources such as https://lpi.oregonstate.edu/mic/minerals/sodium (2022-05-19), https://www.healthline.com/health/sodium-chloride (2022-05-19), https://saltassociation.co.uk/education/salt-health/salt-function-cells/ (2022-05-19), https://www.chemicalsafetyfacts.org/sodium-chloride/ (2022-05-19) idr.

250 Goodhead, L. K., & MacMillan, F. M. (2017). Measuring osmosis and hemolysis of red blood cells. *Advances in Physiology Education*, 41(2), 298–305. https://doi.org/10.1152/advan.00083.2016.

compounds: KCl melts at 776 °C, while NaCl melts at 801 °C, indicating that the crystal structure of NaCl is more stable than that of KCl. Additionally, the density of NaCl crystals is higher (2.16 g/cm³) compared to KCl (1.98 g/cm³).[251] In essence, the differences between these two chemical compounds with very similar cubic crystal lattice structures are relatively minor, but these small differences lead to significantly different properties. This subsection will describe several experiments conducted with NaCl solutions of varying concentrations. The first experiment will involve observing the dissolution of fine KCl crystals in two drops of distilled water.



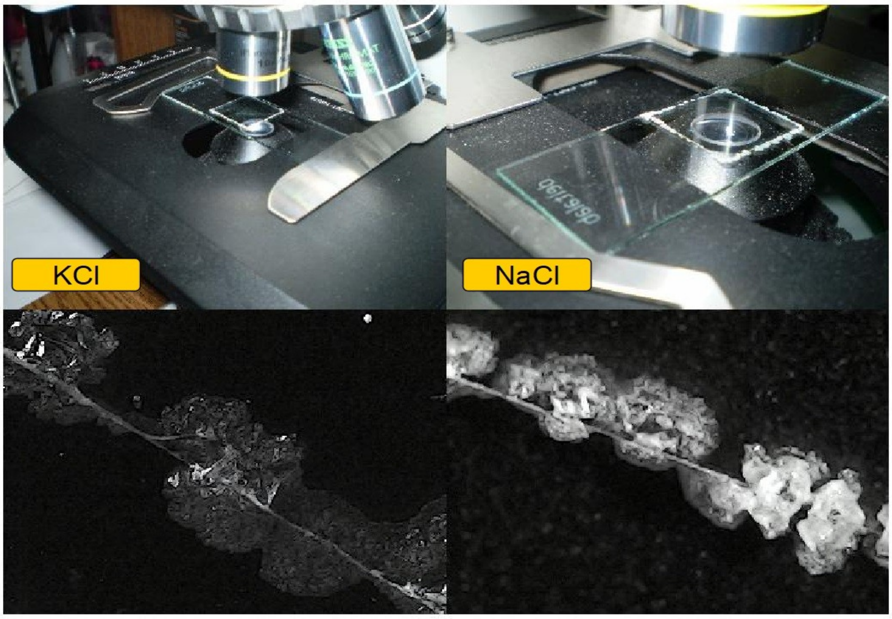
5.4.7.8.3.1 Figure 388: Dissolution of small (less regular) cubic KCl crystals in water

Figure 388 shows small KCl crystals and the stages of their dissolution in two drops of water under a light microscope. In the upper right part of the image, marked as 1, it is evident that KCl crystals have a less regular shape and appear somewhat more opaque compared to NaCl crystals. The way KCl crystals dissolve in two drops of distilled water differs significantly, and the captured images are less clear. Additionally, the dissolution time for these small crystals is considerably longer, and droplets or bubbles tend to merge together—something not observed during the dissolution of NaCl crystals.

251 Data obtained using the ChemSpider database http://www.chemspider.com/Chemical-Structure.4707.html?rid=e68957c3-efb3-4ffc-8489-edeec580db13 (2022-06-21).

In principle, the dissolution process of both NaCl and KCl crystals is essentially the same, as water molecules surround the potassium cations and chloride anions in both cases. In their solid state, like NaCl, KCl does not conduct electricity because the ions within the crystal lattice are relatively immobile, even though the distances between K^+ and Cl^- ions are greater than in NaCl.

As previously mentioned, the crystal lattice structure of KCl is extremely similar to that of NaCl, so a detailed illustration of the KCl lattice will be omitted in this subsection. The following crystallization experiment, performed under a light microscope, will demonstrate the differences in the process and formation of crystals between the two chemical compounds (KCl/NaCl). Under the cover glass, the water evaporates, leading to crystal formation at the edges of the glass.

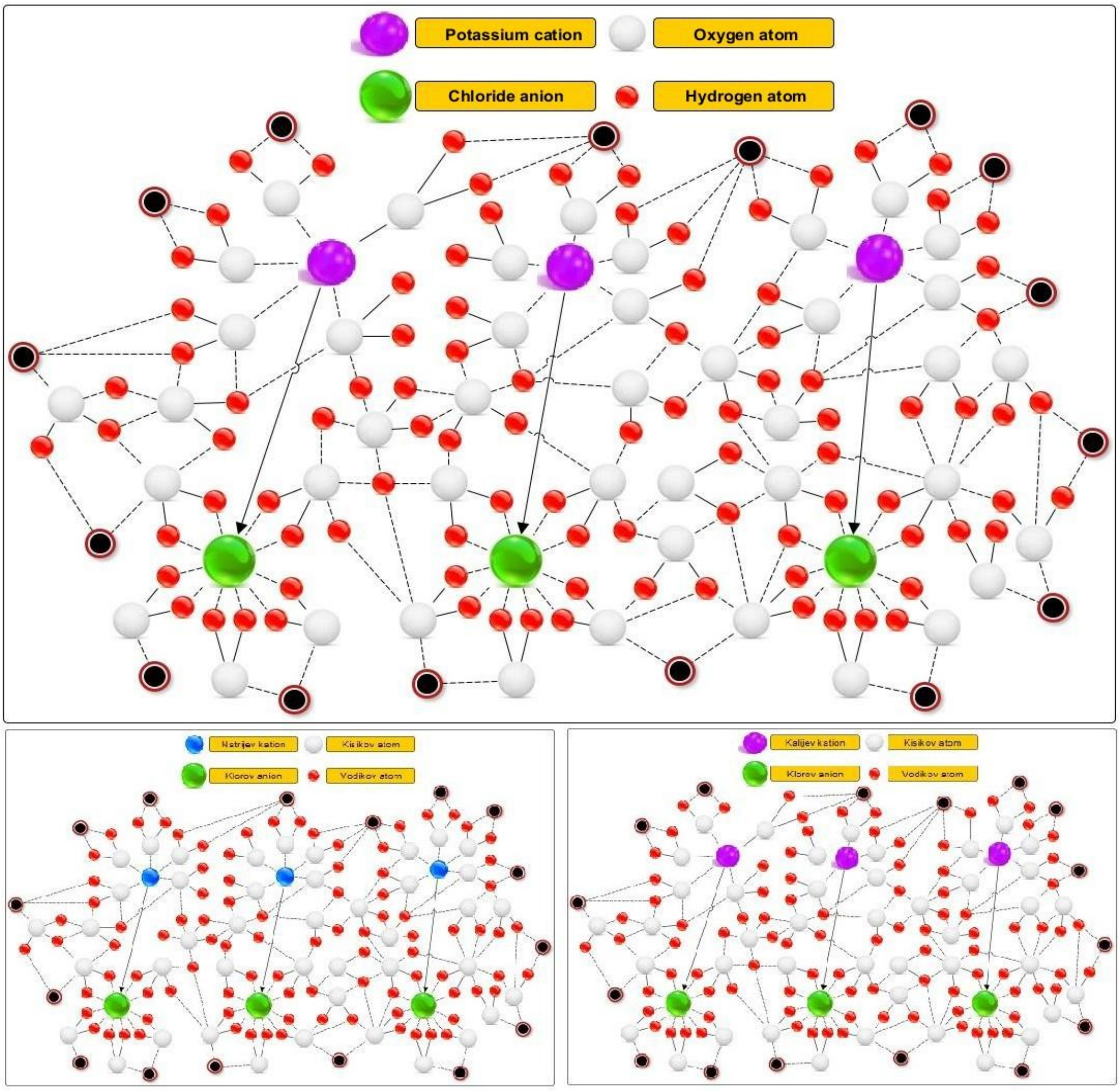


5.4.7.8.3.2 Figure 389: Crystallization of KCl and NaCl under the microscope

Figure 389 shows the crystallization of both KCl and NaCl micro-solutions under a light microscope, highlighting an important difference between the two crystallization processes. The crystallization of KCl under the cover glass takes significantly longer (several hours) compared to NaCl (half an hour to one hour). Additionally, the density of NaCl crystals near the cover glass is much higher than that of KCl, which can be attributed to the fact that the hydration energy of NaCl is greater than that of KCl.[252] It is also known that KCl is somewhat more hygroscopic than NaCl, meaning it absorbs moisture from the air more readily. At this point, it would be useful to examine the lattice structure of potassium and sodium ions surrounded by polarized water shells. The dissociation of KCl in water follows the same principle as that of NaCl, with a very similar lattice

252 Chindapan, N., Niamnuy, C., & Devahastin, S. (2018). Physical properties, morphology and saltiness of salt particles as affected by spray drying conditions and potassium chloride substitution. *Powder Technology*, 326, 265–271. https://doi.org/10.1016/j.powtec.2017.12.014.

structure—except that the distances between potassium cations and chloride anions are slightly greater.
This increased distance between the ions is also the reason why the bond strength between them is somewhat weaker than that between sodium and chloride ions. It's important to note a key difference: potassium ions are slightly larger than sodium ions, which means the size difference between potassium and chloride ions is smaller. This size relationship contributes to a slightly more asymmetric potential in the polar ionic lattice structure.
Additionally, potassium ions may exert a slightly weaker influence on the water molecules surrounding the chloride anions, due to the greater distance between them compared to the polar ionic lattice structure in NaCl. This difference is not offset by the slightly larger diameter of potassium cations. The lattice structure affects various physical properties, especially solution density, solubility, boiling point, and others.



5.4.7.8.3.3 Figure 390: Fragment of the water molecule network with KCl ions and a comparison between NaCl and KCl lattice structures

Figure 390 shows a fragment of the network formed by water molecules and KCl ions (see the upper part of the image), along with a comparison between the polar ionic lattice structures of NaCl and KCl (see the lower part of the image).

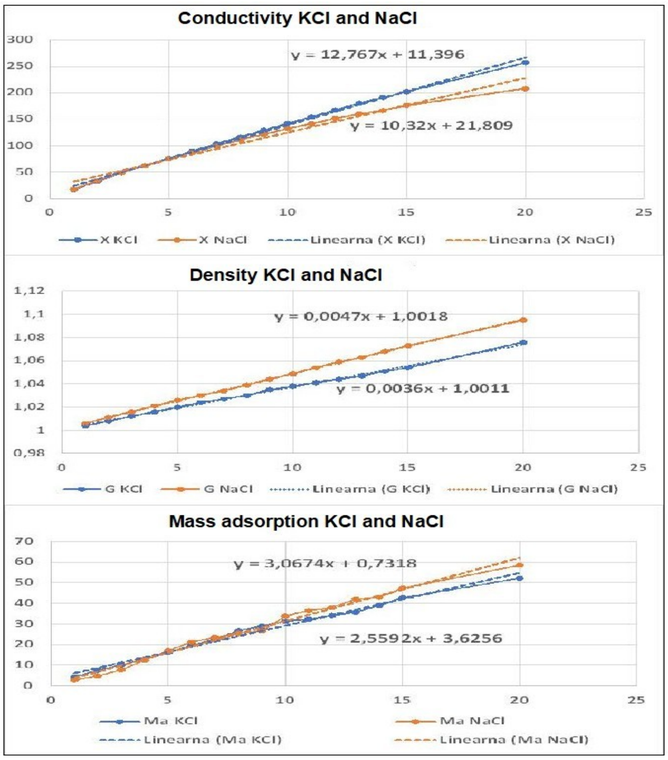
Further measurements of conductivity, density, and mass adsorption on filter strips with a surface area of 4.8 cm², for solutions ranging in concentration from 1 g NaCl/KCl + 100 ml H_2O to 20 g NaCl/KCl + 100 ml H_2O, revealed that the greater distance between K^+ and Cl^- ions contributes significantly to the relatively large differences observed in the measured values.

These greater K^+–Cl^- distances essentially allow for greater mobility of the surrounding water molecules. While their behavior is generally similar to that in NaCl solutions, there is a key difference: the influence of K^+ on the hydration shell around Cl^- is slightly weaker than that of Na^+, allowing water molecules to more strongly assert their own structural tendencies.

The end result of these small differences in ionic distance and size is the emergence of significantly different collective effects in the form of conductivity, density, and mass adsorption on the filter strips. The following section will present the measurements of conductivity, density, and mass adsorption for various concentrations of KCl and NaCl solutions.

5.4.7.8.3.3 Table 179: Conductivity, density and mass adsorption measurements of different concentrations of KCl and NaCl solutions

C	*χ KCl*	*T KCl*	*ρ KCl*	*Ma KCl*	*χ NaCl*	*T NaCl*	*ρ NaCl*	*Ma NaCl*
1	17.05	23.7	1	4.3	17.85	20.5	1.01	2.8
2	32.9	23.3	1.01	7.5	33.9	20.5	1.01	4.8
3	48.1	23.4	1.01	10.2	48.5	21	1.02	7.75
4	62.3	23	1.02	13	62.2	20.9	1.02	12.5
5	76.1	23	1.02	16.1	75.6	20.4	1.03	17.1
6	89.7	23.2	1.02	19.7	87	22.2	1.03	21.2
7	103.4	23.1	1.03	22.5	99.3	22.4	1.03	23.5
8	116.3	24	1.03	26.8	111	21.7	1.04	25.5
9	129.4	23.7	1.04	28.9	121.7	22	1.04	26.6
10	142.1	23.3	1.04	31.3	132.3	21.8	1.05	33.9
11	154.4	24.9	1.04	32.3	141.9	22	1.05	36.5
12	167.4	23.5	1.04	34.1	151.4	22.4	1.06	38
13	180.5	22.7	1.05	35.7	160.5	23.7	1.06	42.1
14	191	24	1.05	39	166.4	25.2	1.07	43
15	202	23.9	1.05	42.7	176.2	22.8	1.07	47.4
20	257	23.1	1.07	52.2	208	22.5	1.1	58.5



5.4.7.8.3.3.1 Figure 391: Linear graphs of conductivity, density, and mass adsorption

Table 179 presents the measurement results for conductivity, density, and mass adsorption for KCl and NaCl solutions of varying concentrations (from 1 g + 100 ml H_2O to 20 g + 100 ml H_2O), while Figure 391 illustrates the linear graphs of these measurements.

In all three measurement categories—χ or X (conductivity), ρ or G (density), and Ma (mass adsorption)—a linear increase in values can be observed. For conductivity measurements across different concentrations of KCl and NaCl, the values remain relatively consistent up to a concentration of 8 g KCl/NaCl + 100 ml H_2O. However, more significant differences emerge at higher concentrations, particularly from 9 g to 20 g per 100 ml H_2O.

The conductivity values for KCl solutions continue to increase sharply and linearly, whereas those for NaCl solutions rise more gradually, with noticeable deviations from the trendline (Linear X NaCl). In contrast, the measured conductivity values for KCl solutions align closely with their trendline (Linear X KCl).

As a result, two linear equations were derived:

- For KCl: $y = 12.767x + 11.396$
- For NaCl: $y = 10.32x + 21.809$

The electrical conductivity of a substance indicates its ability to conduct electrical energy, reflecting how freely electric charges can move. Water molecules tend to be highly ordered around NaCl ions, whereas this order is less pronounced around KCl ions. This suggests that Na^+ cations are more strongly hydrated than K^+ cations.[253] This means that in NaCl solutions, compared to KCl, the stronger hydration effect slightly diminishes the strength of the electric charges. In short, the higher the concentration of KCl ions in the aqueous solution, the higher its electrical conductivity will be. In contrast, the electrical conductivity of NaCl increases less steeply due to the stronger attraction—especially between Na^+ cations and the negatively charged oxygen atoms in water molecules—and may even decline slightly relative to the trendline.

In their solid state, neither KCl nor NaCl conducts electricity.

When it comes to density measurements, there is a noticeable difference between KCl and NaCl, especially at higher solution concentrations. At lower concentrations (from 1 g to 5 g of KCl/NaCl + 100 ml H_2O), the density difference is not very pronounced. However, from 10 g/100 ml and above, the difference becomes significant, with NaCl solutions showing considerably higher densities than those of KCl at equivalent concentrations.

The primary significance of density lies in the information it provides about mass, energy, etc., within a given area or volume. In short, it reflects how compact or concentrated a particular measurable property is. Increasing the concentration of salt in water raises the solution's density, which in turn increases the boiling point and surface tension while lowering the freezing point of water. A higher density of dissolved salt (whether KCl or NaCl) also results in greater electrical

253 Du, H., Ozdemir, O., Wang, X., Cheng, F., Celik, M. S., & Miller, J. D. (2014). Flotation chemistry of Soluble Salt Minerals: From ion hydration to Colloid adsorption. *Mining, Metallurgy & Exploration,* 31(1), 1–20. https://doi.org/10.1007/bf03402344.

conductivity of the solution. In every case, it affects the structure of the water molecules themselves, which become increasingly involved with each addition of salt. Another important aspect is that the density of the crystalline structure of both salts changes when NaCl or KCl is added to water. The density of NaCl crystals is 2.176 g/cm³, while the density of KCl crystals is approximately 1.98 g/cm³. When both substances dissolve in water, the density of the solid crystals decreases, and the density of the water increases. Let us take the example of a 10 g NaCl or KCl solution in 100 ml of water:

- Density of 10 g NaCl crystal = 2.176 g/cm³ → 10 g NaCl + 100 ml H_2O → 1.049 g/cm³
- Density of 10 g KCl crystal = 1.98 g/cm³ → 10 g KCl + 100 ml H_2O → 1.038 g/cm³

In the first case, the density decreased by 48.21%, while in the second case, it decreased by 52.42%. The water density increased by 95.33% in the first case and by 96.34% in the second case. In all cases, significant changes in the physical properties of the involved chemical substances were observed.

From the density measurements of various concentrations of KCl and NaCl solutions, we derived two linear equations:

a. For ρ_KCl: --y = 0.0036x + 1.0011

b. For ρ_NaCl: --y = 0.0047x + 1.0018

Additionally, measurements of the adsorbed mass of different KCl and NaCl solution concentrations show a similar pattern of behavior in their polar ionic bonds. Up to a concentration of around 10 g salt + 100 ml H_2O, no significant differences in adsorption between KCl and NaCl solutions were observed. However, at higher concentrations, increasing differences appear, with more NaCl being adsorbed onto the filter strip than KCl.

During adsorption mass measurement, capillary effects involving the solvent, solute, and stationary medium (such as filter paper) play a role. Water (the solvent) travels upward the fastest, dragging salt particles (KCl or NaCl) along the stationary phase, which acts like a series of capillaries or an adsorbent. This is similar to the way plants draw water and dissolved minerals up from the roots through semipermeable membranes to the flowers.

The results show that adsorbed mass is more closely linked to the density of KCl and NaCl solutions: the higher the density, the greater the adsorption on the filter strip. At lower concentrations, this correlation does not hold, as the densities of the salt solutions are not significantly different.

Adsorption is a surface phenomenon in which attractive forces create a symbiosis between the substrate and the adsorbed substance. As a result of the measurements, two more linear equations were obtained:

a. For Ma_KCl: --y = 2.5592x + 3.6256

b. For Ma_NaCl: --y = 3.0674x + 0.7318

In total, six linear equations were derived, expressing the behavior of electrical conductivity, mass concentration in space (density), and adsorbed mass on a given surface. Electrical conductivity is expressed in millisiemens, mass concentration in g/cm^3, and adsorbed mass in g/cm^2.

The main driving factor behind all the measured indicators is the --concentration-- (g/L) of KCl and NaCl solutions. As concentration increases, so do conductivity, density, and adsorbed mass on the filter paper. The second most significant factor is the --density-- of the solutions, as it influences both the increase in conductivity and in adsorption mass. In contrast, --conductivity and adsorption mass do not influence-- the density or concentration of the solutions, nor do they influence each other directly. In summary, conductivity and adsorption mass are --dependent variables--, while concentration is the --independent variable-- in this conditional system.

Density occupies a special position, acting as a kind of synonym for concentration, since an increase in concentration generally also increases the solution's density. The essential difference is that --concentration-- refers to the amount of a substance present in the solvent at a given moment, while --density-- considers this amount in terms of the mass-to-volume ratio of the substance within the solvent. Both are calculated using the same formula, with different symbols:

- Concentration: --C = m/V
- Density: --ρ = m/V

To model the polar ionic bond of a KCl solution, a similar computational approach as with NaCl would be used. First, the number of adsorbed crystals in each third of the filter strip would be determined using an analytical balance. Then, simple calculations would allow determination of the number of ions in a single crystal measuring 0.05 mm.

To do this, we would need the mass of one crystal of 0.05 mm, the molar mass of KCl (M = 74.5513 g/mol), and Avogadro's number (Na = $6.023 \cdot 10^{23}$). First, we calculate the number of moles from the ratio of the crystal's mass to its molar mass. This value is then multiplied by Avogadro's number to obtain the number of ions in one 0.05 mm KCl crystal. Since the number of crystals in each section of the strip is unknown, the model will be simplified and will not be based on adsorption masses in thirds. For one crystal measuring 0.05 mm, we will assume an average mass of 0.0001 g, which represents the actual mass of a fine KCl crystal.[254] In the following, we simply divide this mass by the molecular weight of KCl, which is 74.5513 g/mol.

254 Individual KCl crystals were weighed using a Vibra analytical balance. The average value was 0.0001 g.

$$ML = \frac{m_{kKCl}}{M_{Kcl}} = \frac{(0{,}0001\,g)}{(74{,}5513\,\frac{g}{mol})} = 1{,}34 \cdot 10^{-6}\,moles$$

The result we obtained was 1.34 · 10^{-6} moles. This value is simply multiplied by Avogadro’s number.

$$N_i = ML \cdot N_a = 1{,}34 \cdot 10^{-6} \cdot 6{,}023 \cdot 10^{23} = 8{,}07 \cdot 10^{17}\,ions$$

A single KCl crystal contains a significantly smaller number of ions compared to NaCl. One KCl crystal weighing 0.0001 g (which is four times lighter than a NaCl crystal weighing 0.0004 g) contains approximately 8.07 · 10^{17} ions, meaning there are around 4.035 · 10^{17} K^+ cations and 4.035 · 10^{17} Cl^- anions. As with NaCl, these are extremely high numerical values that are difficult to model directly.

To simplify, we can define a basic unit cell consisting of two ions (K^+ and Cl^-) and one drop of distilled water (which weighs approximately 0.0444 g on average). This approach allows us to model eight KCl ions (by abstracting the exponent and rounding 8.07 to 8). Let’s now calculate the number of polarized atoms in a single drop of distilled water.

$$ML = \frac{m_{kH2O}}{M_{H2O}} = \frac{(0{,}0444\,g)}{(18\,\frac{g}{mol})} = 0{,}0024\,moles$$

Multiply the resulting number of moles by Avogadro's number.

$$N_i = ML \cdot N_a = 0{,}0024 \cdot 6{,}023 \cdot 10^{23} = 14{,}4 \cdot 10^{20}\ polarized\ atoms$$

In a single drop of distilled water, there are significantly more polarized hydrogen and oxygen atoms than there are ions in one KCl crystal measuring 0.05 mm. Similar to the NaCl solution model, we begin with the assumption that the tendency of KCl ions to form a relatively cubic structure in solution generally remains unchanged. KCl still exists in the form of (elastic) microcrystals surrounded by water molecules.

The adsorbed masses of KCl from solutions ranging from 1 g KCl + 100 ml H_2O to 20 g KCl + 100 ml H_2O increase according to the previously shown linear function:

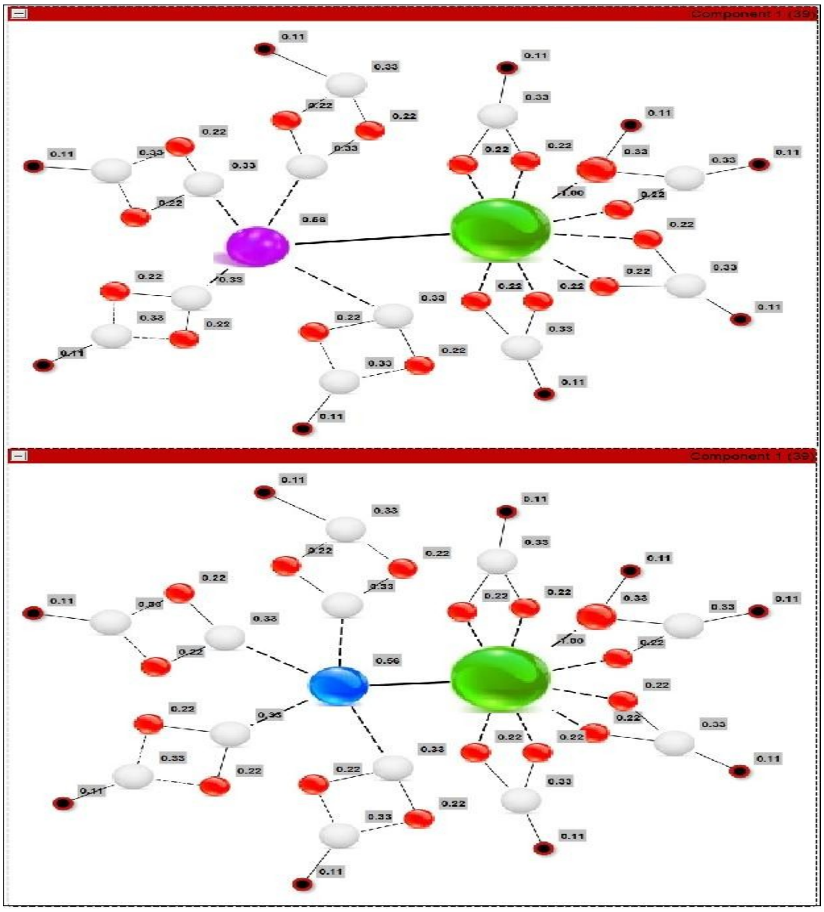
y = 2.5592x + 3.6256

(for NaCl, the corresponding linear function is y = 3.0674x + 0.7318).

Similarly, the trends for conductivity and density are also linearly increasing. The KCl microcrystals, and consequently the ions surrounded by water molecules, repeatedly expand and contract, leading to processes of disintegration into smaller microcrystals and subsequent reaggregation into larger ones. In short, this represents a dynamic organization of KCl ions and water molecules, which would ideally be demonstrated using a dynamic simulation. However, only static models will be shown here.

First, we will examine the basic unit cell consisting of two KCl ions and their surrounding water molecules. This unit will then be compared with the corresponding basic unit cell of two NaCl ions and their hydration shells. Following this, a hierarchical associative network of eight KCl ions in solution will be presented (with the exponent abstracted—see the $8.07 \cdot 10^{17}$ ions mentioned earlier). Only a small portion of the water molecules will be illustrated, since in reality there are approximately 1,784 times more water molecules.

It is assumed that the water molecules around KCl ions bend slightly, altering their tetrahedral structure. The so-called free water molecules largely retain their original structure. On average, each ionic pair is surrounded by at least five water molecules, which is a necessary condition for the dissociation of KCl into K^+ cations and Cl^- anions.[255]



5.4.7.8.3.4 Figure 392: Comparison between the basic unit cell of KCl and NaCl ions in solution

Figure 392 illustrates a comparison between the basic unit cells of KCl and NaCl ions in solution. The main difference between the two networks lies in the distance between the potassium cation

255 Sen, A., & Ganguly, B. (2010). What is the minimum number of water molecules required to dissolve a potassium chloride molecule? *Journal of Computational Chemistry.* https://doi.org/10.1002/jcc.21590.

(see the purple node) and the chloride anion (green node), compared to the sodium cation (blue node) and the chloride anion. The potassium ion is farther from the chloride ion than the sodium ion is. Another noticeable difference is that the potassium cation is slightly larger than the sodium cation.

As for the structure of the surrounding water molecules, there are no major differences observed. However, it can be imagined that the water structure around NaCl ions is slightly more distorted than around KCl ions, possibly due to the difference in ion distances between K^+ and Cl^-.

A single crystal of NaCl with a size of 0.100 mm and a mass of 0.0004 g contains more ions than a KCl crystal of 0.05 mm and 0.0001 g, even if the mass and size of the potassium crystal were scaled to match that of sodium. To match the mass of one NaCl crystal (0.0004 g), four smaller KCl crystals (each 0.05 mm) would be needed. The following calculation illustrates this:

- Number of ions in 0.0004 g of NaCl: $4.136 \cdot 10^{18}$
- Number of ions in 0.0001 g of KCl: $8.07 \cdot 10^{17}$
- Multiplying by four (to match 0.0004 g) gives $3.228 \cdot 10^{18}$ ions
- This results in a difference of $9.08 \cdot 10^{17}$ ions in favor of NaCl.

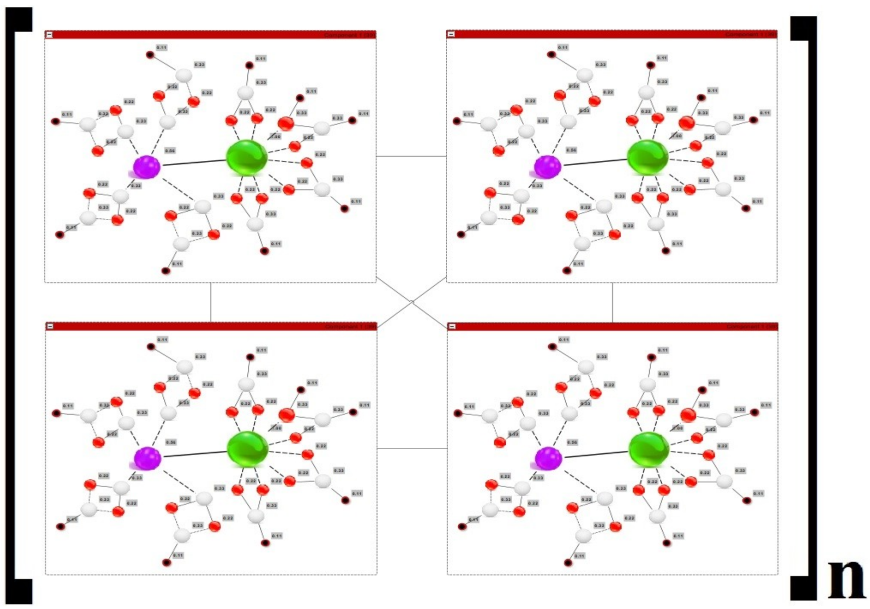
Despite the slightly lower number of KCl ions in solution, KCl can exhibit higher electrical conductivity than NaCl in the same volume of water. At low concentrations, this difference is not very noticeable, especially not in a single drop of distilled water, which contains approximately $1.44 \cdot 10^{21}$ polarized atoms ($7.2 \cdot 10^{20}$ oxygen atoms and $7.2 \cdot 10^{20}$ hydrogen atoms). More noticeable differences in conductivity appear only at higher concentrations (above 10 g KCl or NaCl + 100 ml H_2O), even though the number of KCl ions remains lower than in the NaCl solution.

Although both solutions have a similar structure, they show different collective effects in terms of conductivity, density, and adsorption mass. A higher number of ions in solution does not necessarily lead to stronger collective effects—these depend primarily on how all participating particles, including water molecules, are organized.

The electrical conductivity of a solution is influenced by at least four factors:

1. Temperature
2. Concentration or density of ions
3. Type of ions
4. Ion mobility

Electronegativity also plays a role in ion type. Potassium (0.82) is less electronegative than sodium (0.93), meaning it more readily donates electrons to chlorine (3.16). This property can outweigh the sheer number of ions in solution and lead to greater collective effects, such as higher conductivity and enhanced electrical output. Water molecules are also important in this context. Oxygen (3.44) is more electronegative than hydrogen (2.20), allowing water to bond more tightly with Na^+ and Cl^- than with K^+ and Cl^-. This was observed under a light microscope during the dissolution of NaCl and KCl crystals in two drops of distilled water: the NaCl crystal dissolved faster and more completely into ions compared to KCl. Furthermore, crystallization of the NaCl micro-solution occurred more rapidly than with KCl, which can be attributed to the fact that K^+ cations are more hygroscopic than Na^+ cations. This is precisely why K^+ cations are more mobile in solution and can more quickly and easily deliver the necessary electron to Cl^- anions. Simply put, K^+ cations are more reactive than Na^+ cations. The greater distance between K^+ cations and Cl^- anions results in the previously mentioned characteristic of increased mobility. This difference in electronegativity not only affects conductivity but also influences other physical properties such as boiling point, solubility, ionization energy, electron affinity, atomic radius, density, and so on. What follows is the previously announced modeling of eight KCl ions with a quantity of "$n = 10^{17}$," surrounded by water molecules.



5.4.7.8.3.4.1 Figure 393: Cluster network of KCl ions and water molecules

Figure 393 illustrates a cluster network of KCl ions and water molecules ($n = 10^{17}$), in which all clusters are interconnected through associative links. The effect of distance between the ions is somewhat reminiscent of the influence of genetic distance, which can affect the formation and development of various populations of living organisms, including humans. As a result, proportionally diverse properties emerge, ranging from physiological to psychological differences.[256] Human populations share approximately 99.1% of the same genetic composition and

256 Vrieze, S. I., Iacono, W. G., & McGue, M. (2012). Confluence of genes, environment, development, and behavior in a post genome-wide association study world. *Development and Psychopathology*, 24(4), 1195–1214. https://doi.org/10.1017/s0954579412000648.

structure, with only about 0.1% of genes differing. However, the distances between genes can lead to proportionally significant differences between various species of living organisms, and even within a single species. This results in considerable variations in physical appearance and potential behavioral patterns. This is also related to the strength of connections: greater distances between genes—or between ions—create weaker connections, which in turn lead to more pronounced differences in properties.

In the case of KCl, it has been observed that the distance between the K^+ cation and the Cl^- anion is greater than the distance between the Na^+ cation and the Cl^- anion. Smaller distances between ions result in stronger spatial confinement and reduced mobility. Stronger hierarchies and associations are defined by both the distance and the strength of the connection between individual units within hierarchical associative networks, ultimately producing different collective effects.

The average distance between water molecules and K^+ cations is approximately 2.56 Å, whereas the average distance between Na^+ cations and water molecules or O^{2-} ions is slightly larger, around 2.72 Å. The distances between Cl^- anions and H^+ ions range from 2.06 Å to 2.29 Å, and the average distance between water molecules themselves is about 3.1 Å. In this spatial framework, all ions and polar molecules distribute themselves within a defined space.

Electrostatic and dispersion forces shape double dipoles in the direction of ionic dipole attraction. On one hand, hydrogen bonds form between water molecules; on the other hand, ionic dipole forces act between K^+ and Cl^- ions and water molecules. Within these interactions, we observe hierarchies among oxygen and hydrogen atoms, as well as between potassium and chloride ions. Additionally, associative mediation occurs—oxygen atoms mediate toward potassium cations, while hydrogen atoms mediate toward chloride anions.

These relationships give rise to hierarchical associative networks, where hierarchical forces alone are not sufficient to maintain the network structure. Proportional relationships of equivalence, in the form of mediating bridges, are also necessary. The strength of a collective system exists only when there are binding forces that ensure persistent and repetitive interactions, thereby enabling useful collective effects.

In short, hierarchical structures are just one key component of hierarchical associative networks. This can be conditionally compared to an electrical circuit with a light bulb: without a power source (the hierarchically superior unit), a conductor (the associative mediating unit), and the light bulb (the subordinate unit), no useful collective effect—such as light—is achieved. Even in systems as simple as aqueous solutions of chemical compounds, similar relationships are observed as in biological systems, where the absence of a key organ prevents proper functioning.

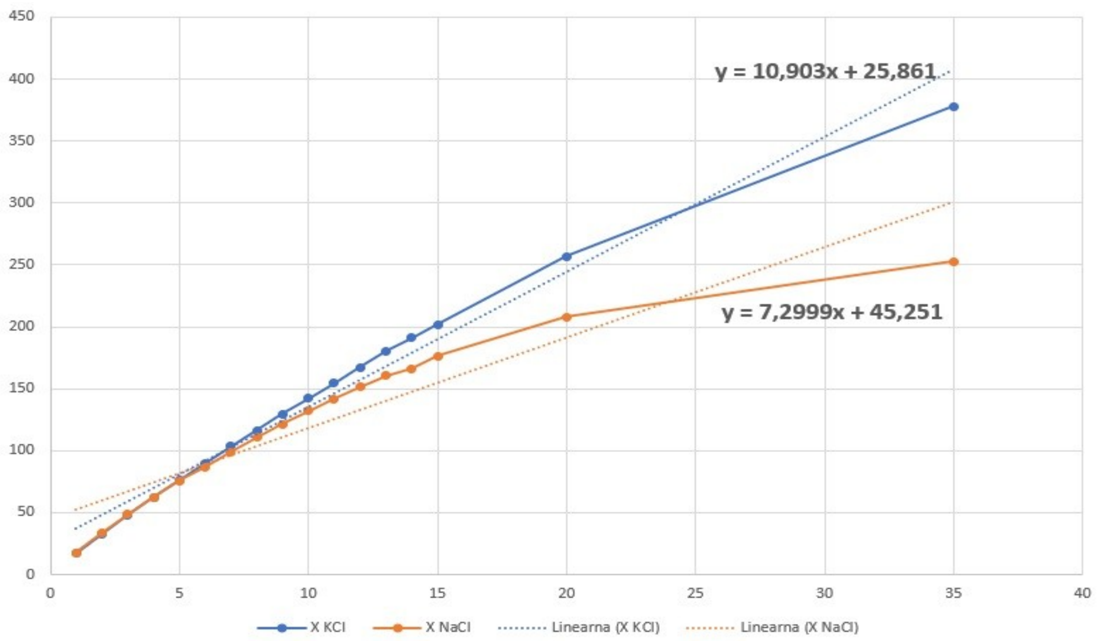
In highly concentrated KCl or NaCl solutions, it is known that hydrogen bonds between water molecules remain largely intact; however, ions significantly alter the behavior of oxygen bonding and even distort it. This resembles the effect of exposing pure water to specific pressures.[257] The greater the curvature of water molecules or oxygen bonds in KCl and NaCl solutions, the greater the collective effects in terms of conductivity. However, this curvature does not have an unlimited collective effect; it has critical points that appear when the solutions become excessively saturated. At approximately 20°C, a solution with 35 g of KCl in 100 g of water becomes saturated, while NaCl reaches saturation only at 36 g per 100 g of water. Any excess in the mass that exceeds the saturation point of either solution will transition towards forming the basic crystalline structure of a solid phase for both KCl and NaCl, as the mobility of ions is limited.

The strength of electrical conductivity and, potentially, the generation of (electrical) kinetic energy depend on the movement of electric charges. Without this movement, we would primarily deal with potential energy in the form of potential light, heat, elasticity, and dynamics. It would be appropriate to perform measurements using saturated solutions of KCl and NaCl.

257 Mancinelli, R., Botti, A., Bruni, F., Ricci, M. A., & Soper, A. K. (2007). Perturbation of water structure due to monovalent ions in solution. *Physical Chemistry Chemical Physics*, 9(23), 2959. https://doi.org/10.1039/b701855j.

5.4.7.8.3.4.2 Table 180: Conductivities of KCl and NaCl solutions up to saturation

C	*X KCl*	*T KCl*	*X NaCl*	*T NaCl*
1	17.05	23.7	17.85	20.5
2	32.9	23.3	33.9	20.5
3	48.1	23.4	48.5	21
4	62.3	23	62.2	20.9
5	76.1	23	75.6	20.4
6	89.7	23.2	87	22.2
7	103.4	23.1	99.3	22.4
8	116.3	24	111	21.7
9	129.4	23.7	121.7	22
10	142.1	23.3	132.3	21.8
11	154.4	24.9	141.9	22
12	167.4	23.5	151.4	22.4
13	180.5	22.7	160.5	23.7
14	191	24	166.4	25.2
15	202	23.9	176.2	22.8
20	257	23.1	208	22.5
35	378	24.8	253	26.8



5.4.7.8.3.4.3 Figure 394: Conductivity graphs of KCl and NaCl solutions

Table 180 presents the conductivity measurements of KCl and NaCl solutions from lower concentrations up to saturation, while Figure 394 illustrates the conductivity graphs based on these measurements. Both trend graphs show a completely linear increase, whereas the actual measurement graphs deviate slightly from the trend lines. This deviation was already noticeable in NaCl solutions but appeared in KCl solutions only at the concentration of 35 g KCl + 100 ml H_2O.

With the additional measurements of saturated solutions — 35 g KCl + 100 ml H_2O and 36 g NaCl + 100 ml H_2O — two new linear equations were obtained. These differ noticeably from the original ones due to a decrease in the slope (x-axis coefficient):

- $y_kCl = 12.767x + 11.396 \rightarrow y_kCl = 10.903x + 25.861$
- $y_naCl = 10.32x + 21.809 \rightarrow y_naCl = 7.2999x + 45.251$

Since higher concentrations typically lead to increased conductivity, this decrease in the slope in both cases indicates a certain loss in the efficiency of the collective effects of ionic-polar bonds. The optimal collective conductivity effects in saturated KCl and NaCl solutions resemble oversaturated urban environments, where various forms of congestion arise — such as communication, social, healthcare, financial, and traffic congestion. These can lead to social conflict, poverty, excessive wealth, increased psychophysical illnesses, environmental pollution, and a higher incidence of fatal traffic accidents. As a result, unproductive and harmful networks form, which prevent optimal utilization of positive collective effects.

By analogy, we can assume that similar "blockages" occur in these saturated KCl and NaCl solutions, reducing electrical conductivity. These blockages form as dense clusters of ions and excessively curved water molecules, which hinder the movement of otherwise functional ions and water molecules. Consequently, disturbances in ion and polar molecule movement occur, potentially reducing ion spacing, breaking hydrogen bonds, and deforming the hydration shells around ions.

As seen in the linear graphs of KCl and NaCl solution conductivity, a decline in the collective effects of conductive and mediating particles is already apparent in the saturation range. To model the conductivity blockages in saturated KCl and NaCl solutions, calculations of the number of ions and polar atoms in a given solution volume will be carried out. This requires determining the solution volume and calculating the number of crystals based on the dissolved masses of KCl and NaCl (at 20 ºC: 35 g KCl + 100 g H_2O and 36 g NaCl + 100 g H_2O).

Given that the number of ions in a single crystal of KCl and NaCl has already been calculated, the total number of ions can be obtained by multiplying the number of crystals in 35 g KCl and 36 g NaCl by their respective ion counts. Additionally, it will be necessary to calculate the number of water droplets in 100 g of distilled water. Since the number of polar atoms in one droplet is already known, multiplying it by the number of droplets yields the total number of polar atoms in the water.

The volume of the two saturated solutions can then be calculated using the formula $V = m/\rho$ (volume equals mass divided by density). The density of saturated NaCl solution at 20 ºC is approximately 1.2021 g/cm³, while that of saturated KCl solution is about 1.1753 g/cm³.[258]

258 Data obtained from the following online source: Thurmond, V. L., Potter, R. W., & Clynne, M. A. (1984). The densities of saturated solutions of NaCl and KCL from 10 degrees to 105 degrees C. *Open-File Report*. https://doi.org/10.3133/ofr84253.

$V_{KCl} = m_{KCl}/\rho_{KCl} = 35$ g/1,1753 g/cm^3 = 29,78 cm^3

$V_{NaCl} = m_{NaCl}/\rho_{NaCl} = 36$ g/1,2021 g/cm^3 = 29,95 cm^3

$V_{H2O} = m_{H2O}/\rho_{H2O} = 100$ g/0,9982 g/cm^3 = 100,18 cm^3

The total volume or space occupied by the saturated KCl solution at 20 ºC is 129.96 cm^3, while the total volume of the saturated NaCl solution is 130.13 cm^3. The following section includes the calculations of the number of crystals in both saturated solutions.

$N_{KCl} = m_{KCl}/m_{1KCl} = 35$ g/0,0001 g = 350000 KCl crystals are contained within a saturated solution at 20º C.

$N_{NaCl} = m_{NaCl}/m_{1NaCl} = 36$ g/0,0004 g = 90000 NaCl crystals are contained within a saturated solution at 20º C.

$N_{H2O} = m_{H2O}/m_{1H2O} = 100$ g/0,0444 g = 2252 drops of H_2O are contained within both saturated solutions.

The number of ions and polarized atoms for a single crystal of each salt, as well as for one drop of distilled water, has already been calculated. Therefore, these values are simply multiplied by the number of crystals for each salt and the number of drops of distilled water. This yields the final results — the total number of ions in the entire mass of each saturated solution and the number of polarized atoms within them. These results will serve as the basis for modeling ionic-polar blockages or "clogs" in both saturated solutions.

$N_{ionovconcKCl\ (20º\ C)} = N_{KClkristali} \cdot N_{1KClioni} = 350000 \times 8{,}07 \cdot 10^{17} = 2824{,}5 \cdot 10^{17}$ ions $= 28{,}245 \cdot 10^{19}$ is the number of KCl ions inside a saturated solution at 20º C.

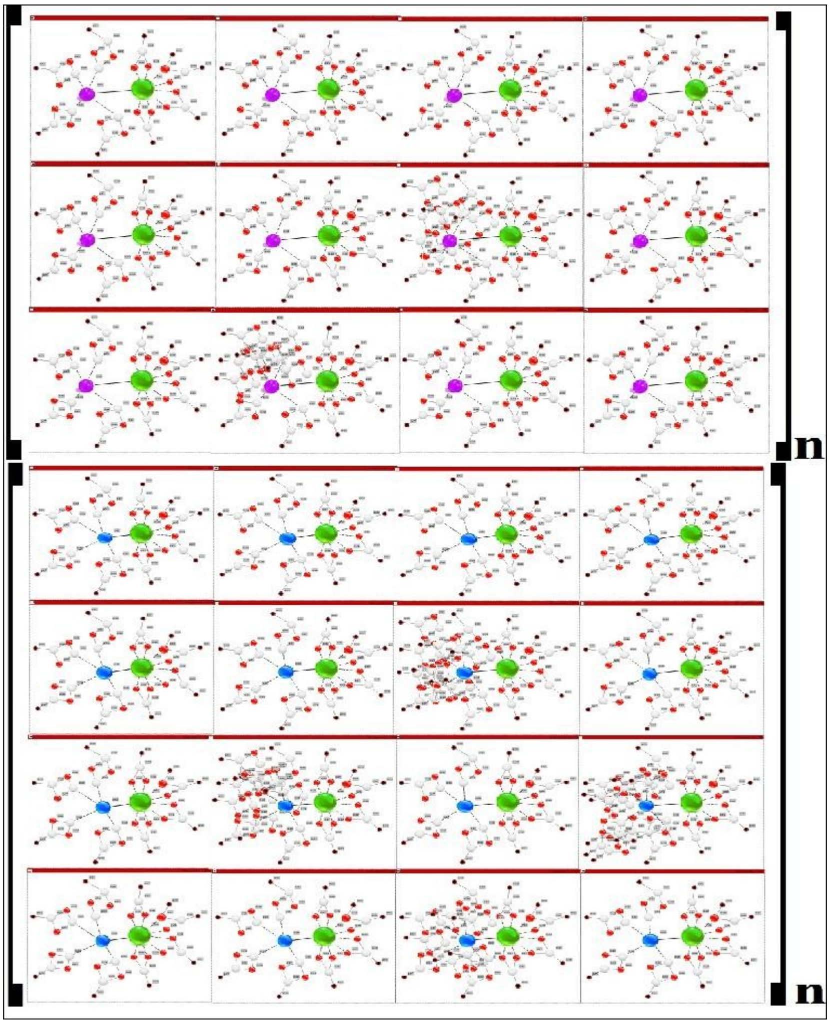
$N_{ionovconcNaCl\ (20º\ C)} = N_{NaClkristali} \cdot N_{1NaClioni} = 90000 \cdot 41{,}36 \times 10^{17} = 3722{,}4 \cdot 10^{17}$ ions $= 37{,}22 \cdot 10^{19}$ is the number of NaCl ions inside a saturated solution at 20º C.

$N_{paH2O\ (20º\ C)} = N_{H2Okapljice} \cdot N_{1kapljicaH2Opa} = 2252 \cdot 14{,}4 \cdot 10^{20} = 32428{,}8 \cdot 10^{20}$ polarized atoms - thus, the number of polarized atoms in both saturated solutions at 20 ºC is $3.24288 \cdot 10^{24}$.

It is becoming clear that a comprehensive modeling of polarized atoms within this framework will not be feasible, as their number significantly exceeds the number of ions in both saturated solutions. What we are dealing with is essentially a network visualization that further highlights the point made on the previous page — excessively curved water shells around cations create clogs or blockages that slow down the transfer of electrons to anions and consequently weaken the effect of these negatively charged particles.

In oversaturated KCl and NaCl solutions, this can even lead to a complete blockage of electron transfer to chloride anions. This is the main reason why, although saturated solutions of KCl and NaCl reach their maximum possible conductivity, their efficiency relative to the amount of dissolved mass is lower than that of more diluted solutions. This was demonstrated by a greater deviation from the steeply rising trend line and a reduction in slope on the x-axis.

On one hand, water molecules — particularly at the oxygen atom side — are compressed into a smaller volume; on the other hand, cations are trapped within these water shells, which further affects conductivity and the dynamics of ion movement.

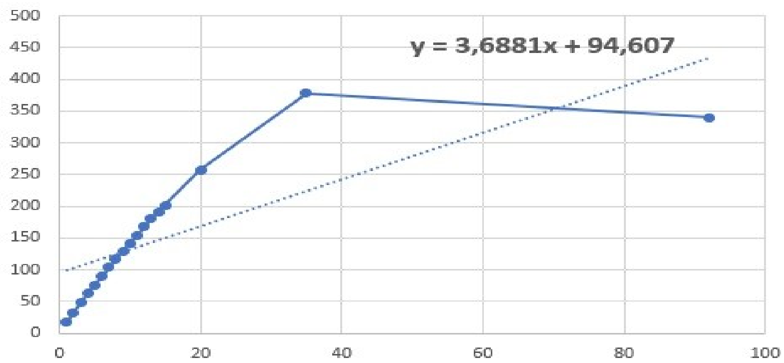


5.4.7.8.3.4.4 Figure 395: Modeling of blockages and/or clogs

Figure 395 illustrates the modeling of blockages or clogs in the ionic polar bonds within two saturated solutions, KCl and NaCl. In certain areas around the cations, compressed and densely packed water molecules can be observed. These molecules form specific obstructions or even complete blockages that slow down or, in some cases, entirely prevent the transfer of electrons to the chloride anions. These clogs or blockages are more pronounced in the saturated NaCl solution and somewhat less noticeable in the KCl solution. In oversaturated solutions, conductivity values relative to the added mass of salt decrease further, as the excess dissolved substance begins to form particle clusters or even larger crystals within the solution. With each additional dose of salt added to a saturated solution, the initially steeply rising linear conductivity graph begins to decline, increasingly deviating from the linear trend line. This results in a functional shape that represents a mix of a linear and a quadratic function, similar to the equation $Y = 2x – x^2/4$. After an additional conductivity measurement using 92 g of KCl per 100 g of distilled water, the following result was obtained:

5.4.7.8.3.4.5 Table 181: Conductivities of KCl solutions up to supersaturation

C	*X KCl*	*T KCl*
1	17.05	23.7
2	32.9	23.3
3	48.1	23.4
4	62.3	23
5	76.1	23
6	89.7	23.2
7	103.4	23.1
8	116.3	24
9	129.4	23.7
10	142.1	23.3
11	154.4	24.9
12	167.4	23.5
13	180.5	22.7
14	191	24
15	202	23.9
20	257	23.1
35	378	24.8
92	340	20.1



5.4.7.8.3.4.6 Figure 396: Conductivity graph of KCl solutions

Table 181 and Graph 396 present the conductivity measurements for a solution containing 92 g of KCl and 100 ml of H_2O. As previously mentioned, the conductivity drops significantly with further additions of KCl to an already saturated solution, indicating that the relationship is no longer linear.

If the same measurement were conducted with an oversaturated NaCl solution, the deviation from the linear trend line would likely be even more pronounced.

Undissolved and precipitated particles of KCl and NaCl act as resistors, with metal ions exerting additional pressure on water molecules, significantly hindering ion mobility in the solution.

Although the solution with 92 g of KCl per 100 ml of water still shows high conductivity compared to lower concentration solutions (ranging from 1 g to 20 g per 100 ml), the efficiency relative to the mass of added salt is considerably lower than expected based on the previous trend line.

This behavior is typical of many collective effects in hierarchical associative systems, where overall system efficiency depends on spatial capacity. In the case of saturated KCl and NaCl solutions, the volume is approximately 130 cm³ (129.96 cm³ for KCl + H_2O and 130.13 cm³ for NaCl + H_2O). To improve efficiency, the system's volume would need to be expanded.

A similar phenomenon is seen in societal hierarchical associative systems: when large corporations seek increased profit but lack new consumers, they expand their operations to other geographic areas. A comparable process occurs in natural ecosystems—if predator populations grow excessively and prey becomes scarce, they must expand their territory or migrate, or else face endangerment. Oversaturated conditions, whether in social or natural systems, lead to high levels of negative stress and force systemic adaptation.

Even in miniature systems like chemical solutions, oversaturation reduces system efficiency. The same principle applies to more complex causal systems—societies where extreme poverty and wealth are concentrated in the hands of a few tend to have very poor long-term collective outcomes. The modeled saturated KCl and NaCl solutions indicate a critical point of systemic efficiency, beyond which any additional dissolved salt only worsens the collective effects rather than improving conductivity. Any saturated state can serve as a warning signal, while oversaturated states already call for concrete actions or at least damage mitigation.

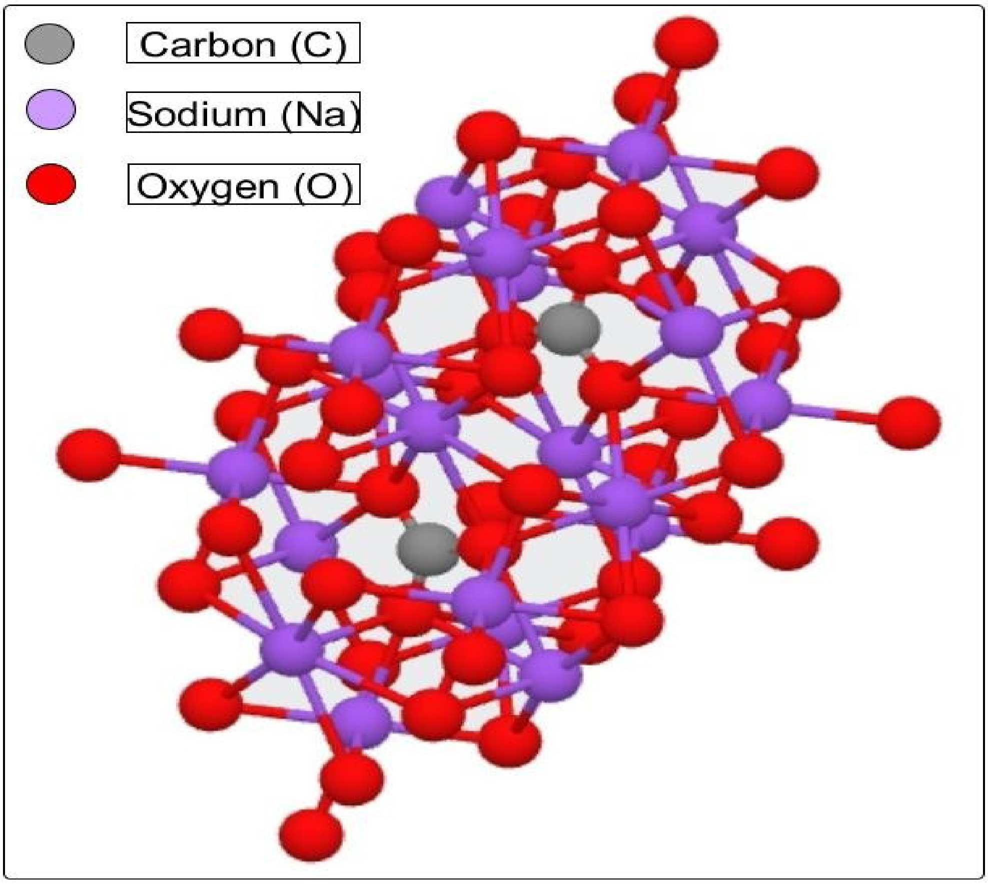
KCl is vitally important for both living organisms and natural hierarchical associative systems. In many organisms, it supports nervous system and muscle function, facilitates nutrient transport into cells, and aids in the removal of waste. It also plays a crucial role in energy production, heart protection, and protein function.

Using KCl instead of NaCl in water softeners can reduce the environmental impact of brine discharge, as KCl is an essential nutrient for many living beings, including humans and plants. Potassium is critical for all life forms, enabling water uptake and the conversion of plant sugars into nutrients. Therefore, KCl is essential for sustaining and developing biomass on Earth—without sufficient potassium, most living organisms would inevitably perish.

5.4.7.8.4 Sodium carbonate (washing soda)

Sodium carbonate (hereafter referred to as Na_2CO_3) is an ionic chemical compound that forms as the final product of a reaction between a strong base, sodium hydroxide (NaOH), and a weak carbonic acid (H_2CO_3). All forms of sodium carbonate are white, odorless, and exist in various hydrated states such as $Na_2CO_3 \cdot 10H_2O$, $Na_2CO_3 \cdot 7H_2O$, and $Na_2CO_3 \cdot H_2O$.

Anhydrous Na_2CO_3 has a molar mass of 105.9888 g/mol, a density of 2.54 g/cm³ (at 25 °C), a melting point of 851 °C, and a water solubility of 34.07 g per 100 ml at 27.80 °C. The crystal system of anhydrous Na_2CO_3 is monoclinic, meaning that its crystals extend along three axes (a, b, and c) of unequal lengths. To better understand this compound, let's take a closer look at its crystal structure.



5.4.7.8.4.1 Figure 397: Crystal structure of Na_2CO_3

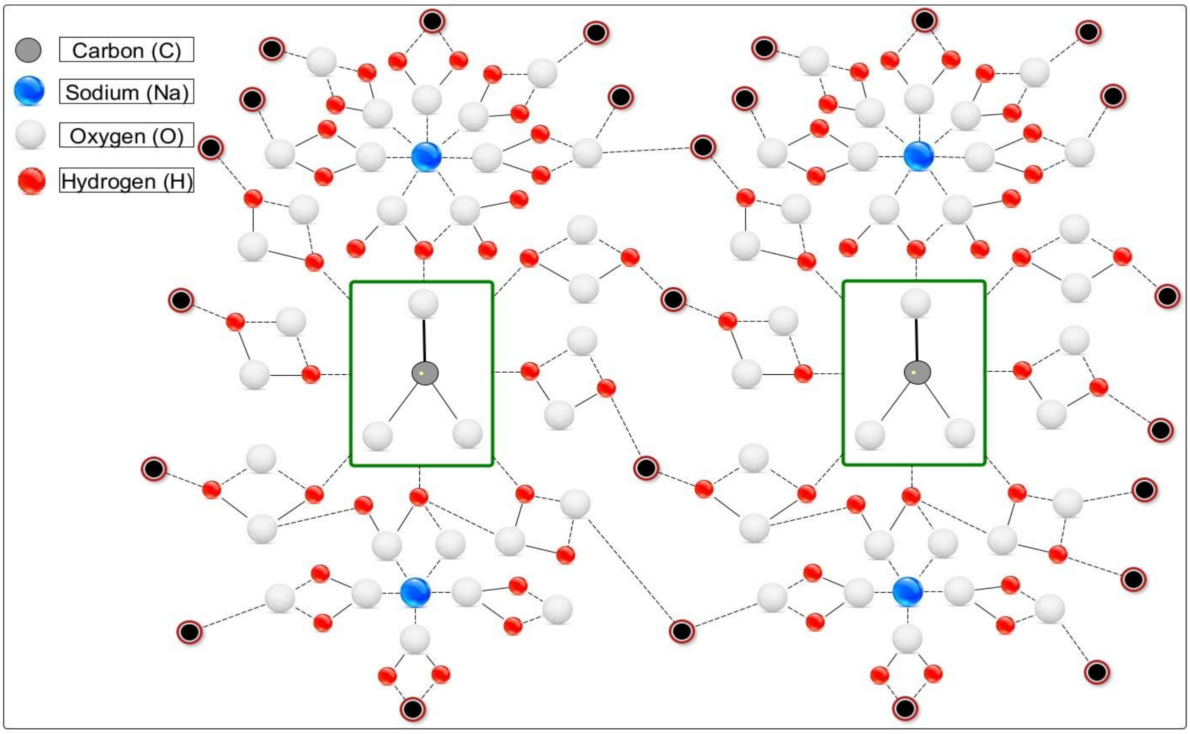
Figure 397 shows the monoclinic crystal structure of anhydrous Na_2CO_3, where axis a is perpendicular to axes b and c, but b and c are not perpendicular to each other.[259] A rectangular prism is formed, with a parallelogram as its base. An ionic bond exists between the Na^+ and $(CO_3)^{2-}$ ions, while the bond between C^{4+} and O^{2-} is covalent. These bonds that hold the molecule together are primarily governed by electrostatic attractive forces.

259 The crystal structure was created based on the web application on the website https://materialsproject.org/materials/mp-3070/# (2022-07-04).

The largest ions in the structure are oxygen ions, with a relative radius of 1.26 Å, followed by sodium ions at 1.16 Å, and the smallest are carbon ions at 0.16 Å. Oxygen bridges appear in the structure, binding on one side to Na^+ cations and on the other to C^{4+} atoms. This means that there are no direct bonds between Na^+ cations and C^{4+} atoms. From a structural perspective, the chemical formula could more accurately be written as Na_2OCO_2. When Na_2CO_3 is dissolved in distilled water, the final products are a strong base, sodium hydroxide (NaOH), and a weak carbonic acid (H_2CO_3). The latter is unstable and quickly decomposes into carbon dioxide (CO_2) and water (H_2O). The dissociation of Na_2CO_3 in water differs significantly from that of NaCl and KCl, especially in terms of energy release. While the dissolution of KCl and NaCl causes the solution to cool due to an endothermic reaction, dissolving Na_2CO_3 in water releases thermal energy, making it a strongly exothermic reaction. The solubility of Na_2CO_3 in 100 g of water at 25 °C is 30.7 g.[260] The dissociation process of Na_2CO_3 in water is not entirely clear. On one hand, it is often written as dissociating into 2 Na^+ cations and $(CO_3)^{2-}$ anions, while on the other hand, it is thought to undergo an exothermic chemical reaction with the previously mentioned final products. Following this, a neutralization reaction between the strong base NaOH and the weak carbonic acid (H_2CO_3) is expected, forming sodium bicarbonate ($NaHCO_3$) and NaOH.

In modeling the network of Na_2CO_3 solution, the first aspect of dissociation will be used, i.e., the breakdown into 2 Na^+ and $(CO_3)^{2-}$ ions, following the same principle of hydration shells as in KCl and NaCl. These shells surround both Na^+ cations and $(CO_3)^{2-}$ polyatomic anions. The density of Na_2CO_3 solution in concentrations ranging from 1% to 14% at 20 °C is between 1.0086 g/cm³ and 1.1463 g/cm³, which is significantly higher than that of KCl and NaCl solutions. This means that the density of cations and polyatomic anions in the solution is also higher, resulting in smaller distances between these particles.

260 Data obtained from the website https://pubchem.ncbi.nlm.nih.gov/compound/Sodium-carbonate#section=Boiling-Point (2022-07-04).



5.4.7.8.4.2 Figure 398: Fragment of the water molecule network and Na_2CO_3 ions

Figure 398 shows a fragment of the network formed by water molecules and Na_2CO_3 ions, which consists of four different elements: carbon (C), sodium (Na), oxygen (O), and hydrogen (H). The positive side of the water molecules surrounds the polyatomic carbonate anions $(CO_3)^{2-}$, while the negative side surrounds the sodium cations (Na^+). The principle behind the bonding of these ions is quite similar to that observed in previously discussed chemical compounds like NaCl and KCl. However, there is a significant difference: instead of chloride anions, Na_2CO_3 contains polyatomic carbonate anions $(CO_3)^{2-}$. The difference in charge between oxygen and carbon atoms is 0.89. In comparison, chlorine (Cl) has an electronegativity of 3.1, which represents a substantial difference. Sodium has an electronegativity of 0.9, so the difference between sodium and chlorine is 2.1. In the case of Na_2CO_3, the difference is slightly greater, about 2.51, since Na^+ does not bind directly to the $(CO_3)^{2-}$ anion, but rather to the oxygen atoms within this polyatomic group. The bond between carbon (C) and oxygen (O) is covalent, whereas the bond between sodium (Na) and oxygen (O) is ionic. This means that Na_2CO_3 exhibits a hybrid bond with both covalent and ionic characteristics. Despite this hybrid nature, Na_2CO_3 is generally classified as a compound with ionic bonding. Additionally, Na_2CO_3 acts as a strong stabilizer of the water structure, primarily by strengthening the hydrogen bonds between water molecules.[261]

261 Ozdemir, O., Çelik, M. S., Nickolov, Z. S., & Miller, J. D. (2007). Water structure and its influence on the flotation of carbonate and bicarbonate salts. *Journal of Colloid and Interface Science*, 314(2), 545–551. https://doi.org/10.1016/j.jcis.2007.05.086.

The influence of the Na^+ cation on the $(CO_3)^{2-}$ anion is quite strong—not only due to electron transfer, but primarily because of its effect on the water molecules surrounding the anion. Discussions about the structural changes of water molecules under the influence of dissolved salts remain inconclusive, as two different experimental approaches—neutron diffraction and infrared spectroscopy—have produced completely contradictory results regarding changes to the tetrahedral structure of water molecules.[262] The authors of a recent scientific paper, using a neural network-based molecular dynamics computer simulation method, conclude that the tetrahedral structure of water remains relatively intact under the influence of dissolved salts, and that the water molecules are under no significant stress.[263] The heated debates on this topic are far from settled. Given the fact that the structure of water molecules is highly flexible and that they are constantly forming and breaking bonds, it is likely crucial at which phase they are being observed or simulated. Dissolved salts undoubtedly influence both phases by significantly slowing down the processes of association and dissociation of water molecules in salt solutions. As a result, physical properties of water—such as surface tension, density, and conductivity—are altered.

During the association phase of water molecules, dissolved salts—especially at lower concentrations—have a negligible impact on changes to the tetrahedral structure of water molecules. However, this claim does not hold at higher salt concentrations, particularly when the water molecules are in the dissociation phase. In such cases, dissolved salts are likely to have a significant effect on the changes to water's tetrahedral structure.

As previously mentioned, both phases occur continuously, and dissolved salts slow down this cycle. The more concentrated the salt solution, the more pronounced this effect becomes, meaning that the tetrahedral structures of water molecules can remain disrupted or deformed for longer periods due to the influence of salts. At very high concentrations of dissolved salts, these structures are effectively under ionic pressure, which further prolongs the time intervals between the two phases. These prolonged intervals of molecular association and dissociation, of course, do not occur over seconds but over micro- or even nanoseconds. In short, determining the actual changes to the tetrahedral structure of water molecules under the influence of dissolved salts depends heavily on the measurement method used and the capability to capture extremely short time intervals.

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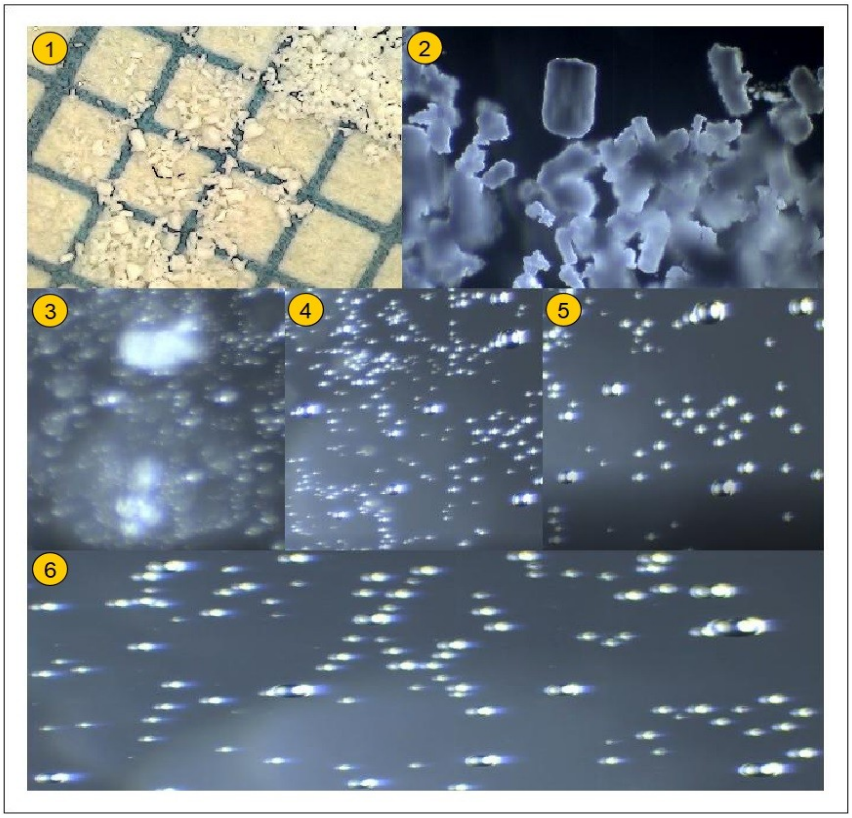
262 Leberman, R., & Soper, A. K. (1995). Effect of high salt concentrations on water structure. *Nature*, 378(6555), 364–366. https://doi.org/10.1038/378364a0.
Omta, A. W., Kropman, M. F., Woutersen, S., & Bakker, H. J. (2003). Negligible effect of ions on the hydrogen-bond structure in liquid water. *Science*, 301(5631), 347–349. https://doi.org/10.1126/science.1084801.

263 Zhang, C., Yue, S., Panagiotopoulos, A. Z., Klein, M. L., & Wu, X. (2022). Dissolving salt is not equivalent to applying a pressure on water. *Nature Communications*, 13(1). https://doi.org/10.1038/s41467-022-28538-8.

As with NaCl and KCl, it would be reasonable to record Na_2CO_3 powder with a USB microscope and observe the melting of a micro-quantity of this substance in two drops of distilled water, while monitoring the process with a light microscope.



5.4.7.8.4.3 Figure 399: Melting of fine amorphous Na_2CO_3 crystals in water

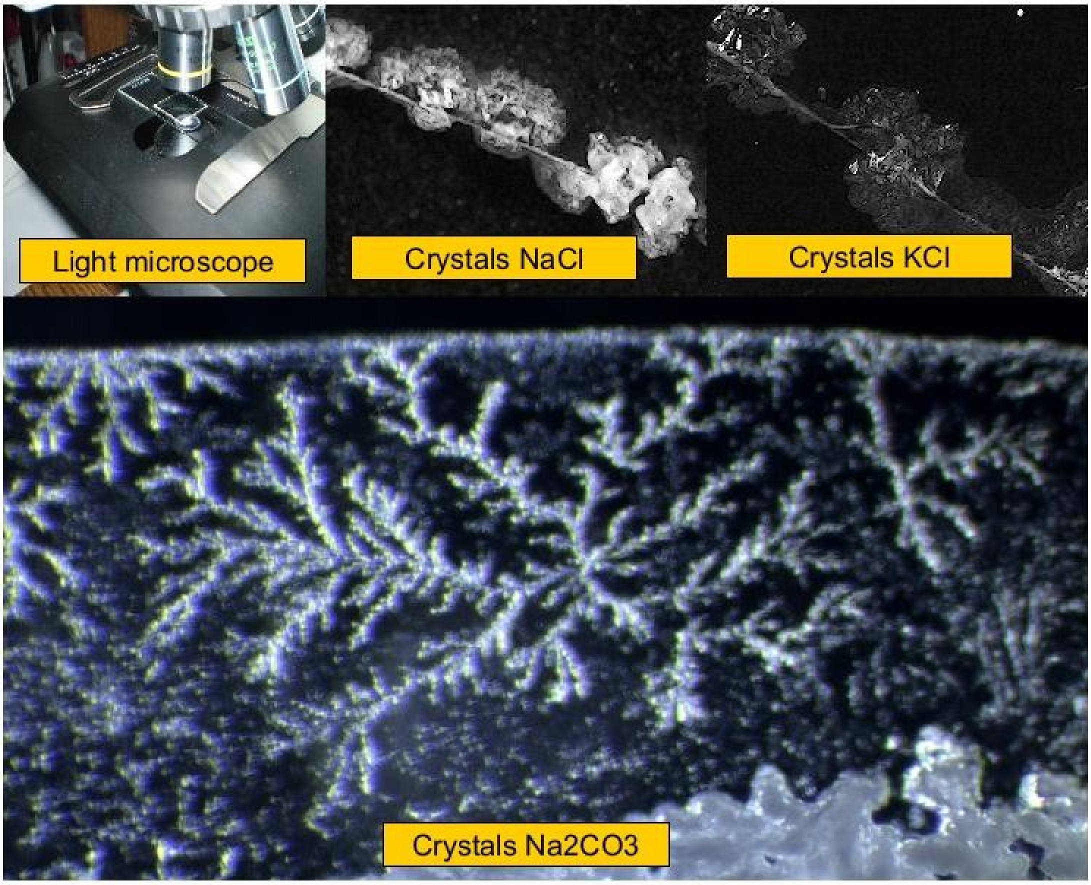
Figure 399 shows fine amorphous Na_2CO_3 crystals and the stages of their melting in two drops of distilled water under a light microscope. In the upper right part of the image, marked with the number 1, it can be observed that the Na_2CO_3 crystals are predominantly amorphous in shape and somewhat smaller than those of NaCl and KCl.

The melting of Na_2CO_3 crystals in two drops of distilled water differs significantly from the melting of NaCl and KCl, as the particles appear to be much smaller. The dissolution time for these fine amorphous crystals is considerably shorter, during which small spheres or bubbles form, creating interesting associative clusters—a phenomenon less pronounced in the melting of NaCl and KCl crystals.

The speed of this dissociation may be explained by the short distance between Na^+ cations and O^{2-} anions. Although exact data on this distance was not available, it can be roughly estimated by simply adding the ionic radii of the O^{2-} anion and the Na^+ cation:

$d = r_{aO^{2-}} + r_{cNa^+} = 1.40$ Å $+ 0.90$ Å $= 2.3$ Å $(2.3 \cdot 10^{-10}$ m)

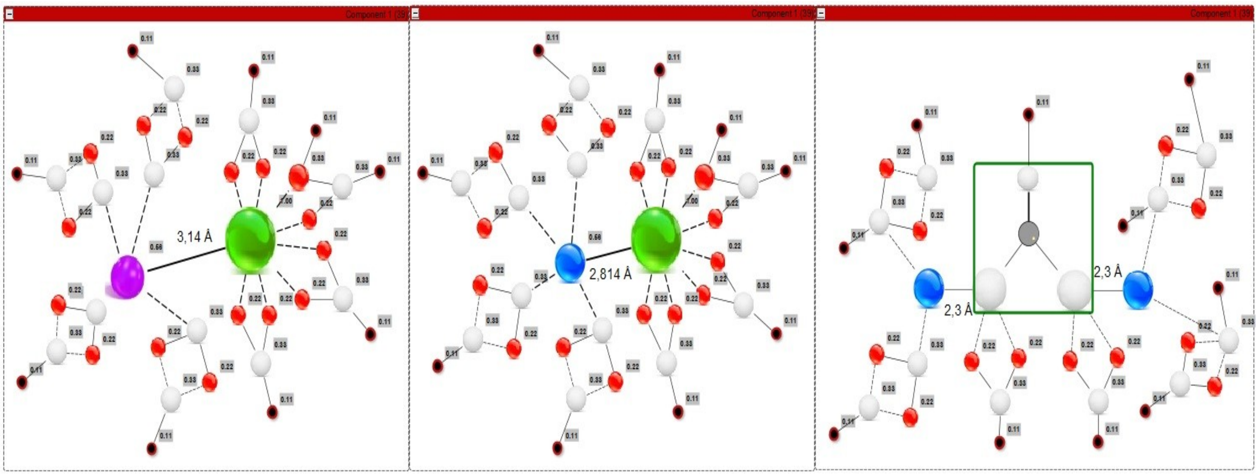
The sum of these values indicates that the interionic distance between Na^+ and O^{2-} is significantly shorter than in NaCl or KCl, measuring just 2.3 Å. This small distance between the ions could explain the formation of these intriguing associative clusters in the form of spheres or bubbles. It is recommended to observe the crystallization of Na_2CO_3 under a light microscope, similarly to what has been done with NaCl and KCl.



5.4.7.8.4.4 Figure 400: Crystallization of Na_2CO_3 under a light microscope and comparison

Figure 400 shows the crystallization of Na_2CO_3 under a light microscope, along with a comparison to the crystallization of NaCl and KCl. Even a basic comparison of the resulting NaCl and KCl crystals revealed significant differences, which are further emphasized by the formation of Na_2CO_3 crystals along the edges of the cover glass. The formed crystal structures resembled plants, with branching patterns and leaf-like formations, indicating a high particle density and close proximity. The crystallization process of Na_2CO_3 lasted approximately two hours—longer than that of NaCl but shorter than that of KCl. Given the shorter distances between cations and anions in the Na_2CO_3 micro-solution, one might expect a faster crystallization rate than in NaCl micro-solutions.

It is likely that the formation of Na_2CO_3 crystals at the edges of the cover glass occurs more rapidly, but remains imperceptible to the human eye, as amorphous Na_2CO_3 crystals in the solid state are considerably smaller than KCl crystals and much smaller than NaCl crystals. The density of Na_2CO_3, both in its solid and dissolved states, is higher than that of NaCl and KCl. We will now present a comparison of the distances between cations and anions in solutions of NaCl, KCl, and Na_2CO_3.



5.4.7.8.4.5 Figure 401: Distances between cations and anions in NaCl, KCl, and Na_2CO_3 solutions

Figure 401 illustrates the distances between Na^+ cations and anions in solutions of NaCl, KCl, and Na_2CO_3. These distances are greatest in KCl (3.14 Å), smaller in NaCl (2.814 Å), and smallest in Na_2CO_3 (2.3 Å). These distances affect the density values of the respective solutions: at equal concentrations, Na_2CO_3 solutions have the highest densities, followed by NaCl, with KCl solutions having the lowest.

$d_{Na_2CO_3} < d_{NaCl} < d_{KCl} \rightarrow \rho_{Na_2CO_3} > \rho_{NaCl} > \rho_{KCl}$

By multiplying the interionic distance (in meters) with the density (in kg/m³), we obtain the mass surface area (in kg/m²) between cations and anions—that is, the mass-related surface area occupied by ions within the various solutions. Let's calculate this for the given solutions using a concentration of 1 g of salt per 100 mL of H_2O, with the following densities:

- $\rho_{Na_2CO_3}$ = 1008 kg/m³
- ρ_{NaCl} = 1006 kg/m³
- ρ_{KCl} = 1004 kg/m³

Calculations:

$\rho_{Na2CO3} = 1008\ Kg/m^3$; $\rho_{NaCl} = 1006\ Kg/m^3$; $\rho_{KCl} = 1004\ Kg/m^3$

$S_{Na2CO3+/-} = d_{Na2CO3+/-} \cdot \rho_{Na2CO3} = 2{,}3 \cdot 10^{-10}\ m \cdot 1008\ Kg/m^3 = 2318{,}4 \cdot 10^{-10}\ Kg/m^2$

$S_{NaCl+/-} = d_{NaCl+/-} \cdot \rho_{NaCl} = 2{,}814 \cdot 10^{-10}$ m $\cdot$ 1006 Kg/m^3 = 2830,9 $\cdot$ 10^{-10} Kg/m^2

$S_{KCl+/-} = d_{KCl+/-} \cdot \rho_{KCl} = 3{,}14 \cdot 10^{-10}$ m $\cdot$ 1004 Kg/m^3 = 3152,6 $\cdot$ 10^{-10} Kg/m^2

Thus, the ions in KCl solutions occupy the largest mass surface area, followed by NaCl, with Na_2CO_3 ions occupying the smallest.

$d_{Na_2CO_3} < d_{NaCl} < d_{KCl} \cdot \rho_{Na_2CO_3} > \rho_{NaCl} > \rho_{KCl} \rightarrow S_{KCl} > S_{NaCl} > S_{Na_2CO_3}$

Solutions in which ions occupy the largest mass surface area also exhibit the highest electrical conductivity. This topic will be revisited later when conductivity measurements are presented for NaCl, KCl, and Na_2CO_3 solutions across a concentration range from 1 g of salt + 100 mL H_2O to 20 g of salt + 100 mL H_2O. Special attention will be given to saturated solutions of NaCl, KCl, and Na_2CO_3, focusing on the relationship between ionic mass surface area and the measured conductivity values.

Next, we will determine (similarly to the process used for NaCl and KCl) the number of ions within a single Na_2CO_3 crystal. This will be somewhat more difficult to perform, as these amorphous crystals appear as white powder and come in various shapes and sizes. Therefore, an average estimate will be required, based on weighing individual Na_2CO_3 crystals. A small amorphous Na_2CO_3 crystal weighs approximately 0.00005 g on average, based on ten measurements, and measures about 0.01 mm in size. The molar mass of Na_2CO_3 is known and is approximately 105.9888 g/mol. Using this data, we can calculate the number of moles of Na_2CO_3 in a single crystal.

$$ML = \frac{m_{kNa2CO3}}{M_{Na2CO3}} = \frac{(0{,}00005\,g)}{(105{,}9888\,\frac{g}{mol})} = 4{,}72 \cdot 10^{-7}\,moles$$

0.00005 g of Na_2CO_3 contains $4.72 \cdot 10^{-7}$ moles. The number of ions is obtained by multiplying the number of moles by Avogadro's number.

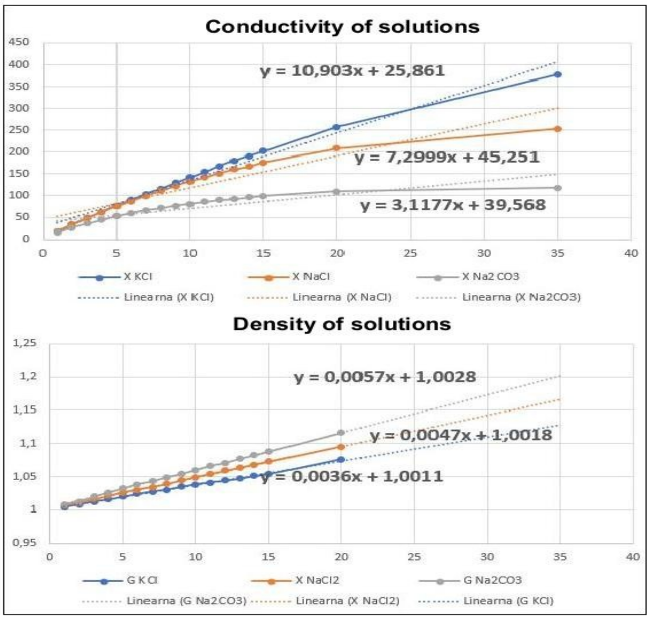
$$N_i = ML \cdot N_a = 4{,}72 \cdot 10^{-7} \cdot 6{,}023 \cdot 10^{23} = 2{,}84 \cdot 10^{17}\,ions$$

On average, a single amorphous Na_2CO_3 crystal contains $2.84 \cdot 10^{17}$ ions, which means there are $1.42 \cdot 10^{17}$ Na^+ cations and $1.42 \cdot 10^{17}$ polyatomic $(CO_3)^{2-}$ anions, which is fewer than in NaCl and KCl. Based on the data about the mass surface area between ions (kg/m^2) in a Na_2CO_3 solution and the number of ions, we can expect that conductivity measurements of solutions ranging from 1 g Na_2CO_3 + 100 ml H_2O to 20 g Na_2CO_3 will yield lower conductivity values than those observed in

NaCl and KCl solutions. This hypothesis, however, can only be reliably confirmed through empirical conductivity measurements.

5.4.7.8.4.6 Table 182: Measured conductivities and densities for KCl, NaCl and Na_2CO_3 solutions

C	χ KCl	0,0000	χ NaCl	ρ NaCl	χ Na2CO3	ρ Na2CO3
1	17.0500	1.0040	17.8500	1.0060	14.8400	1.0080
2	32.9000	1.0080	33.9000	1.0110	26.3000	1.0120
3	48.1000	1.0120	48.5000	1.0160	36.1000	1.0200
4	62.3000	1.0160	62.2000	1.0210	44.8000	1.0260
5	76.1000	1.0200	75.6000	1.0260	52.4000	1.0320
6	89.7000	1.0240	87.0000	1.0300	59.4000	1.0380
7	103.4000	1.0270	99.3000	1.0340	65.6000	1.0430
8	116.3000	1.0300	111.0000	1.0390	71.4000	1.0490
9	129.4000	1.0350	121.7000	1.0440	76.6000	1.0540
10	142.1000	1.0380	132.3000	1.0490	80.7000	1.0600
11	154.4000	1.0410	141.9000	1.0540	85.7000	1.0660
12	167.4000	1.0440	151.4000	1.0590	90.0000	1.0710
13	180.5000	1.0470	160.5000	1.0630	92.4000	1.0770
14	191.0000	1.0510	166.4000	1.0680	96.1000	1.0820
15	202.0000	1.0540	176.2000	1.0730	99.0000	1.0880
20	257.0000	1.0690	208.0000	1.0980	109.3000	1.1160
35	378.0000		253.0000		117.6000	



5.4.7.8.4.6.1 Figure 402: Comparison of conductivity and density of solutions for Na_2CO_3, KCl, and NaCl

Table 182 shows the measured values for conductivity (χ) and density (ρ) of solutions at various concentrations (C) for KCl, NaCl, and Na_2CO_3, while Figure 402 presents comparative graphs derived from the measured values. The hypothesis was confirmed that conductivity values are lower in those solutions of chemical compounds that have higher density and shorter distances between cations and anions, resulting in a smaller mass surface area.

The explanation regarding the number of ions is not entirely straightforward, as KCl in a given solution with the same concentration contains more ions than Na_2CO_3 but fewer ions than a NaCl solution with the same concentration, and still exhibits higher conductivity. A solution with the same concentration of NaCl contains more ions than a Na_2CO_3 solution and also has higher conductivity. From this, we can conclude that the number of ions in a given solution cannot directly indicate greater or lesser conductivity, since the number of ions says little about the distance between cations and anions, the mass surface area occupied by the cations and anions, or the ion density in a given space or volume.

In short, measurement values such as the distance between ions, the mass surface area between ions, and the density of the solution can be very helpful in predicting the greater or lesser conductivity of a given solution with an ionic polar bond. As we will see, we can also estimate the greater or lesser conductivity of a given solution with an ionic polar bond using data on adsorbed masses obtained through the previously presented method of modified paper chromatography and gravimetric analysis.

5.4.7.8.4.6.2 Table 183: Adsorptions of KCl, NaCl and Na_2CO_3 solutions by mass

C	*Ma KCl*	*Ma NaCl*	*Ma Na_2CO_3*
1	4.3	2.8	1.5
2	7.5	4.8	6.2
3	10.2	7.75	10.5
4	13	12.5	15.3
5	16.1	17.1	21.8
6	19.7	21.2	na
7	22.5	23.5	na
8	26.8	25.5	na
9	28.9	26.6	na
10	31.3	33.9	na
11	32.3	36.5	na
12	34.1	38	na
13	35.7	42.1	na
14	39	43	na
15	42.7	47.4	na
20	52.2	58.5	na

Table 183 shows the measured values of adsorbed masses from solutions of various concentrations of KCl, NaCl, and Na_2CO_3.

For Na_2CO_3 solutions with concentrations higher than 5 g Na_2CO_3 + 100 ml H_2O, the method of modified paper chromatography combined with gravimetric analysis was not suitable. The dried filter paper strip with Na_2CO_3 particles was nearly completely resistant to the burner and only burned with considerable difficulty.

As a result, the data for these measurements cannot be presented due to significant errors. However, for concentrations ranging from 1 g to 5 g Na_2CO_3 + 100 ml H_2O, the measurements of the adsorbed masses could be conducted consistently and accurately.

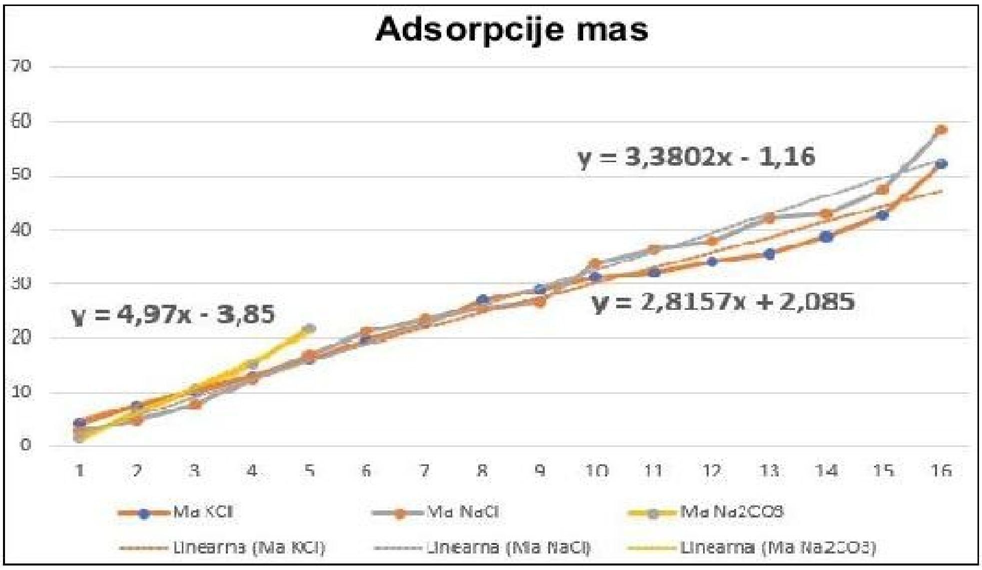
As previously mentioned, the adsorbed masses from solutions of different concentrations can be related to the unit of density: the higher the density of a given solution, the higher the adsorbed masses on the paper filter strip tend to be.

In part, the results of these adsorbed masses can also be used to estimate the conductivity strength of a solution with ionic polar bonding: generally, the higher the adsorbed mass on the filter strip, the lower the conductivity of the solution.

A particular feature of higher concentration Na_2CO_3 solutions was that particles adsorbed along all three sections of the paper strip, since the strip remained relatively resistant to burning even in the last third.

For KCl and NaCl solutions, it was observed that only a very small mass of particles adsorbs in the last third, and particles do not reach the target line. In contrast, particles in Na_2CO_3 solutions do reach the target line.

This behavior can be explained by the fact that Na_2CO_3 particles have a strong tendency to bind water in the form of dihydrates and especially decahydrates, whose crystals expand into a tree-like structure with branches and leaves. Let us illustrate the general rule about adsorbed masses using linear graphs of these measurements.



5.4.7.8.4.6.3 Figure 403: Adsorption of masses from Na_2CO_3, NaCl, and KCl solutions

Figure 403 presents the measurement values of adsorbed masses from Na_2CO_3, NaCl, and KCl solutions at various concentrations. The highest adsorbed masses were observed in Na_2CO_3 solutions with concentrations from 4 g to 5 g Na_2CO_3 per 100 ml of H_2O, whereas no significant differences were noticed for NaCl and KCl solutions.

This outcome aligns with the measured densities of the solutions, with Na_2CO_3 solutions showing the highest densities, followed by NaCl, and then KCl solutions with the lowest. The smallest interfacial area between cations and anions occurs in Na_2CO_3 solutions, allowing water molecules to more easily attract and carry Na_2CO_3 particles. In contrast, KCl solutions have larger interfacial areas between cations and anions, making this process more difficult.

These interactions involve clusters of ions and their surrounding hydration shells, which behave as cohesive units. These hydrated clusters adsorb onto the filter paper as a whole, rather than as individual dissociated ions. In essence, when water molecules pull cations along, they also drag along the corresponding anions.

The larger the interfacial area between cations and anions in a solution, the more the water molecules organize themselves so that free water travels first along the paper, followed by the associated ions and their hydration shells. In Na_2CO_3 solutions, the smaller distances between ions (and thus smaller interfacial areas) make it easier for water molecules to carry these particles along the filter strip, which functions like a network of tiny capillaries.

As a result, low-concentration KCl solutions are much more suitable for watering plants than NaCl and especially Na_2CO_3 solutions, since plant systems can more easily transport nutrients in such conditions. This process is governed by attractive, hierarchical, and associative forces, which lead to a high degree of particle organization, minimizing the influence of individual particle behavior. This high level of organization gives rise to various collective effects, which can be illustrated through measurements of adsorbed mass, density, and conductivity. It implies that higher concentrations of ionic polar-bonded solutions generally result in lower entropy of the ions and water molecules. This is a case of particle self-organization triggered by the aforementioned forces. Such reduced entropy doesn't occur only in biological systems, but also in inanimate matter. If this concept is extrapolated to the macrocosmic level, one could hypothesize that the universe expands and contracts in an organized rhythm, leading to points of extreme saturation—seen in so-called black holes with highly concentrated, relatively static masses.

Similarly, in the mesocosmic realm of social hierarchical systems, over-saturation can increase entropy and lead to stress. In both cases, the reduced mobility of organized masses results in unproductive or blocked collective effects.

At this point, we arrive at a special discussion of NaCl, KCl, and Na_2CO_3 solutions at saturation, from the perspective of the interfacial area between ions and their measured conductivities. In saturated ionic polar-bonded solutions, reduced ion distances result in a decrease in interfacial area, which in turn causes relatively low conductivity values for the amount of mass involved.

This decline in collective effects can be clearly illustrated using trend lines. A larger deviation from the trend line (toward lower conductivity) indicates a poorer utilization of collective particle behavior in saturated ionic solutions.

For example, the conductivity measurement for a saturated KCl solution (35 g + 100 ml H_2O) was 378 mS, while the trend line predicted 420 mS—resulting in an efficiency of 90%.

Similarly, for a saturated NaCl solution (36 g + 100 ml H_2O), the measured conductivity was 253 mS, compared to a predicted 300 mS, yielding an efficiency of 84.33%.

For saturated Na_2CO_3 (35 g + 100 ml H_2O), the measured conductivity was 117.6 mS, whereas the trend line predicted 150 mS—giving an efficiency of 78.4%.

This calculated efficiency for conductivity is lowest for Na_2CO_3, followed by NaCl, with the highest efficiency recorded for the saturated KCl solution.

$\eta_{\chi KCl} > \eta_{\chi NaCl} > \eta_{\chi Na2CO3}$

In oversaturated solutions, efficiency decreases even further due to ionic blockages and distorted water molecules surrounding the ions. This leads to shorter distances between cations and anions in some parts of the solution and consequently reduces the interfacial area between them.

Each additional substance introduced into the solution reduces the efficiency of electrical conductivity (relative to the amount of substance added) and disrupts the so-called generic natural organization of the particles.

An interesting experiment involved creating a hybrid solution using 2 g of Na_2CO_3, 2 g of KCl, and 2 g of NaCl. In a 150 ml beaker, exactly 2.0000 g of each compound in solid form was weighed using an analytical balance, followed by the addition of 100 ml of distilled water.

A magnetic stir bar was placed into the beaker to mix the solution using a magnetic stirrer. The mixing process lasted for approximately 20 minutes, after which the conductivity, density, and adsorbed mass of this hybrid solution were measured.

The obtained values were then compared to those of individual solutions with concentrations of 6 g KCl + 100 ml H_2O, 6 g NaCl + 100 ml H_2O, and 6 g Na_2CO_3 + 100 ml H_2O.

5.4.7.8.4.6.4 Table 184: Comparisons between hybrid solution and pure solutions

Solutions	*χ (mS)*	*ρ (g/cm³)*	*Ma (mg)*
Hibridna 6 g+100 ml H_2O	78.1	1.0300	21.1
KCl 6 g+100 ml H_2O	89.7	1.0240	19.7
NaCl 6 g+100 ml H_2O	87	1.0300	21.2
Na_2CO_3 6 g+100 ml H_2O	59.4	1.0380	24.5

Table 184 shows the measured values for conductivity, density, and mass adsorption for the hybrid solution (2 g Na_2CO_3 + 2 g KCl + 2 g NaCl + 100 ml H_2O), compared with the pure solutions of KCl, NaCl, and Na_2CO_3 at a concentration of 6 g + 100 ml H_2O. The purpose of this comparison is to determine the extent to which each individual salt influenced the measured values—particularly the drop in conductivity—when comparing the hybrid solution to the KCl and NaCl solutions.
The measured conductivity of the hybrid solution was 78.1 mS, which is lower than the NaCl solution (87 mS) and even lower than the KCl solution (89.7 mS), but significantly higher than that of Na_2CO_3 (59.4 mS). From the perspective of the pure KCl solution, the presence of Na_2CO_3 in the hybrid caused a drop in conductivity from 89.7 mS to 78.1 mS (a difference of 11.6 mS), while the influence of NaCl on the decrease in conductivity was negligible.
When calculating the average conductivity of the three pure solutions, the result is 78.7 mS, which is very close to the conductivity of the hybrid solution (78.1 mS). This suggests that NaCl contributed positively to maintaining the conductivity. Mixing the three salts resulted in a conductivity lower than that of the pure KCl and NaCl solutions but higher than that of pure Na_2CO_3. From the perspective of the Na_2CO_3 solution, mixing the three salts increased conductivity

by 18.7 mS. Considering the differences with KCl and Na_2CO_3, the net increase was 7.1 mS, indicating that the influence of KCl ions within the hybrid solution was slightly stronger than that of Na_2CO_3 ions.

In summary, the relationships are not entirely straightforward or linear. A key question is whether the NaCl ions in the hybrid solution supported the KCl ions, given their similar structure. Another important aspect is the internal organization of particles in the hybrid solution.

Based on the measured densities of the three pure solutions, one might expect Na_2CO_3 particles to settle at the bottom, NaCl particles in the middle, and KCl particles to float closer to the surface. However, the measured density of the hybrid solution was 1.030 g/cm³, which is nearly the average of the three pure solution densities (ρKCl = 1.024 g/cm³; ρNaCl = 1.030 g/cm³; ρNa_2CO_3 = 1.038 g/cm³). This raises the question: Could Na_2CO_3 particles also be present in the middle or at the surface of the solution?

What role do water molecules play here? Water molecules form mosaics of hydration shells around cations and anions throughout the solution. This property allows Na_2CO_3 ions to be distributed across all levels of the hybrid solution, just like KCl and NaCl ions.

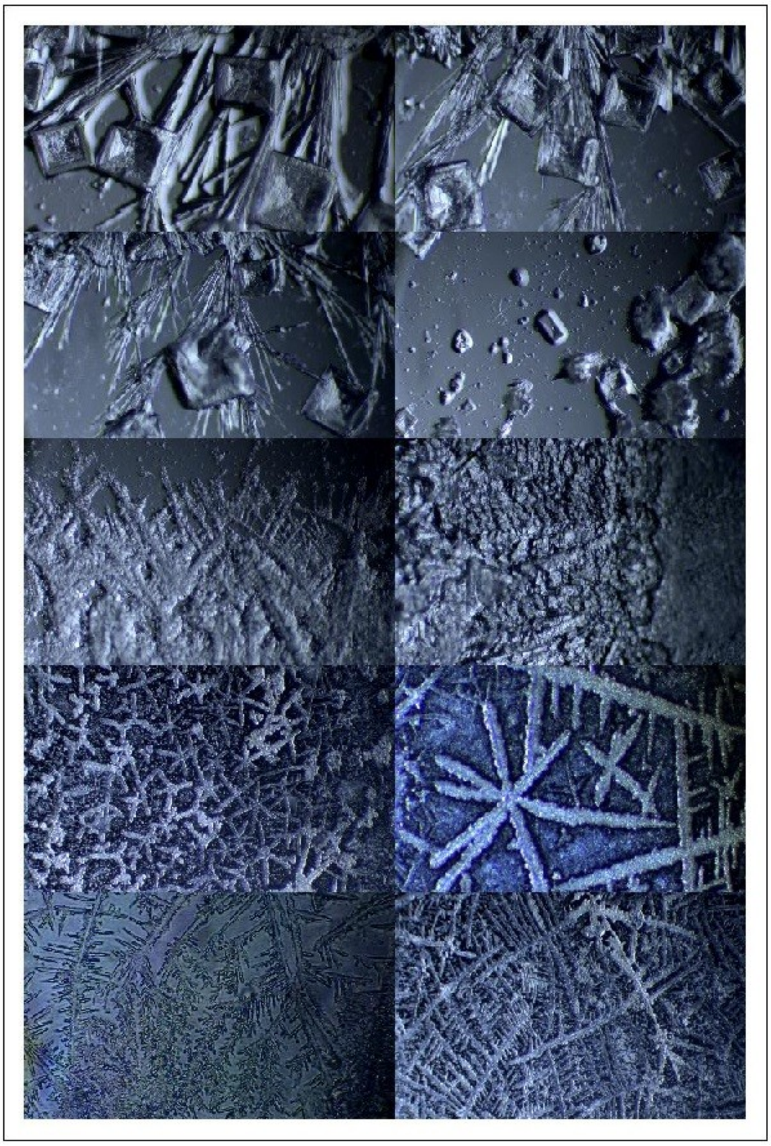
Although water molecules (M = 18 g/mol) have a significantly lower molar mass than KCl (M = 74.5513 g/mol), NaCl (M = 58.44 g/mol), and Na_2CO_3 (M = 105.9888 g/mol), their ability to surround and "carry" ions allows even heavier ions to remain at the top of the solution. The ions are essentially encased within “cells” with walls made of water molecules, resembling a honeycomb structure—but instead formed as tetrahedral networks.

The studied hybrid solution represents a kind of average of the properties of all three pure solutions, which was supported by the measurements of conductivity, density, and adsorption. Small deviations from the pure solution measurements can likely be attributed to factors such as temperature, air pressure, and humidity. Additionally, all three compounds are hygroscopic, meaning they can absorb moisture from the air. Of the three, KCl is the most hygroscopic, followed by NaCl, with Na_2CO_3 being the least.

This also means that all three compounds are highly soluble in water, in the order NaCl > KCl > Na_2CO_3.

An interesting next step will be to examine crystallization of the hybrid microsolution (same concentration: 6 g of salts + 100 ml H_2O) under a light microscope. The experiment will reveal which crystal structures dominate at the edges of the cover slip, and the results can then be compared with those of pure microsolutions of NaCl, KCl, and Na_2CO_3. To make the experiment more compelling, it would be useful to collect samples from different parts of the solution: the surface, the middle, and the bottom.

Two drops of the solution were placed on each microscope slide and carefully covered with a cover slip. The samples were then dried using a burner positioned 20 cm away. After the water evaporated, crystals formed at the edges of the cover slips. These crystals were observed using a light microscope at 10x and 40x magnification (phase contrast) and 100x magnification (immersion oil). The results are shown in the following composite image.



5.4.7.8.4.6.5 Figure 404: Crystalline structures from the hybrid solution

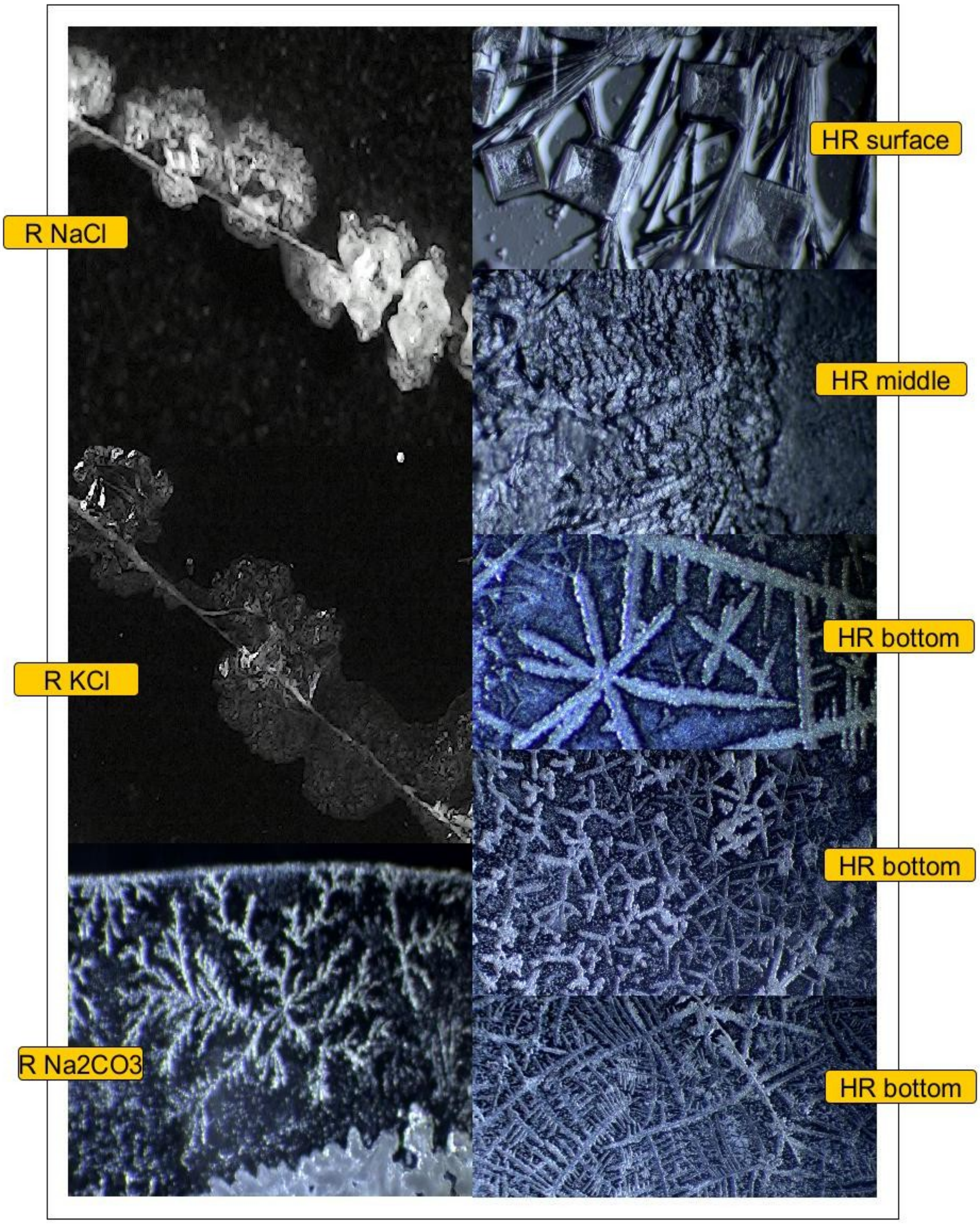
Figure 404 shows the resulting crystalline structures under a light microscope. The top four images display crystals from the surface of the hybrid solution. In the center of the large image, there are two photos showing crystals from the middle layer of the hybrid solution, while the bottom four images depict crystals with continuously repeating patterns from the bottom of the hybrid solution. The least informative appear to be the images from the middle layer, where a higher concentration dominates and the individual crystal structures are not clearly distinguishable—they appear more like clusters of various particles.

The most inspiring are the images from the surface of the hybrid solution, which reveal clearly identifiable cuboid and rod-like crystal structures.

The images from the bottom of the hybrid solution again show dense, but distinct and recognizable crystalline forms resembling trees, stars, and networks.

Despite the high informational value of these images, it is difficult to determine—especially for those from the middle and bottom of the solution—which specific crystals are actually present. Has a synthesis of different crystal structures occurred?

Before attempting to answer this complex question, we will first, as previously mentioned, present the crystal images for the individual solutions of KCl, NaCl, and Na_2CO_3, which will then be compared with the crystals from the hybrid solution.

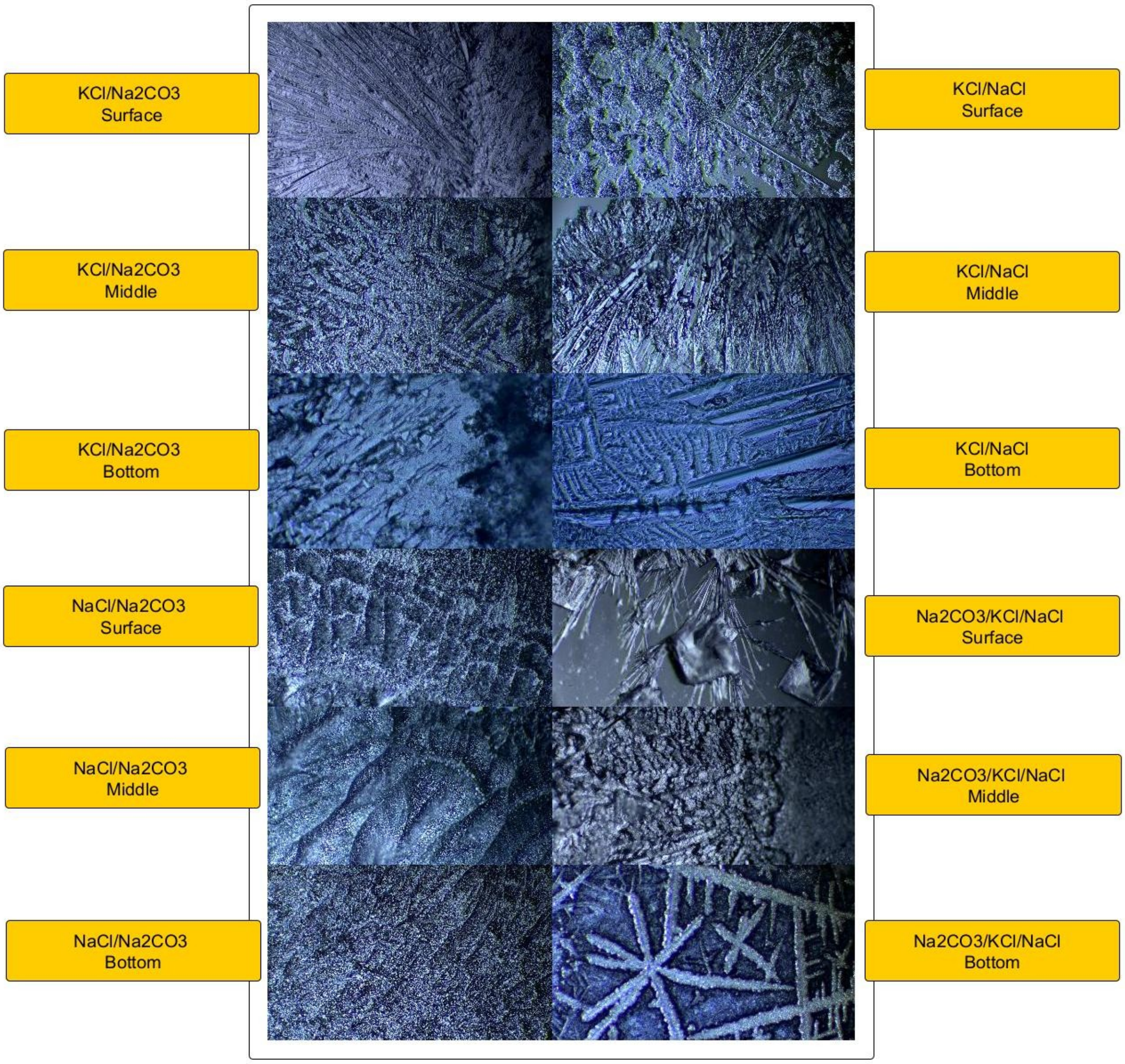


5.4.7.8.4.6.6 Figure 405: Crystal structures from pure solutions and the hybrid solution

Figure 407 shows the crystal structures obtained from pure solutions (R NaCl, R KCl, and R Na_2CO_3) as well as from the hybrid solution at different locations (HR from the surface, HR from the middle, and HR from the bottom). There are significant differences between the crystal structures formed in the pure solutions and those in the hybrid solution.

One important reason for these differences may lie in the different crystallization methods. In the case of the pure solutions, water evaporated slowly under the light microscope, whereas for the hybrid solution, heat was applied using a burner, causing much faster crystallization. In the NaCl and KCl solutions, we mostly observe dense clusters of particles, while in the Na_2CO_3 solution, a clear tree-like structure is visible. A similar pattern is also seen at the bottom of the hybrid solution, although with noticeable differences.

To better understand these differences in crystal structures, further experiments will be conducted using solution combinations such as 6 g KCl/Na_2CO_3 + 100 ml H_2O, 6 g NaCl/Na_2CO_3 + 100 ml H_2O, and 6 g NaCl/KCl + 100 ml H_2O. These solutions will be crystallized using the same procedure, and the resulting crystals will be examined under a light microscope. Once images are taken, they will be compared to those from the hybrid solution. It is expected that the resulting crystal structures will differ significantly.



5.4.7.8.4.6.7 Figure 406: Comparison of crystal structures from different solution combinations

Figure 406 presents a comparison of the crystal structures from various solution combinations previously mentioned, along with those from the hybrid solution (KCl, NaCl, and Na_2CO_3). As expected, the crystal structures differ significantly. In the hybrid solution, there appears to have been a chemical reaction between KCl and Na_2CO_3, resulting in the formation of K_2CO_3 (potassium carbonate) and additional NaCl. On the surface of this solution, characteristic rod-shaped structures of K_2CO_3 and cubic structures of NaCl can be observed. In the middle of the solution, the crystal structures are less distinct and densely packed, likely due to the accumulation of K_2CO_3, NaCl, and unreacted KCl and Na_2CO_3 particles. At the bottom of the solution, the structures are once again less compact and clearly formed into star-like and asymmetric mesh patterns.

A basic rule in crystal growth is that crystals expand in the direction where space is available, often deviating from ideal shapes like cubes. A more complex rule involves the attractive and repulsive forces between particles, which, alongside available space, greatly influence the formation of diverse crystal shapes. These forces guide particles to specific locations within the confined space, limiting their movement and thereby shaping the system. A third rule involves the speed of crystal formation, influenced by the supply of heat and cooling. Heat accelerates water evaporation and consequently speeds up crystallization, while rapid cooling solidifies the crystals in fixed positions. It is known that K_2CO_3 and Na_2CO_3 crystals tend to form rod-like and tree-like structures, whereas KCl and NaCl form mostly regular cubic shapes. On the surface of the hybrid solution, both rod-like and cubic crystals are observed, suggesting that a double displacement reaction between KCl and Na_2CO_3 may have occurred. However, this assumption cannot be extended to the middle and bottom of the solution due to the higher particle density and diversity, which limits the space available for ideal geometric forms. Given the available resources, it is difficult to identify all the individual crystal structures. Backscattered electron imaging with a scanning electron microscope might provide more insight.

The most important insight from these experiments is the role of limited space, intermolecular forces, and dynamic external conditions in determining the hierarchical associative systems within different layers of matter. This understanding also supports the discussion of Na_2CO_3's significance for humans and the broader natural hierarchical associative system.

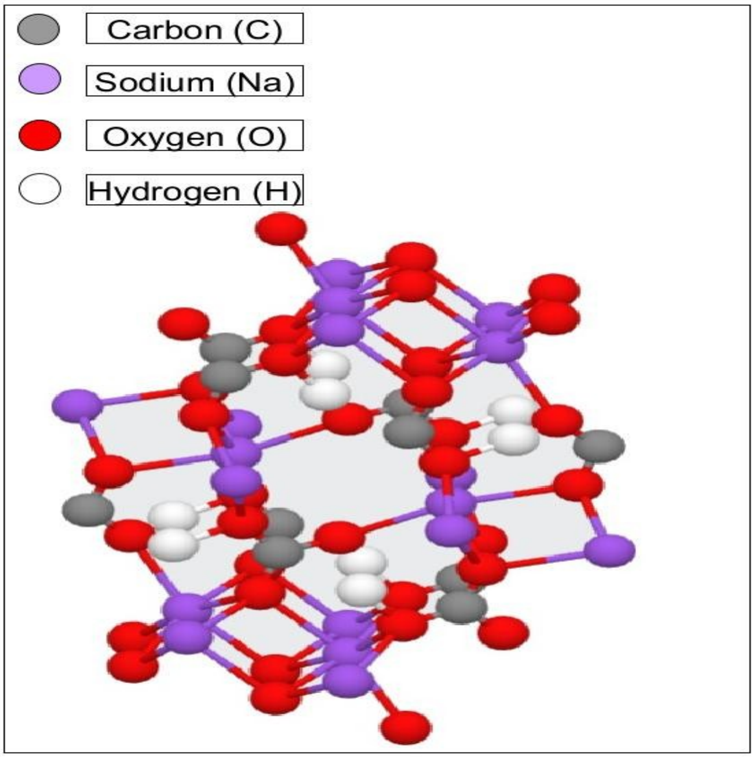
Na_2CO_3 is a widely occurring compound in nature, found in mineral waters and minerals such as natron, trona, and thermonatrite, commonly appearing as mono- or decahydrate. It plays a vital role in neutralizing overly acidic water sources and soils, which in turn makes more drinkable water available for diverse life forms and supports plant growth—a key food source. In agriculture, Na_2CO_3 is used as a natural fertilizer. Environmentally, it is a very eco-friendly compound and acts as an air purifier by neutralizing toxic gases like sulfur dioxide (SO_2) and hydrochloric acid (HCl) from factory emissions, without undergoing oxidation. Additionally, it serves as a water softener, which benefits both humans and other living organisms. It is also a component in the bone structure of some animals and humans.

For humans, Na_2CO_3 is particularly important in healthcare (e.g., gastrointestinal treatments), industry (e.g., laundry detergents, glass production), and agriculture (e.g., as a livestock feed additive). In natural hierarchical associative systems, Na_2CO_3 especially helps maintain homeostasis in regions dominated by acidic substances. This enables the growth of additional biomass in the form of plants, which are a foundational food source for many animals. While NaCl may seem more prominent, without Na_2CO_3, our planet would not be the same—Na_2CO_3 helps make Earth a hospitable home for countless living beings.

5.4.7.8.5 Sodium bicarbonate (Baking Soda)

Sodium bicarbonate (hereafter: $NaHCO_3$), like Na_2CO_3, is an ionic compound with very similar properties. It is the product of a chemical reaction between the strong base NaOH and the weak acid H_2CO_3, and it has a fairly alkaline pH (around 9). When heated, it decomposes into Na_2CO_3, CO_2, and H_2O. $NaHCO_3$ is one of the few bicarbonates that is soluble in water (and is also slightly soluble in acetone and methanol). It appears as a white powder or white crystals. In its solid state, $NaHCO_3$ has a density of 2.2 g/cm³ and a molar mass of 84.007 g/mol. Its solubility in water at 20 °C is 9.34 g per 100 ml.

In nature, sodium bicarbonate also occurs as a mineral in a whitish-grey crystalline form known as nahcolite or thermokalite. The crystal system of $NaHCO_3$, like that of Na_2CO_3, is monoclinic. It is worth taking a closer look at the crystal structure of $NaHCO_3$.



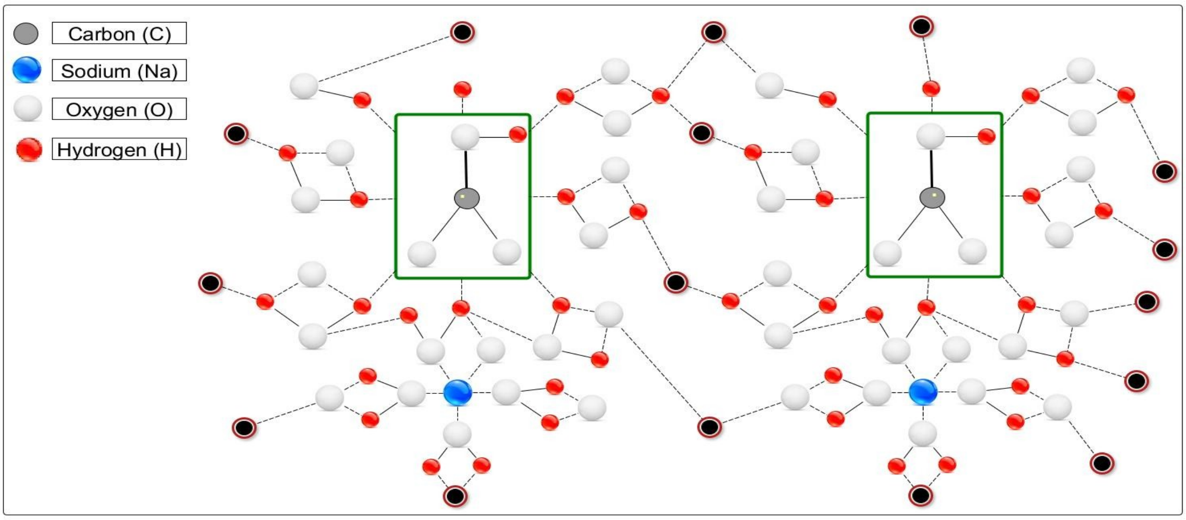
5.4.7.8.5.1 Figure 407: Crystal structure of $NaHCO_3$

Figure 407 shows the crystal structure of $NaHCO_3$, which is remarkably similar to that of Na_2CO_3, with the key difference being the presence of hydrogen atoms.[264] In this crystal structure, hydrogen atoms link the carbonate groups together to form infinite chains. The crystals exhibit perfect cleavage, and the bonds between hydrogen and oxygen atoms are not particularly strong. $NaHCO_3$ crystals are monoclinic and prismatic. The unit cell contains four molecules. Each sodium atom is surrounded by six oxygen atoms at an average distance of 2.47 Å. Each hydrogen atom is bonded to

264 The crystal structure was created based on a web application on the website https://materialsproject.org/materials/mp-696396/ (2022-07-20).

two oxygen atoms, forming a nearly linear O–H–O group, with the H–O distance being approximately 1.27 Å.[265] In this structure, we once again encounter oxygen bridges, which bond on one side to the Na^+ cation and on the other to C^{4+} atoms, meaning that there are no direct bonds between the Na^+ cation and the C^{4+} atom in $NaHCO_3$. Instead of the $(CO_3)^{2-}$ polyatomic anion found in Na_2CO_3, this compound contains the $(HCO_3)^-$ polyatomic anion. The C^{4+} atom is bonded to two oxygen atoms and one OH^- group, leaving one oxygen atom with a free bond that is attached to the Na^+ cation. From this structural perspective, the empirical formula could also be written as NaOCOOH.

When $NaHCO_3$ dissolves in water, it dissociates into Na^+ cations and $(HCO_3)^-$ polyatomic anions. Similar to the case of Na_2CO_3, this process is an exothermic reaction that releases thermal energy. The density of a 5% $NaHCO_3$ solution at 20°C is approximately 1.030 g/cm³. The distances between Na^+ cations and $(HCO_3)^-$ anions are greater than those observed in Na_2CO_3, which could suggest that the conductivity of $NaHCO_3$ solutions is higher than that of Na_2CO_3. This hypothesis will be revisited during measurements of density and conductivity. As with the previously discussed solutions of chemical compounds, this subsection will also examine the network of water molecules and $NaHCO_3$ ions.

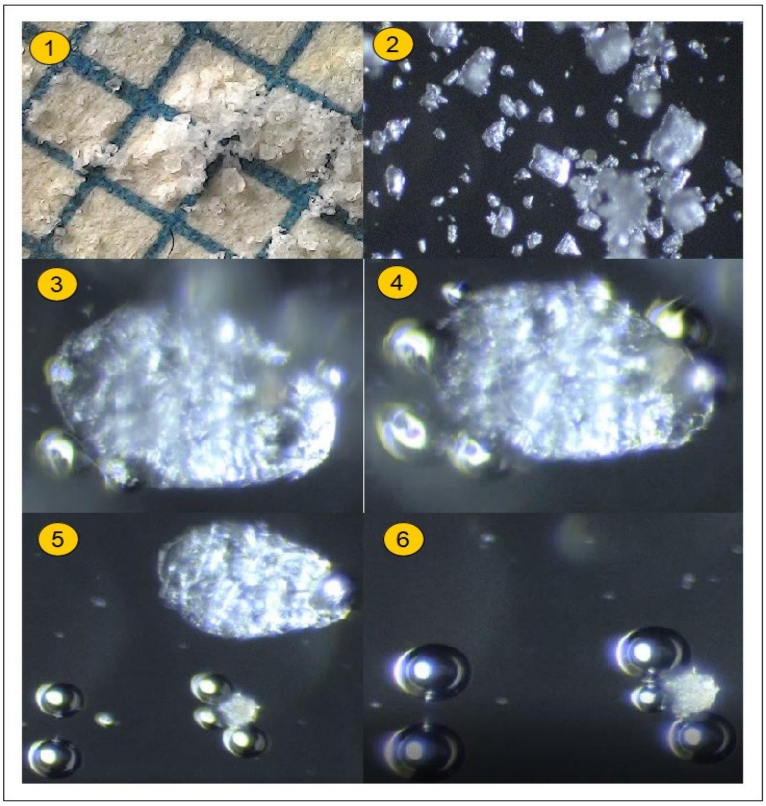


5.4.7.8.5.2 Figure 408: Fragment of the network of water molecules and $NaHCO_3$ ions

Figure 408 shows a fragment of the network of water molecules and $NaHCO_3$ ions, which consists of four different elements: carbon (C), sodium (Na), oxygen (O), and hydrogen (H). The positive side of the water molecules surrounds the $(HCO_3)^-$ polyatomic anions, while the negative side surrounds the Na^+ cations. Given that this structure is quite similar to the one observed in the Na_2CO_3 solution, further detailed discussion of this specific substance will be omitted. As with the

265 Zachariasen, W. H. (1933). The crystal lattice of sodium bicarbonate, $NaHCO_3$. *The Journal of Chemical Physics*, 1(9), 634–639. https://doi.org/10.1063/1.1749342.

previously examined chemical compounds, images of $NaHCO_3$ powder will be taken under a USB microscope, and a micro quantity of the substance will be dissolved in two drops of distilled water, with the process again observed under a light microscope.

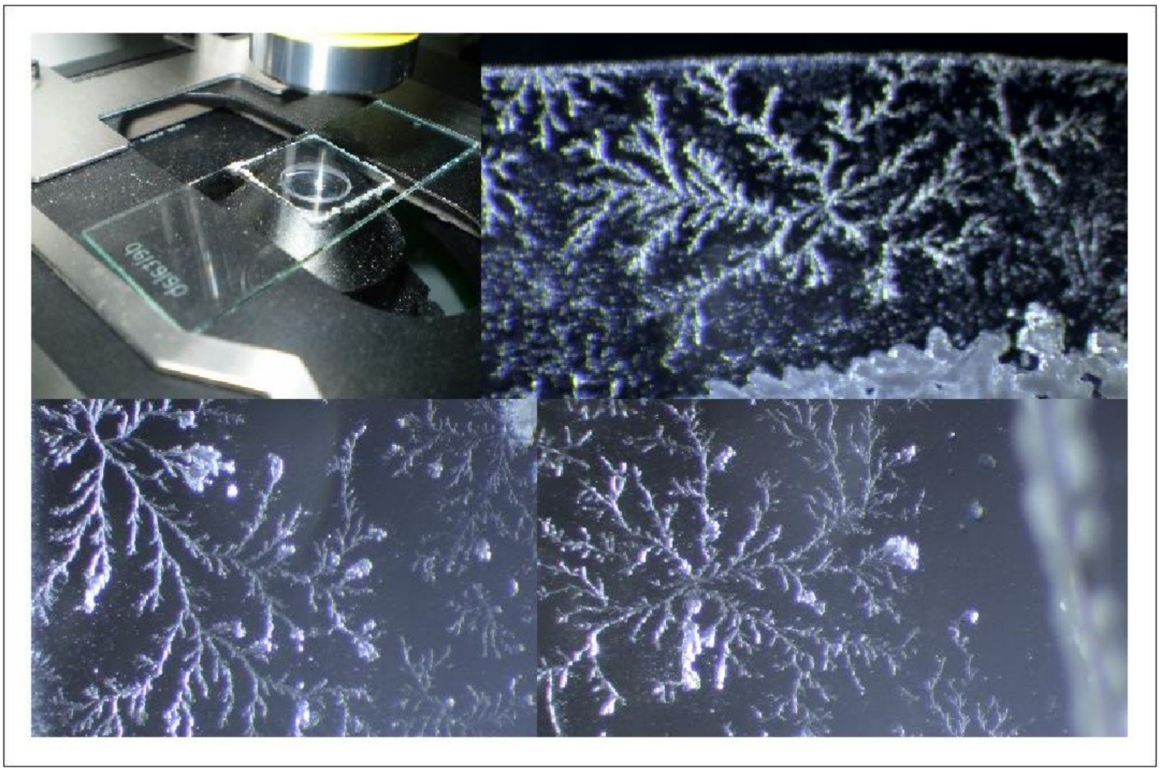


5.4.7.8.5.3 Figure 409: Dissolution of fine amorphous $NaHCO_3$ crystals in water

Figure 409 shows amorphous $NaHCO_3$ crystals (see the upper left part of the image marked as 1) and the phases of their dissolution in two drops of distilled water (see images marked from 2 to 6). Once again, we are dealing with a distinctly different dissolution process of the crystals, and it is worth emphasizing that the dissolution time of smaller microcrystals was significantly faster, while the dissolution of larger crystals took slightly longer compared to Na_2CO_3. This longer dissolution time of larger $NaHCO_3$ crystals, in comparison with Na_2CO_3 crystals, can be explained by the greater distance between the Na^+ cation and the oxygen atom bonded within the polyatomic $(HCO_3)^-$ ion group:

d_{NaHCO_3} = 2.47 Å > d_Na_2CO_3 = 2.30 Å.

What follows is a comparison of the crystallization processes between $NaHCO_3$ and Na_2CO_3 under a light microscope.



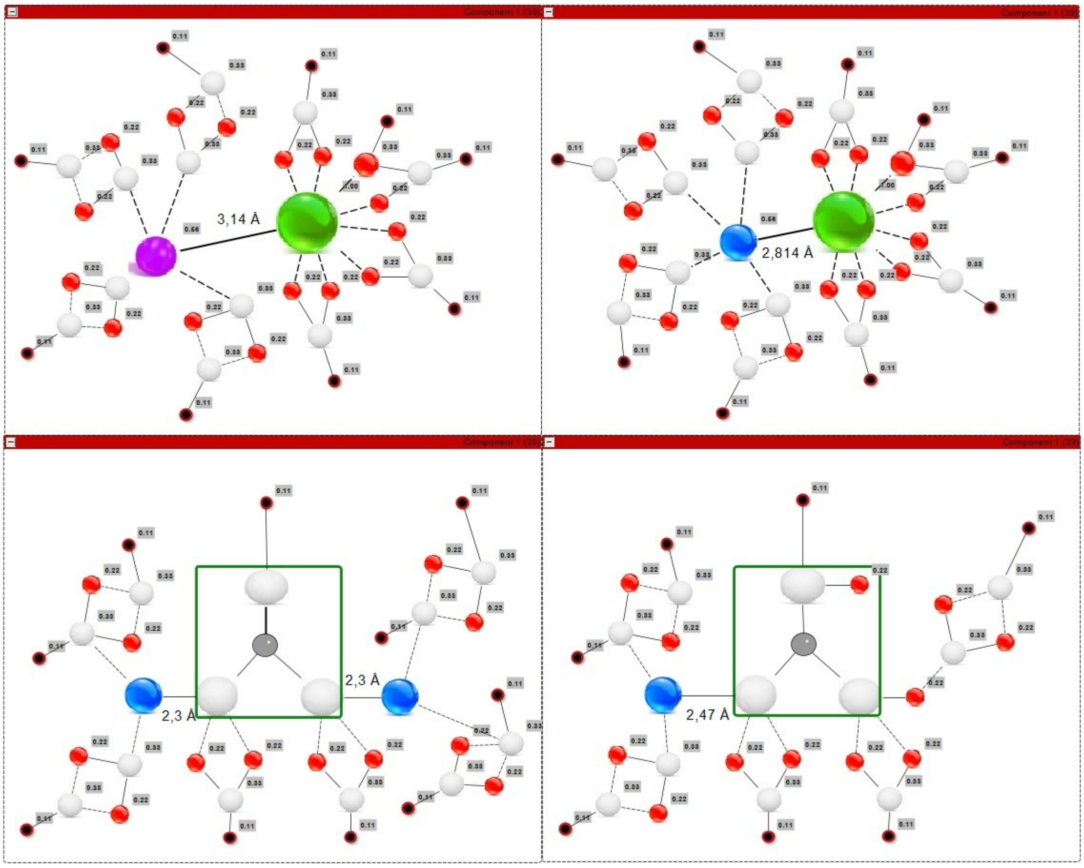
5.4.7.8.5.4 Figure 410: Comparison of crystallization between $NaHCO_3$ and Na_2CO_3 under a light microscope

Figure 410 presents a comparison of the crystallization patterns of $NaHCO_3$ (see the lower part of the image) and Na_2CO_3 (see the upper part of the image). The images reveal that both compounds form very similar tree-like crystal structures, with recurring patterns of branches and leaf-like formations. The branch and foliage density is higher in Na_2CO_3 crystals than in $NaHCO_3$, which can be inferred from the images and the ionic distances between the Na^+ cation and the O^{2-} atom bonded within the polyatomic anions $(HCO_3)^-$ and $(CO_3)^{2-}$.

When observing crystals of both alkali metal chlorides and carbonates, we repeatedly encounter structurally similar forms that primarily differ in the spacing and density of the ions. These differences ultimately result in distinct collective ionic behaviors, measurable through conductivity in millisiemens (mS). Salts of weak acids and strong bases typically exhibit lower conductivity, while salts formed from strong acids and strong bases show higher conductivity.

The tree-like structures of Na_2CO_3 and $NaHCO_3$ crystals raise the intriguing notion that the resulting crystal formations may be somewhat distorted reflections of ionic organization in solution. On the one hand, strict hierarchical arrangements appear to govern the crystal shape, clearly visible in the tree-like structures; on the other hand, associative forces allow for the repeated patterns of branches and leaves. The final result of this interplay between hierarchy and association is the branching and variability of the crystal structures.

When external conditions such as heat input change, both the hierarchy and association of particles are significantly altered, leading to distinctly different hierarchical and associative structures. Next follows a comparative overview of cation-anion distances in the ionic polar solutions discussed so far.



5.4.7.8.5.5 Figure 411: Comparison of distances between cations and anions in NaCl, KCl, Na_2CO_3, and $NaHCO_3$ solutions

Figure 411 shows a comparison of the distances between cations and anions in solutions of NaCl, KCl, Na_2CO_3, and $NaHCO_3$. The greatest ionic distance was measured in KCl solutions (d = 3.14 Å), followed by NaCl (d = 2.814 Å), then $NaHCO_3$ (d = 2.47 Å), with the shortest distances found in Na_2CO_3 solutions (d = 2.30 Å).

In terms of solution density, the ranking is as follows: Na_2CO_3 has the highest density, followed by NaCl, while KCl and $NaHCO_3$ solutions fall at the lower end. Interestingly, this breaks the typical rule that shorter ion distances correspond to higher densities—since $NaHCO_3$ has a shorter ionic distance than NaCl, it would be expected to have a higher density, but it does not.

This deviation could be attributed to the hydrogen atom bonded to the carbonate group in $NaHCO_3$, which effectively replaces a Na^+ cation in Na_2CO_3 solutions. Despite this, it is important to highlight that $NaHCO_3$ has a higher molecular mass than both KCl and NaCl, but a lower molecular mass than Na_2CO_3.

Since mass surface values for other compound solutions have already been calculated, the next step will be to calculate the mass surface for $NaHCO_3$ ions in a solution with a concentration of 1 g of salt per 100 mL of H_2O.

ρ_{Na2CO3} = 1008 Kg/m^3; ρ_{NaCl} = 1006 Kg/m^3; ρ_{KCl} = 1004 Kg/m^3; ρ_{NaHCO3} = 1004 Kg/m^3

$S_{Na2CO3+/-} = d_{Na2CO3+/-} \cdot \rho_{Na2CO3} = 2{,}3 \cdot 10^{-10}\ m \cdot 1008\ Kg/m^3 = 2318{,}4 \cdot 10^{-10}\ Kg/m^2$

$S_{NaCl+/-} = d_{NaCl+/-} \cdot \rho_{NaCl} = 2{,}814 \cdot 10^{-10}\ m \cdot 1006\ Kg/m^3 = 2830{,}9 \cdot 10^{-10}\ Kg/m^2$

$S_{KCl+/-} = d_{KCl+/-} \cdot \rho_{KCl} = 3{,}14 \cdot 10^{-10}\ m \cdot 1004\ Kg/m^3 = 3152{,}6 \cdot 10^{-10}\ Kg/m^2$

$S_{NaHCO3+/-} = d_{NaHCO3+/-} \cdot \rho_{NaHCO3} = 2{,}47 \cdot 10^{-10}\ m \cdot 1004\ Kg/m^3 = 2479{,}9 \cdot 10^{-10}\ Kg/m^2$

The ions with the largest mass surface area in solutions with the given concentration are those of KCl, followed by NaCl, $NaHCO_3$, and finally Na_2CO_3, which has the smallest mass surface area.

The relationship can be summarized as:

$d_{Na2CO3} < d_{NaHCO3} < d_{NaCl} < d_{KCl} \triangleq \rho_{Na2CO3} > \rho_{NaCl} > \rho_{KCl} = \rho_{NaHCO3} \triangleq S_{KCl} > S_{NaCl} > S_{NaHCO3} > S_{Na2CO3}$

Based on this expression, $NaHCO_3$ solutions are expected to have a higher conductivity than Na_2CO_3 solutions. This hypothesis will be revisited once the conductivities of $NaHCO_3$ solutions at various concentrations have been measured.

Now, let's calculate the number of ions in a small crystal with an estimated mass of 0.00005 g. The molar mass of $NaHCO_3$ is known to be 84.0007 g/mol. Using this information, we can calculate the number of moles:

$$ML = \frac{m_{kNaHCO3}}{M_{NaHCO3}} = \frac{(0{,}00005\,g)}{(84{,}0007\frac{g}{mol})} = 5{,}95 \cdot 10^{-7}\,moles$$

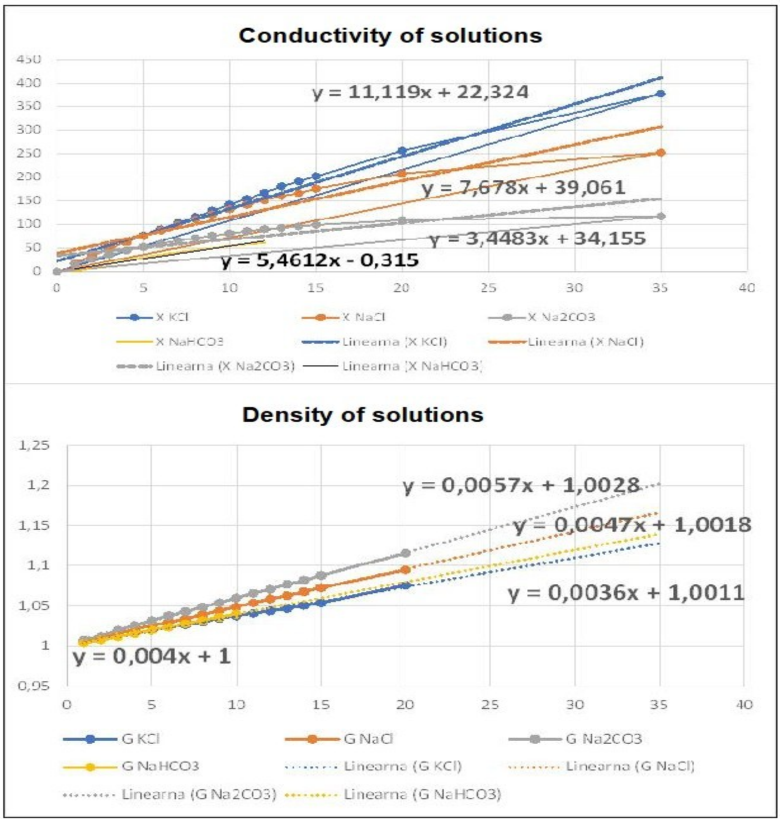
In a small $NaHCO_3$ crystal with a mass of 0.00005 g, there are $5.95 \cdot 10^{-7}$ moles present. As per the standard calculation procedure, the number of ions is calculated as follows:

$$N_i = ML \cdot N_a = 5{,}95 \cdot 10^{-7} \cdot 6{,}023 \cdot 10^{23} = 3{,}58 \cdot 10^{17}\,ions$$

In a single amorphous $NaHCO_3$ crystal, there are on average $3.58 \cdot 10^{17}$ ions, which means $1.79 \cdot 10^{17}$ Na^+ cations and $1.79 \cdot 10^{17}$ $(HCO_3)^-$ polyatomic anions—more than in Na_2CO_3 but fewer than in NaCl and KCl. Based on data about the mass surface area between ions (kg/m^2) in the $NaHCO_3$ solution and the number of ions, we can expect to measure higher conductivity values for $NaHCO_3$ solutions (ranging from 1 g $NaHCO_3$ + 100 ml H_2O to 20 g $NaHCO_3$) than for Na_2CO_3, but lower than those of NaCl and KCl solutions. This assumption will be addressed based on the results of conductivity measurements.

5.4.7.8.5.5.1 Table 185: Measured conductivities and densities for KCl, NaCl, Na2CO3 and NaHCO3 solutions

C	*χ KCl*	*P KCl*	*χ NaCl*	*ρ NaCl*	*χ Na_2CO_3*	*ρ Na_2CO_3*	*ρ $NaHCO_3$*	*χ $NaHCO_3$*
1	17.05	1.0040	17.85	1.0060	14.84	1.0080	1.0040	8.89
2	32.9	1.0080	33.9	1.0110	26.3	1.0120	1.0080	16.5
3	48.1	1.0120	48.5	1.0160	36.1	1.0200	1.0120	23.3
4	62.3	1.0160	62.2	1.0210	44.8	1.0260	1.0160	29.5
5	76.1	1.0200	75.6	1.0260	52.4	1.0320	1.0200	35.1
6	89.7	1.0240	87	1.0300	59.4	1.0380	1.0240	40.7
7	103.4	1.0270	99.3	1.0340	65.6	1.0430	1.0280	45.2
8	116.3	1.0300	111	1.0390	71.4	1.0490	1.0320	49.8
9	129.4	1.0350	121.7	1.0440	76.6	1.0540	1.0360	54.1
10	142.1	1.0380	132.3	1.0490	80.7	1.0600	1.0400	58.3
11	154.4	1.0410	141.9	1.0540	85.7	1.0660		60.8
12	167.4	1.0440	151.4	1.0590	90	1.0710		
13	180.5	1.0470	160.5	1.0630	92.4	1.0770		
14	191	1.0510	166.4	1.0680	96.1	1.0820		
15	202	1.0540	176.2	1.0730	99	1.0880		
20	257	1.0690	208	1.0980	109.3	1.1160		
35	378		253		117.6			

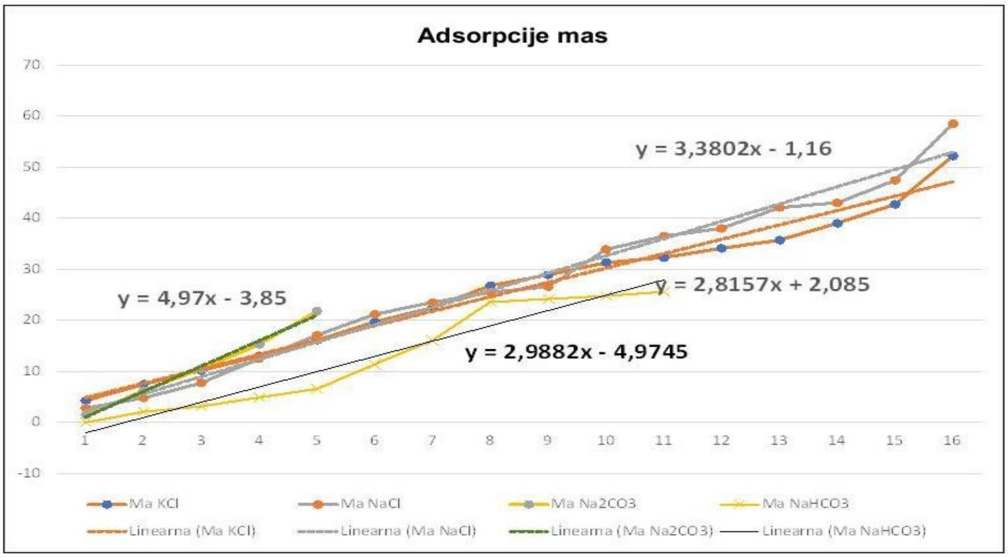


5.4.7.8.5.5.2 Figure 412: Comparison of conductivity and density of solutions for $NaHCO_3$, Na_2CO_3, KCl, and NaCl

Table 185 presents the measured values for conductivity (χ) and density (ρ) of solutions with various concentrations (C) for KCl, NaCl, Na_2CO_3, and $NaHCO_3$, while Figure 412 shows comparative graphs resulting from these measured values. The deviation from the established rule, which states that conductivity values are lower for solutions of chemical compounds with higher density, shorter distances between cations and anions, and consequently smaller molecular surface area, is observed in the measured values for $NaHCO_3$ solutions. These have lower conductivity than Na_2CO_3, a lower density, and a greater distance between cations and anions (d_{NaHCO_3} = 2.47 Å > $d_{Na_2CO_3}$ = 2.30 Å). Based on the values of these distances, we would expect $NaHCO_3$ solutions to have higher conductivity than Na_2CO_3 solutions. The deviation from this rule can be explained by the lower solubility of $NaHCO_3$ in water compared to Na_2CO_3. Hydrogen carbonates are generally extremely poorly soluble in water, with $NaHCO_3$ being the most soluble hydrogen carbonate. In alkali metal hydrogen carbonates, an intermolecular hydrogen bond is involved, which inhibits the normal dissociation process in water, requiring more energy for the dissociation of $NaHCO_3$ into ions. When heat is supplied to the $NaHCO_3$ solution, its solubility increases. At 20°C, the solubility of $NaHCO_3$ in water is 9.34 g/100 ml, which means we are dealing with a saturated solution. During these measurements, $NaHCO_3$ at a concentration of 10 g + 100 ml H_2O completely dissolved due to the higher sample temperature (27.6°C). However, when attempting to dissolve 11 g of $NaHCO_3$ in 100 ml of H_2O, it no longer completely dissolved, resulting in the formation of an over-saturated solution. In summary, in addition to the distance between ions, the number of ions, density, and mass adsorption on the filter paper, it is necessary to include the solubility potential in water in the rule, which allows for a preliminary estimation of the conductivity of solutions. Despite a relatively clear measure regarding the solubility potential of a given salt in water, this is not entirely without exceptions, as highlighted by the comparison of conductivity between NaCl and KCl solutions. Namely, NaCl is more soluble in water than KCl, yet KCl solutions achieve higher conductivity, which can be explained by interionic distances. The greater the distance between ions, the higher the conductivity of the solution may be. What has been discussed means that there are different hierarchies of explanations for better or worse solubility in solutions with ionic polar bonds, and a comprehensive or matrix-based study of the causes is necessary. There is no completely linear rule regarding explanations of better conductivity, which is characteristic of hierarchical associative systems, although science continues to develop models that, for simplification, approximate a linear view. There is nothing wrong with using such simplifications as initial guidance when studying specific phenomena, but for a better understanding of these phenomena, it is necessary to deepen and expand the interpretation with associative connections. For the specific case of studying the cause of better or worse conductivity, this means considering all indicators and clearly defining their greater or lesser influence. As a basic model, we can derive the statistical dominance of individual indicators over others, but it is much more appropriate to include a comparison with less influential indicators. In this case, it was clear that there are a relatively large number of exceptions that do not conform to a particular model or rule, which makes any model of statistical dominance just a large approximation of our relative truths. Let us now examine the obtained results for the adsorbed masses.

5.4.7.8.5.5.3 Table 186: Adsorptions of KCl, NaCl, Na2CO_3 and $NaHCO_3$ solutions by mass

C	*Ma KCl*	*Ma NaCl*	*Ma Na_2CO_3*	*Ma $NaHCO_3$*
1	4.3	2.8	1.5	2.1
2	7.5	4.8	6.2	3.2
3	10.2	7.8	10.5	4.9
4	13.0	12.5	15.3	6.6
5	16.1	17.1	21.8	11.4
6	19.7	21.2	na	16.1
7	22.5	23.5	na	23.6
8	26.8	25.5	na	24.2
9	28.9	26.6	na	24.8
10	31.3	33.9	na	25.6
11	32.3	36.5	na	na
12	34.1	38.0	na	na
13	35.7	42.1	na	na
14	39.0	43.0	na	na
15	42.7	47.4	na	na
20	52.2	58.5	na	na



5.4.7.8.5.5.4 Figure 413: Adsorption of masses from $NaHCO_3$, Na_2CO_3, NaCl, and KCl solutions

Table 186 shows the measured values of adsorbed masses from solutions of various concentrations of KCl, NaCl, Na_2CO_3, and $NaHCO_3$, while Figure 413 provides a visual representation of the measured adsorption values for $NaHCO_3$, Na_2CO_3, NaCl, and KCl solutions of different concentrations.

The lowest adsorption masses were observed for $NaHCO_3$ solutions, with a slight initial increase. From a concentration of 5 g $NaHCO_3$ + 100 ml H_2O to 8 g $NaHCO_3$ + 100 ml H_2O, the adsorption values increase sharply, and from 9 g to 10 g $NaHCO_3$ + 100 ml H_2O, the increase is almost negligible.

Interestingly, in these experiments, it was possible to measure the adsorbed mass of $NaHCO_3$ using ignition (burning) of the filter paper, although the paper was somewhat more difficult to ignite at higher concentrations. This method could not be used for Na_2CO_3 solutions at a concentration of 6 g + 100 ml H_2O.

An important note regarding $NaHCO_3$ is that it decomposes at 80°C into Na_2CO_3, H_2O, and CO_2. During ignition, the reduction in adsorbed mass is due to the loss of CO_2, meaning the final result reflects the adsorbed mass of Na_2CO_3. For more accurate results with $NaHCO_3$, drying the soaked filter paper (without ignition) would be a better method. However, for consistency across all adsorption mass measurements, the ignition method was still appropriately used.

The lowest adsorbed mass values of $NaHCO_3$ coincided with the lowest conductivity values of $NaHCO_3$ solutions at different concentrations. For Na_2CO_3 solutions, it was found that particles reached as far as the final third or even the edge line of the filter paper, which did not occur with KCl and NaCl solutions. In those cases, only a very small mass was adsorbed in the final third of the filter paper.

A similar effect was observed for $NaHCO_3$ solutions—especially between concentrations of 4 g + 100 ml H_2O and 10 g + 100 ml H_2O—where many particles reached the final third or edge of the filter paper. As a result, the paper was more difficult to ignite. Impregnating the paper with Na_2CO_3 could prevent ignition and thus avoid fires. This is not necessarily true for $NaHCO_3$, as the paper still ignites, albeit with more difficulty. It is also worth noting that in the paper industry, Na_2CO_3 is commonly used to soften cellulose fibers and to bleach paper.[266] The density of $NaHCO_3$ solutions, along with KCl solutions, is the lowest among the studied compounds. The interionic distances are small, only slightly larger than those in Na_2CO_3 solutions. Among the chemical compounds examined so far, $NaHCO_3$ is the least soluble in water, which results in the lowest conductivity values compared to solutions of other chemical compounds. Consequently, the smallest adsorption masses were also observed on the filter papers.

266 https://www.echemi.com/cms/703927.html (2022-07-24).

At or near the saturation level of the $NaHCO_3$ solution, the conductivity was measured at 58.3 mS, while at supersaturation, it was 60.8 mS. This indicates that, relative to the input mass, the conductivity reached its highest efficiency at (approximately) the saturation point.
When applying the efficiency indicator based on the input mass, an impressively high efficiency of about 95.89% was observed—this is the highest among all the studied solutions of various chemical compounds.
A comparison of the conductivity values of $NaHCO_3$ solutions with those of other chemical solutions reveals a significant difference, indicating the weakest collective ion effects in $NaHCO_3$ solutions. This observation is further supported by the measured values of adsorbed masses.
The maximum adsorbed mass was found to be 25.6 mg, and the trend line does not show a significant increase (approximately 28 mg). The clearest understanding of this can be obtained by calculating the ratios of the maximum values for both conductivity and adsorbed mass.

$\chi_{maxKCl} : \chi_{maxNaHCO3} = 378$ mS : 60,8 mS = 6,22; $M_{amaxKCl} : M_{amaxNaHCO3} = 52{,}2$ mg : 25,6 mg = 2,04

$\chi_{maxNaCl} : \chi_{maxNaHCO3} = 253$ mS : 60,8 mS = 4,16; $M_{amaxNaCl} : M_{amaxNaHCO3} = 58{,}5$ mg : 25,6 mg = 2,29

$\chi_{maxNa2CO3} : \chi_{maxNaHCO3} = 117{,}6$ mS : 60,8 mS = 1,93; $M_{amaxNa2CO3} : M_{amaxNaHCO3} = 21{,}8$ mg : 11,4 mg = 1,91

In all calculated ratios, it can be observed that the collective effects of dissolved $NaHCO_3$ ions are the weakest compared to other dissolved chemical compounds in water. The collective effects of dissolved KCl ions are 6.22 times stronger than those of $NaHCO_3$, for NaCl the multiplier was calculated at 4.16, while the collective effects of Na_2CO_3 ions were 1.93 times stronger than those of $NaHCO_3$. These weaker collective effects are further confirmed by the calculated adsorption mass ratios.

A key reason for the weaker collective effects is the small hydrogen atom bonded within the carbonate group, which essentially acts as a kind of resistance. In natural hierarchical associative systems, this resistance—or more accurately, a kind of safeguard—likely helps maintain a balance of different types of forces and prevents excessive conductivity potential at certain locations on our planet where it might otherwise hinder the optimal functioning of natural forces.

An additional experiment was carried out using a hybrid or multi-component solution, this time with the inclusion of $NaHCO_3$. The solution was prepared by weighing 1.5 g each of $NaHCO_3$, Na_2CO_3, KCl, and NaCl into a 150 ml glass, followed by the addition of 100 ml of distilled water. Due to the need to mix the hybrid solution, a magnetic stirrer and a stirring magnet were used. The sample was covered with a piece of stiff paper. The stirring process lasted several hours, after which the solution was placed in a dark corner of the room.

The following day, the conductivity, density, and adsorption mass of the hybrid solution were measured. The obtained values were then compared with those from the first hybrid solution experiment.

5.4.7.8.5.5.5 Table 187: Comparison between hybrid solutions and pure solutions

Solutions	*χ (mS)*	*ρ (g/cm³)*	*Ma (mg)*
Hybrid 6 g+100 ml H_2O	78,1	1,030	21,1
Hybrid2 6 g+100 ml H_2O	68,3	1,029	15
KCl 6 g+100 ml H_2O	89,7	1,024	19,7
NaCl 6 g+100 ml H_2O	87	1,030	21,2
Na_2CO_3 6 g+100 ml H_2O	59,4	1,038	24,5

Table 187 presents data on the measurements of conductivity, density, and adsorbed mass for two hybrid and three pure solutions. The hybrid solution labeled 2 consisted of 1.5 g of NaCl, 1.5 g of KCl, 1.5 g of Na_2CO_3, and 1.5 g of $NaHCO_3$ in 100 ml of distilled water.
It can be observed that under the influence of $NaHCO_3$, the conductivity decreased to 68.3 mS, which is 9.8 mS lower than that of the hybrid solution without $NaHCO_3$. This drop in conductivity was accompanied by a decrease in adsorbed mass on the filter paper strip: in hybrid solution 2, the adsorbed mass was 15.0 mg, whereas in the first hybrid solution it was 21.1 mg.
Interestingly, the density of the two hybrid solutions did not differ significantly ($\rho H1 = 1.030$ g/cm³ $\neq \rho H2 = 1.029$ g/cm³). This suggests that $NaHCO_3$ acts as a kind of resistance, reducing conductivity in the hybrid solution. This effect is mainly due to its lower solubility in water, which is further influenced by the hydrogen bond within the $(HCO_3)^-$ polyatomic anion group.
In nature, $NaHCO_3$, found in the form of the mineral nahcolite, likely performs a similar role to Na_2CO_3. It is found around the world—except in Australia—and acts as a buffer, neutralizing soil acidity and promoting the growth of plants and algae, which contribute to both food production and oxygen generation in the atmosphere. Additionally, $NaHCO_3$ plays a role in maintaining water purity.
Sodium bicarbonate is widely useful in both household and industrial contexts. It is used as a food additive, medicine, and cleaning agent, and also finds application in pyrotechnics (e.g., fireworks), fire extinguishers, fungicides, and pesticides.
In the human body, $NaHCO_3$ is produced daily by the kidneys, stomach, and pancreas, helping to reduce acidity in bodily fluids, especially in the blood. Based on this brief overview, it can be concluded that $NaHCO_3$'s positive role in natural hierarchical associative systems is primarily

neutralizing and healing in nature. Over the centuries, humans have acquired various forms of knowledge about this chemical compound in order to use it beneficially across many industrial applications. Sodium bicarbonate can also be found in small quantities in various water sources such as seas and lakes.

5.4.7.8.6 Calcium carbonate (Limestone, Chalk, Marble)

Calcium carbonate (hereafter referred to as $CaCO_3$) can occur in both -amorphous (powdered)- and -crystalline- forms. It is found in rocks such as -aragonite-, -vaterite-, -vermiculite-, -calcite-, -chalk-, -limestone-, -marble-, -travertine-, and others. In its solid aggregate state, its -density ranges- from approximately -2.7 to 2.9 g/cm^3-, and its -molecular weight- is -100.1 g/mol-. It decomposes at a temperature of -800°C- into -calcium oxide (CaO)- and -carbon dioxide (CO_2)-, and is -poorly soluble in water- (only -0.0013 g per 100 ml of H_2O-).

$CaCO_3$ is -slightly to moderately alkaline- and has an -ionic chemical bond-, consisting of a -Ca^{2+} cation- and a -$(CO_3)^{2-}$ polyatomic anion-. Unlike Na_2CO_3, the -Ca^{2+} cation binds to two oxygen atoms-, so the empirical structure could be written as -CaOOCO-.

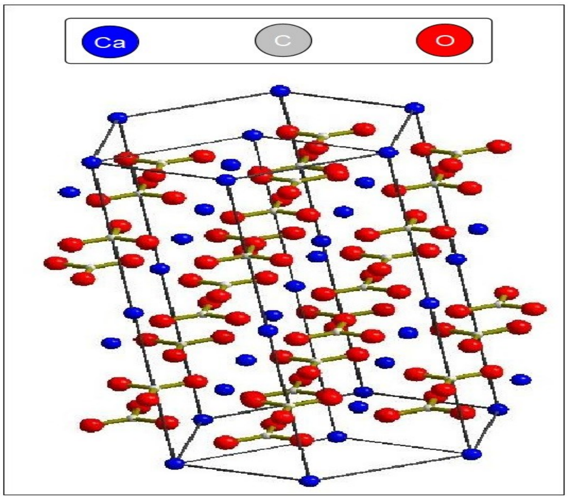
This ionic compound occurs in -three different crystalline forms-:

-Calcite- (trigonal-hexagonal β),

-Aragonite- (orthorhombic λ),

-Vaterite- (hexagonal μ).

Since the experiments will be conducted using -pure white powdered $CaCO_3$-, most commonly derived from the -mineral calcite- (e.g., -limestone- or -chalk-), we will take a closer look specifically at the -crystal structure of calcite.



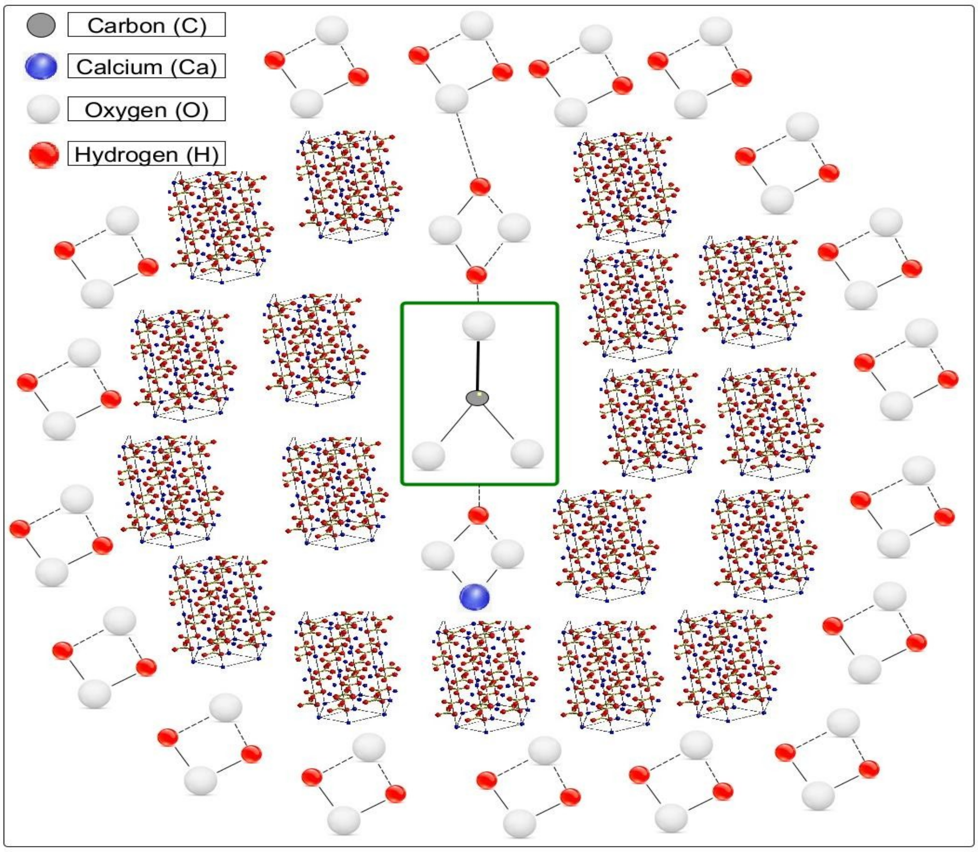
5.4.7.8.6.1 Figure 414: Crystal structure of calcite

Figure 414 illustrates the trigonal crystal structure of calcite, which is mostly white in color, although it can also be found in other colors. The distance between Ca^{2+} cations and O^{2-} ions is approximately 2.3528 Å, while the distance between C^{4+} and O^{2-} ions is 1.2713 Å. The ionic radii are as follows: Ca^{2+} is 1.14 Å, C^{4+} is 0.16 Å, and O^{2-} is 1.26 Å.

The lattice energy of $CaCO_3$ (calcite) is approximately 2800 kJ/mol, while its hydration energy is –229 kJ/mol. Due to the significantly higher lattice energy compared to the hydration energy, this chemical compound is not very soluble in water. For a substance to be more soluble, the hydration energy must not be lower than the lattice energy of the compound.

$CaCO_3$ is most soluble in very cold water, as its solubility decreases with increasing temperature. This is also the main reason why it does not react or fully dissociate in distilled or tap water. However, $CaCO_3$ does react with rainwater, as it contains CO_2, forming calcium hydrogen carbonate ($Ca(HCO_3)_2$), which is much more soluble in water.

Based on this information, it is clear that measurements of conductivity, density, and adsorbed mass for $CaCO_3$ will not be feasible. In the following section, a model of $CaCO_3$ will be presented, showing hydration shells around the ions, although these are limited due to the compound's poor solubility.



5.4.7.8.6.2 Figure 415: Ionic polar bond network of $CaCO_3$ in water

Figure 415 illustrates the network of ionic polar bonds of $CaCO_3$ in water, where it is immediately noticeable that there are very few hydration shells surrounding both the Ca^{2+} cations and the $(CO_3)^{2-}$

polyatomic anions. This is due to the extremely low solubility of $CaCO_3$ in water, preventing the formation of repeating patterns typically seen in dissolved ionic compounds.

However, repeating motifs of undissolved $CaCO_3$ crystal lattices (calcite) are clearly present. Water molecules are located around these lattices, but they do not form hydration shells around the undissolved crystal structures. The undissolved $CaCO_3$ settles at the bottom of the container, and in a solution containing 1 g of $CaCO_3$ in 100 ml of water, only about 0.13% of the compound actually dissolves.

This very small amount of dissolved salt can primarily be found in the central part of the solution, with a notable concentration near the sediment. At the very top of the solution, water molecules dominate even more strongly. The number of ions present in the solution at a concentration of 1 g $CaCO_3$ + 100 ml H_2O can be calculated using the same method applied in previous calculations.

$$ML=\frac{m_{kCaHCO3}}{M_{CaCO3}}=\frac{(0{,}0013\,g)}{(100{,}1\frac{g}{mol})}=1{,}30\ \cdot 10^{-5}\,moles$$

The mass of 0.0013 g of soluble CaCO3 gives us 1.35 · 10^{-5} moles as a result.

$$N_i=ML\ \cdot N_a=\ 1{,}30\ \cdot 10^{-5}\ \cdot 6{,}023\ \cdot 10^{23}=7{,}83\ \cdot 10^{18}\,ions$$

In the mass of dissolved $CaCO_3$ in 100 ml of water, there are approximately 7.83 × 10^{18} ions. For the optimal functioning of the natural hierarchical associative system, this low solubility in water—and consequently the small number of ions—is likely of critical importance in maintaining the neutralization balance of both soil and water sources.

In every respect, $CaCO_3$ contributes to the creation of water with minimal carbon dioxide content and an optimal amount of undissolved oxygen, which is vital for many forms of life, such as insects, fish, amphibians, plants, and algae. Although $CaCO_3$ is poorly soluble in pure water, it dissolves much more readily in rainwater, which contains relatively high levels of CO_2. This reaction produces calcium hydrogen carbonate ($Ca(HCO_3)_2$).

This chemical reaction plays a key role in the erosion of carbonate rocks, which leads to the formation of underground caves. These caves are crucial for maintaining a healthy environment, providing essential habitats for many species that rely on them as shelters. Calcium carbonate minerals form the structural basis of skeletons and shells of numerous aquatic and terrestrial organisms, including humans. Many living beings require calcium for strong bones, proper muscle function, and the healthy operation of the nervous system and heart.

The Earth's crust contains about 4% $CaCO_3$, which also contributes to its compactness and helps shield the planet from more intense seismic activity. Additionally, $CaCO_3$ significantly influences the amount of CO_2 in the atmosphere, and thereby plays a role in climate regulation. When $CaCO_3$

decomposes at high temperatures, it releases CO_2, while rainwater containing CO_2 reacts with $CaCO_3$, reducing the net CO_2 emissions into the atmosphere.

From a human perspective, $CaCO_3$ is widely used across various industries, including construction (e.g., as a building material or in cement), medicine (e.g., as an antacid), and in the production of paint, paper, plastics, and more. Large deposits of $CaCO_3$ are found near water sources and serve as the foundation for the bodies of living organisms, aid in the formation of new rocks and minerals, and are an important component of the Earth's crust.

Nature itself has ensured the limited solubility of $CaCO_3$ in water, because in the opposite scenario we would face extremely hard water, which would be undrinkable for many living beings, and the structural stability of the Earth's crust would be significantly reduced.

In short, without this chemical compound, the natural hierarchical associative system could not function optimally—neither in supporting life nor in maintaining climatic balance. The other side of the coin, however, warns us of the growing accumulation of excess inorganic mass on our planet, which is primarily caused by human industrial activities (e.g., concrete, plastics).

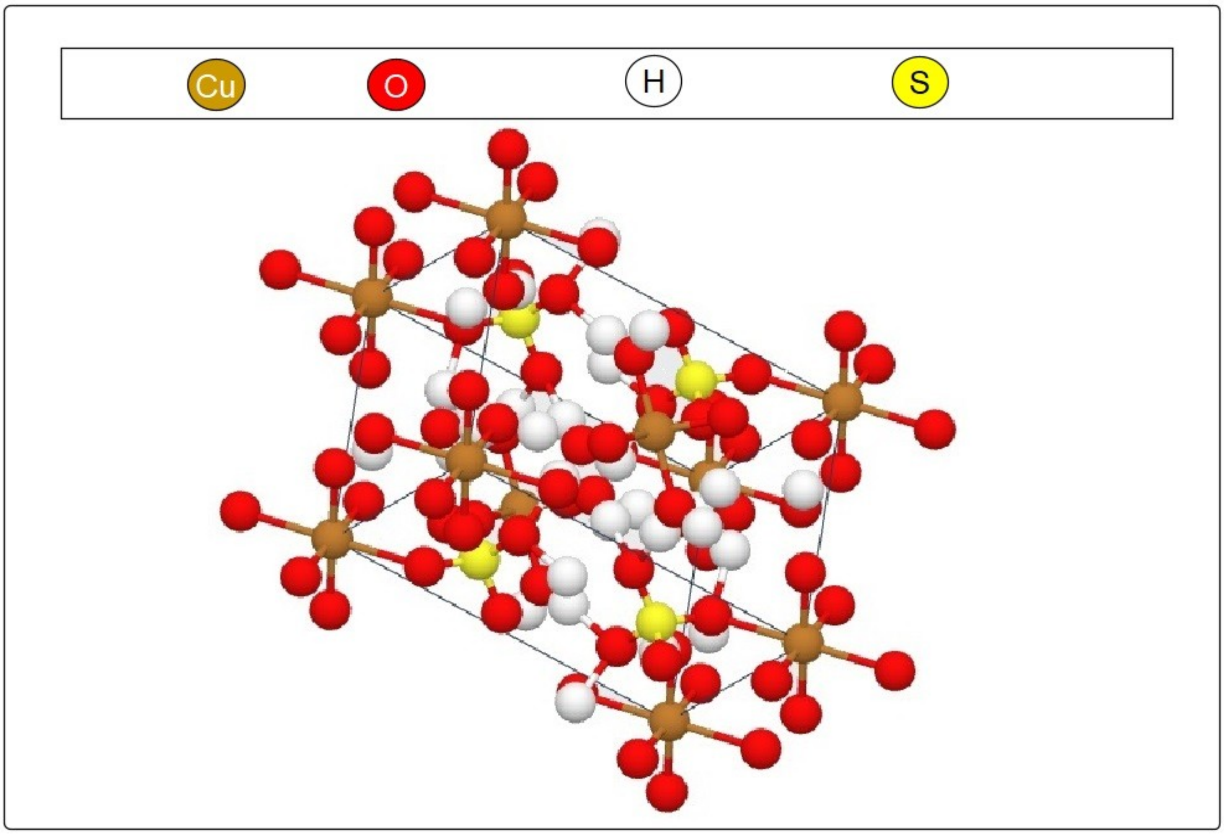
5.4.7.8.7 Copper(II) sulfate pentahydrate (Blue vitriol, Blue stone, Chalcanthite)

Copper(II) sulfate pentahydrate (hereafter: $CuSO_4 \cdot 5H_2O$) is the most common form of this chemical compound. Pure $CuSO_4$ is a white to pale green powder, but due to its strong hygroscopic nature, it quickly absorbs moisture from the air and forms various hydrated forms—from $CuSO_4 \cdot 2H_2O$ to $CuSO_4 \cdot 7H_2O$. Because anhydrous $CuSO_4$ is unstable in the presence of air, it is extremely rare in nature. In human use, the pentahydrate form is by far the most well-known and widely applied.

In nature, it most commonly occurs as the mineral chalcanthite. The molecular mass of $CuSO_4 \cdot 5H_2O$ is 249.68 g/mol, its density is 2.284 g/cm³, and it melts at 150 °C. Its solubility at 20 °C is about 32 grams per 100 ml of distilled water. At 650 °C, the compound decomposes into copper oxide (CuO) and sulfur trioxide (SO_3).

It has a triclinic crystal structure, which is the least symmetrical crystal system, meaning the unit cell has vectors of unequal lengths and angles, and it lacks mirror planes.

Let's take a closer look at the crystal structure of $CuSO_4 \cdot 5H_2O$.

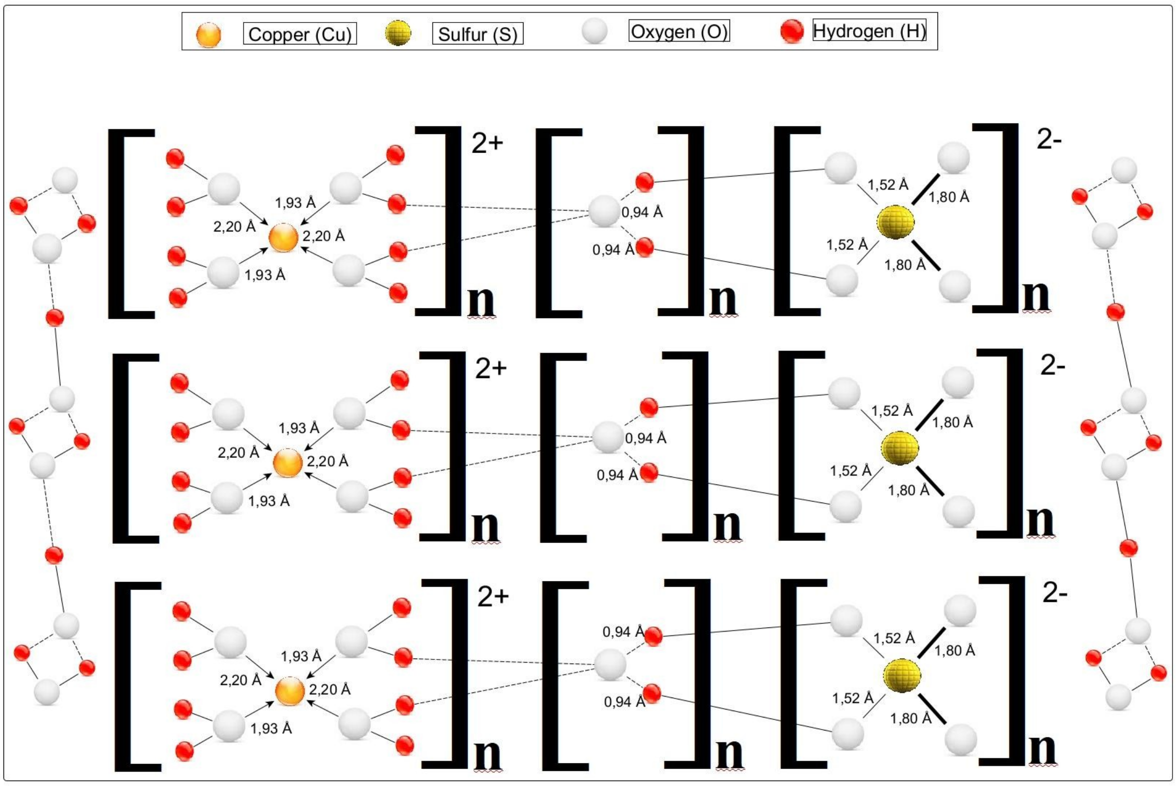


5.4.7.8.7.1 Figure 416: Crystal structure of $CuSO_4 \cdot 5H_2O$

Figure 416 shows the crystal structure of $CuSO_4 \cdot 5H_2O$, which includes copper cations (Cu^{2+}), sulfate polyatomic anions (SO_4^{2-}), and bound water molecules ($5H_2O$). When $CuSO_4 \cdot 5H_2O$ dissolves in water, an exothermic reaction occurs, resulting in the formation of weak but relatively stable bonds between Cu^{2+} cations and water molecules. This leads to the formation of complex ions $(Cu[H_2O]_6)^{2+}$, which are connected via hydrogen-oxygen bridges to the polyatomic sulfate anions (SO_4^{2-}), with S–O bond distances ranging from 1.52 Å to 1.80 Å.

The final result of this process is an octahedral molecular structure. The atomic radius of a copper atom is approximately 1.35 Å, and the ionic radius is about 0.73 Å. For sulfur (S), the atomic radius is around 1.02 Å, and the ionic radius of S^{6+} is estimated at 1.70 Å, which is larger than that of oxygen (0.73 Å for the ionic radius; 1.26 Å for the atomic radius) and hydrogen (0.53 Å for atomic radius; 0.31 Å for ionic radius). The distance between Cu^{2+} cations and O^{2-} atoms ranges from 1.93 Å to 2.38 Å.[267] Four water molecules (H_2O) are coordinated with the Cu^{2+} cation, while one water molecule is coordinated with the polyatomic anion $(SO_4)^{2-}$. Based on the obtained data, an experiment will be conducted to model the $CuSO_4 \cdot 5H_2O$ solution, where we are dealing with ionic bonds (Cu^{2+} and $(SO_4)^{2-}$), covalent bonds (S and O), and coordinated covalent bonds ($5H_2O$).

267 Persson, I., Lundberg, D., Bajnóczi, É. G., Klementiev, K., Just, J., Sigfridsson Clauss, K. G. (2020). EXAFS study on the Coordination Chemistry of the solvated copper(ii) ion in a series of oxygen donor solvents. *Inorganic Chemistry*, 59(14), 9538–9550. https://doi.org/10.1021/acs.inorgchem.0c00403.



5.4.7.8.7.2 Figure 417: Network of ionic, polar, and coordinative bonds in the $CuSO_4{\cdot}5H_2O$ solution

Figure 417 shows the network of ionic, polar, and coordinative bonds in the $CuSO_4{\cdot}5H_2O$ solution, along with the distances between the involved particles such as Cu^{2+}, O^{2-}, H^{+}, and S^{2-}, which form repeating motifs of the complex $[Cu(4H_2O)]^{2+}$, water bridges, and polyatomic anions $(SO_4)^{2-}$. The coordinative covalent bond between four water molecules (H_2O) and the Cu^{2+} cation is surrounded by polar covalent water molecules in the aqueous solution. Similarly, we observe the covalent bond between S^{6+} and four O^{2-} atoms, which is coordinatively bound to one water molecule, and this complex is also surrounded by polar covalent water molecules.

The concept that water molecules in the complex are surrounded by other water molecules is harder to grasp, as this has not been observed in the previously studied chemical compounds. A similar situation can be seen when liquid water is poured onto ice crystals. The liquid water molecules first surround the ice crystals, which then begin to melt due to the higher temperature. In $CuSO_4{\cdot}5H_2O$, we also encounter a crystal structure in which water molecules are bound to the $CuSO_4$ crystal, and even liquid water cannot separate them. This relatively stable bond between the five water molecules and $CuSO_4$ can only be broken by heating to around 200 °C. At this temperature, the coordinatively bound water evaporates, and the $CuSO_4$ crystals change color from blue to white. Upon cooling, the white $CuSO_4$ crystals turn blue again, as the compound absorbs water molecules from the air and reforms the pentahydrate. This physical process is reversible, and it can be continuously repeated.

Reversibility is an important characteristic of hierarchical associative systems, as it enables so-called feedback loops and opposes irreversibility. However, there are also many irreversible processes in nature, where feedback loops do not exist and are therefore irreversible, much like certain irreversible actions. Does this mean that some segments of our universe are finite? Based on our understanding of the world, we might conclude so.

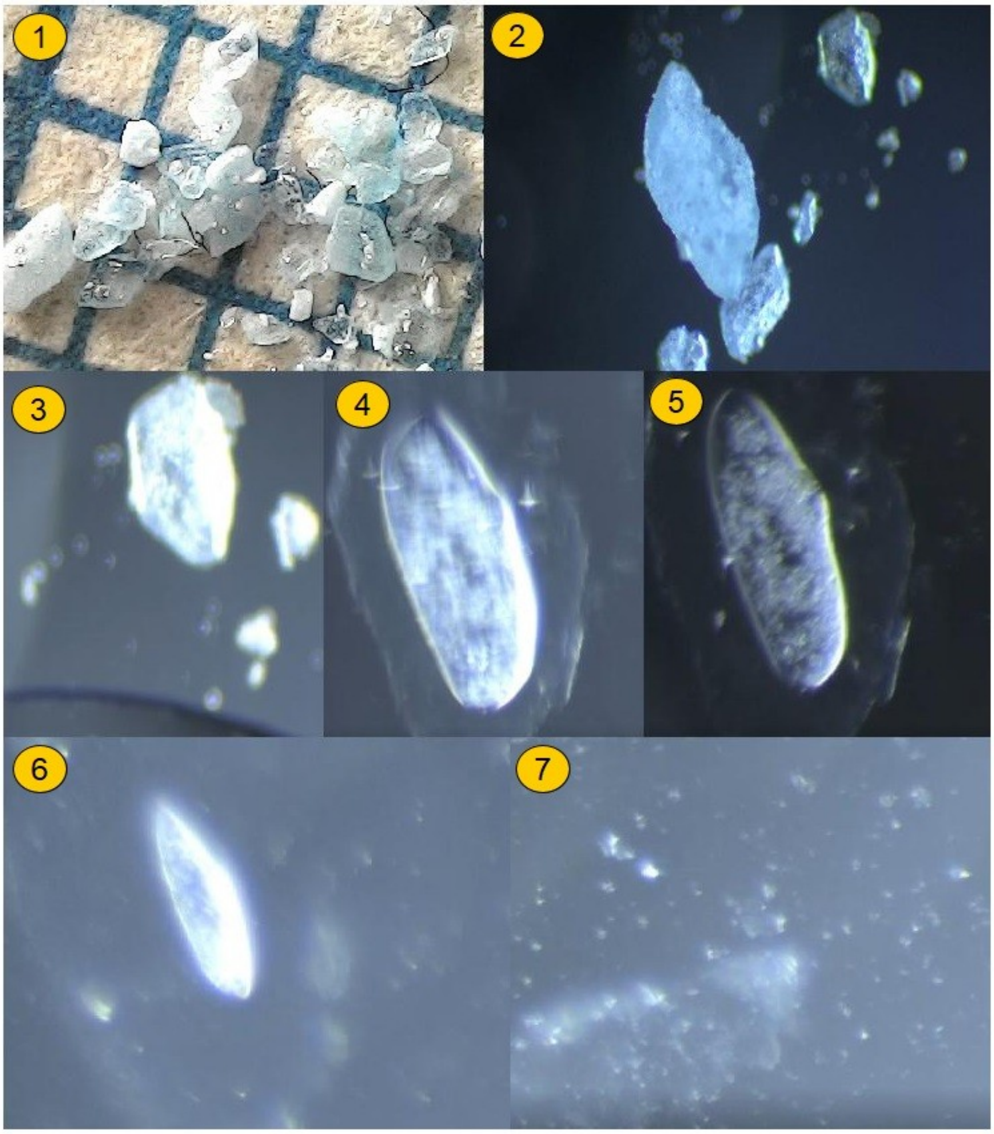
In studying chemical compounds and solutions, we have identified certain effects at various cosmic levels. At the microcosmic level, we analyzed ions and crystals under a microscope, at the mesocosmic level, we studied the effects of these compounds on living organisms, and at the macrocosmic level, we examined their effects on the climate and the planet. It seems that with further research, we could clarify the relationship between the reversibility and irreversibility of our world.

At all cosmic levels, reversible and irreversible processes are constantly occurring, which can change significantly due to changes in conditions (e.g., pressure, temperature) and do not represent a final state. Final states can only be hypothesized, determined, and agreed upon, while infinite states can only be perceived through our ignorance and limitations. Essentially, it is always about the interplay of finiteness and infinity, reversibility and irreversibility.

A similar process occurs in the formation and melting of crystals. In the solution, water first evaporates due to heat, and then we dissolve crystals under a microscope in drops of distilled water. This process can be repeated several times, and we always observe certain effects. These effects may be similar, but in each cycle, some of the energy is lost, redistributed, or changed in form. Even the smallest changes in external conditions, such as humidity, pressure, and temperature, influence this process. Dust particles, which are invisible to the human eye and contain both organic and inorganic substances, are also an important factor.

This means that we are constantly encountering dynamic finiteness and infinity, which transitions into perceivable finiteness when we can no longer detect motion at the mesocosmic level. This motion is crucial for electromagnetic fields and the conductivity of solutions. Solutions with ionic and polar bonds are conductive because there are attractive and repulsive forces that encourage invisible particles to move, while also forming stable hierarchical associative complexes. These complexes create a specific space and thus limit particle movement.

Next, we will observe the phases of the melting of microcrystals of $CuSO_4 \cdot 5H_2O$ under a light microscope in two drops of distilled water.



5.4.7.8.7.3 Figure 418: $CuSO_4{\cdot}5H_2O$ crystals and melting phases

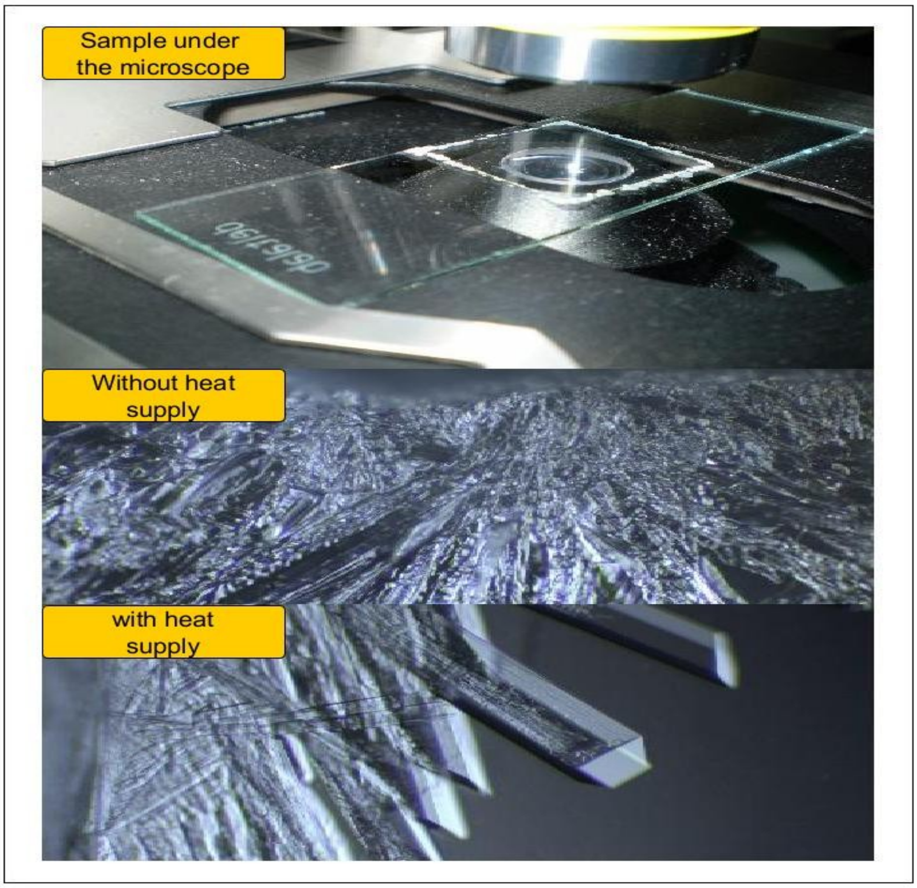
Figure 418 shows crystals of $CuSO_4{\cdot}5H_2O$ under a USB microscope (labeled as number 1), along with the melting phases of a single crystal in two drops of distilled water, observed under a light microscope and labeled from 2 to 7. In its dissolved form, $CuSO_4{\cdot}5H_2O$ exhibits an octahedral molecular geometry, where six atoms or groups of atoms are arranged around a central atom, forming the center of an octahedron. This hierarchical, associative, geometrical structure—resembling a double pyramid—determines various chemical and physical properties of the compound or molecule.

The upper left part of the image shows $CuSO_4{\cdot}5H_2O$ crystals of various shapes and sizes. Due to the light emitted by the USB microscope, the characteristic blue color is less pronounced. When observing the melting phases of $CuSO_4{\cdot}5H_2O$, a noticeable difference can be seen compared to other chemical compounds and solutions. Instead of forming bubbles during melting, the final phase results in a sort of cluster of smaller particles that somewhat resemble star nebulae.

The melting of $CuSO_4 \cdot 5H_2O$ crystals occurs relatively quickly, indicating that this substance is highly soluble in water. Due to the larger and uneven distances between the Cu^{2+} ion and four O^{2-} atoms, this part of the pyramidal structure exhibits a lower solubility potential in water. In contrast, on the other side of the pyramidal structure—between the S^{6+} ion and four O^{2-} atoms—smaller distances result in a higher solubility potential. In short, we can assume that the solubility potential within the compound, or within a single $CuSO_4 \cdot 5H_2O$ crystal, is not evenly distributed, but rather influenced by factors such as interatomic distances and the angles between particles.

Given that the $[Cu(4H_2O)]^{2+}$ complex is not an independent unit but is instead connected to water molecules and the polyatomic anion group $(SO_4)^{2-}$, we can presume that these connections help to relatively balance the solubility potential in water. On the one hand, we are dealing with individual units or groups, but these are simultaneously linked to other units or groups. A similar principle can be observed in biological systems, where organs function as individual entities, but without their connection to other organs, they have no functional value in terms of producing a positive collective effect. In the case of $CuSO_4 \cdot 5H_2O$, this means that without the close interaction between the $[Cu(4H_2O)]^{2+}$ complex, the water bridge, and the polyatomic anion group $(SO_4)^{2-}$, there would be no collective effect on the solution's conductivity.

Conductivity measurements will be discussed later. First, it makes sense to present the crystallization of the $CuSO_4 \cdot 5H_2O$ solution under a light microscope, using either water evaporation or heating. This time, the sample under investigation has a concentration of 13 g of $CuSO_4 \cdot 5H_2O$ per 100 ml of H_2O.



5.4.7.8.7.4 Figure 419: Crystallization of a $CuSO_4 \cdot 5H_2O$ solution

Figure 419 shows the crystallization of a $CuSO_4 \cdot 5H_2O$ solution with a concentration of 13 g of this salt in 100 ml of H_2O, both without heat application and with the addition of heat. During slow crystallization (without heat), a dense, shard-like structure forms, while fast crystallization (with heat) results in polygonal geometric bodies. Additional heat input leads to the formation of more geometrically defined crystals, as the water evaporates more quickly. In this case, the relatively high solution concentration enabled the rapid formation of larger and more recognizable crystals. Slow evaporation of water leads to the formation of smaller crystals, which spread less in the given space compared to fast crystallization, where added thermal energy accelerates the process.

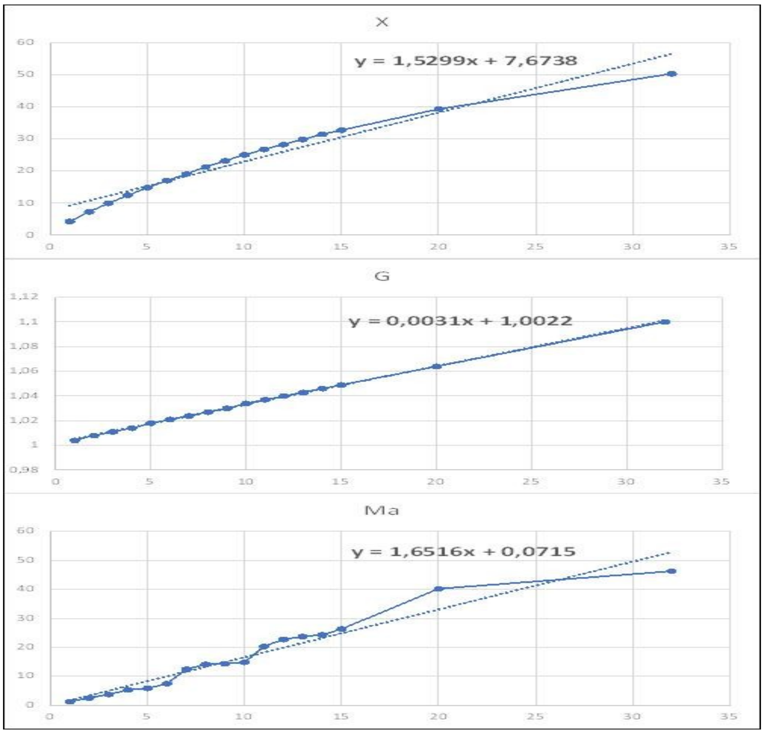
Crystal formation is strongly influenced by external factors such as air pressure, humidity, ambient temperature, and crystallization conditions (e.g., solution concentration, container volume). Even small variations in these factors can lead to significantly different crystal structures. This raises an interesting question: do geometric differences in crystals also affect the conductivity of the solution? This could be tested by preparing a new solution from the resulting crystal structures and then measuring its conductivity. Would a conductometer detect minor differences, or would the conductivity vary more substantially?

When preparing a $CuSO_4 \cdot 5H_2O$ solution, crystals of varying shapes and sizes form, meaning that the initial geometric organization of the crystals is quite different from what results after water evaporation. This variation in particle organization could also influence the solution's conductivity. It is well known that the organization of ions in a solution significantly affects conductivity, with key influencing factors including interionic distances, distances to the hydration shell, curvature of water molecules, ion density, and external conditions. If these factors change as a result of altered crystal geometry, they could affect whether the solution becomes more or less conductive.

It is also important to consider the fundamental chemical properties of a compound, which are largely independent of the initial crystallization conditions. Using a loose analogy to humans and their environment, one could argue that an individual's basic characteristics or genetic makeup are constant, but external circumstances can enhance, weaken, or significantly alter that potential. If we compare an individual to a crystal, it would mean that different growth conditions can lead to end results quite different from what would be expected based on the compound's basic structure. Additionally, certain pathological changes in a crystal's structure could also alter its physical properties. The arrangement of crystals—and, consequently, of ions in the solution—can influence conductivity if these key factors are affected. This extremely complex question will be addressed later in order to arrive at a satisfying answer. For now, measurements of conductivity, density, and mass adsorption will be conducted for solutions with different concentrations, ranging from 1 g of $CuSO_4 \cdot 5H_2O$ in 100 ml of H_2O up to 20 g in 100 ml. A measurement of a saturated solution with a concentration of 32 g $CuSO_4 \cdot 5H_2O$ in 100 ml of H_2O will also be performed. As before, the results will be compared with those of other chemical compound solutions, with $CaCO_3$ excluded from the analysis due to its very low solubility in water.

5.4.7.8.7.5 Table 188: Conductivity, density and mass adsorption measurements for solutions of different concentrations of $CuSO_4 \cdot 5H_2O$

C	*X*	*T*	*G*	*Ma*
1	4.2600	27.0000	1.0040	1.2000
2	7.3000	27.0000	1.0080	2.5000
3	9.9500	26.5000	1.0110	3.7000
4	12.4600	26.6000	1.0140	5.3000
5	14.8300	25.2000	1.0180	5.8000
6	17.0000	25.5000	1.0210	7.4000
7	19.0900	25.3000	1.0240	12.4000
8	21.3000	25.3000	1.0270	14.1000
9	23.2000	25.2000	1.0300	14.3000
10	25.1000	25.2000	1.0340	14.8000
11	26.8000	25.0000	1.0370	20.3000
12	28.3000	25.4000	1.0400	22.7000
13	29.9000	25.4000	1.0430	23.7000
14	31.5000	25.7000	1.0460	24.3000
15	32.8000	26.4000	1.0490	26.3000
20	39.4000	26.1000	1.0640	40.2000
32	50.4000	25.8000	1.1000	46.3000



5.4.7.8.7.5.1 Figure 420: Graphs based on measurements of various $CuSO_4 \cdot 5H_2O$ solutions

Table 188 presents statistical data on the measurements of conductivity, density, and mass adsorption for $CuSO_4 \cdot 5H_2O$ solutions of various concentrations, while Figure 420 provides a visual representation of these data. The measured conductivity values deviate slightly from the linear trend line, the density values increase almost perfectly linearly, while the values for adsorbed mass show the most significant deviations from linearity. In the latter case, periodic fluctuations can be observed between higher and lower amounts of mass adsorbed onto the paper filter strip.

In the saturated solution with a concentration of 32 g of $CuSO_4 \cdot 5H_2O$ per 100 ml of H_2O, only a relatively small increase in adsorbed mass is observed compared to the solution with a concentration of 20 g per 100 ml. The additional 12 g of $CuSO_4 \cdot 5H_2O$ resulted in only a 6.1 mg increase in adsorbed mass.

The measured density values for $CuSO_4 \cdot 5H_2O$ solutions at different concentrations initially closely match those measured for KCl solutions of varying concentrations. However, at concentrations above 13 g of $CuSO_4 \cdot 5H_2O$ per 100 ml of H_2O, the densities of the KCl solutions become slightly higher.

Among all the chemical compound solutions studied so far (excluding $CaCO_3$), it can be concluded that $CuSO_4 \cdot 5H_2O$ solutions exhibit the lowest conductivity values and also the lowest values of adsorbed mass. Let’s now take a look at a comparison of all the measured values to date.

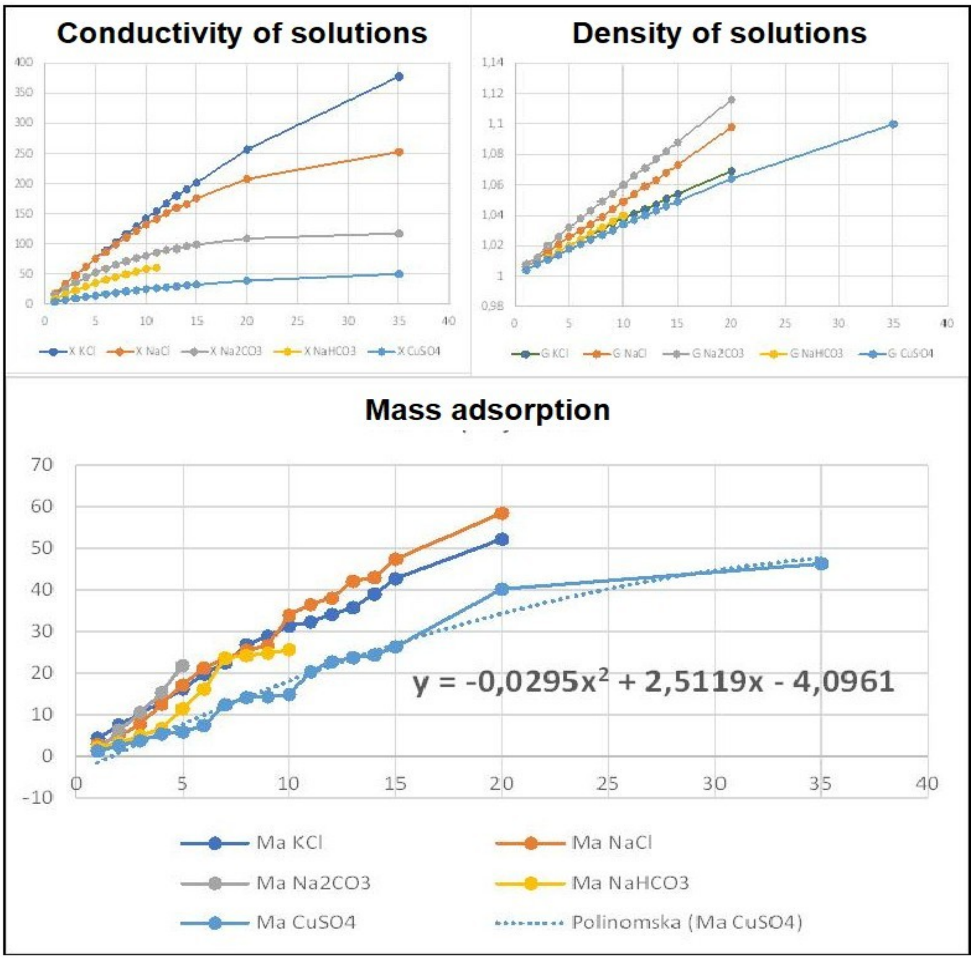
5.4.7.8.7.5.2 Table 189: Comparison of measured values for different solutions of chemical compounds

C	*X KCl*	*G KCl*	*Ma KCl*	*X NaCl*	*G NaCl*	*Ma NaCl*	*X Na2CO3*	*G Na2CO3*	*Ma Na2CO3*	*X NaHCO3*	*G NaHCO3*	*Ma NaHCO3*	*X CuSO4*	*G CuSO4*	*Ma CuSO4*
1	17.05	1.004	4.30	17.85	1.006	2.80	14.84	1.008	1.50	8.89	1.004	2.10	4.26	1.004	1.20
2	32.90	1.008	7.50	33.90	1.011	4.80	26.30	1.012	6.20	16.50	1.008	3.20	7.30	1.008	2.50
3	48.10	1.012	10.20	48.50	1.016	7.75	36.10	1.020	10.50	23.30	1.012	4.90	9.95	1.011	3.70
4	62.30	1.016	13.00	62.20	1.021	12.50	44.80	1.026	15.30	29.50	1.016	6.60	12.46	1.014	5.30
5	76.10	1.020	16.10	75.60	1.026	17.10	52.40	1.032	21.80	35.10	1.020	11.40	14.83	1.018	5.80
6	89.70	1.024	19.70	87.00	1.030	21.20	59.40	1.038		40.70	1.024	16.10	17.00	1.021	7.40
7	103.40	1.027	22.50	99.30	1.034	23.50	65.60	1.043		45.20	1.028	23.60	19.09	1.024	12.40
8	116.30	1.030	26.80	111.00	1.039	25.50	71.40	1.049		49.80	1.032	24.20	21.30	1.027	14.10
9	129.40	1.035	28.90	121.70	1.044	26.60	76.60	1.054		54.10	1.036	24.80	23.20	1.030	14.30
10	142.10	1.038	31.30	132.30	1.049	33.90	80.70	1.060		58.30	1.040	25.60	25.10	1.034	14.80
11	154.40	1.041	32.30	141.90	1.054	36.50	85.70	1.066		60.80			26.80	1.037	20.30
12	167.40	1.044	34.10	151.40	1.059	38.00	90.00	1.071					28.30	1.040	22.70
13	180.50	1.047	35.70	160.50	1.063	42.10	92.40	1.077					29.90	1.043	23.70
14	191.00	1.051	39.00	166.40	1.068	43.00	96.10	1.082					31.50	1.046	24.30
15	202.00	1.054	42.70	176.20	1.073	47.400	99.00	1.088					32.80	1.049	26.30
20	257.00	1.069	52.20	208.00	1.098	58.500	109.30	1.116					39.40	1.064	40.20
35	378.00			253.00			117.60						50.40	1.100	46.30

Table 189 shows a comparison of the measured values for various chemical compound solutions analyzed so far.

The lowest values across all measured parameters are observed in $CuSO_4 \cdot 5H_2O$ solutions of different concentrations, followed by $NaHCO_3$ solutions, and then Na_2CO_3 solutions.

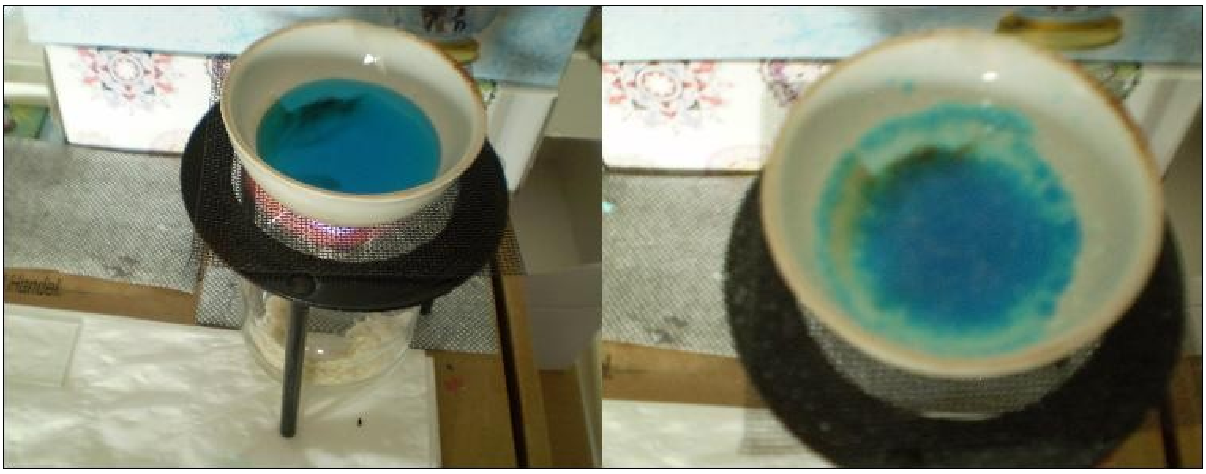
Comparing all the measured values for different parameters of NaCl and KCl solutions across various concentrations is not entirely straightforward. In the concentration range from 1 g of NaCl/KCl per 100 ml of H_2O to 3 g per 100 ml, NaCl solutions show slightly higher conductivity than KCl solutions. However, at higher concentrations, this trend gradually reverses, with KCl solutions showing significantly higher conductivity than NaCl solutions.
For measured density values, NaCl solutions consistently show higher values than KCl solutions. In terms of adsorbed mass, a similar trend to conductivity is observed, but with the difference that at higher concentrations, the adsorbed mass values for NaCl solutions are considerably higher.
These deviations from expected results are likely due to the hierarchical associative organization of ions, which is still not fully understood. When it comes to mass adsorption, we observe that for solutions of various chemical compounds—except for $CuSO_4 \cdot 5H_2O$—the values are relatively linear.



5.4.7.8.7.5.3 Figure 421: Visualization of the comparison between different solutions of various chemical compounds

Figure 421 presents a visualization comparing solutions of various chemical compounds based on measured values of conductivity, density, and adsorbed mass. For the adsorbed mass of $CuSO_4 \cdot 5H_2O$, a linear trend is not observed; instead, the data follow a polynomial trend (see

equation: Y = -0.0295x² + 2.5119x – 4.0961). This may indicate that when $CuSO_4·5H_2O$ crystals dissolve in water, the ions are organized and distributed in a non-uniform manner—something less pronounced in other chemical compounds, especially NaCl and KCl.
The behavior of distilled water remains relatively consistent, as osmotic forces help lift both water molecules and dissolved particles from different chemical compounds along the filter paper. This suggests that the particle behavior of $CuSO_4·5H_2O$ is less consistent compared to NaCl and KCl.
Based on the measured conductivity values of $CuSO_4·5H_2O$ solutions at various concentrations, we can assume that the ions in the solution are distributed relatively uniformly, which is confirmed by the linear increase in conductivity (in mS). Similarly, the measured densities also confirm a consistent linear growth pattern.
Now, an experiment will be conducted to address an intriguing question: does the geometric diversity of crystals affect the conductivity of the solution? For this purpose, a simple experiment involving the evaporation of water from a solution with a concentration of 32 g $CuSO_4·5H_2O$ per 100 ml of H_2O was performed.



5.4.7.8.7.5.4 Figure 422: Evaporation of water from a saturated $CuSO_4·5H_2O$ solution

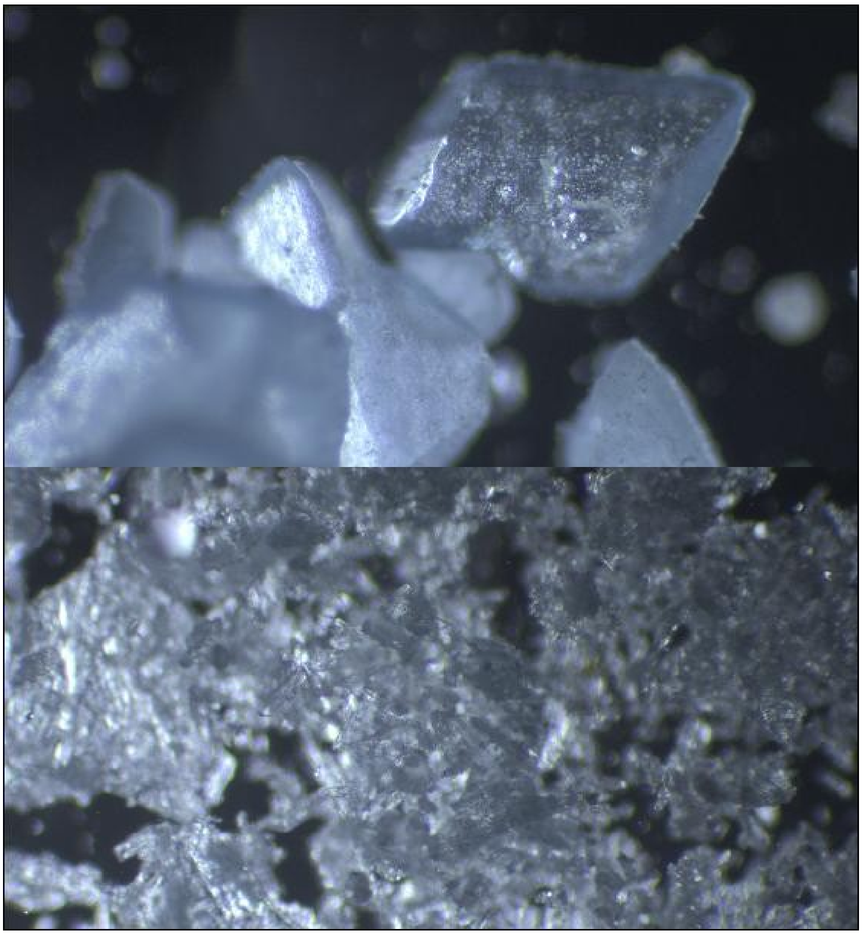
Figure 422 shows a simple experiment involving the evaporation of water from a saturated $CuSO_4·5H_2O$ solution (approximately 12 ml). The solidified salt (around 5.4489 g) collected in the evaporating dish was cooled and then used to prepare solutions. In one 150 ml beaker, 2.0000 g of the recovered $CuSO_4·5H_2O$ was weighed out, and in another, 1.0000 g of the same substance. Each sample was then dissolved in 100 ml of distilled water.
A small magnetic stir bar was added to each solution, and both were stirred using a magnetic stirrer for 15 minutes. After mixing, the conductivity of both solutions was measured in millisiemens (mS). The results were then compared with previous measurements for factory-grade $CuSO_4·5H_2O$ at the same concentrations (1 g and 2 g per 100 ml H_2O).

Measured conductivity values:

- Factory $CuSO_4 \cdot 5H_2O$ (1 g + 100 ml H_2O): 4.26 mS
- $CuSO_4 \cdot 5H_2O$ after evaporation (1 g + 100 ml H_2O): 4.11 mS
- Factory $CuSO_4 \cdot 5H_2O$ (2 g + 100 ml H_2O): 7.30 mS
- $CuSO_4 \cdot 5H_2O$ after evaporation (2 g + 100 ml H_2O): 6.78 mS

Based on the results, we can conclude that the differences in conductivity between factory $CuSO_4 \cdot 5H_2O$ and the $CuSO_4 \cdot 5H_2O$ obtained after evaporation are relatively small. This essentially demonstrates that the geometric form of the crystals does not have a significant effect on the solution's conductivity. However, it is noticeable that the solutions made from post-evaporation crystals had slightly lower conductivity.

Finally, we will take a look at images of the crystal shapes of factory $CuSO_4 \cdot 5H_2O$ and those obtained after water evaporation from the saturated solution.



5.4.7.8.7.5.5 Figure 423: Factory $CuSO_4 \cdot 5H_2O$ crystals and crystals after water evaporation

Figure 423 presents images of factory-produced $CuSO_4 \cdot 5H_2O$ crystals (see the top part of the figure) and crystals formed after the evaporation of water from a saturated solution (see the bottom part of the figure). The difference in the geometric shapes of the crystals is striking. In the top image, individual crystals are visible, most of which have irregular, asymmetric shapes. In contrast, the bottom image shows fused layers of $CuSO_4{\cdot}5H_2O$ crystals, composed of both larger and smaller fine crystals.[268] Despite this variation, the differences in conductivity values were not significantly pronounced. The key question is: which level of granularity are we considering when assessing these differences? From a mesoscopic and macroscopic perspective, the differences in values are negligible. However, this is not the case at the microscopic level, where the differences are actually substantial.

In samples with a concentration of 1 g $CuSO_4{\cdot}5H_2O$ per 100 ml of H_2O, the difference in conductivity is approximately 150 µS, and for a concentration of 2 g per 100 ml, it increases to 520 µS. We can assume that the differences in conductivity at higher concentrations—from 3 g to 32 g $CuSO_4{\cdot}5H_2O$ per 100 ml—would be even more pronounced.

At the microscopic level, then, the differences in measured conductivity values are quite large. This observation changes the central thesis: the geometric structure of the crystals significantly influences the conductivity of a solution at the micro level. From a practical, mesoscopic perspective, these collective conductivity effects may be less relevant. Nevertheless, we must not overlook the fact that dynamic processes involving microparticles occur precisely at the microscopic level—and with ions, even at the femtoscopic level.

A single powdered crystal of $CuSO_4{\cdot}5H_2O$ weighs on average about 0.00004 g, or 40 µg. If we calculate the number of moles in such a tiny crystal, we can then determine the number of ions it contains—resulting in an extremely large numerical value. Let's first calculate the number of moles in one such crystal, and then determine the number of ions.

$$ML = \frac{m_{kCuSO4x5H2O}}{M_{CuSO4x5H2O}} = \frac{(0{,}00004\,g)}{(249{,}68\,\frac{g}{mol})} = 1{,}6\ \cdot 10^{-7}\,moles$$

One tiny crystal with a mass of 0.00004 g contains $1.6 \cdot 10^{-7}$ moles. Multiply this value by Avogadro's number and we get.

$$N_i = ML\ \cdot N_a = \ 1{,}6\ \cdot 10^{-7}\ \cdot 6{,}023\ \cdot 10^{23} = 9{,}64\ \cdot 10^{16}\,ions$$

In one such tiny crystal with a mass of 0.00004 g, there are $9.64 \cdot 10^{16}$ ions ($4.82 \cdot 10^{16}$ cations and $4.82 \cdot 10^{16}$ anions). These ions, surrounded by water molecules, are conductive and thus potential generators of electrical energy. The assumption regarding the geometric shapes of crystals may provide a more or less favorable basis for creating collective effects, as certain ions in less efficient organizational structures may act more like resistors than conductors. This can lead to ionization blockages, which further distort water molecules and consequently reduce the collective effects

268 The images were taken using a Zeiss Primostar 3 light microscope and an Axio 208 color camera with a 10x magnification and objective lens. The phase contrast technique was used.

toward greater conductivity. It would be useful to compare the measured values of units such as the number of ions, the surface area occupied by the ions, the density, and the conductivity of the chemical compound solutions discussed so far (excluding $CaCO_3$): NaCl, KCl, Na_2CO_3, $NaHCO_3$, and $CuSO_4 \cdot 5H_2O$ at a concentration of 1 g of salt + 100 ml of H_2O.

5.4.7.8.7.5.6 Table 190: Data for conductivity, density, number of ions and occupied mass surfaces between ions

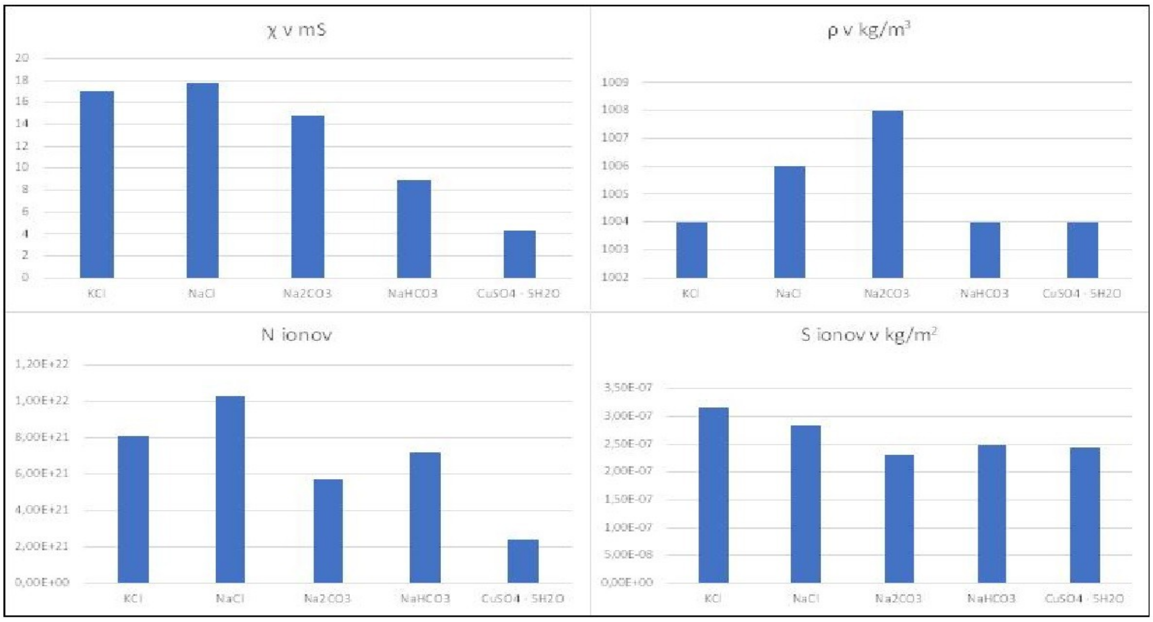
Compounds	*χ*	*ρ*	*N ions*	*S ions*
KCl	17.05	1004.00	$8.07 \cdot 10^{21}$	$3.15 \cdot 10^{-7}$
NaCl	17.85	1006.00	$10.3 \cdot 10^{21}$	$2.83 \cdot 10^{-7}$
Na_2CO_3	14.84	1008.00	$5.68 \cdot 10^{21}$	$2.32 \cdot 10^{-7}$
$NaHCO_3$	8.89	1004.00	$5.68 \cdot 10^{21}$	$2.48 \cdot 10^{-7}$
$CuSO4 \cdot 5H_2O$	4.26	1004.00	$2.41 \cdot 10^{21}$	$2.44 \cdot 10^{-7}$

Table 190 presents data on the conductivity, density, number of ions, and occupied mass surface area between ions for solutions of various chemical compounds at a concentration of 1 g of salt + 100 ml of H_2O. For the NaCl solution, it is evident that it exhibits the highest conductivity compared to the other compound solutions. This highest conductivity (χ_{NaCl} = 17.85 mS) can be attributed secondarily to the second-largest occupied mass surface area between ions, approximately $S_{NaCl} = 2.83 \cdot 10^{-7}$ kg/m², and primarily to the highest number of ions, $N_{NaCl} = 10.3 \cdot 10^{21}$. The density of NaCl is the second-highest among these solutions (ρ_{NaCl} = 1006 kg/m³).
The second-highest conductivity is observed in the KCl solution (χ_{KCl} = 17.05 mS), which also has the second-highest number of ions ($N_{KCl} = 8.07 \cdot 10^{21}$), but the highest occupied surface area between ions ($S_{KCl} = 3.15 \cdot 10^{-7}$ kg/m²). Its density is among the lowest (ρ_{KCl} = 1004 kg/m³). Based on measurements at higher concentrations, it is known that KCl solutions exhibit greater conductivity than NaCl solutions from concentrations of 4 g + 100 ml H_2O onward. This has been attributed to the more optimal organization of KCl ions relative to water molecules, which contributes to stronger collective effects that enhance conductivity.
At this point, one might ask why KCl ions do not demonstrate greater collective conductivity effects at lower concentrations. Given the larger size of the K^+ cation compared to Na^+, greater differences in electronegativity, stronger ionic character, and greater electrostatic effects, one might expect KCl to show higher conductivity even at concentrations between 1 g and 3 g + 100 ml H_2O. While these are micro-level differences, as previously noted, they can be highly significant within the dynamic microcosmic scenario. The largest occupied mass surface area between ions is a strong factor in promoting higher conductivity. Although the KCl solution meets this condition, its slightly lower

density may slightly reduce the influence of the larger ion surface area at concentrations between 1 g and 3 g + 100 ml H_2O.

The Na_2CO_3 solution at 1 g + 100 ml H_2O has the highest density ($\rho_{Na_2CO_3}$ = 1008 kg/m³), but the smallest occupied ion surface area ($S_{Na_2CO_3} = 2.32 \cdot 10^{-7}$ kg/m²) and the fourth-highest number of ions ($N_{Na_2CO_3} = 5.68 \cdot 10^{21}$), resulting in the third-highest conductivity ($\chi_{Na_2CO_3}$ = 14.84 mS). The $NaHCO_3$ solution at the same concentration has a lower density (ρ_{NaHCO_3} = 1004 kg/m³), the third-largest occupied surface area ($S_{NaHCO_3} = 2.48 \cdot 10^{-7}$ kg/m²), and also the third-highest number of ions ($N_{NaHCO_3} = 5.68 \cdot 10^{21}$), resulting in the fourth-highest conductivity (χ_{NaHCO_3} = 8.89 mS).

Finally, the $CuSO_4{\cdot}5H_2O$ solution at 1 g + 100 ml H_2O shows the lowest conductivity (χ_{CuSO_4} = 4.26 mS), the fourth-lowest occupied surface area ($S_{CuSO_4} = 2.44 \cdot 10^{-7}$ kg/m²), lower density (ρ_{CuSO_4} = 1004 kg/m³), and the lowest number of ions ($N_{CuSO_4} = 2.41 \cdot 10^{21}$). The listed values for density, number of ions, and occupied mass surface area between ions undoubtedly influence the overall collective effect on conductivity—positively or negatively—but may be overridden by the generic properties of the compounds, such as electronegativity, solubility potential, electrostatic character, and ion size. In the cases of KCl and NaCl solutions, the number of ions and occupied surface area between ions have a significant influence, as both produced the highest conductivity. On the other hand, solutions like Na_2CO_3, $NaHCO_3$, and $CuSO_4{\cdot}5H_2O$ exhibited considerably lower conductivity due to smaller values in both the number of ions and occupied surface area. For greater clarity and to support the creation of a predictive model, the obtained values should be visualized using bar charts.



5.4.7.8.7.5.7 Figure 424: Visualization of measured data

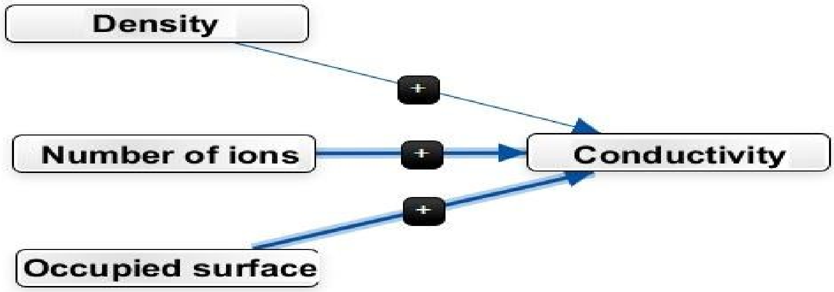
Figure 424 shows a visualization of the measured data for conductivity, density, number of ions, and the occupied mass surface area between ions. Variations in density, whether higher or lower, do not significantly impact conductivity. Conductivity is more strongly influenced by the number of ions and the occupied mass surface area between them, although this influence is not straightforward or uniform.

To illustrate this, consider an analogy with groups of people divided into five teams, each with a different number of members, all performing the same task. The effectiveness can vary greatly—20 people might complete the task more efficiently, with higher quality, or even faster than 30, 40, 100, or even 200 people. The key to this higher efficiency or collective performance lies in organization, work strategy and tactics, technological tools, and the physical and psychological characteristics of the individuals involved.

In essence, one could compile a very extensive list of units and factors that contribute to greater or lesser collective effects. However, the most critical factor lies in the intrinsic nature of the individuals and the competence of the leader who can motivate individuals toward stronger collective outcomes. People differ from one another, even though they also share many common traits. A similar situation may be observed with ions of the same chemical compound dissolved in water. Among identical ions, there must exist femto-level differences that ultimately result in varying collective effects.

Based on this, we may hypothesize the existence of leading ions of a given salt, as well as leading polar water molecules. Attractive and repulsive forces act like a kind of conductor's baton, governing the distances between ions and polar water molecules, thereby influencing their association, dissociation, and resulting hierarchies.

From this, we can conclude that higher conductivity arises from the interplay of differences and similarities among particles, such as ions and polar water molecules. What follows is a proposed model of influence.



5.4.7.8.7.5.8 Figure 425: A model of the influence of density, ion Count, and mass surface area between ions on conductivity

Figure 425 illustrates a simple model showing how density, the number of ions, and the mass surface area between ions affect conductivity—either increasing or decreasing it. Based on the studied solutions of various chemical compounds, it can be concluded that density has no significant or identifiable effect on conductivity. For example, the solution of 1 g KCl in 100 ml H_2O had a relatively low density but still the second-highest conductivity, while the solution of 1 g Na_2CO_3 in 100 ml H_2O had the highest density yet only the third-highest conductivity.

A more pronounced influence was observed from the number of ions and the occupied mass surface area between ions, as both factors more clearly contributed to higher conductivity, especially in the cases of KCl and NaCl. It is worth noting that the solution of 1 g Na_2CO_3 in 100 ml H_2O, while having the third-highest conductivity, had the smallest occupied surface area between ions and only the fourth-highest number of ions.

The $CuSO_4{\cdot}5H_2O$ solution (1 g + 100 ml H_2O) had lower density, the fourth-largest surface area between ions, and the fewest ions overall, which resulted in the lowest conductivity. The least soluble compound in water, $NaHCO_3$, showed the fourth-highest conductivity at the same concentration, along with the third-largest number of ions and surface area between ions—despite its poor solubility. This is unexpected, especially when compared to the much more soluble $CuSO_4{\cdot}5H_2O$ solution.

We can conclude that ion count and the mass surface area between ions do have a certain influence on conductivity, but this influence is more apparent in salts that result from a reaction between a

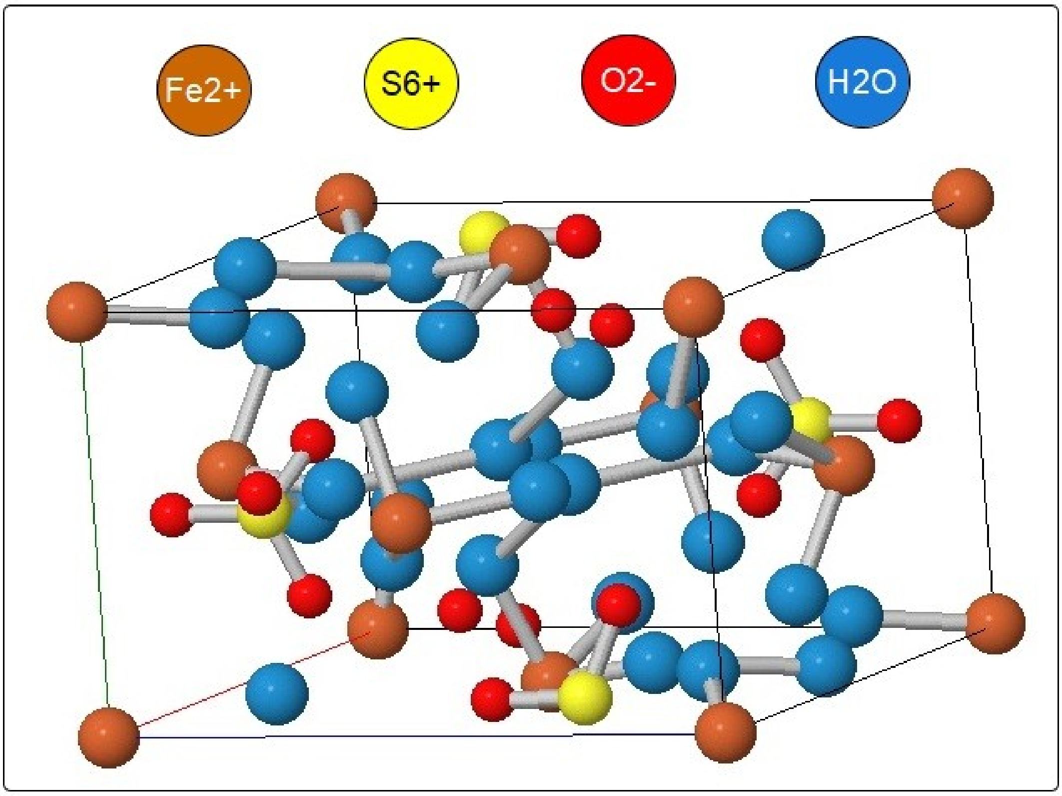
strong acid and a strong base. Density, on the other hand, is not a reliable indicator of conductivity levels.
Just as with human personality, where a wide range of metrics is needed for an accurate description due to significant individual differences despite common traits, the same applies to ions of the same chemical compound. Though simplified as small spheres in models, this is a major abstraction from reality. The geometric assumption of crystal shapes does play a role in conductivity at the microcosmic level, but this is less detectable from a mesocosmic perspective. A greater influence on conductivity comes from the ions themselves, which may differ considerably on the femtoscopic scale—a level science is currently not equipped to measure or identify with precision.
As a result, current atomic and ionic models are simplified, providing only probabilities of location and assumed shapes.
$CuSO_4 \cdot 5H_2O$ is a chemical compound widely found in nature and acts as a natural pesticide, fungicide, and algaecide. From this, we can infer that in natural hierarchical associative systems, this salt functions as a regulator or inhibitor, preventing the excessive spread of insects, mollusks, fungi, and algae. It is found in plants, soil, food, and water. In soil, it contributes to a more acidic pH, enabling the growth of certain plant species.
It occurs across various regions including North America, Central and South America, Africa, Asia, Australia, and Europe. The largest chalcanthite mines are located in Peru, Mexico, and the United States. It is most commonly used in agriculture and healthcare.
In agriculture, it is primarily used to prevent and manage bacterial diseases in tomatoes, lettuce, potatoes, and cherries. It works by destroying bacteria that feed on plant tissue. In healthcare, it is used to accelerate wound healing, as an antidote for phosphorus poisoning, to test blood samples and detect anemia, to eliminate harmful bacteria and fungi, and to help prevent malaria. It is also used as an additive in the production of plastics, copper, and in the glass and textile industries.

5.4.7.8.8 Iron(II) sulfate heptahydrate (Green vitriol)

Iron(II) sulfate heptahydrate (hereafter referred to as $FeSO_4 \cdot 7H_2O$) is the most common naturally occurring form of this chemical compound, typically found as the mineral melanterite. There are also other hydrated forms of $FeSO_4$, including $FeSO_4 \cdot H_2O$, $FeSO_4 \cdot 4H_2O$, $FeSO_4 \cdot 5H_2O$, and $FeSO_4 \cdot 6H_2O$.
At a temperature of 90 °C, the heptahydrate converts into the monohydrate form. When further heated to 480 °C, it decomposes into iron(III) oxide (Fe_2O_3), sulfur dioxide (SO_2), and sulfur trioxide (SO_3). The density of $FeSO_4 \cdot 7H_2O$ in its solid state is approximately 1.898 g/cm³. Its

solubility in water is 25.6 g per 100 ml of H_2O, and its melting point is 400 °C—although it begins to decompose at that temperature. The molar mass is 278.05 g/mol.

$FeSO_4 \cdot 7H_2O$ has a monoclinic crystal structure, in which six water molecules are coordinated to the Fe^{2+} cation, while one water molecule is associated with the $(SO_4)^{2-}$ polyatomic anion. This type of water molecule coordination is very similar to that found in the previously discussed chemical compound. Once again, we are dealing with a positively charged complex, a water bridge, and a polyatomic anion—together forming an ionic-coordinative covalent bond. Let’s now take a closer look at the crystal structure of $FeSO_4 \cdot 7H_2O$.

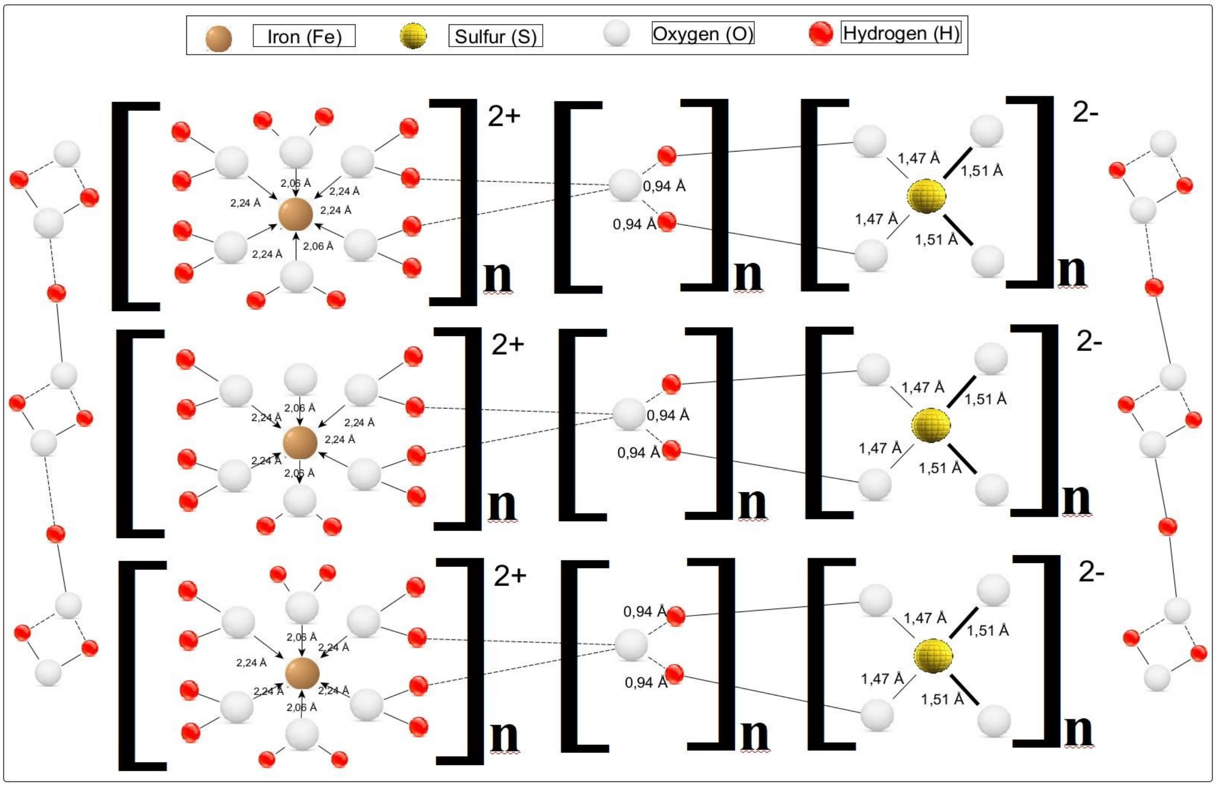


5.4.7.8.8.1 Figure 426: Crystal structure of melanterite

Figure 426 illustrates the crystal structure of melanterite, in which the hydrogen and oxygen atoms are combined into a single node, represented by blue spheres.[269] Six water molecules are coordinatively bonded to the iron cation in the complex [$Fe^{2+}(H_2O)_6$], while one water molecule is bonded to the polyatomic anion $(SO_4)^{2-}$. Within the polyatomic anion $(SO_4)^{2-}$, the bonds between the sulfur atom and the four oxygen atoms are covalent, while the bond between Fe^{2+} and $(SO_4)^{2-}$ is ionic. The crystals are slightly prismatic in shape. The distances between the sulfur and oxygen atoms within the $(SO_4)^{2-}$ anion vary, ranging from 1.47 Å to 1.51 Å (with two shorter and two longer distances). Likewise, the distances between the Fe^{2+} cation and the six O^{2-} ions vary between 2.06 Å and 2.24 Å (with two shorter and four longer distances).[270] The atomic radius of an Fe atom is approximately 1.26 Å, while the radius of the Fe^{2+} cation is about 0.77 Å. The radius of a sulfur (S) atom is approximately 1.02 Å, and the radius of the S^{6+} ion is estimated to be 1.70 Å, which is larger than the radius of oxygen (0.73 Å; 1.26 Å) and hydrogen (0.53 Å; 0.31 Å). At first glance, $FeSO_4 \cdot 7H_2O$ is somewhat similar to $CuSO_4 \cdot 5H_2O$ in terms of its physical and chemical properties, but it decomposes at a significantly lower temperature. Its solubility is also slightly lower than that of $CuSO_4 \cdot 5H_2O$. This compound is often referred to as the iron version of copper vitriol or green vitriol. Similar to $CuSO_4 \cdot 5H_2O$, a solution modeling experiment of $FeSO_4 \cdot 7H_2O$

269 See crystal structure: https://www.mindat.org/min-2633.html (2022-08-12).
270 Data were obtained at URL: https://www.osti.gov/dataexplorer/biblio/dataset/1193934 (2022-08-12).

will be conducted based on the obtained data, involving ionic bonding (Fe^{2+} and $(SO_4)^{2-}$), covalent bonding (S and 4 O), and coordinate covalent bonding (5 H_2O).



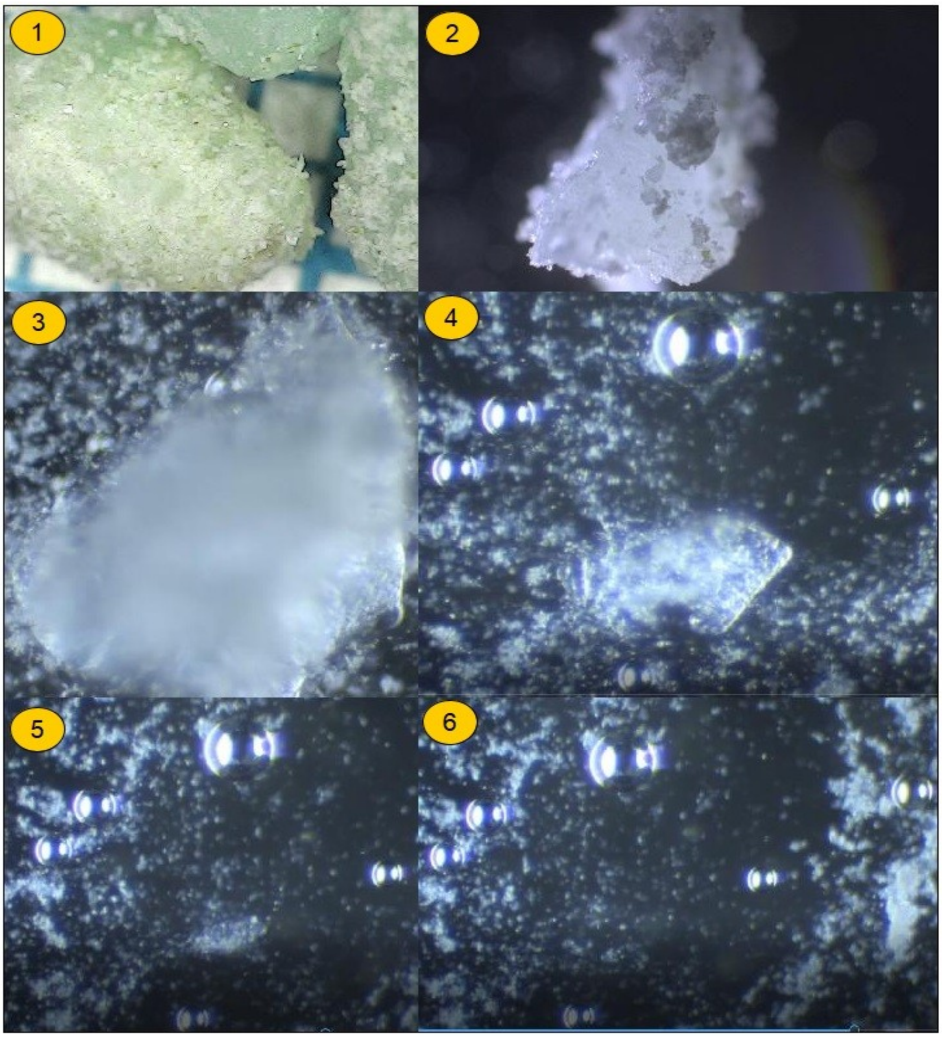
5.4.7.8.8.2 Figure 427: Network of the $FeSO_4 \cdot 7H_2O$ solution

Figure 427 shows the network of ionic-polar coordinate bonds in a solution of $FeSO_4 \cdot 7H_2O$, with distances between the involved particles—such as Fe^{2+}, O^{2-}, H^+, and S^{6+}—represented as repeating motifs of the $[Fe(H_2O)_6]^{2+}$ complex, water bridges, and polyatomic anions $(SO_4)^{2-}$. The coordinate covalent bond between six H_2O molecules and the Fe^{2+} cation in aqueous solution is surrounded by polar covalently bonded water molecules. Similarly, a covalent bond exists between S^{6+} and four O^{2-} atoms, with one H_2O molecule also coordinate-bonded to the complex, which is likewise surrounded by polar covalent water molecules.

As with $CuSO_4 \cdot 5H_2O$, the process of crystalline water evaporation and rehydration of $FeSO_4$ is reversible and can be repeated, indicating the same reversible nature in this case. The $[Fe(H_2O)_6]^{2+}$ complex has a double-pyramidal or octahedral molecular geometry and exhibits paramagnetic properties—meaning it responds to external magnetic fields and forms internally induced magnetic fields.

When comparing the distances in the $FeSO_4 \cdot 7H_2O$ and $CuSO_4 \cdot 5H_2O$ solutions, it is evident that the distances between Fe^{2+} and O^{2-} are slightly longer than those between Cu^{2+} and O^{2-}, while the distances between S^{6+} and O^{2-} are slightly shorter. These minor differences at the mesoscopic level result in significantly different chemical and physical properties between the two compounds:

$FeSO_4 \cdot 7H_2O$ is less soluble in water and decomposes at a much lower temperature than $CuSO_4 \cdot 5H_2O$. These subtle differences, although seemingly negligible at the mesoscale, are also responsible for the distinct colors of their crystals and solutions. The next section includes an observation of $FeSO_4 \cdot 7H_2O$ crystals under a USB microscope and the melting of a micro-amount of the substance in two drops of distilled water using an optical microscope.

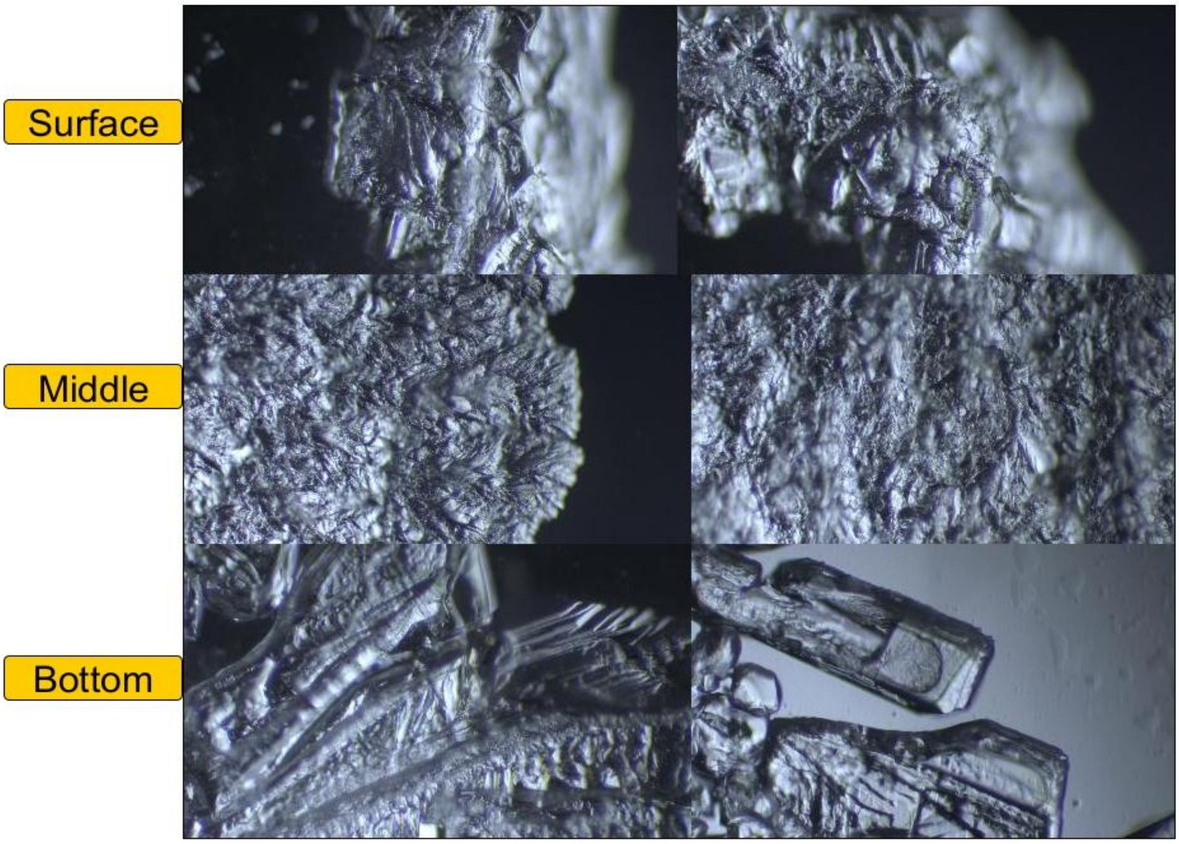


5.4.7.8.8.3 Figure 428: $FeSO_4 \cdot 7H_2O$ crystals and melting phases

Figure 428 shows $FeSO_4 \cdot 7H_2O$ crystals under a USB microscope (see label 1) and the melting phases of a single crystal in two drops of distilled water under a light microscope, labeled from 2 to 6. In its dissolved form, $FeSO_4 \cdot 7H_2O$ exhibits an octahedral molecular geometry, similar to $CuSO_4 \cdot 5H_2O$. This hierarchical associative geometric structure—essentially a double pyramid—defines the compound’s various chemical and physical properties.

The upper-left section of the figure displays $FeSO_4 \cdot 7H_2O$ crystals in different shapes and sizes. Despite the illumination from the USB microscope, the green color of the crystals remains clearly visible. When observing the melting phases of $FeSO_4 \cdot 7H_2O$, notable differences are again observed compared to previously studied compounds or solutions. Unlike $CuSO_4 \cdot 5H_2O$, $FeSO_4 \cdot$

$7H_2O$ produces bubble clusters during melting, which solidify in the final phase. The crystal melts relatively quickly, indicating that this substance is also highly soluble in water.
Due to the greater and uneven distances between Fe^{2+} and the six O^{2-} atoms, this side of the pyramidal structure has a lower solubility potential. Conversely, the shorter distances between S^{6+} and four O^{2-} atoms on the other side lead to a slightly higher solubility potential in water. In summary, as with $CuSO_4 \cdot 5H_2O$, the solubility potential is not uniform within the $FeSO_4 \cdot 7H_2O$ compound or even within a single crystal, as it is again influenced by parameters such as interatomic distances and bond angles.
Considering that the $[Fe(H_2O)_6]^{2+}$ complex is not an isolated unit but connected to a water molecule and the polyatomic anion group $(SO_4)^{2-}$, we can again assume a relative balance of solubility potential in water. Similar to $CuSO_4 \cdot 5H_2O$, $FeSO_4 \cdot 7H_2O$ also demonstrates that without the critical interconnection between the $[Fe(H_2O)_6]^{2+}$ complex, water bridge, and polyatomic anion group $(SO_4)^{2-}$, there is no collective effect on solution conductivity.
Next is an experiment on the crystallization of $FeSO_4 \cdot 7H_2O$ solution through water evaporation or heat application. Slow crystallization under the light microscope did not provide clear observable results. The same concentration will be used again: 13 g of $FeSO_4 \cdot 7H_2O$ in 100 ml of water. Special care must be taken during water evaporation, as $FeSO_4 \cdot 7H_2O$ begins to chemically decompose at 400 °C. This is also the main reason why later conductivity and density measurements will not include adsorbed masses. Natural drying is too time-consuming and also not comparable to drying with an alcohol burner. Additionally, the Fe^{2+} cation oxidizes rather quickly into Fe^{3+}.



5.4.7.8.8.4 Figure 429: Rapid crystallization of $FeSO_4 \cdot 7H_2O$

Figure 429 shows microscopic images resulting from the rapid crystallization of a solution with a concentration of 13 g $FeSO_4 \cdot 7H_2O$ in 100 ml of water. Drops from the surface, middle, and bottom of this solution were transferred onto microscope slides, which were then covered with cover slips. Heat was applied using an alcohol burner positioned approximately 20 cm from the slides.

First, it is noticeable that, despite the heat, the $FeSO_4 \cdot 7H_2O$ solution does not crystallize as quickly or expansively as seen with solutions of NaCl, KCl, Na_2CO_3, $NaHCO_3$, or even $CuSO_4 \cdot 5H_2O$. The density of crystals on the surface of the solution is somewhat lower than in the middle and bottom layers. No distinct geometric shapes are observed at the surface.

A similar observation applies to the crystals from the middle of the solution, though a higher concentration of crystals is present there. For the crystals from the bottom, the density is lower than in the middle, but more recognizable geometric forms, such as rectangular prisms and cylinders, can be observed.

This diversity within the same solution reflects the varied distribution of ions, which essentially act as the driving force behind crystal formation. The next section involves measurements of conductivity and density for the $FeSO_4 \cdot 7H_2O$ solution.

5.4.7.8.9 Table 191: Conductivities of $FeSO_4 \cdot 7H_2O$ solutions of different concentrations

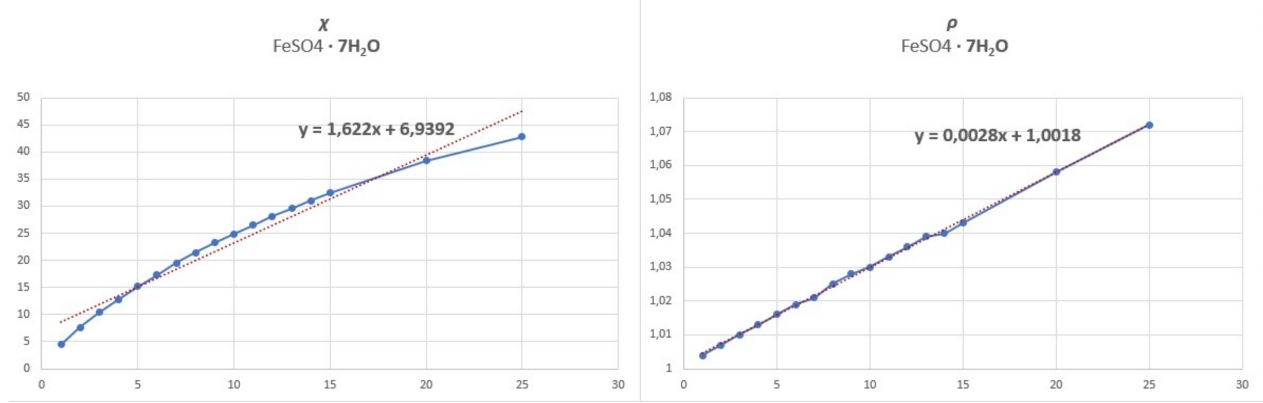
C	*χ $FeSO_4$*	*ρ $FeSO_4$*
1	4.510	1.004
2	7.580	1.007
3	10.420	1.010
4	12.780	1.013
5	15.220	1.016
6	17.330	1.019
7	19.460	1.021
8	21.400	1.025
9	23.200	1.028
10	24.900	1.030
11	26.500	1.033
12	28.100	1.036
13	29.600	1.039
14	31.000	1.040
15	32.400	1.043
20	38.400	1.058
25	42.800	1.072

Table 191 presents the results of conductivity and density measurements for $FeSO_4 \cdot 7H_2O$ solutions of various concentrations, ranging from 1 g $FeSO_4 \cdot 7H_2O$ + 100 ml H_2O to 25 g $FeSO_4 \cdot 7H_2O$ + 100 ml H_2O.

As can be observed, the values for conductivity (in mS) and density (in g/cm³) are relatively low. Based on the data, both conductivity and density exhibit a generally linear increase with concentration. However, this increase is not perfectly uniform, which raises questions—since one would expect a consistent and homogeneous rise in values as the concentration of the solution increases.

The primary reason for this slight asymmetry in the trend could lie in impurities present in the industrially produced $FeSO_4 \cdot 7H_2O$ in its solid state. A secondary, potentially less significant factor may be the tendency of Fe^{2+} cations to oxidize to Fe^{3+} cations, as previously mentioned.

To gain a clearer understanding of this asymmetrical trend in conductivity and density with increasing concentration, a visual representation will follow.



5.4.7.8.9.1 Figure 430: Visualization of conductivity and density data for $FeSO_4 \cdot 7H_2O$ solutions

Figure 430 presents a visualization of the data from Table 190, showing conductivity and density of $FeSO_4 \cdot 7H_2O$ solutions at various concentrations. According to the trend line, conductivity rises relatively steeply between concentrations of 5 g + 100 ml H_2O and 15 g + 100 ml H_2O. Beyond this range, as more of the salt is added, the conductivity begins to gradually decline. In the saturated state of the solution, the conductivity value is noticeably lower than what would be expected based on the trend line.

The difference in conductivity ($\Delta\chi = \chi_t - \chi_m$ = 47.5 mS – 42.8 mS) is about 4.7 mS, corresponding to a drop of approximately 9.9%—roughly equivalent to the contribution of one gram of the substance (see conductivity of the 1 g $FeSO_4 \cdot 7H_2O$ + 100 ml H_2O solution, which is 4.51 mS). This drop from the expected trend can again be attributed to impurities in the industrial $FeSO_4 \cdot 7H_2O$ and the oxidation of Fe^{2+} cations to Fe^{3+}.

In contrast, the measured density values align more closely with the trend line, showing a generally uniform linear increase. Typically, density rises by 0.003 g/cm³ with each concentration increase, although there are exceptions at concentrations of 8, 10, and 14 g $FeSO_4 \cdot 7H_2O$, which show increases of 0.002 g/cm³, 0.004 g/cm³, and 0.001 g/cm³, respectively. These deviations are likely also due to impurities and oxidation of Fe^{2+}.

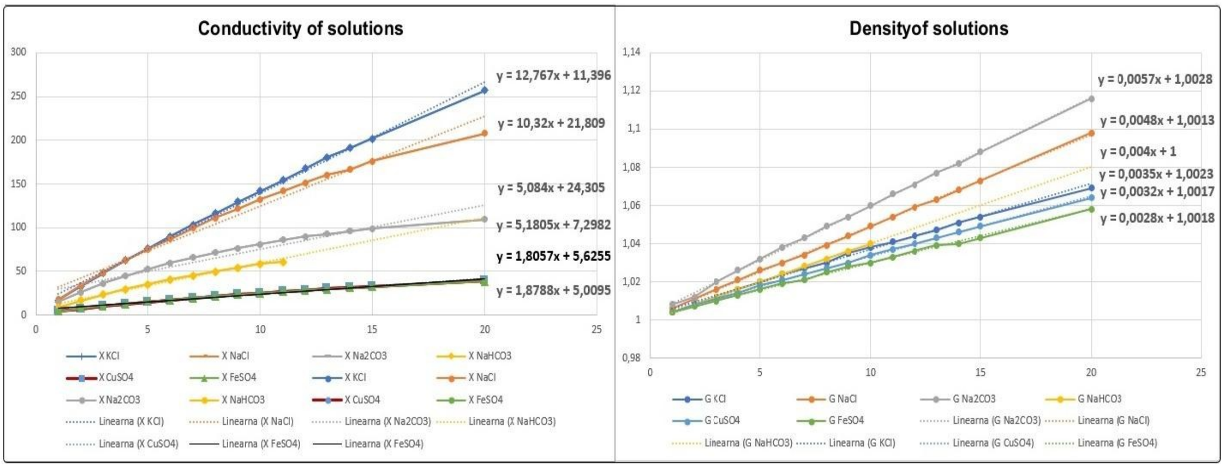
At lower concentrations (1 g to 4 g $FeSO_4 \cdot 7H_2O$ per 100 ml H_2O), the solution appears pale yellow. As the concentration increases, the color shifts increasingly toward green. Similarly, solution clarity improves with higher concentrations.

It’s important to note that properly prepared $FeSO_4 \cdot 7H_2O$ solutions typically include an addition of dilute sulfuric acid (H_2SO_4), which serves to prevent oxidation of Fe^{2+} to Fe^{3+}. Given that H_2SO_4 was not used in these measurements, we can assume that the measured results may partially reflect a mixture of $FeSO_4 \cdot 7H_2O$ and $Fe_2(SO_4)_3$.

Next follows a comparison of conductivity and density values for the previously measured solutions: NaCl, KCl, Na_2CO_3, $NaHCO_3$, $CuSO_4 \cdot 5H_2O$, and $FeSO_4 \cdot 7H_2O$.

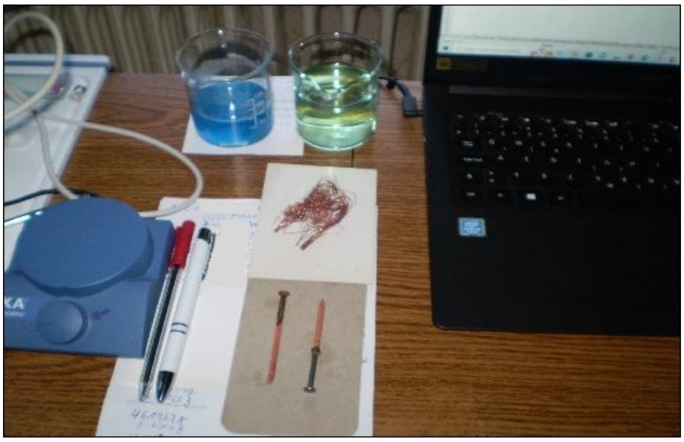
5.4.7.8.9.2 Table 192: Comparison of values for conductivity and density of different chemical solutions

C	χ *KCl*	ρ *KCl*	χ *NaCl*	ρ *NaCl*	χ Na_2CO_3	ρ Na_2CO_3	χ $NaHCO_3$	ρ $NaHCO_3$	χ $CuSO_4$	ρ $CuSO_4$	χ $FeSO_4$	ρ $FeSO_4$
1	17.05	1.004	17.85	1.006	14.84	1.008	8.89	1.004	4.26	1.004	4.51	1.004
2	32.90	1.008	33.90	1.011	26.30	1.012	16.50	1.008	7.30	1.008	7.58	1.007
3	48.10	1.012	48.50	1.016	36.10	1.020	23.30	1.012	9.95	1.011	10.42	1.010
4	62.30	1.016	62.20	1.021	44.80	1.026	29.50	1.016	12.46	1.014	12.78	1.013
5	76.10	1.020	75.60	1.026	52.40	1.032	35.10	1.020	14.83	1.018	15.22	1.016
6	89.70	1.024	87.00	1.030	59.40	1.038	40.70	1.024	17.00	1.021	17.33	1.019
7	103.40	1.027	99.30	1.034	65.60	1.043	45.20	1.028	19.09	1.024	19.46	1.021
8	116.30	1.030	111.00	1.039	71.40	1.049	49.80	1.032	21.30	1.027	21.40	1.025
9	129.40	1.035	121.70	1.044	76.60	1.054	54.10	1.036	23.20	1.030	23.20	1.028
10	142.10	1.038	132.30	1.049	80.70	1.060	58.30	1.040	25.10	1.034	24.90	1.030
11	154.40	1.041	141.90	1.054	85.70	1.066	60.80		26.80	1.037	26.50	1.033
12	167.40	1.044	151.40	1.059	90.00	1.071			28.30	1.040	28.10	1.036
13	180.50	1.047	160.50	1.063	92.40	1.077			29.90	1.043	29.60	1.039
14	191.00	1.051	166.40	1.068	96.10	1.082			31.50	1.046	31.00	1.040
15	202.00	1.054	176.20	1.073	99.00	1.088			32.80	1.049	32.40	1.043
20	257.00	1.069	208.00	1.098	109.30	1.116			39.40	1.064	38.40	1.058



5.4.7.8.9.3 Figure 431: Visualization of comparative conductivity and density values of chemical solutions

Table 192 presents measurement data for the conductivity and density of various chemical solutions at different concentrations, while figure 431 visualizes these values. From the linear equations of the trend lines, we can identify which chemical solutions showed the highest conductivity values (KCl, NaCl, Na_2CO_3) and which showed the lowest ($NaHCO_3$, $CuSO_4 \cdot 5H_2O$, $FeSO_4 \cdot 7H_2O$) — as seen on the left side of the figure. Notably, the conductivity values of $CuSO_4 \cdot 5H_2O$ and $FeSO_4 \cdot 7H_2O$ are very close to each other. In the concentration range from 1 g to 9 g salt + 100 ml H_2O, $FeSO_4 \cdot 7H_2O$ solutions exhibit higher conductivity than $CuSO_4 \cdot 5H_2O$ solutions. At a concentration of 9 g salt + 100 ml H_2O, both solutions have identical conductivity values (23.2 mS). At higher concentrations (up to 20 g salt + 100 ml H_2O), the conductivity values for $CuSO_4 \cdot 5H_2O$ are slightly higher than those of $FeSO_4 \cdot 7H_2O$. This is expected, as $CuSO_4 \cdot 5H_2O$ has a higher solubility in water (32 g/100 ml at 20 °C) compared to $FeSO_4 \cdot 7H_2O$ (25 g/100 ml at 20 °C). However, it is less clear why $FeSO_4 \cdot 7H_2O$ shows higher conductivity than $CuSO_4 \cdot 5H_2O$ at lower concentrations (up to 9 g + 100 ml H_2O). A similar phenomenon was observed with KCl vs. NaCl and Na_2CO_3 vs. $NaHCO_3$ solutions. This is likely due to the inherent properties of $FeSO_4 \cdot 7H_2O$, which dissociates into ions more rapidly in water and is more sensitive to temperature than $CuSO_4 \cdot 5H_2O$. Interestingly, the temperatures during $CuSO_4 \cdot 5H_2O$ conductivity measurements were even slightly higher (25 °C to 27 °C) compared to those of $FeSO_4 \cdot 7H_2O$ (22 °C to 25.5 °C). It is well known that iron is more reactive than copper due to having more unpaired electrons. This characteristic also applies to Fe^{2+} and Cu^{2+} cations. Fe^{2+} cations react more quickly and exothermically with water molecules than Cu^{2+} cations, which significantly boosts conductivity at lower concentrations. At higher concentrations, however, this intrinsic property has a smaller effect, as the solubility potential of the compound becomes the dominant factor. If an iron nail is immersed in a $CuSO_4 \cdot 5H_2O$ solution, elemental copper (Cu) deposits onto the nail, while Fe^{2+} cations form from the iron and bond with the polyatomic anion $(SO_4)^{2-}$. After preparing a saturated $CuSO_4 \cdot 5H_2O$ solution, an iron nail was submerged in it, and its surface began turning reddish-pink. The nail remained in the solution for about 15 hours to form a copper electrode for later use in building a galvanic cell. In parallel, a saturated $FeSO_4 \cdot 7H_2O$ solution was prepared, into which a coil of copper wire was placed. The result is shown in the next figure.



5.4.7.8.9.4 Figure 432: Enrichment of iron and copper

Figure 432 shows the outcome of two reactions involving the enrichment of iron and copper. The iron nail, which was immersed in a saturated $CuSO_4 \cdot 5H_2O$ solution, changed color, and elemental copper (Cu) was deposited. A coil of copper wire was immersed in a saturated $FeSO_4 \cdot 7H_2O$ solution, but no change occurred on the elemental copper.

Additionally, the volume of the $CuSO_4 \cdot 5H_2O$ solution significantly decreased, while the volume of the $FeSO_4 \cdot 7H_2O$ solution remained unchanged. Iron (U = -0.49 V) has a lower standard reduction potential than copper (U = 0.34 V), which makes it more reactive, a property that also applies to Fe^{2+} cations in aqueous solutions. Furthermore, elemental iron has a higher resistance ($R = 9.78 \cdot 10^{-8}\ \Omega$) than elemental copper ($R = 1.68 \cdot 10^{-8}\ \Omega$). Due to these inherent physical-chemical properties, elemental copper does not change in the $FeSO_4 \cdot 7H_2O$ solution, while elemental iron in the $CuSO_4 \cdot 5H_2O$ solution transforms into elemental copper.

This reaction involves both oxidation and reduction processes. Cu^{2+} cations are reduced to elemental copper (Cu), while elemental iron is oxidized to Fe^{2+} cations. Both half-reactions can be written as follows:

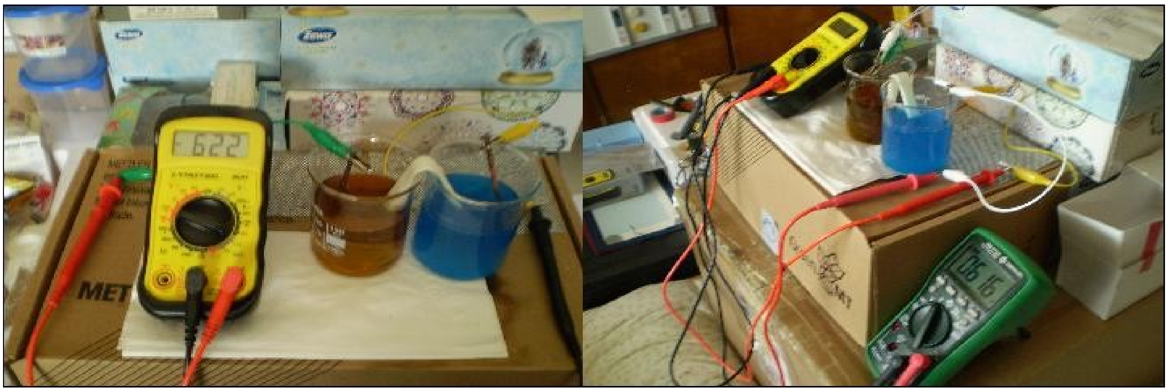
Cu^{2+} (H_2O) + $2e^-$ $\rightarrow$ Cu^0 (solid)

Fe^0 (solid) $\rightarrow$ Fe^{2+} (H_2O) + $2e^-$

These two half-reactions of reduction and oxidation can be combined into one overall reaction:

Fe^0 (solid) + Cu^{2+} (H_2O) $\rightarrow$ Fe^{2+} (H_2O) + Cu_0 (solid)

This experiment, as already mentioned, was designed to create a galvanic cell. Distilled water of a different brand was used, which caused the $FeSO_4 \cdot 7H_2O$ to change color from green to brown upon its addition. This resulted in the oxidation of Fe^{2+} cations to Fe^{3+} cations, forming a solution of iron(III) sulfate ($Fe_2(SO_4)_3 \cdot nH_2O$). Thus, the distilled water essentially acted as an oxidant.



5.4.7.8.9.5 Figure 433: Measuring the voltage and current of a galvanic cell

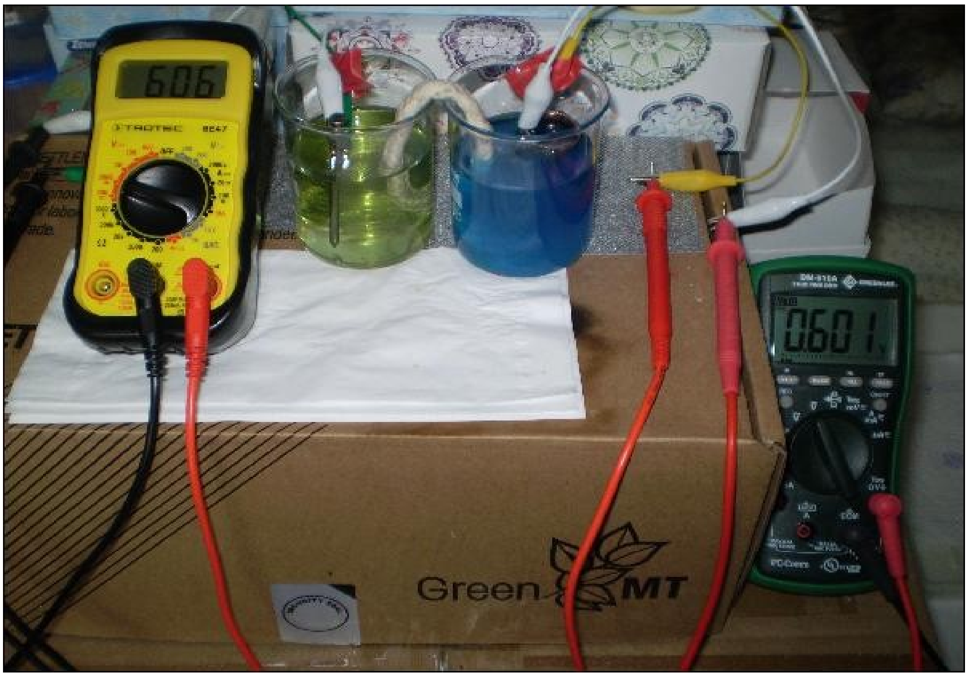
Figure 433 shows the measurement of the voltage and current of a galvanic cell using two multimeters.[271] On the left side is a saturated solution of $Fe_2(SO_4)_3 \cdot nH_2O$ (a brown-colored solution), while on the right side is a saturated solution of $CuSO_4 \cdot 5H_2O$ (a dark blue solution). A salt bridge made of folded filter paper, previously soaked in a 5% NaCl solution, serves as the connecting element between the two solutions (a white strip over both beakers containing the solutions).

271 The values were measured using a Greenline DM-510A and a Trotec Be 47 multimeter.

An iron nail, acting as the iron electrode, is immersed in the saturated $Fe_2(SO_4)_3 \cdot nH_2O$ solution, while a copper-coated nail serves as the copper electrode, immersed in the saturated $CuSO_4 \cdot 5H_2O$ solution. Both electrodes are connected with alligator clips, which are in turn connected to the terminals of two multimeters.

The voltage and current generated by the described galvanic cell were measured. With the Greenline DM-150A multimeter, a voltage of 616 mV and a current of 0.158 mA were recorded. Similar values were measured with the second multimeter, the Trotec Be 47: voltage (U = 619 mV) and current (I = 0.159 mA).

The experiment was repeated under three modified conditions. Distilled water was used to prepare both saturated solutions, consistent across all (except the earlier) solution preparations. This time, a cotton wick for alcohol burners, previously soaked in a 5% NaCl solution, was used as the salt bridge. A copper cylinder was used as the copper electrode in this trial. All other conditions remained unchanged.



5.4.7.8.9.6 Figure 434: Galvanic cell with saturated solutions of $FeSO_4 \cdot 7H_2O$ and $CuSO_4 \cdot 5H_2O$

Figure 434 shows a galvanic cell composed of two saturated solutions—$FeSO_4 \cdot 7H_2O$ and $CuSO_4 \cdot 5H_2O$—connected by a salt bridge made of cotton wick. Voltage and current measurements were again taken using the mentioned multimeters. Despite the three modified conditions, the differences in readings were negligible.

With the Greenline multimeter, a voltage of 615 mV and a current of 0.160 mA were recorded. With the Trotec multimeter, the voltage measured was 620 mV, and the current was 0.158 mA. The copper-coated nail from the previous experiment served adequately as the copper electrode, as did the salt bridge and the distilled water used. In the earlier experiment, the distilled water enabled the oxidation of Fe^{2+} ions to Fe^{3+}, but this did not significantly affect the performance of the galvanic cell. Both galvanic cells generated nearly identical voltage and current. The tests confirmed the assumption that, due to the higher reactivity of Fe^{2+} ions compared to Cu^{2+} ions—and the tendency of Fe^{2+} to oxidize to Fe^{3+}—$FeSO_4{\cdot}7H_2O$ solutions exhibit greater conductivity at lower concentrations than $CuSO_4{\cdot}5H_2O$ solutions. At low concentrations, the solubility potential of both compounds in water does not differ significantly. However, at concentrations above 9 g of salt per 100 ml of water, the solubility potential of $FeSO_4{\cdot}7H_2O$ slightly decreases, while that of $CuSO_4{\cdot}5H_2O$ increases. It is important to consider the inherent property of both compounds—their solubility in water. $CuSO_4{\cdot}5H_2O$ is more soluble (32 g/100 ml) than $FeSO_4{\cdot}7H_2O$ (25 g/100 ml). Overall, $CuSO_4{\cdot}5H_2O$ is significantly more soluble, meaning that at higher concentrations, stronger associative forces exist between the solute and solvent in $CuSO_4{\cdot}5H_2O$ solutions. When measuring the conductivity of a $Fe_2(SO_4)_3{\cdot}nH_2O$ solution, the result is close to that of a $FeSO_4{\cdot}7H_2O$ solution. It is not precisely known which hydrated form of $Fe_2(SO_4)_3{\cdot}nH_2O$ (with n being unknown) was formed in the first experiment, but it is assumed to be the monohydrate $Fe_2(SO_4)_3{\cdot}H_2O$. This compound has a solubility of approximately 25.6 g/100 ml at room temperature, slightly higher than that of $FeSO_4{\cdot}7H_2O$. Additionally, $Fe_2(SO_4)_3{\cdot}H_2O$ has a higher molecular weight (477.18 g/mol) compared to $FeSO_4{\cdot}7H_2O$ (278.014 g/mol).

Based on this information, it can be concluded that the number of ions in the two solutions differs significantly. Despite these differences, the measured values of voltage, current, and the conductivity of the two saturated solutions were very similar. It would be meaningful to calculate the number of ions in the saturated solutions of both $FeSO_4{\cdot}7H_2O$ and $Fe_2(SO_4)_3{\cdot}H_2O$.

$$ML=\frac{m_{kFeSO4}}{M_{FeSO4}}=\frac{(25{,}0\,g)}{(278{,}014\,\frac{g}{mol})}=8{,}99\cdot10^{-2}\,moles$$

$$ML=\frac{m_{kFe2SO43}}{M_{Fe2SO43}}=\frac{(25{,}6\,g)}{(417{,}88\,\frac{g}{mol})}=6{,}12\cdot10^{-2}\,moles$$

A saturated solution of $Fe_2(SO_4)_3{\cdot}H_2O$ contains fewer moles than a saturated solution of $FeSO_4{\cdot}7H_2O$, which also means a lower number of ions. This statement is supported by the following calculations.

$$N_{iFeSO4}=ML\cdot N_{aFeSO4}=8{,}99\cdot10^{-2}\cdot6{,}023\cdot10^{23}=5{,}414\cdot10^{22}\,ions$$

$$N_{iFe2SO43}=ML\cdot N_{aFe2SO43}=6{,}12\cdot10^{-2}\cdot6{,}023\cdot10^{23}=3{,}69\cdot10^{22}\,ions$$

A saturated solution of $Fe_2(SO_4)_3{\cdot}H_2O$ contains fewer ions (1.845×10^{22} cations and 1.845×10^{22} anions) than a saturated solution of $FeSO_4{\cdot}7H_2O$ (2.707×10^{22} cations and 2.707×10^{22} anions). Despite this significant difference in the number of ions between the two chemical solutions, the measured values do not differ substantially. It appears that there is no existing theory or model that can explain the reason for the nearly identical measurements.

In this case, we cannot rely on solubility potential in water, ion size, density, conductivity, or the number of ions to account for the similarity. Instead, we must at least hypothesize the reason behind it. In such situations, mathematical language as a primary tool often falls short, and it becomes necessary to use natural language without numerical symbols. In both saturated solutions, we are dealing with ions that are still sufficiently mobile, though less so than in more dilute solutions. Ions and water molecules can organize together to create collective effects that influence conductivity, either increasing or decreasing it. A smaller number of ions may produce roughly the same collective effect on conductivity as a larger number of ions, which could suggest the following:

a) Leading ions, together with water molecules, can organize subordinate ions and their hydration shells in such a way that an optimal collective effect is achieved.

b) The organization of a larger number of ions and water molecules may be less efficiently directed toward enhancing collective effects.

c) There may be fewer inhibiting or blocking factors in ion organization that would otherwise prevent stronger collective effects.

Again, we encounter the fact that ions of the same chemical compound can behave quite differently in solution. The same applies to water molecules, which bend under the influence of ions and already at this stage begin to generate potentials for various collective effects. Without appropriate organization on multiple levels—from micro to macrocosm—these collective effects cannot arise. This universal principle applies across micro, meso, and macro levels, and to all hierarchical associative systems.

This insight could form the foundation for developing a new theory of particle statics and dynamics. The current obstacle to developing such a theory is the lack of measurement methods that would allow precise detection of differences between individual ions of the same compound in aqueous solution. At present, we can only measure the collective effects of particles on the femto-cosmic scale, which resembles statistical models that often disregard individual influences. A possible solution would be to use analogies from the meso-cosmic level and connect them to network models and developed scales. However, this would require extensive research effort, ideally within well-organized scientific teams, with the hope of achieving useful and positive results.

$FeSO_4$ is a natural neutralizer of overly alkaline soils, allowing the growth of certain plant species that are important for food chains. It can also inhibit the excessive growth of invasive plants such as moss, contributing to ecological balance and biomass production. $FeSO_4$ is used as a fertilizer for various types of plants, including grasses and trees. Additionally, it helps suppress the overgrowth of E. coli bacteria in nature, thereby preventing food poisoning in living organisms.

Humans use $FeSO_4 \cdot 7H_2O$ in medicine (e.g., for treating anemia), in the dye industry (as a pigment), and in agriculture (as an herbicide and to enhance the growth of nutrient-rich plants). The mineral melanterite, the natural form of $FeSO_4 \cdot 7H_2O$, is found worldwide, with the largest mines located in Germany, Portugal, France, the USA, Argentina, Australia, and other countries.

Only a very small selection of ionic inorganic chemical compounds in connection with water was studied—out of approximately 500,000 known inorganic compounds, not all of which are water-soluble. This subsection presented chemical compounds and their aqueous solutions that play a significant role in both the living and non-living world, as well as in the functioning of the natural hierarchical associative system as a whole. The salts discussed include those from the chloride group (NaCl and KCl), carbonates (Na_2CO_3, $NaHCO_3$, and $CaCO_3$), and sulfates ($CuSO_4 \cdot 5H_2O$ and $FeSO_4 \cdot 7H_2O$).

It is worth noting that there are also nitrates, phosphates, iodides, bromides, fluorides, borates, and other salts, which also have a significant impact on our planet and climate. Many of these salts are widespread in water sources, soils, and even in the atmosphere. Ionic compounds are generally the result of a reaction between a specific acid and base, which leads to more or less complete pH neutralization. The pH model is based on a scale between two extremes—acidic and alkaline—where neutralization occurs in the middle of the scale, between values 0 and 14. These two opposing forces create an additional balancing force.

The discussed chemical compounds and their solutions are geographically widespread, indicating their role in maintaining planetary homeostasis. Furthermore, they influence Earth’s magnetic fields, as the movement of electric charge generates magnetic fields within matter. Magnetism is a property of all materials containing electrically charged particles. The geographic distribution of these ionic and/or ionically polar compounds thus contributes to the relative homeostasis of Earth’s dynamic magnetic fields. Especially when combined with water, the mobility of ions increases, which can indirectly amplify or reduce magnetic fields on the planet.

Denser rocks that contain mineral ores generate stronger local gravitational fields at Earth’s surface, while less dense rocks create weaker fields. Water sources also influence Earth's gravity. The entire system of minerals and water resources maintains gravitational fields close to a constant value of approximately 9.80665 m/s^2. Larger or smaller deviations from this average are local and, as mentioned, mainly depend on the presence of inorganic minerals and water sources around the globe.

Some minerals also possess natural radioactivity, as they contain varying amounts of radionuclides. Water significantly mitigates the effects of radioactivity, although it can absorb small amounts of it. Natural radioactivity plays a crucial role in heating Earth's interior, as it results from the slow decay of radioactive substances. This internal heating maintains the Earth's magnetic field, protects us from harmful cosmic radiation, and prevents the atmosphere from dissipating.[272] In short, the chemical compounds discussed—along with their aqueous solutions—affect major natural forces such as electromagnetism, gravity, and radioactivity. Additionally, they play a key role in various inductive processes within natural hierarchical associative systems, which enable natural information-communication platforms and thereby help overcome physical distances more quickly. These distances often slow down certain natural processes, potentially affecting their efficiency. Chemical compounds and their solutions are often perceived as inanimate and lifeless—simply inert matter surrounding us and existing within us. However, despite not meeting most conventional criteria for living organisms, these substances, through the organization and activity of their particles, significantly influence natural forces and, in turn, the atmosphere, landscape, climate, and living beings.

This subsection focused on crystal structures, particle organization, and measurements of the conductivity of various aqueous chemical solutions that have the potential to generate electrical energy. This potential becomes realized when an appropriate interface or bridge is present—the very principle on which galvanic cells or batteries operate. The measurements revealed that some chemical solutions exhibit higher conductivity than others, primarily due to their inherent properties such as solubility potential in water, electronegativity and charge of particles, ion concentration and organization, ion size, the mass surface area between cations and anions, interionic distances, interaction angles between ions and water molecules, the degree of symmetry disruption in water molecules, and the number and strength of bonds within hierarchical associative structures between ions and water molecules.

In addition to ionic polar solutions with high electrical conductivity, there are also covalently polar solutions (e.g., hydrochloric acid – HCl, hydrofluoric acid – HF) and basic solutions (e.g., sodium hydroxide – $NaOH$, potassium hydroxide – KOH), which often exhibit greater conductivity than solutions of most ionic salts. Based on this, one might expect salts formed from strong acid–strong base reactions to have the highest conductivity, but this is not always the case. While such a pattern

272 https://www.universetoday.com/148796/what-role-do-radioactive-elements-play-in-a-planets-habitability/ (2022-08-22).
https://www.iaea.org/sites/default/files/38205680915.pdf (2022-08-22).

was observed during the study of ionic solutions, certain salts (e.g., calcium chloride – $CaCl_2$, aluminum chloride – $AlCl_3$, barium chloride – $BaCl_2$) showed higher conductivity than NaCl or KCl. This can be explained by the greater number of ions in solution. These salts result from reactions between strong acids and moderately strong bases, suggesting that the origin of the acid and base is not the decisive factor in electrical conductivity—instead, the effectiveness of polar and ionic interfaces or bridges plays the more crucial role. A similar principle can be observed in the game of chess: although player A may have more pieces than player B, this does not guarantee victory. If the connections between the pieces are weak and their activity is low, player A may be at a disadvantage despite their numerical superiority. Poor organization of the pieces reduces spatial efficiency and weakens both strategic and tactical options. Likewise, in ionic polar bonds, dynamic ion networks are constantly rearranging their structure to achieve the best possible collective effects, such as enhanced electrical conductivity.

The key difference between a network of chess pieces and ionic polar bonds is that it's not about a victory of positive ions over negative ones or vice versa, but rather about establishing an optimal hierarchical associative structure that adapts to its environment and its properties. Just as in the world of ions and water molecules, bodily systems also cannot function without interfaces—without them, organs do not interact, and collective effects essential for life do not occur. This principle is also observed in social, internet, bacteriological, and even solar networks.

All networks require a platform and a space that allow for both stability and movement, thereby enabling the formation of a generic infrastructure. In salt crystal lattices, both platform and space serve as the basis for the proper arrangement of cations and anions. The same applies to water molecules, which enable the continuous association and dissociation of particles. When salts dissolve in water, many new configurations emerge, and due to the dynamic nature of ionic polar networks, these gradually transform into more stable and recurring patterns.

With these insights, we conclude the subsection on chemical compounds and their aqueous solutions. In the following section, we will turn to the previously announced topic of soil, which is closely linked to the structure of Earth's surface and interior. In this context, we distinguish between the mechanical division of Earth's structure (lithosphere, asthenosphere, mesosphere, outer and inner core) and the chemical division (Earth's crust, upper and lower mantle, outer and inner core).

5.5 Earth or Soil

Before we begin describing and studying different types of soil, we will first present the structure and composition of our planet Earth.

1. Earth's crust

The Earth's crust makes up the smallest portion of the planet—about 1%—and is primarily composed of basalt and granite. The crust is divided into individual tectonic plates that are constantly moving. These plates vary in thickness, which allows us to distinguish between the continental crust (ranging from 20 km to 70 km thick) and the oceanic crust (ranging from 5 km to 10 km thick). The temperature of the crust is lowest at the surface and roughly corresponds to the ambient atmospheric temperature.

The Earth’s crust is mainly composed of oxides, including:

- Silicon dioxide or quartz (SiO_2 – approx. 59.3%)
- Aluminum oxide (Al_2O_3 – approx. 15.9%)
- Iron(II) oxide (FeO – approx. 4.5%)
- Iron(III) oxide (Fe_2O_3 – approx. 2.5%)
- Titanium dioxide (TiO_2 – approx. 0.9%)
- Manganese oxide (MnO – approx. 0.1%)
- Magnesium oxide (MgO – approx. 4.0%)
- Calcium oxide (CaO – approx. 7.2%)
- Sodium oxide (Na_2O – approx. 3.0%)
- Potassium oxide (K_2O – approx. 2.4%)
- Diphosphorus pentoxide (P_2O_5 – approx. 0.2%)

Chlorides, sulfides, and fluorides rarely exceed 1%.[273]

The Earth’s crust is especially important as it provides the habitat for countless living organisms on our planet—particularly plants and algae. These organisms are not only a vital source of food for animals and humans, but they also produce oxygen, without which many life forms, including humans, could not survive.

2. The Earth’s mantle

The mantle lies between the Earth’s crust and the outer core, comprising about 84% of Earth’s volume and extending to a depth of approximately 2,890 km. It consists mostly of extremely solid material that surrounds the Earth’s hot, iron-rich core. In thinner regions of the mantle, processes such as melting and volcanism occur, releasing gases that significantly influence the relatively balanced composition of our atmosphere.

The mantle is primarily made up of oxides, with the following approximate composition:

- Silicon dioxide (SiO_2 – ~46%)
- Magnesium oxide (MgO – ~37.8%)

273 Data obtained using the source: Gupta, A. K. (2009). *Physics and chemistry of the Earth's interior crust, mantle and Core : a platinum jubilee special issue*. Springer.

- Iron(II) oxide (FeO – ~7.5%)
- Aluminum oxide (Al_2O_3 – ~4.2%)
- Calcium oxide (CaO – ~3.2%)
- Sodium oxide (Na_2O – ~0.4%)
- Potassium oxide (K_2O – ~0.04%)

Temperatures in the mantle range from around 500°C at its upper boundary to about 4,000°C at the boundary with the core. The mantle played a key role in the formation of the Earth's crust, which is essential for plant life. Without the mantle, there would be no plate tectonics, which shape the continents—forming the basis for terrestrial life, including humans.

Moreover, the movement of tectonic plates creates mountain ranges, which are critical for storing freshwater sources, thus fulfilling basic needs for water. Mountainous landscapes also have a strong impact on climate patterns.

3. The Earth’s core

The Earth's core, the innermost layer, is divided into the outer and inner core. The outer core is a liquid layer composed mainly of iron (Fe) and nickel (Ni), located between the mantle and the solid inner core. Temperatures in the outer core range from approximately 2,730°C to 13,940°C.

This outer core generates an extremely strong magnetic field, around 2.5 milliteslas (mT)—approximately 50 times stronger than the magnetic field at Earth’s surface. The inner core exists in a solid state due to the extremely high pressures and temperatures. It is the densest part of the planet, contributing to Earth's gravitational field. This field keeps mass anchored to the surface, affects land movement, and influences glacial motion.

The core is also the site of radioactive decay, which heats the planet and powers geodynamo activity, the process that generates Earth’s magnetic field. This geomagnetic induction protects us from cosmic threats by shielding the planet from harmful radiation.

This chapter will now shift focus to rocks, minerals, and most importantly, soils. As in the previous subchapter on chemical solutions, the following sections will be based on physical and chemical experiments.

5.5.1 Rocks

Geologists distinguish between igneous (covering about 3% of the Earth's surface), sedimentary (approximately 93%), and metamorphic rocks (around 4%). Among the most common examples of igneous rocks are granite and basalt, while limestone is the most well-known representative of sedimentary rocks. Over time, both igneous and sedimentary rocks can transform into metamorphic rocks, with marble being the most famous example.

There are about 700 known types of igneous rocks, and the most common components are silicates. These are primarily compounds of silicon (Si), oxygen (O), aluminum (Al), sodium (Na), potassium (K), calcium (Ca), iron (Fe), and magnesium (Mg). Based on their mineral composition, igneous rocks are classified into the following groups:

- Granite group (e.g., granite, rhyolite, pegmatite)
- Sienite group (e.g., trachyte, porphyry, keratophyre)
- Diorite group (e.g., diorite, tonalite, andesite)
- Gabbro group (e.g., gabbro, basalt)
- Peridotite group (e.g., biotite, amphiboles)

The most important minerals that make up igneous rocks are clay minerals, quartz, pyroxenes, carbonates, and others.

Sedimentary rocks allow for the development of microorganisms and are divided into:

- Clastic (e.g., quartzite, magnetite, rutile)
- Biochemical (e.g., aragonite)
- Chemical (e.g., chalk, quartz, iron ore, limestone, rock salt)
- Pyroclastic (e.g., volcanic materials such as ash and sand, which eventually form solid rocks)

Sedimentary rocks are of great economic importance, as they are widely used in construction. In addition, over millions of years, they have contributed to the formation of fossil fuels, which are crucial for the economy.

Metamorphic rocks form from a protolith under the influence of various types of metamorphism:

- Thermal metamorphism (e.g., marble)
- Tectonic metamorphism (e.g., mylonite)
- Regional metamorphism (e.g., gneiss)

Metamorphic rocks usually form deep beneath the Earth's surface, but they can also be found on the surface.

5.5.2 Minerals (Ores)

Minerals are chemical compounds with more or less distinctive crystalline structures that have formed through long geological processes. They essentially represent the building blocks of rocks, which have a heterogeneous composition of inorganic and organic substances. Minerals include both chemical elements (e.g., iron, diamond) and chemical compounds (e.g., silicates, oxides, sulfides).

The science that deals with the study of minerals is called mineralogy, and to date, about 4,000 different minerals are known. Minerals are inorganic or organic substances with relatively well-defined chemical and crystalline structures.

Examples of minerals in the form of chemical elements are:

- Metals (e.g., platinum, mercury, iridium, iron, copper, silver, gold, osmium)
- Semimetals (e.g., boron, silicon, antimony)
- Nonmetals (e.g., carbon in the form of diamond and graphite)

Minerals as chemical compounds can include:

- Sulfides
- Halides
- Oxides
- Hydroxides
- Nitrates
- Carbonates
- Borates
- Sulfates
- Chromates
- Phosphates
- Silicates and others

Minerals are studied based on their physical properties (e.g., the geometric structure of the crystal, hardness, luster, cleavability, specific mass) and chemical properties (e.g., classification into classes such as carbonates, silicates, sulfates, halogens, oxides, sulfides, phosphates, and some chemical elements). The focus of this chapter is strictly directed towards the study of soils.

5.5.3 Soils

Soils are formed through a long process of pedogenesis, during which rocks first gradually weather. Smaller pieces of disintegrated rock then form the parent material, which is influenced by microorganisms, water, and air. The final phase of this process is crucial for the formation of soil. Soil is a heterogeneous mixture of substances, composed of 95% inorganic matter (e.g., minerals) and 5% organic matter, which includes organisms, humus, and roots. The study of the physical, chemical, and biological properties of soil, as well as its fertility, genesis, and classification, is called pedology.

The most important physical properties of soil that are studied include:

- Distribution of mineral grains

- Water and air content

- Structure

- Color

Factors that influence soil are called pedogenetic factors, and these include climate, time, water resources, geological composition, relief, living organisms, and human impact.

There are various classifications of soils. One of the simplest divides them into:

- Coarse-grained (e.g., sandy soil)

- Fine-grained (e.g., clay soil)

- High-organic (e.g., humus soil)

Soils have the ability to supply plants with water, minerals, and oxygen. Additionally, they provide support to plants and shelter to animals.

Soils represent a complex three-phase system, composed of three main components:

1. Solid organic and mineral substances,

2. Groundwater,

3. Soil air.[274]

There are strong interrelationships between the lithosphere, atmosphere, hydrosphere, and biosphere. Without soil, many organisms, as we know them today, would not exist, as soils play a crucial role in the growth of biomass on our planet. Soils represent only a very thin layer of the Earth's crust, but they have a key role in the formation and development of life.

Soil profiling is conducted by studying the following properties:

- Color,

- Structure,

- Granularity,

- Humus content,

- Carbonate content,

- pH value.

The pH value of soil is determined based on a scale divided into six levels:

- <3.5 – extremely acidic,

- 3.5–5.0 – very acidic,

- 5.01–6.5 – acidic,

- 6.51–7.5 – neutral,

- 7.51–8.7 – alkaline,

274 Urbančič Mihej, Simončič Primož, Prus Tomaž, & Kutnar, L. (2005). *Atlas Gozdnih Tal Slovenije. Zveza gozdarskih društev Slovenije*.

- > 8.7 – very alkaline.[275]

Soil profiling can also include measurements of conductivity, moisture, aeration, and salinity. A more consistent or holistic profiling of soil is possible through the use of analytical methods from the fields of biology, physics, chemistry, and applied sciences, such as computer science and information technology. This involves integrating biological, physical, chemical, and applied aspects into a comprehensive analysis.

Within these analyses, it is possible to study the relationship between minerals and microorganisms, the influence of physical factors, and practical scenarios from the perspective of living organisms, particularly humans. Just like in bodily systems, nature also has close connections between soil, air, water, light, and living organisms. If any part of this connection fails, it can lead to minor functional disturbances or even complete failure of certain processes within natural hierarchical systems. Because of the obviousness of their existence, these connections are often overlooked.

The focus of research is not only on chemical, biological, or physical reactions and their practical domains, but on the comprehensive interplay of all these factors that provides a more complete picture.

When profiling soil, it is essential to determine its water content or moisture. The most accurate measurement can be made at a temperature of around 105°C, as at this temperature, the water evaporates without negatively affecting organic substances or temperature-sensitive inorganic substances.[276] It should be noted that at this temperature, bound water in certain minerals is not removed, as higher temperatures (around 1000°C) are required for that. In any case, these are comparative analyses in which we study the soil with and without water.

Another important soil analysis is determining the size, shape, density, and distribution of particles. In analyzing soil texture, we can use a classification scale proposed by Atterberg in 1912, which defines two main fractions:

- Fine soil (clay, silt, and sand) with particles smaller than 2 mm,
- Coarse elements (gravel, stones) with particles larger than 2 mm.[277] There may be more modern methods for determining soil texture. For this purpose, humus could be used as a standard and compared to other types of soil with the help of USB and light microscopes. We will return to this idea in later tests.

Measuring soil sedimentation in water is also very interesting and informative. In these analyses, it is useful to measure the settling rate of particles. These measurements allow us to determine the

275 The following source was used to assist in compiling this subsection Pansu, M. (2006). *Handbook of Soil Analysis*: *Mineralogical, organic and inorganic methods*. Springer.

276 Pansu, M. (2006). *Handbook of Soil Analysis*: *Mineralogical, organic and inorganic methods*. Springer.

277 Pansu, M. (2006). *Handbook of Soil Analysis*: *Mineralogical, organic and inorganic methods*. Springer.

mass of particles that settle at the bottom and the mass of those that resist. Additionally, we can also examine substances that dissolve in water. Analyzing the hardness and conductivity of the soil filtrate would also be interesting, which will be discussed in more detail in the actual tests.
The presence and content of carbonates in the soil can be determined by adding hydrochloric acid (HCl), which releases carbon dioxide (CO_2). Before this, a certain amount of soil must be weighed, then HCl is added, and the sample is weighed again. The difference between the initial and final mass tells us the carbonate content in the soil. This analysis also shows us that the pH of the soil is higher than 7. Manganese (Mn) can be detected with hydrogen peroxide (H_2O_2).
Particle size can be studied for larger particles using a USB microscope, and for smaller particles with a light microscope. A method for measuring the rate at which water passes through a soil sample would also be interesting. This can be done by weighing a specific amount of soil, placing it on double-folded filter paper, and positioning it in a funnel. Then, 100 ml of water is poured over the sample, and the time taken for the water to pass through the soil and filter is measured.
Thermal analysis can also be performed during soil analysis, observing any changes that occur (e.g., variations in mass, color changes, present odors). These findings can be combined with other measurements, such as conductivity, pH, and density.
Electrochemical methods, such as electrolysis, voltage and current measurements of galvanic cells, can also be used in soil analysis. In this case, humus and brown soils could be used as standard soil samples. Among possible methods, paper chromatography could be used to measure the travel time of color under the influence of a soil suspension and determine the coarseness or fineness of particles affecting the shape of the color trace.
By manually removing or filtering plant parts, changes in pH and conductivity measurements could be identified, as organic substances in the sample can affect the physical, chemical, and biological properties of the soil. Furthermore, information about the past location of the sample can help in studying the relationship between the ecosystem and the soil.
A test for soil magnetism could be very informative, as neodymium magnets could be used to extract any iron particles.

5.5.3.1 Types of soil

There are various names for types of soil, so the following types will be listed here: alluvial soil, black soil, red soil, laterite soil, forest soil, mountain soil, arid and desert soil, saline soil, alkaline soil, peat soil, and marshy soil.

1. Alluvial soils (e.g., silt, sand, clay, gravel) are deposited by water sources, especially rivers and streams. In valleys, they are generally more loamy and silty, while in higher and mountainous areas, they tend to be coarser in texture.
2. Black soils are dark-colored and contain a high amount of humus (about 4%–16%). They also have a high content of phosphoric acid, phosphorus, and ammonia. Black soil is very fertile and especially important in agriculture due to its ability to retain large amounts of moisture.
3. Red soils typically develop in warm, temperate, and humid climates and make up about 13% of Earth's soil. They usually contain high amounts of clay and iron and form mainly due to weathering of old crystalline and metamorphic rocks. These soils have low water retention capacity, making them less suitable for agriculture without additives.
4. Laterite soils are reddish due to their high iron and aluminum content. These soils are predominantly found in humid tropical regions of the world.
5. Forest soils are often black or dark brown due to a high percentage of humus, which retains water well, as they have a relatively balanced particle distribution. Forest soils are known for supporting a wide variety of plant species.
6. Mountain soils are often coarser and less developed, with acidic pH and relatively low fertility, which further decreases with elevation. These soils contribute significantly to cleaner air.
7. Arid and desert soils are found in hot, desert regions. They are extremely infertile and unsuitable for agriculture. They appear light greyish or yellowish and contain very little humus.
8. Saline soils are typical of arid areas and contain high concentrations of various salts, often giving them a whitish appearance. These soils are very infertile and unsuitable for agriculture.
9. Alkaline soils contain high levels of clay and sodium carbonate (Na_2CO_3) and have a high pH value, greater than 8.5. Their texture is rather coarse. Alkaline soils are, however, suitable for rice cultivation.
10. Peat soils are composed of partially decomposed plant material or organic matter and are typical of natural wetlands such as bogs and marshes. These soils usually have a more acidic pH.
11. Marshy soils consist of solids (e.g., minerals, organic matter), liquids, and gases present on the Earth’s surface. These soils are known for having very acidic pH values.

In this section, only a small selection of different soil types (garden soil, forest soil, riparian soil) will be studied through laboratory testing and compared with humus. For this purpose, specific laboratory testing methods will be used to measure values such as:

- pH of suspensions,
- pH of filtrates,
- filtrate hardness,

- filtrate conductivity,
- soil moisture,
- particle size,
- particle granulation,
- particle structure,
- soil permeability,
- presence of microorganisms,
- presence of plant matter in the soil,
- carbonate content,
- iron content,
- suspension electrolysis,
- filtrate electrolysis,
- resistance, voltage, and current of galvanic cells in suspensions and filtrates, etc.

For these tests, various devices and tools will be used, such as pH meters, magnetic stirrers, conductivity meters, TDS meters, analytical balances, alcohol burners, filtration setups, batteries, multimeters, metal and carbon electrodes, evaporating dishes, beakers, neodymium magnets, USB microscopes, light microscopes, and more.

The primary goal of these investigations will be to determine the potential for electrical energy and magnetism contained within this small selection of soils. The following section will describe the different laboratory tests.

5.5.4 Laboratory tests

As previously mentioned, a variety of laboratory tests will be carried out using different methods, techniques, and instruments. These tests will examine the properties of soil, particularly in terms of its potential to generate electrical energy and possible magnetism, as well as exploring critical connections with living organisms (e.g., plants, animals, microorganisms, algae, fungi, viruses). In addition, the influence of soil on our atmosphere and climate will also be studied.

5.5.4.1 Measuring soil pH

Measuring the pH value of soil provides insight into the concentration of hydronium ions (H_3O^+), carbonate ions ($(CO_3)^{2-}$), and hydroxide ions (OH^-) in the soil, measured on a scale from 0 to 14. A pH meter measures the voltage difference in millivolts (mV) between a sensing electrode and the sample into which the electrode is immersed. The meter then translates this voltage into a pH value on the aforementioned scale.

- When the voltage difference between the sensor and the sample is extremely small or zero, the pH is close to or exactly 7 (neutral).
- pH values below 7 correspond to positive voltage values.
- pH values above 7 correspond to negative voltage values.
For example:
- A pH of 5 equals +114.29 mV
- A pH of 9 equals –114.29 mV
The pH meter measures hydronium ion concentration within a voltage range from +400 mV to –400 mV. The primary purpose of the pH meter is to determine the concentration of H_3O^+ ions, from which the pH is calculated using the formula:
> pH = –log\[H_3O^+]
A low concentration of H_3O^+ ions indicates a neutral or alkaline environment (pH between 7 and 14), corresponding to voltage values between 0 mV and –400 mV.
To convert between pH and voltage, the following simple formulas apply (where 1 pH unit ≈ 57.14 mV):
- $U_{ph}H_3O^+ = U_0 + n \cdot U_{k1e} \rightarrow$ 0 mV + 1 · 57.14 mV = +57.14 mV (pH = 6)
- $U_{ph}H_3O^+ = U_0 + 0.1 \cdot U_{k1e} \rightarrow$ 0 mV + 0.1 · 57.14 mV = +5.714 mV (pH = 6.9)
- $U_{ph}H_3O^- = U_0 - n \cdot U_{k1e} \rightarrow$ 0 mV – 1 · 57.14 mV = –57.14 mV (pH = 8)
- $U_{ph}H_3O^- = U_0 - 0.1 \cdot U_{k1e} \rightarrow$ 0 mV – 0.1 · 57.14 mV = –5.714 mV (pH = 7.1)
In the next section, we will look at the pH measurements of soil suspension samples taken from a garden environment.

5.5.4.1.1 Soil pH measurement

There are various methods and instruments available for measuring the pH value of soil. These include direct methods (e.g., the ICZD06 soil pH and moisture meter) and indirect methods (e.g., measuring pH in a soil suspension or filtrate), both of which can determine the soil's pH and moisture levels.
This section will first present the indirect methods for measuring soil pH, followed by the direct method using a pH meter. It is known that direct measurement methods using a pH meter generally provide more accurate results than indirect ones. Nevertheless, pH measurements of garden soil and citrus humus will be conducted using suspensions and filtrates. It will be interesting to observe whether there are significant differences in the pH values obtained by the two approaches.
In all cases, soil suspensions are necessary to later prepare filtrates, which will then be tested for electrical conductivity (in µS) and hardness (in ppm). These tests will provide feedback on the

presence and concentration of minerals and ions in the soil. Additionally, the filtration process can offer some insights into soil permeability, although the tests will be performed using relatively small soil quantities. It is assumed that measuring permeability using larger soil volumes would be time-consuming and unlikely to significantly improve the accuracy of results.

Although more time-intensive, the indirect method is useful when multiple properties of the soil are being analyzed. If only the pH value needs to be determined, the direct method would be more appropriate.

It's important to note that adding distilled water to soil samples can activate certain ions that cannot be detected with the direct method. These ions are often adsorbed onto organic materials in the soil (e.g., roots, dead leaves, bark, microorganisms, and small animals like earthworms, centipedes, ants), and are only released upon hydration. Additionally, there's a concern that small animals in the soil may influence the sample's pH (e.g., ants releasing formic acid when water is added). Therefore, it is crucial to remove larger organic materials from the sample before testing. Small stones can also interfere with the measurement and should be removed.

For the test, 10 grams of soil from different locations within the same garden environment were weighed using an analytical scale and placed in 150 ml beakers. Each sample was mixed with 100 ml of distilled water, then stirred for approximately 20 minutes using a magnetic stirrer. During mixing, a pH electrode was immersed in the suspension. The results are presented in the following table.

5.5.4.1.1.1 Table 193: Measurements of soil pH values from garden environments by location

Date	*ID*	*Ph*	*T*	*Sampling location*
11.05.21	1	7.90	19.74	Vine by the shed1
11.05.21	2	7.50	19.00	Pile of land by the cherry tree1
12.05.21	3	8.10	20.11	Vine by the shed2
12.05.21	4	7.50	20.06	Pile of land by the cherry tree2
13.05.21	5	8.10	19.56	Vine by the shed3
13.05.21	6	7.80	20.17	Pile of land by the cherry tree3
14.05.21	7	8.00	19.28	Vine by the shed4
14.05.21	8	7.80	19.44	Pile of land by the cherry tree4
15.05.21	9	8.20	18.83	Vine by the shed5
15.05.21	10	7.80	19.11	Pile of land by the cherry tree5
16.05.21	11	7.70	19.39	Vine by the shed6
16.05.21	12	8.10	19.22	Pile of land by the cherry tree6
18.05.21	13	8.00	17.83	Near the cherry tree
18.05.21	14	7.90	18.00	Behind the porch by the spruce tree
21.05.21	15	8.40	17.33	By the lilies
21.05.21	16	8.40	17.44	By the forte
26.05.21	17	8.50	16.94	Near the cherry tree2
26.05.21	18	8.50	16.94	By the lilies2
27.05.21	19	8.00	16.94	In the thicket1
27.05.21	20	8.00	17.17	In the thicket2
29.05.21	21	7.70	18.28	By the hedge near the spruce tree
29.05.21	22	8.00	18.50	By the hedge near the hydrant
30.05.21	23	7.90	17.77	By the sewer manhole1
30.05.21	24	8.00	17.77	By the sewer manhole2
02.06.21	25	6.70	19.00	By the boxwood
02.06.21	26	7.80	19.22	By the wild plum tree

Table 193 presents the measured pH values of suspensions from the same garden soil, recorded on different dates and from various locations within the garden. Based on these results, we can conclude that the soil is predominantly alkaline in nature, with one location even showing strong alkalinity (see the locations “Near Cherry Tree 2” and “Near Lilies 2”, pH = 8.5).
A neutral pH value was observed at three locations (“Next to Boxwood”, pH = 6.7, and “Soil pile near Cherry Tree 1” and “Soil pile near Cherry Tree”, both pH = 7.5). These two locations are essentially the result of mixed soil from different areas of the garden.
The sampling location is an important detail, as it may provide insight into the influence of plants and microorganisms on the soil. Likewise, the date of sampling is also significant, as it can offer feedback regarding rainfall and sunlight conditions, which affect soil moisture and consequently influence pH levels.

The influence of plant life on soil pH is a highly plausible scenario. Now, we will present pH measurements of soil from a different gardening environment.

5.5.4.1.1.2 Table 194: Soil pH measurements from other horticultural environments

Location	Ph	T
Poppy	7.6	23
Strawberries	7.2	23.11
Cabbages	7.52	23.22

Table 194 presents the measured pH values of soil from different garden beds, each associated with a specific type of plant. The soil near the poppies (pH = 7.6; -34.29 mV) and cabbage (pH = 7.52; -29.71 mV) shows a slightly alkaline value, while the soil near the strawberries displays an ideal neutral value (pH = 7.2; U = -11.43 mV).

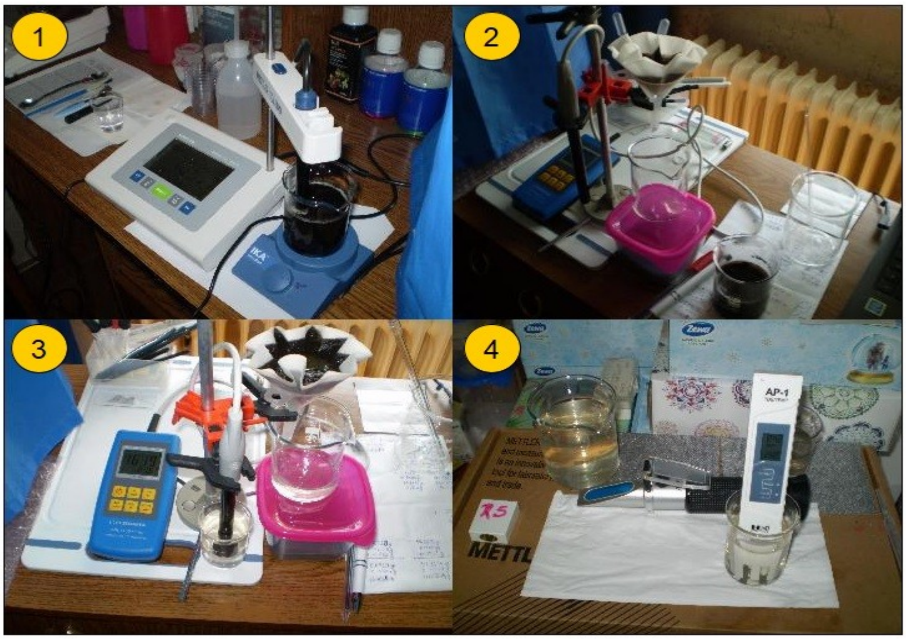
Strawberries themselves are slightly acidic due to their citric acid content, which may have contributed to the somewhat lower pH value of the soil. Although strawberries thrive best in acidic to slightly acidic soils (pH 5.4 to 6.5), they can also adapt well to soils with slightly higher pH levels.

Poppies prefer soil that remains somewhat dry and within a pH range of 6.5 to 7.5. In this case, their influence on the pH level of the soil would likely be negligible. Cabbage grows best in soils with a pH range of 6.0 to 7.0, and based on the measured pH value, a similar conclusion applies as with poppies.

A more significant influence on soil pH might come from insects, invertebrates, and microorganisms. In general, acidic soils tend to lack fungi and microorganisms such as bacteria, which play a crucial role in decomposing organic matter by feeding on carbon, minerals, and nutrients. Bacteria and fungi thrive best in soils with pH values between 6.0 and 7.5, with bacteria favoring slightly alkaline conditions (above 7).

Because of these justified considerations regarding mutualistic relationships between plants, animals, and microorganisms, it's important to study not only the chemical and physical properties but also the biological characteristics of the soil. Biological properties primarily refer to the direct and indirect effects of living organisms that inhabit the soil's surface and deeper layers. These ideas will be revisited later.

For now, it would be reasonable to perform several measurements—such as pH of the suspension, pH of the filtrate, electrical conductivity, water hardness, and density of the filtrate—for a humus-rich soil called "Substral Citrus". This substrate is composed of black and white peat, bark, natural bio-stimulants, and NPK fertilizer. It is designed to provide the optimal acidity for planting lemons, oranges, and grapefruits. Humus-rich soils typically have a high capacity to retain water and nutrients.



5.5.4.1.1.3 Figure 435: Measurements of pH, conductivity, hardness, and density of humus soil

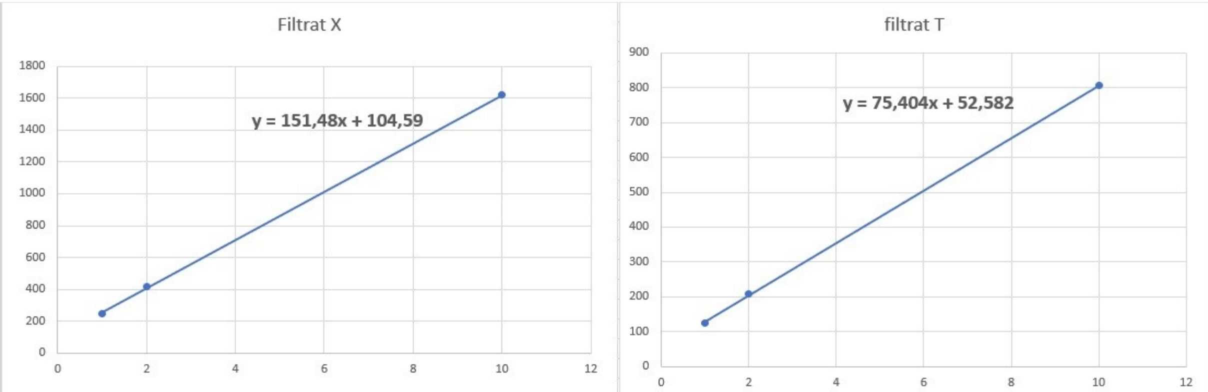
Figure 435 shows the measurements of various properties of humus soil. The top left part of the image (labeled 1) presents the pH measurement of the humus soil suspension. The top right section (labeled 2) illustrates the filtration of the soil suspension. The bottom left part (labeled 3) displays the electrical conductivity of the soil filtrate, while the bottom right section (labeled 4) shows the hardness and density of the filtrate. A refractometer is also shown next to the TDS meter.

The sample preparation process for pH measurements was the same as for the garden soil, with the exception that two additional samples were prepared using 1 g and 2 g of humus soil, respectively. The pH of the humus suspensions was measured while continuously mixing the samples with a magnetic stirrer. Other measurements, such as conductivity, hardness, and density, were performed using the filtrates of the individual samples.

5.5.4.1.1.4 Table 195: Measured values for pH, conductivity, hardness and density of humus soil

C (g/100 ml)	*Ph*	*T (°C)*	*Filtrate Ph*	*Filtrate χ (μS)*	*Filtrate ρ (g/cm³)*	*filtrate T (ppm)*
1	6.51	24.80	6.56	245.00	1.0005	123
2	6.91	25.00	6.54	420.00	1.0005	209
10	6.84	25.00	6.67	1618.00	1.0010	806

Table 195 presents the measured values of suspension pH, filtrate pH, filtrate conductivity, filtrate density, and filtrate hardness. As can be observed, the concentration of humus soil in the solution has a significant impact on conductivity and hardness, as the values increase steeply and linearly. In contrast, the influence on pH and density is relatively small or even negligible. This is entirely understandable: the pH meter operates by detecting the presence of H_3O^+ ions, whereas the conductivity meter (conductometer) measures the presence of all charged ions. Similarly, the TDS meter detects charged mineral ions as well as uncharged organic substances.



5.5.4.1.1.5 Figure 436: Linear trend graphs for conductivity and hardness

Figure 436 shows linear trend graphs for the conductivity and hardness of filtrates from humus solutions with different concentrations (1 g of humus + 100 ml H_2O, 2 g of humus + 100 ml H_2O, and 10 g of humus + 100 ml H_2O).

It can be concluded that both measurement values increase proportionally with higher concentrations of humus soil in the solution. In humus soil, many organic substances are not water-soluble, whereas a large portion of inorganic substances are water-soluble, allowing them to ionize (e.g., $(NO_3)^-$, $(NH_4)^+$, $(SO_4)^{2-}$ ions).

5.5.4.1.2 Combined measurements of pH, conductivity, hardness, temperature, and soil permeability assessment

Samples were analyzed from citrus humus soil (HC), soils near water sources, and soils within two maintained gardens. The following values were measured:

1. pH using various methods (in suspensions, filtrates, and directly with a soil pH meter),
2. Soil moisture level on a scale from 0 to 10 using a moisture meter (0–3.5 = dry soil, 3.5–7.5 = moist soil, and 7.5–10 = wet soil). These values are not percentages, but rather relative numeric indicators showing whether water needs to be added to the soil,
3. Soil temperature measured using an analog thermometer,
4. Soil permeability assessment of the suspension through double-folded filter paper on a scale from 1 to 4 (1 = highly permeable soil, 4 = poorly permeable soil),

5. Conductivity of soil filtrates in µS, and

6. Hardness of filtrates in ppm.

Based on these measurements, it is already possible to effectively profile the soil types and assign them to suitable classification groups. The following section presents the measurement results and interpretation of the findings.

5.5.4.1.2.1 Table 196: Combined measurements of different soil types

Type	χ	Ph_f	T_f	*PPM*	Ph_{nep}	*Svl*	Ph_s	*BF*	Pr_o	m	V_{H2O}	T_z
DVT	85.10	6.92	22.40	41.00	6.95	5.50	8.40	RRM	2	10	100	22
JPG	34.10	5.91	23.10	19.00	7.00	1.80	7.82	M	4	10	100	22
JPZ	92.80	7.34	22.20	44.00	6.60	6.80	7.61	MR	2	10	100	20.5
SP	94.70	6.99	22.40	45.00	6.70	2.00	8.24	RM	3	10	100	23
SPJ	177.00	7.56	22.90	86.00	6.70	3.00	8.22	RRM	2	10	100	22.5
TLV	71.40	6.62	23.10	35.00	6.82	2.00	7.51	RM	2	10	100	20
HC	1618.00	6.67	25.00	806.00	6.90	6.00	6.84	B	1	10	100	21

Table 196 shows various measurements of different types of soil from different environments, with the column labels meaning the following:

a. Type refers to the type of soil from a specific environment. Samples were taken from two gardens near grapevines (DVT and TLV), one location near a river water source (SP), one location near a lake (SPJ), and two locations in a forest near a cave (JPG and JPZ). A special type of sample is citrus humus (HC), which serves as a reference for soil quality, as other soil samples will be compared to HC.

b. Filtrate conductivity (χ) is measured in µS. The filtrate is obtained through the filtration of a soil suspension (a mixture of 10 g of soil with 100 ml of H_2O). These measurements are very informative, as they provide feedback on the presence of charged ions in the soil, which consequently gives insight into the presence of mineral nutrients for plants.

c. pH of the filtrate (Phf) is one of the methods of measuring soil pH. The filtrate is obtained through the filtration of a soil suspension.

d. Filtrate temperature (Tf) refers to the temperature in °C measured by the pH meter.

e. PPM of the filtrate (PPM) represents the hardness of the soil filtrate measured in ppm.

f. Direct pH measurement using a meter (Phnep) is performed by inserting the meter into a specific part of the loosened soil and reading the value.

g. Soil moisture level (Svl) tells us (as already mentioned) whether the soil is too dry, sufficiently moist, or too wet.

h. Suspension pH (Phs) is another possible method for measuring soil pH. All samples were prepared in the same way, meaning the soil content was 10 g (m) and 100 ml of distilled water (VH_2O). The procedure for this measurement method was already described in the previous subchapter.
i. Clarity of the filtrate (BF) is a qualitative description of the clarity or turbidity of the filtrate, where the filtrates can be clear (B), slightly turbid (RM), mildly turbid (RRM), turbid (M), or turbid with a red hue (MR).
j. Permeability assessment of the soil suspension through double-folded filter paper (Pro) is a rough estimate of the rate of passage of the suspension through the filter paper, divided into four stages (as already described).
k. Soil temperature (Tz) was directly measured at the soil location, along with pH and moisture level.
The measurements of electrical conductivity in µS among different soils showed that the HC soil is the most conductive (1618 µS). Electrical conductivity in soil is essentially a useful measure of the amount of charged particles or ions in the soil. These measurements provide feedback on the availability and loss of nutrients, as well as being a good indicator of soil texture and water retention capacity. From this, we can conclude that the HC soil is the most efficient and nutrient-rich. The sample near the lake (SPJ) had the second-highest electrical conductivity (177 µS), which is much lower than HC. Even lower values were measured for other samples, such as SP (94.7 µS), JPZ (92.8 µS), DVT (85.1 µS), TLV (71.4 µS), and the lowest value was found in JPG (34.1 µS). Very low electrical conductivity values in the soil mainly indicate a lack of nutrients, suggesting more sandy soils with low organic matter content. In very clayey soils, electrical conductivity values can be excessively high, which is also not a good indicator of soil quality. The optimal electrical conductivity values for soil should be less than 4 mS. Considering that we were dealing with a suspension of 10 g of soil + 100 ml of H_2O, filtered through two folded filter papers, we obtained results in µS. Typically, electrical conductivity is measured with a saturated soil suspension or in a 1:1 ratio, with 20 g of soil being weighed. The ratio in these tests was 1:10, meaning the sample mass was half the size. It is understandable that a larger sample mass, due to soil heterogeneity, provides more accurate results, especially when the sample is first sieved to remove larger particles such as stones and plant debris. On the other hand, such prepared samples do not represent the actual state of the soil and are not entirely authentic, as all substances in the soil affect both the smaller and larger conductivities.
Regarding the pH measurements of the filtrates, nearly all the samples had nearly ideal values, ranging from 5.91 (JPG) to 7.34 (JPZ), while the pH values of the suspensions were mostly in the

alkaline range, from 7.51 (TLV) to 8.4 (DVT). The main reasons for this deviation between the two methods of pH measurement are the presence of stones and plant parts in the soil. Small stones certainly affect higher pH values, while plant parts adsorb certain ions, which are then released by the water in the soil suspension. In the case of $(CO3)^{2-}$ anions, it is clear that they increase the pH value towards alkalinity. The most reliable method seems to be the direct pH measurement with a meter, which is inserted into the soil. This method provided ideal pH values ranging from 6.6 (JPZ) to 7.0 (JPG). The only drawback of this method is that it excludes the presence of adsorbed ions in plant material and stones.

For the soil moisture level (Svl) measurements, some soils were dry (JPG = 1.8; SP = 2; TLV = 2; SPJ = 3), while others were optimally moist (DVT = 5.5; HC = 6; JPZ = 6.8). Filtrate hardness is very closely related to filtrate conductivity, as lower conductivities result in lower hardness (e.g., JPG χ = 34.1 μS ↔ PPM = 19 ppm; HC χ = 1612.1 μS ↔ PPM = 806 ppm). Hardness, measured with a TDS meter, gives feedback on the content of mineral substances with charged particles and organic substances in the soil filtrate. For filtrate clarity, only HC soil achieved the highest clarity (B). All other filtrates were either slightly cloudy (SPJ), mildly turbid (DVT, SP, and TLV), or completely turbid (JPG and JPZ). Turbid filtrates indicate the presence of substances that are more difficult or insoluble in water, while clear filtrates indicate solubility in the filtrate. Finally, we have the assessment of soil permeability for water (Pro) on a scale from 1 to 4. The HC soil achieved the best permeability rating for water (Pro = 1), followed by soils such as DVT, JPZ, SPJ, and TLV with the second-best water permeability (Pro = 2). The SP soil was rated third (Pro = 3), while the worst water permeability (Pro = 4) was found in JPG soil.

Based on the results obtained, we can conclude that JPG soil achieved the worst values for conductivity (34.1 μS), hardness (19 ppm), filtrate clarity (M - turbid), moisture level (only 1.8), and water permeability (worst rating 4), while the pH values were not exceptionally negative. However, it should be noted that the pH value of the filtrate was only 5.91, which is already considered an acidic value, though not critical. Additionally, the filtrate was very turbid with a red hue. The pH of the JPG soil suspension was in the mildly alkaline range, specifically 7.82. The TLV soil can be classified as the second lowest quality soil based on the results, with a conductivity of 71.4 μS, hardness of 35 ppm, moisture level of 2, and water permeability rating of 2. The pH values for this soil were not notably high or low. The next in quality is the DVT soil, with a conductivity of 85.1 μS, hardness of 41 ppm, a solid moisture level (5.5), and a water permeability rating of 2. The pH values did not stand out, except for the suspension pH, which was nearly strongly alkaline (8.4). Slightly higher in quality than DVT was the JPZ soil, which had a higher conductivity (92.8 μS), hardness (44 ppm), moisture level (6.6), and the same water permeability rating. There were no significant pH values for this soil either. The SP soil ranked similarly in quality to the previous one, with a conductivity of 94.7 µS and hardness of 45 ppm. However, it had a lower moisture level (Svl = 2) and poorer water permeability (Pro = 3). The pH values did not stand out in this case either. The second highest quality soil, based on the results, is the SPJ soil, with a conductivity of 177 µS, hardness of 86 ppm, water permeability rating of 2, and a lower moisture level (Svl = 3). Again, the pH values did not stand out for this soil. The best soil is the HC soil, which achieved by far the highest conductivity (χ = 1618 µS), hardness (806 ppm), filtrate clarity, and water permeability (Pro = 1). Additionally, it had an optimal moisture level (Svl = 6). All measured pH values were in the ideal range, including the suspension pH, which was 6.84. The results are very informative and provide a representative soil that could serve as an ideal standard for determining the quality and purity of a given soil. Based on these measurements, we can determine the purity of a given soil compared to the HC soil through simple mathematical calculations. This can be done based on both the conductivity and hardness of different soils.

$$\%Cl_{\chi}=\frac{\chi_{SPJ}}{\chi_{HC}}\cdot 100\,\%=\frac{(177\,\mu S)}{(1618\,\mu S)}\cdot 100\,\%=10{,}94\,\%$$

$$\%Cl_{t}=\frac{TR_{SPJ}}{TR_{HC}}\cdot 100\,\%=\frac{(86\,ppm)}{(806\,ppm)}\cdot 100\,\%=10{,}67\,\%$$

The SPJ soil achieves 10.94% of the ideal value in terms of conductivity compared to the HC soil and 10.67% of the ideal value in terms of TDS hardness compared to the HC soil.

$$\%Cl_{\chi}=\frac{\chi_{SP}}{\chi_{HC}}\cdot 100\,\%=\frac{(94{,}7\,\mu S)}{(1618\,\mu S)}\cdot 100\,\%=5{,}85\,\%$$

$$\%Cl_{t}=\frac{TR_{SP}}{TR_{HC}}\cdot 100\,\%=\frac{(44\,ppm)}{(806\,ppm)}\cdot 100\,\%=5{,}46\,\%$$

The SP soil achieves 5.85% of the ideal value in terms of conductivity compared to the HC soil and 5.46% of the ideal value in terms of TDS hardness compared to the HC soil.

$$\%Cl_{\chi}=\frac{\chi_{JPZ}}{\chi_{HC}}\cdot 100\,\%=\frac{(92{,}8\,\mu S)}{(1618\,\mu S)}\cdot 100\,\%=5{,}73\,\%$$

$$\%Cl_{t}=\frac{TR_{JPZ}}{TR_{HC}}\cdot 100\,\%=\frac{(45\,ppm)}{(806\,ppm)}\cdot 100\,\%=5{,}58\,\%$$

The JPZ soil achieves 5.73% of the ideal value in terms of conductivity compared to the HC soil and 5.58% of the ideal value in terms of TDS hardness compared to the HC soil.

$$\%Cl_{\chi}=\frac{\chi_{DVT}}{\chi_{HC}}\cdot 100\,\%=\frac{(85{,}1\,\mu S)}{(1618\,\mu S)}\cdot 100\,\%=5{,}26\,\%$$

$$\%Cl_{t}=\frac{TR_{DVT}}{TR_{HC}}\cdot 100\,\%=\frac{(41\,ppm)}{(806\,ppm)}\cdot 100\,\%=5{,}09\,\%$$

The DVT soil achieves 5.26% of the ideal value in terms of conductivity compared to the HC soil and 5.09% of the ideal value in terms of TDS hardness compared to the HC soil.

$$\%Cl_{\chi}=\frac{\chi_{TLV}}{\chi_{HC}}\cdot 100\,\%=\frac{(71{,}4\,\mu S)}{(1618\,\mu S)}\cdot 100\,\%=4{,}41\,\%$$

$$\%Cl_{t}=\frac{TR_{TLV}}{TR_{HC}}\cdot 100\,\%=\frac{(35\,ppm)}{(806\,ppm)}\cdot 100\,\%=4{,}34\,\%$$

The TLV soil achieves 4.41% of the ideal value in terms of conductivity compared to the HC soil and 4.34% of the ideal value in terms of TDS hardness compared to the HC soil.

$$\%Cl_{\chi}=\frac{\chi_{JPG}}{\chi_{HC}}\cdot 100\,\%=\frac{(34{,}1\,\mu S)}{(1618\,\mu S)}\cdot 100\,\%=2{,}11\,\%$$

$$\%Cl_{t}=\frac{TR_{JPG}}{TR_{HC}}\cdot 100\,\%=\frac{(19\,ppm)}{(806\,ppm)}\cdot 100\,\%=2{,}36\,\%$$

The JPG soil achieves 2.11% of the ideal value in terms of conductivity compared to the HC soil and 2.36% of the ideal value in terms of TDS hardness compared to the HC soil.

The comparison between the HC soil and other types of soil more clearly highlights the differences in quality. For the JPG soil, it can be said that it is more of a sandy soil. It is known that sandy soils are poorer at retaining and storing cations, meaning they lose nutrients more quickly than other types of soils (for example, the electrical conductivity was only 34.1 µS). In addition, they are less capable of storing water, which is also demonstrated by the lowest measured moisture level, which was only 1.8. The second worst soil in terms of quality based on measured values for conductivity, hardness, pH, and moisture level is TLV soil. It has a lower water retention capacity (the moisture level was only 2, and the measurements were taken in the shade) and lacks optimal amounts of nutrients. It also contained a greater amount of small stones. Slightly better quality soil is DVT, as it has higher conductivity, hardness, and moisture level (Svl = 5.5), which means it retains water better. Additionally, this soil contained fewer small stones than TLV soil. The SP soil had slightly higher conductivity than JPZ soil but a lower moisture level, which suggests that the latter stores water reserves better. The SPJ soil, according to these measurements, was the second best soil, as it had a conductivity of 177 µS and a hardness of 86 ppm. On the other hand, it had a lower moisture level (Svl = 3), which could indicate poorer water storage capacity. The absolute champion in terms of soil quality was, as mentioned earlier, HC soil, which is a type of humus. Humus is not a soil type, but rather an important component of soil. It contains a large amount of organic matter, which is the product of plant and animal decomposition. Without this crucial component, soil is not easily fertile. Humus typically contains around 60% carbon, 6% nitrogen, small amounts of sulfur, phosphorus, and other components like magnesium and calcium. For these measurements, a special artificially created HC soil was used, enriched with NPK fertilizer and other substances. The special feature of HC soil was that pH measurements using different methods produced comparable results. All other tested soils did not produce comparable pH measurement results. The pH filtrate results were relatively comparable to the direct measurements, but (as already mentioned) there were significant discrepancies between the suspension pH method and the other two methods. A possible explanation for this has already been provided, so we will not revisit this issue. For these measurements, the soil samples were prepared in a 1:10 ratio (10 g of soil + 100 ml of H_2O), which does not align with the agreed-upon preparation of the soil samples. Because of this, measurements were also conducted with the same soils in a 1:5 ratio, corresponding to a mass of 20 g of soil and 100 ml of H_2O. However, there is no true standard for the pH measurement method in soil, as these methods are adapted to various circumstances (e.g., geographic location, climate, precipitation, national agreements).[278]

5.5.4.1.2.2 Table 197: Combined measurements of different soil types in a ratio of 1:5

Type	*χ*	*Ph_f*	*T*	*PPM*	*Ph_{nep}*	*Svl*	*Ph_s*	*BF*	*Pr_o*	*m*	*V_{H2O}*	T_z
DVT	155.5	7.30	24.2	74	6.95	5.50	7.91	M	3	20	100	22.0
JPG	30.4	6.45	24.6	14	7.00	1.80	5.06	MR	4	20	100	22.0
JPZ	323.0	7.16	24.2	160	6.60	6.80	7.27	RM	2	20	100	20.5
SP	133.3	7.14	24.4	65	6.70	2.00	7.75	RM	2	20	100	23.0
SPJ	164.7	7.75	24.1	80	6.70	3.00	8.66	RM	2	20	100	22.5
TLV	130.5	7.47	23.7	64	6.82	2.00	7.78	M	3	20	100	20.0
HC	2390	6.57	23.4	1204	6.90	6.00	6.80	B	1	20	100	21.0

Table 197 shows the results of combined measurements for different soil types. This time, the samples were prepared in a 1:5 ratio, whereas in previous measurements they were prepared in a 1:10 ratio. It is important to note that certain differences emerged, particularly in soils such as DVT and SP. Significant differences were observed in the measured conductivity, in the clarity ratings of the filtrates, and in water permeability. The conductivity and TDS (Total Dissolved Solids) values of the DVT soil (155.5 µS; 74 ppm) were higher in the new ratio than those of the SP soil (133.3 µS; 65 ppm). Additionally, both qualitative assessments changed: the filtrate from the DVT soil was cloudy, and its water permeability was rated at the lower third level. The SP soil filtrate, as in the previous evaluation, was slightly cloudy, but its water permeability was rated at a higher second

278 Miller, R. O., & Kissel, D. E. (2010). Comparison of soil ph methods on soils of North America. *Soil Science Society of America Journal*, 74(1), 310–316. https://doi.org/10.2136/sssaj2008.0047.

level. For the SPJ soil, the conductivity and hardness were slightly lower in the new ratio (164.7 μS; 80 ppm) than in the 1:10 ratio (177 μS; 86 ppm). In the new ratio, the clarity of the SPJ soil filtrate was rated as slightly cloudy, which was also the case in the 1:10 ratio. For the other soils studied, the results were consistent with previous measurements. In pH measurements of the suspensions, the value for JPG soil shifted toward the acidic range (previously at 1:10: pH = 7.82; now at 1:5: pH = 5.06), which is surprising given that the filtrate's pH in the 1:10 ratio was acidic (pH = 5.91). In the new 1:5 ratio, the filtrate pH was 6.45. In the pH measurements of suspensions for other soils, the values were generally above 7, and even above 8, except for the HC soil. Overall, the pH values of soil filtrates were lower in the 1:10 ratio than in the 1:5 ratio, while the pH values of suspensions were higher in the 1:10 ratio. These measurements indicate that soils are inherently very heterogeneous, making it difficult to obtain fully consistent results. Therefore, it is not surprising that there is no universally accepted standard for measuring soil pH. The most consistent results came from direct pH measurements in the soil. It would be reasonable to once again calculate the purity of a given soil in comparison with the HC soil.

$$\%Cl_{\chi}=\frac{\chi_{SPJ}}{\chi_{HC}}\cdot 100\%=\frac{(164{,}7\,\mu S)}{(2390\,\mu S)}\cdot 100\%=6{,}89\%$$

$$\%Cl_{t}=\frac{TR_{SPJ}}{TR_{HC}}\cdot 100\%=\frac{(80\ ppm)}{(1204\ ppm)}\cdot 100\%=6{,}64\%$$

In the 1:10 ratio measurements, the SPJ soil achieved 10.94% of the ideal value based on the conductivity of the HC soil and 10.67% of the ideal value based on the TDS hardness of the HC soil. In the 1:5 ratio, however, there was a decline in soil quality based on percentage values (see 6.89% for conductivity and 6.64% for TDS hardness).

$$\%Cl_{\chi}=\frac{\chi_{SP}}{\chi_{HC}}\cdot 100\%=\frac{(133{,}3\,\mu S)}{(2390\,\mu S)}\cdot 100\%=5{,}58\%$$

$$\%Cl_{t}=\frac{TR_{SP}}{TR_{HC}}\cdot 100\%=\frac{(65\ ppm)}{(1204\ ppm)}\cdot 100\%=5{,}40\%$$

In the 1:10 ratio measurements, the SP soil achieved 5.85% of the ideal value based on the conductivity of the HC soil and 5.46% of the ideal value based on the TDS hardness of the HC soil. In the 1:5 ratio, the obtained values were close to the previous results (see 5.58% for conductivity and 5.40% for TDS hardness).

$$\%Cl_{\chi}=\frac{\chi_{JPZ}}{\chi_{HC}}\cdot 100\%=\frac{(323\,\mu S)}{(2390\,\mu S)}\cdot 100\%=13{,}51\%$$

$$\%Cl_{t}=\frac{TR_{JPZ}}{TR_{HC}}\cdot 100\%=\frac{(160\ ppm)}{(1204\ ppm)}\cdot 100\%=13{,}29\%$$

In the 1:10 ratio measurements, the JPZ soil achieved 5.73% of the ideal value based on the conductivity of the HC soil and 5.58% of the ideal value based on the TDS hardness of the HC soil. In the 1:5 ratio, the obtained values were significantly higher than the previous results (see 13.51% for conductivity and 13.29% for TDS hardness).

$$\%Cl_{\chi}=\frac{\chi_{DVT}}{\chi_{HC}}\cdot 100\,\%=\frac{(155{,}5\,\mu S)}{(2390\,\mu S)}\cdot 100\,\%=6{,}51\,\%$$

$$\%Cl_{t}=\frac{TR_{DVT}}{TR_{HC}}\cdot 100\,\%=\frac{(74\,ppm)}{(1204\,ppm)}\cdot 100\,\%=6{,}15\,\%$$

In the 1:10 ratio measurements, the DVT soil achieved 5.26% of the ideal value based on the conductivity of the HC soil and 5.09% of the ideal value based on the TDS hardness of the HC soil. In the 1:5 ratio, the obtained values were higher than the previous results (see 6.51% for conductivity and 6.15% for TDS hardness). Both JPZ and DVT soils may have a highly heterogeneous composition of different substances and distributions of charged particles or ions throughout the entire sample. In fact, additional measurements with different ratios of soil to distilled water would be needed to confirm the previous hypothesis. It would also be necessary to repeat the previous measurements multiple times, which, of course, is beyond the scope of this monographic work.

$$\%Cl_{\chi}=\frac{\chi_{TLV}}{\chi_{HC}}\cdot 100\,\%=\frac{(130{,}5\,\mu S)}{(2390\,\mu S)}\cdot 100\,\%=5{,}46\,\%$$

$$\%Cl_{t}=\frac{TR_{TLV}}{TR_{HC}}\cdot 100\,\%=\frac{(64\,ppm)}{(1204\,ppm)}\cdot 100\,\%=5{,}32\,\%$$

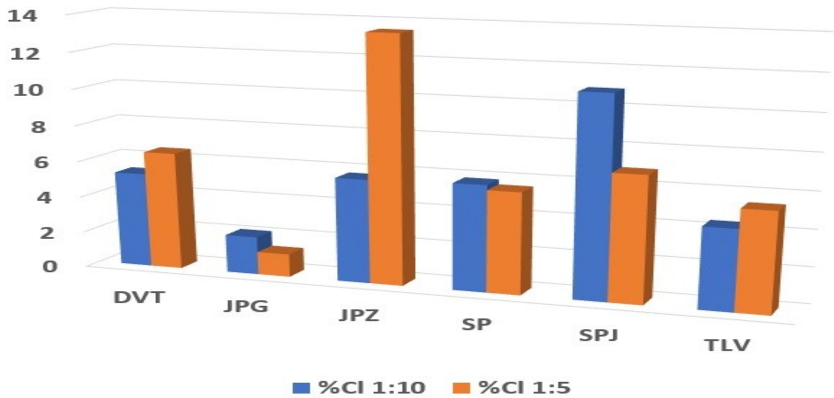
In the 1:10 ratio measurements, the TLV soil achieved 4.41% of the ideal value based on the conductivity of the HC soil and 4.34% of the ideal value based on the TDS hardness of the HC soil. In the 1:5 ratio, the obtained values were higher than the previous results (see 5.46% for conductivity and 5.32% for TDS hardness).

$$\%Cl_{\chi}=\frac{\chi_{JPG}}{\chi_{HC}}\cdot 100\,\%=\frac{(30{,}4\,\mu S)}{(2390\,\mu S)}\cdot 100\,\%=1{,}27\,\%$$

$$\%Cl_{t}=\frac{TR_{JPG}}{TR_{HC}}\cdot 100\,\%=\frac{(14\,ppm)}{(1204\,ppm)}\cdot 100\,\%=1{,}16\,\%$$

In the 1:10 ratio measurements, the JPG soil achieved 2.11% of the ideal value based on the conductivity of the HC soil and 2.36% of the ideal value based on the TDS hardness of the HC soil. In the 1:5 ratio, the obtained values were even lower than the previous results (see 1.27% for conductivity and 1.16% for TDS hardness).

The conductivity and hardness measurements of the soil filtrates essentially showed that most soils (except for the SP soil) are very heterogeneously composed, both in terms of organic and inorganic substances, particularly in the form of soluble substances or ions in water. To illustrate this more clearly, let's present a comparative visualization of the obtained percentages for conductivity.



5.5.4.1.2.3 Figure 437: Comparison of ideal percentage values among soils for conductivity

Figure 437 shows the comparison of ideal percentage values relative to the HC soil for conductivity among the studied soils (DVT, JPG, JPZ, SP, SPJ, and TLV). With the exception of the SP soil, the differences between the soils are quite large, especially for the JPZ and SPJ soils, while the differences for DVT, JPG, and TLV soils are smaller. The rankings based on soil quality slightly changed after conductivity measurements in the 1:5 ratio. The highest quality soil remains the SPJ soil, followed by the DVT soil (rank 2), the SP soil (rank 3), the TLV soil (rank 4), and lastly, the JPG soil (rank 5). Based on the conducted measurements, we can confidently state that the SPJ soil is the highest quality soil among the studied soils compared to the HC soil, while the TLV and JPG soils are the lowest quality. All these measurements show that the results for the soils are somewhat "up in the air," and there is no true standard. In this context, the HC soil could serve as a benchmark or even a standard for evaluating measurements of various soil types. The same combined measurements were conducted with the same soils in the 1:5 ratio, with the difference that the soils were first sieved through a fine sieve (except for the HC soil), and then the samples were weighed. Sieving removed small stones and larger plant parts. The main purpose of these additional measurements was to determine whether the small stones and larger plant parts in the previous measurements had a greater or lesser impact on pH values, conductivity, hardness, clarity of the filtrate, and water permeability.

5.5.4.1.2.4 Table 198: Sieved soil samples and combined measurements

Type	*χ*	*Ph_f*	*T*	*PPM*	*Ph_{nep}*	*Svl*	*Ph_s*	*BF*	*Pro*	*m*	*V_{H2O}*
DVT	153.2	7.15	23.90	73.00	6.95	5.50	7.95	M	3	20	100
TLV	122.3	7.68	23.50	58.00	6.82	2.00	7.54	RM	3	20	100
HC	2390.0	6.57	23.40	1204	6.90	6.00	6.80	B	1	20	100
SPJ	223.0	7.77	23.90	111.00	6.70	3.00	8.49	RRM	2	20	100
SP	155.4	7.17	23.50	79.00	6.70	2.00	8.13	RM	2	20	100
JPG	47.9	6.48	23.90	21.00	7.00	1.80	5.09	Mr	4	20	100
JPZ	180.2	7.08	24.00	87.00	6.60	6.80	7.51	RM	2	20	100

Table 198 presents data on combined measurements for sieved soil samples such as DVT, TLV, HC, SPJ, SP, JPG, and JPZ. The pH values measured by various methods do not differ significantly compared to previous measurements without sieving. The pH of the suspensions was slightly higher (except for the JPG soil, similar to the measurements without sieving), and the pH of the filtrates was slightly lower. A larger discrepancy can be observed for certain soils in terms of conductivity and filtrate hardness measurements (SPJ). For DVT, TLV, SP, and JPG soils, no significant differences were observed in the results for conductivity and hardness. These soils contained a considerable amount of small stones and plant parts in the form of roots before sieving, which indicates that both did not significantly impact the conductivity and hardness of these soils. A different picture emerges when considering the SPJ and JPZ soils. For the SPJ soil, conductivity and hardness significantly increased after sieving (previous measurement: 164.7 μS; 80 ppm, after sieving: 223 μS; 111 ppm). The SPJ soil contained a large number of slightly larger stones and thinner roots. It can be assumed that both stones and roots had a significant impact on the relatively drastic change in conductivity and hardness, as the values without these components were higher. Stones and roots essentially acted as obstructions that blocked a more complete flow of charged particles. For the JPG soil, an anomaly was observed in the measurement of pH suspensions and filtrates, as in all attempts (except one), the pH values were in the acidic range (see measurements for 1:10, 1:5, and 1:5 after sieving: filtrate pH 5.91, 6.45, and 6.48; suspension pH 7.82 – the mentioned exception; 5.06 and 5.09). The exception of 7.82 is difficult to explain sensibly. Perhaps the sample of weighed soil had a slightly different composition? The low pH values can likely be explained by a chemical reaction triggered by the addition of 100 ml of distilled H_2O. The JPG soil sample was taken in a forest approximately 20 meters from a (limestone) cave, so it likely contained $CaCO_3$. It is known that $CaCO_3$ is slightly soluble in water and reacts with CO_2 to form calcium bicarbonate ($Ca(HCO_3)_2$), which has an acidic pH value.

$CaCO_3 + H_2O + CO_2 \rightarrow Ca(HCO_3)_2$

$Ca(HCO_3)_2$ exists only in liquid form and is highly soluble in water. In short, the JPG soil had a certain limestone base. For the conductivity and hardness measurements of the JPG soil, the lowest values were recorded (see $\chi_{1}:_{10}$ = 34.1 μS; $\chi_{1}:_{5}$ = 30.4 μS and $\chi_{1}:_{5}$ = 47.9 μS; $PPM_{1}:_{10}$ = 19 ppm; $PPM_{1}:_{5}$ = 14 ppm and $PPM_{1}:_{5}$ = 21 ppm), which does not align with the previous explanation, as the presence of $Ca(HCO_3)_2$ increases both conductivity and hardness of aqueous solutions.

The presence of univalent cations like Na^+ and K^+ could perhaps affect the reduction of conductivity and hardness in the filtrate. The most reasonable explanation for the lower conductivity and hardness values in the JPG soil is that this soil contained a relatively large mass of insoluble substances in water. The addition of distilled water did not manage to dissolve a significant portion of the mass in the JPG soil, which is why the measured conductivity and hardness values were in the range of distilled water, which has a hardness of 0 ppm to 71.2 ppm. This also explains the measurements of other soil types (except for HC soil and partly JPZ soil), where the conductivity and hardness values of the filtrates were lower than most tap water (e.g., PPM = 270 ppm). Conductivity is strongly dependent on the number of charged ions, their rate of movement, and the type of ion with a particular charge. By measuring TDS hardness in ppm, we essentially determine the number of charged active ions in the solution (e.g., a value of 19 ppm means 19 ions).

It was found that the filtrate from the JPG soil contained an extremely small number of ions – comparable to distilled water, while other soil types (except for HC soil) contained the number of active ions similar to tap water. In this context, an interesting question arises: which ions are present in the filtrates of the soils? Most soils typically contain Na^+, K^+, NH_4^+, H_3O^+, Ca^{2+}, Mg^{2+}, Cl^-, NO_3^-, SO_4^{2-}, and PO_4^{3-} ions. Many soils also contain other ions, such as Fe^{2+}, Fe^{3+}, Al^{3+}, Mn^{4+}, Si^{4+}, CO_3^{2-}, O^{2-}, and others. We will return to the proof reactions for some ions after performing the sedimentation test for individual studied soils in distilled water.

5.5.4.1.3 Sedimentation of the studied soils

In the sedimentation test for the soils DVT, TLV, JPG, JPZ, SPJ, SP, and HC, suspensions were first prepared in a 1:5 ratio (20 g of soil and 100 ml of H_2O). The suspensions were thoroughly mixed and then left to stand on the countertop for approximately 18 hours. During this time, the coarse particles settled at the bottom of the suspension, while finer and/or soluble particles formed a more or less clear water phase.

The measurements of the water phase yielded the following results:

- JPG soil = 3.5 cm (cloudy, reddish-brown color)
- JPZ soil = 3.7 cm (slightly cloudy, grayish color tone)

- SP soil = 4.4 cm (clear, no distinct color tone)
- DVT soil = 4.02 cm (slightly cloudy, whitish-gray color tone)
- TLV soil = 4.02 cm (clear, with a slight whitish color tone)
- SPJ soil = 3.9 cm (slightly cloudy, whitish color tone)
- HC soil = 4.5 cm (clear, no distinct color tone)

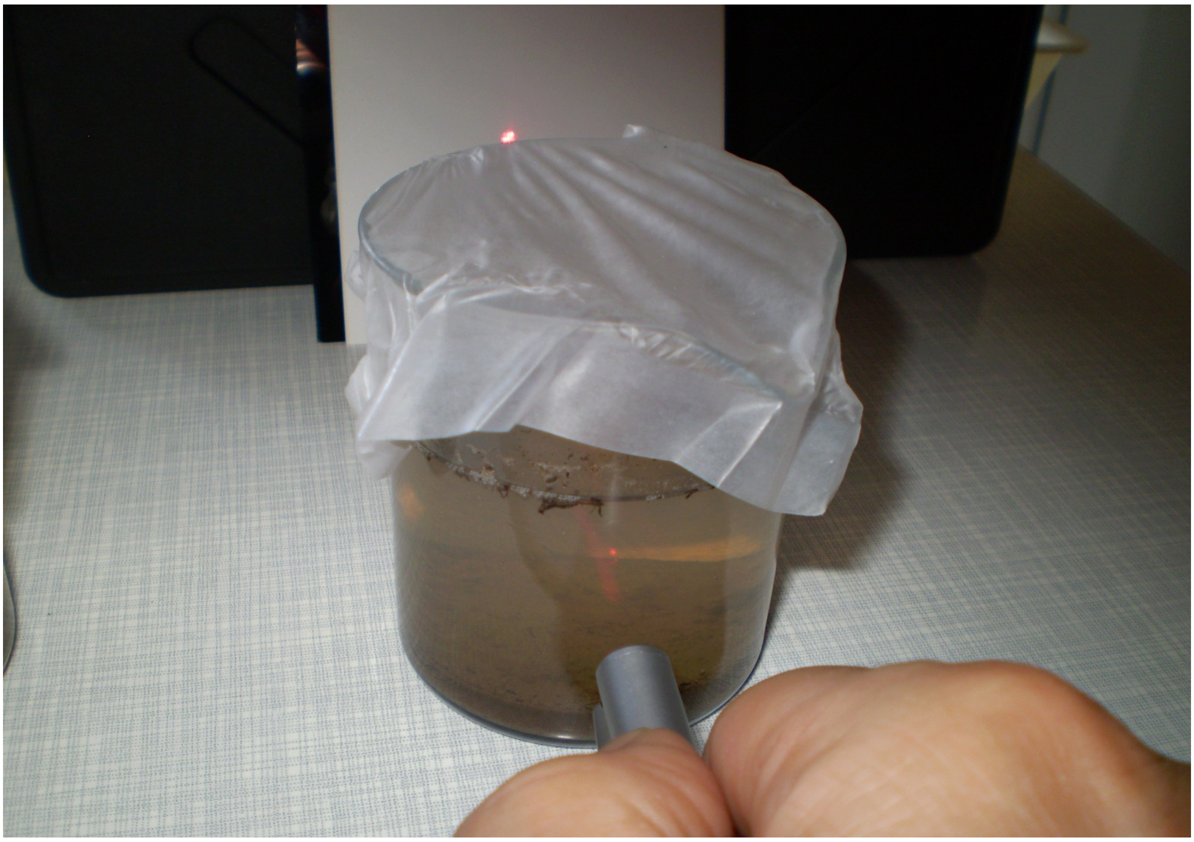
For better understanding of the description, a figure of the test follows.

5.5.4.1.3.1 Figure 438: Sedimentation of the studied soils with a digital caliper

Figure 438 shows the sedimentation of the studied substances in distilled water using a digital caliper, which was used to measure the height of the water phase in centimeters (cm). The sedimentation of soil in water is based on two main principles: the effect of gravity and the attraction of particles. Heavier particles settle at the bottom of the suspension, while lighter, finer, and charged particles remain suspended in the water phase. Even lighter particles, usually of plant origin, tend to accumulate at the surface of the water phase.

In this test, the height of the phase of lighter particles was measured, as they resist gravitational force due to attractive forces. The larger the water phase of lighter and soluble particles in the soil suspension, the higher the soil quality, as it contains more nutrients in the form of ions. Based on the measurements with the digital caliper, the HC soil proved to be the highest quality, as its water phase was clear and measured 4.5 cm. It also contained a significant amount of organic matter,

which accumulated on the surface of the water phase. The lowest quality was the JPG soil, as its water phase was only 3.5 cm and was highly cloudy with a reddish-brown tone.
In connection with the liquid phase, an interesting measurement was also performed using laser light, which was used to test the clarity or transparency of the water phases in the suspensions.



5.5.4.1.3.2 Figure 439: Transparency of water phases in suspensions

Figure 439 shows the transparency of the water phases in different suspensions of the studied soils using a laser pointer. Prior to this measurement, the suspension was left to stand for approximately 24 hours to allow the coarser particles to settle. The glass with the sample was placed about 15 cm from a screen with millimeter paper (which is not visible in this image as it only shows white paper), and then the laser pointer was directed at the more or less clear phase of the soil suspensions.
Finally, the diameter of the laser spot was measured on the millimeter paper for each suspension, and the strength of the light reflection was assessed. The results were as follows:
- HC soil: laser spot diameter 3 mm, light reflection assessed as strong.
- TLV soil: laser spot diameter 3 mm, light reflection assessed as weak.
- DVT soil: laser spot diameter 2.5 mm, light reflection assessed as weak.
- SPJ soil: laser spot diameter 3 mm, light reflection assessed as strong.
- SP soil: laser spot diameter 3 mm, light reflection assessed as weak.
- JPZ soil: laser spot diameter 3 mm, light reflection assessed as weak.

- JPG soil: laser spot diameter was the smallest, only 2.5 mm, and light reflection was assessed as very weak.

We can assume that there is a close connection between conductivity, hardness, the size of the laser spot, and the strength of light reflection. This assumption is why conductivity, hardness, and pH values of these water phases in the suspensions were also measured.

HC soil: The conductivity was 2030 μS, hardness was 1011 ppm, and pH was 6.64. In this case, the result for the size of the laser spot and the strength of its reflection matches the highest values for conductivity and hardness.

JPG soil: The conductivity was 23.8 μS, hardness was 11 ppm, and pH was only 5.61. In this case, the low values for conductivity and hardness correspond to the measurement of the laser spot diameter and the very weak strength of its reflection.

For the extreme cases regarding conductivity and hardness values, we can confirm the assumption of a close connection with the size of the laser spot and the strength of its reflection. It would now make sense to examine the other water phases of the soil suspensions.

JPZ soil: The conductivity was 149.5 μS, hardness was 73 ppm, and pH was 6.91. The laser spot diameter and the strength of its reflection align with the hypothesis so far.

SP soil: The conductivity was 118.2 μS, hardness was 58 ppm, and pH was 7.07. The smaller diameter of the laser spot and its weak reflection strength correspond to the lower values of conductivity, hardness, and pH.

SPJ soil: The conductivity was 182.4 μS, hardness was 85 ppm, and pH was 7.43. This case also confirms the hypothesis.

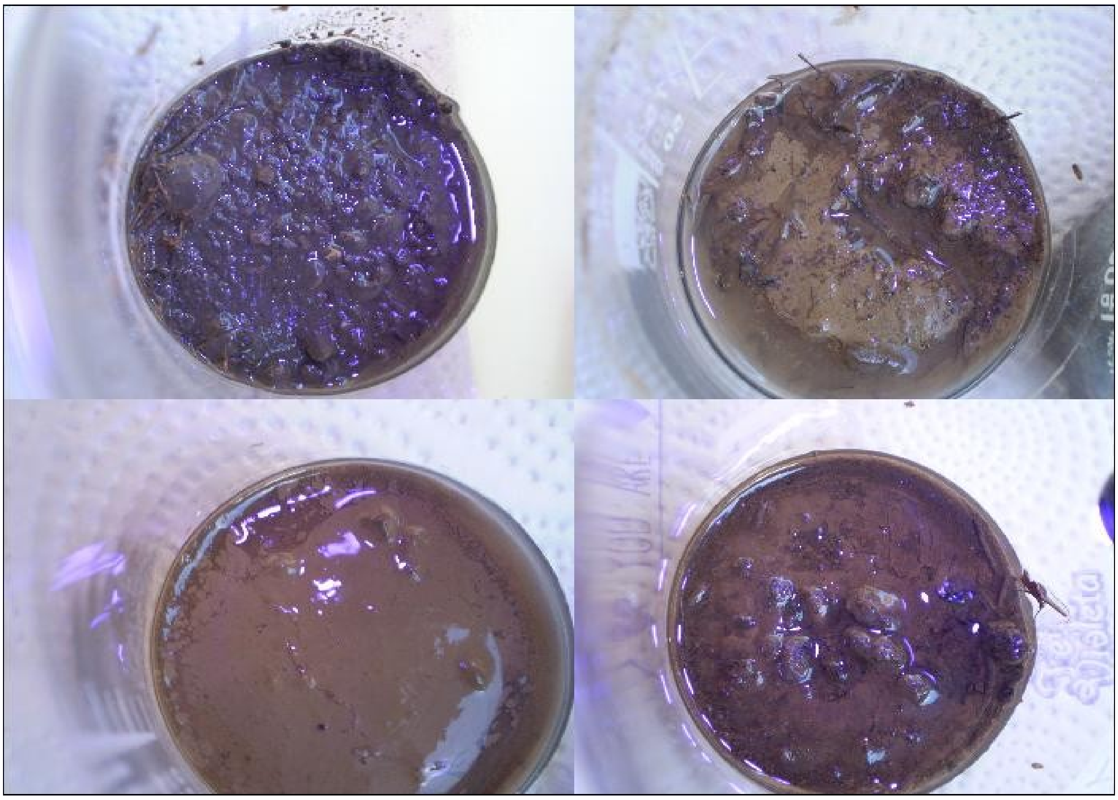
DVT soil: The conductivity was 77.3 μS, hardness was 38 ppm, and pH was 6.9. Based on the smaller diameter and weak reflection of the laser spot, we can also establish a closer connection between the measured values in this case.

TLV soil: The conductivity was 102.8 μS, hardness was 45 ppm, and pH was 6.99. The conductivity and hardness were lower than those of SP soil, but the diameter of the laser spot and its reflection strength were higher for TLV soil than for SP soil. In this exceptional case, we can disprove the assumption of a closer connection between conductivity, hardness, and the size of the laser spot and its reflection strength.

Overall, the test with laser light proved to be very successful, as it is possible to reasonably and reliably estimate the descriptive values of electrical conductivity and TDS hardness of soil suspensions based on the diameter and strength of the laser spot's reflection.

The measured values of conductivity and TDS hardness in the water phase of the suspensions were slightly lower than those in the filtrates of the suspensions after sieving; however, the ranges mostly remained the same, except for DVT and TLV soils, where conductivity and TDS hardness were higher.

Next, an interesting test with ultraviolet (UV) light will be presented, where the densities of the studied soils were evaluated on a scale from 1 to 5 (with 1 representing the least dense soils and 5 representing the most dense soils).



5.5.4.1.3.3 Figure 440: Evaluation of soil density using UV light

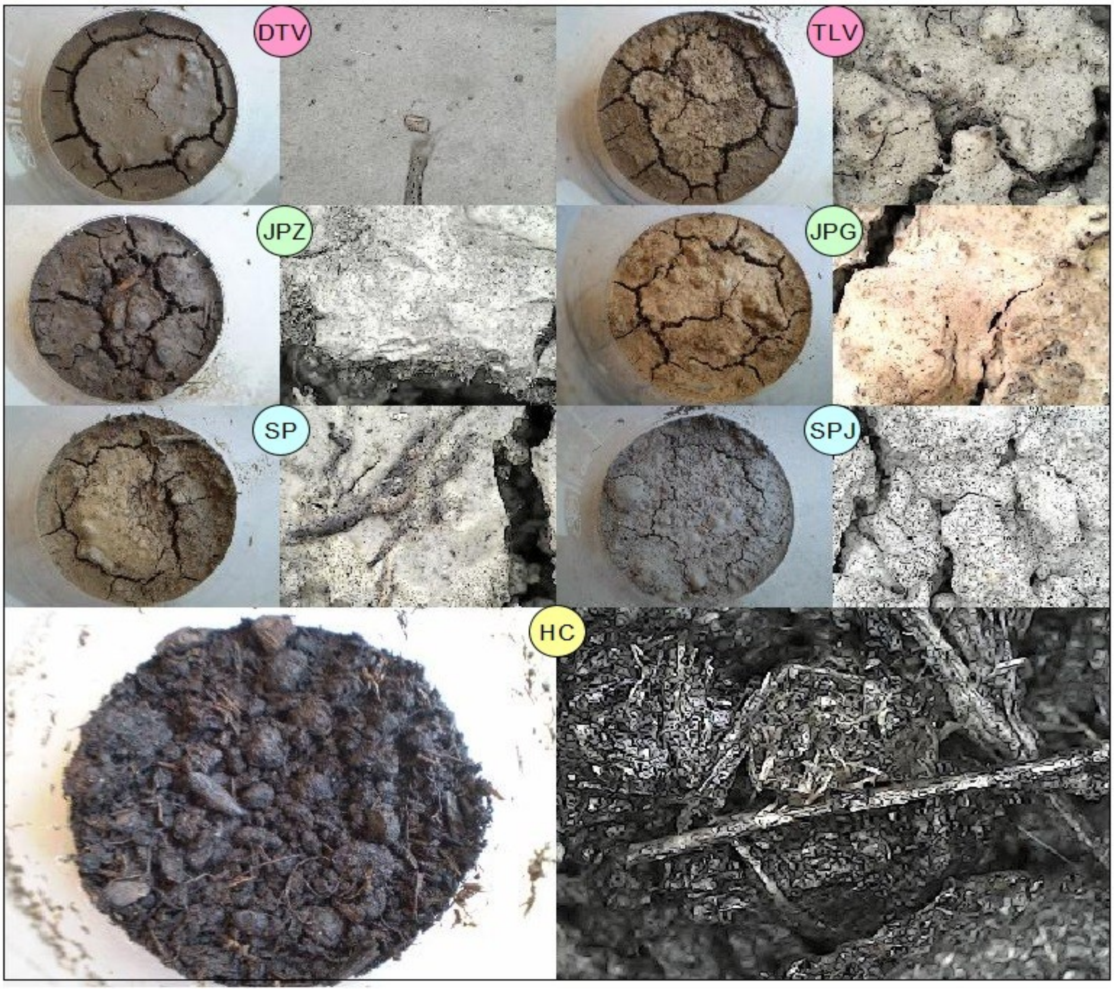
Figure 440 shows some examples of evaluating soil density using UV light. First, the solid part of the suspensions was separated from the water phase, so the studied soils were prepared for UV light exposure. The UV light source was directed at a right angle, a few centimeters above the surface of the soil, where the effect of the distribution of illuminated purple spots was visible. These spots actually represented a kind of density relief of these surfaces.

Based on these reliefs, the densities of the individual soils were evaluated on the mentioned scale. The results were as follows:

- HC soil: Rated with a score of 1, meaning it was among the least dense.
- DVT soil: Rated with a score of 5, meaning it was the densest.
- TLV soil: Rated with a score of 2, meaning it was denser than HC soil, but considerably less dense than DVT soil.
- SPJ soil: Rated with a score of 1, similar to HC soil, as it was among the least dense.

- SP soil: Rated with a score of 3, meaning it was denser than HC, TLV, and SPJ soils, but less dense than DVT soil.
- JPZ soil: Rated with a score of 2 and was similar in density to TLV soil.
- JPG soil: Rated with a score of 3, as it was similar in density to SP soil.

In the next test, the soils dried in the sun (drying time was approximately 10 hours) will be examined under a USB microscope.



5.5.4.1.3.4 Figure 441: Smooth and rough soil surfaces under USB microscope

Figure 441 shows the smooth and rough surfaces of the studied soils under a USB microscope, where patterns of cracks are clearly visible. These patterns are divided by color markings:
- Pink marking represents garden soils DVT and TLV.
- Green marking represents forest soils JPZ and JPG.
- Blue marking represents riparian soils SP and SPJ.
- Yellow marking represents artificially created soil HC.

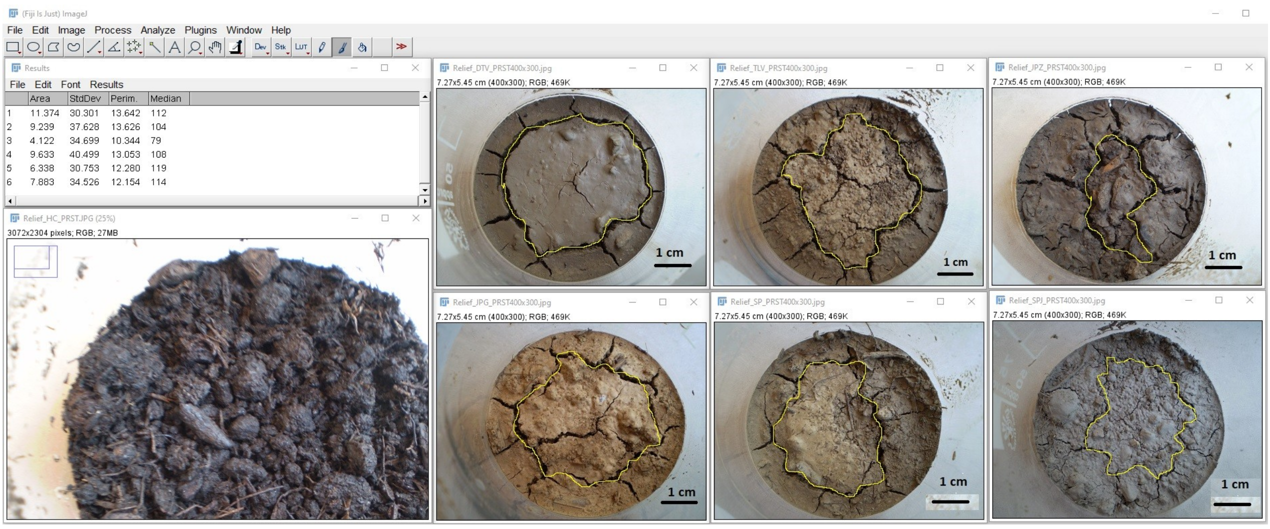
The USB microscope images clearly illustrate the characteristics of the surfaces of the individual soils. For DVT soil, we can observe an almost flat surface, while other soils exhibit varying degrees of roughness, deviating from flat surfaces. Even for HC soil, a relatively rough structure is visible. Rough soil surfaces usually indicate certain irregularities, which can be caused by various factors, such as texture, particle size, stone content, larger plant residues, land use methods, and climatic influences (e.g., high rainfall or drought).

It is known that soils with rough or uneven surfaces fall into the categories of sandy loams and sandy soils, as they contain a higher proportion of sand. Conversely, soils with smooth surfaces are classified as clayey or silty.

In the case of DVT soil, despite its relatively smooth surface, larger sand particles and small stones can be observed, meaning that this soil is likely not loamy or clayey. A more accurate answer will be provided by the subsequent sedimentation analysis.

By using image processing analysis, useful information can be obtained not only about the image itself but also about the studied soils. A particular point of interest is the main or central cracks, as they can provide insight into soil properties such as water retention capacity, permeability, and even chemical composition.

To begin with, we will present a possible image processing analysis and, consequently, an analysis of certain properties of the studied soils.



5.5.4.1.3.5 Figure 442: Image processing analysis of the studied soils

Figure 442 shows the image processing analysis of the studied soils, with an emphasis on the surface area of the central cracks.[279] In these analyses, special attention should be given to the preparation of the images, which must reflect the actual size and be prepared in a uniform format (e.g., JPEG) and pixel dimensions (e.g., 400 x 300). Additionally, the images should be equipped

279 The analysis was performed using the Fiji (ImageJ) software tool. It is an open source software tool available at the URL: https://imagej.net/software/fiji/downloads (2022-09-17).

with an accurate scale, which in this case is 1 cm or 55 pixels, so that the appropriate scale can be determined later (known distance in pixels is 55, known distance is 1 cm, scale is 1:1, and the unit of measurement is cm). In this analysis, the main focus is on the surface area of cracks in individual soils. Using image processing software with a freehand marker, the desired areas can easily be marked, after which, using the measurement command ("measures"), the software calculates the individual areas of the main cracks in the soils. The largest crack was measured in the DVT soil, with an area of 11.374 cm^2, followed by the JPG soil with an area of 9.633 cm^2, the TLV soil with an area of 9.239 cm^2, the SP soil with an area of 7.883 cm^2, the SPJ soil with an area of 6.338 cm^2, and finally, the JPZ soil with an area of 4.122 cm^2. In the case of HC soil, no significant cracks were observed, as it is known that humus-rich soils store water exceptionally well and retain nutrients. Typically, clay-rich soils crack when lacking moisture and exposed to sunlight because the water in the soil evaporates, causing shrinkage of certain minerals such as smectite, montmorillonite, etc. Based on the obtained results on the surface areas of central cracks, it could be concluded that the DVT soil contains the highest percentage of clay, and the JPZ soil contains the lowest percentage. Given that the SPJ soil has only small cracks, it could be categorized as the soil with the lowest clay content. Now, it would be logical to assess the percentage of sand, silt, and clay in the studied soils. A texture calculator for determining soil texture will be helpful in this analysis.[280]

The JPG soil consists of 2 cm of sand, 0.6 cm of silt, and 0.3 cm of clay. It contains approximately 69% sand, 20.7% silt, and 10.3% clay. The JPG soil can be classified as sandy loam.

The main characteristics of this type of soil include large reddish particles that break down quickly under slight physical pressure. Its pH value is usually slightly alkaline but can also reach mildly acidic levels. Sandy loams have good aeration, allowing them to absorb water effectively and facilitate good oxygen flow in the soil.

Small animals and microorganisms live in such soils, contributing to better plant growth. They have poor water retention, which can lead to insufficient nutrient supply to plants during dry periods. Therefore, they need to be watered and fertilized regularly.

This is also the main reason why the electrical conductivity and TDS hardness values are low (see measurements). Sandy loams can contribute to soil fertility when constantly supplemented with water and fertilizers.

The JPZ soil consists of 2 cm of sand, 0.8 cm of silt, and 0.2 cm of clay. It contains approximately 66.7% sand, 26.7% silt, and 6.6% clay. The JPZ soil can be classified as sandy loam.

It is similar to the JPG soil, but it is a slightly darker brown. Samples of both soils were collected in a forested area near a karst cave. The JPZ soil was located about 300 meters from the karst cave.

280 https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_054167 (2022-09-11).

The DVT soil consists of 1 cm of sand, 0.5 cm of silt, and 0.4 cm of clay. It contains approximately 52.6% sand, 26.3% silt, and 21.1% clay, so it can be classified as sandy clay loam.

Such soils are mainly composed of sand but also contain a higher proportion of silt and clay. When water is added, they can be easily kneaded and shaped. They contain a lot of nutrients and can store large amounts of water but have poor water permeability. Cracks often form under high temperatures and water evaporation. Nevertheless, these soils are highly suitable for agricultural production.

The TLV soil consists of 2.4 cm of sand, 0.4 cm of silt, and 0.1 cm of clay. It contains approximately 82.8% sand, 13.8% silt, and 3.4% clay, so it can be classified as loamy sand.

These soils are characterized by good water permeability but poor water retention. Sandy soils are not very cohesive, as they cannot be kneaded and shaped like silty and clayey soils. For this reason, they are somewhat less suitable for agricultural production.

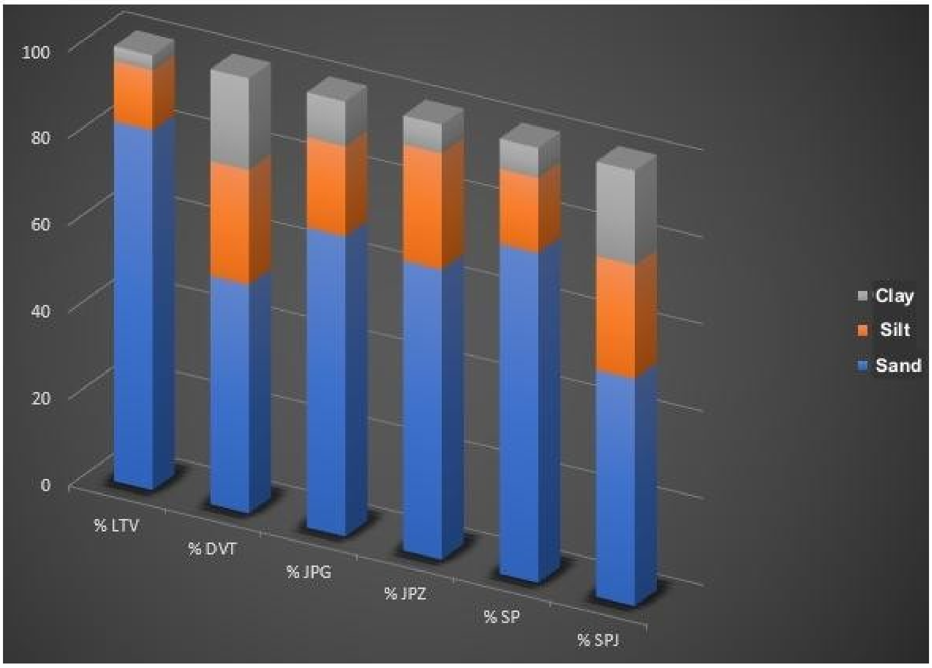
The SP soil consists of 2.2 cm of sand, 0.5 cm of silt, and 0.2 cm of clay. It contains approximately 75.86% sand, 17.24% silt, and 6.90% clay, so it can be classified as sandy loam.

The SPJ soil consists of 1.2 cm of sand, 0.6 cm of silt, and 0.5 cm of clay. It contains approximately 52.2% sand, 26.1% silt, and 21.7% clay, so it can be classified as sandy clay loam.

It has similar properties to the DVT soil. The SP soil (near the river) and the SPJ soil (near the lake) were located about 20 meters apart.

The HC soil is an artificially made soil, primarily of organic origin, containing various additives such as fertilizers and other materials. Therefore, it cannot be classified in the same classification system as the other soil types.

The particle size of sand is defined by a diameter range from 0.05 mm to 2.0 mm, while the particles of silt have a diameter range from 0.002 mm to 0.05 mm. The finest particles are found in clay, where the diameter is less than 0.002 mm.



5.5.4.1.3.6 Figure 443: Percentage composition of sand, silt, and clay in the studied soils

Figure 443 shows the percentage composition of sand, silt, and clay in the studied soils, from which we can infer that the TLV soil contains the highest amount of coarse particles in the form of sand and the lowest amount of fine particles, particularly silt and clay. The SPJ soil contains the least amount of coarse sand particles, while having the highest proportion of silt and clay. This is closely followed by the DVT soil. In general, these two soils are very similar in texture, but this is not true for the surface and central cracks that form after drying. The surface area of the central crack in the SPJ soil was considerably smaller than in the DVT soil. This could indicate a lower proportion of clay, but the texture analysis of the soil refuted this, as the SPJ soil actually contained slightly more clay than the DVT soil.

The percentage values of sand, silt, and clay content in the JPG and JPZ soils are relatively similar, although these two soils, originating from the same forest environment, differ significantly in color and central cracks after drying. The black color of the JPZ soil suggested a higher amount of humus, while the reddish-brown JPG soil indicated its lack. Significant differences were also observed between the SPJ and SP soils, which come from the same environment and were only a few meters apart. The SP soil contained a significantly higher proportion of sand and considerably less silt and clay compared to the SPJ soil. Based on the difference in the surface area of the central cracks after drying, this was not expected.

In such heterogeneous substances as soil, it is difficult to determine rigid patterns. For a meaningful comparison, it is necessary to conduct various tests and use diverse methods and techniques. This was already evident in the pH value measurements, where some results were quite different from what was expected.

All the studied soils, except for the TLV soil, could be formed into relatively stable rolls, which is not surprising given the measured amounts of silt and clay. As mentioned earlier, the TLV soil contained the least silt and clay and the most sand.

Magnetization Test of the Studied Soils

20 g of each individual soil was weighed into 150-milliliter beakers. Using neodymium magnets with a capacity ranging from 80 kg to 100 kg, magnetic particles were extracted. After extraction, the samples were re-weighed to determine the mass difference between the initial and final mass.

All the studied soils (except for the HC soil) contained a certain proportion of magnetic particles in the form of iron and/or iron minerals. The obtained magnetization results were as follows:

- DVT soil: 14.3 mg of magnetic substances were extracted, which represents 0.073%.
- TLV soil: 18.3 mg of magnetic substances were extracted (0.0915%).
- JPG soil: Mass difference after extraction was 12.9 mg of magnetic substances (0.0645%).
- JPZ soil: 12 mg of magnetic substances were extracted (0.06%).
- SP soil: Only 2.5 mg of magnetic substances were extracted (0.0125%).
- SPJ soil: 90.5 mg of magnetic substances were extracted, which represents 0.45%.

It has been proven that magnetic substances, such as elemental iron and mineral compounds with magnetic properties, stimulate plant growth and increase the activity of small animals and microorganisms, especially fungi and bacteria.[281] Magnetic particles in the soil represent a heterogeneous mixture of various minerals, including diamagnetic, paramagnetic, and ferromagnetic phases.[282] The soil primarily contains compounds with magnetic properties, such as various iron oxides, including magnetite and titanium magnetites. Iron oxides with magnetic properties are mainly the result of rock weathering processes and associated precipitation. In short, magnetic particles in the soil, despite their relatively low quantity, are important factors in soil function and consequently in plant growth. During these natural magnetism processes, magnetic inductions can reappear, triggering magnetization effects even in paramagnetic and diamagnetic substances, without direct physical contact.

As mentioned earlier, the HC soil, which is composed mostly of organic matter in the form of dead plant material, animals, and various artificial fertilizers, did not contain magnetic particles. The filtrates of HC soil, compared to other soils, exhibited the highest conductivity and hardness. This

281 Pittman, U. J. (1964). Magnetism and plant growth: II. effect on root growth of cereals. *Canadian Journal of Plant Science*, 44(3), 283–287. https://doi.org/10.4141/cjps64-055.

282 Jordanova, N. (2017). *Soil magnetism: Applications in Pedology, environmental science and agriculture*. Elsevier/Academic Press.

fact will be used in the subsequent test of galvanic cells between HC soil and other soils. Voltage and current values will be measured with a multimeter.

5.5.4.1.3.7 Figure 444: Voltage and current measurements of the soil galvanic cell

Figure 444 shows the voltage and current measurements of the soil galvanic cell, which is composed of an iron electrode (see the HC soil filtrate in the left 150 ml beaker) and a carbon electrode (see the filtrate of another soil in the right 150 ml beaker), a cotton bridge (which was soaked in a 10% KCl solution), and alligator clips, which are connected to the sensor electrodes of the multimeter. The measurements showed that the HC soil filtrate in combination with the filtrates of other soils produced both low electrical voltage and low electrical current. The results were as follows:

- The galvanic cell between HC and DVT soil (HC || DVT) produced approximately 488 mV of electrical voltage and 15 µA of electrical current.
- The galvanic cell between HC and TLV soil (HC || TLV) produced approximately 492 mV of electrical voltage and 13 µA of electrical current.
- The galvanic cell between HC and JPZ soil (HC || JPZ) produced approximately 502 mV of electrical voltage and 12.5 µA of electrical current.
- The galvanic cell between HC and JPG soil (HC || JPG) produced approximately 498 mV of electrical voltage and 6 µA of electrical current.
- The galvanic cell between HC and SP soil (HC || SP) produced approximately 505 mV of electrical voltage and 12.5 µA of electrical current.

- The galvanic cell between HC and SPJ soil (HC || SPJ) produced approximately 520 mV of electrical voltage and 18 μA of electrical current.

These are measurements that produced low values of electrical voltages and currents, indicating a close relationship between humus and soils, as soils with a low humus content predominantly yield lower values, especially of electric current (see JPG soil, only 6 μA). Additionally, these measurements showed that soils are more or less dynamic and have the properties of a natural capacitor that collects and stores currents. The connections between humus and soils also act as natural fuses or resistors, preventing excessive flow of electrical voltage and current through the soils. In this context, resistance (MΩ - megaohm) and capacitance (nF - nanofarad) values of sieved soils were measured using a multimeter. The resistance of a substance prevents current dynamism, while capacitance describes the ability of the substance to store or retain electric charges.

- The measurement for HC soil yielded a result of 0.37 MΩ resistance and 20 nF capacitance.
- The measurement for DVT soil yielded a result of 0.5 MΩ resistance and 0.07 nF capacitance.
- The measurement for TLV soil yielded a result of 4.7 MΩ resistance and 0.03 nF capacitance.
- The measurement for JPZ soil yielded a result of 2.1 MΩ resistance and 0.03 nF capacitance.
- The measurement for JPG soil yielded a result of 3.5 MΩ resistance and 0.02 nF capacitance.
- The measurement for SP soil yielded a result of 1.1 MΩ resistance and 0.05 nF capacitance.
- The measurement for SPJ soil yielded a result of 3.8 MΩ resistance and 0.03 nF capacitance.

Very high values were obtained for resistance, while the values for capacitance were quite low. The lowest resistance and highest capacitance were recorded for HC soil, followed by soils such as DVT, SP, SPJ, JPZ, TLV, and lastly JPG soil. In these measurements, the particularly high resistance of TLV soil and the relatively low resistance of JPG soil are surprising, since much higher resistance would be expected for JPG soil based on its low conductivity and hardness values.

The measured values of soil capacitance are of greater interest for our purposes. It is a known principle that the presence of a magnetic field in the soil prevents the loss of capacitive properties, so the soils have the ability to retain electric charges. The results for the measured soil capacitance values in nF are as follows:

- HC soil = 20 nF (The obtained capacitance value is quite high and outside the range of natural soils, whose values are much lower.)
- DVT soil = 0.07 nF
- TLV soil = 0.03 nF
- JPZ soil = 0.03 nF
- JPG soil = 0.02 nF
- SP soil = 0.05 nF

- SPJ soil = 0.03 nF

When measuring current and voltage in galvanic cells between humus and different soils, it was found that they produce weak voltages and weak currents, which are essentially stored in layers at the nanofarad level. Additionally, due to the movement of soil influenced by small animals, microorganisms, and weather factors, there are numerous weaker magnetic fields, which are needed by both plants and other living beings for optimal life. In harmony with electric and magnetic fields, the Lorentz force repeatedly appears. It acts on charged particles moving at a certain velocity in both electric and magnetic fields, which triggers electromagnetic waves or electromagnetic fields. All living beings, including humans, depend on these almost countless syntheses of weak magnetic and electric fields, as without them, plants in particular would develop and grow with more difficulty. This is important for the optimal functioning of food webs. Thus, in addition to the main terrestrial magnetic and electric field, we are essentially dealing with numerous nano- or even pico-cells of electromagnetic fields both on the surface and in the depths of the soil. This is essentially a prerequisite for the countless and less perceptible electrolysis processes (depending on the content of carbon and magnetic Fe micro-rods in the soil) occurring on the surface and in the depth of the soil, which to some extent change the chemical composition of the soil. In these cases, the reactions are not exclusively irreversible chemical reactions, but partly also reversible ones.

The efficiency between irreversibility and reversibility is far from 100%, and over time the soil becomes somewhat depleted. The revitalization of soil in nature is partly ensured by living organisms and partly by external factors in the form of more or less dynamic air masses, sun, and precipitation. Within cultivated land, such as various gardens and agricultural areas, people take care of maintaining and enhancing the soil's vitality.

In connection with the idea of countless electrolysis processes in the soils, electrolysis tests were carried out on various soil suspensions, such as HC, LTV, DVT, JPG, JPZ, SP, and SPJ. The soil suspensions were prepared by weighing 5 g of each of the mentioned soils into 150 ml beakers, after which 100 ml of distilled water was added to each sample. Before starting electrolysis, the suspensions were thoroughly stirred with a glass rod. The next step involved setting up the electrolysis applications, as shown in a smaller-scale setup in the following figure.

5.5.4.1.3.8 Figure 445: Electrolysis of soil suspensions

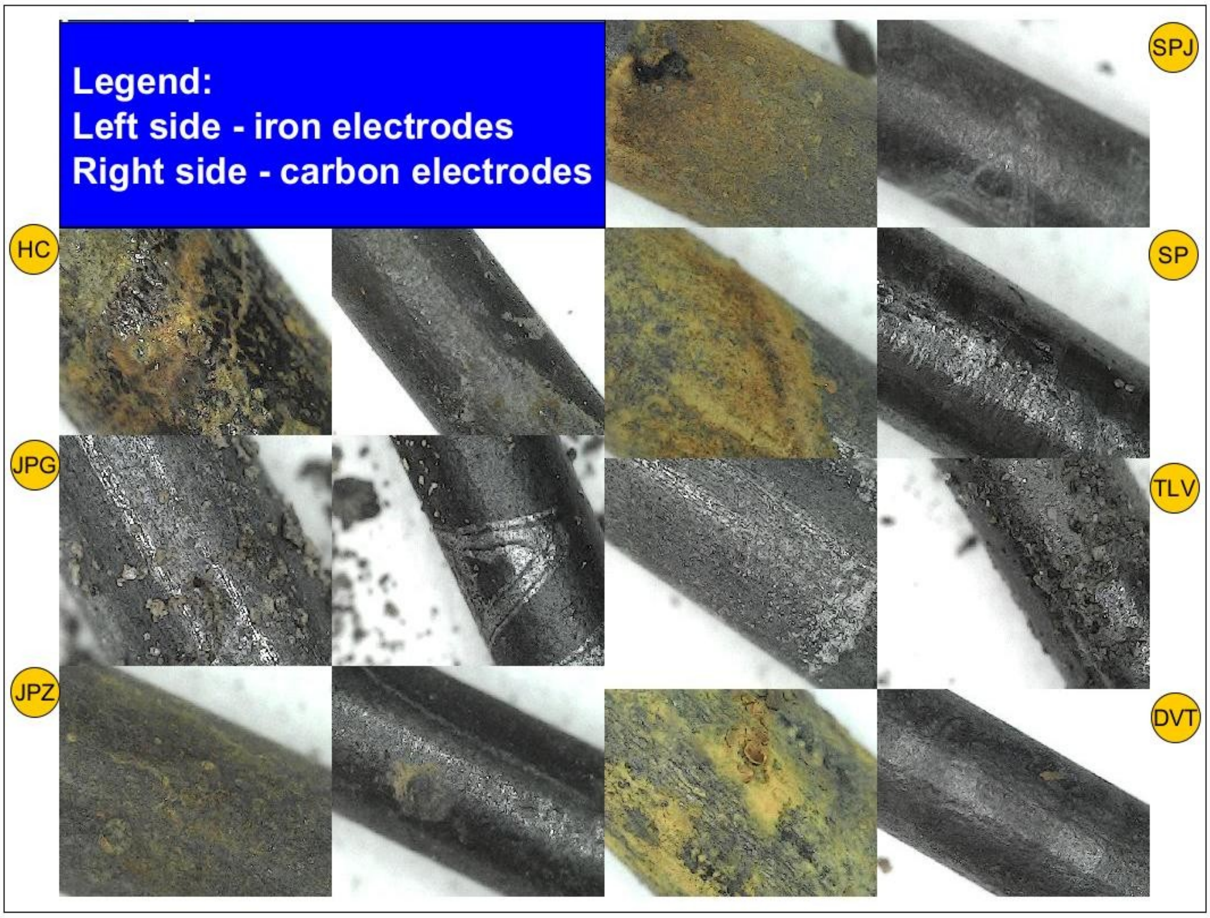
Figure 445 shows the electrolysis of suspensions of various soils, where iron (cathode) and graphite (carbon) electrodes (anode) were used. The former were connected to the negative terminals of 9 V batteries using alligator clips, while the carbon electrodes were connected to the positive terminals. All electrodes were submerged in suspensions of different soil types. All electrolysis processes lasted exactly five hours.

After a certain amount of time, small bubbles (hydrogen) were observed around the carbon electrodes and larger bubbles (oxygen) around the iron electrodes. After approximately one hour, a light brown substance appeared around the iron electrodes, resembling iron(III) hydroxide ($Fe(OH)_3$). This light brown substance also appeared in smaller amounts around the carbon electrodes. On the iron electrodes of the suspensions, a similarly brown substance formed in the shape of iron(III) oxide (Fe_2O_3), while on the carbon electrodes, a more porous white substance precipitated, most likely in the form of various carbonates, phosphates, and nitrates.

The latter was not the primary focus of these experiments, as a general analysis of the chemical composition of the studied soils will be conducted in one of the following subsections. The main interest of these tests was focused on examining the electrodes and the pH values after electrolysis. Each electrode was observed under a USB microscope with 1500x magnification.

Based on the embedded substances and deposits on the electrodes, one could infer the pH environment of the suspensions. If this assumption is correct, the pH measurements of these suspensions after the electrolysis will provide more insight. For each electrode submerged in the soil suspensions, images were taken to indicate the similarities and/or differences between the individual soils.

As expected, a larger amount of the previously mentioned brown substance should have precipitated on certain iron electrodes, and a larger amount of white substance on some graphite electrodes. In cases where a greater quantity of Fe_2O_3 formed on the iron electrodes, we can assume that a smaller amount of $Fe(OH)_3$ was produced within the electrolytic suspension, indicating a lower degree of alkalinity.



5.5.4.1.3.9 Figure 446: Electrodes after electrolysis of soil suspensions

Figure 446 shows the condition of the iron and carbon electrodes after the completed electrolysis of various soil suspensions. In two suspensions—JPG and TLV—with lower pH values, an exceptionally small amount of engraved brown-yellow substance can be observed on both iron electrodes. It can be reported that a white porous substance primarily precipitated on both the iron and carbon electrodes.

In the other suspensions, which had higher pH values, a larger amount of brown-yellow substance was visible on the iron electrodes, while a greater quantity of white crystalline substance precipitated on the carbon electrodes. The yellowish particles on the iron electrodes may indicate the presence of sulfur (S) in the suspensions, from which it can be inferred that JPG and TLV soils contained the lowest amounts of it.

Based on these observations, it can be assumed that the pH values of the JPG and TLV suspensions after electrolysis will be lower, while the remaining suspensions will have higher pH values in the alkaline range.

The electrical energy triggered chemical reactions and thus chemical changes in all studied suspensions. According to the measurements of the mass of magnetic substances in the soils, it was not only the electric field that influenced the chemical changes in the suspensions, but also a weak magnetic field.

Both the electric and magnetic fields produced the effect of the Lorentz force, which is essentially the result of the synthesis of both fields. However, due to the weaker influence of the magnetic field compared to the electric one, this synthesis is of a partial nature, as the dominant influence remained that of the pure electric field, which was not subject to synthesis.

The following section presents the results of pH measurements of the suspensions after electrolysis.

5.5.4.1.3.9.1 Table 199: Measurements of suspensions pH after electrolysis

Type	*Ph_s*	*T*
TLV	6.18	16.10
JPG	7.03	16.80
DVT	8.15	15.50
SPJ	10.44	16.60
JPZ	10.55	16.70
SP	10.65	16.10
HC	10.99	15.50

Table 199 presents the results of the pH values of various soil suspensions after electrolysis, confirming the assumptions formed based on the observations of the iron and carbon electrodes. Indeed, the pH values were lower for the TLV soil (6.18) and JPG soil (7.03). Soils in the alkaline range included DVT (8.15), SPJ (10.44), JPZ (10.55), SP (10.65), and HC (10.99). Especially in the case of the last four soils, we can state that the suspensions were in a very strongly alkaline range, while the pH of DVT soil was moderately alkaline.

Despite these findings, the reliability of the obtained values can be questioned, as they exceed expectations—particularly those in the highly alkaline range. The measured pH values of the soil suspensions are more like approximations, given the heterogeneous nature of soil, which makes it difficult to determine an exact and reliable value. The soil suspensions were also tested with universal pH paper, which yielded more typical values in the range of 6 to 8. The TLV suspension had a pH of around 6.5, JPG around 7.5, and the others ranged between 7.5 and 8.

In homogeneous chemical water solutions, pH meter readings usually align well with pH paper estimates. However, for the SPJ, JPZ, SP, and HC soils, significant differences were observed. The suspensions were further tested using phenolphthalein indicator. After adding four drops of phenolphthalein ($C_{20}H_{14}O_4$), all suspensions turned varying shades of purple. The TLV suspension was the least purple, which contradicts the pH meter reading, as it should not have changed color. The same applies to the JPG suspension.

Upon adding more phenolphthalein, white crystalline precipitates formed in all samples, though they did not spread to the center or bottom of the suspensions. These precipitates indicate the presence of high local concentrations of solid particles that are dispersed in the water phase but not soluble. These are mostly organic substances, such as plant matter, fats, oils, and so on. These components are the main reason pH measurements of soil suspensions are challenging.

At high pH values above 10, it is important to consider that negative voltages in millivolts were also recorded. Are these high pH values after electrolysis due to the presence of potassium, sodium, carbonate, and hydroxide ions, or are they caused by induced negative voltages? The chemical composition analysis of the soils is expected to provide a more satisfactory answer to this question. Given the high levels of nitrogen, phosphorus, and especially potassium ions, it could be assumed that alkali metal ions are responsible for the elevated pH readings. On the other hand, this could also mean that soils like DVT, JPG, and especially TLV may lack sufficient potassium ions.

5.5.4.1.4 Analysis of soil chemical composition

The chemical composition analysis of the soil includes the following measurements or estimations: the content of carbonate $(CO_3)^{2-}$ ions, nitrogen (N), phosphorus (P), potassium ions, sulfate ions, and other ions.

5.5.4.1.4.1 Carbonate ion content in soil

The analysis of carbonate ion ($(CO_3)^{2-}$) content was performed by observing the release of CO_2 gas from the soil when treated with 20% hydrochloric acid (HCl). In 150 ml beakers, 5 grams of each soil sample were weighed and combined with 5 grams of 20% HCl. Vigorous reactions followed, predominantly releasing CO_2 gas. However, in all samples except for TLV and JPG soils, a slight odor of hydrogen sulfide (H_2S) was also detected, indicating the presence of sulfide ions (S^{2-}) or sulfur.

After the reactions were complete, the beakers were cooled, and the contents were weighed using an analytical balance. From these measurements, the percentage content of carbonate ions in each soil sample was calculated. This is a very simple method, which does not provide highly precise measurements but gives a rough estimate of the presence of carbonate ions in the soil.

The results were as follows:

- DVT soil: 2.1%
- TLV soil: 1.15%
- JPG soil: 0.58%
- JPZ soil: 0.73%
- SP soil: 4.47%
- SPJ soil: 4.45%

No measurement was conducted for HC soil. Although it is rich in carbon, it is believed to contain little to no carbonate ions, as its pH should range between 5.6 and 7.0. The presence of carbonate ions in HC soil could lead to an undesirably alkaline environment. Therefore, HC soil is estimated to contain 0% $(CO_3)^{2-}$ ions.

It is known that a deficiency of carbonate ions in soil can lead to an acidic environment, which can threaten many types of plants and other organisms vital to soil fertility. Carbonate ions significantly affect soil structure and water permeability—both of which are essential for the growth and flourishing of various plant species that form a major part of the food web. Additionally, carbonate ions contribute to the retention of heavy metals in the soil.[283] For both representatives of forest soils (JPG and JPZ), it can be estimated that they contain a relatively small amount of carbonate ions ($(CO_3)^{2-}$) on the surface, despite the proximity of a karst cave. Given the presence of large trees in the forest with deep and thick root systems, it can be assumed that the surface deficiency of $(CO_3)^{2-}$ does not reflect the conditions deeper in the soil.

A somewhat higher percentage of $(CO_3)^{2-}$ ion content was estimated for the two garden soil samples (DVT and TLV), which is a good indicator that the soil is not acidic and does not negatively affect the growth of garden crops such as grapevines. The highest percentage of $(CO_3)^{2-}$ ions was found in soils located near water sources (SP and SPJ). Encouragingly, these soils are neither acidic nor excessively alkaline.

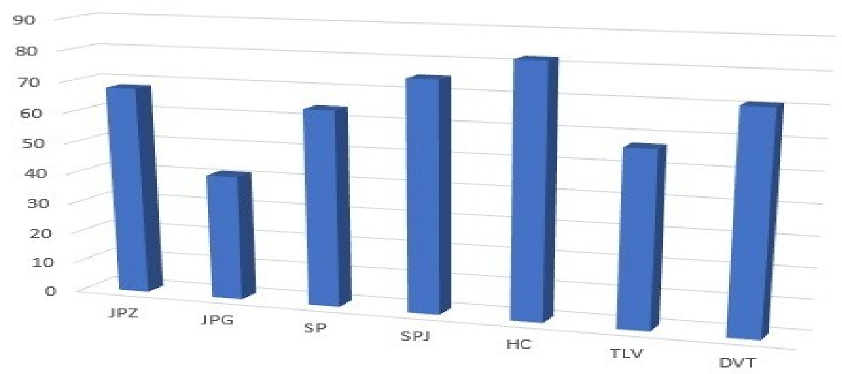
In this context, it is logical to correlate the obtained estimates with data from other measurements/assessments, such as pH (direct, in filtrates, and in suspensions before and after electrolysis), conductivity, hardness, texture, magnetism, permeability, density, carbonate content ($(CO_3)^{2-}$), etc., in order to comprehensively evaluate the quality of each soil type.

283 Wang, C., Li, W., Yang, Z., Chen, Y., Shao, W., & Ji, J. (2015). An invisible soil acidification: Critical role of soil carbonate and its impact on heavy metal bioavailability. *Scientific Reports*, 5(1). https://doi.org/10.1038/srep12735.

The results of these measurements and assessments were first ranked and then scored on a scale from 1 (lowest quality) to 7 (highest quality). The score values for each soil type are presented in the following table and bar chart.

5.5.4.1.4.1.1 Table 200: Scores achieved by individual soil types according to various measurements/assessments

Type	*Px*	*Pppm*	*Pvrphf*	*Pvrphn*	*Pvrphs*	*Pvrphpe*	*Psvl*	*Pmag*	*Ppro*	*Ptx*	*Pco3*	*Pgp*	*Pivhc*	*Ppiraz*	*Pc*	*Psvf*	*SUM*
JPZ	3	3	7	1	6	2	7	3	6	4	3	5	6	6	4	2	68
JPG	1	1	3	7	1	7	1	4	1	5	2	3	1	2	1	1	41
SP	5	5	5	3	3	2	2	2	6	3	7	3	3	4	5	6	64
SPJ	6	6	1	3	2	4	4	7	6	6	6	7	5	5	4	3	75
HC	7	7	4	5	7	1	6	1	7	1	1	7	7	7	7	7	82
TLV	2	2	2	4	5	6	2	6	3	2	4	5	2	3	4	5	57
DVT	4	4	6	6	4	5	5	5	3	7	5	1	4	1	6	5	71



5.5.4.1.4.1.2 Figure 447: Visualization of total scores based on measurements/evaluations

Table 200 presents the total points earned by different soil types based on various measurements and evaluations, while Figure 447 provides a visual representation of this data. Points for each parameter were assigned based on proximity to ideal values for each measurement unit (e.g., pH = 7; moisture level – ML = 5–7; soil magnetism – Mag > 10 mg; % $(CO_3)^{2-}$ > 2%; soil texture – 40% sand, 40% silt, 20% clay).

This is a qualitative comparison of different soils based on the measurements and evaluations conducted thus far. The resulting point totals for each soil type are intended to indicate relative soil quality—the higher the total score, the better the soil quality.

Based on the recorded values and assessments, HC soil scored highest with 82 points, making it the top-quality soil. SPJ soil ranked second with 75 points, closely followed by DVT soil with 71 points. The remaining soil types scored lower: JPZ (68 points), SP (64 points), TLV (57 points), and at the bottom, JPG soil with 41 points.

Measurements of conductivity and hardness are often reliable indicators of soil quality, while pH values can sometimes be less dependable. Texture is also a relatively good quality indicator, as it provides insight into the percentage of sand, silt, and clay, which can then be compared with ideal values to classify soil type (e.g., sandy clay loam).

Additionally, determining the content of magnetic materials in the soil provides useful information about its potential fertility. Comparing measured conductivity and hardness values with those of HC soil allows for an estimation of how close another soil is to the ideal (see Pivhc in the table).

In summary, by ranking and scoring all the conducted measurements and evaluations, we can assess soil quality more reliably than by relying solely on individual parameters such as pH, conductivity, hardness, or moisture level. For this reason, the same simple yet informative method will be applied in upcoming evaluations, such as those measuring optical blackness, organic content, FeS_2 content, and overall chemical composition.

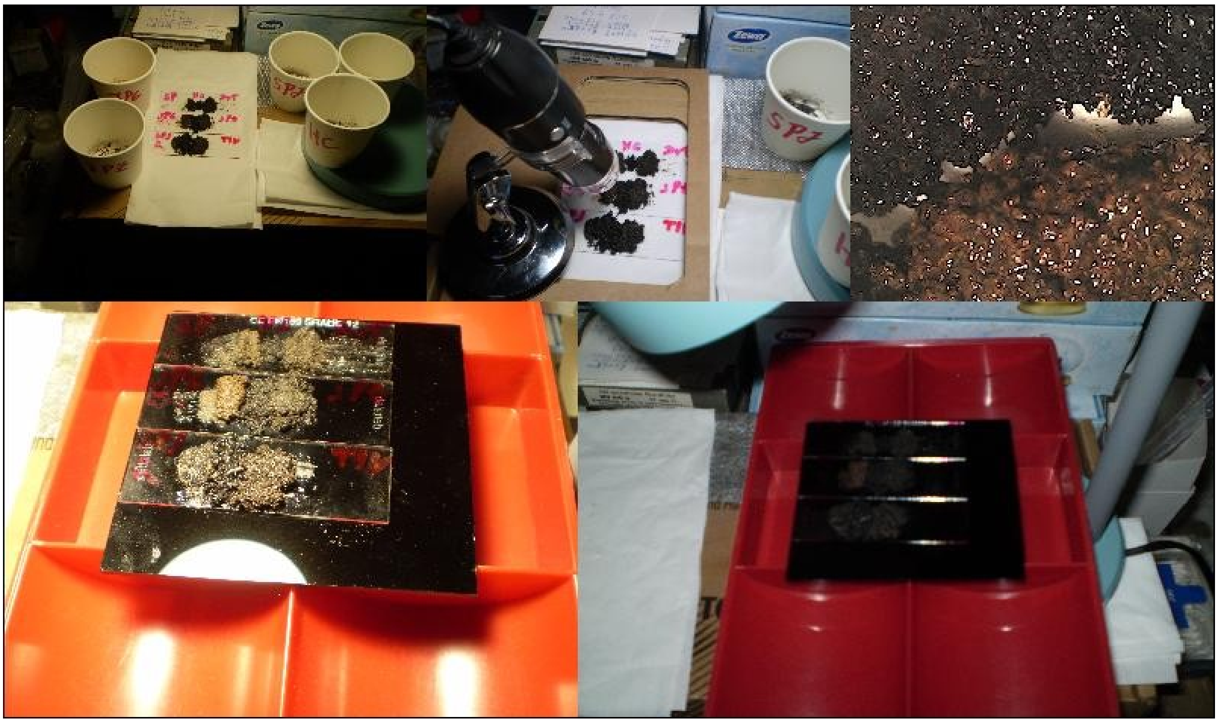
5.5.4.1.4.2 Evaluation of soil optical blackness

Using a qualitative method for evaluating the optical blackness of soil, we can estimate the carbon content present in the soil. Essentially, this involves visually comparing artificially produced humus soil (HC) with other soil types, since humus soils can contain around 60% carbon (C), making them appear extremely black. Natural soils, on the other hand, typically contain less carbon, and therefore range in color from grey, yellow, red, and brown to dark brown. In this context, evaluating the carbon content provides an additional indicator of soil quality.

The comparison of color differences between HC soil and other soils is a straightforward method to determine the relative darkness of the soil. This section presents a technique for assessing soil blackness through the preparation of pastes using immersion oil. Comparisons were made between HC and the following soil types: DVT, TLV, JPG, JPZ, SP, and SPJ.

Seven appropriately labeled containers were prepared, each containing one gram of a specific soil type. Then, 25 drops of immersion oil were added to each, and the mixtures were stirred with a glass rod until they formed a consistent paste. A sample of HC soil paste was applied to the center of each microscope slide, while pastes of the other soils were applied to the left and right sides of the HC sample.

In the final step, differences in blackness between HC soil and the other samples were evaluated using a 1 to 5 scale. A blackness score of 1 indicates that the tested soil contains a relatively low amount of carbon compared to the HC sample, while higher scores reflect a greater carbon content. These differences in soil blackness were assessed under strong lighting and observed with a USB microscope, as illustrated in the following image.



5.5.4.1.4.2.1 Figure 448: Technique for evaluating optical blackness between HC soil and other soils

Figure 448 illustrates the technique used to evaluate optical blackness between HC soil and other soils such as DVT, TLV, JPG, JPZ, SP, and SPJ. For optimal visibility of optical blackness, it is recommended to use a strong LED light and, if possible, a USB microscope with 1500x magnification, which allows for a more precise assessment of contrasts (see the top center and right side of the image).

The blackness of HC soil was rated with the highest score of five, while the other soils received lower scores in comparison. The lowest score, one, was given to JPG soil, which stood out due to its reddish-brown color. This score indicates the lowest carbon content, meaning this soil is of lower quality. The second-lowest score, two, was assigned to SP soil, which had a lighter grayish tint, also suggesting low carbon content and thus reduced soil quality.

DVT and TLV soils were each rated with a blackness score of three, indicating they contain more carbon than the previously mentioned soils. Based on this score, they can be classified as medium-quality soils. Finally, JPZ and SPJ soils received a score of four, showing they have higher carbon content and, therefore, belong to a higher quality class in terms of carbon presence.

In this context, humus soil (HC) can serve as a benchmark for assessing all other soil types. This qualitative method of evaluating soil blackness allows for a quick assessment of carbon deficiency, which in turn indicates reduced fertility and limits plant growth as well as the development of animals and microorganisms in and on the soil. A lack of carbon in soil leads to decreased biodiversity and, consequently, a reduction in overall biomass.

More precise carbon assessments can be made using other methods, such as thermal analysis, incubation, or extraction with chloroform. However, for the purpose of this study, the presented blackness evaluation technique is sufficiently effective.

The obtained blackness scores can be used as an additional input in the overall soil quality evaluation, as discussed in the previous subsection. These blackness ratings are translated into point values from one to seven:

- HC soil: 7 points
- JPZ and SPJ soils: 6 points each
- DVT and TLV soils: 4 points each
- SP soil: 2 points
- JPG soil: 1 point

5.5.4.1.4.2.2 Table 201: Scores achieved by individual soil types according to various measurements/assessments 2

Type	*Px*	*Pppm*	*Pvrphf*	*Pvrphn*	*Pvrphs*	*Pvrphpe*	*Psvl*	*Pmag*	*Ppro*	*Ptx*	*Pco3*	*Pgp*	*Pivhc*	*Ppiraz*	*Pc*	*Psvf*	*OC*	*SUM*
JPZ	3	3	7	1	6	2	7	3	6	4	3	5	6	6	4	2	6	74
JPG	1	1	3	7	1	7	1	4	1	5	2	3	1	2	1	1	1	42
SP	5	5	5	3	3	2	2	2	6	3	7	3	3	4	5	6	2	66
SPJ	6	6	1	3	2	4	4	7	6	6	6	7	5	5	4	3	6	81
HC	7	7	4	5	7	1	6	1	7	1	1	7	7	7	7	7	7	89
TLV	2	2	2	4	5	6	2	6	3	2	4	5	2	3	4	5	4	61
DVT	4	4	6	6	4	5	5	5	3	7	5	1	4	1	6	5	4	75

Table 201 presents the continuation of the overall soil quality assessment based on various measurements and evaluations, now including the number of points awarded for optical blackness (OB) of the soil. As can be seen, the ranking of soil quality has not changed.

HC soil remains the highest quality with 89 points, followed by:

- SPJ soil with 81 points,
- DVT soil with 75 points,
- JPZ soil with 74 points,
- SP soil with 66 points,
- TLV soil with 61 points,

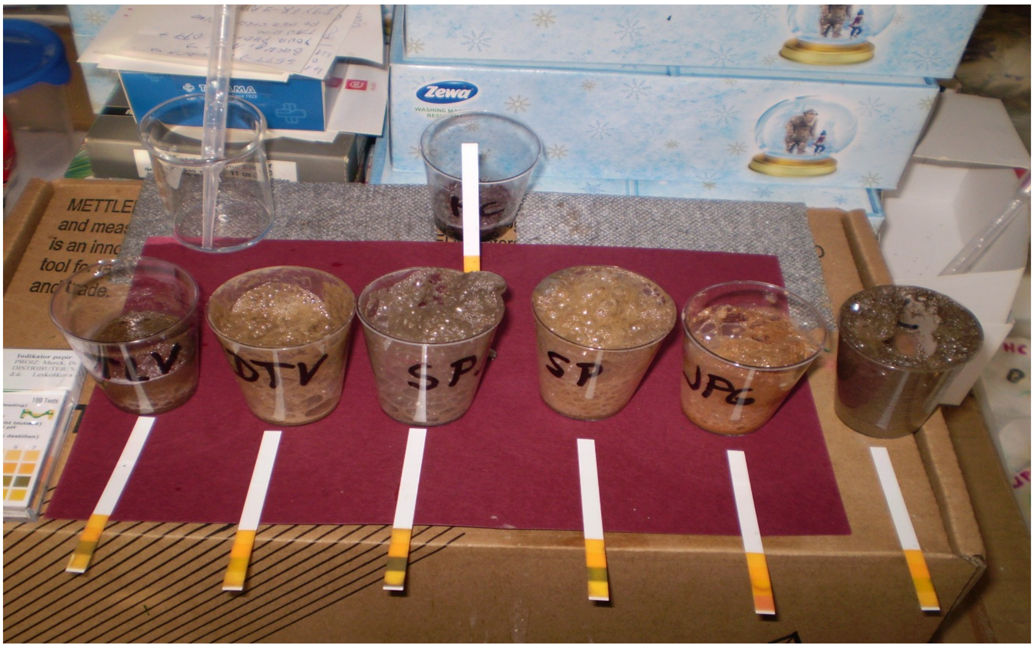
At the bottom of the ranking is again JPG soil, with 42 points.

5.5.4.1.4.3 Assessment of organic matter and pyrite in soils

This subsection presents a very simple soil test for evaluating the content of organic matter and pyrite (FeS_2) using a 30% hydrogen peroxide (H_2O_2) solution. Using an analytical scale, 1 gram each of HC, DVT, TLV, JPZ, JPG, SP, and SPJ soils was weighed into appropriately labeled containers. Upon the addition of 3 ml of 30% H_2O_2 solution to the tested samples, more or less vigorous exothermic chemical reactions occurred, during which some organic substances were decomposed and certain minerals oxidized.

A particularly vigorous reaction was observed in the JPZ soil, though it was short-lived. A similarly intense but slightly longer-lasting reaction occurred in the DVT soil. In the SP and SPJ soils, the initial reactions were mild but gradually intensified, and these two reactions lasted the longest. A rapid and vigorous reaction also occurred in JPG soil, again of short duration, similar to JPZ. TLV soil exhibited a less intense reaction, which was also shorter in duration. Surprisingly, the HC soil showed the least vigorous reaction, even though humus-rich soils typically contain large amounts of organic matter. This reaction was similar to that of TLV, though it lasted even less time.

Based on the intensity and duration of the reactions, we can roughly estimate the organic matter content in the soils. Due to their longer and more intense reactions, SP and SPJ soils can be assessed as having the highest amounts of organic matter in the form of plant residues, fungi, and bacteria. These are followed by DVT, JPZ, and JPG soils. A smaller amount of organic matter is estimated in TLV, and the lowest in HC soil. Subsequently, the pH values of these soils were tested using universal pH strips. The results are shown in the following image.



5.5.4.1.4.3.1 Figure 449: Assessment of FeS_2 in soils

Figure 449 shows the reactions of soils with H_2O_2 and the estimated pH values determined using universal pH strips. The results were as follows:

1. SP and SPJ reached a pH value of around 7 after the reaction, indicating that they did not contain FeS_2.

2. The estimated pH value for TLV soil after the reaction was around 6.5, suggesting that FeS_2 may be present in trace amounts. The same applies to HC soil.
3. For DVT and JPZ soils, the pH was estimated to be in the range of 5.5 to 6.0. This suggests the presence of a small amount of FeS_2.
4. Finally, JPG soil had a pH value in the highly acidic range of 3 to 4. This indicates a higher concentration of FeS_2 in JPG soil. During the chemical reaction of JPG soil with H_2O_2, a highly aggressive compound was formed — sulfuric acid (H_2SO_4). The chemical reaction is as follows:

$FeS_2 + H_2O_2 \rightarrow H_2SO_4 + Fe_2O_3 + H_2O$

In summary, the oxidation of pyrite results in the formation of acid sulfate soils, which have a detrimental effect on plant life, fungi, animals, and microorganisms — especially bacteria. Acid sulfate soils pose a particularly serious problem in agriculture and can negatively impact crop yields. Moreover, when FeS_2 is heavily exposed to water and oxygen, it can even damage buildings or structural components.[284] In small quantities, FeS_2 can be very beneficial for plants, as it promotes their fertility, increases chlorophyll content in the leaves, and boosts glucose levels in the fruit.

5.5.4.1.4.3.1 Table 202: Points achieved by individual soil types according to various measurements/assessments 3

Vrsta	*Px*	*Pppm*	*Pvrphf*	*Pvrphn*	*Pvrphs*	*Pvrphpe*	*Psvl*	*Pmag*	*Ppro*	*Ptx*	*Pco3*	*Pgp*	*Pivhc*	*Ppiraz*	*Pc*	*Psvf*	*OC*	*OOS*	*OP*	*SUM*
JPZ	3	3	7	1	6	2	7	3	6	4	3	5	6	6	4	2	6	4	3	81
JPG	1	1	3	7	1	7	1	4	1	5	2	3	1	2	1	1	1	3	1	46
SP	5	5	5	3	3	2	2	2	6	3	7	3	3	4	5	6	2	7	7	80
SPJ	6	6	1	3	2	4	4	7	6	6	6	7	5	5	4	3	6	7	7	95
HC	7	7	4	5	7	1	6	1	7	1	1	7	7	7	7	7	7	1	5	95
TLV	2	2	2	4	5	6	2	6	3	2	4	5	2	3	4	5	4	2	5	68
DVT	4	4	6	6	4	5	5	5	3	7	5	1	4	1	6	5	4	5	3	83

Table 202 shows the scores achieved by individual soil types based on various measurements and evaluations, including assessments of organic matter and pyrite content. The ranking of soil quality based on these new evaluations did not change significantly, with the exception that HC and SPJ soils now share first place with 95 points. In third place is DVT soil with 83 points, closely followed by JPZ soil with 81 points and SP soil with 80 points. TLV soil scored only 68 points, and JPG soil scored even less, with 46 points. When evaluating FeS_2, it should be noted that soil should not contain excessive amounts of this substance, as, as previously mentioned, it negatively affects

284 Penner, E., Eden, W. J., & Grattan-Bellew, P. E. (1972). Expansion of pyritic shales. *Canadian building digest*, 152, 1-4. Gl. tudi URL: https://www.americangeosciences.org/critical-issues/faq/how-do-pyrite-and-pyrrhotite-damage-building-foundations (2022-11-01).

plants, animals, and microorganisms. For this reason, soils with lower FeS_2 content were awarded higher scores, while those with higher levels of this compound received lower scores.

5.5.4.1.4.4 Assessment of salinity and chlorination in soil decantates

In a broader sense, salinity refers to the concentration of salts excluding carbonates in water or soils. In marine waters, salinity is primarily measured based on NaCl, as this is the most dominant salt. In other, less saline or drinking waters, the focus shifts to the total quantity of various salts. Salinity is classified by cause into three categories: natural, dryland, and irrigation-induced salinity. The most common unit for measuring salinity is ppt (parts per thousand), meaning grams of salt per kilogram of the total sample (g/kg) or per mille (‰).

This subsection will present salinity measurements in soil filtrates. In a 150 ml beaker, 20 grams of dried and sieved soil will be weighed, after which 100 ml of distilled water will be added to each sample to create a suspension. These suspensions will be mixed on a magnetic stirrer for 20 minutes. After mixing, the samples will rest on a tray for 24 hours to allow coarse and insoluble particles to settle. Then, the salinity of the soil decantates will be measured in ppt units.

During this resting period, the chlorine content in the soil decantates will also be evaluated using a pool water tester, with results expressed in mg/l. Chlorination of soil can lead to the destruction of beneficial microorganisms, although it may also eliminate certain pests. If the chlorine concentration in soils exceeds 0.2 mg/l, it can be considered contamination, which is harmful to plants, animals, and microorganisms.

5.5.4.1.4.3.2 Figure 450: Assessment of chlorination and salinity in soil decantates

Figure 450 illustrates both tests, where chlorination (see the left side of the image) and salinity (see the right side of the image) of the soil decantates were assessed. The chlorine tester, typically used to evaluate pH and chlorine levels in aquarium water, was adapted for use in this experiment. The right chamber of the tester was filled with the soil decantate, followed by the addition of the appropriate reagent or tablet. To minimize interference during the reaction, the container was sealed with a rubber cap.

After 15 minutes, the color of the decantate was compared with the color scale on the front of the container, which indicated the concentration of chlorine in the soil decantate in mg/l.

The salinity of the soil decantates was measured using a Greisinger multimeter, previously used for conductivity measurements. Since the soil samples were prepared at a 1:5 ratio (soil to water), the obtained results had to be converted to a 1:1 ratio. Although such conversions usually depend on soil texture, a conversion factor of 7.5 was used in this case. This factor is standard for converting conductivity from a 1:5 to a 1:1 ratio.[285] Given that this test is more of an estimation, the same conversion factor will also be applied to the salinity values. The results of the measurements, or rather the assessments of chlorination and salinity in the soil decantates, are presented in the following table.

5.5.4.1.4.3.3 Table 203: Measurements/estimates of soil chlorination and salinity

Type	*Cl (mg/l)*	*Sl 1:5 (ppt)*	*Sl 1:1 (ppt)*	*χ 1:5 (µS)*
JPZ	0.20	0.10	0.75	180.20
JPG	0.10	0.00	0.00	47.90
SP	0.10	0.10	0.75	155.40
SPJ	0.10	0.20	1.50	223.00
HC	0.10	1.30	9.75	2390.00
TLV	0.20	0.10	0.75	122.30
DVT	0.20	0.10	0.75	153.20

Table 203 presents the measurement results for the estimated chlorination and salinity levels in the soil decantates. It can be observed that the concentration of chlorine in the soils is only present in trace amounts and does not exceed 0.2 mg/l. The HC1:1 soil sample contains the highest amount of salt (9.75 g/kg or 9.75 ppt). This is followed by the SPJ1:1 soil, which contains 1.5 ppt of salt. The third group includes JPZ1:1, SP1:1, DVT1:1, and TLV1:1 soils, all with values of 0.75 ppt. The lowest result, 0 ppt, was recorded for the JPG1:1 soil sample. Similar findings were noted in the conductivity measurements.

285 Seo, B.-S., Lee, K.-S., Park, H.-J., Jeong, Y.-J., Baek, N., Lee, S.-I., Yoon, K.-S., & Choi, W.-J. (2022). Conversion factors for electrical conductivity of 1:5 soil-water extracts to saturated paste of reclaimed tideland soils are affected by sand contents. *Korean Journal of Soil Science and Fertilizer*, 55(3), 251–260. https://doi.org/10.7745/kjssf.2022.55.3.251.

Given the small differences in chlorination levels in the soil decantates, an overall soil quality assessment based on chlorination will not be performed. The same applies to salinity in the decantates, where values—except for HC and JPG soils—do not vary significantly. Furthermore, it can be concluded that conductivity measurements in this case provide a more informative insight into the mineral content of the soils.

We will now proceed with the analysis of nitrogen, phosphorus, and potassium composition in the soils using colorimetric comparison and titration methods. These analyses will make it possible to estimate the concentration of total nitrogen, phosphorus, and potassium, as well as individual ions in mg/l, such as Fe^{2+}, Cu^{2+}, Ca^{2+}, Mg^{2+}, K^+, SiO_2, NH_4^+, NO_2^-, NO_3^-, PO_4^{3-}, and SO_4^{2-}. Additionally, the concentrations of O_2 and NH_3, as well as the carbonate hardness in the soil filtrates, will be determined. The soil filtrate analyses were conducted using commercial test kits typically used for aquarium water testing, while the total NPK content was measured using a field testing kit designed specifically for soils.[286]

5.5.4.1.4.5 Analysis of pH, nitrogen, phosphorus, and potassium in soils

Elements such as nitrogen (N), phosphorus (P), and potassium (K) are of critical importance for soil fertility and, consequently, essential for the survival of many living organisms—plants, algae, fungi, microorganisms, and animals, including humans. These elements, collectively known as NPK, are foundational to the production of chlorophyll, plant metabolism, nutrient processing (N), root system development (P), and the activation of enzymes and growth processes (K). In short, NPK serves as both the mesocosmic and microcosmic basis for the formation of effective food webs.

The ideal ratio of NPK in soil is approximately 3 N : 1 P : 2 K; however, farmers and gardeners often use a 20 N : 20 P : 20 K ratio. No plant species is known to survive without NPK. Therefore, it is crucial that soil contains an optimal amount of NPK, allowing these nutrients to reach plant systems (roots, stems, flowers, and fruits) through water transport.

In sandy soils, there is a risk that due to poor water retention, potassium ions may be leached out, meaning only a small amount reaches the plant roots—or the plant at all. Desert soils often lack components like NPK and organic matter, making them relatively infertile. Such soils typically have high pH values and a high percentage of clay content.

Soils with excessively high levels of NPK are known to attract large numbers of insects, which can lead to the spread of various plant diseases. Furthermore, excessive NPK levels can cause plants to grow too quickly, weakening stems and making them less stable. In this context, we are again faced with a strictly defined determinism that governs the allowable range of NPK values in soil for

286 The analyses were performed with special commercial kits such as NPK farm 40, Hanna soiltest, Zoolek, JBL Aquatest, etc.

optimal plant growth. Nitrogen (N) appears in soils in various forms, including organic and inorganic nitrogen compounds such as ammonium cations ($(NH_4)^+$), ammonia (NH_3), nitrites (NO_2^-), and nitrate anions ($(NO_3)^-$). Phosphorus (P) appears in both organic and inorganic compounds, such as phosphorus pentoxide (P_2O_5), while potassium (K) appears only in inorganic compounds, either in available forms (K^+, e.g., K_2O), bound to certain minerals, or in unavailable forms that are more tightly bound. It is also important to mention the beneficial interactions between NPK and microorganisms, which can act as facilitators and consumers of these nutrients. For example, certain soil bacteria can convert atmospheric nitrogen into usable nitrates, and insoluble phosphorus and potassium into soluble forms. Additionally, bacteria need potassium to strengthen their cell membranes. Rainfall also plays a vital role, as it contains nitrogen, phosphorus, potassium, and other nutrients like calcium, magnesium, and sodium. In a broader sense, climate conditions significantly influence the composition of soil nutrients and the fertility of microbial life, especially beneficial bacterial networks and fungi. All of this reveals strong interconnections between the micro- (e.g., ions, microorganisms), meso- (e.g., soil-rain contact, animals, plants), and macrocosmic levels (e.g., cloud formation, sunlight). The positive outcome of these connections can be observed as an increase in biomass on our planet. In a negative scenario (e.g., excessive rainfall), nutrient leaching may occur, leading to reduced biomass. Before the NPK measurements in the seven soil types are presented, the procedure for NPK analysis will briefly be outlined for better understanding.

5.5.4.1.4.6 Figure 451: Analysis of colors and turbidity of NPK in soils

Figure 451 shows the kit used for analyzing the color and turbidity of NPK in soils, which includes reagents for determining pH, nitrogen (N), phosphorus (P_2O_5), and potassium (K_2O). On the left side in the background of both images, we can see the soil samples that were previously discussed. In addition to the reagents, the kit also contains test tubes for preparing the samples, droppers, and color cards.

The basic principle of these analyses is based on matching the color reactions (for nitrogen and phosphorus) and turbidity (for potassium) between the decantates and the test reagents, which are checked using color scales. The results of the analyses are expressed in descriptive terms based on the NPK content, such as “trace,” “low,” “medium,” and “high.”
Colorimetric analysis was used to determine the nitrogen and phosphorus content, while turbidity assessments, based on a corresponding card with white and black samples, were used to evaluate potassium. These are simple analyses or assessments of the NPK content in soils. The most important factor in these assessments is that the light falls on the sample from the back, and that the room's lighting is appropriate (preferably in natural light). The human eye is not always the most reliable evaluator of color nuances, so it is recommended to trust experience when performing these assessments. The results were as follows:

5.5.4.1.4.6.1 Table 204: NPK estimates in seven different soil types and pH measurements

Type	*N (NO3)*	*mg/Kg*	*P (P2O5)*	*mg/kg*	*K (K2O)*	*mg/kg*	*pH*	*Phf*
JPZ	h	> 40	t	0 - 5	m	15 - 39	6.50	6.49
JPG	t	0 - 5	t	0 - 5	t	0 - 5	4.50	5.52
HC	h	> 40	m	15 - 39	h	> 40	7.00	6.36
DVT	l-m	10 - 15	m	15 - 39	m	15 - 39	6.50	6.52
TLV	m	15 - 39	t	0 - 5	t	0 - 5	6.50	6.26
SP	m	15 - 39	t	0 - 5	m	15 - 39	6.50	6.67
SPJ	m	15 - 39	t	0 - 5	l	5 - 10	7.50	7.31

Table 204 presents descriptive ratings of NPK in seven different soil types with the labels h, m, l, and t. Intermediate ratings (e.g., l-m) are possible for nitrogen and phosphorus, but not for potassium. In addition to descriptive ratings, mass concentration values in mg/kg are also shown. Based on these ratings, we can conclude that JPG soil chronically contains insufficient nitrogen, phosphorus, and potassium (0–5 mg/kg). The JPZ sample, taken approximately 100 meters from the JPG location, contains a high amount of nitrogen (> 40 mg/kg), a very low amount of oxidized phosphorus (0–5 mg/kg), and a medium amount of oxidized potassium (15–39 mg/kg). HC soil, as a representative of artificial soil, contains a high amount of nitrogen (> 40 mg/kg), a medium amount of phosphorus (15–39 mg/kg), and a high amount of potassium (> 40 mg/kg). The garden soil representative, DVT, contains a low to medium amount of nitrogen (10–15 mg/kg), a medium amount of oxidized phosphorus (15–39 mg/kg), and a medium amount of oxidized potassium (15–39 mg/kg). Another garden soil representative, TLV, contains a medium amount of nitrogen (15–39 mg/kg), an extremely low amount of oxidized phosphorus (0–5 mg/kg), and also a low amount of oxidized potassium (0–5 mg/kg). Forest riparian soil, SP, contains a medium amount of nitrogen (15–39 mg/kg), an extremely low amount of phosphorus oxide (0–5 mg/kg), and a medium amount of oxidized potassium (15–39 mg/kg). The lakeside soil, SPJ, with a sample taken approximately 10 meters from the SP location, also contains a medium amount of nitrogen (15–39 mg/kg), but a much lower amount of oxidized phosphorus (0–5 mg/kg) and a low amount of oxidized potassium (5–10 mg/kg).

As an addition to these analyses, the pH values of the soils were determined using colorimetric assessment and a pH meter. With the exception of JPG (pHf = 5.52; pH = 4.5), the pH values were within normal limits, ranging from 6.5 to 7.31. In soils (JPG and partly also DVT) where nitrogen is lacking, we can conclude that beneficial bacterial colonies have less influence on nitrate production, which can negatively affect the formation of optimal chlorophyll levels, nutrient processing, and the optimal metabolism of these substances in plants. The lack of oxidized phosphorus in the soils (JPZ, JPG, TLV, SP, and SPJ) can cause disturbances in the development of plant root systems. In the case of a deficiency of oxidized potassium in the soils (JPG, TLV, and SPJ), the process of enzyme activation and plant growth can be seriously compromised. This also negatively impacts the development of animal life and various microorganisms, with bacteria and fungi leading the way. In this food web, where chemical compounds promote the positive growth and development of these living organisms, humans are also included, as their dependency on the plant world is immense.

This will be followed by more detailed analyses of individual molecules (e.g., NH3, O2), cations (e.g., K+, Ca^{2+}), and anions (e.g., PO_4^{3-}, SO_4^{2-}, NO_3^-) in the soils. As a first step (similar to previous analyses), a visual representation of such analyses with filtrates from different soil types will be presented.

5.5.4.1.4.6.2 Figure 452: Analysis of color and turbidity of soil filtrates

Figure 452 shows kits for analyzing the color and turbidity of molecules, anions, and cations in soil filtrates with a concentration of 5 g + 100 ml H2O. The kit contains reagents for evaluating the concentration of various ions and molecules in mg/l based on simple analyses that allow color changes to be assessed using titration and/or comparative colorimetric methods, as well as turbidity (e.g., evaluating the concentration of sulfate and potassium ions). Before presenting the results or assessments from the analyses, it would be useful to first describe the impact or significance of individual molecules and ions for soil and, consequently, for living organisms such as plants, animals (including humans), and microorganisms.

a. Calcium (Ca^{2+}, Ca^{0}):

These cations contribute to the aggregation of inorganic and organic particles in soils, which can improve soil structure. Another beneficial function of Ca^{2+} cations is that they act as an additional nutrient, enabling a more optimal pH balance on a given surface. Otherwise, acidic cations and anions would dominate. This is crucial for the growth and development of many plant species, as plants require Ca^{2+} cations to form cell walls and membranes. A deficiency of Ca^{2+} cations in soils leads to reduced growth, rotting, poor water permeability, and premature flower drop in plants. Besides water, plants are the most important producers of food, which sustains animals (vertebrates, invertebrates, insects, etc.), microorganisms (e.g., bacteria, fungi), and humans. Calcium also has significant neurophysiological importance (e.g., skeleton, teeth, transmission of signals to muscles, electrical signal conduction through axons, metabolism, cell growth). Calcium, in its elemental and cationic form, also significantly impacts our climate, as mountains contain many calcium minerals that help stabilize the temperature of our atmosphere, preventing excessively low temperatures on our planet. A drastic decrease in calcium levels in oceans and other water sources could trigger water acidification, negatively affecting numerous aquatic plants, animals, and microorganisms. As we can conclude, the importance of calcium is not only related to soils and living organisms but also to the stability of our planet and atmosphere.

b. Magnesium (Mg^{2+}, Mg^0):

Magnesium activates certain enzymatic systems and, as a central element in chlorophyll, ensures proper photosynthetic processes, which, in turn, affects plant growth. Magnesium is important not only for the plant world but also for animals, microorganisms, and humans. It is needed in the diet of living organisms due to its role in cellular metabolism and bone development, as well as preventing various diseases. Mg^{2+} cations are essential for bacterial growth and the maintenance of their cells. Additionally, Mg^{2+} cations play a key role in nerve impulse transmission and proper conductivity between muscles and nerves. Like calcium, magnesium helps prevent excessively acidic pH values in oceans and other water sources. A drastic reduction in magnesium on our planet could lead to climate change, similar to the drastic reduction of calcium.

c. Iron (Fe^{2+}, Fe^0):

Iron improves nutrient absorption in plants and moisture retention in soils. In appropriate concentrations, it stimulates plant growth and contributes to the optimal greening of lawns and certain trees. Iron is an important micronutrient for numerous organisms, as it facilitates basic cellular processes such as respiration, oxygen transport in the blood, photosynthesis (better oxygen transport through roots and leaves), nitrogen fixation, and nitrate reduction. Iron in the Earth's outer core is an excellent conductor of electrical currents, which drives the magnetic field that protects our planet from macrocosmic dangers. In short, iron is extremely important for a variety of existential natural processes, such as gravity, induction, etc., and thus also influences our seasons, climate, and atmospheric conditions.

d. Copper (Cu^{2+}, Cu^0):

The proper concentration of Cu^{2+} in soils is crucial for carrying out various enzymatic reactions in plants, chlorophyll production, and seed formation. In addition to plants, other living organisms need Cu^{2+} cations, e.g., for the color of red blood cells, maintaining healthy nerve cells, and supporting the immune system. Copper is vital for renewable energy technology, which is necessary to prevent more severe climate change. Additionally, copper impacts our atmosphere by reducing carbon emissions. Excessive concentrations of copper can be lethal to microorganisms and mollusks and degrade soil quality.

e. Potassium (K^+, K^0):

The importance of potassium has been previously discussed in the subsection on KCl and NPK. K^+ cations in soils contribute to better plant growth and increase resistance to drought, which, in turn, reduces dehydration and wilting of plants. K^+ cations also contribute to photosynthesis and food production. In short, potassium influences the movement of water, nutrients, and carbohydrates in plant tissue. Potassium is crucial for the functioning of bodily organs and nervous systems. The presence of potassium has a significant impact on living nature, though its effects on the non-living environment are less exposed and studied.

f. Silicon (Si^{4+}, SiO_2, Si^0):

Silicon atoms and ions strengthen soil structure, providing a better foundation for plant growth. Adequate silicon content in the soil can protect plants from harmful insects, diseases, and enhance their defense system, which increases tolerance to environmental stress factors. Silicon has been found in connective tissue and skin in the human body. It is believed to contribute to the production of antibacterial and antifungal compounds that prevent infections. All higher living organisms contain a significant amount of trace silicon, and it is also found in microorganisms such as bacteria and fungi. At present, it is known that silicon is not essential for living organisms, but it influences the stabilization of organic carbon in the soil, thereby preventing climate change. Due to the widespread presence of silicon in the Earth's crust, our planet provides stable foundations, and silicon is also common in the macrocosm. Pure silicon is a semiconductor, which means it can be both an excellent insulator and a good conductor of electricity and heat. SiO_2 is an excellent electrical insulator and a poor heat conductor. Based on this, we can hypothesize that silicon impacts the strength of Earth's electrical and magnetic fields, preventing them from becoming either too highly charged or magnetized.

g. Ammonium (NH_4^+):

Ammonium is one of the main sources of nitrogen that plants require for better growth and development. $(NH_4)^+$ is a primary component in the production of nitrogen fertilizers (e.g., NH_4NO_3). Plants most frequently and intensively use nitrogen in its ammonium and nitrate forms. $(NH_4)^+$ cations in soils can help control pests such as certain types of bacteria and fungi. Furthermore, $(NH_4)^+$ cations can reduce soil acidity and improve the soil’s water retention capacity. In excessive concentrations, $(NH_4)^+$ cations can be harmful to soils, living organisms, and air quality, potentially contributing to environmental pollution. The concentration of $(NH_4)^+$ cations can affect climate and even contribute to climate change. When reacting with other pollutants, they can form aerosols that reduce the influx of sunlight, thus lowering the Earth's surface temperature. $(NH_4)^+$ cations can increase ozone (O_3) production, thereby enhancing the greenhouse effect, which contributes to global warming. $(NH_4)^+$ cations do not directly affect the geodynamics of our planet, but their impact is indirect through chemical and biological processes.[287]

h. Ammonia (NH_3): This is a chemical compound in its gaseous state, which is highly hygroscopic and forms $(NH_4)^+$ cations in the form of the base NH_4OH when it binds with water. The effect of NH_3 on soil, the atmosphere, and the climate is similar to that of $(NH_4)^+$ cations, but with the significant difference that NH_3 can spread more quickly through space. NH_3 is an extremely widespread chemical compound in the universe, as it has been discovered in the atmospheres of planets (e.g., Neptune, Saturn, Jupiter), asteroids, and stardust.

i. Molecular Oxygen (O_2): Molecular oxygen is a highly significant factor that can influence the physical, chemical, and biological properties of soil. It can increase the availability of nutrients for plants, decompose organic matter, and sustain various microorganisms. The concentration of oxygen in the atmosphere has a significant effect on our climate, which in turn affects climate change. Oxygen's presence in both soil and the atmosphere impacts the geodynamics of our planet (e.g., weathering processes, erosion, the formation of new minerals, altered rock properties, and changing biological processes). Its effect on electromagnetic fields is likely indirect and less researched or understood.

j. Nitrite Molecule or Nitrites (NO_2): Nitrites form when bacterial colonies are less numerous and/or disorganized, leading to a decrease in the concentration of beneficial nitrates. This can negatively impact plant life and other organisms. While nitrites are less biologically accessible, they can be converted into nitrates, which are essential nutrients for plants and positively affect their growth. Excessive concentrations of nitrites in the soil can result in acidic pH values, which negatively affect microorganisms and plants. Nitrites, as a potential nitrogen source, can influence climate conditions and changes, as they can enhance the greenhouse effect and pollute the environment. The excessive presence of nitrites can impact the geodynamics of our planet (e.g., tectonic plate movements, magma flow, nitrogen cycle efficiency, and the chemical composition of Earth's surface).

k. Nitrates ($(NO_3)^-$): Nitrates are essential nutrients for plant growth and development. They are a crucial component of plant proteins, necessary for synthesizing amino acids. $(NO_3)^-$ can improve photosynthesis efficiency in plants, positively influencing their growth. Nitrates are also excellent fertilizers that improve yields and enhance plant immunity, helping them resist diseases and pests. Additionally, nitrates increase plant drought resistance. However, nitrates can cause environmental problems, such as water, soil, and air pollution, and even climate change as a byproduct of physical-

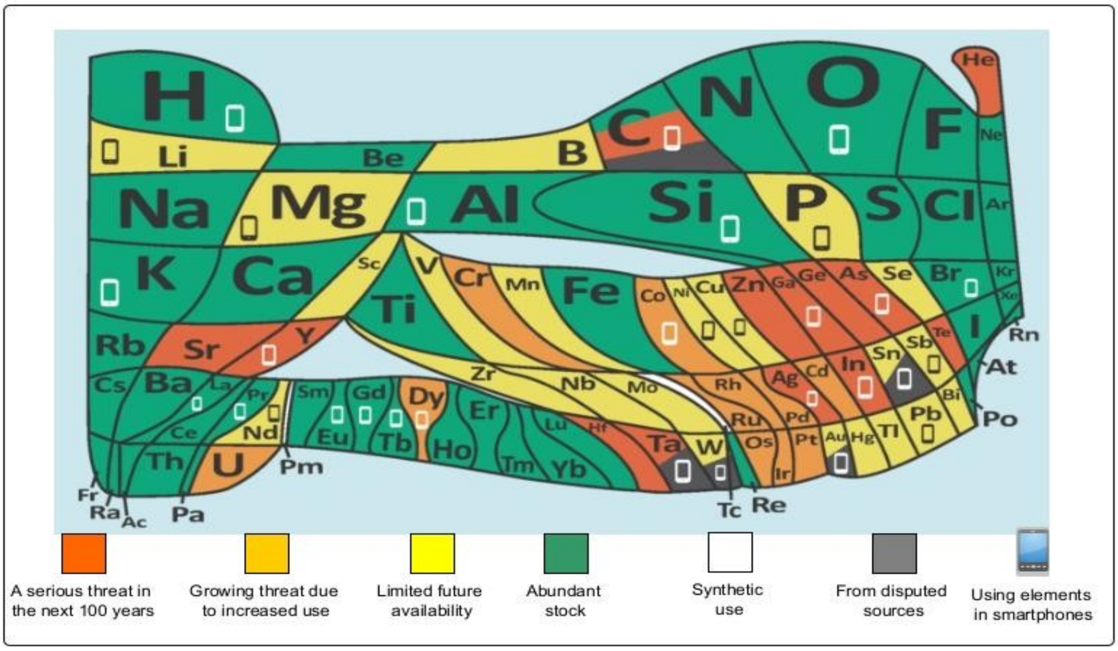
287 The description for ammonium cations, ammonia, oxygen, nitrites, etc. is partly based on the open AI Chat gpt: OpenAI CHATGPT-3 chatbot. OpenAI. (2022, December 30). Retrieved December 31, 2022, from https://openaibot.chat/

chemical reactions, such as nitrogen oxide (NO). Nitrites may also affect geodynamics in the denitrification process, where nitrates are converted into nitrogen gas (N_2). This process is facilitated by certain bacteria in soil and aquatic environments. $(NO_3)^-$ can influence geodynamics if they react with other substances like sulfur, chlorine, etc. The direct effect of $(NO_3)^-$ on electromagnetic fields is likely indirect through the nitrogen cycle. Nitrates are also found in the macrocosm (e.g., comets, planets).

l. Phosphates ($(PO_4)^{3-}$): Phosphates, like $(NO_3)^-$, are vital nutrients for plant growth and development, particularly for root system growth. $(PO_4)^{3-}$ also improves plant health and resistance to pests and drought stress. While $(PO_4)^{3-}$ can positively affect the environment by enriching the soil, they can also negatively affect the environment, such as causing harmful algal blooms and threatening aquatic life. The reckless use of $(PO_4)^{3-}$ as fertilizer can contribute to climate change. Phosphate mining can also improperly affect the climate and geodynamics of our planet. $(PO_4)^{3-}$ are widespread in the macrocosm, found on planets, moons, and in interstellar space and gaseous clouds. $(PO_4)^{3-}$ anions are unlikely to have direct effects on electromagnetic fields, but indirect effects are possible (e.g., phosphate as a component in an electrical conductor).

m. Sulfates ($(SO_4)^{2-}$): In excessive concentrations, these anions have a very harmful effect on plant life. While the presence of $(SO_4)^{2-}$ in soil can be beneficial for plants, some animals, and microorganisms, $(SO_4)^{2-}$ can improve the structure of clay soils by increasing air and water permeability. Additionally, they provide sulfur to plants, which is necessary for the formation of proteins, enzymes, and vitamins. The presence of $(SO_4)^{2-}$ in soil can lower pH and inhibit the growth of certain pathogens, benefiting some crops. At appropriate concentrations, $(SO_4)^{2-}$ can enhance the availability of phosphorus in the soil. However, $(SO_4)^{2-}$ can also contribute to soil, air, and water pollution. Excessive concentrations of $(SO_4)^{2-}$ can lead to climate change, such as global warming. $(SO_4)^{2-}$ can impact various geodynamic processes, which may cause unfavorable changes in the structure and composition of Earth's crust. $(SO_4)^{2-}$ are important components in the solar system and may contribute to the formation and development of celestial bodies (e.g., comets, planets, moons, asteroids). $(SO_4)^{2-}$ can also affect electromagnetic fields by increasing the conductivity of certain materials and their magnetic properties. Some $(SO_4)^{2-}$ are paramagnetic and can be magnetized. $(SO_4)^{2-}$ may influence the way electrical charges are stored and released in dielectric materials.

Through brief descriptions of ions and molecules, we have learned that they not only affect the mesocosmic level but also exert indirect and direct effects on the microcosm and macrocosm. They play a role in strengthening soil structure and providing essential nutrients for living organisms, especially plants, but they can also contribute to climate changes, gravity, induction, and the strength of electromagnetic fields on our planet. A similar understanding can be drawn from the subsection on chemical compounds or solutions (e.g., $CaCO_3$, NaCl, $FeSO_4$). It would be useful to present the relative abundance of ions and molecules in the soil next. The relative content of ions and molecules in the soil on our planet can vary significantly depending on various factors, including soil type, local climate, and the species of plants and animals in the area. Generally, the most common ions in the soil are cations (e.g., Ca^{2+}, Mg^{2+}, K^{+}), which are essential nutrients for plants. Common anions in the soil include chlorides (Cl^{-}), sulfates $(SO_4)^{2-}$, and nitrates $(NO_3)^{-}$. In addition to ions, various molecules can be found in the soil. These include organic molecules such as carbohydrates, lipids, and proteins, as well as inorganic molecules such as water (H2O), carbon dioxide (CO_2), and oxygen (O_2). The relative abundance of these molecules can differ and often change due to factors such as soil type, carbonate hardness of rainfall, and local climate. On our planet, the relative abundance of elements might look approximately as follows:



5.5.4.1.4.6.3 Figure 453: Relative abundance of elements on earth and associated threats

Figure 453 illustrates the relative abundance of chemical elements on our planet, as well as potential future threats related to shortages of these elements. Additionally, the figure uses color coding to show the richness of reserves, synthetic usage, controversial sources, and the role of these elements in smartphones. A significant threat over the next 100 years could stem from the reckless use of carbon resources, which may disrupt the carbon cycle—a vital regulator of photosynthesis, the process that supports plant life. Excessive CO_2 emissions in both the atmosphere and soil could further intensify global warming, posing serious harm to numerous living organisms. Similarly concerning is the irresponsible use of carbon from fossil fuels for military purposes, which could drastically reduce the planet's biomass. A modified periodic table of elements highlights other issues as well, such as the depletion of magnesium—particularly in connection with its use in smartphones (see yellow field). For now, magnesium is still considered a relatively abundant element. As previously mentioned, magnesium cations are essential nutrients for living beings and play a critical role in neurophysiology. Magnesium atoms are also central to the chlorophyll molecule, which is vital for photosynthesis. No less alarming is the limited availability of phosphorus in the future (see yellow field), without which plants, in particular, cannot survive. As with magnesium, excessive use of phosphorus in smartphone production is not only unsustainable but also harmful to the future of global biomass. These are three extremely important and necessary elements—carbon, magnesium, and phosphorus—that make significant contributions to the existence and development of biomass on Earth.[288] From this perspective, we once again encounter hierarchical associative networks across the micro-, meso-, and macrocosmic levels, which are, on the one hand, strictly deterministically organized, but on the other hand, show a significant degree of stochastic organization from our point of view. The described composition of elements, ions, and molecules essentially reflects the existence of the living organic world. The makeup of the previously discussed ions and molecules in the soil, along with the widespread elements on our planet, creates the necessary conditions for the existence of living organisms. We now continue with the results of the colorimetric/titration analyses of the previously mentioned ions and molecules.

5.5.4.1.4.6.4 Table 205: Results of ion and molecule concentrations in soils

Type	*Ca^{2+}*	*Mg^{2+}*	*Fe^{2+}*	*NO_2*	*NO_3^-*	*NH3*	*NH_4^+*	*PO_4^{3-}*	*K^+*	*SiO_2*	*Cu^{2+}*	*O2*	*SO_4^{2-}*
SP	20	3	0	0	7.5	2	0.2	0.25	2	2	<0.05	4	0
SPJ	30	6	0.2	0	2	3	0.05	0.13	3.7	>6	<0.05	8	25
JPG	10	3	50.00	0.012	0	0	0.05	0	0	<0,1	<0.05	8	60
JPZ	15	3	25.00	0.012	0.5	0	0.05	0.13	1	2	<0.05	8	0
DVT	10	3	10.00	0.050	0	1	0.05	0.75	4.5	>6	<0.05	8	25
TLV	15	3	0	>1	0	0.5	0.05	1	2.3	>6	<0.05	4	0
HC	215	6	0	0	35	0	0.05	0	15.5	0.2	<0.05	8	150

Table 205 presents the results of ion and molecule concentrations (in mg/L or ppm) found in various soil filtrates. Particularly low values are observed in the JPG soil sample, including for Ca^{2+} (10 mg/L), Mg^{2+} (3 mg/L), Fe^{2+} (0.050 mg/L), NO_3^- (0 mg/L), NH_4^+ (0.050 mg/L), PO_4^{3-} (0 mg/L), K^+ (0 mg/L), Si^{4+} (<0.1 mg/L), and NH_3 (0 mg/L). However, it does contain potentially harmful concentrations of NO_2^- (0.012 mg/L) and SO_4^{2-} (60 mg/L).

288 Image from the following source: EuChemS. (2019). EuChemS periodic table. Accessed at: https://www.euchems.eu/periodic-table/.

Especially critical for the health of plants, animals, and microorganisms are the low concentrations of Mg^{2+}, NO_3^-, PO_4^{3-}, K^+, and Si^{4+}, along with the disproportionately high concentration of SO_4^{2-} ions. Conductivity and Total Dissolved Solids (TDS) measurements indicate that the JPG soil filtrates have the lowest values overall. Due to the high concentration of SO_4^{2-} anions, this soil is quite acidic, which is unfavorable for many plant species as well as beneficial bacteria and fungi.
It is important to note that in dry JPG soil, FeS_2 (pyrite) predominates rather than SO_4^{2-} anions. SO_4^{2-} only forms when water reacts chemically with FeS_2, producing H_2SO_4 (sulfuric acid).
Tree species such as Norway spruce, beech, and oak were observed growing at this site. For optimal development, Norway spruce requires a soil pH between 5.5 and 6.0 but can tolerate a pH range from 4.5 to a maximum of 6.5.[289] The pH value of the JPG soil was slightly above 5, which is still suitable for the growth of Norway spruce. In addition to an appropriate pH, successful growth and development of Norway spruce also require adequate concentrations of essential nutrients such as nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur.
It was found that the JPG soil at this location lacks adequate concentrations of nitrogen, phosphorus, potassium, and magnesium. The calcium concentration was also at the lower limit of acceptability. For successful growth and development, beech trees require a soil pH between 6.0 and 7.0, although they can also tolerate soils with pH values ranging from 5.0 to even 8.0.[290] Beech trees require adequate concentrations of nitrogen, phosphorus, and potassium, along with smaller amounts of zinc (Zn), iron (Fe), and copper (Cu). While beech is still able to grow at this location, the soil conditions are not optimal for its long-term survival.
Similar to beech, oak is relatively tolerant of lower soil pH levels, with an optimal range between 6.0 and 7.0, and a tolerance range from 4.5 to 7.5. The same applies to nutrients—the soil should contain optimal amounts of nitrogen, phosphorus, and potassium, as well as smaller amounts of Zn, Fe, and Cu. The JPG soil is also less favorable for optimal oak growth and development.
Notably high concentrations of ions and molecules were observed in the HC soil, which is extremely rich in carbon and contains high levels of Ca^{2+} (215 mg/l), K^+ (15.5 mg/l), and SO_4^{2-} (150 mg/l). This soil provides a favorable base for planting lemons, oranges, and grapefruits.

289 Data obtained: Heiskanen, J., & Rikala, R. (2006). Root growth and nutrient uptake of Norway spruce container seedlings planted in mounded boreal forest soil. *Forest Ecology and Management*, 222(1–3), 410–417. https://doi.org/10.1016/j.foreco.2005.10.047.
Alfredsson, H., Condron, L. M., Clarholm, M., & Davis, M. R. (1998). Changes in soil acidity and organic matter following the establishment of conifers on former grassland in New Zealand. *Forest Ecology and Management*, 112(3), 245–252. https://doi.org/10.1016/s0378-1127(98)00346-6.

290 Cremer, M., & Prietzel, J. (2017). Soil acidity and exchangeable base cation stocks under pure and mixed stands of European Beech, Douglas Fir and Norway Spruce. *Plant and Soil*, 415(1–2), 393–405. https://doi.org/10.1007/s11104-017-3177-1.

The table also shows an anomaly in the garden soil TLV, which contains an unusually high concentration of NO_2^- (>1 mg/l). This value is quite elevated and could negatively impact plant growth, as it may interfere with the availability of other essential nutrients such as K^+ and Mg^{2+}.[291] The soil sample was taken near a grapevine, which can tolerate a wide range of pH values (from 5.5 to 7.0), but for optimal growth it requires adequate concentrations of nitrogen, phosphorus, potassium, sulfur, calcium, and magnesium, along with smaller amounts of zinc, iron, and copper. Based on the results (see table), it was determined that several nutrient conditions are not optimally met, particularly the deficiencies in NO_3^-, Mg^{2+}, and Fe^{2+}. Due to the high concentration of NO_2^- in this soil, it is also likely that the uptake of K^+ cations by the grapevine is significantly hindered.
Another garden soil sample, DVT (also near a grapevine), mainly lacks nutrients such as NO_3^- (0 mg/l), and contains approximately 0.05 mg/l of NO_2^-, which is more harmful than beneficial to the grapevine. This soil also has slightly elevated levels of NH_3, which may threaten microorganisms, especially beneficial bacteria and fungi.
Another forest soil sample, JPZ, contains adequate concentrations of Ca^{2+} (15 mg/l), Fe^{2+} (0.025 mg/l), Cu^{2+} (<0.05 mg/l), Si^{4+} (2 mg/l), NO_3^- (0.5 mg/l), and PO_4^{3-} (0.125 mg/l). However, it also contains some NO_2^- (0.2 mg/l) and K^+ cations (1 mg/l), which could indicate a higher amount of organically bound potassium unavailable to plants. Unlike the JPG soil, JPZ does not contain SO_4^{2-} anions, even though the two samples were taken only about 100 meters apart.
The remaining soil samples are riparian soils: SP (near a river) and SPJ (by a lake). SP soil contains relatively high levels of NO_3^- (7.5 mg/l), Ca^{2+} (20 mg/l), and appropriate concentrations of other ions such as PO_4^{3-} (0.25 mg/l), NH_4^+ (0.05 mg/l), Si^{4+} (>6.0 mg/l), and K^+ (2 mg/l). A similarly favorable ionic composition is found in SPJ soil, which contains Ca^{2+} (30 mg/l), Fe^{2+} (0.2 mg/l), NO_3^- (2 mg/l), PO_4^{3-} (0.125 mg/l), NH_4^+ (0.05 mg/l), Si^{4+} (>6.0 mg/l), and K^+ (3.7 mg/l).
Near both of these locations grow tree species such as black alder, hornbeam, and bird cherry. The optimal soil pH for bird cherry is between 6.0 and 7.0. In more acidic soils, essential nutrients such as nitrogen, phosphorus, and potassium may become less available to plants, which also applies to hornbeam and black alder.[292] Hierarchical associative networks of the living and non-living world are closely interconnected, both in terms of hierarchy and associations, which represent various forms of cooperation through strictly defined functions, probabilities, and—based on our perception—even apparent randomness.

291 Chen, B.-M., Wang, Z.-H., Li, S.-X., Wang, G.-X., Song, H.-X., & Wang, X.-N. (2004). Effects of nitrate supply on plant growth, nitrate accumulation, metabolic nitrate concentration and nitrate reductase activity in three leafy vegetables. *Plant Science*, 167(3), 635–643. https://doi.org/10.1016/j.plantsci.2004.05.015.

292 Barrow, N. J., & Hartemink, A. E. (2023). The effects of ph on nutrient availability depend on both soils and plants. *Plant and Soil*, 487(1–2), 21–37. https://doi.org/10.1007/s11104-023-05960-5.

We have learned that without ions and molecules from the non-living world, the living world cannot function. This applies not only to microorganisms, plants, algae, fungi, and animals but also to humans. In this context, ions and molecules in the soil hold a dominant position over the living world or living nature, as together with water, they form the foundation for living or organic producers (plants, algae, fungi). It is clear that the hierarchical perspective mentioned is not the only one and that other viewpoints exist which can alter this hierarchy. With these measurements and results, we have only touched on the important connection between the chemical composition of soil and the living world (e.g., plants and microorganisms), which will be explored in more detail in one of the later subchapters. To conclude these measurements, we will first evaluate soil quality based on the appropriate presence of ions and molecules. Nitrogen, phosphorus, and potassium are essential indicators for assessing soil quality, while secondary criteria include the presence (or absence) of other ions and molecules such as Ca^{2+}, Mg^{2+}, SO_4^{2-}, NO_3^-, PO_4^{3-}, Cu^{2+}, Fe^{2+}, Si^{4+}, NH_4^+, NO_2^-, NH_3, and O_2.

5.5.4.1.4.6.5 Table 206: Final assessment of soil quality based on NPK, ion and molecule concentrations

Type	*Px*	*Pppm*	*Pvrphf*	*Pvrphn*	*Pvrphs*	*Pvrphpe*	*Psvl*	*Pmag*	*Ppro*	*Ptx*	*Pco3*	*Pgp*	*Pivhc*	*Ppiraz*	*Pc*	*Psvf*	*OC*	*OOS*	*OP*	*NPK +/-*	*SUM*
JPZ	3	3	7	1	6	2	7	3	6	4	3	5	6	6	4	2	6	4	3	4	85
JPG	1	1	3	7	1	7	1	4	1	5	2	3	1	2	1	1	1	3	1	1	47
SP	5	5	5	3	3	2	2	2	6	3	7	3	3	4	5	6	2	7	7	5	85
SPJ	6	6	1	3	2	4	4	7	6	6	6	7	5	5	4	3	6	7	7	6	101
HC	7	7	4	5	7	1	6	1	7	1	1	7	7	7	7	7	7	1	5	7	102
TLV	2	2	2	4	5	6	2	6	3	2	4	5	2	3	4	5	4	2	5	3	71
DVT	4	4	6	6	4	5	5	5	3	7	5	1	4	1	6	5	4	5	3	3	86

Table 206 presents the current evaluations of soil quality, based on the assessment of nutrient concentrations such as NPK, individual ions, and molecules.

The highest quality soil was rated as HC (102 points), closely followed by SPJ soil (101 points). In third place is DVT soil (86 points), while JPZ and SP soils share fourth place (85 points). TLV soil ranks sixth (71 points), and the lowest quality is attributed to JPG soil (47 points).

Based on the soil quality, we can infer which living organisms are likely to dominate and thrive in a given area. This primarily refers to plant life, microorganisms, and certain animals such as tardigrades, mollusks, insects, spiders, and other species. In this space where the non-living world is interwoven with the living world, hierarchical associative food networks emerge, built on the relationships between nutrient producers and consumers. Organic producers, such as plants, as we know from experience, cannot survive without inorganic sources like water and various chemical compounds. For hierarchical associative food networks to function effectively, appropriate concentrations of chemical compounds and elements must be present. These are partially strictly defined, but within a certain tolerance range that still allows for the growth, development, and survival of various living organisms. The quality of a given soil is not determined solely by the mesocosmic level; it is also closely linked to the micro- and macrocosmic levels. As a result of these interconnections and interdependencies, various hierarchical associative networks emerge. The prevailing hierarchical concept can shift depending on the perspective taken, leading to the formation of different network structures within these levels. Even the levels themselves can take on entirely different hierarchical associative structures under the influence of a changed perspective. These are dynamic networks, whose hierarchical emphases are constantly reshaped by various factors. On the one hand, the macrocosm has a strong influence on the mesocosm and microcosm; on the other hand, the microcosm also contributes to shaping and altering the mesocosm and macrocosm. With these reflections in mind, we now move on to the exploration of biological factors in the soil.

5.5.4.1.4.7 Influence of biological factors on soils

This subsection discusses the influence of biological factors on different types of soils. Here, we are referring primarily to various microorganisms, plant root systems, animals, and humans. First, let us examine living microorganisms that inhabit soils, such as bacteria, protozoa, and fungi, in garden, forest, and riparian soils.

In garden soils with a pH range from 6.0 to 7.5, we can find various types of bacteria that thrive in both acidic and neutral soils. Among the bacteria that prefer to live in more acidic soils are representatives of the genus Streptomyces. These have a positive effect on certain plant species, as they limit the reproduction of less beneficial or even harmful bacteria. In addition, they improve soil fertility by increasing the availability of nutrients (e.g., nitrogen and phosphorus), decomposing organic matter, and producing chemical compounds that stimulate plant growth.[293] In more acidic soils, mycobacteria can also thrive. They produce a wide range of enzymes and other biologically active compounds. These contribute to increased availability of nutrients such as nitrogen, phosphorus, and potassium, while also reducing soil contamination with undesirable chemical compounds. Additionally, they improve plants’ tolerance to stress factors and enhance their ability to break down excess organic matter.[294] Among the bacteria that thrive in more neutral soils are

293 Olanrewaju, O. S., & Babalola, O. O. (2018). Streptomyces: Implications and interactions in plant growth promotion. *Applied Microbiology and Biotechnology*, 103(3), 1179–1188. https://doi.org/10.1007/s00253-018-09577-y.

294 Shirkot, C. K., & Sharma, N. (2005). Growth promotion of apple seedlings by plant growth promoting rhizobacterium (bacillus megaterium). *Acta Horticulturae*, (696), 157–162. https://doi.org/10.17660/actahortic.2005.696.26.

those from the genus Pseudomonas, which contribute to nitrogen fixation in the soil and increase its fertility. Additionally, they can protect plants from diseases and play an important cleansing role in the soil by preventing contamination with undesirable chemical compounds.[295]

In garden soils with a neutral pH, bacteria from the genus Bacillus can also thrive. These bacteria contribute to more efficient production of enzymes and other biologically active chemical compounds, which enables better decomposition of excess organic matter and promotes soil health.

In garden soils (DVT and LTV) with slightly acidic, neutral, or slightly alkaline pH values (6.0 to 7.5), protozoa (e.g., flagellates, ciliates, amoebae) are often found. These organisms play an important role in regulating populations of harmful bacteria.

Protozoa feed on bacteria and other microorganisms, breaking them down and releasing nutrients important for plant growth. When bacterial numbers in the soil are very low, protozoa enter a dormant state, which appears under a light microscope as outlined circles.

In garden soils with a pH around 5.5 or lower, and 8.0 or higher, the number of protozoa is significantly reduced.

Garden soils with a pH between 6.0 and 7.5 also commonly contain many species of fungi. Among the most important for plants are both decomposer fungi and mycorrhizal fungi. Decomposer fungi break down unnecessary organic matter, while mycorrhizal fungi form mutualistic relationships with plant roots. Fungi in forest soils are especially important for the functional cycling of water and nutrients, providing a healthier environment for plant growth.

In forest soils (JPG and JPZ), there is greater soil diversity. Here, we will focus only on representatives of red (JPG) and black forest soils (JPZ). Red forest soils typically have a pH range from 4.5 to 6.5. These soils are less fertile and more acidic. They are mainly found in cold, humid, and temperate regions where coniferous forests thrive best. Bacteria living in these soils are specially adapted to survive in acidic conditions, primarily acidophilic and acid-tolerant species (e.g., Streptomyces and Mycobacterium). These bacteria perform important functions such as nutrient cycling, organic matter decomposition, and releasing nutrients for plants.

In red forest soils, decomposer fungi from genera such as Laccaria and Pleurotus are also present. Additionally, mycorrhizal fungi from genera like Suillus and Thelephora live in these soils, forming mutualistic symbioses with plant root systems. Acidophilic and acid-tolerant protozoa, including certain species of flagellates and amoebae, typically survive in red forest soils. The role of protozoa in acidic red forest soils is similar to that in garden soils. A lower diversity of microorganisms is

295 F, S., M.R, I., M.A, S., & M.M, H. (2020). Plant growth promotion and suppression of damping off in tomato by plant growth promoting Rhizobacterium Bacillus Amyloliquifaciens. *Canadian Journal of Agriculture and Crops*, 5(1), 59–68. https://doi.org/10.20448/803.5.1.59.68.

expected in red forest soils.[296] Black forest soils, or cambisols, typically have a pH range from 6.0 to 7.5 and are moderately fertile while retaining water well. The bacteria inhabiting these soils are adapted to survive in neutral (neutrophilic bacteria) to slightly alkaline environments (alkalitolerant bacteria). Their key roles include decomposing organic matter and efficiently cycling nutrients. Compared to other soil types, bacterial populations in black forest soils are very numerous and diverse. Neutrophilic bacteria found here mainly belong to the genera Pseudomonas and Bacillus, while alkalitolerant bacteria include species from the genera Arthrobacter and Micrococcus. Protozoa are characteristic inhabitants of black forest soils, indicating favorable conditions for their survival and growth. Various species of flagellates, ciliates, flagellates, ciliates, and amoebae are present, playing an important role in controlling populations of harmful bacteria.

Fungi in black forest soils are adapted to neutral to slightly alkaline conditions and include both decomposer and mycorrhizal fungi. The main decomposer fungi belong mostly to the genera Penicillium, Aspergillus, and Fusarium, known for breaking down excess organic matter and releasing nutrients. Mycorrhizal fungi primarily come from the genera Glomus and Rhizopogon, forming mutualistic relationships with plant root systems that enhance nutrient and water absorption. Other fungi present include yeasts, molds, and mushrooms, which contribute to more efficient nutrient cycling, supporting better plant health and growth.

Humus (HC), composed of plant and animal organic residues, usually has a pH range from 5.5 to 7.0. It predominantly hosts acid-tolerant bacteria (such as Streptomyces and Mycobacterium) and neutrophilic bacteria (Pseudomonas and Bacillus). These bacteria perform beneficial functions similar to those in other soil types. Various protozoa, including flagellates, ciliates, and amoebae, also inhabit humus, along with numerous fungi ranging from decomposers to mycorrhizal species that fulfill comparable beneficial roles.

A representative of riparian soils (SPJ), as indicated by our texture assessment, is relatively rich in clay. Such soils have high water and nutrient retention capacity but poor drainage and are less suitable for agricultural use. Many microorganisms find it harder to survive in clay-rich soils. Similar to previously discussed soils, neutrophilic bacteria like Pseudomonas and Bacillus are found here, along with clay-tolerant bacteria such as Sporosarcina and Clostridium. Many protozoan

296 Data were obtained by sources:
El-Tarabily, K. A., & Hardy, G. E. S. J. (2015). Pseudomonas as plant growth-promoting rhizobacteria: A review. *Australian Journal of Crop Science*, 9(6), 826-835.
Gao, Y., & Zhang, S. (2018). Pseudomonas: A versatile genus of plant-associated bacteria. *Microbiology and Molecular Biology Reviews*, 82(4), e00028-17.
Okamoto, M., & Miyamoto, K. (2019). Pseudomonas as plant growth-promoting bacteria: Current perspectives and future prospects. *Microbes and Environments*, 34(3), 1-10.

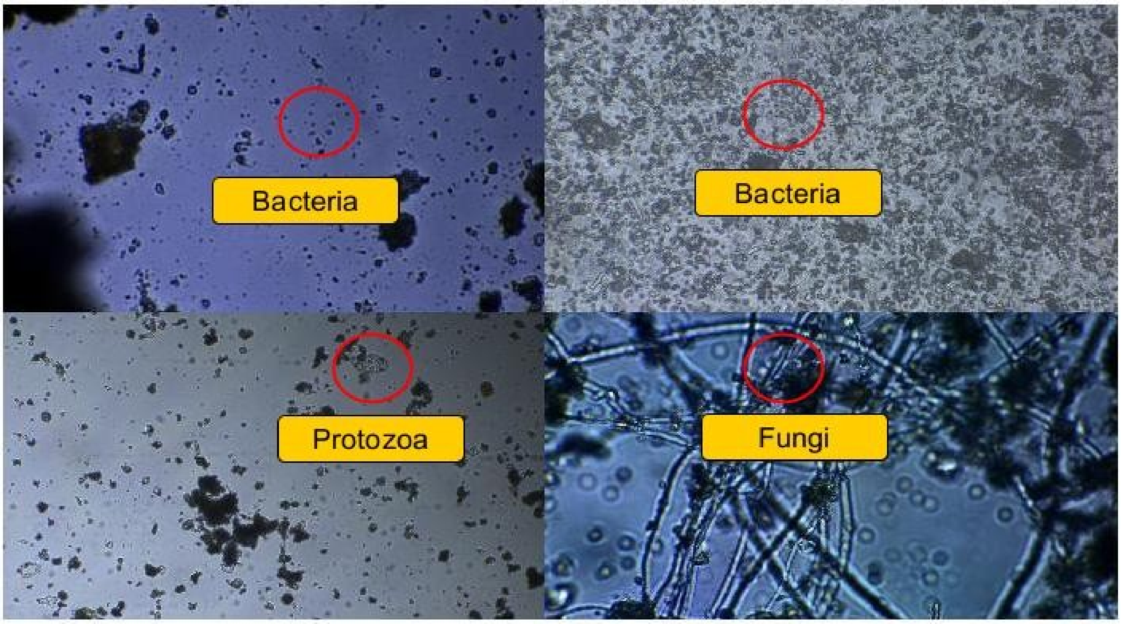
species struggle to survive in clay-rich soils. Fungi remain essential in these soils as well, including genera like Penicillium, Aspergillus, and Fusarium.

Soils near water sources are often frequently flooded, resulting in high water content that is highly favorable for many microorganisms. In these soils (SP), bacteria adapted to high moisture levels, including aquatic species, predominate. Similar conditions apply to protozoa and fungi.

We have briefly introduced the most characteristic microorganisms inhabiting various soil types. Microorganisms influence biochemical reactions in soil both directly and indirectly. A good example is nitrification, where bacteria actively convert NH_4^+ ions from fertilizers and organic matter into NO_2^-. High NO_2^- levels can be harmful to plants, animals, and humans. However, if beneficial bacterial colonies in the soil are sufficiently abundant, NH_4^+ ions are further converted into NO_3^- ions, which in appropriate concentrations greatly benefit plants, animals, and humans alike. Next, we will examine microscopic images of decanted samples from the previously discussed soil types to assess the presence of microorganisms such as bacteria, protozoa, and fungi.

5.5.4.1.4.7.1 Figure 454: Prepared samples for assessing the presence of microorganisms in soils

Figure 454 shows the prepared samples used to assess the presence of microorganisms in soils such as LTV, DVT, JPZ, JPG, SP, SPJ, and HC. The samples were prepared at a ratio of 1:5, meaning that test tubes were filled with 1 ml of soil up to the mark, then all samples were topped up with distilled water to the 5 ml mark. Next, the samples were gently mixed for half a minute and then left to stand for three days. During this time, larger particles settled, making the samples ready for examination under a light microscope. Using a micropipette, samples were collected and applied as two drops onto microscope slides. In the final step of this precise sampling procedure, cover slips were placed over the samples. The following image presents several microscopic views captured using light microscopy at magnifications of 10x, 40x, and 100x.



5.5.4.1.4.7.2 Figure 455: Microscopic images of microorganisms in soils

Figure 455 shows selected microscopic images of microorganisms in the soil, where bacteria, protozoa (such as larger ciliates), and fungi can be observed. When observing soil under a light microscope, smaller amoebas, flagellates, and ciliates were also visible. It should be noted that bacteria, ciliates, amoebas, flagellates, and fungi were not present in large numbers.

Regarding the quantity of fungi in the soil, two exceptions are worth highlighting, namely SP and SPJ soils, where smaller fungal networks were observed. Protozoa, such as ciliates and amoebas, are known to enter a sort of hibernation state due to the lack of bacteria in the soil, which can be observed under a light microscope as well-defined circles. They remain in this state until bacteria and other smaller microbial populations become available. Once sufficient bacteria and other microorganisms, which protozoa feed on, are available, they wake up and begin to multiply.

The smallest number of microorganisms was detected in HC soil, as it primarily consists of plant matter and chemicals, such as NPK fertilizer. Slightly more fungi were observed in LTV soil, but there were few bacteria and protozoa. This observation corresponds with the NO_2 measurement in the soil, as LTV soil exhibited a higher concentration of NO_2 (>1 mg/l), while NO_3^- was only present in trace amounts. In DVT soil, slightly more bacteria, protozoa, and fungi were detected, but without larger populations. Similar to LTV soil, DVT soil also showed a higher concentration of NO_2 (0.05 mg/l), while NO_3^- was present only in trace amounts.

Based on rough estimates, JPZ soil showed somewhat larger populations of microorganisms compared to LTV and DVT soils. This soil contained NO_2 at a concentration of 0.012 mg/l and 0.5

mg/l of NO_3^- anions. The composition of JPG soil, which is considered less fertile due to a lack of nutrients in the form of ions (low conductivity and TDS hardness), was somewhat surprising. It contained a certain concentration of harmful NO_2 (0.012 mg/l). Based on a rough estimate of microorganism numbers, this soil contained relatively more bacteria and protozoa but a small population of fungi. It can be said that JPG soil is quite depleted, and the role of bacteria and protozoa in it is not fully understood. On one hand, the bacterial colonies in this soil are still too small to produce the NO_3^- anions essential for plant growth, and on the other hand, bacteria mostly act as decomposers of organic matter, while protozoa serve as predators of bacteria.

The riparian soils, SP and SPJ, contained the largest fungal populations but relatively fewer bacteria and protozoa compared to the fungi. However, the populations of bacteria and protozoa were large enough for the bacteria to produce NO_3^- in relatively high concentrations (SP NO_3^- = 7.5 mg/l, SPJ NO_3^- = 2 mg/l), and protozoa were effective predators.

In this hierarchical associative network, various hierarchical food webs are continuously established, maintained, decomposed, renewed, and changed as a result of physical, chemical, and biological reactions. This occurs based on the interweaving and interdependence of the three cosmic levels, meaning that the dynamics and statics of network connections between the living and non-living worlds at the micro-, meso-, and macrocosmic levels must be monitored. Only with a holistic approach can we hope to achieve a better understanding of natural hierarchical associative systems. This means that when studying hierarchical food webs, it is not meaningful to separate the organic and inorganic worlds, as the organic world cannot exist without the inorganic world, which forms the basis for every living organism. Consequently, the influence of the inorganic world is crucial for the functioning of hierarchical systems and for the causal and conditional relationships between different phenomena, events, and rules, which are continuously maintained (statics) and changed (dynamics).

A human can only exist if they have access to sufficient amounts of existentially important chemical elements and compounds (e.g., Ca^{2+}, Mg^{2+}, HCl, H_2O, O_2, C), as well as enough beneficial microorganisms and nutrients (e.g., vitamins, proteins, fats) in their body. Additionally, humans depend on food producers, climate, magnetism, electrical charges (induction), gravity, and the movement of the Earth around the Sun. This dependence likely extends further into the macrocosm, but for easier understanding, it is reasonable to limit this to the factors mentioned above. The same applies to microorganisms and other living organisms.

Let us examine some causal relationships in the form of conditional questions between populations of bacteria, protozoa, and fungi:

1. What would happen if the soil contained a small biomass of bacteria and a large biomass of fungi?

If the soil has a small biomass of bacteria and a large biomass of fungi, it could mean that the nutrient cycling in the soil is not optimal, making the soil less fertile. Bacteria are crucial for the breakdown of organic matter and nutrient flow to plants, while fungi assist in decomposition and nutrient absorption. Without a balanced relationship between bacteria and fungi, the soil will not optimally support plant diversity. A large biomass of fungi could also indicate a higher presence of harmful fungi to plant populations.

2. What would happen if the soil contained a small biomass of fungi and a large biomass of bacteria?

If the biomass of fungi in the soil is small and the biomass of bacteria is large, it could indicate that the soil is rich in nutrients and less conducive to fungal expansion. The lack of fungi in the soil could lead to less efficient decomposition of organic matter and lower diversity of other microorganisms, negatively affecting many plant crops and ecosystem balance in the long term.

3. What would happen if the soil contained a small biomass of protozoa and a large biomass of bacteria?

If the biomass of protozoa is small and the biomass of bacteria is large, it could mean that nutrient cycling is less efficient and there is a lack of control over bacterial populations. Protozoa regulate the number of bacteria in the soil by feeding on them and other microorganisms, recycling nutrients in the process. Without balance between protozoa and bacteria, the soil may be less capable of supporting plant diversity. A large biomass of bacteria could cause excessive competition for available nutrients, making it harder for plants to access them. A small biomass of protozoa could also reduce the efficiency of organic matter decomposition, negatively affecting plant health.

4. What would happen if the soil contained a small biomass of bacteria and a large biomass of protozoa?

If the biomass of bacteria is small and the biomass of protozoa is large, it could mean that the soil has low nutrient availability and high predation, further reducing the bacterial population. Bacteria play a key role in the breakdown of organic matter and the release of nutrients for plants, so a small biomass of bacteria would likely result in less fertile soil. A significant dominance of protozoa over bacteria could indicate intense microbial predation, limiting the availability of bacteria and negatively affecting nutrient cycling and organic matter decomposition.

5. What would happen if the soil contained a small biomass of fungi but a large biomass of protozoa and bacteria?

If the biomass of fungi is small and the biomass of bacteria and protozoa is large, it could mean that the soil lacks essential nutrients, causing high disruption in their mediation. Fungi play an important role in the decomposition of organic matter and promoting nutrient cycling. The absence of fungi could reduce fertility and plant productivity. Large populations of bacteria and protozoa could lead to excessive decomposition of fresh organic matter, further disturbing the ecosystem.

6. What would happen if the soil contained a small biomass of protozoa but a large biomass of fungi and bacteria?

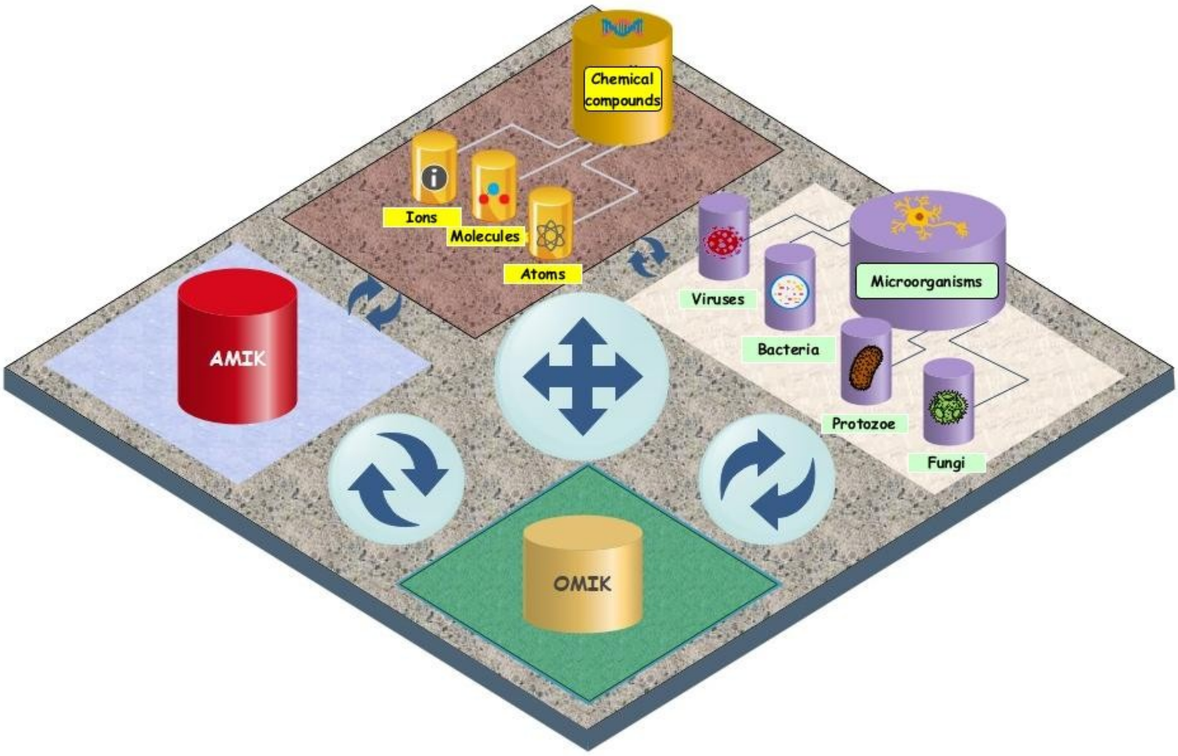
In this scenario, the soil could be relatively stable without significant disturbing factors. However, the lack of protozoa might result in uncontrolled growth of bacterial colonies, leading to an imbalanced flow of nutrients and lower soil fertility. A large biomass of bacteria and fungi could indicate that the soil is rich in organic matter and supports efficient nutrient cycling. However, this process is most effective when all three populations of microorganisms are balanced. The lack of protozoa might result in excessive competition between fungi and bacteria.

7. What would happen if the soil contained a small biomass of bacteria but a large biomass of fungi and protozoa?

In this case, it could mean that the soil is not suitable for plant growth, as there might be a lack of organic and other essential nutrients.

From the different scenarios regarding the relationship of populations in these three groups of microorganisms, we can conclude that their impact on the soil and consequently on plants is immense. This is reflected in the lack of essential ions and organic matter, without which plants cannot thrive optimally. This, in turn, impacts smaller and larger animals as well as humans. The soil, as a heterogeneous mixture of organic and inorganic substances, is closely connected to the living world, with plants playing a key role in food production. Soils consist of numerous ions, inorganic and organic molecules, which form the basis for the life of plants and other living organisms (e.g., microorganisms, animals, humans).

As established, almost all living organisms (including microorganisms such as bacteria and protozoa) require potassium, nitrogen, phosphorus, water, etc. This implies a close connection between microorganisms and the chemical substances that are part of the inorganic and organic microcosm. This crucial component provides nutrients to plants and fungi (algae were not detected in the studied soils), which are transferred to the roots, stems, leaves, and flowers with the help of water. This essentially represents the transition from the microcosmic level to the mesocosmic level, as most plants are located within the mesocosmic plane. We also know that fungi exist as both microfungi (e.g., mildew) and mesofungi (e.g., mushrooms). It would be meaningful to examine the microcosmic level in more detail with images.



5.5.4.1.7.3 Figure 456: A microcosmic view of soil and microorganisms

Figure 456 presents a microcosmic view of soil from the perspective of chemical substances in the form of ions, molecules, and atoms, as well as microorganisms such as viruses, bacteria, protozoa, and fungi. The entire microcosmic level can be divided into inorganic and organic microcosms. Without an appropriate balance between inorganic and organic components, soil cannot exist and is far from reaching its fertile potential.

Various types of energy operate within the soil, including:

- Thermal energy, which affects soil properties and microbial activity.
- Kinetic energy, since soil particles are constantly moving due to physical processes like erosion, sedimentation, and water flow.
- Chemical energy, released during exothermic and endothermic chemical reactions.
- Radiant energy, such as light in the form of electromagnetic radiation, which influences the soil.
- Magnetic energy, although not typically defined as a characteristic energy within soil, it affects plant growth and microbial activity.
- Electrical energy, generated by the movement of ions in the soil, influencing chemical reactions and nutrient availability.
- Gravitational energy, impacting the physical properties of soil and the movement of water molecules.

- Elastic energy, which provides resistance against physical stressors and reduces the risk of excessive soil deformation.

Nuclear energy is not particularly significant in soil systems and generally does not affect them. However, many soil types contain small amounts of natural radioactive isotopes such as uranium, thorium, and radium.

The last type of energy constantly present in soil is potential energy, which manifests as heat, electromagnetic radiation, electrical charges, magnetism, gravity, chemical reactions, kinetic energy, elasticity, and the mild presence of nuclear isotopes. Potential energy represents the capacity to be converted into other energy forms and originates from both the inorganic and organic realms. This aspect would also be beneficial to illustrate visually.

5.5.4.1.7.4 Figure 457: Types of energy within the microcosmic plane affecting soil

Figure 457 illustrates the plane of different types of energy that influence the properties and dynamics of soil, and consequently the development and growth of plants, fungi, and microorganisms. The strongest energies in soils generally originate from chemical bonds between minerals and organic matter. These chemical bonds determine soil structure, its stability, and the availability of nutrients accessible to plants for optimal absorption.

Classifying the various types of energy by their strength is challenging because they are interdependent and intertwined. For example, the strength of chemical bonds in soil is influenced by temperature, which itself depends on stored thermal energy. Additionally, soil composition and structure, as well as environmental conditions that can alter its makeup and properties, significantly affect the soil's energy dynamics.

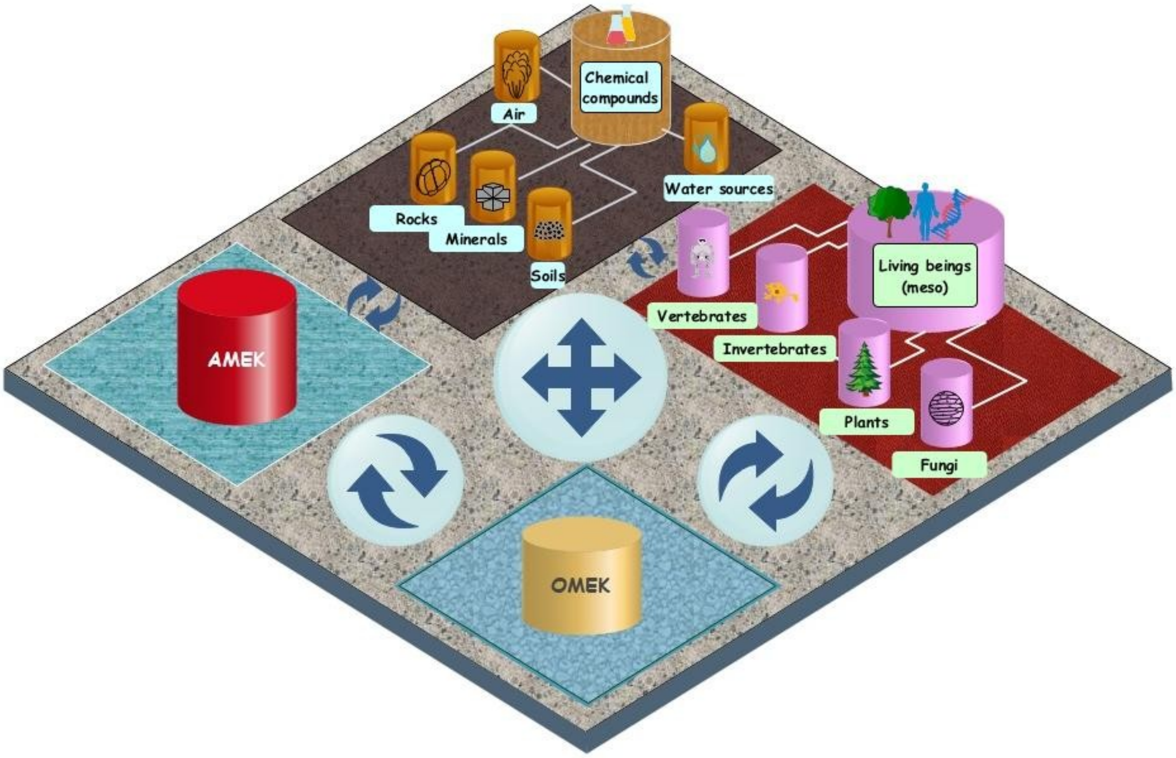
In general, chemical energy in soil can be considered the most stable and fundamental form of energy, while the levels of other forms (such as thermal, elastic, kinetic, electrical, and radiant energy) continuously fluctuate over time. From the perspective of potential energies, chemical energy is especially important because soils contain large amounts of organic and inorganic substances that form unique chemical bonds. The strength of these bonds determines soil stability, reactivity, health, and fertility.

Potential chemical energy stored in organic matter in soil can be converted into other energy forms. For example, decomposition processes can release thermal energy, while gravitational potential energy can influence the size and position of particles, which under stress may convert into elastic energy. Both inorganic and organic potential energies manifest through physical, biochemical, electrochemical, and other processes occurring in connection with existing masses. Each mass represents a certain amount of potential energy that can be triggered by various processes into motion, thereby transforming into other energy types such as kinetic or elastic energy.

From an energy standpoint, microorganisms are similar to soil in that chemical energy is the most important. This energy is stored in chemical bonds of organic molecules like carbohydrates, proteins, and lipids. Microorganisms utilize this energy to carry out numerous cellular processes including growth, reproduction, and metabolism. During metabolic processes, inorganic nitrogen and phosphorus compounds are converted into organic forms, serving as nutrients for various organisms.

Besides chemical energy, radiant energy (especially light) and thermal energy also play important roles in the growth and development of microorganisms, but chemical energy remains key to their survival in soil.

After this brief overview of the different types of energy influencing soil existence and microorganisms, we can now turn our attention to the plant world, marking a transition to the mesocosmic level.



5.5.4.1.7.5 Figure 458: Mesocosmic view with emphasis on plants

Figure 458 presents the mesocosmic plane or mesocosmic view of living organisms (vertebrates, invertebrates, plants, and fungi), with this subsection focusing primarily on plants. Within this level, there is also a fundamental division into inorganic and organic mesocosms. The inorganic mesocosm consists of various chemical substances present in the air, water sources, rocks, minerals, and soil. Plants and fungi are most strongly influenced by chemical substances in the soil, gases in the atmosphere, and water from various sources. For other living organisms, such as vertebrates and invertebrates, the direct influence of soil is less significant, as this connection is indirect-plants serve as a crucial food source for many vertebrate and invertebrate species. Without plants, many living organisms could not survive.

The relationship between energies, soils, and plants again leads us to the energy plane (see Figure 459). Different forms of energy are also expressed at the mesocosmic level, often with greater intensity. The most important form of energy in plants is radiant energy, specifically light energy, which enables the process of photosynthesis. During photosynthesis, light energy is converted into chemical energy in the form of glucose. Plants store this energy and use it for growth and metabolic processes. Respiratory energy, a special form of chemical energy, is also an important energy source. It facilitates the breakdown of organic compounds and the absorption of nutrients from the soil.

Based on the concentration of individual ions and molecules in filtrates from various soils, it is possible to calculate the energy related to their chemical potentials. This energy is defined as the amount of energy required to add or remove a certain quantity of ions or molecules from a solution. The chemical potential of an ion in solution is expressed relative to its concentration and the standard chemical potential in its pure form. The relationship between the energy of an ion in solution and its concentration explains the law of mass action, which states that the chemical potential of a specific ion or molecule in solution is proportional to its concentration. This relationship can be used to calculate the energy of ions or molecules in solution based on their concentration (mg/L) and the standard chemical potential in pure form.

The energy of an ion or molecule in solution depends on various factors such as temperature, pressure, and the presence of other particles in the solution, as these affect the standard chemical potential and thus the energy of the particles. The calculation of this energy is based on a relatively simple procedure. First, the concentration of ions in filtrates from different soils must be converted from milligrams per liter (mg/L) to moles per liter (mol/L). For example, the concentration of K^+ cations in the filtrate of DVT soil was estimated at 4.5 mg/L, and the relative atomic mass of the K^+ ion is 39.1. The actual concentration of K^+ ions in the soil filtrate is calculated by dividing the mg/L value by the relative atomic mass and 1000, resulting in 0.000115 mol/L.

Using this data, the Gibbs free energy (ΔG) can be calculated by applying the number of moles of electrons (in this case 1), Faraday's constant (96485 C/mol), the standard chemical potential (-2.93 V for K^+ ion), and the base-10 logarithm of the concentration of K^+ ions in the soil filtrate.

$$\Delta G_{+K} = -n_e \cdot F \cdot e \cdot \log\left(\frac{C_r}{C_o}\right) = -\ 1 \cdot 96485 \frac{C}{mol} \cdot (-2{,}93\ V) \cdot 1 = 282{,}70 \frac{kJ}{mol}$$

The obtained value of 282.7 kJ/mol represents the change in Gibbs free energy for the reaction based on a concentration of 0.000115 mol/L of K^+ ions and the transfer of one mole of electrons. This amount of energy can positively influence plant systems and their metabolic processes. However, it is important to emphasize that the calculated value is only an estimate of the free energy that can be released during a specific chemical reaction. The final outcome is influenced by many other factors, such as the reactants involved (in this case, chemical compounds containing K^+), reaction conditions, length of the metabolic pathway, temperature, pressure, humidity, and so on.

It is essential to recognize that at both the microcosmic and mesocosmic levels, chemical energy predominates in relation to microorganisms and plants. This does not mean that other forms of energy, such as radiant (light), thermal, kinetic, and others, are unimportant. When studying plant systems, soils, microorganisms, and animals, energy can be considered a common denominator or connecting element between both the microcosm and mesocosm. This energy bridge enables the establishment of hierarchical and associative connections among different entities. Because of the hierarchical and connective role of energy, the existence of hierarchical associative systems is possible.

The greatest amount of energy and mass is found at the macrocosmic level, but the density of energy and mass distribution at this level is lower than at the microcosmic level. While there is a direct influence of the macrocosm on soil, it is smaller compared to the influences of the microcosmic and mesocosmic levels. Let us now examine a speculative 3D model of the macrocosmic level. It will become clear shortly why this model is described as speculative.

5.5.4.1.7.6 Figure 459: A speculative view of the macrocosmic plane

Figure 459 presents a speculative view of the macrocosmic plane, dominated by chemical substances in the form of gases, liquids, icy water sources, rocks, minerals, soil, and living beings at the macrocosmic level. This part of the 3D model is based on the speculative idea that living organisms at higher levels are composed of inorganic and organic mesocosms. From this perspective, living beings, including humans, are essentially microbes performing specific functions within the macrocosmic information-communication infrastructure and simultaneously serving as a kind of repository of events and facts. This infrastructure, besides data and information, also generates various forms of energy that are hierarchically and associatively intertwined and operate in mutual interdependence.

The concept of energy can also be understood as the relationship between dynamics and statics across different levels, such as the micro-, meso-, and macrocosm. Within the microcosm, the dynamics and statics of energies can be explained through interactions among different types of atoms, molecules, ions, and other particles. At this level, various forms of energy are produced and consumed, including chemical, thermal, kinetic, and potential energy, with energy transfer between particles reflected in changes to their physical and chemical properties (e.g., temperature, pressure, chemical composition).

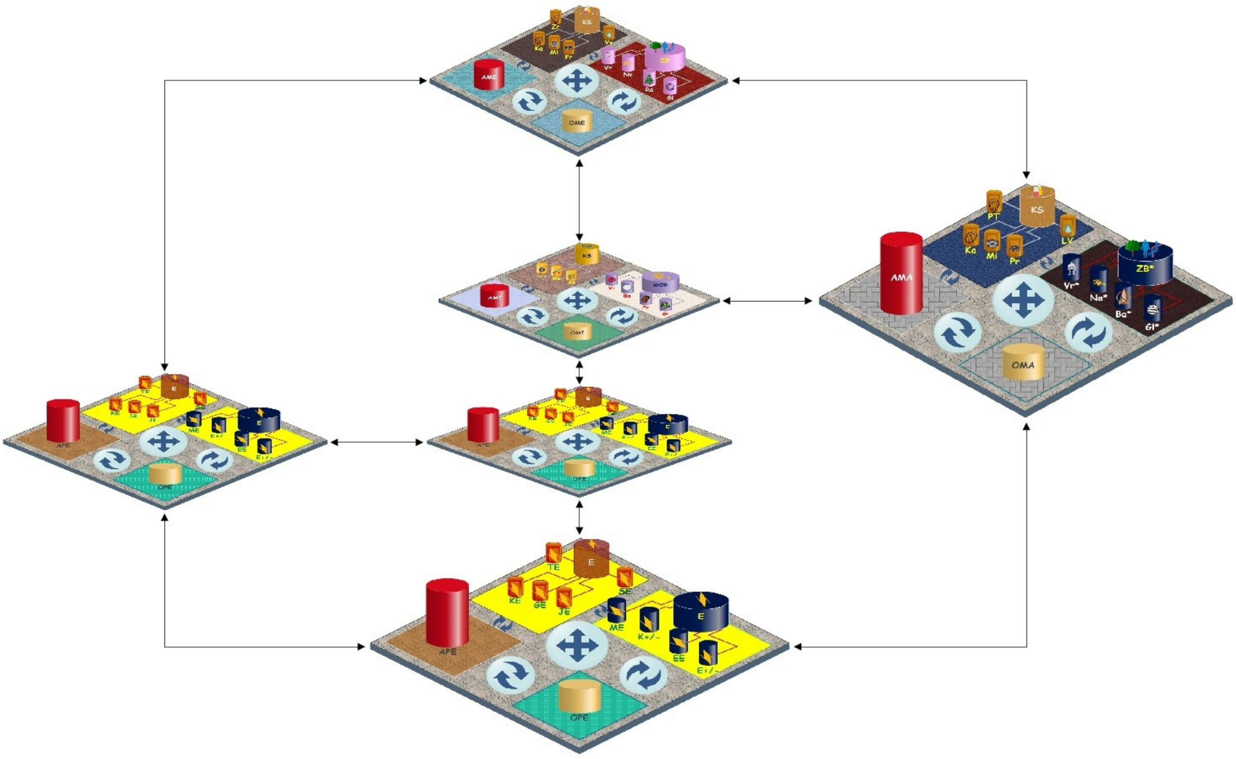
At the mesocosmic level, energies can be studied in terms of collective behavior and interconnections among diverse groups of particles in liquids, solids, and gases.

At the macrocosmic level, energies are examined through extensive systems and processes where energy transfer occurs among different components of the system (e.g., atmosphere, climate, weather).

In short, the concept of energy can be understood and studied from various perspectives-considering the dynamics and statics of individual particles, groups of particles, and entire systems. Considering the total amount of energy in the universe, the macrocosm is undoubtedly the most energy-rich, followed by the mesocosm and finally the microcosm. From this viewpoint, the quantity of energy exponentially decreases from higher to lower levels. However, when energy is considered locally, energy density is highest in the microcosm, as energies are concentrated in the interconnections among diverse particles. In this case, energy density exponentially decreases from lower to higher levels.

As can be seen from this brief description, different hierarchical emphases of thought focus are encountered. Our current scientific mindset still lacks adequate associative connections in this area, which is unsurprising since we will likely never fully comprehend the universe. All we can do is strive toward that understanding.

Energies are distributed differently across levels, primarily depending on inorganic physico-chemical forces present in all three cosmic planes. Based on modeling of cosmic and energy planes, it can be argued that common denominators exist in the form of mass, with an emphasis on inorganic chemical substances (rocks, minerals, soils, gases, liquids) and diverse forms of energy. From the perspective of our perception and understanding of cosmic planes, biomass represents more of an exception than a rule. It would be meaningful to conduct a synthesis of cosmic and energy planes.



5.5.4.1.7.7 Figure 460: Synthesis of cosmic and energy planes

Figure 460 illustrates the synthesis of cosmic and energy planes, which operate relatively autonomously on a local scale within various natural processes but are causally interconnected from a global perspective. Each cosmic plane is rich in both mass and energy, allowing us to conclude that mass and energy are common denominators across all three cosmic planes.

Physicists persistently strive to discover equivalent connections among the laws governing phenomena across all three cosmic planes, yet often without success. Mass and energy distribute differently within each cosmic plane, complicating direct comparisons. However, it is known that energies from the macrocosm influence both the mesocosm and microcosm. It is also evident that inorganic mass strongly dominates over organic mass across all three cosmic levels.

Applying this to soils and living organisms, it can be confidently stated that solar (radiant) energy from the macrocosm affects the existence and development of both inorganic and organic mass. Soils themselves, formed through physicochemical processes influenced by macrocosmic and microcosmic forces, enable plant growth and development, which in turn supports food production for numerous organisms, including invertebrates and vertebrates.

Strong and persistently interconnected natural processes occur within all three cosmic planes. In this context, certain equivalent and associative connections can be observed among all three worlds. Other connections are less visible or indirect, making it difficult to integrate them into a unified scenario. The differing distributions of mass and energy within the cosmic planes effectively prevent clear direct connections and a common scenario, as various mesoscale worlds with distinct existential functions exist.

Nevertheless, it can be hypothesized that numerous equivalent and associative connections exist among natural processes occurring across all three cosmic planes. The common denominator of all three cosmic planes can be summarized by the concept of two fundamental physical categories: mass and energy. Let us now consider the estimated masses and energies within all three cosmic planes.[297] It is clear that estimates of mass and energy within the macrocosm are more or less speculative. All that can be stated with confidence is that these values are extraordinarily large. According to some scientific estimates, the total mass of the universe is approximately 10^{53} kg. Given the unimaginably dynamic processes and transformations involved, this is likely a rather conservative estimate. Similarly, the total amount of energy in the macrocosm is estimated at about 10^{112} joules. This estimate includes various forms of energy such as matter energy, radiation, and dark energy.

Estimating the mass of the mesocosm is also challenging but somewhat closer to an accurate assessment. Estimates place it at approximately $5.97 \cdot 10^{24}$ kg, accounting for the mass of the Earth's solid matter, water sources, atmosphere, and chemical substances on the surface. Like the macrocosm, the energy estimate for the mesocosmic plane is only approximate. The estimated value is about $1.0 \cdot 10^{29}$ joules, excluding energy stored in living organisms and fossil fuels.

Estimates of mass and energy within the microcosm are likewise very approximate. It is estimated to be about $300 \cdot 10^{9}$ tons, representing a significant portion of the total biomass on our planet (e.g., viruses, bacteria, fungi, protozoa, algae). This estimate is by no means fixed, as it continuously changes and transforms. The total energy stored in the biomass of microorganisms on Earth is estimated at roughly $2.0 \cdot 10^{19}$ joules. This value is also not constant, as energy is constantly converted and transferred between different forms.

Based on these estimates, we can conclude that both energy and mass hierarchically and associatively decrease gradually from the macrocosm to the mesocosm and microcosm. The local and autonomous nature of each cosmic plane leads to increasing entropy and changes in the density of mass and energy.

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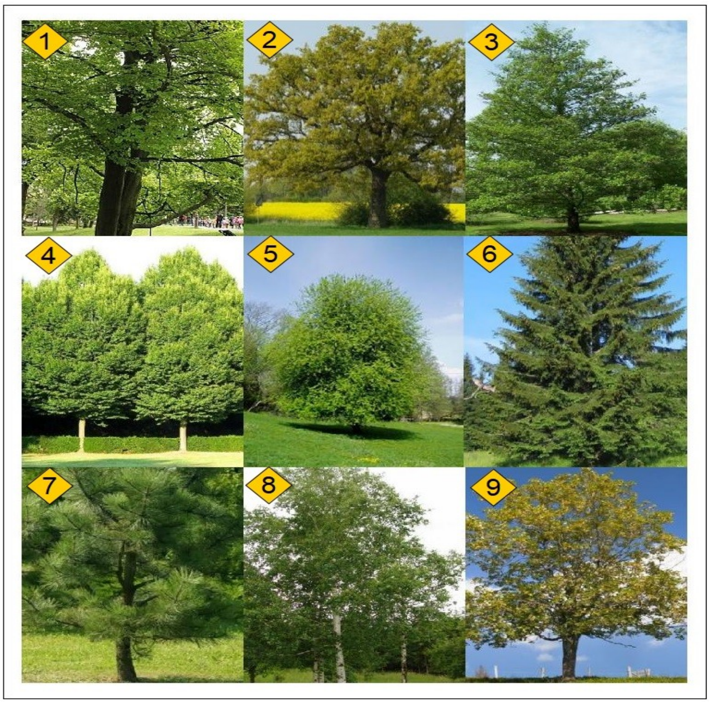
Holton, J. R., & Hakim, G. J. (2019). *An introduction to dynamic meteorology.* Academic Press.
Wallace, J. M., & Hobbs, P. V. (2010) *Atmospheric Science : an introductory survey.* 2nd ed. Academic Press.

In this chapter, focused on soils, chemical compounds and their interactions with living beings, climate, and sunlight are central. Therefore, content related to the macrocosm and microcosm will be highly abstracted. The main emphasis will be on causes and effects within the mesocosmic plane. Accordingly, terrestrial living beings (plants, insects, spiders, reptiles, birds, mammals) will be presented in connection with the studied soils, aiming to form a hierarchically associative food web. Within this thematic focus, numerous existential connections between chemical substances, living beings, climate, atmosphere, and the Sun can be explored.

5.5.4.2 Terrestrial plants

This subsection presents terrestrial plant species in relation to the soils under study. The selection of plant species is quite limited, with some already briefly described (e.g., beech, oak, black alder, hornbeam, Norway spruce, and bird cherry). The plant descriptions will include information about their tolerance to pH, temperature, light, and moisture. Additionally, data will be provided on their ecological significance, their role in food chains, typical associated species, and genome size.



5.5.4.2.1 Figure 461: Tree species within the mesocosmic plane

Figure 461 shows various tree species that can be found within the mesocosmic plane—in forests, near water sources, and in gardens.

1. Beech (*Latin: Fagus grandifolia*):

Beech trees are deciduous and are primarily found in temperate forests across the United States and Canada. They grow slowly, can reach heights of up to 100 meters, and may live for more than 100 years. Beech trees thrive best in soils that are well-drained and rich in organic matter. The optimal pH range for their growth is between 6.0 and 7.5. Their typical soil contains a mix of sand, silt, clay particles, humus, and fallen leaves.

The bark of the beech is light gray, smooth, but quite thin and sensitive to damage from fire, animals, and human activity. Traditionally, beech bark has been used to treat headaches, fever, and skin conditions. These trees provide essential habitats for many animals, including birds, mammals, and insects. Their nut-like fruits are a crucial food source for wildlife, while their branches and foliage offer shelter to birds, supporting biodiversity.

Beech trees grow best in cool (15°C–21°C), moist conditions (60%–80% humidity). They are generally sensitive to high temperatures and dry air, although they can tolerate slightly broader conditions depending on the region. In areas with limited rainfall, beeches struggle to survive without human intervention.

They play a key role in food webs (e.g., supporting squirrels, mice, deer, bears, aphids, caterpillars, birds, fungi, and humans), carbon storage (helping mitigate climate change), and soil health (their leaves enrich the soil with essential nutrients). The average energy value of their dry biomass is estimated at 18 to 19 MJ/kg. This means a beech tree producing 100 kg of dry biomass could generate 1,800 to 1,900 MJ—equivalent to roughly 430,000 to 450,000 kilocalories. Not all of this energy goes into growth and biomass; some is used for respiration and transpiration, while a significant portion supports surrounding animal and human life. The genome size of the beech tree is estimated at approximately 730 Mb to 766 Mb.[298]

2. Oak trees (*Latin: Quercus*)

Oaks are widespread across North America and Europe, reaching heights between 15 and 44 meters. There are more than 600 known species of oak. They have long lifespans and, under favorable conditions, can live for several centuries or even over a thousand years. Their bark is notably thick and durable, providing protection against various diseases and harmful insects.

Oaks develop deep root systems, which help them effectively absorb water and nutrients from the soil. They grow best in well-drained soils with a pH between 6.0 and 7.5. However, some oak species are tolerant of more acidic soils (pH as low as 4.5) or more alkaline soils (pH up to 8.5). Most oaks thrive in temperate and tropical forests, though some species can survive in drier regions.

298 The description of beech was compiled using the following sources:
Peters, R. (1997). Beech forests: Woody species composition, populations and spatial aspects. Beech Forests, 89–130. https://doi.org/10.1007/978-94-015-8794-5_6.Peters, R. (2011). *Beech Forests*. Springer.
Evans, C. A., Lucas, J. A., & Twery, M. J. (2005). *Beech Bark Disease: Proceedings of the Beech Bark Disease Symposium*. https://doi.org/10.2737/ne-gtr-331.
Fagus grandifolia. (2022). In USDA Plants Database. Retrieved February 18, 2023, from https://plants.usda.gov/.

The optimal temperature range for oak growth is between 15°C and 27°C, with ideal humidity levels between 60% and 80%. Other important factors influencing their development include soil quality, altitude, and climate (e.g., rainfall levels).
Oaks play a vital environmental role and have a significant impact on ecosystems. They provide shelter and refuge for many animal species, such as birds, insects, and rodents. Their fruits—acorns—are a key food source for birds, squirrels, deer, and other animals. Oaks enhance biodiversity and are effective carbon sinks, storing carbon in their wood and leaves, thereby contributing to climate change mitigation. They also improve soil structure, enrich it with organic matter, and support nutrient cycling.
The genome size of oak trees is estimated at 836 Mb to 852 Mb. The average energy value of their dry biomass is about 18–19 MJ/kg. An oak tree producing around 150 kg of dry biomass annually could generate approximately 2,700 to 2,850 MJ of energy, equivalent to roughly 640,000 to 680,000 kilocalories.[299]
3. Black alder (*Latin: Alnus glutinosa*)
The black alder is a deciduous tree typically found in wetland environments near water sources such as rivers and marshes across much of Europe, Asia, and North America. It grows quickly and can reach up to 30 meters in height under favorable conditions. The bark of young trees is smooth and grayish-brown, becoming darker and rougher with age. Its leaves are oval, serrated, and dark green, measuring between 5 and 12 cm in length. The tree produces small, cone-like fruits that contain tiny seeds.
Black alders are highly beneficial to ecosystems. They help stabilize riverbanks and prevent excessive erosion. Their roots have the unique ability to fix nitrogen, enriching soils even in nutrient-poor areas. In addition, they provide vital habitats for a wide range of birds, mammals, and insects.
These trees can thrive in a broad range of soil pH levels (from 4.0 to 7.5), temperatures (from –30°C to +30°C), and humidity levels (70% to 80%). They also form a mutualistic symbiosis with

299 The description of oak trees was compiled using the following sources:
Oak trees. (2005). V*an Nostrand's Scientific Encyclopedia*. https://doi.org/10.1002/0471743984.vse5183.
Oak growth and ring measurement. (2014). *Tree-Ring Dating and Archaeology*, 44–67. https://doi.org/10.4324/9781315748689-14.
Koenig, W. D., & Haydock, J. (1999). Oaks, acorns, and the geographical ecology of Acorn Woodpeckers. *Journal of Biogeography*, 26(1), 159–165. https://doi.org/10.1046/j.1365-2699.1999.00256.x.
Morrison, G. (2000). *Oak Tree*. Houghton Mifflin Co.
Williams, A. P., Allen, C. D., Macalady, A. K., Griffin, D., Woodhouse, C. A., Meko, D. M., Swetnam, T. W., Rauscher, S. A., Seager, R., Grissino-Mayer, H. D., Dean, J. S., Cook, E. R., Gangodagamage, C., Cai, M., & McDowell, N. G. (2013). Temperature as a potent driver of regional forest drought stress and tree mortality. *Nature Climate Change*, 3(3), 292-297. https://doi.org/10.1038/nclimate1693.

certain species of Frankia bacteria, which live on their roots. These bacteria can fix atmospheric nitrogen and convert it into nitrates, which are essential for plant growth.

The seeds and buds of the black alder are a rich food source for various birds and mammals, including squirrels and deer, while the leaves feed many insects such as beetles, aphids, and caterpillars. Because black alders often grow along riverbanks, they also help improve water quality, which benefits fish and other aquatic life.

The black alder plays a key role in food chains. The amount of energy it produces and consumes through photosynthesis depends on factors like tree size, age, and environmental conditions. A black alder with a trunk diameter of 20 cm can produce between 30 kg and 50 kg of dry biomass per year through photosynthesis, which corresponds to approximately 540 to 570 MJ (130,000 to 140,000 kilocalories). The estimated genome size of the black alder is about 730 Mb.[300]

4. European hornbeam (*Latin: Carpinus betulus*)

The European hornbeam is a deciduous tree found in forests across Europe and Asia. It can grow up to 25 meters tall, with a trunk diameter reaching up to 80 cm. Its leaves are oval and serrated, turning yellow in autumn. The tree produces winged nutlets that ripen in the fall.

European hornbeams provide habitat for a variety of animal species, including birds, mammals, and insects. Environmentally, they are important for capturing carbon dioxide and producing oxygen through photosynthesis.

They also help regulate soil moisture and prevent unwanted erosion.

This tree is highly adaptable to different soil types, thriving in both sandy and clay-rich soils. It grows best in soils with a pH between 5.5 and 7.5 and is tolerant of a wide range of temperatures—from –30°C to +40°C. It can also withstand varying humidity levels, from 30% to 70%.

Hornbeams contribute to climate change mitigation by effectively storing atmospheric carbon. They also support water balance by absorbing and filtering rainwater. The leaves, bark, and other parts of the tree are an important food source for many animals, such as deer, rabbits, caterpillars, and birds.

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300 Description compiled using the following sources:
Dierschke, H. (1975). Black alder- (Alnus glutinosa-) riverside forests of Corse. *Phytocoenologia*, 2(3–4), 229–243. https://doi.org/10.1127/phyto/2/1975/229.
Heywood, V. H. (1993). *Flowering plants of the world*. Oxford University Press.
Claessens, H., Oosterbaan, A., Savill, P., & Rondeux, J. (2010). A review of the characteristics of black alder (Alnus glutinosa (L.) gaertn.) and their implications for Silvicultural Practices. *Forestry*, 83(2), 163–175. https://doi.org/10.1093/forestry/cpp038.
USDA NRCS. (2019). Alnus glutinosa (L.) *Gaertn. Plants Database*. Retrieved from https://plants.usda.gov/.
Striganavičiūtė, G., Sirgedaitė-Šėžienė, V., Šilanskienė, M. et al. (2024). Black alder's (Alnus glutinosa L.) defense against polycyclic aromatic hydrocarbons (PAHs). *Environmental Science and Pollution Research*. https://doi.org/10.1007/s11356-024-35017-8.
Abdi, E., Majnounian, B., Rahimi, H., & Zobeiri, M. (2009). Distribution and tensile strength of hornbeam (Carpinus betulus) roots growing on slopes of Caspian forests, Iran. *Journal of Forestry Research*, 20(2), 105–110. https://doi.org/10.1007/s11676-009-0019-x.

It is estimated that a European hornbeam with a trunk diameter of 30 cm can produce between 70 and 100 kg of dry biomass annually. The energy value of this biomass is approximately 1,260 to 1,330 MJ per year (300,000 to 320,000 kilocalories). The genome size of the European hornbeam is estimated to range from 1,400 Mb to 2,500 Mb.[301]

5. Bird cherry (*Latin: Prunus padus*)

Some species of bird cherry can grow between 15 and 21 meters tall, with trunk diameters ranging from 0.6 to 0.9 meters, while others remain shorter, growing as large shrubs or small trees. Their canopy is irregularly shaped, and they have short trunks with thick, gnarled bark. The leaves are green, oval, and serrated. Bird cherries produce small flowers and tiny fruits and often grow in colonies, which helps prevent soil erosion.

They thrive best in soils with a pH between 6.0 and 8.0 but are tolerant of a wider range—from acidic to alkaline soils. Bird cherries are highly resilient to varying temperature conditions (from –25°C to +40°C) and humidity levels (50% to 60%). They can grow in both cold and tropical or subtropical regions and tolerate both wet and dry soils. While they are well-adapted to full sunlight, they also grow successfully in shadier environments. These trees are found in a variety of habitats, including forests, savannas, riverbanks, and urban areas.

Bird cherries play an important ecological role by stabilizing soil, preventing excessive erosion, and aiding in water purification and storage. They also help reduce the risk of landslides, enrich the soil with organic matter, and improve soil structure and fertility. Their fruits and leaves are a vital food source and shelter for many animals such as birds, mammals (e.g., squirrels, raccoons, opossums), and insects. As primary producers, they are essential to food chains.

The genome size of the bird cherry is estimated at approximately 1.45 Gb. The amount of energy it can produce and consume through photosynthesis depends on factors such as tree age, size, growing conditions, and overall health. On average, a mature tree with a trunk diameter of 40 cm can produce between 100 and 150 kg of dry biomass per year through photosynthesis. This corresponds to an energy value of approximately 1,800 to 2,000 MJ, or about 430,000 to 450,000 kilocalories.[302]

6. Norway spruce (*Latin: Picea abies*)

The Norway spruce is an evergreen conifer native to northern and central Europe. It can grow to heights of 60 to 70 meters. These trees have a conical shape, straight trunk, and a narrow crown.

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301 Description compiled using the following sources:
Earle, C. J. (2021). Carpinus betulus Fact Sheet. *The Gymnosperm Database*.
United States Department of Agriculture (USDA). (2021). *Plants Database: Carpinus*. Retrieved from https://plants.usda.gov/.

302 Description compiled using the following sources:
Johns, C. A. The bird-cherry. (2014). *The Forest Trees of Britain*, 269–273. https://doi.org/10.1017/cbo9781107252509.011.
Prunus Padus (bird cherry). (2019). CABI Compendium. https://doi.org/10.1079/cabicompendium.44334.

They thrive best in colder regions with lower temperatures and abundant precipitation. Although they tolerate a wide range of soil pH values (from 3.5 to 7.5), they generally prefer more acidic conditions. Norway spruces most commonly grow in moist, well-drained soils.

They have a high tolerance for temperature fluctuations, ranging from –40 °C to +30 °C, but grow best at temperatures between +10 °C and +20 °C. They are also well-adapted to varying humidity levels (between 50% and 70%).

Like many tree species, Norway spruces play a crucial ecological role. They contribute to biodiversity by providing shelter for many animals such as squirrels, deer, and various insects. They also offer food in the form of cones and seeds. These trees absorb carbon dioxide from the atmosphere and store it in their wood and surrounding soil. They play a vital role in preventing erosion and improving soil structure and stability, especially in mountainous areas. Additionally, they help purify both air and water, which is essential for a healthy ecosystem.

The genome size of the Norway spruce is estimated to be around 20 Gb. A mature tree with a trunk diameter between 20 and 30 cm can produce between 20 and 40 kg of dry biomass annually through photosynthesis. This corresponds to an energy value of approximately 360 to 380 MJ (about 85,000 to 90,000 kilocalories).[303]

7. Pines (*Latin: Pinus spp.*)

Pines are evergreen conifers that thrive in a wide variety of habitats, including deserts, rainforests, and temperate forests. They can reach impressive heights, growing up to 100 meters tall. Pines produce cones containing numerous seeds, which serve as an important food source for many animals such as birds, squirrels, and bears. They also provide shelter and nesting sites for a wide range of wildlife.

From an ecological perspective, pines are highly valuable due to their ability to grow in extremely dry and nutrient-poor soils. They help stabilize and structure the soil, reducing the risk of erosion. Pines are exceptionally adaptable to a broad range of soil pH levels (from 4.5 to 7.5), temperatures (from –30 °C to +40 °C), and air humidity levels (from 40% to 60%). Like Norway spruces, they can absorb carbon dioxide from the atmosphere and store it in their wood and needles, contributing to climate regulation.

The genome size of pine trees is estimated to be approximately 22.18 Gb. On average, a mature pine with a trunk diameter of 20 to 30 cm can produce between 20 and 40 kg of dry biomass

303 Description compiled using the following sources:
Martinčič, A., Wraber, T., Jogan, J., Podobnik, A., Turk, B., Vreš, B., Ravnik, V., Frajman, Božo., Strgulc-Krajšek, S., Trčak, B., Bačič, M., Fischer, M. A., Eler, K., & Surina, B. (2010). *Mala Flora Slovenije : ključ Za Določanje Praprotnic in Semenk*. Tehniška založba Slovenije.
Tjoelker, M., Boratyński, A., & Bugała, W. (2019). *Biology and ecology of Norway Spruce*. Scholars Portal. https://link.springer.com/book/10.1007/978-1-4020-4841-8.

annually through photosynthesis. This biomass corresponds to an energy value of about 360 to 380 MJ (roughly 85,000 to 90,000 kilocalories). Not all of this energy is used for growth and biomass production—some is expended on respiration, water transpiration, and supporting other organisms in the ecosystem.[304]

8. Birches (*Latin: Betula spp.*)

Birches are deciduous trees most commonly found across the northern hemisphere. They thrive in boreal and temperate climates. Typically medium-sized, birches are known for their distinctive thin, white bark. Their leaves are triangular, serrated, and green, turning yellow in the autumn.

Depending on the species and growing conditions, birches can reach heights ranging from a few meters to up to 40 meters. Likewise, their trunk diameter can vary from around 10 cm to over 1 meter.

Birches grow best in soils with a pH between 5.0 and 7.5 and are tolerant of a wide range of temperatures. However, their optimal growth occurs at temperatures between +5 °C and +18 °C. They require adequate moisture for healthy development but can also withstand drier conditions, with humidity levels ranging from 40% to 70%.

Ecologically, birches are highly important as they provide habitat for many animals such as birds, insects, and small mammals. Their fallen leaves enrich the soil with organic matter and nutrients, improving soil health and structure while helping prevent erosion. Additionally, birches can absorb nitrogen from the air, contributing to increased soil fertility.

Birches serve as a food source for a variety of animals, including beavers, hares, deer, and moose, which feed on their leaves, twigs, and bark. Their foliage also provides sustenance for certain fungi and insect species.

The genome size of birches varies by species and is estimated to range between 313 Mb and 510 Mb. On average, a mature birch tree with a trunk diameter of 20 to 30 cm can produce about 20 to 30 kg of dry biomass per year through photosynthesis, equivalent to an energy value of around 360 to 380 MJ (approximately 85,000 to 90,000 kilocalories).[305]

9. Maples (*Latin: Sapindaceae*)

Like birches, maples are predominantly found in the Northern Hemisphere, particularly in the temperate regions of North America, Europe, and Asia. They can grow either as shrubs or as large trees reaching up to 44 meters in height. Their leaves are typically U- or V-shaped and display a stunning range of colors in autumn, including yellow, red, and pink.

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304 Gozd in Gozdarstvo. Gozd. https://www.gozd-les.com/slovenski-gozdovi/drevesa/javor (2025-02-14)

305 Description compiled using the following sources:
Zajc, R. (2017). *Rastne značilnosti navadne breze in trepetilke v suhi krajini: diplomsko delo*. Ljubljana: Biotehniška fakulteta. http://www.digitalna-knjiznica.bf.uni-lj.si/gozdarstvo/vs1_zajc_robert.pdf (2025-05-12).
Breza. https://www.mladirod.at/pdf/002721.pdf (2025-05-12).

Maples thrive best in soils with a pH between 5.5 and 7.5 and under moderately moist conditions. They are tolerant of a wide range of temperatures and humidity levels, from –40 °C to +32 °C and 30% to 70% relative humidity.

Environmentally, maples play a vital role. They provide habitat and food for many animals such as birds, squirrels, and insects (including ants and bees). Like other trees, they help prevent soil erosion and contribute to air purification. Importantly, they also help mitigate climate change by absorbing and storing atmospheric carbon.

Maples are a key food source for various consumers such as squirrels, deer, woodpeckers, aphids, caterpillars, and ladybugs. The genome size of maples is estimated to be between 1.5 Gb and 1.9 Gb.

On average, a mature maple tree with a trunk diameter of 20 to 30 cm can produce about 20 to 30 kg of dry biomass annually through photosynthesis. This biomass corresponds to an energy value of approximately 360 to 380 MJ per year (around 85,000 to 90,000 kilocalories). As with other trees, not all the energy produced is used solely for growth and biomass production—some is also used for transpiration, respiration, supporting other organisms, and various metabolic processes.[306]

It is possible that some of the described tree species coexist in the same natural environments, depending on various factors. Norway spruces and pines often grow together in forests and parks. In mixed deciduous forests, birches can commonly be found alongside maples and hornbeams.

The coexistence of these trees is strongly influenced by climate, air quality, soil health, and other specific regional factors such as humidity, the presence of other organisms, and herbivores.

When examining the descriptions of different trees, it becomes apparent that their genome sizes are often significantly larger than those of animals and humans. This large difference is most likely due to a combination of factors, including a greater number of cells, a broader need for adaptation to varying environmental conditions (such as light and soil pH), and the specific composition of their genetic material.

In terms of energy consumption and production, trees generally exhibit much higher values compared to animals and humans. However, it's important to note that making direct energy comparisons between trees, animals, and humans is quite complex, as they differ significantly in lifespan, size, and metabolic processes.

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306 Description compiled using the following sources:
Zhang, M., Luo, Y., Meng, Q., & Han, W. (2022). Correction of leaf nutrient resorption efficiency on the mass basis. Journal of Plant Ecology, 15(6), 1125–1132. https://doi.org/10.1093/jpe/rtac041.
Gozd in Gozdarstvo. *Gozd*. https://www.gozd-les.com/slovenski-gozdovi/drevesa/javorhttps://www.gozd-les.com/slovenski-gozdovi/drevesa/javor (2025-02-14).

5.5.4.2.2 Figure 462: Narrow selection of plants from various sampling locations

Figure 462 presents a narrower selection of plants from various soil sampling locations, such as DVT, TLV (garden soil), JPG, JPZ (forest soil), and SP, SPJ (riparian soil). The figure is followed by descriptions of the numbered plants labeled from 1 to 10.

1. Grasses (*Latin: Poaceae*):

Currently, around 12,000 different grass species are known. They are widespread across the globe and thrive in environments ranging from Arctic tundra and temperate continental climates to tropical rainforests.

Within Europe alone, various grass species grow, including meadow grass, Yorkshire fog, sweet vernal grass, timothy grass, and fescue.[307] Most European grasses prefer slightly acidic soil pH, although some species can tolerate slightly more alkaline conditions.

The suitable soil pH range for grasses spans from 4.5 to 8.0.[308]

European grasses thrive best in temperatures ranging from 15 °C to 25 °C and in air humidity levels between 50% and 70%.

307 Description compiled using the following sources:
Stapleton, C. M. A. (2021). Poaceae. In J. A. Langenheim (Ed.), *Encyclopedia of biodiversity* (pp. 267-274). Elsevier.
Poaceae. https://www.britannica.com/plant/Poaceae (2025-02-15)
Simpson, M. G. (2010). *Plant systematics* (2nd ed.). Elsevier Academic Press.
308 Description compiled using the following sources:
Crozier, C. R., & Hardy, D. H. (2005). *Soil acidity and liming: Basic information for farmers and Gardeners*. N.C. Cooperative Extension Service. https://content.ces.ncsu.edu/soil-acidity-and-liming-basic-information-for-farmers-and-gardeners.
Lemaire, G., Hodgson, J., Chabbi, A. (2011). *Grassland productivity and ecosystem services*. CABI.
Vitousek, P. M., & Sanford, R. L. Jr. (1986). Nutrient cycling in moist tropical forest. *Annual Review of Ecology and Systematics*, 17(1), 137-167.

Some grass species (e.g., meadow grass, sweet vernal grass, fescue) can also tolerate lower temperatures and higher humidity.[309] European common grasses are extremely important for ecosystems, as they support biodiversity and provide shelter and food for numerous living organisms (insects, birds, small mammals, etc.). These widely distributed plants significantly contribute to soil stabilization, erosion prevention, and the improvement of soil health and quality. European grasses play a key role in the efficient cycling of nutrients, ensuring sufficient soil fertility. By absorbing carbon dioxide from the atmosphere, they also help create a more stable climate. In addition, they are an important food source for domestic animals such as cows, horses, sheep, and others. In short, grasses are an essential component of many ecosystems.[310] Consumers of various European grasses are numerous, including domestic animals (e.g., cows, sheep), wild animals (e.g., birds, rodents, deer, insects), and humans, who use grasses for sports fields, wheat cultivation, and gardening. The genome size of European grasses ranges from approximately 3.3 Gb to 17 Gb.[311] The calorific value of grasses depends greatly on their moisture content, as drier grasses have a higher calorific value than wet ones. The approximate calorific values of common European grasses are as follows:

- Fresh grass: 3.5–4.5 MJ/kg (approximately 830–1070 kcal/kg)
- Dry grass (with 10% moisture content): 15–17 MJ/kg (approximately 3600–4100 kcal/kg)

In general, grasses have a lower calorific value than many other biomass sources (e.g., wood, coal). However, grasses offer advantages as a renewable resource that can be cultivated on marginal land, and they have a relatively low carbon footprint. It is also important to note that the actual amount of energy obtained from grasses depends on the efficiency of the conversion process. In biofuel production, some energy losses can occur during conversion.[312] Common European grasses can

309 Description compiled using the following sources:
Blaser, B. C., & Rasmussen, P. (2018). Climate and grassland systems. In *Grassland systems*: An ecosystem perspective (pp. 33-58). Cambridge University Press.
Lemaire, G., & Hodgson, J. (2019). *Grassland productivity and ecosystem services*. CABI.
310 Description compiled using the following sources:
Pol-van Dasselaar, A. van den, Bastiaansen-Aantjes, L., Bogue, F., O'Donovan, M., & Huyghe, C. (2019). Grassland use in Europe Agnes van den pol-van dasselaar, Leanne Bastiaansen-Aantjes, Fergus Bogue, Michael O'Donovan, Christian Huyghe, editors. éditions Quae. https://www.doi.org/10.35690/978-2-7592-3146-1.
Lemaire, G., & Hodgson, J. (2019). *Grassland productivity and ecosystem services*. CABI.
311 Description compiled using the following sources:
Díaz, S., & Cabido, M. (2001). Vive la différence: plant functional diversity matters to ecosystem processes. *Trends in ecology & evolution*, 16(11), 646-655.
Lemaire, G., & Hodgson, J. (2019). *Grassland productivity and ecosystem services*. CABI.
Bennett, M. D., & Leitch, I. J. (2010). Nuclear DNA amounts in angiosperms: targets, trends and tomorrow. *Annals of botany*, 107(3), 467-590.
312 Data obtained:
Ketzer, D., Rösch, C., & Haase, M. (2017). Assessment of sustainable grassland biomass potentials for energy supply in Northwest Europe. Biomass and Bioenergy, 100, 39–51. https://doi.org/10.1016/j.biombioe.2017.03.009.
Lewandowski, I., Scurlock, J. M. O., Lindvall, E., & Christou, M. (2003). The development and current status of perennial rhizomatous grasses as energy crops in the US and Europe. Biomass and Bioenergy, 25(4), 335–361. https://doi.org/10.1016/s0961-9534(03)00030-8.

have both positive and negative effects on climate change, particularly on the greenhouse effect. Positive impacts include carbon sequestration, while negative impacts involve methane emissions, gas releases from the manure of grazing animals, and the use of fertilizers and pesticides.[313]

2. Dandelions (*lat.: Taraxacum officinale*): There are approximately 100 different species of dandelions, primarily native to Asia and Europe, but today they are found worldwide. The plant has distinctive yellow flowers and deeply toothed leaves arranged in a rosette. Dandelions have been used for medicinal and culinary purposes for a long time.

Dandelions thrive best in slightly acidic to slightly alkaline soils (pH from 6.0 to 7.5), but they can also tolerate slightly more acidic or alkaline areas. They are very adaptable plants, growing well in a temperature range of 15 °C to 25 °C and air humidity of 40% to 60%. If they have access to moister soil, they can also thrive in somewhat drier environments. Dandelions are extremely important for ecosystems and significantly contribute to their functioning. They promote biodiversity by providing shelter and food for many animals, such as bees, butterflies, birds, and small mammals. They are an important source of nectar and pollen, which are utilized and spread by various pollinators. Additionally, they absorb carbon dioxide from the atmosphere and store it as carbon in their tissues. Dandelions also have remarkable adaptive abilities to climate change, which is particularly beneficial for the organisms that feed on them. They are known for contributing to the reduction of the urban heat island effect in city centers. Although they are not a major factor in climate change, they can indirectly influence the environment and the carbon cycle. Dandelions are an important food source for numerous organisms in food webs, including insects, birds, rabbits, marmots, deer, and humans. Their genome size ranges from 1.1 Gb to 1.6 Gb. Dandelions generate energy through photosynthesis, converting carbon dioxide and water into glucose and oxygen. It is estimated that a mature dandelion with a mass of 10 g (0.01 kg) can produce approximately 0.0001 MJ (24 cal) of energy per day through photosynthesis.[314]

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313 Garnett, T. (2009). Livestock-related greenhouse gas emissions: Impacts and options for policy makers. Environmental Science & Policy, 12(4), 491–503. https://doi.org/10.1016/j.envsci.2009.01.006.
Smith, P., Haberl, H., Popp, A., Erb, K. H., Lauk, C., Harper, R., ... & Bustamante, M. (2013). How much land-based greenhouse gas mitigation can be achieved without compromising food security and environmental goals? *Global Change Biology*, 19(8), 2285-2302. https://doi.org/10.1111/gcb.12160.
Zomer, R. J., Bossio, D. A., Sommer, R., & Verchot, L. V. (2017). Global sequestration potential of increased organic carbon in cropland soils. *Scientific Reports*, 7(1), 15554. https://doi.org/10.1038/s41598-017-15794-8.

314 Chatterjee, S. J., Ovadje, P., Mousa, M., Hamm, C., & Pandey, S. (2011). The efficacy of dandelion root extract in inducing apoptosis in drug-resistant human melanoma cells. *Evidence-Based Complementary and Alternativ Medicine*, 2011, 1-11. https://doi.org/10.1155/2011/129045.
Gruenwald, J., Brendler, T., & Jaenicke, C. (Eds.). (2007). *PDR for herbal medicines* (4th ed.). Thomson PDR.
Shittu, R. O., Ceesay, I., & Pwavodi, P. C. (2025). Antioxidant and antimicrobial activities of dandelion root extract (taraxacum officinale) and its cytotoxic effect on MDA-MB-231 breast cancer cells. *Discover Applied Sciences*, 7(2). https://doi.org/10.1007/s42452-024-06419-7.
Schütz, K., Carle, R., & Schieber, A. (2006). Taraxacum—a review on its phytochemical and pharmacological profile. *Journal of Ethnopharmacology*, 107(3), 313-323. https://doi.org/10.1016/j.jep.2006.07.021.

3. Grape vine (*lat. Vitis vinifera*): Grape vines have long stems and grow along the ground, often climbing with the help of trellises, fences, posts, or buildings. With their ability to cling using tendrils, they can crawl over various surfaces. Grape vines vary in shape, size, and color and are found almost worldwide.

Common species of grape vines include vine, blackthorn, jasmine, and morning glory. It is estimated that there are more than 10,000 different species of grape vines, including woody vines, herbaceous vines, climbing shrubs, and lianas. Grape vines thrive in soils with a pH between 6.0 and 7.0. The optimal temperature range for their growth and development is between 15 °C and 25 °C, while the ideal air humidity is between 50% and 70%. The grape vine plays an important ecological role. On one hand, it provides shelter and food for numerous animals, and on the other hand, it contributes to the conservation and stabilization of soil, thus preventing erosion. Some species of grape vines can improve soil fertility by fixing nitrogen. Like other plants, grape vines absorb carbon dioxide from the atmosphere, thus contributing to the regulation of the carbon cycle. Additionally, they promote biodiversity in ecosystems. Grape vines can have both positive and negative effects on climate change. If they absorb too much or too little carbon dioxide, it can affect the climate balance. Natural consumers of grape vines include various insects, birds, and mammals. The genome size of the grape vine is estimated to be approximately 0.487 Gb. The amount of energy the grape vine produces through photosynthesis is difficult to estimate precisely. According to some studies, a grape vine can produce between approximately 114,756 MJ and 161,000 MJ of energy per hectare annually.[315]

315 Description compiled using the following sources:
Speck, T., & Burgert, I. (2011). Plant stems: Functional design and Mechanics. *Annual Review of Materials Research*, 41(1), 169–193. https://doi.org/10.1146/annurev-matsci-062910-100425.
Reynolds, A., & Willwerth, J. J. (2020). Spatial variability in Ontario riesling vineyards: I. Soil, vine water status and Vine Performance. *OENO One*, 54, 311–333. https://doi.org/10.20870/oeno-one.2020.54.2.2401.
LI, Z.-N., LI, W., LIU, J.-L., NIU, R.-X., & QIN, Y. (2012). Effect of drip irrigation pattern on wine grape growth, yield, photosynthesis and water use efficiency in arid desert regions. *Chinese Journal of Eco-Agriculture*, 19(6), 1324–1329. https://doi.org/10.3724/sp.j.1011.2011.01324.
ROGIERS, S. Y., HARDIE, W. J., & SMITH, J. P. (2011). Stomatal density of grapevine leaves (vitis vinifera L.) responds to soil temperature and atmospheric carbon dioxide. *Australian Journal of Grape and Wine Research*, 17(2), 147–152. https://doi.org/10.1111/j.1755-0238.2011.00124.x.
Schnitzer, S. A. (2015). The contribution of Lianas to Forest Ecology, diversity, and Dynamics. *Sustainable Development and Biodiversity*, 149–160. https://doi.org/10.1007/978-3-319-14592-1_9.
Houghton, R. A. (2000). Emissions of carbon from land-use change. *The Carbon Cycle*, 63–76. https://doi.org/10.1017/cbo9780511573095.006.
Wan, S., Li, W., Zhu, Y., Liu, Z., Huang, W., & Zhan, J. (2014). Genome-wide identification, characterization and expression analysis of the auxin response factor gene family in Vitis vinifera. *Plant Cell Reports*, 33(8), 1365–1375. https://doi.org/10.1007/s00299-014-1622-7.
Clark, J. W., & Donoghue, P. C. J. (2018). Whole-genome duplication and Plant Macroevolution. *Trends in Plant Science*, 23(10), 933–945. https://doi.org/10.1016/j.tplants.2018.07.006.

4. Daisies (*lat. Bellis perennis*): It is estimated that there are up to 32,000 different species of daisies. In the Asteraceae family, along with the common or English daisy, there are also other plants such as sunflowers and dandelions.

Daisies are primarily found in Europe, North Africa, and some parts of Asia, but they are also present in other parts of the world. A common characteristic of all daisy species is that they consist of a flower head with a central disk surrounded by numerous ray flowers, which can be different colors (e.g., yellow, pink).

They bloom mostly in the spring and summer and are often seen decorating home gardens. English daisies thrive in soils with a pH value between 6.0 and 7.0 (they can also grow in a pH range from 5.5 to 7.5).

They grow in a temperature range from 5 °C to 25 °C and in humidity levels between 50% and 70%. English daisies are very important for ecosystems for various reasons. They provide a welcome source of food for beneficial insects such as butterflies and bees, stabilize the soil and prevent erosion, provide habitat for many animals (e.g., birds, small mammals, insects), and contribute to the aesthetics of home gardens.

The impact of English daisies on climate change is mostly potential or indirect. Their positive effects include storing carbon from the atmosphere, regulating temperature in urban areas, reducing the effects of flooding and erosion, and promoting biodiversity in ecosystems. Consumers of English daisies are numerous, including wild animals (e.g., insects, birds, small mammals), domesticated animals (e.g., sheep, cattle), and humans. Their genome size is estimated to be approximately 1.6 Gb. English daisies produce about 0.72 MJ/kg (approximately 239,000 cal) of energy through photosynthesis.[316]

5. Buttercup (*lat.: Ranunculus acris*): This is an extremely toxic plant that grows to a height of 30 cm to 80 cm. It is primarily found in Europe and Asia, growing in meadows, pastures, and open forests. It blooms from May to August, with its flowers being pollinated by insects. The flowers are bright yellow, with wide petals and a fibrous root system.

The buttercup thrives in soils with pH values ranging from 5.0 to 8.0, but it develops best in soils with a pH value between 6.0 and 7.5. The optimal temperature range for its growth is from 10 °C to

316 Description compiled using the following sources:
Bellis perennis (common daisy). (2019). CABI Compendium. https://doi.org/10.1079/cabicompendium.8874.
Albien, A.-L., & Stark, T. D. (2023). (bio)active compounds in Daisy Flower (Bellis perennis). *Molecules*, 28(23), 7716. https://doi.org/10.3390/molecules28237716.
Leszczuk, A., Szczuka, E., Lewtak, K., Chudzik, B., & Zdunek, A. (2021). Effect of low temperature on changes in AGP distribution during development of Bellis perennis ovules and anthers. *Cells*, 10(8), 1880. https://doi.org/10.3390/cells10081880.
Jaedicke, K., Rösler, J., Gans, T., & Hughes, J. (2011). Bellis perennis: A useful tool for protein localization studies. *Planta*, 234(4), 759–768. https://doi.org/10.1007/s00425-011-1443-7.

20 °C, although it can tolerate temperatures between -5 °C and +30 °C. It grows in areas with higher humidity, ranging from 60% to 90%, according to some studies.
The plant is beneficial to the ecosystem as it provides food and habitat for various insects, birds, and small mammals. On the other hand, the buttercup can displace native plants, and thus it is also referred to as an invasive species.
The impact of these plants on climate change is minor and only indirect, mainly through the storage of carbon via photosynthesis. Insects feed on their leaves, stems, flowers, and even seeds (e.g., beetles, caterpillars, weevils). Birds mainly consume their seeds (e.g., finches, sparrows), while smaller mammals, such as rabbits and hares, feed on the leaves and stems.
The size of their genome is estimated to be between 0.1 Gb and 0.23 Gb. They produce approximately 600 MJ of energy annually (around 14,000 cal) through photosynthesis.[317]
6. Broad-leaved cattail (lat.: Typha latifolia) originates from North America, Europe, and Asia, and typically grows in wetlands, marshes, and along the edges of water sources such as ponds, lakes, and slow-moving streams. It can grow up to three meters in height, with narrow leaves and brownish, cylindrical flower heads that appear in late spring or early summer.
They thrive in soils with a pH value between 6.0 and 7.5, although they can tolerate pH values ranging from 5.0 to 8.0. They are resistant to both low and high temperatures, but they grow best in temperatures between 10 °C and 20 °C and with air humidity between 70% and 80%. Broad-leaved cattails are important plants for the ecosystem because they improve water quality, store carbon from the atmosphere, provide shelter for various animal species (e.g., insects, birds, amphibians, and reptiles), stabilize soils, and prevent erosion and sedimentation. Additionally, they contain a high proportion of cellulose, which makes them useful for bioenergy production. They play an important role in mitigating climate change.
Broad-leaved cattails are also a significant food source for many birds (e.g., red-winged blackbirds, marsh sparrows), insects (e.g., dragonflies, flies), mammals (e.g., beavers, humans), and fish (e.g., bass). They can be classified as riparian plants since they are not typical terrestrial plants. They are described here because a soil sample (SPJ) was taken near them. The size of their genome is

317 Description compiled using the following sources:
Ranunculus acris (meadow buttercup). (2019). CABI Compendium. https://doi.org/10.1079/cabicompendium.46766.
Fröst, S. (2009). The meiotic behaviour of accessory chromosomes in ranunculus acris. *Hereditas*, 62(3), 421–425. https://doi.org/10.1111/j.1601-5223.1969.tb02250.x.
Bourdôt, G. W., Saville, D. J., & Crone, D. (2003). Dairy production revenue losses in New Zealand due to giant buttercup (ranunculus acris). *New Zealand Journal of Agricultural Research*, 46(4), 295–303. https://doi.org/10.1080/00288233.2003.9513557.
Totland, Ørjan. (1999). Effects of temperature on performance and phenotypic selection on plant traits in Alpine Ranunculus acris. *Oecologia*, 120(2), 242–251. https://doi.org/10.1007/s004420050854.
Winter, D. J. (2003). *Stress tolerance of Ranunculus acris and Sanguisorba officinalis*. University of Groningen. Available at https://fse.studenttheses.ub.rug.nl/9174/1/Biol_Ma_2003_DJWinter.CV.pdf.

estimated at around 1.2 Gb. Their caloric value ranges from 18 MJ/kg to 20 MJ/kg (43,000 to 48,000 cal), which translates to approximately 180 GJ to 200 GJ per hectare annually.[318]

7. English ryegrass (*lat.: Lolium perenne*) is a type of grass that naturally grows primarily in Europe, Asia, and North Africa, but is also found in North and South America and Australia. These plants are quite resistant to mechanical stress and have a dark green color with a fine texture. They typically grow to a height of about 30 cm to 60 cm and have a shallow root system, making them thrive best in moist soils with good drainage. English ryegrass grows best in soils with a pH between 5.5 and 7.5, but it can tolerate pH values from 4.5 to 8.0. The optimal temperature for its growth is between 15 °C and 24 °C, and it thrives at air humidity levels between 50% and 70%. They are beneficial to ecosystems as they help reduce erosion and stabilize soil structure. Additionally, they can contribute to reducing greenhouse gas effects and store carbon from the atmosphere in the soil, which aids in mitigating climate change. English ryegrass is an important food source for both domestic animals (e.g., cows, sheep, horses) and wild animals (e.g., deer, wild boars, rabbits, rodents). The size of their genome is estimated to be between 5.5 Gb and 9.2 Gb. Their caloric value ranges from 17 MJ/kg to 19 MJ/kg (approximately 4,250 cal), which means they can contribute about 180 GJ to 200 GJ of energy per hectare annually.[319]

8. Galinsoga (*lat.: Galinsoga ciliata*) originates from South America but has spread to North America, Europe, and Asia. It can grow up to 80 cm in height and has green, hairy leaves and yellow-white flowers that somewhat resemble daisies. The optimal pH value of the soil for its growth is between 6.0 and 7.5. It thrives best at temperatures between 20 °C and 25 °C but can tolerate temperatures ranging from 0 °C to 30 °C. For optimal development, it requires air humidity between 60% and 80%.

In its invasive form, it can negatively impact ecosystems. As an invasive plant, it can displace native plant species, thereby reducing the amount of carbon stored in roots and soil. The consumers that feed on Galinsoga are less well-known, but these plants provide shelter to various insects (e.g.,

318 Description compiled using the following sources:
Ciria, M. P., Solano, M. L., & Soriano, P. (2005). Role of macrophyte Typha latifolia in a constructed wetland for wastewater treatment and assessment of its potential as a biomass fuel. *Biosystems Engineering*, 92(4), 535–544. https://doi.org/10.1016/j.biosystemseng.2005.08.007.
Kumari, M., & Tripathi, B. D. (2015). Efficiency of phragmites australis and Typha latifolia for heavy metal removal from wastewater. Ecotoxicology and Environmental Safety, 112, 80–86. https://doi.org/10.1016/j.ecoenv.2014.10.034.
Sullivan, J. (2008). Typha latifolia. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory.
Clements, D. (2010). *Typha latifolia (broadleaf cattail)*. CABI Compendium. https://doi.org/10.1079/cabicompendium.54297.

319 Description compiled using the following sources:
Popay, I. (2013). *Lolium Perenne (perennial ryegrass)*. CABI Compendium. https://doi.org/10.1079/cabicompendium.31166.
https://identify.plantnet.org/sl/k-world-flora/species/Lolium%20perenne%20L./data (2025-02-15).
Christians, N. E., & Jones, M. (2012). *Perennial Ryegrass Study.* https://doi.org/10.31274/farmprogressreports-180814-2514.

bees) and spiders. The size of their genome is estimated to be around 1.5 Gb. There is no available data on energy production in megajoules (MJ) for this plant species, as this area is less studied.[320]

9. English Ivy (lat.: Hedera helix) is an extremely expansive evergreen plant that can grow up to 50 meters in length. It typically requires support for growth, such as walls or trees, but can also spread across the ground. Its leaves are light green during the early stages of growth, darkening as they age. The lower leaves are heart-shaped, while the upper ones are oval. The flowers are light green and gathered in umbels. It thrives in soil with a pH value between 6.0 and 7.5. The optimal growth conditions are temperatures between 10 °C and 25 °C and air humidity between 40% and 60%.

As an invasive species, English Ivy can be harmful to ecosystems as it displaces native plants, reducing biodiversity, which negatively impacts animals that depend on those plants. Additionally, its excessive growth can alter the chemical composition of the soil and reduce the efficiency of nutrient cycling. Despite this, it can also have positive effects on ecosystems, as it provides shelter for various animals and is an important food source for different birds and insects. English Ivy can influence microclimatic conditions as it can decrease the amount of carbon stored in plants and soil. Various insects (e.g., aphids, spider mites), birds (e.g., tits, thrushes), and mammals (e.g., deer, rabbits) feed on English Ivy. The size of its genome is estimated to be between 1.3 Gb and 1.5 Gb. The energy value of English Ivy biomass is estimated to range from 16.2 MJ/kg to 20.7 MJ/kg (3891–4967 cal/g).[321]

10. Stinging nettle (*lat.: Urtica dioica*) can grow to a height of 50 cm to 150 cm. The stems of this plant are square-shaped and covered with tiny hairs. The tips of the hairs contain formic acid. The flowers are either female or male, with greenish-white shades, and they bloom from May to July. It grows in North America, Europe, Asia, and Africa in moist, fertile soils on fields, meadows, in forests, and along riverbanks. It thrives in soils with pH values between 5.0 and 7.5, at temperatures between 15 °C and 25 °C, and with air humidity ranging from 40% to 70%.

In its natural expansion, stinging nettle can positively impact ecosystems by contributing to soil fertility and biodiversity. Its effect on climate change is primarily potential in terms of carbon storage in the soil. Nettle is consumed by various organisms, including insects (e.g., aphids,

320 Description compiled using the following sources:
Fu, R., & Ashley, R. A. (2006). Interference of large crabgrass (Digitaria sanguinalis), Redroot Pigweed (Amaranthus retroflexus), and hairy galinsoga (galinsoga ciliata) with Bell Pepper. *Weed Science*, 54(02), 364–372. https://doi.org/10.1614/ws-05-053r1.1.
https://www.urbanatura.si/vsebina/2375/Vejicati-rogovilcek (2025-02-15).
Kucewicz, M., Gojło, E., & Kowalska, A. (2012). The effect of achene heteromorphism on progeny traits in the shaggy soldier [galinsoga ciliata (Rafin) S. F. blake]. *Acta Agrobotanica*, 63(2), 51–56. https://doi.org/10.5586/aa.2010.032.
321 Description compiled using the following sources:
Metcalfe, D. J. (2005). Hedera helix L. *Journal of Ecology*, 93(3), 632–648. http://www.jstor.org/stable/3599428.
Süleyman, H., Mshvildadze, V., Gepdiremen, A., & Elias, R. (2003). Acute and chronic antiinflammatory profile of the ivy plant, Hedera helix, in rats. *Phytomedicine*, 10(5), 370–374. https://doi.org/10.1078/0944-7113-00260.
Ivy (Hedera helix). https://www.woodlandtrust.org.uk/trees-woods-and-wildlife/plants/wild-flowers/ivy/ (2025-02-15).

caterpillars, beetles, butterflies), birds (e.g., finches, sparrows), and mammals (e.g., deer, rabbits, humans). Its genome size is estimated to be approximately 611 Mb. The energy value of the dry biomass of this plant ranges from 18.62 MJ/kg to 19.42 MJ/kg (from 4453 cal/g to 4643 cal/g).[322]

11. Mosses (*lat.: Bryophyta*) are evergreen, soft plants that grow from one to ten centimeters in height. They grow in dense clusters and do not have seeds or flowers, which is why they are classified as lower plants. Mosses are found on all continents of the world, including Antarctica. They appear in various habitats, ranging from tundra, shady and humid forests, bogs, wetlands, to urban centers.

Mosses can tolerate both acidic and alkaline soils, but they thrive best in soils with pH values between 5.0 and 7.0. The plants can survive in extremely harsh temperature conditions, from below freezing to 30 °C, with the optimal temperature range being between 10 °C and 25 °C. They also grow well in extremely moist conditions, with air humidity ranging from 60% to 100%.

Mosses are essential for various ecosystems, as they provide nutrients both for living organisms and for the soil. They contribute to proper water circulation and are known as indicators of a healthy environment, as they are highly sensitive to changes in air and water quality. They play an important role in climate change by storing carbon from the atmosphere and regulating the water cycle. As a result, they reduce erosion and increase the ability of soil to retain water.

Mosses are an important food source for many invertebrates, such as snails and insects, and are also consumed by certain insects and mammals, such as deer and caribou. The size of their genome is estimated to be between 280 Mb and 1.8 Gb. Through photosynthesis, they can produce energy ranging from 12 MJ/kg to 24 MJ/kg of dry matter (from 2868 cal/g to 5721 cal/g).[323]

322 Description compiled using the following sources:
Foster, S., & Duke, J. A. (2014). *Peterson field guide to medicinal plants and herbs of eastern and central North America*. Houghton Mifflin Harcourt.
Mohammadian, M., Biregani, Z. M., Hassanloofard, Z., & Salami, M. (2024). Nettle (Urtica dioica L.) as a functional bioactive food ingredient: Applications in food products and edible films, characterization, and Encapsulation Systems. *Trends in Food Science & Technology*, 147, 104421. https://doi.org/10.1016/j.tifs.2024.104421.
Bokelmann, J. M. (2022). Stinging nettle/nettles/nettle (Urtica dioica, Urtica urens). *Medicinal Herbs in Primary Care*, 599–607. https://doi.org/10.1016/b978-0-323-84676-9.00071-4.
Jeannin, T., Yung, L., Evon, P., Labonne, L., Ouagne, P., Lecourt, M., Cazaux, D., Chalot, M., & Placet, V. (2020). Native stinging nettle (Urtica dioica L.) growing spontaneously under short rotation coppice for phytomanagement of trace element contaminated soils: Fibre yield, processability and quality. *Industrial Crops and Products*, 145, 111997. https://doi.org/10.1016/j.indcrop.2019.111997.
Flood, P. J., & Hancock, A. M. (2017). The genomic basis of adaptation in plants. *Current Opinion in Plant Biology*, 36, 88–94. https://doi.org/10.1016/j.pbi.2017.02.003.
Scarlat, N., Martinov, M., & Dallemand, J.-F. (2010). Assessment of the availability of agricultural crop residues in the European Union: Potential and limitations for bioenergy use. *Waste Management*, 30(10), 1889–1897. https://doi.org/10.1016/j.wasman.2010.04.016.

323 Description compiled using the following sources:
Vicherová, E., Hájek, M., & Hájek, T. (2015). Calcium intolerance of Fen Mosses: Physiological evidence, effects of nutrient availability and successional drivers. *Perspectives in Plant Ecology, Evolution and Systematics*, 17(5), 347–359. https://doi.org/10.1016/j.ppees.2015.06.005.
Tyler, T., & Olsson, P. A. (2016). Substrate ph ranges of south Swedish bryophytes—identifying critical ph values and richness patterns. *Flora*, 223, 74–82. https://doi.org/10.1016/j.flora.2016.05.006.

12. Ferns (*lat.: Pteridophyta, Filicophyta*) – Currently, around 20,000 different species of ferns are known, which are classified as higher plants because they have true leaves, but they lack flowers and seeds. They reproduce through spores. These plants are found worldwide, including Antarctica. The bracken fern (lat.: Pteridium aquilinum) is found in more acidic, open forests, wetlands, burned areas, abandoned land, and even in gardens (a more detailed description of this species will follow). It thrives in soils with pH values between 5.5 and 7.5. It tolerates temperatures from 5 °C to 35 °C, but it develops best in a temperature range between 15 °C and 25 °C. For optimal growth, it requires air humidity between 70% and 90%, although it can survive at lower values.

Bracken fern has a positive impact on animals as it provides shelter and food, but it can also negatively affect the biodiversity of plant life. Indirectly, it can influence climate change by contributing to carbon storage from the atmosphere.

This fern species is consumed by various animals, including insects (e.g., butterflies, grasshoppers, crickets), birds (e.g., grouse, wild turkeys), reptiles and amphibians (e.g., lizards, newts), and mammals (e.g., deer, rabbits, rodents). The size of its genome is estimated to be around 32.3 Gb. The energy value produced by these plants through photosynthesis ranges from 20 MJ/kg to 25 MJ/kg (from 4800 cal/g to 6000 cal/g).[324]

It is possible that the described plants occur in the same natural environment, which depends on various factors such as climate, consumers, soil type, humidity, light exposure, and human interventions (e.g., air pollution). These plants belong to different groups, so they can coexist without significant competition. This is especially true for many species of grasses, which are highly adaptable and can grow in various environments, such as wetlands, meadows, forests, and gardens.

Vitt, D. H., & House, M. (2021). Bryophytes as key indicators of ecosystem function and structure of northern peatlands. *Bryophyte Diversity and Evolution*, 43(1). https://doi.org/10.11646/bde.43.1.18.
Lightowlers, P. (2009). The illustrated moss flora of Antarctica. *Journal of Bryology*, 31(2), 143–144. https://doi.org/10.1179/174328209x413286.
Hohenwallner, D., & Zechmeister, H. G. (2001). Factors influencing bryophyte species richness and populations in urban environments: A case study. *Nova Hedwigia*, 73(1–2), 87–96. https://doi.org/10.1127/nova.hedwigia/73/2001/87.
Turetsky, M. R. (2003). The role of bryophytes in Carbon and Nitrogen Cycling. *The Bryologist*, 106(3), 395–409. https://doi.org/10.1639/05.
Magill, R. E. (2014). Moss diversity: New look at old numbers. *Phytotaxa*, 9(1), 167. https://doi.org/10.11646/phytotaxa.9.1.9.
Stech, M., Camara, P. E. A. S., Medina, R., & Munoz, J. (2021). Advances and challenges in bryophyte biology after 50 years of International Association of bryologists. *Bryophyte Diversity and Evolution*, 43(1). https://doi.org/10.11646/bde.43.1.4.
All about bryophytes. https://expeditions.fieldmuseum.org/early-land-plants/all-about-bryophytes (2025-02-16).

324 Description compiled using the following sources:
Vetter, J. (2009). A biological hazard of our age: Bracken fern [pteridium aquilinum (L.) kuhn] — a review. *Acta Veterinaria Hungarica*, 57(1), 183–196. https://doi.org/10.1556/avet.57.2009.1.18.
Rédei, G. (2005). *Encyclopedic Dictionary of Genetics, genomics, and proteomics*. J. Wiley & Sons. https://doi.org/10.1002/0471684228.
Marrs, R. H., & Watt, A. S. (2006). Biological flora of the British Isles: pteridium aquilinum (L.) kuhn. *Journal of Ecology*, 94(6), 1272–1321. https://doi.org/10.1111/j.1365-2745.2006.01177.x.

From the descriptions of these plants, it can be observed that the size of their genomes is significantly smaller than that of trees, but compared to animals, including humans, they are often larger. One reason for this could be that, unlike animals, plants are stationary and cannot escape environmental impacts. As a result, many plants have developed larger genomes that allow them to adapt to different environmental conditions.

The consumption and production of energy in plants depend on factors such as the efficiency of photosynthesis, the rate of respiration, nutrient availability, and environmental conditions. Compared to animals and bacteria, the described plants have a lower metabolic rate and require less energy, as they effectively utilize solar energy and are capable of producing their own food through carbon fixation, which is essential for life. As a result, they are less dependent on external energy sources.

Additionally, they have developed numerous mechanisms to optimize the efficiency of photosynthesis, which can be limited by various environmental factors such as temperature, light exposure, rainfall, etc. On the other hand, these plants must allocate a significant portion of their energy to growth, reproduction, and defense against pathogens and pests. In general, it is true that these plants produce and consume less energy than many other living organisms, such as bacteria, mammals, insects, reptiles, birds, etc.

5.5.4.3 Terrestrial animals

This subsection will present terrestrial animals in relation to the soils that were studied. It should be emphasized that many species of terrestrial animals are only indirectly or loosely dependent on the type of soil. Only a selected range of terrestrial animals will be discussed, including decomposers, insects, spiders, mollusks, reptiles, birds, and mammals.

Descriptions of the selected species will include information on their tolerance to soil pH, temperature, light, moisture, and diet. Additionally, data on their environmental impact, role in the food chain, genome size, and energy content will also be presented.

A. Decomposers

Decomposers are organisms that break down plant and animal remains in the soil. This section will present a smaller selection of decomposers, as shown in the following image.

5.5.4.3.1 Figure 463: A small selection of decomposers in the soil

Figure 463 shows a small selection of decomposers in the soil, including common earthworms, common pill bugs, common dung beetles, millipedes, large garden snails, and fly larvae.

1. Common earthworm (*lat.: Lumbricus terrestris*)

Common earthworms originate from Europe but are now found nearly worldwide. They are hermaphrodites and live in moist soils. They feed just below the soil surface on decaying organic matter, such as dead leaves, although they also dig relatively deep tunnels. There have been reports of common earthworms growing up to 55 cm in length, but they typically range from 15 cm to 25 cm long and 0.5 cm to 1.0 cm in diameter.

Common earthworms can survive in soils with pH values between 5.0 and 8.0, but they thrive best at a pH between 6.5 and 7.5. Their optimal living conditions are temperatures between 10°C and 25°C and soil moisture levels between 60% and 80%.

They are incredibly important to ecosystems, as they enhance soil fertility, improve nutrient cycling, strengthen soil structure, and promote plant growth. Additionally, they are a key food source for numerous animals, especially insects (e.g., beetles, centipedes), reptiles (e.g., lizards, snakes), amphibians (e.g., frogs), birds (e.g., thrushes, robins, starlings), and mammals (e.g., moles, voles, hedgehogs, shrews, mice, and even humans).

Common earthworms can indirectly influence climate change by participating in carbon storage in soils, although they can also contribute to greenhouse gas emissions, such as carbon dioxide and nitrous oxide. Their genome size is estimated to be approximately 2.5 Gb. The energy content of common earthworms ranges from 20 kJ/g to 30 kJ/g (from 5 cal/g to 7 cal/g).[325]

2. Common rough woodlouse (lat.: Porcellio scaber) is a species of isopod crustacean commonly found in gardens and near buildings. They grow up to about two centimeters in length and are mostly gray in color. Originally native to Central and Western Europe, they have spread to other continents, such as North America, South Africa, and Australia.

They primarily feed on decaying plant material but occasionally consume fresh plant tissue as well. To maintain their exoskeleton, they require calcium carbonate, which is why they are often found in more alkaline soils and near house walls or other concrete structures.

Their impact on the ecosystem is mostly positive. They are an important food source for various mammals, birds (such as the European robin, blackbird, and sparrows), and some invertebrates (e.g., centipedes), thus contributing to greater biodiversity. Additionally, they help break down organic matter in the soil, improving nutrient cycling, which benefits plant growth.

Their influence on climate change is indirect, as they contribute to carbon storage in the soil and help maintain healthy ecosystems. Common rough woodlice can survive in slightly acidic to

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325 Description compiled using the following sources:
Schon, N. L., Mackay, A. D., Gray, R. A., van Koten, C., & Dodd, M. B. (2017). Influence of earthworm abundance and diversity on soil structure and the implications for soil services throughout the season. *Pedobiologia*, 62, 41–47. https://doi.org/10.1016/j.pedobi.2017.05.001.
Yadav, R., Kumar, R., Gupta, R. K., Kaur, T., Kiran, Kour, A., Kaur, S., & Rajput, A. (2023). Heavy metal toxicity in earthworms and its environmental implications: A Review. *Environmental Advances*, 12, 100374. https://doi.org/10.1016/j.envadv.2023.100374.
Karaca, A. (2011). *Biology of earthworms*. Springer Berlin Heidelberg.
S, K.K., Ibrahim, M.H., Quaik, S., Ismail, S.A. (2016). *General Introduction to Earthworms, Their Classifications, and Biology.* In: Prospects of Organic Waste Management and the Significance of Earthworms. Applied Environmental Science and Engineering for a Sustainable Future. Springer, Cham. https://doi.org/10.1007/978-3-319-24708-3_4.
Blouin, M., Hodson, M. E., Delgado, E. A., Baker, G., Brussaard, L., Butt, K. R., Dai, J., Dendooven, L., Peres, G., Tondoh, J. E., Cluzeau, D., & Brun, J. -J. (2013). A review of earthworm impact on soil function and ecosystem services. *European Journal of Soil Science*, 64(2), 161–182. https://doi.org/10.1111/ejss.12025.

alkaline soils, but they thrive best at pH levels between 6.5 and 7.0. They prefer environments with moderate temperatures (between 20 °C and 25 °C) and relative humidity around 60%.
The size of their genome is not yet fully studied but is estimated to be around 700 Mb. Their energy content is estimated at approximately 15 kJ/g or 3.6 kcal/g.[326]
3. Common dor beetles (*lat.: Geotrupes stercorarius*) are a species of beetle with a dark blue metallic color, measuring about 2.5 cm in length. They primarily feed on the feces of herbivorous animals. In spring, mating pairs of dor beetles dig burrows up to half a meter deep, where the females lay their eggs in small piles of dung. The larvae feed on the organic matter underground and, after about a year, pupate and transform into adult beetles.
They are mostly found in hilly regions of the subalpine zones of Europe. They thrive in soils with a pH between 6.5 and 7.5, temperatures ranging from 10 °C to 30 °C, and a relative soil humidity between 60% and 80%.
In optimal numbers, common dor beetles are extremely important for ecosystems. They contribute to nutrient recycling in the soil and improve its health. By digging burrows, they enhance soil aeration and promote water infiltration.
They are an important food source for many birds (e.g., the European roller, bee-eater, great spotted woodpecker), insects (e.g., wasps, ants, flies), and small mammals (e.g., hedgehogs, foxes, wild boars, roe deer). However, in large populations, they can do more harm than good to the ecosystem. Common dor beetles may indirectly affect climate change, as their activity contributes to the release of carbon dioxide into the atmosphere. Their genome size is estimated at approximately 287 Mb. The energy content of an average-sized beetle is around 0.5 J/g.[327]

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326 Description compiled using the following sources:
Capinera, J. L. (2020). *Handbook of vegetable pests*. Academic Press, an imprint of Elsevier.
Hassall, M. (2002). Effects of spatial heterogeneity on feeding behaviour of porcellio scaber (Isopoda: Oniscidea). *European Journal of Soil Biology*, 38(1), 53–57. https://doi.org/10.1016/s1164-5563(01)01124-4.
Dolar, A., Petrišič, T., Drobne, D., & Jemec Kokalj, A. (2024). Response of the terrestrial isopod porcellio scaber to lipopolysaccharide challenge after microplastic and insecticide exposure. *Science of The Total Environment*, 925, 171698. https://doi.org/10.1016/j.scitotenv.2024.171698.
Gunn, D. L. (1937). The humidity reactions of the wood-louse,porcellio scaber(latreille). *Journal of Experimental Biology*, 14(2), 178–186. https://doi.org/10.1242/jeb.14.2.178.
Den Boer, P. J. (1962). The ecological significance of activity patterns in the Woodlouse porcellio scaber latr. (Isopoda). *Archives Néerlandaises de Zoologie*, 14(3), 283–409. https://doi.org/10.1163/036551661x00070.
327 Description compiled using the following sources:
Audova, A. (1929). Thanatose des Grossen Rosskäfers geotrupes Stercorarius L. *Zeitschrift Für Morphologie Und Ökologie Der Tiere*, 13(3–4), 722–744. https://doi.org/10.1007/bf00408546.
Guide to British Dung Beetles: GEOTRUPIDAE (Dor beetles).
https://quelestcetanimal-lagalerie.com/wp-content/uploads/2017/04/geotrupidae_lr_web.pdf (2025-02-16).
Twist, C. (2006). *Dung beetles*. Gareth Stevens Pub.
Mota, A. A., Carvalho, E., Correa, C. M., & Vaz-de-Mello, F. Z. (2023). Identification guide of dung beetle species (Coleoptera: Scarabaeidae: Scarabaeinae) of the Brazilian pantanal. *Biota Neotropica*, 23(2).
https://doi.org/10.1590/1676-0611-bn-2022-1443.
Visual Guide to Dung Beetles. https://cals.cornell.edu/new-york-state-integrated-pest-management/eco-resilience/beneficial-insects/visual-guide-dung-beetles (2025-02-16).

4. European garden millipedes (*lat.: Ommatoiulus sabulosus*) are a species of millipede commonly found in domestic gardens throughout Europe. They grow to a length of 3 to 4 centimeters and are gray to brownish in color, with a cylindrical body made up of segments. Each segment has two pairs of legs, which is why they are also called diplopods. They move slowly and are more active at night. They primarily feed on decaying plant matter.

They inhabit moist environments such as well-watered gardens, damp forests, meadows, and riverbanks. They thrive in soils with a pH between 6.0 and 8.0. Since they spend most of their lives underground, they prefer soil temperatures between 10 °C and 30 °C and moisture levels between 70% and 90%.

They are an important food source for a variety of predators, including insects (e.g., ground beetles), birds (e.g., thrushes, blackbirds), amphibians (e.g., toads), and reptiles (e.g., brown snakes, common wall lizards). In optimal numbers, garden millipedes play an important role in nutrient cycling and improving soil structure. However, when populations become too large, they can cause damage to plants, including agricultural crops.

Their impact on climate change is indirect, as they contribute to the release of greenhouse gases and the stabilization of carbon in the soil, although this area is still insufficiently researched. The size of their genome is estimated to be approximately 2.1 Gb. The energy content of an average-sized garden millipede is estimated to range between 23.46 KJ/g and 28.93 KJ/g (5.6 kcal/g to 6.9 kcal/g).[328]

5. Roman snails (*lat.: Helix pomatia*) breathe through lungs and can grow up to eight centimeters in length. Their shells range from three to five centimeters in height and from three to 4.5 centimeters in width. They are hermaphrodites and lay eggs that measure between 5.5 mm and 6.5 mm. Within a few weeks, small snails hatch from the eggs already equipped with their shells.

They live in environments with consistent humidity (around 80%) and mild temperatures (between 15 °C and 20 °C), primarily in vineyards, gardens, and parks. They thrive best in soils with a pH between 7.5 and 8.2.

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328 Description compiled using the following sources:
Stašiov, S., Vician, V., Benčať, T., Pätoprstý, V., Lukáčik, I., & Svitok, M. (2021). Influence of soil properties on millipede (diplopoda) communities in forest stands of various tree species. *Acta Oecologica*, 113, 103793. https://doi.org/10.1016/j.actao.2021.103793.
Occasional Invaders: Millipedes. https://blogs.ifas.ufl.edu/collierco/files/2018/05/Millipedes-R.-Shelley-292-Occasional-Invaders-2016-1-6pp-BLOG-r.pdf (2016-02-169).
Rannavre, R., & Donde, S. (2023). Some notes on the impact of millipedes (Myriapoda: Diplopoda) on fungi and bacteria. *Journal of Bacteriology and Mycology*, 10(3). https://doi.org/10.26420/jbacteriolmycol.2023.1211.
So, W. L., Nong, W., Xie, Y., Baril, T., Ma, H., Qu, Z., Haimovitz, J., Swale, T., Gaitan-Espitia, J. D., Lau, K. F., Tobe, S. S., Bendena, W. G., Kai, Z., Hayward, A., & Hui, J. H. (2022). Myriapod genomes reveal ancestral horizontal gene transfer and hormonal gene loss in millipedes. *Nature Communications*, 13(1). https://doi.org/10.1038/s41467-022-30690-0.

Roman snails play an important role in ecosystems by helping to decompose dead plant matter, enhancing nutrient cycling in the soil, and serving as a food source for many animals. Their predators include birds (e.g., thrushes), mammals (e.g., hedgehogs, humans), amphibians (e.g., fire salamanders), and various invertebrates (e.g., ground beetles, centipedes).

Their potential impact on climate change has not yet been sufficiently studied. The size of their genome is estimated to be approximately 1.8 Gb. The energy value of an average-sized Roman snail is estimated at around 17.57 kJ/g (4.2 kcal/g).[329]

6. Insect larvae/worms (*lat.: Diptera*) have a characteristic soft, elongated, cylindrical body without legs or wings. They can grow from just a few millimeters up to several centimeters in length, depending greatly on the species and external factors such as temperature, humidity, soil pH, and more.

Some species are herbivorous and feed on plant tissues, while others are predatory or scavengers, consuming decaying organic matter. These larvae play an important role in ecosystems by acting as decomposers of organic materials and serving as a valuable food source for other animals, such as birds (e.g., swallows, flycatchers), amphibians (e.g., toads, salamanders), fish (e.g., sea bass), and other insects (e.g., dragonflies, predatory beetles).

They thrive best in soils with a pH between 5.5 and 7.5. Their optimal development and growth occur at temperatures between 25 °C and 30 °C and relative humidity levels ranging from 60% to 70%.

Insect larvae can indirectly influence climate change by facilitating nutrient cycling in soil, accelerating the decomposition of organic matter, and promoting biodiversity. Their genome size is estimated to be between 180 Mb and 200 Mb. The energy content of an average-sized insect larva/worm is estimated at approximately 15 kJ/g to 25 kJ/g (3.58 kcal/g to 5.97 kcal/g).[330]

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329 Description compiled using the following sources:
Idczak-Figiel, P. A., Ostrowski, M., & Nowakowska, A. (2024). The influence of environmental stressful conditions on the interaction between heat shock proteins and chaperone-assisted proteins in land snails, helix pomatia L. *Canadian Journal of Zoology,* 102(2), 175–181. https://doi.org/10.1139/cjz-2023-0118.
Cameron, R. A., Papa, R., & De Grassi, A. (2015). The first large-scale, high-throughput DNA sequencing of an extensively used neurotoxin gene, the alpha-conotoxin Vc1. 1, produced by Conus victoriae. *BMC genomics*, 16(1), 1-13.
Coeurdassier, M., Saint-Denis, M., Vaufleury, A. G., Ribera, D., & Badot, P.-M. (2001). The garden snail (helix aspersa) as a bioindicator of organophosphorus exposure: Effects of dimethoate on survival, growth, and acetylcholinesterase activity. *Environmental Toxicology and Chemistry*, 20(9), 1951–1957. https://doi.org/10.1002/etc.5620200913.
330 Description compiled using the following sources:
Rodriguez, S. D., Drake, L. L., Price, D. P., Hammond, J. I., & Hansen, I. A. (2015). The efficacy of some commercially available insect repellents foraedes aegypti(diptera: Culicidae) andaedes albopictus(diptera: Culicidae). *Journal of Insect Science*, 15(1), 140. https://doi.org/10.1093/jisesa/iev125.
Wiegmann, B. M., & Richards, S. (2018). Genomes of Diptera. *Current Opinion in Insect Science*, 25, 116–124. https://doi.org/10.1016/j.cois.2018.01.007.

B. Terrestrial insects

A limited selection of terrestrial insects will be presented, including grasshoppers, beetles, earwigs, flies, terrestrial butterflies, bees, terrestrial wasps, hornets, and ants. From each insect order, the most characteristic representatives found in Slovenia will be selected.

B1. Grasshoppers and praying mantises

5.5.4.3.2 Figure 464: A small selection of grasshoppers and praying mantises

Figure 464 shows a small selection of grasshoppers and praying mantises living in Slovenia.

1. Great green bush-cricket (*lat.: Tettigonia viridissima*) is green in color and can grow up to seven centimeters in length. It is widespread throughout most of Europe and can be found in various habitats, such as gardens and forest edges. It is most active during the summer months, which is especially noticeable due to the males' characteristic singing produced by rubbing their wings. Great green bush-crickets are omnivorous, feeding on both plant material and smaller insects. They are an important food source for various birds (e.g., thrushes, blackbirds, redstarts), small mammals (e.g., shrews, hedgehogs), and other insects (e.g., praying mantises, ground beetles). They also influence the structure and composition of plant communities, meaning they are beneficial to ecosystems when present in optimal numbers. Soil pH does not directly affect the life and survival of great green bush-crickets, but it can indirectly influence their habitat and food sources. This may affect population size and the overall ecological balance. They thrive best at temperatures between 25 °C and 30 °C and air humidity between 40% and 60%. Great green bush-crickets do not have a direct impact on climate change, though as herbivorous animals, they may indirectly influence carbon cycling and greenhouse gas emissions. The size of their genome is still poorly researched but is estimated to be around 750 Mb. The energy content of an average-sized great green bush-cricket is estimated at approximately 15 kJ/g (3.6 kcal/g).[331]

331 Description compiled using the following sources:
Schirmel, J., & Fartmann, T. (2013). Coexistence of two related bush-cricket species (orthoptera: Tettigonia Caudata, T. viridissima) in an agricultural landscape. *Biologia*, 68(3), 510–516. https://doi.org/10.2478/s11756-013-0177-3.
Hodkinson, I. D. (2005). Terrestrial insects along elevation gradients: Species and community responses to altitude. *Biological Reviews*, 80(3), 489–513. https://doi.org/10.1017/s1464793105006767.
Kneitel, J. M., & Chase, J. M. (2003). Trade-offs in community ecology: Linking spatial scales and species coexistence. *Ecology Letters*, 7(1), 69–80. https://doi.org/10.1046/j.1461-0248.2003.00551.x.

2. Meadow grasshoppers (*lat.: Pseudochorthippus parallelus / Chorthippus parallelus*) belong to the group of short-horned grasshoppers. They reach a length of 1.3 cm to 2.3 cm and are typically green or brown in color. They are widespread mainly across Europe, North Africa, and Asia, and are most commonly found in habitats such as meadows and grassy areas. They are most active in the summer and primarily feed on plants, with a preference for grasses.

Meadow grasshoppers serve as an important food source for birds (e.g., sparrows, finches, larks, snow buntings), reptiles (e.g., common lizards), insects (e.g., praying mantises, robber flies), and small mammals (e.g., shrews, voles, mice, hedgehogs, bats). The optimal soil pH for the growth of the plants they consume ranges between 6.0 and 7.5. They thrive best at temperatures between 25 °C and 30 °C and at air humidity levels between 40% and 60%.

They can have both negative and positive impacts on ecosystems. On the negative side, they may damage agricultural crops or outcompete other important insect species. On the positive side, they contribute to biodiversity within food webs and help regulate the growth and distribution of certain plant species.

Meadow grasshoppers can also indirectly influence climate change by regulating plant populations and, consequently, affecting carbon storage in soil. The size of their genome is still not well studied, but estimates range from approximately 1.5 Gb to 16 Gb. The energy content of an average-sized meadow grasshopper is estimated at around 16 kJ/g to 20 kJ/g (4 kcal/g to 5 kcal/g).[332]

3. European praying mantis (*lat.: Mantis religiosa*) can grow to a length of 4 to 8 centimeters. Depending on their natural environment, they can vary in color from green to pale brown. The nymphs of the European praying mantis closely resemble adults but lack fully developed wings. They are geographically widespread and can be found in Europe, Asia, Africa, and even North America.

They inhabit a variety of environments such as forests, meadows, gardens, and agricultural land. Praying mantises are highly adaptable to different climates, ranging from temperate to subtropical and tropical zones. Soil pH has no direct impact on mantises themselves, but values outside the

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332 Description compiled using the following sources:
Miao, H.-T., Liu, Y., Shan, L.-Y., & Wu, G.-L. (2018). Linkages of plant-soil interface habitat and grasshopper occurrence of typical grassland ecosystem. *Ecological Indicators*, 90, 324–333. https://doi.org/10.1016/j.ecolind.2018.03.008.
Lucas, J. M., Jonas, J., Laws, A. N., Branson, D. H., Pennings, S. C., Prather, C. M., & Strickland, M. S. (2020). Functional and taxonomic diversity of grasshoppers differentially shape above- and below-ground communities and their function. *Functional Ecology*, 35(1), 167–180. https://doi.org/10.1111/1365-2435.13682.
Fartmann, T., Poniatowski, D., & Holtmann, L. (2022). Effects of land-use and climate change on grasshopper assemblages differ between protected and unprotected grasslands. *Basic and Applied Ecology*, 63, 83–92. https://doi.org/10.1016/j.baae.2022.06.005.
Palacios-Gimenez, O. M., Koelman, J., Palmada-Flores, M., Bradford, T. M., Jones, K. K., Cooper, S. J., Kawakami, T., & Suh, A. (2020). Comparative analysis of morabine grasshopper genomes reveals highly abundant transposable elements and rapidly proliferating satellite DNA repeats. *BMC Biology*, 18(1). https://doi.org/10.1186/s12915-020-00925-x.

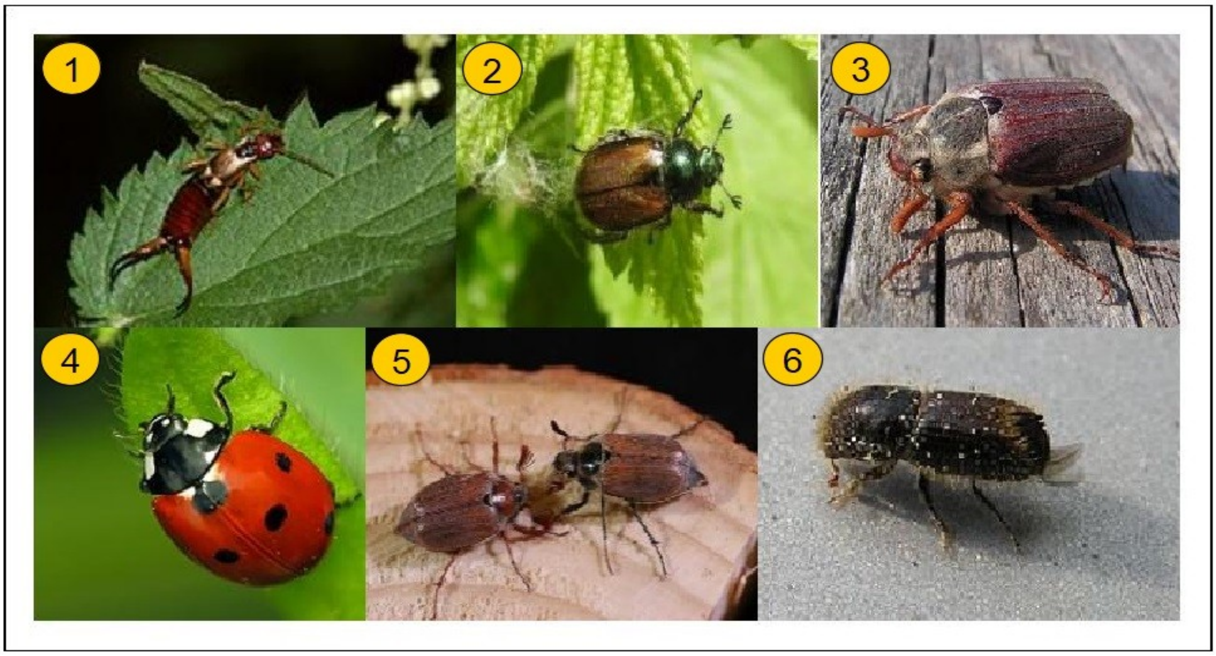
range of 6.0 to 7.5 may negatively affect the development of other insects and their larvae, which serve as the mantises' primary food source.

They thrive best at temperatures between 25 °C and 30 °C and air humidity levels between 50% and 70%, although they can also survive in conditions that deviate from this range. Mantises play an important ecological role as predators, helping to regulate the populations of their prey, which in turn can positively influence plant community dynamics.

They primarily feed on insects (e.g. flies, grasshoppers), spiders, and occasionally on smaller mantises, birds (e.g. hummingbirds), and lizards (e.g. common lizards). In turn, they are a vital food source for a variety of birds (e.g. thrushes, sparrows, redstarts), mammals (e.g. shrews, hedgehogs, moles, mice, bats), amphibians (e.g. frogs), reptiles (e.g. lizards), and insects (e.g. ants, beetles). Their impact on climate change is only indirect, through their role as predators in ecosystems. The size of their genome is still poorly studied, with current estimates around 1 Gb. The energy content of praying mantises is not well researched, but it is believed to be similar to that of other insect species, ranging from approximately 18 kJ/g to 23 kJ/g (4.3 kcal/g to 5.5 kcal/g).[333]

333 Description compiled using the following sources:
Blume, H. P., Brümmer, G. W., Horn, R., Kandeler, E., Kögel-Knabner, I., Kretzschmar, R., Stahr, K., & Wilke, B. M. (2016). *Scheffer/Schachtschabel Soil Science*. Springer.
Ehrmann, R. (2002). *Mantodea: Gottesanbeterinnen der welt*. Natur und Tier-Verlag.
McMonigle, O., & Lasebny, A. (2008). *Praying mantids: Keeping aliens*. Elytra & Antenna.
Goldberg, J. K., Godfrey, R. K., & Barrett, M. (2024). A long-read draft assembly of the Chinese mantis (Mantodea: Mantidae:tenodera sinensis) genome reveals patterns of ion channel gain and loss across Arthropoda. *G3: Genes, Genomes, Genetics*, 14(6). https://doi.org/10.1093/g3journal/jkae062.
Chaulk, A., & Keyghobadi, N. (2022). Insect Landscape Genomics. Population Genomics. https://doi.org/10.1007/13836_2022_106.
Akintunde, Jacob & Obisesan, O.O. & Akinsete, Shade & Adegoke, Ayodeji. (2019). Diet from Mantisa religiosa-egg case abolishes pulmonary dysfunctions triggered by sub-acute exposure to aerosolized-petroleum hydrocarbons in rat model. *Clinical Nutrition Experimental*. 26. https://doi.org/10.1016/j.yclnex.2019.04.001.

B2. Earwigs and beetles



5.5.4.3.3 Figure 465: A small selection of earwigs and beetles

Figure 465 shows a small selection of earwigs and beetles found in soils of the studied environments, numbered from 1 to 6.

1. Common earwig (lat.: Forficula auricularia) grows to a length of 1.2 cm to 1.5 cm and is widely distributed across Europe, North America, and parts of Asia. It can be found in a variety of habitats, such as forests, gardens, meadows, beneath fallen leaves, and under stones. The common earwig is easily recognizable by its brown coloration, relatively long antennae, and characteristic forceps-like pincers at the end of its abdomen.

It is mostly nocturnal and primarily feeds on plants and decaying plant material, though it occasionally preys on smaller insects like aphids, mites, and caterpillars. When present in optimal numbers, these insects have a positive impact on ecosystems by feeding on pest species in gardens and agricultural areas. They are also beneficial in the decomposition of dead plant matter.

Common earwigs serve as an important food source for various animals, including birds (e.g. blackbirds and sparrows), mammals (e.g. shrews, hedgehogs, and mice), insects (e.g. ants and beetles), spiders (e.g. ground spiders, crab spiders, jumping spiders, and wolf spiders), amphibians (e.g. frogs), and reptiles (e.g. common lizards). They play a vital role in food webs.

Their influence on climate change is indirect, primarily through their effect on carbon storage in soils and vegetation. They thrive best in soils with a pH between 5.5 and 7.5, temperatures ranging from 25 °C to 30 °C, and soil moisture between 70% and 90%.

The genome size of common earwigs is not fully studied but is estimated at around 1.12 Gb. Their energy content is also poorly researched, but based on their dry mass, it is estimated to be approximately 10.46 kJ/g to 14.64 kJ/g (2.5 kcal/g to 3.5 kcal/g).[334]

2. Garden leaf beetle (*lat.: Phyllopertha horticola*) grows from 0.9 cm to 1.1 cm in length and is widely distributed in Europe and Western Asia. It can be found in various habitats, such as forests, gardens, and parks. The garden leaf beetle is easily recognized by its brownish-black body, head with a metallic green shine, and reddish-brown antennae. It is primarily active during the day and mainly feeds on pollen and nectar, while its larvae feed on plant roots.

When present in optimal numbers, these beetles positively impact the ecosystem by helping regulate plant populations, decomposing excess organic matter, and contributing to flower pollination. They are also an important food source for various animals, including birds (e.g., thrushes, starlings, and magpies), mammals (e.g., moles, hedgehogs, and badgers), and insects (e.g., ground beetles and wasps). Similar to common earwigs, garden leaf beetles also play an important role in food webs. Their impact on climate change is indirect, as they influence carbon storage in the soil and plants. They thrive best in soils with a pH between 5.5 and 6.5, temperatures ranging from 20 °C to 25 °C (larvae from 10 °C to 15 °C), and humidity levels between 70% and 80%.

The genome size of garden leaf beetles has not been fully studied, but it is estimated to be around 900 Mb. Their energy content, based on their mass, is estimated to be around 15 kJ/g (3.6 kcal/g).[335]

3. May beetle (*lat.: Melolontha melolontha*) grows up to 3 cm in length and is widely distributed in Central Europe. It can be found in various habitats, such as forests, gardens, parks, fields, and meadows. The may beetle is easily recognized by its brown body, while its larvae are whitish. It is primarily active during the day, but is also attracted to artificial light at night.

It feeds on the leaves and flowers of trees (e.g., oak, beech) and shrubs, while its larvae live in the soil, feeding on plant roots. When present in optimal numbers, these beetles have a positive impact

334 Description compiled using the following sources:
Dermaptera. (2008). *Encyclopedia of Entomology*, 681–681. https://doi.org/10.1007/0-306-48380-7_1201. https://doi.org/10.1002/0471684228.
Romeu-Dalmau, C., Piñol, J., & Espadaler, X. (2012). Friend or foe? the role of earwigs in a mediterranean organic citrus orchard. *Biological Control*, 63(2), 143–149. https://doi.org/10.1016/j.biocontrol.2012.06.010.
Orpet, R. J., Crowder, D. W., & Jones, V. P. (2019). Biology and management of European Earwig in orchards and vineyards. *Journal of Integrated Pest Management*, 10(1). https://doi.org/10.1093/jipm/pmz019.
Coulm, M., & Meunier, J. (2021). Effects of temperature, fungal infection and weight on intermoult duration and survival of starving earwig larvae. *Journal of Insect Physiology*, 132, 104262. https://doi.org/10.1016/j.jinsphys.2021.104262.

335 Opis je bil sestavljen s pomočjo naslednjih virov:
Hann, P., Trska, C., Wechselberger, K. F., Eitzinger, J., & Kromp, B. (2015). Phyllopertha horticola (Coleoptera: Scarabaeidae) larvae in eastern Austrian mountainous grasslands and the associated damage risk related to soil, topography and management. *SpringerPlus*, 4(1). https://doi.org/10.1186/s40064-015-0918-6.
EPPO global database. https://gd.eppo.int/taxon/PHPHHO. (2025-02-17)
Raw, F. (1951). The ecology of the garden chafer, phyllopertha horticola (L.) with preliminary observations on Control Measures. *Bulletin of Entomological Research*, 42(3), 605–646. https://doi.org/10.1017/s0007485300029023.

on the ecosystem by contributing to the pollination of plants and playing an important role in nutrient cycling in the soil. However, their larvae are considered pests as they can damage plant roots. They are an important food source for various animals, including birds (e.g., thrushes, starlings, jays, and magpies), mammals (e.g., bats, badgers, foxes, and hedgehogs), and insects (e.g., ground beetles, wasps, and ants). May beetles play a significant role in food webs.
Their impact on climate change is indirect, primarily by storing carbon from the atmosphere in soils and plants. They thrive best in soils with a pH between 6.5 and 7.5, temperatures ranging from 15 °C to 25 °C, and humidity levels between 40% and 70%. The genome size of may beetles is estimated to be around 1.5 Gb. Their energy content is estimated to be between 17 kJ/g and 25 kJ/g (4.06 kcal/g to 5.98 kcal/g).[336]
4. The seven-spotted ladybird (*Latin: Coccinella septempunctata*) grows to a length of 0.4 cm to 1 cm and is widely distributed across Europe, North America, and Australia. It can be found in a variety of habitats, including gardens, wetlands, parks, fields, forests, and meadows. The seven-spotted ladybird is easily recognized by its red or orange upper body, which is decorated with seven black spots. It is mostly active during the day and feeds on insects such as aphids, mites, and scale insects. In optimal numbers, these beetles have a positive impact on ecosystems due to their significant role in controlling pest insect populations. They also serve as an important food source for various animals, including birds (e.g., sparrows, finches, and tits), mammals (e.g., bats and shrews), and insects (e.g., parasitic wasps). Seven-spotted ladybirds play a key role in food webs. They are only indirectly affected by climate change, though this aspect is not yet well studied. They thrive best in soils with a pH between 6.0 and 8.0. Their optimal temperature and humidity conditions are between 20 °C and 30 °C, and 50% to 70% humidity. The size of their genome is estimated to be approximately 398 megabases (Mb). Their energy value is estimated to range between 18 kJ/g and 24 kJ/g (equivalent to 4.3 to 5.7 kcal/g).[337]

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336 Description compiled using the following sources:
Klein, A. M., Vaissière, B. E., Cane, J. H., Steffan-Dewenter, I., Cunningham, S. A., Kremen, C., & Tscharntke, T. (2007). Importance of pollinators in changing landscapes for world crops. *Proceedings of the Royal Society B: Biological Sciences*, 274(1608), 303-313. https://doi.org/10.1098/rspb.2006.3721.
Blüthgen, N., Menzel, F., Hovestadt, T., Fiala, B., & Blüthgen, N. (2007). Specialization, constraints, and conflicting interests in mutualistic networks. *Current Biology*, 17(4), 341-346. https://doi.org/10.1016/j.cub.2006.12.039.
IPBES. (2019). *Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. IPBES secretariat.
Bennett, A. (2010). The role of soil community biodiversity in insect biodiversity. *Insect Conservation and Diversity*, 3(3), 157–171. https://doi.org/10.1111/j.1752-4598.2010.00086.x.
337 Description compiled using the following sources:
Featured creatures : ladybirds. https://entnemdept.ufl.edu/creatures/beneficial/lady_beetles.htm. (2025-02-17).
Biological control : ladybeetles. https://biocontrol.entomology.cornell.edu/predators/ladybeetles.php. (2025-02-17).
Crowley, L. (2021). The genome sequence of the seven-spotted ladybird, coccinella septempunctata Linnaeus, 1758. *Wellcome Open Research*, 6, 319. https://doi.org/10.12688/wellcomeopenres.17346.1.

5. The forest cockchafer (*Latin: Melolontha hippocastani Fabricius*) grows to a length of 2 cm to 3 cm, while its larvae can reach up to 4 cm. It is found across Europe, Western Asia, and Northern Africa. This beetle inhabits a variety of environments, including gardens, hedgerows, forests, and meadows. The forest cockchafer is easily recognized by its characteristic brown color. It is mostly active at night.

Adults feed on the leaves of deciduous trees (such as oak, beech, and horse chestnut), shrubs, and flowers, while the larvae feed on plant roots. In optimal numbers, these insects have a positive impact on ecosystems by contributing to flower pollination, nutrient cycling, and soil aeration. They are also an important food source for various animals, including birds (e.g., jays, blackbirds, and great spotted woodpeckers), mammals (e.g., badgers, foxes, and hedgehogs), and insects (e.g., wasps).

Forest cockchafers play a significant role in food webs. They are only indirectly affected by climate change, although this is not yet well understood. They thrive best in soils with a pH between 6.5 and 8.0, with larvae preferring a range from 7.0 to 8.0. Optimal temperature and humidity conditions for adult beetles are between 20 °C and 25 °C, and 60% to 80% humidity; for larvae, the ideal conditions are 20 °C to 25 °C and 70% to 80% humidity. Their genome size is estimated at approximately 1.5 gigabases (Gb). The energy value of forest cockchafers has not been thoroughly studied, but it is estimated to be around 15 kJ/g (3.6 kcal/g).[338]

6. The eight-toothed spruce bark beetle (*Latin: Ips typographus*) grows to a length of 0.4 cm to 0.5 cm and is widespread throughout Europe and parts of Asia. It is most commonly found in coniferous forests. The eight-toothed spruce bark beetle is easily recognized by its characteristic dark brown or black color and cylindrical body. It is primarily active during the day, from early spring to early autumn.

These beetles feed on the tissues of trees such as spruce, pine, fir, and larch. In optimal numbers, they do not cause significant negative impacts on the ecosystem, but when their population increases, they can lead to the decline of many coniferous trees. They serve as an important food source for various birds (e.g., tits, treecreepers, woodpeckers) and mammals (e.g., shrews, bats). Eight-toothed spruce bark beetles play a crucial role in food webs.

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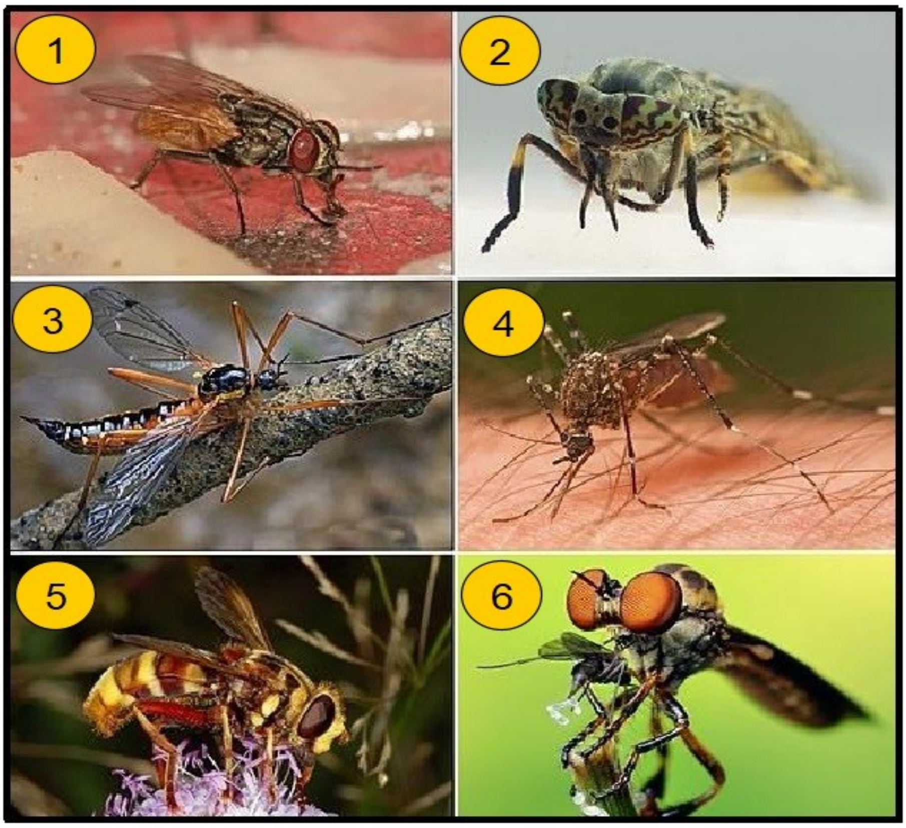
338 Description compiled using the following sources:
Schwerdtfeger, F. (2009). Untersuchungen über die Wanderungen des Maikäfer-Engerlings (Melolontha Melolontha L. und Melolontha Hippocastani F.). *Zeitschrift Für Angewandte Entomologie*, 26(2), 215–252. https://doi.org/10.1111/j.1439-0418.1939.tb01566.x.
Kamp, H. J. (1950). Einiges über das Auftreten von Melolontha melolontha l. und Melolontha Hippocastani F. in Württemberg. *Anzeiger Für Schädlingskunde*, 23(11), 167–168. https://doi.org/10.1007/bf01999790.
Melolontha Hippocastani (cockchafer). (2019). *CABI Compendium*. https://doi.org/10.1079/cabicompendium.33324.

They can be heavily affected by climate change, especially during periods of elevated temperatures, which promote their population growth. This can lead to increased attacks on conifers, resulting in tree mortality and a reduction in atmospheric oxygen production. They thrive best in soils with a pH between 5.0 and 6.5. Optimal conditions for their development are temperatures between 18 °C and 30 °C, and humidity levels between 70% and 80%. Their genome size is estimated at approximately 236 megabases (Mb). While their energy value has not been thoroughly studied, it is estimated to range between 16 kJ/g and 39 kJ/g (3.8 kcal/g to 9.3 kcal/g).[339]

B3. Flies



5.5.4.3.4 Figure 466: A small selection of flies

Figure 466 shows a small selection of flies found in the studied soils, numbered from 1 to 6.

339 Description compiled using the following sources:
Byers, J. A. (1984). Nearest neighbor analysis and simulation of distribution patterns indicates an attack spacing mechanism in the bark beetle, IPS typographus (Coleoptera: Scolytidae). *Environmental Entomology*, 13(5), 1191–1200. https://doi.org/10.1093/ee/13.5.1191.
Faccoli, M. (2009). Effect of weather on IPS typographus(coleoptera curculionidae) phenology, Voltinism, and associated spruce mortality in the southeastern alps. *Environmental Entomology*, 38(2), 307–316. https://doi.org/10.1603/022.038.0202.
Genome size. https://www.ncbi.nlm.nih.gov/datasets/genome/GCA_016097725.1/ (2025-02-17).
Powell, D., Groβe-Wilde, E., Krokene, P., Roy, A., Chakraborty, A., Löfstedt, C., Vogel, H., Andersson, M. N., & Schlyter, F. (2021). A highly-contiguous genome assembly of the Eurasian spruce bark beetle, IPS typographus, provides insight into a major Forest Pest. *Communications Biology*, 4(1). https://doi.org/10.1038/s42003-021-02602-3.

1. House flies (*Latin: Musca domestica*) grow to a length of 0.6 cm to 0.7 cm. They have gray bodies with four black stripes on the thorax and a yellowish abdomen. House flies are widespread and found almost everywhere in the world, except Antarctica. They live in close association with humans, typically in places with decaying organic matter such as garbage, animal waste, and rotting food. They are also commonly observed near stagnant water sources, such as drains and sewage systems.

From a human perspective, they are considered pests because they can transmit harmful bacteria and viruses, potentially causing disease. However, their larvae can be beneficial as they help break down large amounts of decomposing organic material. House flies and their larvae are extremely adaptable and can survive in soils with pH levels ranging from 5.5 to 8.0. They thrive best at temperatures between 25 °C and 35 °C and at humidity levels between 60% and 80%.

House flies and their larvae play an important role in ecosystems by contributing to the decomposition of excess organic matter and enhancing nutrient cycling in the soil. Additionally, they serve as a vital food source for many organisms, including birds (e.g., swallows, sparrows), insects (e.g., dragonflies, robber flies, assassin beetles), spiders (e.g., jumping spiders, wasp spiders, European garden spiders), amphibians (e.g., frogs, toads), reptiles (e.g., common lizards, geckos), and mammals (e.g., shrews, bats).

They may also indirectly influence climate change by participating in soil carbon storage and greenhouse gas emissions. The size of their genome is estimated at approximately 691 megabases (Mb). While their energy content has not been thoroughly studied, it is estimated to range between 16.5 kJ/g and 37.7 kJ/g (3.95 kcal/g to 9.02 kcal/g).[340]

2. Horse flies (*Latin: Tabanidae*) grow to a length of 0.6 cm to 2.5 cm and are generally dark gray or black in color, with light iridescent eyes that can appear green, blue, or purple. They are found all over the world except Antarctica. Horse flies inhabit a variety of environments, including meadows, forests, agricultural fields, and areas near rivers, streams, ponds, and lakes. They typically reproduce in wetlands.

Adult horse flies feed on the blood of mammals such as horses, deer, cattle, and humans, while their larvae feed on small aquatic invertebrates, mosquito larvae, midge larvae, and tiny crustaceans.

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340 Description compiled using the following sources:
Bahrndorff, S., Kjærsgaard, A., Pertoldi, C., Loeschcke, V., Schou, T. M., Skovgård, H., & Hald, B. (2012). The effects of sex-ratio and density on locomotor activity in the house fly,Musca Domestica. J*ournal of Insect Science*, 12(71), 1–12. https://doi.org/10.1673/031.012.7101.
Casagrande, R. A., & Hansens, E. J. (1969). The Effects of Temperature and Humidity on Longevity of Insecticide Resistant and Susceptible Musca domestica Linnaeus. *Journal of the New York Entomological Society*, 77(4), 257–263. http://www.jstor.org/stable/25006183.
Simpson, P. (2002). Evolution of development in closely related species of flies and worms. *Nature Reviews Genetics*, 3(12), 907–907. https://doi.org/10.1038/nrg947.

Adult horse flies also consume nectar from flowers and other sources of sugar. Soil pH does not directly affect adult horse flies, although it may influence the availability of certain nectar-producing plants. Their larvae are aquatic and thrive best in pH conditions ranging from 6.0 to 8.0. Adult horse flies perform best at temperatures between 15 °C and 35 °C and humidity levels between 70% and 90%. They are highly important to ecosystems, serving as effective pollinators and as a key food source for predatory insects (e.g., dragonflies, mantises, assassin beetles, robber flies), birds (e.g., swallows, woodpeckers, cuckoos), and mammals (e.g., bats, hedgehogs, deer). Their potential impact on climate change is currently poorly researched. The size of their genome is estimated to be around 1.1 gigabases (Gb). The energy content of horse flies, estimated based on their mass, is approximately 15 kJ/g or 3.6 kcal/g. However, this value is not yet precisely determined, as most studies focus on their ecology, behavioral patterns, and interactions with other living organisms.[341]

3. Feather-horned crane flies (*Latin: Ctenophora pectinicornis*) grow to a length of 1 cm to 4 cm and are black in color with yellow markings. Males have antennae shaped like combs, which is a distinctive feature. They are primarily active from late spring to autumn.

These flies are mostly found in Europe, particularly in older deciduous forests, orchards, and gardens where decaying trees are abundant. Their larvae depend on decaying wood, which serves as their main food source. Adult crane flies primarily feed on flower nectar and plant sap.

The most favorable soil pH for these insects ranges from 5.5 to 7.5. They thrive best at temperatures between 10 °C and 25 °C and air humidity levels between 50% and 70%. In optimal numbers, they are beneficial to ecosystems due to their role in pollinating flowers, while their larvae are excellent decomposers of organic matter.

They are also an important food source for a variety of birds (e.g., starlings, thrushes, swallows, sparrows), spiders (e.g., wolf spiders), reptiles (e.g., common lizards), and mammals (e.g., bats, moles, shrews). Their impact on climate change is indirect, mainly through their role in carbon storage in the soil and the emission of greenhouse gases.

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341 Description compiled using the following sources:
Takken, W., & Knols, B. G. (1999). Odor-mediated behavior of afrotropical malaria mosquitoes. *Annual Review of Entomology*, 44, 131-157. https://doi.org/10.1146/annurev.ento.44.1.131.
Mullens, B. A. (2002). Horse flies and deer flies (Tabanidae). *Medical and Veterinary Entomology*, 263–277. https://doi.org/10.1016/b978-012510451-7/50015-3.
do Carmo, D. D., Sampronha, S., Santos, C. M., & Ribeiro, G. C. (2022). Cretaceous horse flies and their phylogenetic significance (Diptera: Tabanidae). *Arthropod Systematics & Phylogeny*, 80, 295–307. https://doi.org/10.3897/asp.80.e86673.
Horse-flies (Tabanidae). (2008). *Medical Entomology for Students*, 111–120. https://doi.org/10.1017/cbo9780511811012.011.
Changbunjong, T., Bhusri, B., Sedwisai, P., Weluwanarak, T., Nitiyamatawat, E., Chareonviriyaphap, T., & Ruangsittichai, J. (2018). Species identification of horse flies (Diptera: Tabanidae) in Thailand using DNA barcoding. *Veterinary Parasitology*, 259, 35–43. https://doi.org/10.1016/j.vetpar.2018.07.002.

The size of their genome is estimated at approximately 1.24 gigabases (Gb). Their energy content is around 24.2 kJ/g (5.79 kcal/g).[342]

4. Common mosquitoes (*Latin: Culex pipiens*) grow to a length of 0.3 cm to 0.5 cm and are mostly blackish-brown in color. They are widespread across much of the world, particularly in Europe, North America, Asia, and Africa. They reproduce in a variety of water sources, including both stagnant and moderately flowing waters such as slow-moving streams and rivers. Their habitats include wetlands, ponds, gardens, and forests. The larvae live exclusively in water and primarily feed on microorganisms and plant matter, while adult females feed on the blood of various animals, including humans. Male mosquitoes, on the other hand, feed exclusively on plant juices. Their impact on ecosystems can be highly negative (e.g., due to disease transmission), but also positive, as both adult mosquitoes and their larvae are an important food source for many organisms, including birds (e.g., swallows, blackbirds, sparrows), insects (e.g., dragonflies, damselflies), spiders (e.g., orb-weavers, jumping spiders), amphibians (e.g., tadpoles, frogs), reptiles (e.g., common lizards), and mammals (e.g., bats, shrews). The influence of common mosquitoes on climate change is not well studied. Soil pH does not directly affect their growth and development, while the pH of the water does influence larval development. The optimal pH range for mosquito larvae is between 6.5 and 8.5. Common mosquitoes thrive best at temperatures between 20 °C and 30 °C and relative humidity between 60% and 80%. Their genome size is estimated to be between 575 Mb and 590 Mb. Their energy content is not well researched, but for the larvae, it has been estimated at approximately 16.9 kJ/g to 20.5 kJ/g of dry weight (4.04 kcal/g to 4.90 kcal/g).[343]

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342 Description compiled using the following sources:
Oosterbroek, Pjotr & Bygebjerg, Rune & Munk, Thorkild. (2006). The West Palaearctic species of Ctenophorinae (Diptera: Tipulidae): key, distribution and references. *IEEE Transactions on Information Theory* - TIT. 138-149.
Byriel, D. B., Schmidt, I. K., Justesen, M. J., Pape, T., Hansen, A. K., Riis-Nielsen, T., & Kepfer-Rojas, S. (2020). Forest Management Affects Crane Fly (tipuloidea) community structure through changes in edaphic conditions. *Forest Ecology and Management*, 457, 117756. https://doi.org/10.1016/j.foreco.2019.117756.
Autio, O., Salmela, J., & Suhonen, J. (2013). Species richness and rarity of crane flies (Diptera, Tipuloidea) in a boreal mire. *Journal of Insect Conservation*, 17(6), 1125–1136. https://doi.org/10.1007/s10841-013-9593-5.
Sivell, O., Mitchell, R., & Sivell, D. (2024). The genome sequence of a cranefly, Tipula (lunatipula) Helvola Loew, 1873. *Wellcome Open Research*, 9, 597. https://doi.org/10.12688/wellcomeopenres.23207.1.

343 Description compiled using the following sources:
Kilpatrick, A. M., Daszak, P., Jones, M. J., Marra, P. P., & Kramer, L. D. (2006). Host heterogeneity dominates West Nile virus transmission. Proceedings of the Royal Society B: *Biological Sciences*, 273(1595), 2327-2333. https://doi.org/10.1098/rspb.2006.3575.
Alvial, I. E., Hernández-P, R., Suazo, M. J., González, C. R., Véliz, D., & Benítez, H. A. (2024). Unraveling biotypes of the northern house mosquito, culex pipiens S.L. (Diptera: Culicidae): Molecular differentiation and morphometric analysis. *Journal of Insect Science*, 24(1). https://doi.org/10.1093/jisesa/ieae006.
Kilpatrick, A. M. (2011). Globalization, land use, and the invasion of West Nile virus. *Science*, 334(6054), 323-327. https://doi.org/10.1126/science.1201010.
Krol, L., Blom, R., Dellar, M., van der Beek, J. G., Stroo, A. C. J., van Bodegom, P. M., Geerling, G. W., Koenraadt, C. J. M., & Schrama, M. (2023). Interactive effects of climate, land use and soil type on Culex pipiens/torrentium abundance. *One Health*, 17, 100589. https://doi.org/10.1016/j.onehlt.2023.100589.

5. Hoverflies (*Latin: Syrphidae*) grow to a length of 0.5 cm to 1.5 cm and come in various colors, often mimicking stinging insects such as wasps, bees, bumblebees, and hornets (a form of mimicry).They are distributed almost worldwide but are most common in Europe and North America.

They inhabit a variety of environments including forests, meadows, fields, gardens, wetlands, and even deserts. They are most frequently found in flower-rich areas, as adult hoverflies feed on nectar and pollen. Some rare species are predatory and feed on small insects such as aphids. Their larvae mostly consume plant material, although predatory larvae that feed on aphids also exist.

Hoverflies thrive best in soils with a pH between 6.5 and 7.5. They grow and develop well at temperatures between 20 °C and 30 °C and in air humidity levels between 70% and 90%.

They have a significant ecological impact, serving as important pollinators, helping to control pests, and contributing to nutrient cycling. They are also an important food source for various animals, including birds (e.g. swallows, warblers), insects (e.g. praying mantises), amphibians (e.g. frogs, toads), spiders (e.g. orb-weavers, jumping spiders), reptiles (e.g. lizards, snakes), and mammals (e.g. bats, shrews).

Hoverflies influence climate change only indirectly, by contributing to carbon sequestration through the support of plant photosynthesis. Their genome size is estimated to be between 320 Mb and 612 Mb. Their energy content is still not well researched, but it is estimated to be around 15 kJ/g (3.6 kcal/g).[344]

6. Robber flies (*Latin: Asilidae*) range in length from 0.5 cm to 8 cm and are typically brownish or gray in color, often marked with stripes or spots. They are found worldwide, except in Antarctica.

Robber flies inhabit a wide variety of environments, including forests, agricultural fields, water sources, and even deserts. They are highly predatory and feed on other insects such as flies, bees, wasps, and butterflies. Their larvae prey on soft-bodied insects, including caterpillars and the larvae of beetles and flies.

Adult robber flies and their larvae are not directly affected by soil pH. They grow and develop best at temperatures between 15 °C and 35 °C and air humidity levels between 50% and 80%.

344 Description compiled using the following sources:
van Steenis, J. (2023). Saproxylic breeding sites for hoverflies (Diptera: Syrphidae): From artificial design to natural habitat management. *Journaal van Syrphidae*, 2(1), 1–22. https://doi.org/10.55710/1.diof2888.
Keil, P., & Konvicka, M. (2005). Local species richness of Central European hoverflies (Diptera: Syrphidae): A Lesson taught by local faunal lists. *Diversity and Distributions*, 11(5), 417–426. https://doi.org/10.1111/j.1366-9516.2005.00172.x.
Miličić, M., Vujić, A., & Cardoso, P. (2017). Effects of climate change on the distribution of hoverfly species (Diptera: Syrphidae) in Southeast Europe. *Biodiversity and Conservation*, 27(5), 1173–1187. https://doi.org/10.1007/s10531-017-1486-6. 28(6), 1223–1245. https://doi.org/10.1007/s10841-024-00619-7.

These insects play an important role in ecosystems by regulating pest populations. Additionally, they serve as a valuable food source for various animals, including birds (e.g. hawks, shrikes), insects (e.g. certain wasps, other robber flies, dragonflies), spiders (e.g. jumping spiders), amphibians (e.g. frogs), reptiles (e.g. lizards), and mammals (e.g. bats, shrews).
Their impact on climate change is only indirect, as they participate in the carbon cycle and the emission of greenhouse gases—though this area remains under-researched. Their genome size is estimated to be approximately 279 Mb. The energy content of robber flies has not been precisely determined, but rough estimates based on body mass suggest it is around 15 kJ/g (3.6 kcal/g).[345]

345 Description compiled using the following sources:
McCabe, T. L., & Weber, C. N. (2017). The robber flies (Diptera: Asilidae) of the Albany pinebush. *The Great Lakes Entomologist*, 27(3). https://doi.org/10.22543/0090-0222.1855.
Lenzi, A., Birtele, D., Gisondi, S., Romano, M., Petriccione, B., Cerretti, P., & Campanaro, A. (2023). Robber flies and hover flies (Insecta, Diptera, Asilidae and Syrphidae) in beech forests of the Central Apennines: A contribution to the inventory of insect biodiversity in Italian state nature reserves. *Biodiversity Data Journal*, 11. https://doi.org/10.3897/bdj.11.e101327.
Talley, J., Pusdekar, S., Feltenberger, A., Ketner, N., Evers, J., Liu, M., Gosh, A., Palmer, S. E., Wardill, T. J., & Gonzalez-Bellido, P. T. (2023). Predictive saccades and decision making in the beetle-predating saffron robber fly. *Current Biology*, 33(14). https://doi.org/10.1016/j.cub.2023.06.019.

5.5.4.3.5 Figure 467: A small selection of butterflies

Figure 467 shows a small selection of butterflies that live in the environments of the studied soils, numbered from 1 to 6.

1. Large white butterflies (*Latin: Pieris brassicae*) have a wingspan ranging from 5.5 cm to 6.5 cm. Their wings are white with four black spots and dark edges on the upper side. They are primarily found in Europe, North Africa, and Asia, but can also be encountered in certain parts of North America, Australia, and New Zealand.

Large white butterflies inhabit a variety of environments, such as gardens, meadows, fields, hedgerows, and forest edges. Their larvae, or caterpillars, feed on cauliflower, cabbage, kale, and mustard plants, which can cause significant damage to crops and gardens. Adult butterflies feed on the nectar of various flowers, including dandelions, clover, and holly, and occasionally on rotting fruit. They play a beneficial role in ecosystems by pollinating flowers and helping to maintain plant communities. They are also an important food source for many animals, including birds (e.g., thrushes, warblers, finches), insects (e.g., assassin beetles, mantises), parasitic insects (e.g., parasitic wasps, parasitic flies), spiders (e.g., jumping spiders, wolf spiders), amphibians (e.g., frogs, toads), reptiles (e.g., common wall lizards, geckos), and small mammals (e.g., bats, shrews). The impact of large white butterflies on climate change is negligible and indirect, mainly through their interaction with cultivated plants. Their larvae thrive best in soils with a pH between 6.5 and 7.5. Adult butterflies are only indirectly affected by soil pH. They develop and live best at temperatures between 20°C and 25°C, and at a relative humidity of 70% to 80%. The size of their genome is estimated to be around 278 megabases (Mb). Their caloric value has not yet been studied, but based on their mass, it is estimated to be approximately 15 kJ/g (3.6 kcal/g).[346]

2. Brimstone butterflies (*Latin: Gonepteryx rhamni / Colias croceus*) have a wingspan ranging from 5 cm to 6 cm. Males are bright yellow, while females are pale yellow. They can be found in Europe, North Africa, and Asia. Their habitats include meadows, gardens, and hedgerows. The larvae feed on the leaves of buckthorn, while adult butterflies feed on the nectar of various flowers (e.g., dandelions, clover), tree sap from wounds, and occasionally on rotting fruit. Adult brimstone butterflies are not directly dependent on soil pH, whereas their larvae develop best in soils with a pH between 6.0 and 7.5. Adults thrive and develop optimally at temperatures between 20°C and 25°C and at a relative humidity of 70% to 80%. These butterflies are highly beneficial to ecosystems, acting as pollinators and serving as an important food source for various birds (e.g., blue tits, robins, finches, blackcaps), insects (e.g., parasitic wasps, tachinid flies), spiders (e.g., jumping spiders, wolf spiders), amphibians (e.g., frogs, toads), reptiles (e.g., common lizards, grass snakes), and mammals (e.g., shrews, voles). Their impact on climate change is only indirect, through their interactions with certain cultivated plants. The size of their genome is estimated at approximately 321 megabases (Mb). The energy value of these butterflies, based on their average mass, is estimated to be around 15 kJ/g (3.6 kcal/g).[347]

3. Small tortoiseshell butterflies (*Latin: Aglais urticae*) have a wingspan ranging from 4.5 cm to 5.8 cm. Their wings are orange with black spotted markings. They are found in Europe, North Africa,

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346 Description compiled by following sources:
Hasan, F., & Ansari, M. S. (2010). Population growth of Pieris Brassicae (L.) (Lepidoptera: Pieridae) on different Cole crops under laboratory conditions. *Journal of Pest Science*, 84(2), 179–186. https://doi.org/10.1007/s10340-010-0339-9.
Chahil, G. S., & Kular, J. S. (2013). Biology of pieris brassicae (Linn.) on different brassica species in the plains of Punjab. *Journal of Plant Protection Research*, 53(1), 53–59. https://doi.org/10.2478/jppr-2013-0008.
Romeis, J., & Wäckers, F. L. (2002). Nutritional suitability of individual carbohydrates and amino acids for adult pieris brassicae. *Physiological Entomology*, 27(2), 148–156. https://doi.org/10.1046/j.1365-3032.2002.00281.x.
Gardiner, B. O. (1963). Genetic and environmental variations of Pieris Brassicae. *The Journal of Research on the Lepidoptera*, 2(2), 127–136. https://doi.org/10.5962/p.333439.
Khaling, E., Papazian, S., Poelman, E. H., Holopainen, J. K., Albrectsen, B. R., & Blande, J. D. (2015). Ozone affects growth and development of Pieris Brassicae on the wild host plant brassica nigra. *Environmental Pollution*, 199, 119–129. https://doi.org/10.1016/j.envpol.2015.01.019.
Kumar, P., Brar, Dr. J., & Singh, G. (2020). Life cycle of Cabbage Caterpillar, Pieris Brassicae Linn. (Lepidoptera: Pieridae) on cabbage leaves in Talwandi Sabo (Punjab). *Journal of Entomology and Zoology Studies*, 8(4), 766–769. https://doi.org/10.22271/j.ento.2020.v8.i4m.7206.

347 Gonepteryx rhamni. (2019). *CABI Compendium*. https://doi.org/10.1079/cabicompendium.25655.
Pecháček, P., Stella, D., Keil, P., & Kleisner, K. (2014). Environmental effects on the shape variation of male ultraviolet patterns in the brimstone butterfly (Gonepteryx rhamni, Pieridae, Lepidoptera). Naturwissenschaften, 101(12), 1055–1063. https://doi.org/10.1007/s00114-014-1244-5.
Nekrutenko, Y. P. (1965). 'gynandromorphic effect' and the optical nature of hidden wing-pattern in Gonepteryx rhamni L. (Lepidoptera, Pieridae). *Nature*, 205(4969), 417–418. https://doi.org/10.1038/205417a0.
Gutiérrez, D., & Thomas, C. D. (2000). Marginal Range Expansion in a host-limited butterfly species gonepteryx rhamni. Ecological Entomology, 25(2), 165–170. https://doi.org/10.1046/j.1365-2311.2000.00241.x.
Wang, Y., Peng, C., Yao, Q., Shi, Q., & Hao, J. (2014). The complete mitochondrial genome ofgonepteryx rhamni(lepidoptera: Pieridae: Coliadinae). *Mitochondrial DNA*, 26(5), 791–792. https://doi.org/10.3109/19401736.2013.855755.

and Asia, typically in open, sunny habitats such as meadows and flower-rich gardens. The larvae primarily feed on nettle leaves, while adult butterflies feed on the nectar of various flowers (e.g., knapweed, holly), tree sap, rotting fruit, and other sugary sources. Adult small tortoiseshell butterflies are not directly dependent on soil pH, whereas their larvae develop best in soil with a pH between 5.5 and 8.0. Adults thrive and develop optimally at temperatures between 20°C and 25°C and at relative humidity levels between 20% and 80%. These butterflies are highly beneficial to ecosystems. They act as flower pollinators, contribute to the composition of beneficial soil microorganisms (through their larvae), and serve as an important food source for various birds (e.g., blue tits, great tits, finches), insects (e.g., robber flies, parasitic wasps, ants), spiders (e.g., crab spiders, wolf spiders), amphibians (e.g., toads), reptiles (e.g., viviparous lizards), and mammals (e.g., shrews, bats). Their impact on climate change is only indirect, through their influence on certain plant species. The size of their genome is estimated at approximately 382 megabases (Mb). Similarly, their energy value is estimated at around 15 kJ/g (3.6 kcal/g).[348]

4. Peacock butterflies (*Latin: Aglais io*) have a wingspan ranging from 5.0 cm to 6.3 cm. Their wings are orange with four large spots in blue, black, red, and yellow, resembling peacock feathers. They are found in Europe and Asia and are typically encountered in habitats such as meadows, hedgerows, forests, parks, and gardens with a variety of flowers.

The larvae primarily feed on nettle leaves, while adult butterflies feed on the nectar of various flowers (e.g., holly, nettles, Spanish elder). Adult peacock butterflies are not directly dependent on soil pH, whereas their larvae develop best in soils with a pH between 5.5 and 7.5. Adults develop and thrive optimally at temperatures between 13°C and 30°C and at relative humidity levels between 30% and 80%.

These butterflies are highly beneficial to ecosystems. They act as pollinators, their larvae contribute to the composition of essential soil microorganisms, and they serve as an important food source for various birds (e.g., blue tits, great tits), insects (e.g., robber flies, parasitic wasps, ants), spiders (e.g., zebra spiders), amphibians (e.g., toads), reptiles (e.g., viviparous lizards), and mammals (e.g., shrews, bats).

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348 Meshcheryakova, E. N., Bulakhova, N. A., Zhigulskaya, Z. A., Shekhovtsov, S. V., & Berman, D. I. (2023). Wintering and cold hardiness of the small tortoiseshell aglais urticae (Linnaeus, 1758) (Nymphalidae, Lepidoptera) in the West and east of the Northern Palearctic. *Diversity*, 15(1), 72. https://doi.org/10.3390/d15010072.
Gathmann, A., Wirooks, L., Eckert, J., & Schuphan, I. (2006). Spatial distribution ofaglais urticae(l.) and its host planturtica dioica(l.) in an agricultural landscape: Implications forbtmaize risk assessment and post-market monitoring. *Environmental Biosafety Research*, 5(1), 27–36. https://doi.org/10.1051/ebr:2006014.
Poluha, E. (2023). *The effects of heat stress on the larval behaviour of Pieris brassicae and Aglais urticae* (Doctoral dissertation, University of Lincoln). https://repository.lincoln.ac.uk/ndownloader/files/46868332 (2025-02-18).
Andersson, S. (2003). Antennal responses to floral scents in the butterflies inachis io , Aglais urticae (Nymphalidae), and Gonepteryx rhamni (Pieridae). *Chemoecology,* 13(1), 13–20. https://doi.org/10.1007/s000490300001.
Bishop, G., Ebdon, S., Lohse, K., & Vila, R. (2021). The genome sequence of the small tortoiseshell butterfly, Aglais urticae (Linnaeus, 1758). *Wellcome Open Research*, 6, 233. https://doi.org/10.12688/wellcomeopenres.17197.1.

Their impact on climate change is only indirect, through their influence on certain plant species. The size of their genome is estimated at approximately 382 megabases (Mb). The energy value of these butterflies and their larvae has not yet been measured, but it is estimated to be around 15 kJ/g (3.6 kcal/g).[349]

5. Red admiral butterflies (*Latin: Vanessa atalanta*) have a wingspan ranging from 4.5 cm to 5.0 cm. Their wings are predominantly black with red-orange bands that somewhat resemble military insignia. They are found in Europe, North America, North Africa, and Asia. Typical habitats include meadows, fields, forests, parks, and gardens rich in flowering plants.

The larvae primarily feed on the leaves of nettles, birch, elm, and willow trees, while adult butterflies feed on the nectar of various flowers (e.g., holly, red clover, milkweed, asters), overripe fruit, tree sap, and even carrion.

Adult red admirals are not directly dependent on soil pH, but their larvae develop best in soils with a pH between 6.5 and 7.5. Adults thrive and develop optimally at temperatures between 20°C and 25°C and at relative humidity levels between 60% and 80%.

These butterflies are highly beneficial to ecosystems. They serve as pollinators, contribute to plant diversity, and are an important food source for various birds (e.g., blue tits, robins), insects (e.g., robber flies, parasitic wasps, ants), spiders (e.g., orb-weaving spiders), amphibians (e.g., toads), reptiles (e.g., common lizards), and mammals (e.g., mice, bats, voles).

Their impact on climate change is only indirect, through their interaction with certain plant species. The size of their genome is estimated to be between approximately 326 megabases (Mb) and 405 Mb. The energy value of these butterflies and their larvae has not yet been measured, but it is estimated to be around 15 kJ/g (3.6 kcal/g).[350]

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349 The description was compiled using the following sources:
Park, J., & Heo, D. (2020). The influence of the eyespots of Peacock Butterfly (Aglais IO) and Caterpillar on predator recognition. *Open Science Journal*, 5(2). https://doi.org/10.23954/osj.v5i2.2455.
Lohse, K., Mackintosh, A., & Vila, R. (2021). The genome sequence of the European peacock butterfly, Aglais IO (Linnaeus, 1758). *Wellcome Open Research*, 6, 258. https://doi.org/10.12688/wellcomeopenres.17204.1.
Herremans, M., Gielen, K., Van Kerckhoven, J., Vanormelingen, P., Veraghtert, W., Swinnen, K. R. R., & Maes, D. (2021). Abundant citizen science data reveal that the peacock Butterfly Aglais io recently became Bivoltine in Belgium. *Insects*, 12(8), 683. https://doi.org/10.3390/insects12080683.

350 The description was compiled using the following sources:
Leake, L., & Rice, K. B. (2022). Life history and laboratory rearing of the Red Admiral, Vanessa Atalanta (Lepidoptera: Nymphalidae). *The Great Lakes Entomologist*, 54(2). https://doi.org/10.22543/0090-0222.2399.
Stefanescu, C. (2001). The nature of migration in the red admiral butterflyVanessa Atalanta: Evidence from the population ecology in its Southern Range. *Ecological Entomology*, 26(5), 525–536. https://doi.org/10.1046/j.1365-2311.2001.00347.x.
Brattström, O., Kjellén, N., Alerstam, T., & Åkesson, S. (2008). Effects of wind and weather on red admiral, Vanessa Atalanta, migration at a coastal site in southern Sweden. *Animal Behaviour*, 76(2), 335–344. https://doi.org/10.1016/j.anbehav.2008.02.011.
Lohse, K., García-Berro, A., & Talavera, G. (2021). The genome sequence of the Red Admiral, Vanessa Atalanta (Linnaeus, 1758). *Wellcome Open Research*, 6(356), 1-14. https://doi.org/10.12688/wellcomeopenres.17524.1.

6. Comma butterflies (*Latin: Polygonia c-album*) have a wingspan ranging from 4.5 cm to 6.0 cm. When their wings are open, they are mostly orange with black markings. When their wings are closed, they resemble a dried leaf with a small white "C"-shaped mark, a form of mimicry commonly found in the animal kingdom.

They are found across Europe, North America, and Asia, inhabiting a variety of environments such as meadows, fields, and forests with diverse vegetation.

The larvae primarily feed on nettle leaves but will also consume other plant species. Adult butterflies feed on tree sap and rotting fruit. Comma butterflies are not directly dependent on soil pH, although their larvae develop best in soils with a pH between 5.5 and 7.5. Adult butterflies thrive at temperatures between 20°C and 30°C and at relative humidity levels between 60% and 80%.

In ecosystems, these butterflies are highly beneficial as flower pollinators and through their role in supporting plant diversity. They also serve as an important food source for various animals, including birds (e.g., great tits, blue tits, robins, blackbirds), insects (e.g., robber flies, parasitic wasps, ants), spiders (e.g., crab spiders), amphibians (e.g., frogs, salamanders), reptiles (e.g., common lizards), and mammals (e.g., mice, bats, shrews).

Their impact on climate change is only indirect, mainly through their influence on certain plant species. The size of their genome is estimated to be approximately 373 megabases (Mb). The energy content of these butterflies and their larvae has not yet been measured, but based on body mass, it is estimated to be around 15 kJ/g (3.6 kcal/g).[351]

B5. Eusocial insects

This section will focus on insects that live in socially organized groups. A key characteristic of these groups is that, from a human perspective, they appear to be extremely hierarchical. However, this does not mean that there is no cooperative behavior within them. The following text will describe eusocial insects such as wasps, hornets, bees, bumblebees, and various species of ants that inhabit the areas from which soil samples were collected.

B5a. Wasps, hornets, bees, and bumblebees

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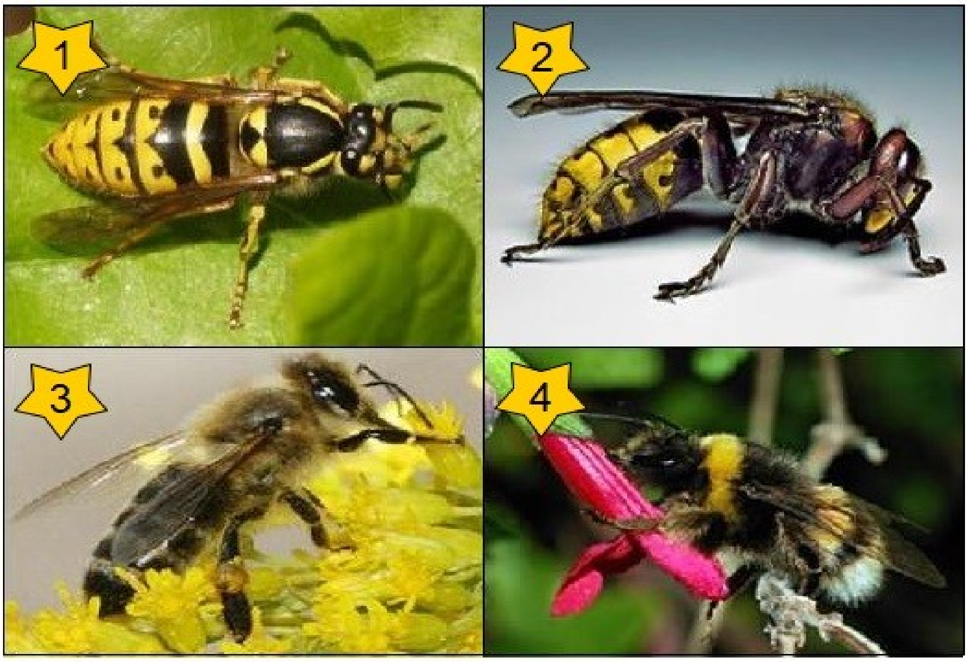
351 The description was compiled using the following sources:
Söderlind, L., Janz, N., & Nylin, S. (2012). *Effects of sequential diets in the comma butterfly, Polygonia c-album: testing predictions from gene expression* (Doctoral dissertation). Stockholm: University, Faculty of Science, Department of Zoology. https://www.diva-portal.org/smash/record.jsf?dswid=-5460&pid=diva2%3A471761 (2025-02-18).
Nylin, S. (1992). Seasonal plasticity in life history traits: Growth and development in Polygonia C-album (Lepidoptera: Nymphalidae). Biological Journal of the Linnean Society, 47(3), 301–323. https://doi.org/10.1111/j.1095-8312.1992.tb00672.x.
Nylin, S., Gamberale-Stille, G., & Tullberg, B. S. (2001). Ontogeny of defense and adaptive coloration in larvae of the comma butterfly, Polygonia c-album (Nymphalidae). *Journal-Lepidopterists Society*, 55(2), 69-73. https://images.peabody.yale.edu/lepsoc/jls/2000s/2001/2001-55(2)63-Nylin.pdf (2025-02-18).
Söderlind, L., & Nylin, S. (2010). Genetics of diapause in the comma butterfly polygonia c-album. *Physiological Entomology*, 36(1), 8–13. https://doi.org/10.1111/j.1365-3032.2010.00756.x.



5.5.4.3.6 Figure 468: A small selection of wasps and bees

Figure 468 shows a small selection of wasps (common wasp, hornet) and bees (Carniolan honey bee, dark earth bumblebee) found in environments where soil samples were studied. They are numbered from 1 to 4.

1. Common wasp (*Latin: Vespula vulgaris*):

Worker common wasps grow to a length of about 1.2 cm to 1.7 cm, while queens are larger, measuring between 1.8 cm and 2.0 cm. They have yellow and black striped abdomens, with black heads and thoraxes. Common wasps are widespread throughout Europe, Asia, and North America, but can also be found in parts of South America and Australia. Highly adaptable, they thrive in various habitats including forests, meadows, agricultural fields, parks, and gardens.

They build multi-tiered nests—also called "wasp nests"—in trees, shrubs, buildings, and even underground burrows. These nests are mostly made of chewed wood fibers and typically have a spherical or oval shape.

Common wasps are eusocial insects living in colonies that may consist of several hundred individuals. Their social structure is highly organized: the colony is founded by a queen who lays the eggs. These eggs develop into workers who build the nest, gather food, and care for the young, while the queen is solely responsible for egg-laying. The colony’s hierarchy places the queen at the top, followed by the workers, and lastly the males, whose only role is to mate with queens from other colonies.

The colonies are annual—most individuals die in autumn, while only fertilized queens survive to start new colonies in spring. Common wasps are not directly dependent on soil pH, but rather on the availability of plants and prey that feed on or shelter in those plants. However, the optimal soil pH for their habitats is estimated to be between 6.5 and 7.5. They thrive best at temperatures between 20 °C and 30 °C and relative humidity between 50% and 80%.

Adult common wasps have a varied diet. They prefer nectar, fruit, and other sweet substances. As active predators, they also feed on flies, spiders, caterpillars, and smaller arthropods, although most of the prey they capture is brought back to their larvae, which are strictly carnivorous. After feeding, the larvae excrete a sugary substance that the worker wasps consume, providing them with extra energy for their tasks.

Common wasps play an important role in ecosystems—when present in optimal numbers, they act as pollinators and as efficient predators of insects and smaller arthropods, helping to maintain balance in food webs. However, overpopulation can disrupt ecological equilibrium. They are also a vital food source for various animals, including birds (e.g., starlings, sparrows), spiders (e.g., garden spiders), and insects (e.g., assassin beetles, praying mantises).

Their impact on climate change is only indirect—by reducing populations of harmful insects and smaller arthropods, they can influence carbon dioxide emissions and reduce the need for pesticide use. The genome size of common wasps is estimated to be approximately 185 Mb, which is relatively small. Their energy content is estimated at around 15 kJ/g (3.6 kcal/g).[352]

2. European hornet (*Latin: Vespa crabro*):

Worker European hornets grow to a length of 1.8 cm to 2.5 cm, while queens are larger, ranging from 2.5 cm to 3.5 cm. These hornets are brightly colored, with a mix of yellow, black, reddish, and brown hues. Like common wasps, they have characteristic brown-yellow banded patterns on their abdomen and a brown head and thorax.

They are mainly found in Europe and Asia. European hornets inhabit a variety of environments, including forests, urban areas, orchards, large gardens, parks, and residential buildings. They build their nests in tree cavities, hollow trunks, barns, attics, and wall crevices. These nests, which can reach the size of a basketball, are made from chewed wood fibers and shaped like a teardrop.

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352 The description was compiled using the following sources:
Wardhaugh, C. W., & Didham, R. K. (2004). The effect of introduced wasp (vespula vulgaris, hymenoptera: Vespidae) predation on the dispersive life history stages of beech scale insects (ultracoelostomaspp., Homoptera: Margarodidae). *New Zealand Entomologist*, 27(1), 91–101. https://doi.org/10.1080/00779962.2004.9722129.
Oliveira, R. C., Oi, C. A., Vollet-Neto, A., & Wenseleers, T. (2016). Intraspecific worker parasitism in the common wasp, Vespula vulgaris. *Animal Behaviour*, 113, 79–85. https://doi.org/10.1016/j.anbehav.2015.12.025.
Steinmetz, I., & Schmolz, E. (2005). Nest odor dynamics in the social wasp Vespula vulgaris. *Naturwissenschaften*, 92(9), 414–418. https://doi.org/10.1007/s00114-005-0006-9.
Pereira, R. A. (2024). Wasp pollination: Mechanisms, evolution and ecological significance in neglected pollinator groups. *Journal of Applied Entomology*. https://doi.org/10.1111/jen.13386.
Free, J. B. (1970). The behaviour of wasps (Vespula germanica L. and v. vulgaris L.) when foraging. *Insectes Sociaux*, 17(1), 11–19. https://doi.org/10.1007/bf02223769.
Crowley, L. (2021). The genome sequence of the common wasp, Vespula vulgaris (Linnaeus, 1758). *Wellcome Open Research*, 6, 232. https://doi.org/10.12688/wellcomeopenres.17205.1.

European hornets are eusocial insects living in colonies of between 200 and 1,000 individuals. These colonies have a highly organized social structure established by a queen. The queen lays eggs that develop into worker hornets. The workers are responsible for building the nest, gathering food, and caring for the brood, while the queen focuses solely on laying eggs. This hierarchical society places the queen at the top, followed by the workers, and lastly the males, whose only role is to mate with queens from other colonies.

Colonies are annual—most hornets die off in the autumn, with only fertilized queens surviving to establish new colonies in the spring. European hornets are not directly dependent on soil pH, but rather on the availability of plants and prey that feed on or shelter within them. However, the optimal soil pH for their habitat is estimated to be between 6.0 and 7.0. They thrive at temperatures between 20 °C and 30 °C and in relative humidity levels of 50% to 70%.

Adult European hornets have a diverse diet, favoring nectar, fruit, and other sweet substances. As predators, they also feed on flies, spiders, caterpillars, and smaller arthropods. Most of the prey they catch is brought back to feed their carnivorous larvae. These hornets play an important ecological role when present in balanced numbers: they are pollinators and effective predators of insects and small arthropods, contributing to the stability of food webs. However, if their population becomes too large, they can disrupt ecological balance (for example, by posing a threat to bee colonies). European hornets are also an important food source for many animals, including birds (e.g., starlings, woodpeckers, larger songbirds), spiders (e.g., crab spiders), insects (e.g., ants, praying mantises, robber flies), amphibians (e.g., frogs, toads), reptiles (e.g., lizards, snakes), and mammals (e.g., bats, shrews, mice).

Their impact on climate change is indirect—by reducing populations of harmful insects and small arthropods, they can potentially help lower carbon dioxide emissions and reduce pesticide use. The genome size of European hornets is estimated to be around 230 Mb. While their exact energy value has not been fully studied, it is estimated to be approximately 16 kJ/g (4 kcal/g).[353]

3. Carniolan honey bee (*Latin: Apis mellifera carnica*):

Worker Carniolan honey bees grow to a length of 1.2 cm to 1.5 cm, while queens are larger, ranging from 1.6 cm to 1.8 cm. These bees have a black to dark brown thorax and a yellowish-brown banded abdomen. They are predominantly found in Central Europe, especially in countries like

353 The description was compiled using the following sources:
Pusceddu, M., Lezzeri, M., Cocco, A., Floris, I., & Satta, A. (2022). Bio-ethology of Vespa Crabro in Sardinia (Italy), an area of new introduction. *Biology*, 11(4), 518. https://doi.org/10.3390/biology11040518.
Bazzato, E., Cocco, A., Salaris, E., Floris, I., Satta, A., & Pusceddu, M. (2025). Modeling the effects of climate change scenarios on the potential distribution of Vespa Crabro Linnaeus, 1758 (hymenoptera: Vespidae) in a Mediterranean Biodiversity Hotspot. *Ecological Informatics*, 86, 103006. https://doi.org/10.1016/j.ecoinf.2025.103006.
Crowley, L. (2022). The genome sequence of the European Hornet, Vespa Crabro Linnaeus, 1758. *Wellcome Open Research*, 7, 27. https://doi.org/10.12688/wellcomeopenres.17546.1.

Austria, Italy, Slovenia, and Hungary. Carniolan bees inhabit various environments such as forests, meadows, orchards, large gardens, and agricultural fields. They build their nests or hives inside tree cavities and other sheltered locations. These nests can be quite large, depending on the size of the colony, which may include between 15,000 and 70,000 workers. The nests are made of beeswax, formed into hexagonal cells used for raising brood, and storing honey and pollen. Carniolan bee colonies have a highly organized social structure established by a queen. The queen lays eggs, which develop into workers. The workers are responsible for building the nest, collecting food, and caring for the brood, while the queen's sole task is egg-laying. This hierarchical society places the queen at the top, followed by the workers, with the males (drones) at the bottom, whose only role is to mate with new queens from other colonies. Drones are later expelled from the colony by worker bees. Bee colonies can live from two to five years, depending on environmental conditions and the lifespan of the queen. Carniolan honey bees are not directly dependent on soil pH, but rather on the availability of nectar- and pollen-producing plants. The optimal soil pH for plant growth is estimated to range between 6.0 and 7.5. Carniolan bees are most productive at temperatures between 32 °C and 36 °C and relative humidity levels between 40% and 70%. Adult bees feed on nectar, pollen, and water, while their larvae are fed royal jelly (produced by worker bees) and bee bread (a mixture of pollen and honey). In ecosystems, Carniolan honey bees are extremely important—they act as pollinators of flowers, contributors to biodiversity among plants and animals, and promoters of agricultural crop productivity. They are also a food source for many animals, including birds (e.g., bee-eaters, woodpeckers), insects (e.g., dragonflies, praying mantises, robber flies, hornets), amphibians (e.g., frogs), reptiles (e.g., lizards), spiders (e.g., crab spiders, orb-weavers, jumping spiders, wolf spiders, black widows), and mammals (e.g., bears, skunks, badgers), though these often feed more on their honey than the bees themselves. Their impact on climate change is indirect—mainly through pollination, which supports plant growth and, in turn, carbon dioxide absorption. The genome size of Carniolan honey bees is estimated to be approximately 230 to 250 Mb. Their energy content is estimated at about 16.20 kJ/g (3.88 kcal/g).[354]

4. Dark earth bumblebees (*Latin: Bombus terrestris*):

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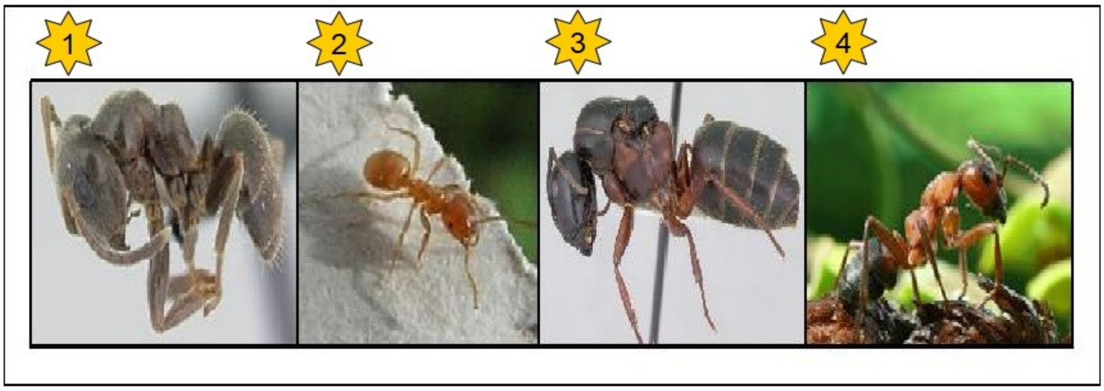
354 The description was compiled using the following sources:
Gregorc, A., & Smodiš Škerl, M. I. (2015). Characteristics of honey bee (apis mellifera carnica, pollman 1879) queens reared in Slovenian commercial breeding stations. *Journal of Apicultural Science*, 59(2), 5–12. https://doi.org/10.1515/jas-2015-0016.
Moškrič, A., Marinč, A., Ferk, P., Leskošek, B., Mosbech, M.-B., Bunikis, I., Pettersson, O., Soler, L., & Prešern, J. (2022). The Carniolan Honeybee from Slovenia—a complete and annotated mitochondrial genome with comparisons to closely related apis mellifera subspecies. *Insects*, 13(5), 403. https://doi.org/10.3390/insects13050403.
Ghosh, S., Jung, C., & Meyer-Rochow, V. B. (2016). Nutritional value and chemical composition of larvae, pupae, and adults of worker honey bee, apis mellifera Ligustica as a sustainable food source. *Journal of Asia-Pacific Entomology*, 19(2), 487–495. https://doi.org/10.1016/j.aspen.2016.03.008.
Šalehar A., (2018). *Kranjska čebela in čebelarji družine Rothschütz*, Ivančna Gorica: Zavod Prijetno domače.

The workers and males of dark earth bumblebees grow to a length of 1.1 cm to 1.7 cm, while the queens are larger, ranging from 1.8 cm to 2.2 cm. Dark earth bumblebees are black-brown with yellow markings and longer hairs resembling fur. They are widespread in Central Europe, Asia, North Africa, South America, and New Zealand. Dark earth bumblebees inhabit a variety of environments such as forest edges, meadows, gardens, and agricultural areas. They build their nests in underground burrows or above the ground in areas with dense vegetation. The queen bumblebee digs a small cavity in the soil and constructs the nest using wax and plant materials. The nest consists of several chambers used for breeding brood, storing food, and providing shelter for the queen and the worker bumblebees. The interior of the nest is stocked with pollen and nectar, which serve as food for the larvae. These nests are much smaller than those of honeybees or hornets. Bumblebee colonies typically consist of 10 to 300 members. Their nests have one entrance and exit point, a short tunnel leading to the nest, a series of cells arranged in clusters (which contain eggs), and pots for storing honey, pollen, and nectar. Like other eusocial insects, dark earth bumblebee colonies have a highly organized social structure initiated by the queen. The queen lays eggs, from which workers emerge. The workers are responsible for building the nest, gathering food, and caring for the brood, while the queens are solely responsible for laying eggs. This hierarchical social structure places the queen at the top, followed by the workers, with males and reproductive queens at the bottom. Male bumblebees are eventually expelled from the colony by the workers. Bumblebee social groups can live from a few months to one year, depending on favorable or less favorable conditions and the lifespan of the queen. Dark earth bumblebees are directly dependent on soil pH, which is believed to range from 6.0 to 7.5. They are most productive within a temperature range of 20 °C to 30 °C and a humidity range of 50% to 70%. Adult dark earth bumblebees mainly feed on nectar and pollen, while their larvae feed exclusively on pollen. In ecosystems, dark earth bumblebees are extremely important as pollinators of flowers, creators of plant and animal biodiversity, and promoters of agricultural crop fertility. They are also an important food source for many animals, such as birds (e.g., starlings, swallows, pipits, thrushes, beekeepers), insects (e.g., dragonflies, praying mantises, robber flies, wasps, hornets, beetles, and occasionally ants), amphibians (e.g., common frogs, tree frogs, common toads, common newts), reptiles (e.g., grass snakes, vipers, common lizards), spiders (e.g., crab spiders, jumping spiders, wolf spiders), and mammals (e.g., hedgehogs, moles, badgers, bats, mice, foxes). Their impact on climate change is indirect—through the storage of carbon in plants, absorption of carbon dioxide from the atmosphere, and general plant health. The genome size of dark earth bumblebees is estimated to be approximately 320 Mb. Their energy content has not yet been fully researched, but it is speculated that it could be higher than that of the Carniolan honeybee (>16.20 kJ/g, >3.88 kcal/g).[355]

B5b. Ants from the studied soil environments



5.5.4.3.7 Figure 469: A small selection of ants

Figure 469 shows a small selection of ants (black garden ants, yellow meadow ants, black forest ants, and large red ants) that live in the environments of the studied soils, numbered from 1 to 4.

1. Black garden ants (*Latin: Lasius niger*):

The workers grow to a length of 0.3 cm to 0.5 cm, while the queens are slightly larger, ranging from 0.6 cm to 0.9 cm. They can easily be recognized by their characteristic black color. They are widespread across Europe, parts of Asia, North and South America. They are found in habitats such as gardens, meadows, parks, and forests. They thrive in various types of soil with a pH range from 3.6 to 7.0. They do best in a temperature range of 20 °C to 25 °C (with a tolerance of 10 °C to 35 °C) and a humidity range of 50% to 70% (with a tolerance from 10% to 70%).

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355 The description was compiled using the following sources:
Williams, P. H., Osborne, J. L., & Rasmont, P. (2009). Bumblebee vulnerability and conservation world-wide. *Apidologie*, 40(3), 367-387. https://doi.org/10.1051/apido/2009025.
Goulson, D., Lye, G. C., & Darvill, B. (2008). Decline and conservation of bumblebees. *Annual Review of Entomology*, 53, 191-208. https://doi.org/10.1146/annurev.ento.53.103106.093454.
Goulson, D. (2012). *Bumblebees: Behaviour, ecology, and conservation*. Oxford University Press.
Stelzer, R. J., Chittka, L., Carlton, M., & Ings, T. C. (2010). Bumblebee foraging rhythms under the midnight sun measured with radiofrequency identification. *BMC Biology*, 8(1), 93.
Stelzer, R. J., & Chittka, L. (2010). Bumblebee foraging rhythms under the midnight sun measured with radiofrequency identification. *BMC Biology*, 8(1). https://doi.org/10.1186/1741-7007-8-93.
Goulson, D., Lye, G. C., & Darvill, B. (2008). Decline and conservation of Bumble Bees. *Annual Review of Entomology*, 53(1), 191–208. https://doi.org/10.1146/annurev.ento.53.103106.093454.
KNIGHT, M. E., OSBORNE, J. L., SANDERSON, R. A., HALE, R. J., MARTIN, A. P., & GOULSON, D. (2009). Bumblebee nest density and the scale of available forage in arable landscapes. *Insect Conservation and Diversity*, 2(2), 116–124. https://doi.org/10.1111/j.1752-4598.2009.00049.x.
González-Varo, J. P., Biesmeijer, J. C., Bommarco, R., Potts, S. G., Schweiger, O., Smith, H. G., Steffan-Dewenter, I., Szentgyörgyi, H., Woyciechowski, M., & Vilà, M. (2013). Combined effects of global change pressures on animal-mediated pollination. *Trends in Ecology & Evolution*, 28(9), 524–530. https://doi.org/10.1016/j.tree.2013.05.008.
Sadd, B. M., Barribeau, S. M., Bloch, G., de Graaf, D. C., Dearden, P., Elsik, C. G., ... & Evans, J. D. (2015). The genomes of two key bumblebee species with primitive eusocial organization. *Genome biology*, 16(1), 1-10. https://doi.org/10.1186/s13059-015-0623-3.

Black garden ants are crucial to ecosystems as they influence seed dispersal, contributing to the biodiversity of plants. Furthermore, they are efficient decomposers of organic matter, especially leaf litter, releasing nutrients back into the soil for plant growth. They also provide effective soil aeration by building complex underground systems with many tunnels. This soil ventilation helps beneficial microorganisms thrive, making the soil healthier and more fertile. Black garden ants also play a significant role in their relationships with other animals. These relationships can be competitive (e.g., competing with other species of ants) or mutualistic (e.g., cultivating aphids, feeding on their sap, and in return offering protection from other predators).

These ants are omnivorous, feeding on both plants and animals, such as flies, caterpillars, and other arthropods. Their larvae feed on small insects, their own species, eggs, and food brought back by the workers. Black garden ants are also known for producing honeydew with the help of aphids, and they cultivate fungi, which they use as an efficient food source. They are also an important food source for various animals, including insects (e.g., other species of ants, wolf spiders), birds (e.g., magpies, sparrows, flycatchers), reptiles (e.g., common lizards), amphibians (e.g., frogs, toads), invertebrates (e.g., millipedes), and mammals (e.g., moles, bats).

These ants do not have a direct impact on climate change, but they do have an indirect effect by storing carbon in the soil and boosting plant biodiversity. Black garden ants are eusocial insects with a rather complex hierarchical organization. Their system is caste-based, with social stratification within a colony and division of labor. The castes consist of queens (the highest hierarchical level, responsible for producing and laying eggs), workers (responsible for foraging, nest maintenance, brood care, and defense), and males (responsible for mating with queens). The division of labor among the workers is also based on age. Younger workers mainly care for the brood and nest, while older workers typically handle food gathering and nest defense. Their communication primarily relies on biochemical substances, such as pheromones, and geomagnetic fields (magnetic induction). This form of communication serves various purposes, such as directing ants to food sources, alerting colony members to impending threats, and recognizing members within the colony.

They build their nests in the soil, under stones, or in decaying wood. Nests can connect to each other in a system with multiple entrances and exits (polydomy). Black garden ant colonies can live from three to 12 years. This long lifespan is facilitated by their efficient overwintering methods. The size of their genome is estimated to be around 245 Mb. The energy content of black garden ants is approximately 16.736 kJ/g (4 kcal/g). They have a relatively high protein, carbohydrate, and lipid content in their bodies. Both the genome size and energy content of black garden ants are only rough estimates.[356]

2. Yellow meadow ants (*Latin: Lasius flavus*):

The workers grow to a length of 0.2 cm to 0.45 cm, while the queens are slightly larger, ranging from 0.7 cm to 0.9 cm. They are easily recognized by their characteristic yellow color. They are widespread across Europe and some parts of North America. They are found in habitats such as meadows and open sunny areas with sandy or loamy soils. They survive in various types of soil with a pH range from 5.5 to 7.5. They thrive in a temperature range of 20 °C to 25 °C and a humidity range from 50% to 70%.

Yellow meadow ants are extremely important to ecosystems, as they influence seed dispersal, thereby contributing to the biodiversity of plants. They also provide effective soil aeration by building complex underground systems with many tunnels. This soil ventilation encourages the activity of beneficial microorganisms, which makes the soil healthier and more fertile. Yellow meadow ants also have important relationships with other animals. These relationships can be competitive (e.g., competing with other ant species) or mutualistic (e.g., cultivating root aphids, feeding on their sap, and in return offering protection from other predators).

These ants are omnivorous, feeding on both plants and animals, such as flies, caterpillars, and other arthropods. Their larvae feed on small insects, honeydew, and digested food brought by the workers. Yellow meadow ants are also known for producing honeydew with the help of aphids.

They are an important food source for various insects (e.g., other ant species, robber flies, assassin bugs), spiders (e.g., crab spiders), birds (e.g., flycatchers, sparrows, wagtails), reptiles (e.g., common lizards, geckos, garter snakes, vipers), amphibians (e.g., frogs, toads, newts), invertebrates (e.g., predatory mites), and mammals (e.g., moles, bats, mice).

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356 The description was compiled using the following sources:

Bird, A. E., Hesketh, H., Cross, J. V., & Copland, M. (2004). The common black ant, lasius niger (hymenoptera: Formicidae), as a vector of the entomopathogenlecanicillium longisporumto rosy apple aphid, Dysaphis plantaginea(Homoptera: Aphididae). *Biocontrol Science and Technology*, 14(8), 757–767. https://doi.org/10.1080/09583150410001720716.

Golichenkov, M. V., Neimatov, A. L., & Kiryushin, A. V. (2009). Microbiological activity of soils populated by Lasius Niger ants. *Eurasian Soil Science*, 42(7), 788–792. https://doi.org/10.1134/s1064229309070096.

Konorov, E. A., Nikitin, M. A., Mikhailov, K. V., Lysenkov, S. N., Belenky, M., Chang, P. L., Nuzhdin, S. V., & Scobeyeva, V. A. (2017). Genomic exaptation enables Lasius Niger adaptation to urban environments. *BMC Evolutionary Biology*, 17(S1). https://doi.org/10.1186/s12862-016-0867-x.

Römer, D., Bollazzi, M., & Roces, F. (2019). Leaf-cutting ants use relative humidity and temperature but not colevels as cues for the selection of an underground dumpsite. *Ecological Entomology*, 44(4), 502–511. https://doi.org/10.1111/een.12727.

Mannino, G., Casacci, L. P., Bianco Dolino, G., Badolato, G., Maffei, M. E., & Barbero, F. (2023). The geomagnetic field (GMF) is necessary for Black Garden Ant (lasius niger L.) foraging and modulates orientation potentially through AMINERGIC regulation and MAGR expression. *International Journal of Molecular Sciences*, 24(5), 4387. https://doi.org/10.3390/ijms24054387.

These ants do not have a direct impact on climate change, but they do have an indirect effect in terms of carbon storage in the soil and enhancing plant diversity. Yellow meadow ants are eusocial insects with a fairly complex hierarchical organization. Their system is caste-based, with social stratification within a colony and division of labor. The castes consist of queens (the highest hierarchical level, responsible for producing and laying eggs), workers (responsible for foraging, nest maintenance, brood care, and defense), and males (responsible for mating with the queens). The division of labor among the workers is also organized based on age. Younger workers mainly care for the brood and nest, while older workers typically handle food gathering and nest defense. Their communication can occur through biochemical substances, such as pheromones, antennae touch, vision, and geomagnetic fields (magnetic induction). This form of communication serves various purposes, such as directing ants to food sources, alerting colony members to approaching threats, and recognizing members within the colony. They build their nests in the soil, under stones, under moss, or under leaf litter. Nests can be interconnected in a system with multiple entrances and exits (polydomy). Yellow meadow ant colonies can live from three to 18 years. This long lifespan is made possible by their efficient overwintering methods.

The size of their genome is estimated to be around 256 Mb. The energy content of yellow meadow ants is likely somewhat lower than that of black garden ants, around 14.644 kJ/g (3.5 kcal/g). They have a relatively high content of proteins, carbohydrates, and lipids in their bodies. Both the genome size and energy content of yellow meadow ants are only rough estimates.[357]

3. Black forest ants (*Latin: Camponotus herculeanus*):

The workers and males grow to a length of 0.8 cm to 1.5 cm, while the queens are larger, reaching up to 2.0 cm. They are easily recognized by their characteristic black or dark brown color with slight red or yellow undertones. They are widespread across almost all of Europe. They are found in habitats such as coniferous or mixed forests with high humidity, where there is a large amount of decaying wood or trees. They survive in various types of soil with a pH range from 5.5 to 6.5. They thrive in a temperature range from 15 °C to 25 °C and a humidity range from 40% to 60%.

Black forest ants are extremely important to ecosystems as they contribute to the decomposition of dead wood, which aids in the cycling of nutrients in ecosystems. They also play a role in seed dispersal. Black forest ants are also important due to their competitive relationships with other ants and arthropods, which increases biological dynamics. These ants are omnivorous, feeding on both

357 The description was compiled using the following sources:
Czechowski, W., Czechowska, W., & Radchenko, A. (2002). *The ants (hymenoptera, Formicidae) of Poland*. Museum and Institute of Zoology PAS. https://www.researchgate.net/publication/274073334_The Ants_Hymenoptera_Formicidae_of_Poland (2025-02-18).
Dauber, J., Rommeler, A., & Wolters, V. (2006). The Ant Lasius flavus alters the viable seed bank in pastures. *European Journal of Soil Biology*, 42. https://doi.org/10.1016/j.ejsobi.2006.06.002.

plants and other animals such as flies, caterpillars, and other arthropods. Their larvae feed on small insects, honeydew, and digested food brought by the workers.
They also serve as a valuable food source for insects (e.g., other ant species, assassin beetles), spiders (e.g., crab spiders, jumping spiders, wolf spiders), birds (e.g., jays, cuckoos, songbirds), reptiles (e.g., lizards), amphibians (e.g., tree frogs, common toads, newts), invertebrates (e.g., millipedes), and mammals (e.g., moles, bats, European anteaters).
These ants do not directly impact climate change, but they have an indirect effect in terms of carbon storage in the soil and enhancing plant diversity. Black forest ants are eusocial insects with a fairly complex hierarchical organization. Their system is caste-based, with social stratification within a colony and a division of labor. The castes consist of queens (the highest hierarchical level, responsible for producing and laying eggs), workers (responsible for foraging, nest maintenance, brood care, and defense tasks), soldiers (responsible for defense), and males (responsible for mating with the queens).
The division of labor among workers is also organized based on age. Younger workers primarily care for the brood and the nest, while older workers generally handle food collection and nest defense. Their communication can occur through biochemical substances, such as pheromones, touching with their antennae, vision, and geomagnetic fields (magnetic induction). This communication serves various purposes, such as guiding ants to food sources, alerting colony members to impending threats, and recognizing members within the colony.
They build their nests in the soil, under stones, under logs, or under tree roots. The nests can be interconnected into a system with multiple entrances and exits (polydomy). They can also have satellite nests connected to the main nest via pheromone trails. Black forest ant colonies can live from a few years to 15 years. This long lifespan is made possible by their efficient overwintering methods.
The size of their genome is estimated to be approximately 790 Mb. The energy content of black forest ants is likely somewhat higher than that of black garden ants, around 19.635 kJ/g (4.7 kcal/g). They have a relatively high content of proteins, carbohydrates, and lipids in their bodies. Both the genome size and energy content of black forest ants are only rough estimates.[358]
4. Large red ants (*Latin: Formica rufa*):

358 The description was compiled using the following sources:
Vander Meer, R. K. (2020). *Applied myrmecology: A world perspective*. CRC PRESS.
Manthey, J. D., Girón, J. C., & Hruska, J. P. (2022). Impact of host demography and evolutionary history on endosymbiont molecular evolution: A test in carpenter ants (genus camponotus) and their blochmannia endosymbionts. *Ecology and Evolution*, 12(7). https://doi.org/10.1002/ece3.9026.
López-Alfaro, C., Coogan, S. C., Robbins, C. T., Fortin, J. K., & Nielsen, S. E. (2015). Assessing nutritional parameters of brown bear diets among ecosystems gives insight into differences among populations. *PLOS ONE*, 10(6). https://doi.org/10.1371/journal.pone.0128088.

The workers and males grow to a length of 0.5 cm to 1.0 cm, while the queens are larger, reaching up to 1.5 cm. They are easily recognized by their characteristic red, brown, or dark brown color. They are widespread across almost all of Europe. They are found in habitats such as coniferous or mixed forests, where they build their large domed nests near trees. They survive in various types of soil with a pH range from 5.0 to 7.0. They thrive in a temperature range from 10 °C to 30 °C and a humidity range from 40% to 60%.

Large red ants are extremely important to ecosystems as they help with soil aeration, contributing to the cycling of nutrients within ecosystems. They also play a role in seed dispersal. These ants are also important due to their competitive relationships with other ants and arthropods, which enhances biological dynamics. They also cultivate aphids to harvest honeydew.

These ants are omnivorous, feeding on both plants, fungi, and other animals, such as flies, caterpillars, arthropods, and occasionally scavenging carcasses. Their larvae feed on larval saliva and digested food brought by the workers. They also serve as a valuable food source for insects (e.g., other ant species, assassin beetles, ground beetles, robber flies, dragonflies, praying mantises), spiders (e.g., crab spiders, jumping spiders, wolf spiders), birds (e.g., jays), reptiles (e.g., lizards), amphibians (e.g., tree frogs, newts), invertebrates (e.g., millipedes), and mammals (e.g., moles, mice, badgers, anteaters).

These ants do not directly impact climate change, but they have an indirect effect on carbon storage in the soil, plant health, insect biomass balance, and enhancing plant diversity. Large red ants are eusocial insects with a fairly complex hierarchical organization. Their system is caste-based, with social stratification within a colony and a division of labor. The castes consist of queens (the highest hierarchical level, responsible for producing and laying eggs), workers (responsible for foraging, nest maintenance, brood care, and defense tasks), and males (responsible for mating with queens from other colonies).

The division of labor among workers is also organized based on age. Younger workers primarily care for the brood and the nest, while older workers generally handle food collection and nest defense. Their communication can occur through biochemical substances, such as pheromones, touching with their antennae, vision, and geomagnetic fields (magnetic induction). This communication serves various purposes, such as guiding ants to food sources, alerting colony members to impending threats, and recognizing members within the colony.

They build their nests on forest floors, under tree stumps, under fallen tree logs, or at the base of trees. The nests can be interconnected into a system with multiple entrances and exits (polydomy). Large red ant colonies can live from a few years up to 15 years. This long lifespan is made possible by their efficient overwintering methods.

The size of their genome is estimated to be between 600 Mb and 700 Mb. The energy content of large red ants is likely somewhat lower than that of black forest ants, around 18 kJ/g (4.3 kcal/g). They have a relatively high content of proteins, carbohydrates, and lipids in their bodies. Both the genome size and energy content of large red ants are only rough estimates.[359]

In the ants being discussed, it can be observed that their communication primarily occurs through biochemical induction, and indirectly through geomagnetic induction. Based on the latter, ants can orient themselves more effectively, as proper orientation is essential for meaningful communication. Eusocial insects, including ants, are believed to contain magnetic substances in their bodies.[360] These are the so-called magnetite nanoparticles, which are believed to be located in the abdomens and antennae of ants. Magnetite forms through a biological process and by consuming iron from food. This presence of magnetic substances is thought to enable ants to have magnetic reception abilities, meaning they are capable of detecting and interpreting magnetic signals in their surroundings, which allows them to orient themselves more effectively both temporally and spatially. This can be conditionally compared to a compass. Additionally, they are able to detect electric fields. Both magnetic and electric fields influence the behavioral patterns of ants, affecting the production of neurotransmitters and hormones in their brains, which can impact their mood and even their decisions.[361] A large part of communication among ants occurs without direct physical contact between them. This is a prime example of induction in natural processes. It is clear that human thinking, without direct physical contact, could influence the reaction of a specific ant and possibly even affect many members of its colony. There is a possibility that insects and spiders can also detect perceived threats from humans, although this has not yet been proven.[362] An ant or spider can detect vibrations, pheromones, or even sound at the micro (nano) level from a human and respond to these stimuli. This is not a direct result of a specific threatening thought concentration from a person. As highlighted several times in this work, induction is an important natural process that accelerates certain syntheses, both in terms of biochemical reactions and in terms of individual and collective communication within natural hierarchical associative systems. This has a profound

359 The description was compiled using the following sources:
Serttaş, A., Bakar, Ö., Alkan, U. M., Yılmaz, A., Yolcu, H. İ., & İpekdal, K. (2020). Nest survival and transplantation success of formica rufa (hymenoptera: Formicidae) ants in southern Turkey: A predictive approach. *Forests*, 11(5), 533. https://doi.org/10.3390/f11050533.
Kadochová, Š., & Frouz, J. (2014). Thermoregulation strategies in ants in comparison to other social insects, with a focus on red wood ants (formica rufa & group). *F1000Research*, 2, 280. https://doi.org/10.12688/f1000research.2-280.v2.

360 Wajnberg, E., Acosta-Avalos, D., Alves, O. C., de Oliveira, J. F., Srygley, R. B., & Esquivel, D. M. (2010). Magnetoreception in eusocial insects: An update. *Journal of The Royal Society Interface*, 7 (suppl_2). https://doi.org/10.1098/rsif.2009.0526.focus.

361 Pereira, M. C., Guimarães, I. de, Acosta-Avalos, D., & Antonialli Junior, W. F. (2019). Can altered magnetic field affect the foraging behaviour of ants? *PLOS ONE*, 14(11). https://doi.org/10.1371/journal.pone.0225507.

362 Heaven, D. (2015). Does consciousness create reality? *New Scientist*, 226(3019), 33. https://doi.org/10.1016/s0262-4079(15)30261-x.

impact on food webs, where predatory, cooperative, and parasitic relationships are formed between members of this large system. This induction within natural hierarchical associative systems influences decisions about prey, cooperation, and parasitism within various food webs. For example, a strong ant colony could completely destroy another species' colony, but sometimes it does not. This can be explained by the collective unconscious thinking of all living beings on our planet. In short, among living beings, including ants, there exists a certain hidden agreement dictated by natural hierarchical associative systems at the micro-, meso-, and macro- levels. This hidden agreement is important because it maintains and/or restores a certain systemic balance between the impulses of the law of the stronger and the law of cooperation. The destruction of one ant colony by another could cause significant harm to the ecosystem, thereby also harming the attackers. These are highly sensitive and interconnected relationships among living beings, which also respond to the dictates of the inorganic world, both in the form of chemical reactions and various physical inductions (e.g., magnetite). While living beings are more dynamic in the short term, they are in a strong subordinate role in terms of energy and mass. Ultimately, living beings are made up of inorganic substances and are dependent on the inorganic superproducer of water, without which they would become part of the lifeless world. We must also not forget the fertile soils that enable the growth and development of plants, as without them, natural hierarchical associative food webs could not exist. In considering these thoughts, we must not overlook the importance of air and light, as without both of these crucial components, life would not be possible.

C. Spiders

5.5.4.3.8 Figure 470: A small selection of spiders

Figure 470 shows a small selection of spiders that live in the environments of the studied soils, numbered from 1 to 6. In spiders, it is a general rule that females are usually larger than males.

1. Common cross spiders (*Latin: Araneus diadematus*): They can grow up to 1.5 cm in length, with a leg span of 3.5 cm. They are recognized by their brown or brownish-gray color, with a characteristic white mark on their abdomen that strongly resembles a cross. They are mostly found in geographic locations in Europe and Asia. They can be encountered in habitats such as gardens, meadows, and forest edges, where they build their beautiful circular webs to catch prey. Common cross spiders are not directly dependent on the pH value of the soil, but this dependency is only indirect, through the plants and animals that feed on plants or their parts. They can survive in quite harsh temperature conditions (from 4°C to 40°C), but they thrive best in a temperature range of 20°C to 25°C. The same applies to humidity; the optimal humidity values range from 60% to 80%. These spiders are very important for ecosystems because they help maintain the population balance of various insects (e.g., flies, mosquitoes, moths), which in turn affects the regulation of carbon dioxide in the atmosphere and plant development. In addition, they provide a good source of food for various birds (e.g., robins, blue tits, great tits), insects (e.g., predatory bugs, wasps, parasitic flies), amphibians (e.g., frogs), reptiles (e.g., common lizards), and other spiders (e.g., orb-weaving spiders). Occasionally, they can also serve as a food source for smaller mammals (e.g., bats, moles). They are only indirectly affected by climate change, in terms of reducing greenhouse gases in the atmosphere. The size of their genome is estimated at approximately 3.19 Gb. Their energy content has not been fully researched yet, but it is known that they have a relatively high nutritional value, as they are rich in proteins and lipids (approximately 14 kJ/g or 3.34 kcal/g).[363]

363 The description was compiled using the following sources:
Foelix, R. F. (2011). *Biology of spiders*. Oxford University Press.

2. Wasp spiders (*Latin: Argiope bruennichi*) can grow up to 1.5 cm in length, with a leg span ranging from 3.0 cm to 4.0 cm. They are recognized by their distinctive black-and-yellow pattern, which strongly resembles that of a wasp. They inhabit primarily geographic areas in Europe and Asia. They can be found in various habitats, such as gardens, meadows, and parks, where they build their beautiful circular webs to catch prey. Wasp spiders are not directly dependent on soil pH; this influence is only indirect, as it affects the plants and animals that feed on plants or their parts. They can survive in quite demanding temperature conditions (from 10°C to 40°C), but they thrive best at temperatures between 20°C and 30°C. The same applies to humidity, with optimal values ranging between 30% and 70%. These spiders are important for ecosystems because they help maintain the population balance of various insects (e.g., flies, mosquitoes, caterpillars), which in turn impacts the regulation of carbon dioxide in the atmosphere and plant development. Additionally, they are an important food source for many birds (e.g., robins, blue tits, great tits), insects (e.g., predatory beetles, wasps, robber flies), amphibians (e.g., frogs), reptiles (e.g., common lizards), and other spiders (e.g., common cross spiders, crab spiders, jumping spiders). Occasionally, they may also serve as food for smaller mammals (e.g., bats, moles, mice). They are only indirectly affected by climate change, as they contribute to the reduction of greenhouse gases in the atmosphere. The size of their genome is estimated at approximately 2.29 Gb. The energy content of wasp spiders is still poorly studied, but it is known that they have a relatively high nutritional value, as they are rich in proteins and lipids (approximately 14 kJ/g or 3.34 kcal/g).[364]

3. Yellow spiders (*Latin: Cheiracanthium punctorium*) can grow up to 0.9 cm in length, with a leg span ranging from 2.0 cm to 3.0 cm. They are recognized by their distinctive yellow or light green color. They mainly inhabit geographic areas in Europe, North America, and Asia. They can be found in various environments such as gardens, meadows, fields, forests, and even in human homes. Yellow spiders are not directly dependent on soil pH; this influence is only indirect, as it affects plants and animals that feed on plants or their parts. They can survive in a temperature range from 10°C to 30°C, but they thrive best at temperatures between 20°C and 25°C. The optimal humidity for them is between 60% and 80%. These spiders are important for the ecosystem because they help maintain the population balance of various insects (e.g., flies, fleas, grasshoppers), which in turn influences the regulation of carbon dioxide in the atmosphere and plant growth. In addition, they are

Schwager, E. E., Sharma, P. P., Clarke, T., Leite, D. J., Wierschin, T., Pechmann, M., ... & McGregor, A. P. (2017). The house spider genome reveals an ancient whole-genome duplication during arachnid evolution. *BMC Biology*, 15(1), 62. https://www.doi.org/10.1186/s12915-017-0399-x.

364 The description was compiled using the following sources:
Kim, K. W. (2015). Individual physical variables involved in the stabilimentum decoration in the wasp spider, Argiope Bruennichi. *Journal of Ecology and Environment*, 38(2), 157–162. https://doi.org/10.5141/ecoenv.2015.017.
Crowley, L. M., & Hutchinson, F. (2023). The genome sequence of the wasp spider, Argiope Bruennichi (Scopoli, 1772). *Wellcome Open Research*, 8, 522. https://doi.org/10.12688/wellcomeopenres.20339.1.

an important food source for many birds (e.g., warblers, finches, sparrows), insects (e.g., praying mantises), reptiles (e.g., common and green lizards), arthropods (e.g., centipedes), and other spiders (e.g., wolf spiders, jumping spiders). Occasionally, they may also serve as food for smaller mammals (e.g., bats, moles, mice). They are only indirectly affected by climate change, as they contribute to the reduction of greenhouse gases in the atmosphere. The size of their genome is less studied but is estimated to be around 2.0 Gb. The energy content of yellow spiders is also poorly researched, but it is known that they have relatively high nutritional value, as they are rich in proteins and lipids (approximately 14 kJ/g or 3.34 kcal/g).[365]

4. Common forest wolf spiders (*Latin: Pardosa lugubris*) can grow up to 1.5 cm in length, with a leg span ranging from 2.5 cm to 3.5 cm. They are recognized by their distinctive dark brown or black color with white markings on their abdomen. They mainly inhabit geographic areas in Europe and Asia. They are found in open environments such as meadows, fields, riverbanks, and sand dunes. Common forest wolf spiders live on the ground and do not build webs; instead, they dig burrows for shelter and nesting. They have a wide tolerance range for soil pH, ranging from 4.5 to 8.5. They are not directly dependent on soil pH; the influence is more indirect, as it affects plants and animals that feed on plants or their parts. They can survive in temperatures ranging from 0°C to 30°C, but they thrive best at temperatures between 15°C and 25°C. The optimal humidity for them is between 20% and 80%. These spiders are important for the ecosystem as they help maintain the population balance of various insects (e.g., flies, beetles, grasshoppers, caterpillars) and other spiders (e.g., smaller wolf spiders), which in turn influences the regulation of carbon dioxide in the atmosphere and plant growth. In addition, they are an important food source for various birds (e.g., thrushes, wagtails) and other spiders (e.g., jumping spiders, crab spiders). Occasionally, they may also serve as food for smaller mammals (e.g., moles, mice). They are only indirectly affected by climate change, as they contribute to the reduction of greenhouse gases in the atmosphere. The size of their genome is less studied but is estimated to be around 2.0 Gb. The energy content of common forest wolf spiders is also poorly researched, but it is known that they have relatively high nutritional value, as they are rich in proteins and lipids (approximately 14 kJ/g or 3.34 kcal/g).[366]

5. Green hunting spiders (*Latin: Micrommata virescens*) can grow up to 2.0 cm in length, with a leg span ranging from 4.5 cm to 6.0 cm. They are recognized by their distinctive green or yellow-green color. They primarily inhabit geographic areas in Europe. They are found in open environments

365 Nyffeler, M., & Birkhofer, K. (2017). An estimated 400-800 million tons of prey are annually killed by the global spider community. *The Science of Nature*, 104(9-10), 30. https://doi.org/10.1007/s00114-017-1440-1.

366 Nyffeler, M., & Benz, G. (2008). Einige Beobachtungen zur Nahrungsökologie der Wolfspinne Pardosa lugubris (WALCK.) (Araneae, Lycosidae). *Deutsche Entomologische Zeitschrift*, 28(4–5), 297–300. https://doi.org/10.1002/mmnd.19810280406.

such as meadows, forests, and gardens. Green hunting spiders build webs among taller plants. They are not directly dependent on soil pH; the influence is more indirect, as it affects plants and animals that feed on plants or their parts. They can survive in temperatures ranging from 10°C to 30°C, but they thrive best at temperatures between 20°C and 25°C. The optimal humidity for them is between 50% and 80%. These spiders are important for the ecosystem as they help maintain the population balance of various insects (e.g., flies, beetles, grasshoppers) and other spiders (e.g., their own species), which in turn influences the regulation of carbon dioxide in the atmosphere and plant growth. In addition, they are an important food source for various birds (e.g., great and blue tits, warblers), insects (e.g., praying mantises, predatory beetles, assassin bugs), amphibians (e.g., frogs, toads), reptiles (e.g., viviparous lizards), and mammals (e.g., moles, mice). They are only indirectly affected by climate change, as they contribute to the reduction of greenhouse gases in the atmosphere. The size of their genome is currently less researched but is estimated to be around 2.1 Gb. Their energy content is also poorly studied, but it is known that they have relatively high nutritional value, as they are rich in proteins and lipids (approximately 14 kJ/g or 3.34 kcal/g).[367]

6. Yellow-brown jumping spiders (Latin: Carrhotus xanthogramma) can grow up to 0.8 cm in length, with a leg span reaching up to 2.0 cm. They are recognized by their characteristic yellow or light brown color. They primarily inhabit geographic areas in Europe, Africa, North America, and Asia. They are found in open environments such as meadows and forests. Yellow-brown jumping spiders build pouch-shaped webs in the area of leaves and twigs of certain plants. They are not directly dependent on soil pH; the influence is more indirect, as it affects plants and animals that feed on plants or their parts. They thrive best at temperatures between 20°C and 30°C. The optimal humidity for them is between 40% and 60%. These spiders are important for the ecosystem, as they help maintain the population balance of various insects (e.g., flies, beetles, grasshoppers, caterpillars), which in turn influences the regulation of carbon dioxide in the atmosphere and plant growth. In addition, they are an important food source for various birds (e.g., owls, hawks), mammals (e.g., bats, moles), and reptiles (e.g., common lizards). They are only indirectly affected by climate change, as they contribute to reducing greenhouse gases in the atmosphere. The size of their genome is estimated to be around 2.16 Gb. The energy content of these spiders is currently less researched, but it is known that they have relatively high nutritional value, as they are rich in proteins and lipids (approximately 14 kJ/g or 3.45 kcal/g).[368]

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367 Opis je bil sestavljen s pomočjo naslednjih dveh virov:
Jäger, P., & Kreuels, M. (2004). Die spinne des jahres goes colour - die Grüne Huschspinne. *Arachnologische Mitteilungen*, 27/28, 121–125. https://doi.org/10.5431/aramit2714.

368 Jackson, R. R., Pollard, S. D., & Nelson, X. J. (1996). Predatory behavior of jumping spiders. *Annual Review of entomology*, 41, 287 – 308. https://doi.org/10.1146/annurev.en.41.010196.001443.

D. Amphibians

5.5.4.3.9 Figure 471: Tree frog, green tree frog

Figure 471 shows the tree frog – the green tree frog (Latin: Hyla arborea), which is the only species of frog in Slovenia whose habitat is on land. It has been loosely described among aquatic amphibians (see mating and egg-laying in water). The green tree frog is easily recognized by its smooth skin, which is green on the back. Under certain circumstances (e.g., when awakening from hibernation or hiding from predators), it can change its color to brown or gray. It predominantly inhabits Europe and some parts of Asia. Except during the breeding season, it lives in coniferous and deciduous forests, meadows, wetlands, and swamps. These frogs prefer sunny spots with dense vegetation, so they thrive best in soils with pH values between 6.0 and 7.0, which aligns with the optimal conditions for the growth of most plants. They are most active at temperatures between 20°C and 30°C, and they have a fairly wide tolerance range for humidity (from 40% to 90%). In the ecosystem, they play an important role as they effectively control pests (e.g., feeding on flies, mosquitoes, and beetles), contribute to the cycling of nutrients for plants, disperse seeds, promote plant biodiversity, and are an important food source for various animals. Their predators include many birds (e.g., waterfowl, green woodpeckers, common cuckoos, blackbirds, magpies), reptiles (e.g., snakes, slow worms, wall lizards), and mammals (e.g., hedgehogs, otters, ferrets, foxes, moles, and voles). The impact of green tree frogs on climate change is only indirect and closely related to their effects on the ecosystem. The size of their genome is estimated at approximately 3.6 Gb, which is larger than the size of the human genome.[369] The energy content of the green tree frog is estimated to be approximately 12.552 kJ/g (3 kcal/g). It is important to emphasize that this estimate is a rough approximation, derived from the average mass or tissue mass of this frog. In this context, it does not rely on scientifically recognized sources that would be relevant for citation. As

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Chang, C., Ng, P. J., & Li, D. (2016). Aggressive jumping spiders make quicker decisions for preferred prey but not at the cost of accuracy. *Behavioral Ecology.* https://doi.org/10.1093/beheco/arw174.

369 https://www.lifeamphicon.eu/sl/zelena-rega (2023-05-21).

can be observed, estimates of the energy content of trees are significantly better researched than those for other living organisms, particularly animals, including humans.

E. Terrestrial reptiles

5.5.4.4 Figure 472: A small selection of terrestrial reptiles

Figure 472 shows a small selection of terrestrial reptiles that live in the environments of the studied soils, numbered from 1 to 9.

1. Common slowworms (*Latin: Anguis fragilis*) are a species of legless lizard that, at first glance, resembles a snake. They grow to a length of 40 cm to 50 cm and can be various colors – ranging from gray and brown to copper, with dark spots or stripes along their bodies. They predominantly inhabit geographical areas of Europe and parts of Asia. They can be found in various habitats such as gardens, meadows, heathlands, and forests. They prefer areas with lush vegetation and high soil moisture, as they can burrow into the soil and hunt for their prey there. They thrive in soils with a pH value between 6.0 and 7.5, at temperatures ranging from 20°C to 30°C, and humidity levels between 40% and 60%. They are important for ecosystems because they help regulate the populations of certain invertebrates, such as snails, insects (e.g., flies, grasshoppers, ants, beetles, earwigs, butterflies, caterpillars, crickets), spiders, and earthworms. By digging tunnels, they

facilitate soil aeration and nutrient cycling, unintentionally spread plant seeds, and contribute to biodiversity. Additionally, they are an important indicator of environmental quality and serve as a food source for various predators, including birds (e.g., owls, hawks, kestrels), reptiles (e.g., adders, smooth snakes, grass snakes), and mammals (e.g., foxes, badgers, domestic cats, moles, mice).
They only indirectly affect climate change by contributing to more effective carbon storage in the soil, biodiversity, and maintaining a healthy environment. The size of their genome is estimated to be approximately 3.2 Gb. The energy content of common slowworms has not been studied yet, but it could be estimated based on their average mass, which would be around 18 kJ/g (4.30 kcal/g).[370]
2. Common lizards or viviparous lizards (*Latin: Lacerta vivipara, Zootoca vivipara*) grow to a length of 10 to 18 cm and can be found in a range of colors, from grey to olive green, often with dark markings along their bodies. They are primarily distributed across geographical regions of Europe and parts of Asia. These lizards inhabit various environments, such as meadows, heathlands, bogs, rocky areas, and forests. They prefer habitats with moderate vegetation, often with access to a water source.
They thrive in soils with a pH ranging from 5.0 to 8.0, at temperatures between 20°C and 35°C, and in relative humidity levels between 30% and 80%.
Common lizards play an important role in ecosystems by regulating populations of certain invertebrates, such as insects (e.g., flies, grasshoppers, ants, beetles, moths, butterflies, true bugs, aphids, caterpillars, crickets, dragonflies), spiders (e.g., wolf spiders, jumping spiders, crab spiders), and other invertebrates (e.g., earthworms, snails, centipedes).
They also help improve microhabitat structure, unintentionally disperse plant seeds, contribute to biodiversity, act as indicators of environmental quality and health, and serve as an important food source for various birds (e.g., kestrels, owls, magpies), reptiles (e.g., grass snakes, smooth snakes), and mammals (e.g., weasels, domestic cats, shrews).
They indirectly influence climate change by promoting greater biodiversity and maintaining a healthy environment.
The size of their genome is estimated to be approximately 1.5 Gb. While their energy content has not yet been specifically studied, based on their average body mass, it is estimated to be about 18 kJ/g (or 4.3 kcal/g).[371]

370 The description was compiled using the following sources:
Abbey, G. (1909). *The balance of nature and modern conditions of cultivation; a practical manual of animal foes and friends for the country gentleman, the farmer, the forester, the gardener, and the sportsman*. G. Routledge & Sons.
Berkovitz, B., & Shells, P. (2017). *Teeth of non-mammalian vertebrates: Dentitions for form, function, and feeding*. Elsevier Academic Press.
Alam, S., Sarre, S., Gleeson, D., Georges, A., & Ezaz, T. (2018). Did lizards follow unique pathways in sex chromosome evolution? *Genes*, 9(5), 239. https://doi.org/10.3390/genes9050239.
371 The description was compiled using the following sources:

3. Wall lizards (*Latin: Podarcis muralis*) grow to a length of 15 to 20 cm and come in various colors, ranging from grey to brown, typically with dark markings along the body. They are predominantly found in Europe. These lizards inhabit a variety of environments, such as gardens, parks, forests, and rocky areas. They prefer habitats with moderate to dense vegetation, especially where rocks, stones, or walls are nearby. They thrive in soils with a pH value between 6.5 and 8.5, at temperatures from 20°C to 35°C, and in relative humidity levels between 40% and 60%.
Wall lizards are important for ecosystems because they help regulate populations of various invertebrates, including insects (e.g., flies, grasshoppers, ants, beetles, moths, butterflies, true bugs, aphids, caterpillars, crickets, dragonflies), spiders (e.g., wolf spiders, jumping spiders, crab spiders), and other invertebrates (e.g., earthworms, snails, centipedes). They also improve the structure of the microhabitat, unintentionally disperse plant seeds, contribute significantly to biodiversity, and serve as an important food source for a variety of birds (e.g., eagles, owls, hawks, falcons, songbirds), reptiles (e.g., grass snakes, other lizards), and mammals (e.g., weasels, domestic cats, shrews). They indirectly affect climate change by promoting greater biodiversity and maintaining a healthy environment. The size of their genome is estimated to be around 1.51 Gb. The energy content of wall lizards is approximately 12.552 kJ/g to 25.104 kJ/g (or 3 to 6 kcal/g).[372]
4. European green lizards (*Latin: Lacerta viridis*) grow to a length of 30 to 40 cm and are easily recognizable by their vivid green coloration. They are predominantly found in Europe and Western Asia. These lizards can be encountered in various habitats such as meadows, grasslands, forest edges, and areas near agricultural land. They prefer open environments with moderate vegetation where they can bask in the sun.
They thrive in soils with a pH ranging from 6.0 to 8.5, at temperatures between 20°C and 35°C, and relative air humidity between 40% and 60%.
European green lizards are important to ecosystems because they help regulate populations of invertebrates such as insects (e.g., flies, grasshoppers, ants, beetles, moths, butterflies, true bugs,

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Benton, T. G., Baguette, M., Clobert, J., & Bullock, J. M. (2013). *Dispersal Ecology and evolution*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199608898.001.0001.
Yurchenko, A. A., Recknagel, H., & Elmer, K. R. (2020). Chromosome-level assembly of the Common Lizard (Zootoca Vivipara) genome. *Genome Biology and Evolution*, 12(11), 1953–1960. https://doi.org/10.1093/gbe/evaa161.
372 The description was compiled using the following sources:
Manley, G. A. (1990). *Peripheral hearing mechanisms in reptiles and birds*. Springer.
Thomas, O. (2020). Predation and ingestion of a viviparous lizard (Zootoca vivipara) by the common wall lizard (Podarcis muralis) in England. *Herpetological Bulletin*, (152, Summer 2020), 44–44. https://doi.org/10.33256/152.44.
Andrade, P., Pinho, C., de Lanuza, G. P., Afonso, S., Brejcha, J., Rubin, C.-J., Wallerman, O., Pereira, P., Sabatino, S. J., Bellati, A., Pellitteri-Rosa, D., Bosakova, Z., Carretero, M. A., Feiner, N., Marsik, P., Paupério, F., Salvi, D., Soler, L., While, G. M., … Carneiro, M. (2018). *Regulatory Changes in Pterin and Carotenoid Genes Underlie Balanced Color Polymorphisms in the Wall Lizard*. https://doi.org/10.1101/481895.

aphids, caterpillars, crickets, dragonflies), spiders (e.g., wolf spiders, jumping spiders, crab spiders), and other invertebrates (e.g., earthworms, snails, centipedes).

They also contribute to microhabitat structure, unintentionally disperse plant seeds, enhance biodiversity, and serve as a vital food source for various birds (e.g., eagles, owls, hawks, falcons, songbirds), reptiles (e.g., grass snakes, other lizards), amphibians (e.g., frogs, toads), and mammals (e.g., weasels, domestic cats, foxes, shrews).

They indirectly influence climate change by supporting greater biodiversity and maintaining a healthy environment.

The size of their genome is estimated at approximately 1.44 Gb. The energy value of European green lizards is roughly estimated to range between 8.368 kJ/g and 16.736 kJ/g (or 2 to 4 kcal/g).[373]

5. Horvath's rock lizards (*Latin: Iberolacerta horvathi*) grow to a length of 7 to 10 cm and are predominantly brown in color. They are mainly distributed across Europe. These lizards are typically found in mountainous and subalpine habitats, where rocky and stony areas dominate and provide suitable basking spots. They prefer open environments and are not dependent on moderate or dense vegetation.

They thrive in habitats with a wide soil pH range, from 4.0 to 8.5, at temperatures between 15°C and 25°C, and in relative humidity levels between 20% and 60%.

Horvath's rock lizards are ecologically important because they help regulate populations of certain invertebrates, such as insects (e.g., flies, grasshoppers, ants, beetles, crickets) and spiders (e.g., wolf spiders, jumping spiders, crab spiders).

They also contribute to the structure of microhabitats, unintentionally disperse plant seeds, support biodiversity, and serve as an important food source for various birds (e.g., eagles, owls, hawks, falcons), reptiles (e.g., vipers, adders, smooth snakes, slowworms, wall lizards), and mammals (e.g., weasels, martens, foxes, shrews, mice, voles).

They influence climate change indirectly, mainly by supporting greater biodiversity and helping to maintain a healthy environment.

The size of their genome is not well studied, but it is estimated to be approximately 1.123 Gb. The energy value of Horvath's rock lizards is also not well researched, but it is likely lower than that of the other lizard species discussed.[374]

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373 The description was compiled using the following sources:
Dieckmann, M. (2017). *Smaragdeidechsen lacerta bilineata und lacerta viridis Wissenswertes über die Farbenfrohen Reptilien Europas*. Thorsten Geier, kleintierverlag.de, Fachverlag für naturnahe Tierhaltung.
Kolora, S. R., Weigert, A., Saffari, A., Kehr, S., Costa, M. B., Spröer, C., Indrischek, H., Chintalapati, M., Lohse, K., Doose, G., Overmann, J., Bunk, B., Bleidorn, C., Grimm-Seyfarth, A., Henle, K., Nowick, K., Faria, R., Stadler, P. F., & Schlegel, M. (2018). Divergent evolution in the genomes of closely-related lacertids, lacerta viridis and L. bilineata and implications for speciation. *GigaScience*. https://doi.org/10.1093/gigascience/giy160.
374 The description was compiled using the following sources:

6. Sand lizards (*Latin: Lacerta agilis*) grow to a length of 15 to 20 cm and are predominantly brown in color, with males displaying a striking emerald green coloration along the upper part of their bodies. They are mainly found throughout Europe.

They typically inhabit dry and sandy environments where sand, rocks, and stony areas dominate (e.g., dunes, heathlands, sandy grasslands, rocky regions), offering suitable conditions for basking. They prefer open habitats and are not dependent on moderate or dense vegetation.

Sand lizards thrive in soils with a pH between 6.0 and 8.0, at temperatures ranging from 25°C to 35°C, and in relative humidity levels between 30% and 50%.

They are important for ecosystems because they help regulate populations of various invertebrates, such as insects (e.g., flies, grasshoppers, ants, beetles, caterpillars, crickets) and spiders (e.g., wolf spiders, jumping spiders, crab spiders). They also contribute to improving microhabitat structure, unintentionally disperse plant seeds, enhance biodiversity, and serve as an important food source for various birds (e.g., kestrels, owls, hawks), reptiles (e.g., smooth snakes, grass snakes, slowworms, wall lizards, green lizards), and mammals (e.g., foxes, weasels, domestic cats, hedgehogs, martens, ferrets). They influence climate change indirectly, primarily by promoting greater biodiversity and supporting a healthy environment. The size of their genome is estimated to be approximately 2.0 Gb. The energy content of sand lizards is not well studied but is estimated to range between 15.0 kJ/g and 17.6 kJ/g (or 3.6 to 4.2 kcal/g).[375]

7. Nose-horned vipers (*Latin: Vipera ammodytes*) grow to a length of 60 to 90 cm and are predominantly light grey or brown in color, with distinctive black zigzag markings along their bodies. They are mainly found in Europe, but also occur in some parts of Turkey.

Osojnik, N., & Vrezec, A. (2012). *Primerjava Območja optimalnih telesnih Temperatur pri Pozidni (Podarcis muralis) in Velebitski Kuščarici (Iberolacerta Horvathi) Diplomsko Delo: Univerzitetni študij = preferred body temperature ranges comparison between common wall lizard (Podarcis muralis) and Horvath's rock lizard* (Iberolacerta Horvathi): Graduation thesis: University studies. N. Osojnik.

Bitenc, K., & Vrezec, A. (2013). *Plenilski Pritisk na Pozidno in Velebitsko Kuščarico v sintopičnih in alotopičnih populacijah: Magistrsko Delo*: Magistrski študij - 2. stopnja = predation pressure on common wall lizard and Horvath's rock lizard in syntopic and allotopic populations: M. Sc. thesis: Master study programmes. K. Bitenc.

Žagar, A., Vrezec, A., & Carretero, M. A. (2016). *Interspecific competition between the common wall lizard (Podarcis muralis laurenti 1768) and the Horvath's rock lizard (Iberolacerta Horvathi Méhely 1904) Medvrstno Tekmovanje Med Pozidno (Podarcis muralis (Laurenti 1768)) in Velebitsko Kuščarico (Iberolacerta Horvathi (méhely 1904)): Doctoral dissertation.* A. Žagar.

375 The description was compiled using the following sources:

Fearnley, H. (2009). *Towards the ecology and conservation of sand lizard (Lacerta agilis) populations in southern England*. Original typescript.

Glandt, D., & Bischoff, W. (1988). *Biologie und schutz der zauneidechse (lacerta agilis) = biology and conservation of the sand lizard (Lacerta agilis)*. Deutsche Gesellschaft für Herpetologie und Terrarienkunde.

https://genomeark.github.io/vgp-curated-assembly/Lacerta_agilis.html (2023-06-01).

Pough, F. H. (1973). Lizard energetics and Diet. *Ecology*, 54(4), 837–844. https://doi.org/10.2307/1935678.

These snakes typically inhabit dry, sandy, and rocky environments, but they are also frequently encountered in shrublands, meadows, and open woodlands. They prefer open habitats and are not dependent on moderate or dense vegetation.

They thrive in environments with soil pH values ranging from 4.5 to 8.5, at temperatures between 20°C and 30°C, and in relative humidity between 40% and 60%.

In ecosystems, they play a crucial role by regulating populations of various vertebrates, such as mammals (e.g., voles, shrews, mice, smaller rats), birds (e.g., sparrows, finches), amphibians (e.g., frogs, toads), and reptiles (e.g., sand lizards, green lizards, grass snakes, smooth snakes, other vipers).

They also contribute to improving microhabitat structure, enhance biodiversity, and serve as an important food source for certain birds (e.g., eagles, hawks) and mammals (e.g., badgers, foxes, wild boars).

They influence climate change indirectly, primarily by helping to maintain biodiversity and healthy ecosystems.

The size of their genome is estimated at approximately 1.75 Gb. The energy value of nose-horned vipers is not well studied, but is estimated to range between 20.91 kJ/g and 21.08 kJ/g (or 4.9 to 5.04 kcal/g).[376]

8. Smooth snakes (*Latin: Coronella austriaca*) grow to a length of 60 to 85 cm and are predominantly grey-brown in color, with dark spots running along their bodies. They are mainly distributed throughout Europe.

They are typically found in heathlands, wetlands, meadows, and open woodlands. They prefer semi-open habitats and favor areas with dense vegetation or rocky terrain where they can find shelter or hide.

Smooth snakes thrive in environments with soil pH values between 6.5 and 8.5, at temperatures ranging from 22°C to 35°C, and in relative humidity levels between 50% and 70%.

In ecosystems, they play an important role by regulating populations of various vertebrates, such as mammals (e.g., voles, shrews, mice), birds (e.g., sparrows, finches), amphibians (e.g., frogs, toads), and reptiles (e.g., common lizards, slowworms, sand lizards).

Additionally, they unintentionally disperse plant seeds, improve microhabitat structure, contribute to biodiversity, and serve as an important food source for certain birds (e.g., owls, kestrels), reptiles (e.g., vipers, grass snakes), and mammals (e.g., badgers, foxes, weasels, domestic cats).

376 The description was compiled using the following source:
Crnobrnja-Isailovic, J., Ajtic, R., & Tomovic, L. (2007). Activity patterns of the sand viper (Vipera ammodytes) from the central Balkans. *Amphibia-Reptilia*, 28(4), 582–589. https://doi.org/10.1163/156853807782152598.

They influence climate change indirectly, mainly by supporting biodiversity and maintaining healthy ecosystems.
The size of their genome is estimated to be approximately 1.98 Gb. The energy value of smooth snakes is not well researched, but is estimated to range between 17.0 kJ/g and 18.0 kJ/g (or 4.31 to 4.55 kcal/g).[377]
9. Aesculapian snakes (*Latin: Zamenis longissimus*) can grow up to 2 meters in length, and in rare cases even up to 2.5 meters. Their coloration is predominantly grey-brown with darker spots along the body. They are primarily distributed across Europe.
They can be found in meadows, forests, shrublands, parks, and even rocky areas. They are often encountered near water sources such as rivers, large streams, and lakes. These snakes prefer habitats with suitable vegetation and sunning spots.
They thrive in environments with soil pH values between 4.5 and 8.5, at temperatures ranging from 22°C to 30°C, and relative air humidity between 40% and 60%.
In ecosystems, Aesculapian snakes play an important role by regulating populations of various vertebrates, including mammals (e.g., voles, shrews, mice, small rats), birds (e.g., sparrows, finches, tits, warblers, flycatchers, thrushes, blackbirds, small ducks, goslings, coots), and reptiles (e.g., smaller snakes, skinks, green lizards, wall lizards, geckos). Additionally, they unintentionally disperse plant seeds, enhance microhabitat structure, contribute to biodiversity, and serve as an important food source for certain birds (e.g., owls, hawks, eagles), reptiles (e.g., larger snakes, when Aesculapian snakes are younger or smaller), and mammals (e.g., foxes, martens). They influence climate change indirectly, primarily by supporting biodiversity and maintaining healthy ecosystems.
The size of their genome is estimated at approximately 1.90 Gb. The energy value of Aesculapian snakes is not well studied, but it is estimated to be around 20.92 kJ/g (or 5.0 kcal/g).[378]

377 The description was compiled using the following sources:
Galarza, J. A., Mappes, J., & Valkonen, J. K. (2014). Biogeography of the smooth snake (coronella austriaca): Origin and conservation of the northernmost population. *Biological Journal of the Linnean Society*, 114(2), 426–435. https://doi.org/10.1111/bij.12424.
https://www.first-nature.com/reptiles/coronella-austriaca.php (2023-06-02).
https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?mode=Info&id=201445 (2025-02-19).
378 The description was compiled using the following sources:
Leutscher, A., & Driscoll, B. (1965). *The Curious World Of Snakes*. McGraw-Hill.
Street, D. (1979). *The reptiles of Northern and Central Europe*. Batsford.
https://www.ncbi.nlm.nih.gov/datasets/taxonomy/201439/ (2025-02-19).

F. Terrestrial birds

5.5.4.4.1 Figure 473: A small selection of terrestrial birds

Figure 473 shows a small selection of terrestrial birds that inhabit the environments of the studied soils, numbered from 1 to 16.

1. The great tit (*Latin: Parus major*) grows to a length of 13 to 14 cm and is a relatively colorful bird. It is recognizable by its black head, white cheeks, olive-green upper body, yellow belly, and bluish-grey wings. It is mainly distributed across Europe, Asia, and parts of North Africa.

The great tit can be found in a variety of habitats, such as meadows, forests, parks, and gardens. It prefers environments with suitable vegetation, particularly areas with trees, which are essential for nesting. Although it is not directly dependent on soil pH, it lives in ecosystems where vegetation thrives best at soil pH values between 6.0 and 7.5. It performs best in temperatures ranging from 10°C to 30°C and in air humidity between 40% and 70%. It plays an important role in ecosystems by regulating populations of certain insects (e.g., butterflies, moths, caterpillars, beetles, ants, grasshoppers, crickets, flies, and insect larvae) and spiders (e.g., crab spiders, jumping spiders, daddy longlegs). Additionally, it unintentionally disperses seeds and contributes to flower pollination by feeding on fruit (e.g., strawberries, cherries, elderberries), seeds, nuts, and nectar. Through these activities, it supports biodiversity and serves as an important food source for other birds (e.g., owls, hawks, falcons, shrikes), reptiles (e.g., Aesculapian snakes), and mammals (e.g., stoats, weasels, squirrels, rats, domestic cats). Its impact on climate change is indirect, primarily through enhancing biodiversity and maintaining healthy ecosystems. The size of its genome is estimated to be approximately 1.62 Gb. The energy content of great tits is not well studied, but based on their body mass, it is estimated to range from 16.73 kJ/g to 41.84 kJ/g (equivalent to 4.0 kcal/g to 10.0 kcal/g).[379]

2. The common blackbird (*Latin: Turdus merula*) grows to a length of 23 to 29 cm and is typically black or brown in color, with a yellow-orange beak. Males have black plumage, while females are slightly smaller and have browner feathers.

They are mainly distributed across Europe, Asia, and parts of North Africa. They inhabit environments such as forests, shrublands, parks, and gardens. Blackbirds prefer areas with dense vegetation and undergrowth, especially for nesting.

While not directly dependent on soil pH, they live in ecosystems where vegetation thrives at pH values between 6.0 and 7.5.

They can survive in temperatures ranging from -10 °C to 40 °C, with optimal conditions between 15 °C and 30 °C, and relative humidity from 40% to 70%.

They play an important ecological role by regulating populations of certain insects (e.g., caterpillars, beetles, ants, grasshoppers, and flies), spiders (e.g., crab spiders, jumping spiders, and harvestmen), and other invertebrates (e.g., slugs, earthworms, centipedes, and millipedes).

They also unintentionally disperse seeds by consuming fruit (e.g., strawberries, raspberries, blackberries, elderberries, hawthorn berries, and sloes), seeds (e.g., from grasses, wildflowers, and trees), nuts (e.g., acorns, beech nuts, and hazelnuts in autumn and winter), and certain plants (e.g., ivy and yew berries).

Blackbirds make a significant contribution to biodiversity and serve as a valuable food source for various birds (e.g., owls, hawks, falcons), reptiles (e.g., Aesculapian snakes, ratsnakes), and mammals (e.g., domestic cats, foxes, martens, stoats, and weasels). Their influence on climate change is indirect, primarily through promoting biodiversity and supporting a healthy environment.

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379 The description was compiled using the following sources:
Kluijver, H. N. (1951). *The population ecology of the Great Tit, Parus M. Major L*. E. J. Brill.
Hinde, R. (1952). *The behaviour of the Great Tit (parus major) and some other related species*. E.J. Brill.
https://www.ncbi.nlm.nih.gov/datasets/genome/GCF_001522545.2/ (2025-02-19).

The size of their genome is estimated to be approximately 1.2 Gb. The energy content of Eurasian blackbirds is not well studied, but based on their body mass, it is estimated to be between 14 kJ/g and 16 kJ/g (or 3.3 kcal/g to 3.8 kcal/g).[380]

3. The house sparrow (*Latin: Passer domesticus*) grows to a length of 14 to 16 cm and is grayish-brown in color. It is widely distributed across Europe, Asia, North America, South America, Africa, and parts of Australia. House sparrows can be found in urban centers, parks, agricultural land, forest edges, shrublands, and gardens. They prefer environments with dense vegetation, particularly for nesting and shelter.

House sparrows are not directly dependent on soil pH but inhabit ecosystems where vegetation thrives at pH values between 6.0 and 7.5. They thrive best in environments with temperatures between 20 °C and 30 °C and relative humidity between 40% and 60%.

They play an important role in ecosystems by regulating populations of certain insects (e.g., caterpillars, beetles, ants, grasshoppers, and flies), spiders (e.g., crab spiders, jumping spiders, and harvestmen), and other invertebrates (e.g., worms and earthworms). They also unintentionally disperse seeds and contribute to pollination by consuming fruit (e.g., strawberries, raspberries, blackberries, elderberries, hawthorn berries, sloes, apples, pears, cherries, and grapes), seeds (e.g., from grasses, corn, cereals, barley, oats, sunflowers, and dandelions), and occasionally nectar. They also consume scraps of human food (e.g., breadcrumbs).

House sparrows contribute significantly to biodiversity and serve as a food source for various birds (e.g., owls, hawks, falcons, crows, shrikes, and jays), reptiles (e.g., Aesculapian snakes and ratsnakes), and mammals (e.g., domestic cats, wildcats, squirrels, weasels, and rats). Their influence on climate change is indirect, primarily through supporting greater biodiversity and maintaining healthy ecosystems.

The size of their genome is estimated to be approximately 1.04 Gb. The energy content of house sparrows is poorly studied but is estimated, based on their body mass, to be around 19 kJ/g or 4.5 kcal/g.[381]

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380 The description was compiled using the following sources:
Stephan, B. (1999). *Die Amsel, Turdus Merula*. Westarp Wissenschaften.
Roche, G. (2022). *Blackbird = Manu Pango = Merle Noir = Amsel = Kurōtadori: (Turdus Merula)*. Geoffrey Roche.
Landmann, A. (1991). Habitat preferences and seasonal dynamics of Space Atilization in Blackbirds (Turdus Merula) living in villages. *Journal Für Ornithologie,* 132(3), 303–318. https://doi.org/10.1007/bf01640539.
http://www.genomesize.com/result_species.php?id=998 (2023-06-04).

381 The description was compiled using the following sources:
Lowther, P. E., & Cink, C. L. (1992). *House sparrow (passer domesticus)*. American Ornithologists' Union.
Liker, A. (2022). Passer domesticus (house sparrow). *CABI Compendium*, CABI Compendium. https://doi.org/10.1079/cabicompendium.38975.
https://www.ncbi.nlm.nih.gov/genome/?term=Passer+domesticus (2023-06-04).

4. The Eurasian nuthatch (*Latin: Sitta europaea*) grows to a length of 13 to 14 cm and is a rather colorful bird. Its upper body is bluish-grey, the underside is orange, and it has a distinctive black stripe running across the eyes. It is primarily found throughout Europe, Asia, and parts of North Africa. Eurasian nuthatches inhabit urban areas with parks and trees, gardens, as well as deciduous and coniferous forests.

They prefer environments with dense vegetation, especially areas with trees, which they use for nesting, foraging, and shelter. Although they are not directly dependent on soil pH, they live in habitats where vegetation thrives at pH levels between 6.0 and 7.0. They thrive best in environments with temperatures ranging from 10 °C to 25 °C and relative humidity between 40% and 70%.

Nuthatches play an important role in ecosystems by helping regulate populations of certain insects (e.g., caterpillars, beetles, ants, grasshoppers, and flies), spiders (e.g., crab spiders and jumping spiders), and other invertebrates (e.g., worms, larvae, woodlice, and bark beetles). They also unintentionally disperse seeds by consuming and later excreting them (e.g., acorns, beech mast, hazelnuts, and pine seeds), thereby contributing significantly to biodiversity.

Eurasian nuthatches are a valuable food source for a variety of predators, including birds (e.g., owls, hawks, falcons), reptiles (e.g., Aesculapian snakes and ratsnakes), and mammals (e.g., domestic cats, wildcats, and squirrels). They can also fall victim to parasitic insects such as lice, mites, and ticks.

Their influence on climate change is only indirect, primarily through enhancing biodiversity and supporting healthy ecosystems. The size of their genome is estimated to be approximately 1.02 Gb. The energy content of Eurasian nuthatches is not well studied but may be estimated, based on their body mass, at around 19 kJ/g or 4.5 kcal/g.[382]

5. The Eurasian magpie (*Latin: Pica pica*) grows to a length of 44 to 46 cm and has a distinctive black-and-white coloration, with bluish wings and a black tail with a bluish sheen. It is widespread across Europe, Asia, and parts of North Africa. Magpies inhabit a variety of environments, including urban areas with parks, gardens, clearings, meadows, agricultural land, and forest edges. They thrive in both densely vegetated habitats and open areas.

382 The description was compiled using the following sources:
Schmidt, F., & Wiese, V. (2006). *Der Kleiber: Sitta Europaea ; Linnaeus 1758*. Verein zur Förderung der Naturkunde in Cismar e.V.
Löhrl, H. (2010). Das Verhalten des Kleibers (Sitta Europaea Caesia Wolf). *Zeitschrift Für Tierpsychologie*, 15(2), 191–252. https://doi.org/10.1111/j.1439-0310.1958.tb00564.x.
https://www.ncbi.nlm.nih.gov/genome/?term=Sitta+europaea (2023-06-04).

Magpies are not directly dependent on soil pH, but they tend to live in ecosystems where vegetation flourishes at pH levels between 6.0 and 7.5. They prefer environments with temperatures ranging from 5 °C to 30 °C and relative humidity between 40% and 80%.

They play an important ecological role by helping to control populations of various insects (e.g., caterpillars, beetles, grasshoppers), spiders (e.g., crab spiders and jumping spiders), vertebrates (e.g., lizards, small snakes, frogs, and bird chicks), mammals (e.g., mice, voles, shrews, and young hares), and other invertebrates (e.g., worms). They also contribute to the decomposition of carrion and unintentionally disperse seeds by consuming and excreting them (e.g., seeds of field crops, berries, and fleshy fruits).

Magpies contribute significantly to biodiversity and serve as a valuable food source for various predators, including birds (e.g., owls, hawks, eagles, crows, and ravens) and mammals (e.g., domestic cats, wildcats, and foxes). They are also susceptible to parasitic insects such as lice, mites, fleas, and ticks.

Their impact on climate change is indirect, primarily through their contribution to greater biodiversity and the maintenance of healthy ecosystems. The size of their genome is estimated to be approximately 1.06 Gb. The energy content of magpies has not been well studied, but it may be estimated, based on their body mass, at around 19 kJ/g or 4.5 kcal/g.[383]

6. The hooded crow (*Latin: Corvus cornix*) grows to a length of 48 to 52 cm and has a grey-and-black coloration. It is predominantly found across Europe and Asia. Hooded crows inhabit a wide range of environments, including urban areas with parks, gardens, clearings, meadows, agricultural land, forest edges, forests, and coastal regions. They can adapt to both densely vegetated areas and open landscapes.

They are not directly dependent on soil pH but typically live in ecosystems where vegetation thrives at pH levels between 6.0 and 7.5. They are best suited to environments with temperatures ranging from -10 °C to 30 °C and relative humidity between 40% and 80%.

Hooded crows play an important ecological role by regulating the populations of various insects (e.g., caterpillars, beetles, grasshoppers, and ants), spiders (e.g., crab spiders and jumping spiders), vertebrates (e.g., lizards, small snakes, frogs, bird chicks, and bird eggs), mammals (e.g., mice, voles, shrews, and young hares), and other invertebrates (e.g., worms, centipedes, and millipedes). They also contribute to the decomposition of carrion and unintentionally disperse seeds by consuming and excreting them (e.g., seeds of field crops, berries, and fleshy fruits).

383 The description was compiled using the following sources:
Bährmann, U. (1995). *Die Elster (Pica Pica)*. Westarp-Wiss.
Tatner, P. (2008a). The diet of Urban Magpies Pica Pica. *Ibis*, 125(1), 90–107. https://doi.org/10.1111/j.1474-919x.1983.tb03086.x.
https://www.ncbi.nlm.nih.gov/genome/?term=Pica+pica (2023-06-04).

Hooded crows significantly contribute to biodiversity and serve as a food source for various birds (e.g., owls, hawks, and eagles) and mammals (e.g., raccoons, foxes, and domestic dogs). Their influence on climate change is indirect, mainly through promoting biodiversity and maintaining healthy ecosystems.

The size of their genome is estimated to be approximately 1.05 Gb. The energy content of hooded crows has not been thoroughly studied, but based on their body mass, it may be estimated at around 19 kJ/g or 4.5 kcal/g.[384]

7. Tawny owls (*Latin: Strix aluco*) grow to a length of 37 to 39 cm and are brownish-grey in color, with lighter markings around the eyes. Their plumage can vary depending on their environment, and may also appear reddish-brown or grey. Tawny owls are primarily found in Europe, Asia, and parts of North Africa.

They inhabit environments such as urban areas with parks, large gardens, forests, and agricultural land. They prefer areas with trees, which provide nesting sites and places to rest during the day.

Tawny owls are not directly dependent on soil pH but live in environments where vegetation thrives at pH levels between 5.5 and 7.5. They do best in habitats with temperatures ranging from 15 °C to 30 °C and relative humidity between 40% and 60%.

Tawny owls play an important role in ecosystems by controlling populations of various insects (e.g., caterpillars, beetles, grasshoppers, and moths), spiders (e.g., wolf spiders and ground spiders), amphibians (e.g., frogs and toads), birds (e.g., finches, tits, and smaller owls), mammals (e.g., mice, voles, shrews, and rats), and small fish (e.g., small trout).

They contribute significantly to biodiversity and serve as a food source for larger birds (e.g., eagle owls, hawks, and eagles) and mammals (e.g., martens and foxes). Their influence on climate change is indirect, mainly through supporting biodiversity and maintaining a healthy environment.

The size of their genome is not well studied, but it may be estimated at approximately 1.22 Gb (this estimate is based on a different owl species, Tyto alba alba). The energy content of tawny owls is poorly researched but may be roughly estimated at 19 kJ/g or 4.5 kcal/g based on body mass.[385]

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384 The description was compiled using the following sources:
Melde, M. (2014). *Raben- und nebelkrähe: Corvus Corone, Corvus Cornix*. VerlagsKG Wolf.
Madge, S. (2020). Hooded Crow (Corvus Cornix). *Birds of the World*. https://doi.org/10.2173/bow.hoocro1.01.
https://www.ncbi.nlm.nih.gov/genome/?term=Corvus+cornix (2023-06-04).

385 The description was compiled using the following sources:
Melde, M. (1995). *Der Waldkauz Strix Aluco*. Westarp-Wiss.
Mikkola, H. (2010). *Owls of Europe*. Poyser.
Ducrest, A., Neuenschwander, S., Schmid-Siegert, E., Pagni, M., Train, C., Dylus, D., Nevers, Y., Warwick Vesztrocy, A., San-Jose, L. M., Dupasquier, M., Dessimoz, C., Xenarios, I., Roulin, A., & Goudet, J. (2020). New Genome Assembly of the barn owl (tyto alba alba). *Ecology and Evolution*, 10(5), 2284–2298. https://doi.org/10.1002/ece3.5991.

8. Northern goshawks (*Latin: Accipiter gentilis*) grow to a length of 48 to 61 cm and are dark grey to slate-blue in color, with dark bands on the underside of their body. They are primarily found across Europe, Asia, North America, and parts of North Africa.

They inhabit deciduous and coniferous forests, strongly preferring wooded environments where they can nest and hunt. Northern goshawks are not directly dependent on soil pH, but they live in areas where vegetation thrives within a pH range of 5.5 to 7.5. They thrive in habitats with temperatures between 15 °C and 25 °C and relative humidity between 40% and 80%.

They are ecologically important as they help regulate populations of birds (e.g., pigeons, jays, magpies, crows, and grouse) and mammals (e.g., mice, voles, hares, squirrels, foxes, and raccoons). Northern goshawks contribute significantly to biodiversity and also serve as a food source for larger birds (e.g., eagle owls and eagles) and mammals (e.g., grey wolves).

Their influence on climate change is only indirect, primarily through enhancing biodiversity and supporting healthy ecosystems. The size of their genome is estimated to be approximately 1.22 Gb. The energy content of goshawks is poorly studied, but may be estimated based on body mass at around 21 kJ/g or 5 kcal/g.[386]

9. Peregrine falcons (*Latin: Falco peregrinus*) grow to a length of 38 to 50 cm and have dark bluish-grey plumage with lighter patterns on the underside, marked with dark streaks. Their head is very dark with a distinctive black line resembling a mustache.

They are found on every continent except Antarctica. Peregrine falcons inhabit environments such as mountainous rocky areas, coastal regions, wetlands, grasslands, and urban centers with tall buildings. They have a strong preference for mountainous habitats, where they can nest and hunt. Peregrine falcons are not directly dependent on soil pH, but they live in areas where vegetation thrives within a pH range of 4.5 to 7.0. They inhabit areas with temperatures ranging from 0 °C to 30 °C and relative humidity between 20% and 80%.

They play an important ecological role by regulating the populations of birds (e.g., pigeons, ducks, geese, swans, terns, finches, sparrows, warblers, grouse, and quail) and, to a lesser extent, mammals (e.g., mice and voles). Peregrine falcons contribute significantly to biodiversity and also serve as prey for larger birds (e.g., eagle owls and eagles) and mammals (e.g., foxes and raccoons).

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386 The description was compiled using the following sources:
Griffith, R. S. (1993). *Accipiter gentilis. USDA Forest Service*, Rocky Mountain Research Station, Fire Sciences Laboratory.
Proposed Wildlife Habitat Areas for the Northern Goshawk (Accipiter gentilis laingi) on the Central Coast of British Columbia (2008).
https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crownland/land-use-plans-and-objectives/westcoast-region/great-bear-rainforest/ei02a_nogo_general_release_report.pdf.
https://www.ncbi.nlm.nih.gov/genome/?term=Accipiter+gentilis (2023-06-05).

Their impact on climate change is only indirect, by supporting biodiversity and helping to maintain healthy ecosystems. The size of their genome is estimated to be around 1.16 Gb. The energy content of peregrine falcons is not well researched, but it may be estimated based on body mass at about 14.2 kJ/g or 3.4 kcal/g.[387]

It should also be noted that white-tailed eagles (Haliaeetus albicilla) could be considered within the context of aquatic mesocosms, as they are semi-aquatic creatures that catch most of their prey on water surfaces. However, they are not typically classified as waterbirds, since they do not live on water or build their nests near water, but instead exclusively on land in elevated areas.

10. White-tailed eagles (*Latin: Haliaeetus albicilla*) grow to a length of 66 to 94 cm and are dark brown in color with a distinctive white tail. They have strong yellow beaks and pale yellow eyes. They are found across Europe, Asia, and parts of North America. Their habitats include coastal areas near large lakes and rivers, wetlands, rocky plateaus, and forests at higher elevations (primarily for nesting and hunting). They prefer environments in mountainous regions and near bodies of water, where they can nest and hunt effectively.

White-tailed eagles are not directly dependent on soil pH, but they live in habitats with vegetation and prey that thrive within a pH range of 4.5 to 8.5. They inhabit environments with temperatures ranging from 0 °C to 30 °C and air humidity levels between 30% and 80%.

They play an important ecological role by regulating populations of fish (e.g., salmon, trout, herring, cod), birds (e.g., ducks, geese, swans), and to a lesser extent, mammals (e.g., hares, mice, and voles). They contribute significantly to biodiversity and can serve as a food source for various birds (e.g., eagle owls, golden eagles) and, to a lesser extent, mammals (e.g., foxes and raccoons—mainly by preying on their eggs and unguarded young).

Their impact on climate change is only indirect, through their contribution to increased biodiversity and the maintenance of healthy ecosystems. The size of their genome is estimated at approximately 1.20 Gb. The energy content of white-tailed eagles is poorly studied but could potentially be estimated based on body mass at 14.2 kJ/g or 3.4 kcal/g.[388]

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387 The description was compiled using the following sources:
White, C. M. (2002). *Peregrine Falcon: Falco peregrinus*. Birds of North America, Inc.
Landenberger, J. F., Roosa, D. M., Stravers, J. W., Ehresman, B., & Patterson, R. (2013). Peregrine Falcon: Falco peregrinus. In *The Raptors of Iowa* (pp. 56–57). University of Iowa Press. https://doi.org/10.2307/j.ctt20q1vqp.25.
https://www.ncbi.nlm.nih.gov/genome/?term=Falco+peregrinus (2023-06-05).

388 The description was compiled using the following sources:
Nadjafzadeh, M. (2011). *Feeding ecology of and lead exposure in a top predator: The white-tailed eagle (haliaeetus albicilla)*. Logos-Verl.
Scholz, F. (2010). *Spatial use and habitat selection of white-tailed eagles (haliaeetus albicilla) in Germany*. Logos-Verl.
https://www.ncbi.nlm.nih.gov/genome/?term=Haliaeetus+albicilla (2023-06-05).

11. European greenfinches (*Latin: Fringilla coelebs*) grow to a length of 12.5 to 14 cm and have bright greenish-yellow plumage (females display a paler green coloration). They are primarily found across Europe, North Africa, and parts of Australia.
They inhabit environments such as urban centers, parks, agricultural land, forests, hedgerows, and gardens. They prefer areas with dense vegetation, especially for nesting and shelter.
Greenfinches are not directly dependent on soil pH but live in habitats with vegetation that thrives in a pH range of 6.0 to 7.5. They are most comfortable in environments with temperatures between 10 °C and 30 °C and relative humidity levels from 40% to 80%.
They play an important role in ecosystems by helping regulate populations of certain insects (e.g., caterpillars, beetles, grasshoppers, and flies) and spiders (e.g., crab spiders, jumping spiders, and daddy longlegs). They also contribute to seed dispersal by consuming fruits (e.g., berries, apples, cherries, grapes) and seeds (e.g., grasses, trees, weeds, dandelions, and sunflowers), which pass through their digestive systems.
European greenfinches contribute significantly to biodiversity and serve as a food source for various predators, including birds (e.g., owls, hawks, falcons), reptiles (e.g., smooth snakes, rat snakes), and mammals (e.g., domestic cats and weasels). It's worth noting that greenfinches are not frequently targeted by predators, as their feeding habits result in relatively low nutritional value.
Their influence on climate change is only indirect—primarily through promoting plant biodiversity and supporting healthy ecosystems. The size of their genome is estimated to be approximately 995 Mb. The energy content of greenfinches is poorly studied, but it could potentially be estimated based on their body mass at 20 kJ/g or 4.8 kcal/g.[389]
12. European robins (*Latin:Erithacus rubecula*) grow to a length of 12.5 to 14 cm and have a reddish-brown plumage, with a white belly and a reddish-orange breast. They are primarily found in Europe, North Africa, Western Asia, and parts of Australia.
They inhabit environments such as urban areas, parks, agricultural land, forests, hedgerows, shrubs, and gardens. They prefer habitats with dense vegetation, particularly for nesting and shelter.
Robins are not directly dependent on soil pH, but they live in areas with vegetation that thrives in a pH range of 6.0 to 7.5. They are most comfortable in environments with temperatures between 10 °C and 25 °C and relative humidity levels between 40% and 80%.
They are ecologically important because they help regulate populations of certain insects (e.g., caterpillars, beetles, ants, and flies), spiders (e.g., crab spiders, jumping spiders, and harvestmen),

389 The description was compiled using the following sources:
Krägenow, P. (2004). *Der Buchfink Fringilla coelebs*. Westarp-Wiss.-Verl.-Ges.
Newton, I., & Vaisanen, R. A. (1997). *Fringilla coelebs: Chaffinch*. T. & A.D. Poyser.
https://www.ncbi.nlm.nih.gov/genome/?term=Fringilla+coelebs (2023-06-06).

and other invertebrates (e.g., snails, earthworms, and small crustaceans). They also contribute to seed dispersal by consuming fruits (e.g., berries, apples, cherries, grapes) and, more rarely, seeds (mainly during the winter months).

European robins contribute significantly to biodiversity and serve as a food source for various birds (e.g., owls, hawks, falcons), reptiles (e.g., smooth snakes, rat snakes), and mammals (e.g., domestic cats, weasels). However, they are not frequently targeted by predators.

Their impact on climate change is indirect, primarily through promoting plant biodiversity and supporting healthy ecosystems. The size of their genome is estimated to be approximately 980 Mb. The energy content of robins is poorly researched, but it could potentially be estimated based on their body mass at 20 kJ/g or 4.8 kcal/g.[390]

13. Green woodpeckers (*Latin: Picus viridis*) grow to a length of 30 to 36 cm and have olive-green plumage (with a yellowish-green belly). They are primarily found in Europe and parts of Asia. They can be found in habitats such as forests, parks, agricultural land, orchards, and gardens. They prefer environments with trees, particularly for nesting and shelter.

Green woodpeckers are not directly dependent on soil pH, but they live in areas with vegetation that thrives in a pH range of 6.0 to 7.5.

They are most comfortable in environments with temperatures between 10 °C and 25 °C and relative humidity levels between 40% and 80%.

They are important for ecosystems because they help regulate populations of certain insects (e.g., caterpillars, beetles, ants, grasshoppers, crickets, butterfly larvae, moth larvae), spiders (e.g., jumping spiders, wolf spiders), and other invertebrates (e.g., snails, earthworms, centipedes, millipedes).

They also unintentionally spread seeds by consuming fruits (e.g., strawberries, blackberries, raspberries, apples, cherries, pears), nuts (e.g., beech nuts, chestnuts), and seeds (e.g., grasses, trees, weeds).

Green woodpeckers contribute significantly to biodiversity and serve as a welcome food source for various birds (e.g., hawks) and mammals (e.g., domestic cats, weasels, martens). They are not often preyed upon.

Their impact on climate change is indirect, primarily supporting greater plant biodiversity and maintaining a healthy environment. The size of their genome is estimated to be around 1.17 Gb (this data applies to a related species, Dryobates pubescens). The energy content of green woodpeckers is

390 The description was compiled using the following sources:
Pätzold, R. (1995). *Das Rotkehlchen: Erithacus Rubecula*. Westarp Wissenschaften.
Lack, D. (2008). Geographical variation in Erithacus rubecula. *Ibis*, 93(4), 629–630. https://doi.org/10.1111/j.1474-919x.1951.tb05469.x.
https://www.ncbi.nlm.nih.gov/genome/?term=Erithacus+rubecula (2023-06-06).

poorly researched, but it could potentially be estimated based on their body mass at 19 kJ/g or 4.5 kcal/g.[391]

14. Mistle thrush (*Latin: Turdus viscivorus*) grows to a length of 25 to 29 cm and has pale gray-brown plumage (the underside is yellowish-white with dark spots). They are primarily found in Europe and parts of Asia.

They can be found in habitats such as forests, parks, agricultural land, scrublands, and gardens. They prefer environments with trees in deciduous, mixed, and coniferous forests, particularly for nesting, foraging, and shelter.

Mistle thrushes are not directly dependent on soil pH, but they live in areas with vegetation that thrives in a pH range of 6.0 to 7.5. They are most comfortable in environments with temperatures between 10 °C and 25 °C and relative humidity levels between 40% and 80%.

They are important for ecosystems because they help regulate populations of certain insects (e.g., caterpillars, beetles, insect larvae), spiders (e.g., common cross spiders, jumping spiders, wolf spiders, orb-weaving spiders), and other invertebrates (e.g., earthworms). They also unintentionally spread seeds by consuming fruits (e.g., strawberries, blackberries, raspberries, elderberries, mistletoe berries, rowan), nuts (e.g., beech nuts, chestnuts, oak nuts, hazelnuts), and seeds (e.g., grasses, wildflowers).

Mistle thrushes contribute significantly to biodiversity and serve as a welcome food source for various birds (e.g., hawks), mammals (e.g., domestic cats, foxes, weasels), and reptiles (e.g., snakes). Like green woodpeckers, mistle thrushes are not often preyed upon.

Their impact on climate change is indirect, supporting greater plant biodiversity and maintaining a healthy environment. The size of their genome is estimated to be around 1.05 Gb (this data applies to a related species, such as the red thrush). The energy content of mistle thrushes is poorly researched, but it could potentially be estimated based on their body mass at 17 kJ/g or 4 kcal/g.[392]

15. Garden warblers (*Latin: Sylvia borin*) grow to a length of 12 to 14 cm and have gray-brown plumage (the underside is pale gray with a pale yellow belly). They are primarily found in Europe, as well as some parts of Asia and Africa.

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391 Blume, D., & Blume, D. (1996). Schwarzspecht, Grauspecht und grünspecht: Dryocopus Martius, Picus canus, Picus viridis. Westarp Wissenschaften.
Winkler, H., & Christie, D. (2020). Eurasian green woodpecker (Picus viridis). Birds of the World. https://doi.org/10.2173/bow.eugwoo2.01.
https://www.ncbi.nlm.nih.gov/genome/?term=woodpecker (2023-06-06).

392 The description was compiled using the following sources:
Chiatante, G. (2022). Habitat use of the mistle thrush (turdus viscivorus): The importance of urban areas and permanent crops. *Journal of Vertebrate Biology*, 71(22041). https://doi.org/10.25225/jvb.22041.
Crossley, R., Baicich, P. J., & Barry, J. (2017). *The crossley ID guide*. Crossley Books, Princeton University Press.
https://www.ncbi.nlm.nih.gov/genome/?term=Turdus (2023-06-06).

They can be found in habitats such as forests, parks, hedgerows, shrubs, wetlands, marshes, and gardens. They prefer environments with dense vegetation, especially for nesting, foraging, and shelter.

Garden warblers are not directly dependent on soil pH, but they live in areas with vegetation that thrives in a pH range of 5.5 to 7.0. They are most comfortable in environments with temperatures between 15 °C and 25 °C and relative humidity levels between 40% and 70%.

They are important for ecosystems because they help regulate populations of certain insects (e.g., caterpillars, beetles, moths, ground beetles, flies, grasshoppers, crickets, leafhoppers), spiders (e.g., crab spiders, jumping spiders), and other invertebrates (e.g., aphids). They also unintentionally spread seeds by consuming fruits (e.g., strawberries, blackberries, raspberries) and seeds (e.g., grasses, flowers).

Garden warblers contribute significantly to biodiversity and serve as a welcome food source for various birds (e.g., hawks, falcons, owls, magpies, jays), mammals (e.g., domestic cats, wild cats, foxes, weasels), and reptiles (e.g., common lizards).

Their impact on climate change is indirect, supporting greater biodiversity and maintaining a healthy environment. The size of their genome is estimated to be around 1.04 Gb. The energy content of garden warblers is poorly researched, but it could potentially be estimated based on their body mass at 19 kJ/g or 4.5 kcal/g.[393]

16. Stonechats (*Latin: Saxicola rubicola*) grow to a length of 11 to 13 cm and are quite colorful birds (black head, white collar, reddish-orange chest). They are primarily found in Europe, some parts of Asia, and Africa.

They can be found in habitats such as open grasslands, heathlands, scrublands, and marshes. They prefer environments with low vegetation, which provides a better vantage point for hunting insects.

Stonechats are not directly dependent on soil pH, but they live in areas with vegetation that thrives in a pH range of 6.0 to 7.5. They are most comfortable in environments with temperatures between 10 °C and 25 °C and relative humidity levels between 40% and 70%.

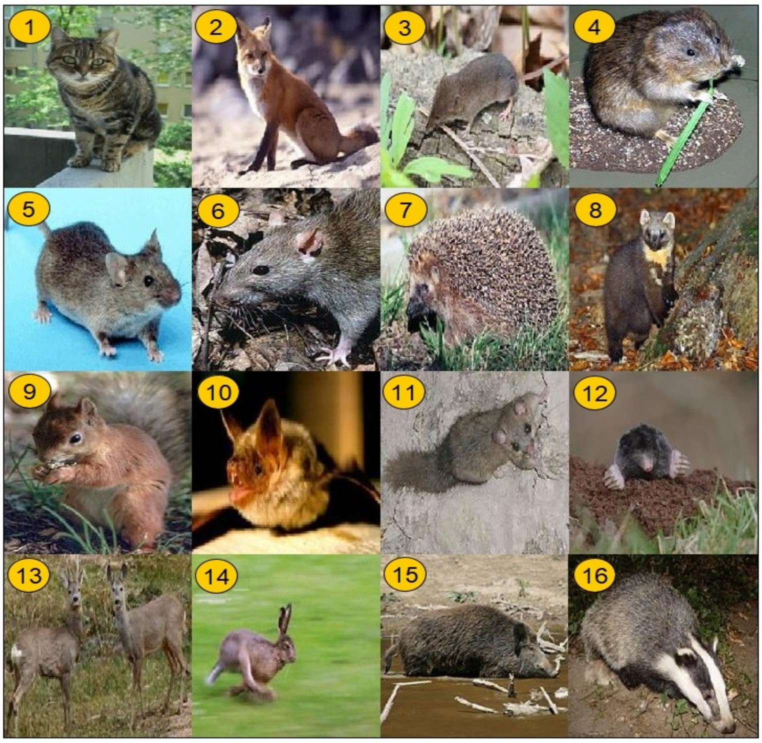
They are important for ecosystems because they help regulate populations of certain insects (e.g., caterpillars, beetles, moths, butterflies, leaf beetles, flies), spiders (e.g., crab spiders, jumping spiders), and other invertebrates (e.g., bedbugs).

They unintentionally spread seeds by occasionally consuming fruits (e.g., strawberries) and seeds (e.g., grasses). They contribute significantly to biodiversity and serve as a valuable food source for

393 The description was compiled using the following sources:
Shirihai, H., Gargallo, G., Helbig, A. J., Harris, A., Kirwan, G. M., & Svensson, L. (2001). *Sylvia warblers*. Princeton University Press.
Urban, E. K., Fry, C. H., & Woodcock, M. (2013). *The birds of Africa*. Christopher Helm.
https://www.ncbi.nlm.nih.gov/genome/?term=Sylvia+borin (2023-06-06).

various birds (e.g., hawks, falcons, owls, crows, magpies, jackdaws), mammals (e.g., foxes, weasels), and reptiles (e.g., slow worms, grass snakes).
Their impact on climate change is indirect, promoting greater biodiversity and maintaining a healthy environment. The size of their genome is estimated to be around 1.02 Gb (this data is for the Siberian stonechat). The energy content of stonechats is poorly researched, but it could potentially be estimated based on their body mass at 20 kJ/g or 4.8 kcal/g.[394]

G. Terrestrial mammals



5.5.4.4.2 Figure 474: Small selection of terrestrial mammals

Figure 474 shows a small selection of terrestrial mammals that live in the environments of the studied soils, numbered from 1 to 16.[395]

1. Domestic cats (*Latin: Felis catus*) grow to a length of up to one meter or up to 1.30 meters and can come in various colors, from gray-white, entirely white, black, brown, and other shades. Domestic cats live on all continents except Antarctica. They are highly adaptable animals that can

394 The description was compiled using the following sources:
Urquhart, E., & Bowley, E. (2002). *Stonechats: A guide to the genus saxicola*. Christopher Helm.
Collar, N. (2020). European stonechat (saxicola rubicola). *Birds of the World*. https://doi.org/10.2173/bow.stonec4.01.
https://www.ncbi.nlm.nih.gov/genome/?term=Saxicola (2023-06-06).
395 Descriptions partly compiled based on the following sources:
The Status and Distribution of European Mammals. https://portals.iucn.org/library/sites/library/files/documents/RL-4-013.pdf (2025-02-19).
Corlatti, Luca & Zachos, Frank. (2022). *Terrestrial Cetartiodactyla - Handbook of the Mammals of Europe*. Springer Nature. https://www.doi.org/10.1007/978-3-030-24475-0.
Hackländer, K., & Zachos, F. E. (Eds.). (2020). *Mammals of Europe-Past, Present, and Future*. London: Springer.

thrive in a variety of environments and have a kind of dual role. On one hand, they are domestic animals or pets, while on the other hand, they are wild creatures capable of fending for themselves. They can be found in both urban and rural areas, in gardens, agricultural land, forests, and near water sources such as streams, rivers, and lakes. The pH value of the soil for plants in areas where these mammals live is estimated to be between 6.0 and 7.5. In terms of temperature range, they feel most comfortable at temperatures between 20°C and 25°C and with humidity levels from 40% to 60%. However, they can also survive in very low and quite high temperatures and humidity levels. Their impact on ecosystems can be negative (e.g., excessive hunting of birds, lizards, snakes, and beneficial insects, which can disrupt the ecosystem's balance, as well as their potential to transmit dangerous diseases) or positive (e.g., they regulate populations of rodents that cause damage to humans, and as pets, they provide emotional and mental support to people).

Their diet mainly consists of commercial food provided by humans, as well as birds (e.g., tits, thrushes, sparrows, robins, waterfowl), mammals (e.g., mice, rats, moles, squirrels, rabbits, voles, bats), reptiles (e.g., smaller lizards, smaller snakes), amphibians (e.g., frogs, toads, newts), and even insects (e.g., ladybugs, field beetles, moths, butterflies, flies, mosquitoes, grasshoppers, crickets, ants, house spiders, garden spiders, jumping spiders). They rarely consume plant-based food (e.g., grass, some flowers). Domestic cats have an indirect impact on climate change, mainly through the production of commercial cat food, which contributes to greenhouse gas emissions. A similar effect can be observed with cat feces, and they can also weaken populations of certain animals that are important for ecological balance. Their genome size is estimated to be around 2.48 Gb. The energy content of domestic cats' body mass is approximately 16 kJ/g or 3.82 kcal/g.

2. Red foxes (*Latin: Vulpes vulpes*, already discussed in relation to (semi)aquatic mammals) grow to a length of up to one meter or 1.30 meters. They have a characteristic red-orange coat with a white collar. They are widespread in Europe, Asia, North America, and some parts of North Africa. They can be found in various habitats, such as forests, open grasslands, agricultural lands, large parks, and even colder Arctic areas. The pH value of the soil for plants in the areas where these mammals live is between 6.0 and 7.5. In terms of temperature range (from –40°C to 40°C) and humidity (from 20% to 80%), these animals are extremely adaptable. Their impact on ecosystems is mainly positive, as they regulate populations of rodents and reptiles, contribute to seed dispersal, increase biodiversity, and act as important decomposers due to their scavenger role. However, their impact can also be negative, as they transmit some diseases. Foxes feed on birds (e.g., tits, waterfowl, pheasants), reptiles (e.g., snakes, lizards, turtle eggs), amphibians (e.g., frogs, toads, newts), insects (e.g., beetles, grasshoppers, crickets), spiders (e.g., jumping spiders, crab spiders), and mammals (e.g., rabbits, hares, voles, mice, rats, squirrels, smaller injured deer). They also consume carrion

(e.g., dead wolves, bears, deer) and occasionally fruit (e.g., forest fruits like strawberries, cranberries, raspberries, and blackberries). The impact of red foxes on climate change is minimal and primarily indirect, as they contribute to biodiversity, seed dispersal, and the maintenance of ecosystem balance and health. Their genome size is estimated at approximately 2.42 Gb. The energy content of their body mass is approximately 20 kJ/g or 4.78 kcal/g.

3. Shrews (*Latin: Soricidae*) grow from approximately 7 cm to 13 cm in length and are brown or gray in color. They are found in Europe, Asia, Africa, North America, and some areas of Central and South America. They inhabit various environments such as forests, grasslands, wetlands, scrublands, agricultural lands, and gardens. Most species of shrews are best adapted to soils with a pH value between 6.0 and 7.0, although some species can thrive in soils with a pH value around 5.0 or even 8.5. European shrews prefer temperatures between 5°C and 30°C and humidity levels between 50% and 80%. They are very important to ecosystems as they regulate populations of insects (e.g., terrestrial and aquatic beetles, ants, grasshoppers, crickets, butterflies, caterpillars, moths, flies) and other invertebrates (e.g., spiders, earthworms, snails, millipedes, centipedes). Additionally, they unintentionally spread plant seeds, contributing to biodiversity. Their activities help in the efficient cycling of nutrients, and by digging burrows, they improve soil aeration, which facilitates better water and air flow. Shrews are also an important food source for various birds (e.g., owls, hawks, eagles), reptiles (e.g., slow worms, grass snakes), and mammals (e.g., weasels, martens, foxes, domestic cats, coyotes, wolves). Their impact on climate change is purely indirect, as they contribute to carbon storage in the soil, increase biodiversity, and help maintain healthy environments. Their genome size is estimated to be approximately 2.41 Gb. Their energy content is about 16.74 kJ/g or 4 kcal/g.

4. Large voles (*Latin: Arvicola terrestris*) grow to a length of approximately 12 cm to 20 cm and are reddish-brown or gray-brown in color. They are found in Europe, where they inhabit the edges of forests, grasslands, wetlands, marshes, agricultural lands, and gardens. These mammals are best adapted to soils with a pH value between 6.0 and 7.5. They thrive at temperatures between 15°C and 25°C and with humidity levels ranging from 40% to 80%. Large voles play an important role in ecosystems as they regulate populations of plants (e.g., roots, bulbs, tubers), unintentionally spread plant seeds, and thus contribute to biodiversity. Their activities facilitate efficient nutrient cycling, and by digging burrows, they improve soil aeration, enhancing water and air flow. Additionally, they are an important food source for various birds (e.g., owls, hawks), reptiles (e.g., slow worms, grass snakes), and mammals (e.g., weasels, ferrets, foxes, domestic cats). Their impact on climate change is purely indirect, as they contribute to carbon storage in the soil, increase biodiversity, and

maintain healthy ecosystems. Their genome size is estimated at approximately 2.03 Gb. Their energy content is approximately 19.7 kJ/g or 4.7 kcal/g.

5. Mice (*Latin: Mus*) grow to a length of approximately 6.5 cm to 10 cm and are brown, gray, or black in color. They are found on all continents except Antarctica. They inhabit various environments such as human dwellings, gardens, meadows, agricultural land, and forests. These mammals are most adapted to soil with a pH value between 6.0 and 7.5. House mice thrive at temperatures between 20°C and 26°C and with air humidity ranging from 40% to 70%. They are important for ecosystems as they regulate populations of plants (e.g., seeds, grains, fruits), insects (e.g., beetles, cockroaches, moths, butterflies, caterpillars, ants, crickets), and spiders (e.g., jumping spiders, crab spiders). They also unintentionally spread plant seeds, contributing to biodiversity in ecosystems. Their activity facilitates the effective cycling of nutrients, and by digging tunnels, they improve soil aeration, which enhances water and air flow. Mice are a crucial food source for various birds (e.g., owls, hawks, eagles), reptiles (e.g., slowworms, adders), and mammals (e.g., shrews, rats, foxes, stoats, domestic cats, ferrets, martens). Their impact on climate change is primarily indirect, as they influence vegetation changes, carbon storage in soils, increase biodiversity, and help maintain a healthy environment, although they may also disrupt ecological balance. The size of their genome is estimated to be around 2.50 Gb. Their energy value is approximately 17.0 kJ/g or 4.0 kcal/g.

6. Rats (*Latin: Rattus*) grow to a length of approximately 18 cm to 45 cm and are brown, gray, or black in color. They are distributed across all continents except Antarctica. They inhabit various environments such as human dwellings, sewers, gardens, meadows, agricultural land, and forests. These mammals are most adapted to soil with a pH value between 6.0 and 7.5. Rats are most comfortable at temperatures between 20°C and 26°C and with air humidity ranging from 40% to 70%. They are important organisms for ecosystems as they regulate populations of plants (e.g., seeds, grains, fruits), insects (e.g., beetles, cockroaches, moths, butterflies, caterpillars, ants, crickets), spiders (e.g., jumping spiders, crab spiders), reptiles (e.g., common lizards, blindworms, smaller snakes), amphibians (e.g., frogs, toads), birds (e.g., sparrows, tits and their eggs), and mammals (e.g., shrews, mice, voles). They also unintentionally spread plant seeds, contributing to biodiversity in ecosystems. Their activity facilitates nutrient cycling, and by digging tunnels, they improve soil aeration, which helps the flow of water and air. Rats are an important food source for various birds (e.g., owls, hawks, falcons), reptiles (e.g., larger snakes), and mammals (e.g., shrews, foxes, stoats, domestic cats, ferrets, martens). Their impact on climate change is primarily indirect – they affect vegetation changes, carbon storage in soils, biodiversity increase, and maintaining a

healthy environment, but they may also disrupt ecological balance. The size of their genome is estimated at approximately 2.70 Gb. Their energy value is around 17.0 kJ/g or 4.0 kcal/g.

7. European hedgehogs (*Latin: Erinaceinae*) grow to a length of approximately 20 cm to 30 cm. Their spines are brown, gray, white, or black, while their body is dark brown. They are distributed across Europe, Asia, and Africa. They inhabit various environments, such as hedgerows, gardens, parks, meadows, agricultural land, and forests. These mammals are most adapted to soil with a pH value between 6.0 and 7.5. European hedgehogs feel most comfortable at temperatures between 15°C and 25°C and with air humidity ranging from 40% to 70%. They are important organisms for ecosystems as they regulate populations of insects (e.g., beetles, cockroaches, moths, butterflies, caterpillars, ants, crickets, grasshoppers), spiders (e.g., jumping spiders, crab spiders), reptiles (e.g., common lizards, blindworms, smaller snakes), amphibians (e.g., frogs, toads), birds (mainly their eggs), and other invertebrates (e.g., earthworms, millipedes, strigids). Additionally, they unintentionally spread plant seeds, contributing to biodiversity in ecosystems. Their activity supports nutrient cycling, and by digging tunnels, they improve soil aeration, which enhances water and air flow. Hedgehogs are also an important food source for various predators, such as owls, reptiles (e.g., slowworms, adders), and mammals (e.g., foxes, stoats, badgers). Their impact on climate change is primarily indirect – they influence vegetation changes, carbon storage in soils, biodiversity increase, and the maintenance of a healthy environment. The size of their genome is estimated at around 2.42 Gb. Their energy value is approximately 17.0 kJ/g or 4.0 kcal/g.

8. Pine marten (*Latin: Martes martes*) grows to a length of approximately 45 cm to 58 cm. Its fur is dark brown or gray, with a lighter yellowish-white throat patch. It is distributed across Europe, primarily in forests and areas with dense vegetation. These mammals are most adapted to soil with a pH value between 5.5 and 7.5. Pine martens feel most comfortable at temperatures between –20°C and 30°C and with air humidity ranging from 40% to 80%. They are important organisms for ecosystems as they regulate populations of insects (e.g., beetles, butterflies, caterpillars, grasshoppers), reptiles (e.g., smaller lizards and snakes), amphibians (e.g., frogs, toads), birds (e.g., tits, finches, sparrows), and mammals (e.g., mice, voles, rats, shrews). They also unintentionally spread plant seeds by consuming fruit, contributing to biodiversity in ecosystems. Their presence facilitates nutrient cycling and helps maintain a healthy environment. Pine martens are also an important food source for some birds (e.g., owls, eagles) and mammals (e.g., gray wolves, lynxes, badgers, otters, domestic cats). Their impact on climate change is primarily indirect – they influence vegetation changes, carbon storage in soils, biodiversity increase, and the maintenance of a healthy environment. The size of their genome is estimated to be around 2.45 Gb. Their energy value is approximately 22.0 kJ/g or 5.0 kcal/g.

9. Red squirrel (*Latin: Sciurus vulgaris*) grows to a length of approximately 19 cm to 43 cm. Its fur is predominantly reddish-brown, with a lighter, whitish throat patch and belly. It is distributed across Europe and Asia, most commonly found in forests and large city parks with plenty of trees, such as pine, spruce, fir, and oak. These mammals are most adapted to soil with a pH value between 6.0 and 6.5. Red squirrels feel most comfortable at temperatures between 0°C and 30°C and with air humidity ranging from 40% to 80%. They are extremely important for ecosystems as they contribute to plant health and nutrient cycling. They unintentionally spread plant seeds as they feed on seeds, nuts, apples, pears, raspberries, blackberries, tree bark, conifer cones, and mushrooms. This significantly contributes to biodiversity and tree regeneration. They are also an important food source for various birds (e.g., owls, hawks, eagles), reptiles (e.g., slowworms, adders), and mammals (e.g., martens, foxes, stoats, domestic cats). Their impact on climate change is primarily indirect – they influence vegetation changes, carbon storage in soils, biodiversity increase, and the maintenance of a healthy environment. Particularly important is their role in maintaining trees, which contribute a large share of oxygen to the atmosphere. The size of their genome is estimated to be around 2.12 Gb. Their energy value is approximately 17.0 kJ/g or 4.0 kcal/g.

10. Common bat (*Latin: Myotis myotis*) grows to a length of approximately 6.0 cm to 8 cm. Its fur is dark brown or black-brown. It is distributed across Europe and inhabits various environments such as old buildings, gardens, shrublands, agricultural lands, and forests. These mammals are not directly dependent on soil pH, but the plants and some insects they prey on require specific conditions for survival. From this perspective, the optimal soil pH value is between 5.5 and 7.5. Common bats feel most comfortable at temperatures between 10°C and 35°C and with air humidity ranging from 50% to 70%. They are very important for ecosystems as they regulate insect populations, including moths, beetles, flies, gnats, mosquitoes, bedbugs, grasshoppers, crickets, wasps, and bees. They also unintentionally spread plant seeds and pollinate flowers, contributing to biodiversity and nutrient cycling. They are also an important food source for certain birds (e.g., owls), reptiles (e.g., rat snakes), and mammals (e.g., domestic cats). Their impact on climate change is primarily indirect – they contribute to vegetation maintenance, nutrient cycling, carbon storage in soils, increasing biodiversity, and maintaining a healthy environment. The size of their genome is estimated to be around 2.10 Gb. Their energy value is approximately 17.0 kJ/g or 4.0 kcal/g.

11. Edible dormouse (*Latin: Glis glis*)

The edible dormouse grows to a length of approximately 20 to 35 cm. Its fur is brown or grey, with a lighter-colored underside. It is widespread in Europe and is most commonly found in deciduous and mixed forests. Although these mammals are not directly dependent on soil pH, the plants and some insects they feed on require specific conditions to thrive. An optimal soil pH for their habitat ranges between 6.0 and 7.5. They thrive best at temperatures between 20°C and 25°C and at air humidity levels between 50% and 70%.

They play an important ecological role by regulating populations of insects (e.g., beetles, caterpillars) and other invertebrates (e.g., spiders, earthworms). They also feed on plants such as fungi, tree bark, tree sap, fruit, and seeds, inadvertently dispersing seeds and promoting biodiversity. They contribute to nutrient cycling and serve as a food source for various birds (e.g., owls, hawks, falcons), reptiles (e.g., vipers), and mammals (e.g., domestic cats, foxes, martens, weasels, badgers). Their impact on climate change is indirect—through supporting vegetation, controlling insect populations, facilitating nutrient cycling, storing carbon in the soil, increasing biodiversity, and maintaining a healthy environment. The size of their genome is estimated at approximately 2.46 Gb. Their energy value is about 20.0 kJ/g or 4.8 kcal/g.

12. European mole (*Latin: Talpa europaea*)

European moles grow to a length of approximately 12 to 15 cm and have black-brown fur. They are widespread across Europe, particularly in deciduous and mixed forests. These mammals thrive best in soil with pH values ranging from 5.5 to 7.0. They prefer temperatures between 15°C and 25°C and air humidity between 70% and 80%.

They are crucial to ecosystems by regulating populations of insects (e.g., beetles, ants, flies, insect larvae) and other invertebrates (e.g., spiders, earthworms, snails, centipedes). Occasionally, they also consume vertebrates such as frogs, small mice, and shrews. By dispersing plant seeds unintentionally, they contribute to ecosystem biodiversity. Their tunneling aerates the soil, improving airflow and water penetration, which also enhances nutrient cycling. They are a valuable food source for various birds (e.g., owls, hawks) and mammals (e.g., cats, foxes, martens, weasels, badgers, ferrets). Their impact on climate change is indirect—by regulating insect populations, aiding nutrient cycling, storing soil carbon, increasing biodiversity, and supporting a healthy environment. Their genome size is about 2.01 Gb, and their energy value is approximately 20.0 kJ/g or 4.8 kcal/g.

13. Wild boar (*Latin: Sus scrofa*)

Wild boars grow to lengths between 90 cm and 150 cm and have black-brown or grey fur. They are found across Europe, Asia, and North Africa, inhabiting forests, meadows, agricultural fields, and shrublands. These mammals thrive alongside plants growing in soils with a pH of 6.0 to 7.5. They prefer temperatures from 5°C to 25°C and air humidity from 40% to 70%.

Ecologically, they help regulate plant populations (e.g., roots, tubers, berries, apples, pears, nuts, acorns, corn, wheat, rice) and animal populations such as invertebrates (e.g., spiders, earthworms, snails, insect larvae, beetles), amphibians (e.g., frogs, toads, newts), reptiles (e.g., snakes, lizards), and small mammals (e.g., mice, shrews, voles, rats). By feeding on carcasses and dispersing seeds, they contribute to biodiversity. Their rooting behavior aerates soil and enhances nutrient cycling. Wild boar are prey for large birds (e.g., eagles, owls) and mammals (e.g., grey wolves, bears, foxes, coyotes, jackals). They can spread diseases and become pests when overpopulated. Their climate impact is indirect—via population control, nutrient cycling, carbon storage, biodiversity support, and habitat maintenance. Their genome size is about 2.46 Gb and energy content around 20.0 kJ/g or 4.8 kcal/g.

14. European roe deer (*Latin: Capreolus capreolus*)

European roe deer grow to about 60 to 75 cm in length and are mostly reddish-brown with whitish necks and bellies. They are widespread across Europe and can be found in forests, large urban parks, meadows, and farmland. They flourish alongside plants in soils with a pH of 6.0 to 7.5. Preferred temperatures are 0°C to 20°C, and humidity levels between 40% and 80%.

They are important for ecosystem health by maintaining plant populations, cycling nutrients, and unintentionally dispersing seeds (e.g., of fruits, nuts, apples, pears, bark, conifer cones, fungi). They also help with forest regeneration and are prey for birds (e.g., eagles) and mammals (e.g., wolves, bears, lynxes, foxes). Their climate impact is indirect—affecting vegetation dynamics, soil carbon storage, biodiversity, and the maintenance of oxygen-producing trees. Their genome size is approximately 2.78 Gb, and energy content about 18.0 kJ/g or 4.3 kcal/g.

15. European hare (*Latin: Lepus europaeus*)

European hares grow to about 50 to 70 cm and are mainly reddish-brown or grey (lighter in winter). They are found throughout Europe and Asia in open forests, meadows, shrublands, and farmland. They thrive in areas with soil pH values of 6.0 to 7.0. Ideal temperatures range from 0°C to 30°C with humidity between 40% and 70%.

These animals play a vital role in ecosystems by maintaining plant health, aiding nutrient cycling, and dispersing seeds (they eat seeds, grasses, herbs, and crops like carrots and cabbage), promoting biodiversity. They are a food source for many birds (e.g., eagles, hawks, owls) and mammals (e.g., wolves, martens, weasels, lynxes, foxes, humans). Their climate impact is indirect—through vegetation changes, soil carbon storage, biodiversity enhancement, and environmental health. Their genome size is estimated at 2.80 Gb, and their energy content is about 19.0 kJ/g or 4.5 kcal/g.

16. European badger (*Latin: Meles meles*)

European badgers grow to about 70 to 90 cm and have black-and-white fur with distinct stripes. They are mostly found in Europe and Asia, particularly in forests, meadows, and shrublands. They thrive in soils with a pH between 5.5 and 7.0, at temperatures from 0°C to 30°C and air humidity between 40% and 70%.

Badgers regulate insect populations (e.g., beetles, ants, larvae) and other invertebrates (e.g., spiders, earthworms, snails, centipedes), as well as amphibians (e.g., frogs, toads), reptiles (e.g., lizards, snakes), mammals (e.g., mice, voles, rats, hares), and bird eggs. By consuming plant materials (e.g., berries, nuts, roots), they help disperse seeds and support biodiversity. They also scavenge carrion, aerate soil for air and water flow, and enhance nutrient cycling. They are preyed upon by birds (e.g., eagles, which target young badgers) and mammals (e.g., wolves, bears, foxes, lynxes). Their impact on climate change is indirect—through insect control, nutrient cycling, carbon storage, biodiversity, and habitat health. Their genome is estimated at 2.72 Gb, and their energy content is around 22.0 kJ/g or 5.3 kcal/g.

In the following section, a synthesis of findings and insights related to the terrestrial micro- and mesocosmos will be conducted, with a particular focus on soil. Soil serves as a super-producer, as terrestrial plants cannot produce food for consumers or generate valuable oxygen without it, which means that ecological balance cannot be maintained in its absence.

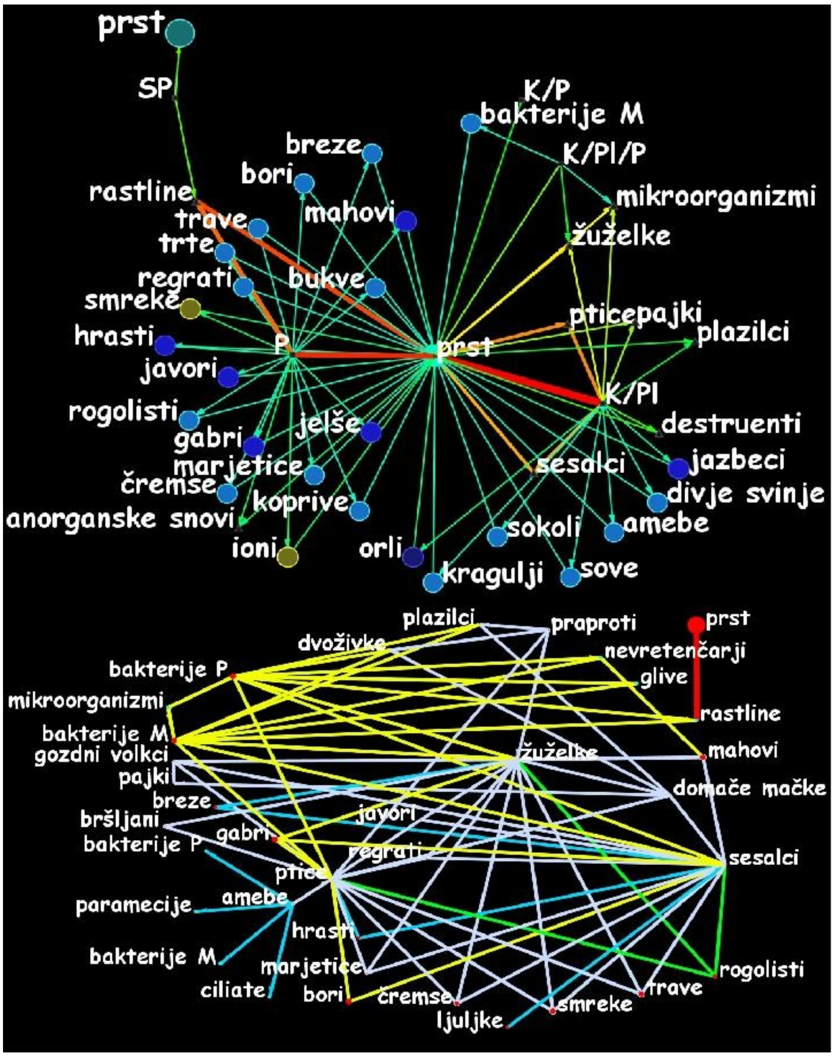
As with the aquatic micro- and mesocosmos, the data for the terrestrial micro- and mesocosmos will be compiled into three tables.

To briefly recap, the first table will once again be based on a microthesaurus, which will illustrate the relationships between the soil as a super-producer (ions, molecules, inorganic and organic substances – TT), producers (DE), and food consumers (DE). An evaluation of the productivity of producers and predation strength will be added to this first table, rated on a scale from 0 to 100 (MPROPIE).

Next, a second table will be created focusing on food consumers and producers (ZB), including ratings of their resistance and adaptability to physico-chemical conditions based on the biomechanical characteristics of terrestrial organisms. These ratings will also be on a scale from 0 to 100 (FKOBL). This table will include, as in the aquatic case, relationships between food consumers and producers (K1 to K11), as well as predators or natural enemies (P1 to P11).

Following this, a third table will be compiled containing data on mutualistic symbioses between organisms within the terrestrial micro- and mesocosmos (M2, V2). These relationships will also be rated on a scale from 0 to 100 (OMS).

All data will be imported into the Ora Casos software tool, where an analysis and assessment of symbiotic feeding networks at the micro- and mesocosmic terrestrial level will be conducted. The resulting networks will then be presented, but this time only in an extracted format.



5.5.4.4.3 Figure 475: Extracted network of the strongest representatives of terrestrial living organisms

Figure 475 shows the extracted network of the strongest representatives of living organisms (both food producers and consumers), along with their resilience and adaptability to physico-chemical conditions, in relation to their biomechanical properties. In both cases, a rating filter of > 90.1 was applied, meaning only organisms with scores above 90.1 were included.

It would be logical to first take a closer look at the extracted network of the strongest representatives of living organisms, which includes both producers and consumers of food. The strongest inorganic producer, or superproducer, is soil, as it supplies most terrestrial plants with nutrients and provides a stable foundation (see the largest green node with a value of 200.0). It is well known that most terrestrial plants perform the function of food production for first-order consumers and, to some extent, higher-order consumers. From this base, hierarchical connections lead to organisms with general classifications such as microorganisms, plants, insects, decomposers, reptiles, birds, and mammals.

Additionally, two more inorganic producers are worth mentioning: inorganic substances and ions. These serve as starting points for hierarchical connections to specific strong representatives of living organisms, such as bacteria M, which play roles as consumers, prey, and producers (microorganisms); eagles, owls, hawks, and falcons, which act as consumers and predators in the food web (birds); and wild boars and badgers (mammals), which also function as consumers and prey.

Among food producers are plants such as grasses, vines, nettles, daisies, dandelions, mosses, hornworts, bird cherries, hornbeams, alders, maples, beeches, oaks, spruces, and pines. Alongside these consumers and predators within the food web, it should be emphasized that the listed species primarily serve as predators.

The lower network graph shows the most resilient and adaptable living organisms in terms of their resistance to physico-chemical conditions, in connection with their biomechanical properties.

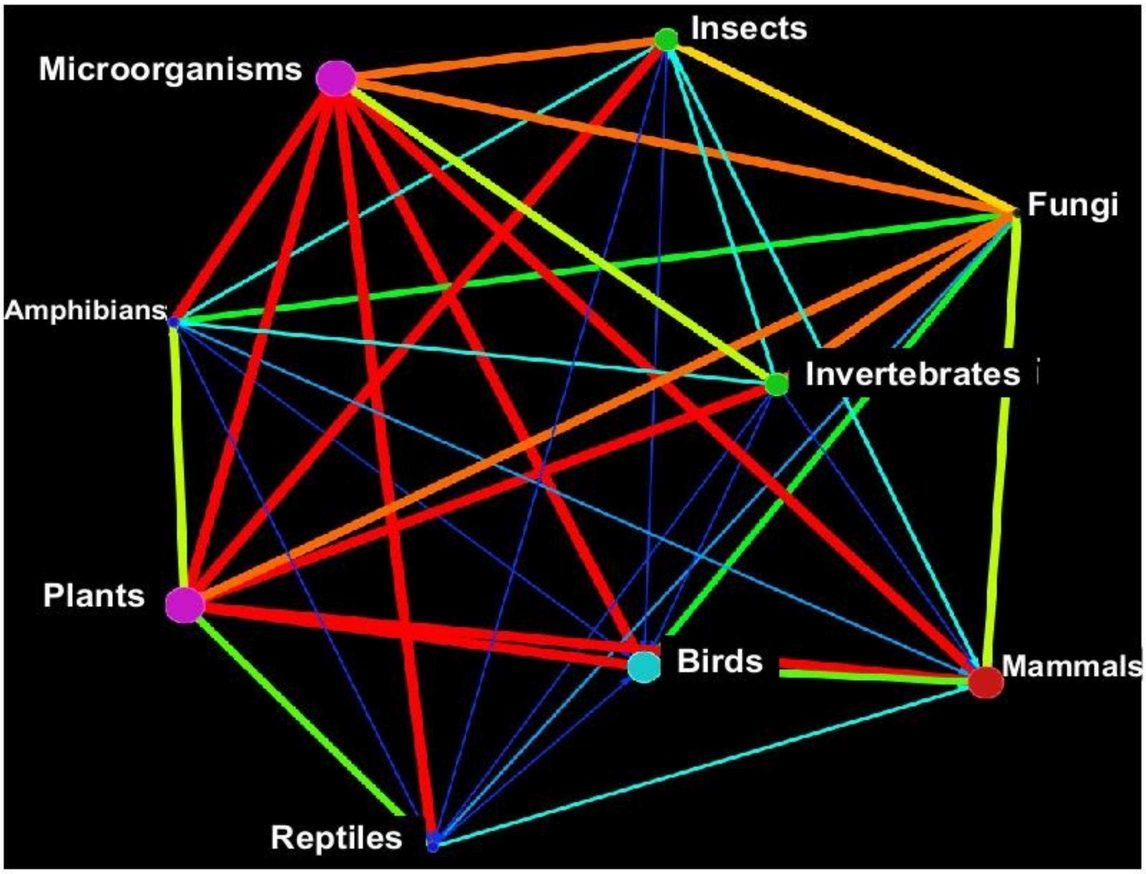
As shown, the listed terrestrial plant species—supported by soil that provides resistance, adaptability, and appropriate functional biomechanical traits—include grasses, daisies, dandelions, mosses, ryegrass, ferns, hornworts, birches, bird cherries, hornbeams, maples, oaks, spruces, and pines.

Highly resilient and adaptable terrestrial microorganisms with optimal biomechanical characteristics include bacteria M, bacteria P, amoebas, ciliates, and paramecia. These microorganisms can enhance the fertility potential of certain soils, thereby providing terrestrial plants with better conditions for growth and development.

The domestic cat is the only mammal among the most resilient and adaptable organisms. It is extremely resilient and adaptable, having retained its role as a predator despite close association with humans. Although the domestic cat is not the most effective predator and rarely serves as prey, it benefits from human protection in terms of food and shelter.

Also included among the most resilient and adaptable organisms is a representative of spiders – the woodland wolf spider – which is highly resistant and adaptable to physico-chemical conditions (e.g., temperature, air pressure, humidity, soil pH). Woodland wolf spiders are effective predators of insects and other spiders, though they are also preyed upon by birds, other spiders, and small mammals. For this reason, they were not included in the network of the strongest living organisms in terms of predatory strength.

The analysis continues with an overview of the mutualistic symbiosis ratings for various groups of living organisms.



5.5.4.4.4 Figure 476: Evaluation of the strength of mutualistic symbioses among groups of terrestrial living organisms

Figure 476 illustrates the evaluation of mutualistic symbioses between various groups of terrestrial living organisms using a network graph. The weakest group in terms of mutualistic symbiosis is reptiles. Most reptiles are strictly carnivorous, which limits their potential for forming mutualistic relationships with other terrestrial organisms—especially plants. In this regard, they share similarities with semi-aquatic reptiles.

The strongest mutualistic symbiosis among reptiles is with microorganisms, particularly bacteria, which aid in digestion and support their immune systems. This observation also applies broadly to the relationships between microorganisms and other terrestrial organisms.

The following sections systematically describe findings by organism type (using generic names) and identify those considered the strongest based on their capabilities in food production, predation or consumption, resistance, and adaptability to physical and chemical environmental conditions.

1. Terrestrial microorganisms

Like their aquatic counterparts, terrestrial microorganisms include top-level predators—though many are sensitive to specific environmental conditions. These include moisture levels, soil pH, aeration, ion composition, and compatible plant communities. Terrestrial amoebas, bacteria, ciliates, and paramecia fall under this group and are particularly sensitive to such factors.

Despite their sensitivity, bacteria that enhance soil fertility and promote plant growth (ranging from small plants to large trees) were ranked among the most impactful organisms. Especially notable are M-type bacteria (mutualistic bacteria) and amoebas, whose scores exceeded 90.1.

Many mutualistic symbioses exist between terrestrial microfungi and bacteria. While a few microorganisms become prey to larger organisms (e.g., amoebas near earthworms that are eaten by birds, or larvae feeding on microbes), mutualistic relationships between micro- and meso-level organisms appear even more abundant. M-type bacteria and certain fungi interact positively with nearly all living groups—plants, invertebrates, amphibians, reptiles, birds, fungi, and mammals.

The mutualism network graph confirms microorganisms as some of the most active mutualistic partners across both micro and meso-ecosystems. They enable healthy and fertile life conditions by boosting immunity and reproductive success.

2. Terrestrial plants

Many terrestrial plant species are key players in both food production and mutualistic symbioses. They provide shelter and shade, while in return, animals and fungi supply nutrients and help disperse their seeds.

Fourteen plant species ranked among the top based on food production, including grasses, daisies, dandelions, mosses, ryegrass, ferns, hornworts, birches, bird cherries, hornbeams, maples, oaks, spruces, and pines. These plants serve as sources of food, shelter, and materials for numerous animals.

Terrestrial plants are exceptional at food production and relatively resistant to extreme environmental conditions—such as temperature fluctuations, air pressure, soil pH, moisture, ion composition, low light, and even pollution. They play a critical environmental role by providing food, oxygen, and energy.

Some expansive plant species can become invasive. In terms of symbiosis frequency and intensity, they rival microorganisms, forming strong relationships with fungi, insects, invertebrates (e.g., spiders, worms, snails), amphibians, reptiles, birds, and mammals. Reptiles, particularly snakes, have the weakest ties with plants due to their strictly carnivorous diets, making their interaction mostly commensal.

Plants are vital to humans for food and energy and help preserve biodiversity and environmental balance. They have especially strong mutualistic ties with invertebrates, birds, and mammals.

3. Terrestrial insects and invertebrates

No terrestrial insects or invertebrates were ranked among the strongest living beings. These creatures often serve as consumers and prey for numerous species.

Their most significant mutualistic relationships are with plants and microorganisms. Symbioses with other animals are less common, though not nonexistent. Insects, in particular, often exhibit parasitic relationships with other organisms.

The primary role of insects seems to be overproduction—ensuring food availability for more advanced species and contributing to biodiversity.

4. Terrestrial amphibians

No terrestrial amphibians made the list of strongest living beings. Few amphibians spend most of their lives on land. In the examined region, the only notable species was the tree frog, which returns to water during mating season, with eggs and larvae developing in aquatic environments.

Their primary role is regulating insect and invertebrate populations. Most mutualistic relationships involve microorganisms, plants, and to some extent, aquatic flora and algae. Partnerships with other animals are less well documented.

5. Terrestrial reptiles

Reptiles have the fewest mutualistic relationships with other terrestrial species. However, they do engage with microorganisms, particularly in digestive and immune support, as shown in the mutualism graph.

For reptiles, predation dynamics are more prominent than cooperation. They are hardy and adapted to harsh environments, making them survival specialists.

None were classified as top predators within the evaluated sample.

6. Terrestrial birds

Birds ranked among the strongest were primarily birds of prey—eagles, owls, falcons, and hawks. These carnivores have few natural enemies and show high resistance and adaptability to adverse conditions. Some can even hunt near or on water surfaces.

These birds primarily prey on mammals, other birds, and reptiles, not insects. Their most frequent mutualistic relationships are with microorganisms and plants.

7. Terrestrial mammals

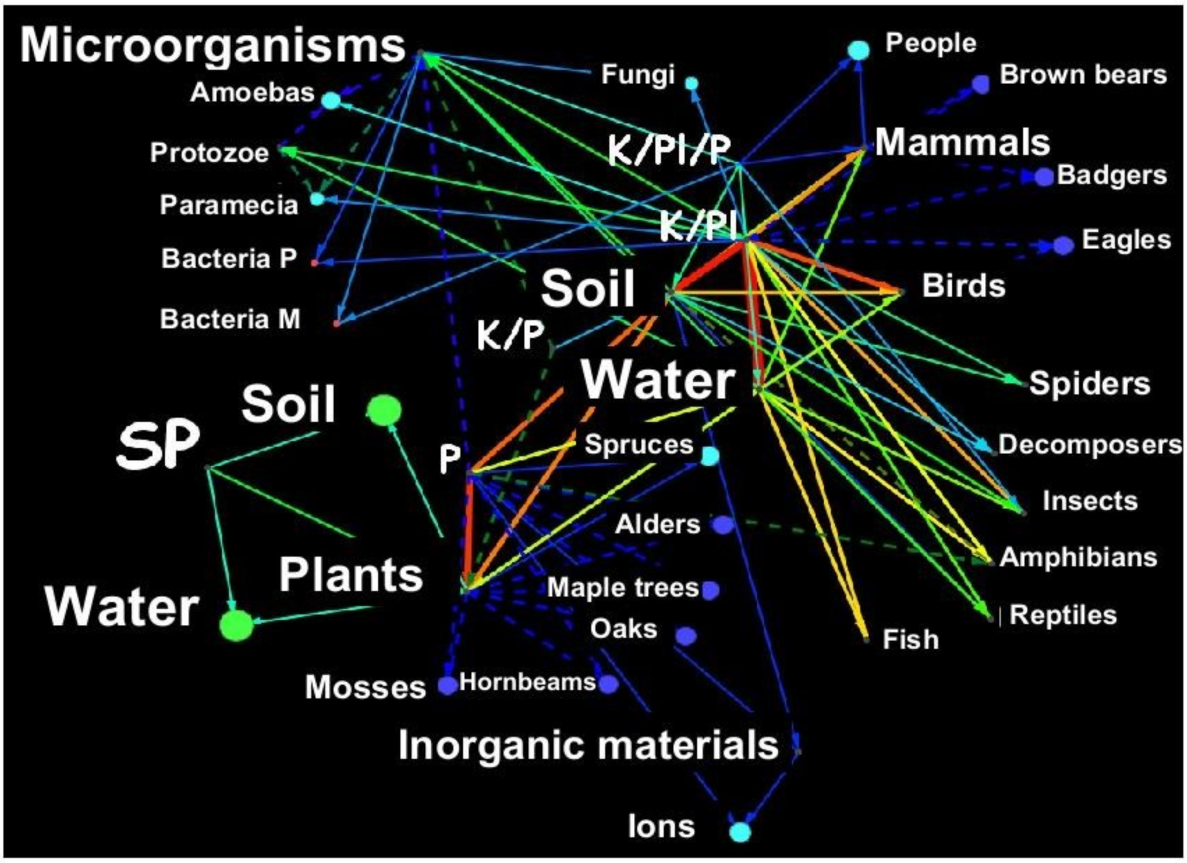
Mammals, including humans, are the most advanced and intelligent organisms on the planet.

Among those ranked strongest were badgers and wild boars—omnivores with virtually no natural enemies in the study region. They are durable, adaptable, and biomechanically robust, capable of effective defense.

In terms of mutualistic partnerships, mammals rank third—after microorganisms and plants. They are social, cooperative, and communicative species. Although humans were not included in this terrestrial overview, they were covered in the aquatic section.

As with the aquatic ecosystem, survival competition only partially explains the overall picture. Cooperation plays an equally crucial role. Ions in soil also deserve attention—they are essential for plant nutrition, which supports the food chain.

On a broader scale, ions like potassium, calcium, magnesium, and iron are indispensable for all life. Without them, Earth's ecosystems and atmosphere couldn't function properly. A synthesis of both terrestrial and aquatic ecosystem networks will follow, acknowledging both similarities and key differences between them.



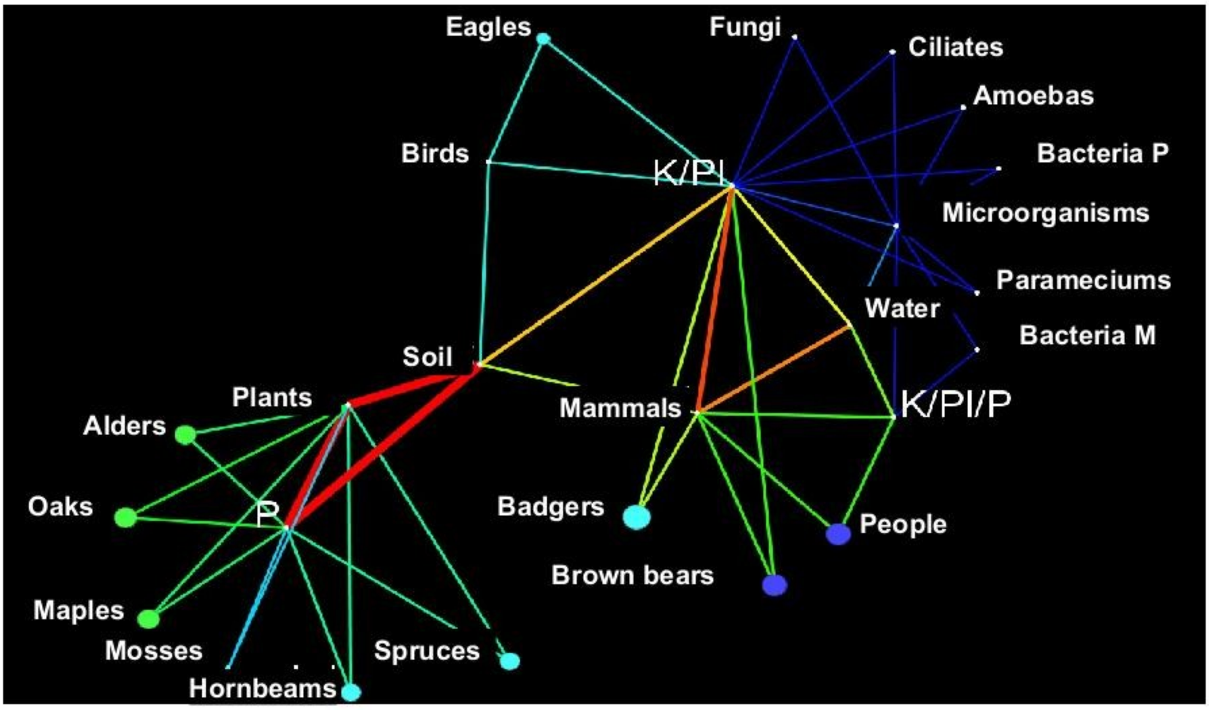
5.5.4.4.5 Figure 477: Synthesis of terrestrial and aquatic network systems based on the strongest representatives of living beings

Figure 477 illustrates the synthesis of terrestrial and aquatic ecosystems, emphasizing the strongest representatives among living organisms that depend on the superproducers—water and soil. At the center of this network are these two superproducers, which make the existence of plant species possible as we know them in our world. As a result, they enable both food and oxygen production.

The former is essential for the existence of hierarchical, associative food networks, while the latter is crucial for maintaining our atmosphere.
We can observe that many terrestrial plants, especially trees (except mosses), rank among the strongest representatives of living beings. Within this group, spruces stand out as the most resilient and adaptable to physical and chemical conditions (see the dark blue arrow connecting to a slightly larger light blue node marked with a value of 100). Their biomechanical traits are highly optimized: they grow tall, have deep and branched root systems (beneficial for nutrient absorption), produce large amounts of oxygen, their seeds are accessible to other organisms (enabling effective reproduction and biodiversity), and they efficiently use sunlight for photosynthesis. Because of this capability, they are less sensitive to low-light environments, which allows them to remain evergreen even during winter.
Trees such as beeches, hornbeams, oaks, maples, and alders exhibit similar resilience, adaptability, and biomechanical properties but are generally somewhat less capable (see dashed dark blue arrows pointing to smaller dark blue nodes with a value of 95). Mosses also rank among the strongest producers (see dashed dark blue arrow pointing to a dark blue node with a value of 95).
This collective producer scenario also includes ions (see the large light blue node marked with a value of 100, linked via a dark blue arrow to the food producers – P). Ions are essential for both terrestrial and aquatic plants and can be described as inorganic bridges or intermediaries within the network. Notably, aquatic plants are absent from this extracted network (based on the >99.0 OR >90.1 criterion), likely due to their relative sensitivity to adverse physical and chemical conditions (temperature, humidity, pressure, pH, water hardness, conductivity, pollution) and lower energy production potential.
Another major group of living beings acting as bridges or intermediaries in food production are microorganisms. Among them, protozoa (such as amoebae, paramecia, ciliates) and M bacteria stand out. When population sizes are optimal, these organisms engage in mutualistic symbioses that support the lives of other organisms and enhance soil fertility, contributing to greater food production. A key role of protozoa (e.g., amoebae, ciliates, flagellates, paramecia) is maintaining a balanced bacterial population. M bacteria possess a relatively rare ability to function as consumers, prey, and producers of food (C/P/F).
Among microorganisms, fungi also deserve mention (see the large light blue node with a value of 70). They can form parasitic or mutualistic symbioses with plants and serve as a significant food source for other organisms.

The next group of living beings are mammals. The top representatives in this category include brown bears, badgers, wild boars, and humans. These omnivorous organisms consume both plant and animal matter. They are strong food consumers and are rarely preyed upon.
In the case of humans (see the large light blue node with a value of 100), it's worth noting that they can also be food producers, although they simultaneously act as biomass destroyers on the planet. In this respect, they can be conditionally compared to bacteria, which perform the roles of consumer, prey, and producer in the food web. Badgers and wild boars contribute to soil aeration and permeability, while brown bears and humans have a wide range of hunting grounds, extending from land to water sources or even over water surfaces.
Finally, among birds, eagles have been identified as the strongest representatives. Eagles are strictly carnivorous predators with extensive hunting ranges—from forests and fields to water sources. They are top-tier hunters, equipped with sharp vision, strong beaks, broad wings, and sharp talons. Additionally, they are extremely fast and agile both in the air and, to a lesser extent, on land.
Many organisms are not directly dependent on soil, while most are directly dependent on water. In terms of food production, soil is as important as water. Although the roles of ions and microorganisms in food production are less pronounced, they function as essential intermediaries that sustain various plant and animal species. It's also important to acknowledge algae and fungi, which depend on other microorganisms and ions.
In short, water and soil function as superproducers of food, while the microcosm (including nano-, pico-, femto- and other sub-scales) acts as a bridge or intermediary in both food production and life support. Microorganisms and ions enable optimal collective effects; without these bridges or intermediaries, we wouldn't be able to recognize key collective phenomena such as particle condensation, swarming behavior, emergence of intelligence via neural networks, rhythm synchronization, phase transitions between different states of matter, collective intelligence, various forms of induction (natural, social, mental), organizational structures, self-organized criticality, language development, communication processes, information dissemination, decision-making, etc.
The selection of the strongest representatives in the studied local environment results from their resilience and adaptability to external physical-chemical factors (climate, temperature, pressure, humidity, pH, ion and molecule content, water and soil properties, pollution), biomechanical traits (e.g., structure, size, body parts as weapons, intelligence, genome), number of natural predators, ecological impact, potential influence on climate change, food production capability, dietary range, and energy value.
It has been found that genome size has relatively little influence. As for the energy value of the described organisms, there are no drastic differences, though this factor affects consumption

preferences (e.g., predators often target prey rich in proteins and lipids) and food production (e.g., some plants offer leaves, seeds, and fruits, while others only seeds). It would be worthwhile to analyze the energy aspect of this extracted network of the strongest living organisms in more detail. It should be emphasized that the estimated energy values of living beings are only rough approximations (see the end of each species description).



5.5.4.4.6 Figure 478: Representation of energy content within the network of the strongest representatives of living beings

Figure 478 shows the energy content within the network of the strongest representatives of living beings in the studied environment. The network highlights higher energy content (in kJ/g) in six plant species (hornbeam, oak, maple, alder, moss, and spruce), three mammal species (badger, human, and brown bear), and one bird species (eagle).

In this context, plants are directly dependent on soil quality, whereas mammals and birds rely on it only indirectly. The energy content of living beings is significant because it plays a major role in maintaining or disrupting the overall balance of the ecosystem. The distribution of energy content within the microcosm and mesocosm forms the basis for various decisions made by living organisms—such as in food production and consumption, as well as in establishing mutualistic symbioses that enhance survival conditions. Food producers primarily support first-order consumers, who in turn serve as food for higher-order consumers.

The establishment of a proportional balance in the energy content of living beings within the dynamic interplay of the microcosm and mesocosm partially determines the level of plant production and the size of food consumer populations. This is also influenced by other factors such as climate, light, heat, nutrients, ions, molecules, and above all, water. Consequently, the population sizes of the strongest representatives of living beings—those with few natural predators and often top predators or organisms with broad dietary ranges (e.g., omnivores like the brown bear and human)—are also shaped by these conditions.

Energy content, particularly in both cosmic planes (micro and meso), highlights the importance of kinetic energy, which governs the movement of organisms in search of food and thus their survival. Hierarchical and associative (cooperative) relationships—both among living beings and between cosmic planes—are heavily dependent on the distribution of energy content. This is directly tied to the biomass of living beings on our planet, as it drives the energy flow across different energy forms within natural hierarchical-associative systems, and in turn influences the dynamics of kinetic energy.

The biomass of different groups of living beings is estimated in gigatons of carbon (Gt C) and has the following values:[396]

a. Plants are the absolute leaders, with approximately 450 Gt C.

b. Microorganisms (excluding viruses) have an estimated biomass of around 81 Gt C, with bacteria accounting for approximately 70 Gt C, and protozoa about 4 Gt C.

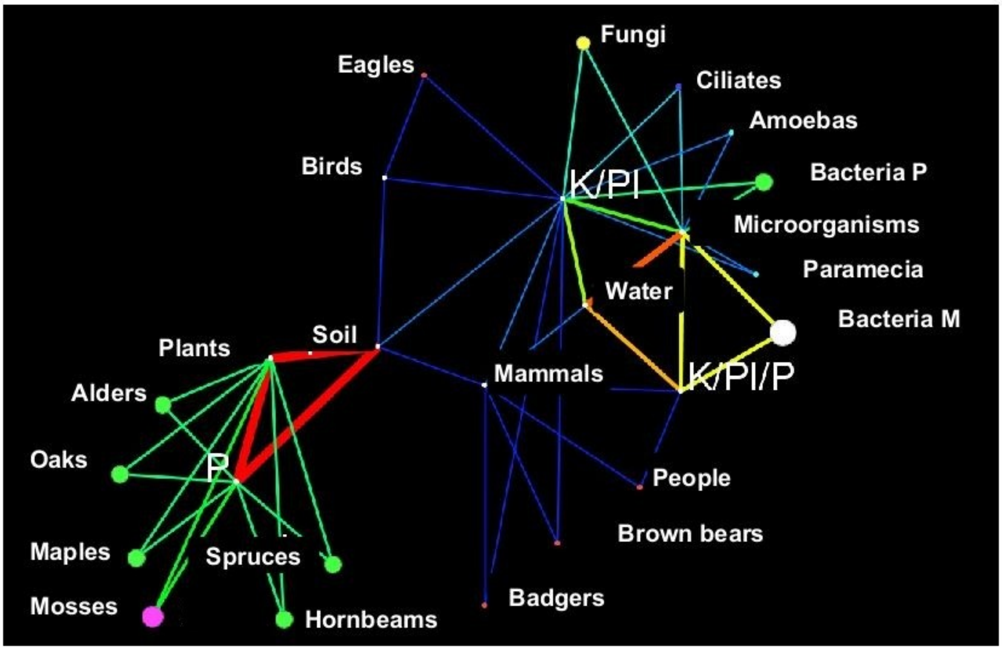
c. Fungi (across both the microcosm and mesocosm) have an estimated biomass of around 12 Gt C.

d. Animals, including humans, have an estimated biomass of around 2 Gt C.

396 Bar-On, Y. M., Phillips, R., & Milo, R. (2018). The biomass distribution on Earth. *Proceedings of the National Academy of Sciences*, 115(25), 6506–6511. https://doi.org/10.1073/pnas.1711842115.

5.5.4.4.7 Table 207: Data on the most powerful representatives of living beings with emphasis on biomass Gt C

DE	MPROPIE	Biomass (Gt C)	W (kJ/g)	VG (Gb)	TT	CC	BT
amoebas	90	1.0000		3100	water	K/Pl	microorganisms
bakteria M	50	50.0000		0.004	water	K/Pl/P	microorganisms
bakteria P	50	20.0000		0.004	water	K/Pl	microorganisms
ciliates	60	2.0000		0.06	water	K/Pl	microorganisms
fungi	70	12.0000		0.01	water	K/Pl	microorganisms
people	100	0.0600	20	3.1	water	K/Pl/P	mammals
paramecia	70	1.0000		0.07	water	K/Pl	microorganisms
brown bears	95	0.0010	20	2.4	water	K/Pl	mammals
hornbeams	95	20.0000	17	2,5	soil	P	plants
oaks	95	20.0000	19	0.85	soil	P	plants
maples	95	20.0000	18	1.9	soil	P	plants
badgers	95	0.0010	22	2.7	soil	K/Pl	mammals
alders	95	20.0000	18	0.7	soil	P	plants
mosses	95	30.0000	12	1	soil	P	plants
eagles	97	0.0010	14	1.2	soil	K/Pl	birds
spruces	100	20.0000	17	20	soil	P	plants



5.5.4.4.7.1 Figure 479: Network of the strongest representatives of living beings with emphasis on biomass (Gt C)

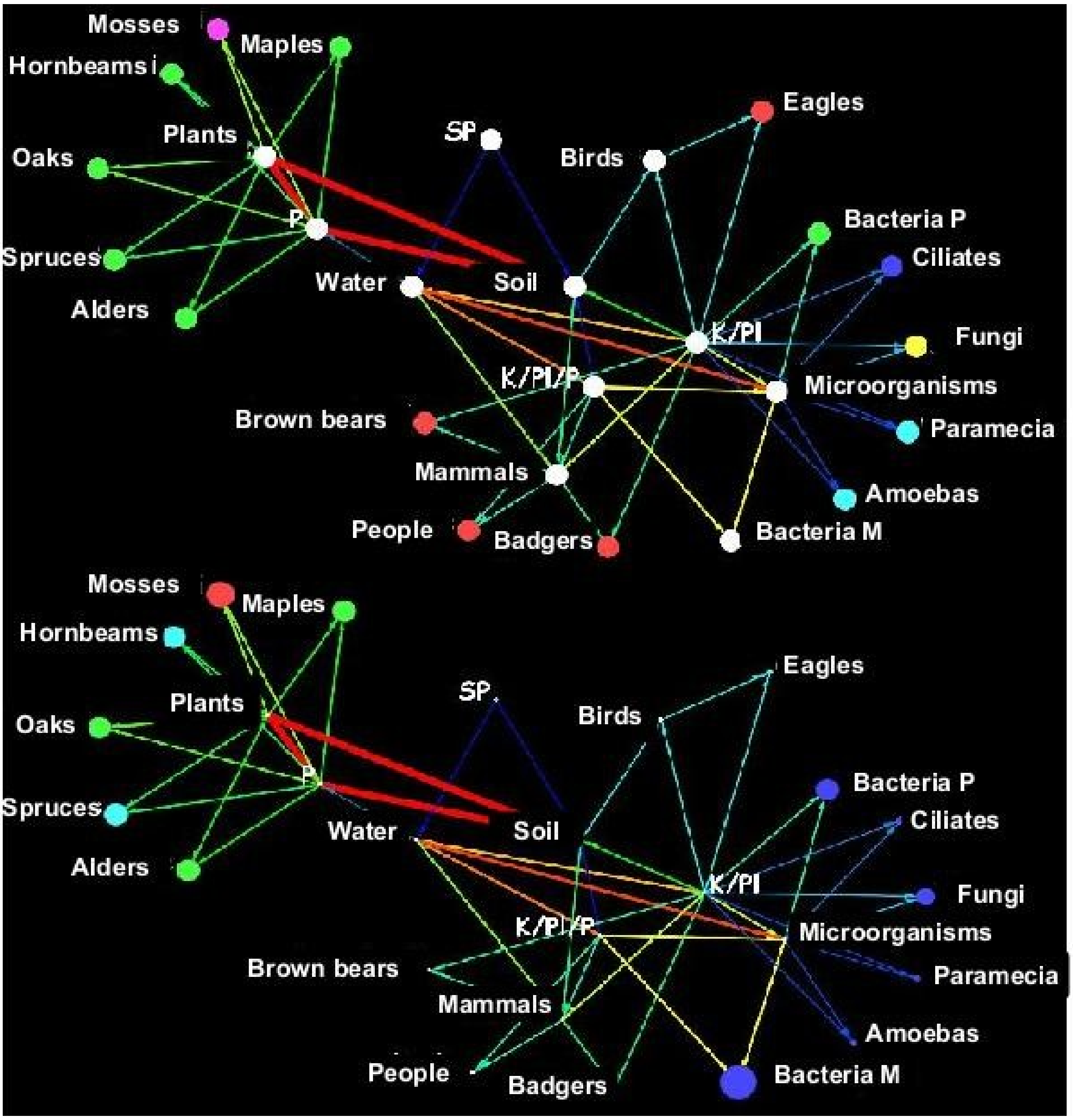
Table 207 presents data on the strongest representatives of living beings with a focus on biomass in gigatons of carbon (Gt C) (see the light blue column), while Figure 479 visualizes this data in the form of a network.

It can be observed that mammals and birds collectively have significantly lower biomass compared to microorganisms and plants. This indicates that animal populations are extremely small in comparison to those of microorganisms and plants. While the strongest representatives of animal species possess relatively high energy content, their biomass in Gt C is very low.

Plants are not only champions in terms of energy content, food and oxygen production, and the number of mutualistic symbioses with other living beings, but also in terms of total biomass (see the sum of plant representatives, amounting to 130 Gt C). Microorganisms are also highly influential, with bacteria taking the lead (50 Gt C), while mammals (such as badgers, brown bears, and humans) and birds (e.g., eagles) contribute only 0.063 Gt C.

If we were to convert the estimated biomass values into thermal energy (Wq = Q/m), we would see significant differences in thermal energy values—with plants once again emerging as the dominant entities, closely followed by microorganisms. Similar outcomes would result from calculations of chemical, kinetic, and potential energy.

A simulation of two networks should be carried out, focusing on local energy content and global biomass of the strongest representatives of living beings.



5.5.4.4.7.2 Figure 480: Comparison of two networks of the strongest representatives of living beings

Figure 480 illustrates a comparison between two networks of the strongest representatives of living beings: one emphasizing local energy content in kJ/g (see the upper part of the figure), and the other emphasizing global biomass in gigatons of carbon (Gt C). From the perspective of local energy content, we observe a relatively even distribution. However, from the global viewpoint of biomass, there is a clear dominance of plant and microorganism populations.

The strongest representatives of animal species (mammals, birds) contribute only a statistically negligible share of the total biomass in Gt C within natural hierarchical associative systems. Based on this simulation, one could infer that the majority of living organisms (microorganisms, plants, fungi) function to support the survival of the minority (mammals, birds). This observation draws a parallel with social hierarchical associative systems, where the majority of people work for the benefit of a small elite, which in turn controls the distribution of wealth.

Pushing this idea further, one might even consider that the entire natural hierarchical associative system—on both micro- and mesocosmic levels—functions primarily for humans and other top predators. Especially when examining human history since the first industrial revolution, it becomes apparent that the human species has consistently exploited and often abused natural resources. It has significantly disrupted natural systems, contributed to ozone depletion, and driven climate change. Due to technological development, humans have caused the extinction of numerous plant and animal species, intensifying selective processes that generally carry negative consequences. While these outcomes were not always intentionally planned, excessive pursuit of prestige and comfort clearly was. The distribution of that prestige and comfort is highly asymmetrical, and this asymmetry leads to numerous negative side effects, such as environmental pollution, crime, stress, war, and depletion of natural resources.

This raises a profound question: is the human-induced asymmetry fundamentally different from the asymmetries produced by other natural systems? Evidence suggests that the asymmetrical contribution of other living beings is far less destructive. A strong case can be made by examining the destruction of biomass—humans have eliminated far more biomass than natural disasters or other species ever have. Humans also act as producers of both biomass and inorganic mass, but the production is heavily skewed toward the latter (inorganic matter production is said to already surpass all biomass on the planet).

What, then, is the ultimate meaning of this overwhelming asymmetry? One possible interpretation is that all living systems must be mortal (depending on the perspective), so that new forms of energy and matter can emerge. In this light, humanity may be unintentionally causing a gradual "disease" or even an inevitable "death" of the natural hierarchical associative system—potentially leading to the birth of new forms and contents.

If this scenario is indeed influenced by macrocosmic forces of energy and mass, then the human species could be seen as serving a higher inorganic force. However, since we do not know this for certain, we should not blindly believe in such a scenario, despite its plausibility and strong arguments. Here lies the space for free thought, and from it, our future decisions.

Important changes are needed in the decision-making models of politics, healthcare, economics, law, and technology. Most of the Earth's biomass (plants, microorganisms) benefits the consumers at all trophic levels—including humans. Humanity has the opportunity to make thoughtful, conscious choices that are not excessively driven by biological addictions or hedonism, in order to pursue a positive scenario aligned with balanced homeostasis in natural biological systems.

It is also clear that this system is not eternal. Our Sun does not have an unlimited lifespan in its current form; eventually, its form and content will transform drastically. We cannot escape this cosmic metamorphosis—we can only accept and adapt to it.

For now, the Sun continues to sustain biomass on Earth, and this is expected to persist for long geological periods. From a strictly anthropocentric viewpoint, one could argue that the entire natural associative system supports human existence, with other living beings acting as our food and allies.

In our previous discussion of various organisms and chemical substances, we saw that most contribute to life's fertility and productivity (e.g., soil aeration, biodiversity, carbon storage, emission reduction, climate stability, temperature regulation, oxygen production). A time may come when humanity will engage even more deeply in learning from other species and change its behavior accordingly.

This requires a thorough introspective analysis of the human species—especially of the groups that make and implement existential decisions on global and local scales.

Next, we will move on to a new subchapter exploring the relationship between soil and the macrocosm.

5.5.4.5 Soil and the macrocosm

Reflections on soil in connection with the macrocosmic plane are particularly complex, as we still lack sufficient feedback to form more precise ideas. Another challenge in studying soil within the macrocosm is defining its boundaries. Due to the vast spatial scale of this plane, we must limit ourselves to known planets and moons within our Solar System. In this regard, we can partially rely on observations gathered from human space exploration.

Based on composition, soils in the more familiar parts of our Solar System can be categorized into rocky soils, icy soils, and soils containing organic compounds. Rocky soils are mainly composed of minerals and rocks, which vary depending on the specific planet or moon.

Earth's satellite, the Moon, is believed to have soil made primarily of small rock particles, minerals, and glassy fragments, typically of basaltic origin. Martian soil is thought to consist of iron oxide, basalt, olivine (a magnesium-iron silicate), pyroxene (tetrahedral silicates also containing aluminum, iron, and titanium), and perchlorates (strong oxidizers of organic compounds). On Mercury, the soil appears to be a mix of silicate materials, including basaltic rocks and glassy fragments.

The soil on Pluto (though no longer officially classified as a planet) is entirely different—it's icy and composed of water ice, nitrogen ice, carbon dioxide, carbon monoxide, methane, and rocky particles. Europa, a moon of Jupiter, is entirely covered with a layer of water ice, beneath which there may be rocky debris and potential organic compounds. The soil on Saturn's moon Titan is also icy and contains a mixture of organic compounds (e.g., ethane, methane). There is evidence that cryovolcanic activity (ice volcanoes) may occur there.

Titan's soil can be classified as rich in organic compounds. Mars also fits into this category, as it is believed to contain complex organic molecules—possibly an encouraging sign for the potential emergence of microbial life.

From these brief descriptions, it is clear that soils on other celestial bodies differ significantly from the various types of soil we know on Earth. Based on current knowledge, we can state that soils from other planets and their moons are not capable of supporting fertility and, as a result, do not support the development of higher or more complex forms of life.

Despite being composed predominantly of non-living, inorganic matter, these planets and moons still exist and exhibit different masses, gravitational forces, magnetic fields, orbital speeds, rotational speeds, and axial tilts.

Nevertheless, it is important to emphasize that our planet—along with its living systems and climate—is dependent on the existence of these celestial bodies. Without Jupiter or Saturn, Earth would likely face more frequent asteroid collisions, which could have had a negative impact on the development of life. Let us take a closer look at the properties of the planets based on the previously mentioned indicators (these are only approximate values).[397]

397 Data obtained using Chat GPT 3.0 https://chat.openai.com/ (2023-07-09)

5.5.4.5.1 Table 208: Masses, diameters, gravitational strength, magnetic field strength, speed of motion and axial tilt of the planets and the Sun in our Solar System

Planets in our Ss and the Sun	*Mass (kg)*	*Diameter (km)*	*Gravitational field strength (m/s^2)*	*Magnetic field strength (µT)*	*Movement speed (km/s)*	*Axial tilt (°)*
Mercury	$3.30 \cdot 10^{23}$	4789.00	3.70	0.44	47.87	0.03
Venus	$4.87 \cdot 10^{24}$	12104.00	8.87	0.01	35.02	177.30
Earth	$5.97 \cdot 10^{24}$	12742.00	9.81	40.00	29.78	23.50
Mars	$6.42 \cdot 10^{23}$	6779.00	3.71	1.50	24.07	25.19
Jupiter	$1.9 \cdot 10^{27}$	139820.00	24.79	417.00	13.07	3.13
Saturn	$5.68 \cdot 10^{26}$	116460.00	10.44	21.00	9.69	26.73
Uranus	$8.68 \cdot 10^{25}$	50724.00	8.69	160.00	6.81	97.77
Neptune	$1.02 \cdot 10^{26}$	49244.00	11.15	170.00	5.43	28.32
Sun	$1.99 \cdot 10^{30}$	$1.40 \cdot 10^{6}$	247.00	1000.00	220.00	7.25

Table 208 presents data on the masses, diameters, gravitational strengths, magnetic field strengths, orbital speeds, and axial tilts of the planets and our Sun in the Solar System.

The Sun orbits the center of the Milky Way at an average speed of 220 km/s, while, compared to the planets in our Solar System, it moves at a much lower speed. The planets' orbital speeds are as follows: Mercury – 47.87 km/s, Venus – 35.02 km/s, Earth – 30 km/s, Mars – 24.13 km/s, Jupiter – 13.07 km/s, Saturn – 9.69 km/s, Uranus – 6.81 km/s, and Neptune – 5.43 km/s.

The Sun also has by far the greatest mass, diameter, strongest gravity, and most powerful magnetic field. Its axial tilt is relatively small (only 7.25°). In short, the Sun is the most important celestial body in this system, as its strong gravitational force keeps the planets in their orbits. Additionally, its powerful magnetic field (around 1000 µT) influences the climate of all the planets. The impact of other planets on Earth's climate is considered to be minimal. However, it has been observed that Venus and Jupiter together may cause climatic changes on Earth approximately every 405,000 years.[398] The main influences discussed here are indirect—such as tidal disturbances, climate changes caused by planetary forces, space weather around Earth, and the previously mentioned planetary shielding (see Jupiter). It appears there are no strong direct connections between the planets within this system. The overall electrical charge of both the Sun and the planets is believed to be neutral, although weak positive or negative charges may occasionally occur.

Except for Earth, no form of life has yet been discovered on any of the other planets. All planets in our Solar System influence Earth and its moons only indirectly, yet these effects are still significant. Without the presence of other planets, Earth's orbit would be less stable, interactions with asteroids

398 Horner, J., Gilmore, J. B., & Waltham, D. (2015). The role of Jupiter in driving Earth's orbital evolution: an update. In *Proceedings of the 14th Australian Space Research Conference (ASRC 2014)* (pp. 25-38). National Space Society of Australia Ltd. See also the source: https://bigthink.com/surprising-science/the-pull-of-jupiter-and-venus-on-earth-causes-major-climate-events/ (2023-07-10).

and comets would be different, tides would be less pronounced, and the night sky would look entirely different. These consequences could potentially impact various life forms and their survival.

From this, we can infer that our Solar System—with its planets and their satellites—is extremely precisely organized, making it difficult to attribute its structure to random processes. This raises a serious question about the likelihood of life arising on Earth by chance. The static and dynamic properties of the Solar System, particularly the planets and moons, form a structure that has made life on Earth possible. In this context, it is reasonable to assume that many similar systems exist in the macrocosm.

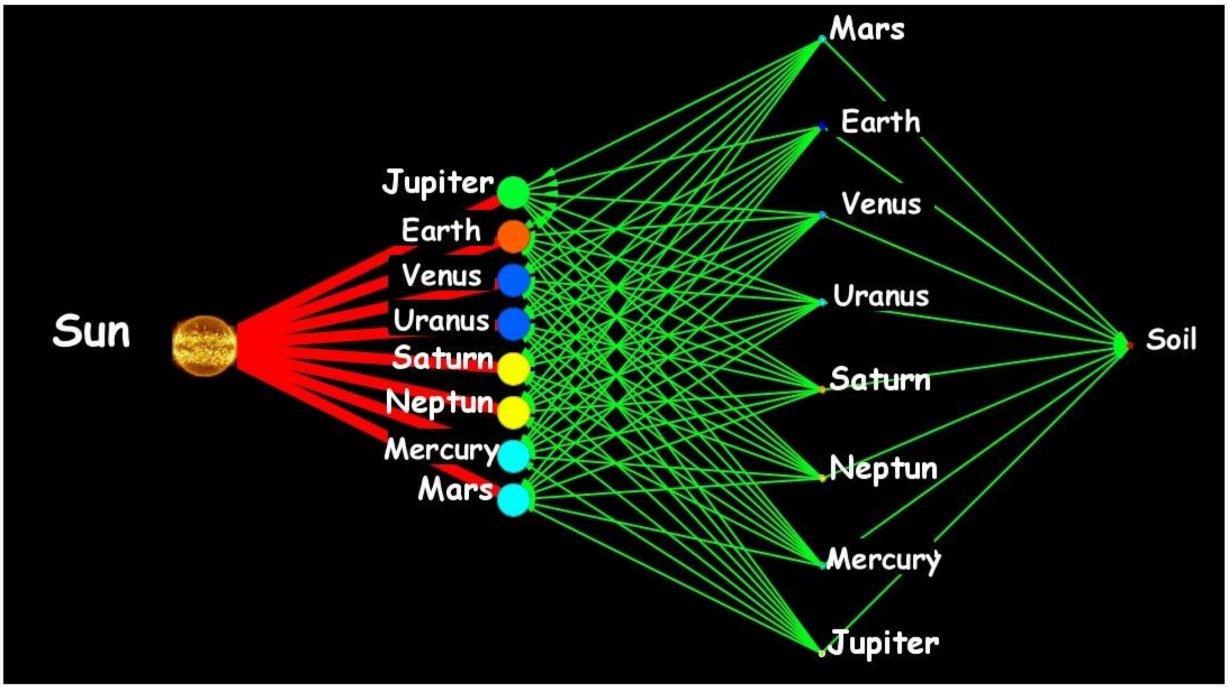
It is often stated that the common equivalent of all three cosmic planes is mass and energy. This brings up the question: why do these cosmic planes even require living beings to transform and transfer mass and energy? Compared to the inanimate world, the living world is much smaller, rarer, lighter, and energetically less powerful. It's true that inanimate particles require external energy for movement, while living beings generate their own energy—referred to as life force—which enables them to make autonomous decisions.

Living beings, through their choices and actions, can affect fine or small structures in the universe and thereby improve the energy efficiency of the entire system on local levels. Another important aspect is the storage and dissemination of information, which can be considered a special form of energy. This raises the question of who, besides known living beings (including humans), can utilize such information. Due to our limited understanding, we can only speculate that various energy-based beings may exist in the universe. These could exist purely as energy or temporarily take on physical form as living beings.

Why would such energy beings need to do this at all? Perhaps to transfer subtle energies to smaller surfaces? Or as a method of energy release while in a state of rest? Perhaps even as a way of traveling through time? Or maybe as a form of energy condensation that enables easier transmission of energy (see the speculative model on the macrocosmic plane)?

Returning to the topic of soil in connection with the macrocosm: in most cases, soil does not have a life-supporting function, unlike on our planet. On the one hand, soil serves to protect planets from impacts, and on the other hand, it provides surface stability. This helps maintain planetary compactness over longer periods, which is essential for stable orbital movement. On Earth, soil—beyond these functions—plays a key role in fertility, and in the growth and development of living beings, especially plants.

The formation of different soil types on Earth mainly depends on the Sun, the movement of air and water masses, rocks, minerals, and organic substances, and—albeit to a lesser extent—on the motion of other planets in the Solar System. Based on these insights, it would be worthwhile to visualize a hierarchical associative structure between the Sun and its planets. To this end, a custom microthesaurus will be developed and later supplemented with data from the table.



5.5.4.5.2 Figure 481: Hierarchical associative diagram of the Sun and its planets in the Solar System

Figure 481 presents a hierarchical associative diagram of the Sun and its planets in the Solar System, with an emphasis on gravitational force. The Sun has the greatest gravitational force (see the large yellow node with a value of 247 m/s²), as it keeps all the planets in their orbits. This represents a distinctly hierarchical relationship between the Sun and the planets, since the organized and stable existence of all planets in our Solar System depends on it (see the strongly emphasized red links between the Sun and the planets).

Distances between the Sun and the planets are measured in astronomical units (AU). The distances of individual planets from the Sun vary significantly. From Mercury (see the larger light blue node with a value of 3.70 m/s²), Venus (larger dark blue node, 8.87 m/s²), Earth (larger orange node, 9.81 m/s²), to Mars (larger light blue node, 3.71 m/s²), the distances increase almost linearly (0.39 AU, 0.72 AU, 1.00 AU, and 1.52 AU). Beyond Mars, the distances to Jupiter and the other outer planets grow exponentially (5.20 AU, 9.54 AU, 19.22 AU, and 30.06 AU). It seems no coincidence that the largest planet, Jupiter, lies near the center of this distribution and has the strongest gravitational force among the planets (see the large green node with a value of 24.79 m/s²). Jupiter's role can be seen as supporting the Sun in maintaining the stability and order of the remaining planets in the system.

The following planets have weaker gravitational forces (see Saturn's large yellow node with 10.44 m/s^2, Uranus's large dark blue node with 8.69 m/s^2, and Neptune's large yellow node with 11.15 m/s^2). Weaker associative connections exist between the planets (see the green arrows), which contribute to the relatively stable organization of their orbital motion. Despite these connections, there are no existential dependencies among the planets—for example, our planet could exist even without the others in the Solar System. In this system, the Sun can be considered a completely independent variable in relation to the planets, as it does not need them for its own existence.
On the far right of the hierarchical associative diagram, we can observe a common denominator among the planets—soil (see the faint green arrows from the planets to soil). As previously mentioned, soils vary greatly—in fact, only Mercury, Venus, Earth, and Mars have actual soil, and only Earth's soil supports the development of more complex forms of life. Soils represent an extremely small portion of the planets' total mass, which is also true for Earth. The mass relationships among the planets are just as interesting as the distribution of gravitational forces. Expressed in Earth masses (Me), Mercury has the smallest mass (0.055 Me), followed by Mars (0.107 Me), Venus (0.815 Me), Earth (1 Me), Uranus (14.50 Me), Neptune (17.10 Me), and Saturn (95.20 Me), while Jupiter has by far the greatest mass (317.8 Me). If these masses are shown in sequence, the graph appears almost linear up to Jupiter, after which it increases exponentially due to Jupiter's massive size. This is followed by an exponential drop in mass (at Saturn and Uranus), and then a relatively linear rise again (from Uranus to Neptune). Jupiter is once again highlighted for its significant contribution to the stable and organized motion of the remaining planets in their orbits. The hierarchical associative system of the Sun in relation to the planets is strictly hierarchical, whereas the relationships among the planets are more associative. The different types of soil result from autonomous development within individual planets, though still under the influence of the Sun. The farther a planet is from the Sun, the lower its temperature, which directly affects its climate and thus the formation of soil. On the more distant planets (Jupiter, Saturn, Uranus, Neptune), we primarily speak of ice and gases, while Mercury, Venus, Earth, and Mars contain soils in which we find anions (Cl^-, $(SO_4)^{2-}$, O^{2-}) and cations (Na^+, K^+, Mg^{2+}, Ca^{2+}, Fe^{2+}, Fe^{3+}). The formation of ions in soil results from numerous factors, with solar heat and light playing a key role. These influence temperature, photodissociation, chemical reactions, biological processes, and evaporation. Therefore, ion formation on a given planet is directly dependent on its distance from the Sun, meaning that the formation of fertile soil on a planet is also connected to the Sun.
In conclusion, aside from speculative theories about energetic life forms, there is currently no evidence of living organisms in connection with soil and the macrocosm. This concludes the chapter on soil and leads us into the next chapter—Air.

5.6 Air

Air is a heterogeneous mixture of gases, composed of nitrogen (approximately 78%), oxygen (approximately 21%), argon (approximately 0.9%), and carbon dioxide (approximately 0.04%).[399] In addition, air contains very small amounts of neon, helium, krypton, xenon, sulfur dioxide, nitrogen oxides, methane, ammonia, iodine, ozone, water vapor, and other gases. Its composition varies depending on human activities (especially industrial) and altitude. In higher layers of the atmosphere, the air becomes thinner, while industrial areas tend to have higher concentrations of ammonia, hydrogen sulfide, and carbon, nitrogen, and sulfur oxides.

Air density depends on temperature and atmospheric pressure. The higher the air temperature, the lower the density, while atmospheric pressure decreases exponentially with altitude. Relatively clean air is colorless and odorless. Most living organisms require oxygen to survive, as their bodies use it for breathing and metabolism. However, there are also organisms that do not require oxygen and instead use other gases such as methane (e.g., the previously discussed archaea).

The atmosphere is made up of different layers of air that surround a celestial body, such as Earth. It enables breathing, regulates surface temperature, influences weather, and protects Earth from harmful cosmic radiation. According to the Kármán line, the atmosphere is part of the mesocosmic plane. It is divided into several layers:

- Troposphere (6 km to 20 km above the surface),
- Stratosphere (20.1 km to 50 km),
- Mesosphere (50.1 km to 85 km), and
- Thermosphere (85.1 km to 600 km).

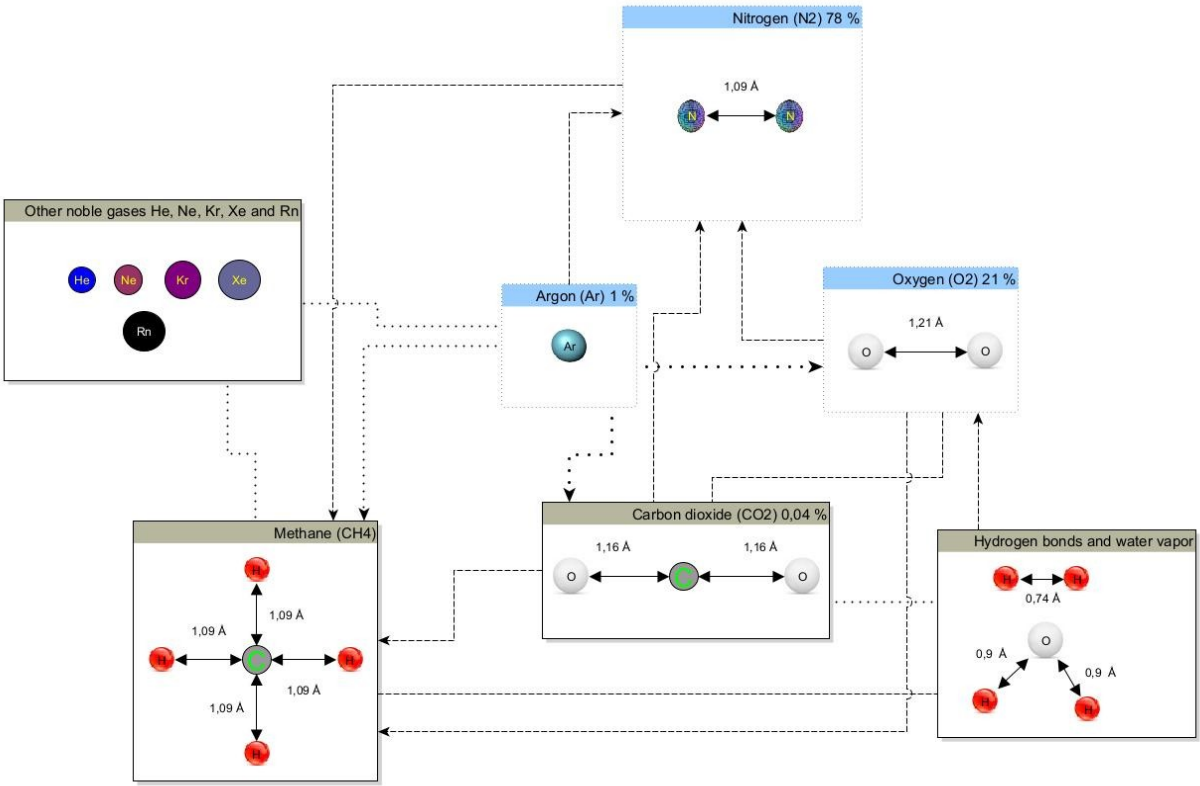
A significant portion of the thermosphere (from 100 km upward) already belongs to the macrocosmic plane.

Various microorganisms have been discovered in the troposphere and stratosphere, such as bacteria, microscopic fungi and algae, plant particles (e.g., pollen), and even some insects (e.g., aphids, beetles, mites). Pollen and insects typically reach these layers due to air movement caused by strong winds, storms, and water evaporation from various sources.

Numerous parameters can be measured in the air, such as temperature, humidity, pressure, wind speed and direction, air volume, the concentration of solid particles and gases (e.g., CO_2, CO, SO_2, H_2S, CH_4, O_3, NO_2, NH_3, volatile organic compounds), ultraviolet radiation, visibility, dew point, and atmospheric stability. These measurements allow for the assessment of air quality, weather forecasting, climate change research, and evaluating health impacts.

399 Spellman, F. R. (2019). *The Science of Air: Concepts and Applications*. CRC Press.

Air contains a large number of different molecules and atoms, yet it remains relatively compact. This is primarily due to intermolecular forces (e.g., London dispersion forces, dipole interactions, hydrogen bonds) that keep particles close together even without chemical bonds. Modeling the structure of air is complex, as it includes many substances held together by weak intermolecular forces. Nitrogen (N_2) and oxygen (O_2) molecules are predominant, while other components are only present in trace amounts. Because of these weak forces, organisms that breathe with lungs can easily take in oxygen, which is essential for cellular function and metabolism, with carbon dioxide being expelled as a waste product. Nitrogen plays no active role in respiration, acting as an inert gas that is simply exhaled back into the atmosphere. Due to the weaker intermolecular forces, the process of breathing is energetically less demanding. We continue with the modeling of air's heterogeneous composition and structure. It is important to highlight that each gas in the air retains its original geometric structure: N_2, O_2, and CO_2 molecules have a linear geometry, while noble gases like argon exist as individual atoms with spherically symmetrical distribution.



5.6.1 Figure 482: A possible model of the structure of air

Figure 482 shows a possible model of the structure of air, characterized by weak intermolecular forces, also known as London dispersion forces or Van der Waals forces. These forces can induce polarizability in the form of temporary dipoles. This is precisely why air, which is a mixture of various gases, remains relatively compact. The degree of polarizability is determined by the shape and size of the molecule or atom. As shown, the oxygen molecule is larger than the nitrogen molecule, allowing it to induce stronger temporary dipoles (see the dashed arrow connecting the oxygen molecule to the nitrogen molecule).

The noble gas argon (Ar) also forms weak intermolecular interactions with oxygen (O), nitrogen (N), methane (CH_4), carbon dioxide (CO_2), hydrogen (H), water vapor (H_2O), and with other noble gases such as helium (He), xenon (Xe), krypton (Kr), neon (Ne), and radon (Rn). The argon atom is larger than the oxygen, nitrogen, and carbon atoms (and also larger than compounds like methane and carbon dioxide), which allows this noble gas to create stronger temporary dipoles.

These temporary dipoles can be imagined as clouds surrounding atoms and molecules, which are either positively or negatively charged. The process of these clouds becoming charged and discharging is continuous and dynamic. On one hand, the gas mixture can be seen as a hierarchy based on the size of atoms and molecules, and on the other, as associative groupings, each of which behaves independently.

From the perspective of respiration, nitrogen molecules are more important for plants, while oxygen molecules are essential for animals. Although the noble gas argon is not biologically relevant, it plays a role in stabilizing the Earth's atmosphere. Carbon dioxide is an important gas for our climate system and for the process of photosynthesis. The percentage of other gases (such as methane) in the atmosphere is very small, but these gases still contribute to climate regulation.

If, primarily due to human industrial and agricultural activities, gases such as hydrogen sulfide, nitrogen dioxide, ammonia, and sulfur dioxide enter the atmosphere, the composition of the air is no longer stable. These gases cause significant pollution and initiate chemical reactions that produce new substances, which often cause even greater environmental harm.

Hydrogen sulfide reacts with oxygen in the air to produce sulfur dioxide. This can further oxidize into sulfur trioxide, which is much more hygroscopic than sulfur dioxide. In reactions with water, sulfurous (IV) and sulfuric (VI) acids are formed, which can be particularly harmful to many plant species. Thus, air pollution also leads to soil contamination and a further reduction of biomass.

Nitrogen dioxide can oxidize into additional ozone, which is harmful to the health of living organisms, including humans. Ammonia can react with sulfuric acid to form ammonium salts, which settle into the soil. This can severely reduce soil fertility and hinder the beneficial functions of microorganisms. In contact with water, ammonium salts can cause excessive algal blooms and reduce oxygen levels, harming fish and other aquatic life. From these surface deposits, toxic ammonia can also be released, leading to respiratory diseases. This, again, is not only air pollution but also soil and water pollution, often resulting in a decline in biomass.

Sulfur dioxide, through oxidation and hydrolysis, can be converted into sulfurous (IV) acid. This leads to the formation of acid rain, which damages many plant species and other forms of life. In all of these reactions, the final outcome is the reduction of biomass on our planet.

Regarding carbon dioxide, it is important to emphasize that it is a relatively stable gas and a significant component of the atmosphere. Due to human activities such as excessive use of fossil fuels, deforestation, and various industrial processes, the concentration of this gas in the atmosphere is rising. This contributes to negative effects such as climate change (global warming), acidification of water bodies—especially oceans (which harms certain aquatic life forms), glacial melting (causing sea-level rise), reduction in planetary biomass (some organisms cannot adapt to the changes and die), and lower agricultural yields.

We must also consider the presence and influence of ions in the atmosphere. These affect air quality, climate, and induce processes (e.g., communication within systems) in natural hierarchical associative systems. Without ions in the atmosphere, cloud formation would not occur in the way we know it. Additionally, ions indirectly promote precipitation by accelerating droplet formation. Ions are also crucial in the discharge of electrical energy in the form of lightning. They may also contribute to the thinning of the ozone layer through chemical reactions.

In the upper atmosphere, there is the ionosphere, which consists mainly of ions and electrons. It is strongly influenced by solar activity. A good example of the Sun's effect on the ionosphere is the formation of polar auroras, where charged particles from the solar wind interact with the Earth’s ionosphere, resulting in beautiful, colorful light displays. From the perspective of the Earth's magnetic field and charged particles, auroras could be conditionally defined as a special type of magnetic induction.

Despite the important role of ions in our atmosphere, no direct influence on climate change has been established so far. They also do not seem to affect the relatively stable composition of our atmosphere, which is mainly regulated by various natural processes such as photosynthesis, respiration, volcanic activity, gas exchange within the atmosphere, oceanic and biospheric processes (e.g., mud, carcasses, plant decay), and human activities (e.g., fossil fuel use, deforestation, industrial production).

5.6.2 Climate change, global warming, and entropy

Climate change, global warming, and entropy are all processes that naturally and continuously occur in a generic sense. However, the presence of the human species on our planet significantly accelerates these processes—particularly climate change. As previously noted, the composition of air is relatively constant and renewable. Nevertheless, various industrial, agricultural, and consumer activities (e.g., the use of fossil fuels) are continuously releasing excessive amounts of gases such as CO_2, SO_2, NO_2, H_2S, NH_3, and others into the atmosphere.

Essentially, there is a constant influx of these and other gases into the atmosphere, which alters their concentrations. Gases like SO_2, NO_2, H_2S, and NH_3 undergo chemical reactions and transform into other substances that appear as liquids or solid salts on the surface of our planet.

CO_2, on the other hand, is one of the greenhouse gases that largely remains in its pure form and is not subject to significant chemical reactions. Due to the aforementioned human activities, CO_2 is continually being emitted into the atmosphere in excessive amounts, which significantly changes its concentration.

This can be loosely compared to measuring the concentration of CO_2 in a bedroom. Before sleep, the air is of good quality, with CO_2 concentrations typically ranging between 350 ppm and 450 ppm. During sleep, a person exhales CO_2 into the room, causing the concentration to rise—potentially reaching values between 850 ppm and 2200 ppm, depending greatly on the size of the room. After the sleep session ends and the room is ventilated, the CO_2 concentration typically drops back down to the lower range of 350 ppm to 450 ppm.[400] This process of air renewal is even more pronounced if the bedroom window is slightly open. The restoration of high-quality air is only possible due to the absence of human respiratory activity in the space, as the individual is located elsewhere in the home or outside. A similar situation occurs with human activities that continuously produce and emit greenhouse gases into the atmosphere.

The problem is that we don’t have special “windows” that could ventilate this atmospheric space. While the idea is interesting, implementing such a concept could lead to various risks by disrupting the natural balance. Moreover, with current technology, such processes would be impossible to manage or maintain effectively.

Excessive emissions of greenhouse gases into the atmosphere cause a rise in temperature because these gases absorb infrared radiation. This light—more specifically, heat—disperses throughout the atmosphere, causing it to thin, as particles move more rapidly due to the added heat. Among these, water vapor molecules are the most influential in atmospheric thinning, as they are the most effective at absorbing infrared radiation and thus contribute the most to atmospheric warming. Other greenhouse gases, such as CO_2 and CH_4 (methane), in excessive and concentrated amounts, further contribute to global warming. As the temperature increases, more water evaporates from various sources, leading to an excessive rise in water vapor concentration in the atmosphere.

400 Some measurements were taken using a carbon dioxide, temperature and humidity meter (Extech CO 100).

Some of this water vapor condenses and falls to Earth as precipitation, but the surplus remains in the atmosphere, creating ongoing imbalance. This imbalance manifests in the melting of ice masses in the Arctic and in the warming of the planet's surface.

The interaction between light and greenhouse gases leads to rising temperatures and, gradually, to climate change. These changes arise due to alterations in Earth's weather patterns, with temperature increases playing a key role. Other significant effects include changes in precipitation, wind patterns, air humidity, atmospheric pressure, and chemical changes—such as the acidification of water sources (especially oceans) and changes in soil pH (acidification or alkalization).

Drastic shifts in soil pH (becoming highly acidic or alkaline) can have devastating effects on plant and animal life, which in turn indirectly influences climate change.

As previously mentioned, entropy refers to a state of disorder and unpredictability from our perspective. Hierarchical and associative relationships break down at high levels of entropy. This principle applies across different types of entropy.

In a broader sense, entropy is a concept that highlights the tendency toward dispersion and diffusion in space. In short, structured, hierarchical, and associative organization becomes less likely.

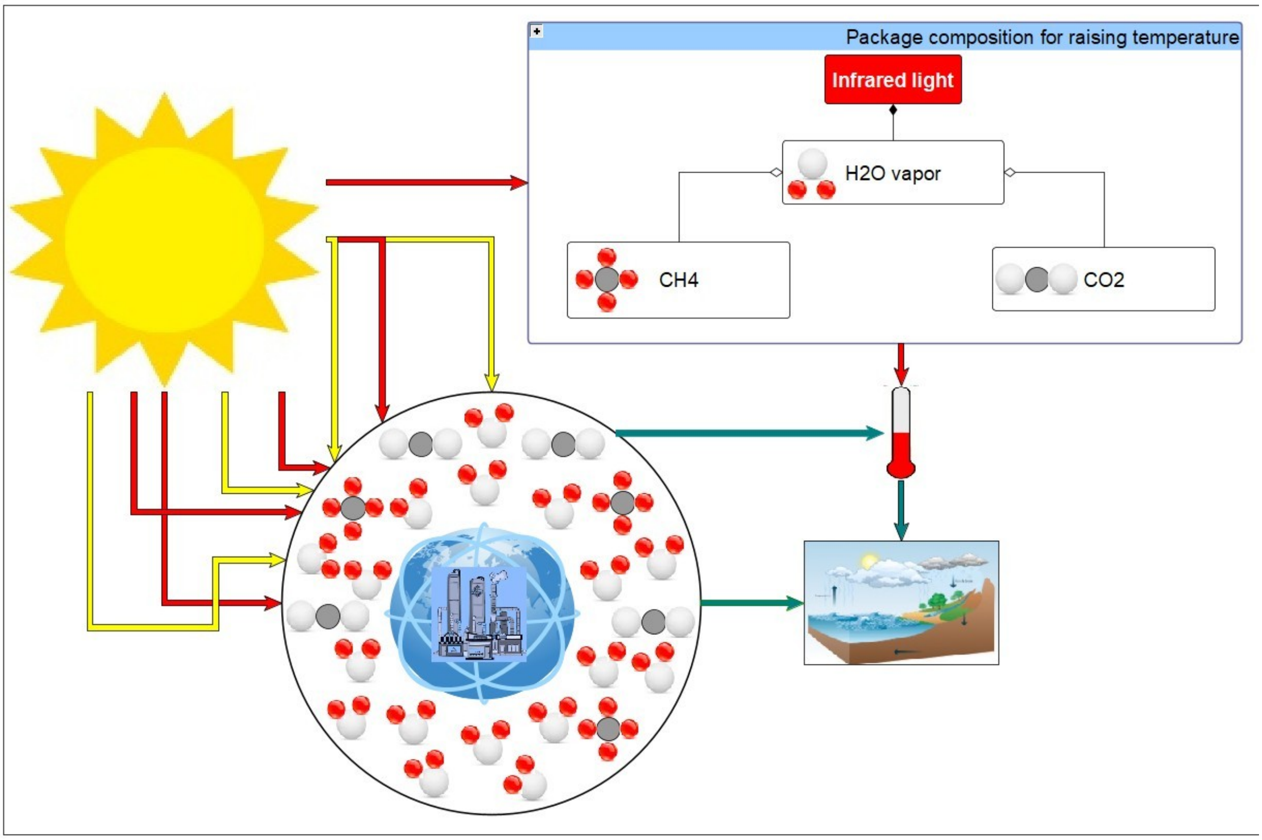
Entropy can be interpreted primarily through the lens of usable energy (e.g., the second law of thermodynamics: high entropy means less usable energy is available to perform work) and information (e.g., informational entropy: the principle of uncertainty, indeterminacy, and randomness between the sender and receiver of a message).

It also involves identifying patterns in the distribution of observed parameters (e.g., energy, information). Through this expansive concept, we can identify strong connections between energy and information. Both are key concepts we use to understand hierarchical associative systems. In some ways, energy can be transformed into information and vice versa.

Both energy and informational entropy have only an indirect influence on climate change, as natural processes and human activities are the primary driving forces. Lower and higher degrees of entropy are merely consequences within causal and conditional systems that weaken or even dismantle hierarchical associative structures, both from an energetic and informational standpoint.

Accelerated climate change due to excessive harmful human activity occurs primarily because of excess water vapor in the atmosphere and emissions of other greenhouse gases. These significantly promote the buildup of excess water vapor molecules in the atmosphere, caused by rising temperatures and increased particle motion.

From this perspective, it is a hierarchical and associative configuration of chemical compounds and physical effects that rapidly influence climate change. Viewed in this light, humans in legally and technologically advanced societies could be seen as catalysts of chemical and physical reactions.



5.6.2.1 Figure 483: A possible scenario of global warming and climate change

Figure 483 illustrates a possible scenario of global warming and climate change, with an emphasis on water vapor molecules, as the interactions between these molecules and infrared radiation play a key role in shaping Earth's climate, driving climate change, and maintaining the planet's energy balance.

Among all greenhouse gases in our atmosphere, water vapor molecules have the highest concentration, while other gases—such as CO_2 and CH_4—are present in significantly lower concentrations. One could even argue that their concentrations are negligible in comparison. Nevertheless, in cooperation with water vapor molecules, they gradually contribute to climate change.

As our atmosphere and the Earth's surface continue to warm, increasing amounts of water evaporate. The resulting excess water vapor molecules absorb a portion of the infrared radiation and then re-emit it into the atmosphere, producing additional unwanted thermal energy. When this energy combines with that generated by other greenhouse gases, the total amount of heat increases further, gradually destabilizing the atmospheric system.

This imbalance disrupts the optimal hierarchical and associative structure of our atmosphere, leading to an increase in energy entropy. From the perspective of living organisms, this type of entropy is harmful, as the dispersion of thermal energy causes global warming of the atmosphere and the planet. This already sets the stage for climate change.

Excessively dispersed energy radiates in multiple directions, which—when viewed from a human perspective—is inefficient and represents a lower energy yield within the overall natural hierarchical and associative system. An interesting idea might arise from this—that we could simply redirect the excess water vapor molecules into space. However, this would require enormous energy inputs and advanced modern technologies, as such an endeavor would have to overcome Earth's gravitational pull, which is currently beyond our technological reach. Additionally, we would not be able to predict the potential consequences this might have on the water cycle, cloud formation, and various altered weather patterns.

It is known that our Sun is gradually losing its intensity and that climate change is, in some sense, a necessary natural process. However, human activities in industry, agriculture, and consumption are accelerating the entire progression far beyond its natural pace. This further increases energy entropy, which does not support a balanced state within the natural hierarchical associative system.

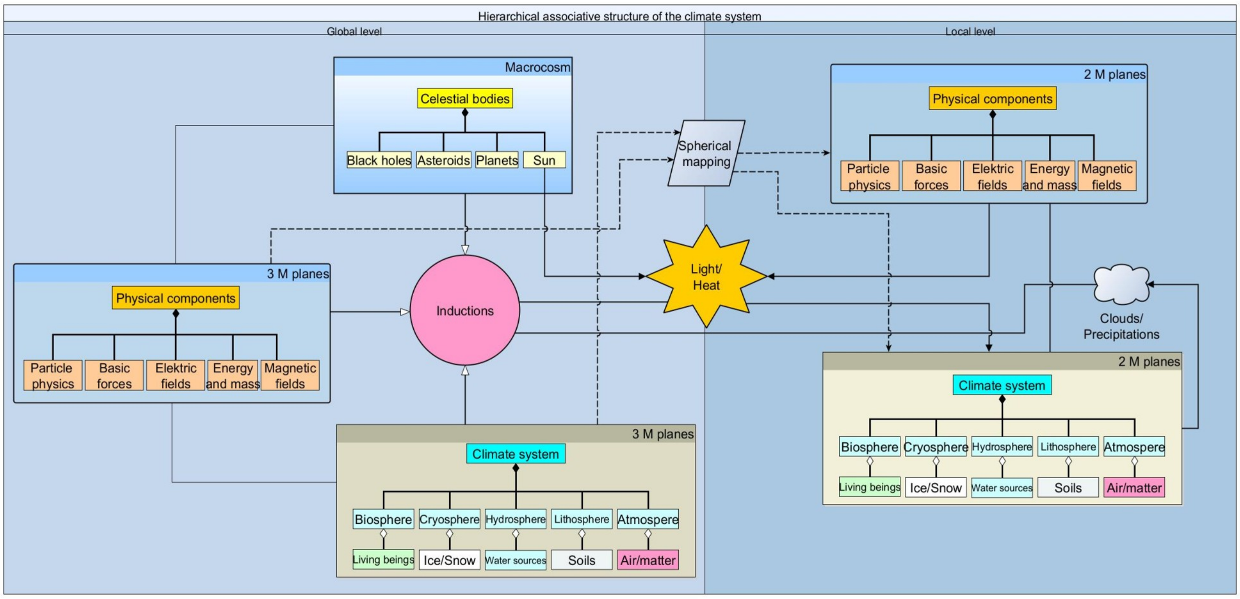
This simplified scenario does not take into account many other influential factors, such as wind, air pressure, various water sources, gravity, induction, magnetic and electric fields, interactions between air masses and soil, the activities of microorganisms in the atmosphere, water sources, and soil, as well as the concentration of various salts in water sources (e.g., NaCl), all of which also significantly contribute to climate change.

The climate system is extremely complex, and it is becoming clear that it does not function solely under the influence of macrocosmic forces—it is also subject to microcosmic and mesocosmic effects. In reality, it represents a multi-layered hierarchical associative structure in which the climate system is only a small unit or cell.

On a global scale, macrocosmic units (such as the Sun, asteroids, and other planets) are superior to meso- and microcosmic units. From a local perspective, however, macrocosmic elements are interwoven with micro-units (e.g., photons, pions, ions, atoms) and meso-units (e.g., ice, rocks), making them functionally aligned in specific ways—ways in which patterns within the micro- and mesocosm already exist or are being formed. This local perspective suggests more of an associative connection.

It is a kind of spherical reflection between the strict hierarchy of the macrocosm above and the looser associations of the micro- and mesocosm. This could be illustrated using a mirrored hierarchical associative diagram. It is crucial to point out that the manifestation of this reflected strict hierarchy appears as a more or less loose association which, from our perspective, results in certain recognizable patterns from which we can extract specific structures.

In essence, we do not perceive what we would literally see in a mirror, but rather a different image —one that our brains must interpret and transform. This is somewhat comparable to the inverted projection of an image on the inside of the eye, which the brain then recognizes and understands.



5.6.2.2 Figure 484: The basic unit of a multi-layered climate system

Figure 484 illustrates the basic unit of a multi-layered climate system, incorporating a spherical mapping of components from the global to the local level. This concept is based on the principle of infinitely repeating patterns that are more or less identically projected onto local levels.

On the left side of the figure, a cluster of celestial bodies from the macrocosmic plane is shown, which exists only at the global level. Celestial bodies (excluding Earth and its satellite) do not directly belong to the category of the climate system, but they can be more or less strongly associatively linked to it and influence it. The most significant example in this context is the Sun, which emits various forms of electromagnetic radiation, including visible light (which allows us to see our surroundings), infrared radiation (felt as heat), ultraviolet radiation (mostly absorbed in the atmosphere), X-rays (also largely absorbed), and gamma rays (similarly mostly absorbed).

This electromagnetic radiation represents a strong and important associative link with the climate system, as visible and infrared radiation are essential for the development and functioning of the biosphere (plants, animals, microorganisms, and humans). Additionally, this radiation significantly affects the thermosphere (temperature), ionosphere (generation of charged particles), stratosphere (production and removal of ozone molecules), and troposphere (heating of the planet’s surface).

Solar electromagnetic radiation also plays a crucial role in maintaining the energy balance, as it is the primary driving force behind our climate system. In the center of the left side of the figure, a cluster of physical components is depicted, which significantly influence the climate system across all three cosmic planes (see the "3M" planes). These include elements such as particle physics components (e.g., atoms, ions, electrons, photons, pions, muons, neutrinos), fundamental forces (e.g., gravitational, electromagnetic, weak and strong nuclear forces), energy and mass, as well as electric and magnetic fields. Like the Sun, these physical components are not part of the climate system per se, but there exists a strong associative relationship between them.

On the bottom right side of the figure is the climate system cluster, composed of the biosphere (living organisms), cryosphere (ice, snow), hydrosphere (water sources), lithosphere (soil, rocks, minerals), and atmosphere (air, chemical substances). The climate system, even at the global level, exists across all three cosmic planes. Both the physical and climate system clusters also appear in a distorted, mapped form on the local level (see the right side of the figure), but are then present only on two cosmic planes (see "2M" planes: microcosm and mesocosm).

The connecting elements between the physical components and the climate system are induction (e.g., electromagnetic induction, electrostatic induction), and the aforementioned light and heat. These connectors are also associatively linked, manifested through various phenomena resulting from electromagnetic waves (e.g., electromagnetic induction), thermal radiation (e.g., air induction), electrostatic charges (e.g., lightning – see clouds/precipitation), and other effects. Induction also occurs within the hierarchical associative systems of living organisms. Without the presence of electromagnetic and thermal radiation, these induction phenomena would be less perceptible or not observable at all. This suggests that the strength of induction and radiation is a key factor for our climate system, which differs significantly from the climate systems of other planets in our solar system.

The climate system’s common denominators are especially the various types of induction and radiation, which primarily originate from our Sun. These inductions represent indirect consequences of the Sun and other intermediaries such as clouds, air, particle physics, chemical compounds, and living beings. In other words, without these intermediaries, the known induction phenomena would either not occur or be less recognizable.

The key insight into this hierarchical associative structure of the climate system is that the main driving force of the system is solar energy in the form of electromagnetic waves. Interestingly, the Sun does not constitute a hierarchically superior unit to the climate system but rather acts as a strong associative component. The Sun primarily produces energy through nuclear fusion of hydrogen into helium, a process that releases vast amounts of energy in the form of light and heat. This release results from high levels of entropy within the Sun’s core, enabling the generation of numerous solar rays that travel to the Sun’s surface and then to other planets in the solar system.

In essence, solar rays represent dispersed energy with high entropy, some of which reach Earth’s surface. From this perspective, the rays are not purposefully directed toward Earth, but rather result from the independent operation of nuclear fusion in the Sun's core. The entropy of this energy, in the form of solar radiation, enables associative connections with our climate system. This entropy is especially beneficial for life on Earth, as living organisms contribute to increasing the degree of organization and thereby reduce energy entropy on a local microcosmic and mesocosmic level. However, living beings also contribute to disorganization—particularly the human species in technologically advanced societies. Industrial, agricultural, and consumer activities create high levels of organization, but simultaneously increase informational entropy (e.g., the unmanageable exponential growth of publications) and energy entropy (e.g., excessive greenhouse gas emissions into the atmosphere). This has a significant impact on the accelerated transformation of our climate. Physical components, similarly, do not represent a hierarchically superior unit in relation to the climate system, but rather form a strong associative connection with it. These components possess broader significance and are essential for understanding the fundamental principles believed to govern the entire universe, including our planet and its environment.

Physical components often refer to concepts that are validated through observation and measurement. From this perspective, the climate system exhibits a kind of dual nature. On one hand, it functions as a small unit within the macrocosmic plane; on the other, through spherical mapping, it operates across two additional cosmic levels—the microcosm and mesocosm. In this latter context, the climate system appears as a large, overarching unit, hierarchically above many other units (such as microorganisms, plants, algae, fungi, animals, humans, water sources, soils, rocks, and minerals).

The same applies to physical components, which represent key conceptual foundations through which the sciences attempt to explain numerous phenomena and processes across all cosmic scales, both globally and locally. The problem with physical components arises particularly when natural sciences attempt to reconcile findings across the macro-, meso-, and microcosmic levels. They encounter incompatible laws and principles (e.g., time, space, energy, mass, particle physics), which cannot easily be compared or unified.

The climate system is therefore linked to incomparable cosmic planes and a heterogeneous composition of laws. This is fundamentally why the climate system is predominantly interpreted through a limited segment of the macrocosm, and the entirety of the other two cosmic levels.

We can acknowledge that such an interpretation of the climate system is incomplete; however, there is currently a lack of knowledge and/or capabilities that would allow us to establish meaningful comparability between the governing laws across different cosmic planes.

5.6.3 Air and Soil

The impact of air on the quality and fertility of different soil types is relatively significant, as it ensures that plant roots have access to oxygen, which is essential for respiration. Optimal air quality promotes the activity of beneficial microorganisms, supports the development of stronger roots, enhances nutrient availability, increases soil aeration for effective drainage of excess water, indirectly aids in regulating soil pH, controls soil temperature, prevents excessive soil compaction, reduces erosion, and contributes to overall plant health. It is important to note that the relationship between air and soil is not one-way; soils can also influence air quality.

Soils located near water sources with a higher clay content may contribute to increased erosion, which can result in a greater number of airborne particles, leading to air pollution. Wind can accelerate this process by dispersing these particles over larger distances. Additionally, polluted water sources with vegetation can also reduce air quality. Clay soils may influence local climatic conditions by lowering or raising air temperature (through heat reflection and absorption), reducing air humidity, and affecting wind patterns. When such soils are heated, various gases may be released, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), water vapor (H_2O), and sulfur dioxide (SO_2). These gases can contribute to both local and global warming, thereby impacting air quality.

Garden soils with a higher sand content can affect air quality through dust erosion. When directly exposed to wind, fine soil particles can become airborne, contributing to air pollution. Microbial activity in sandy soils can also release harmful gases into the air. When heated, these soils may emit gases such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), nitrogen dioxide (NO_2), volatile organic compounds (VOCs), ammonia (NH_3), hydrogen sulfide (H_2S), water vapor (H_2O), and sulfur dioxide (SO_2). Similar gases are released when silt-rich garden soils are heated, including carbon monoxide (CO). This also applies to forest sandy loam soils.

These brief descriptions reveal the complexity of the bidirectional relationship between air and soil. The same can be said for the interaction between wind and soil. Winds can alter the physical, chemical, and biological properties of soils. The degree of wind influence depends on wind speed, duration, and the soil’s physical-chemical-biological composition. Stronger winds can cause wind erosion, removing and transporting solid particles through the air, thereby reducing soil fertility and permeability. Even weaker winds can increase soil moisture evaporation, which is particularly detrimental in arid regions.

Winds may also compact the soil, altering its optimal structure and reducing its ability to absorb water and air—conditions unfavorable for plant growth and development. Winds can also transport and deposit particles from one location to another, potentially burying vegetation in the process.

Additionally, winds can alter the microclimate around plants and within the soil. A negative impact of such microclimate changes is the drying out of both soil and plants.
Moderate winds tend to have more positive effects on soil and plant health—for example, by improving soil aeration. These winds can also influence temperature regulation, helping to dissipate heat from the soil during colder periods and contributing to heat gain in warmer periods. Winds are also known to sort particles by size and weight. In areas near saline water bodies, wind can carry droplets of salty water inland, leading to gradual salt deposition in soils. This process negatively affects plant growth and development by disrupting the absorption of water and nutrients.

5.6.4 Winds

It has been observed that winds affect various types of soil and, consequently, influence the growth and development of plants. But how can wind be defined? Wind is the natural movement of air or air masses, primarily caused by horizontal differences in atmospheric pressure. It arises due to factors such as solar energy, the Earth's rotation around its axis and the Sun, and the uneven heating of the planet's surface.[401] Winds are classified based on criteria such as their origin, speed, direction, volume, and various geographical characteristics into the following categories:

a. Global winds (e.g., trade winds, westerlies, polar easterlies)

b. Local winds (e.g., sea breezes, land breezes, mountain and valley winds)

c. Monsoon winds (e.g., winter monsoons)

d. Katabatic winds (e.g., mountain katabatic winds, polar katabatic winds)

e. Foehn winds (e.g., warm and dry downslope winds)

f. Doldrums (e.g., weak equatorial winds)

Most of these types of wind are not present at the locations where soil samples were taken. At these sites, the most likely winds are local valley winds (airflow from the cool valley floor to the heated slopes), local mountain winds (air masses moving from the mountains down into the valleys at night), and prevailing westerlies (air masses moving from west to east).
Local valley winds can influence soil moisture and erosion, which can negatively affect vegetation. Local mountain winds can affect soil temperature, where low temperatures may negatively impact microbial activity and nutrient availability, thereby altering soil structure. These winds may also cause moisture accumulation in the soil.
Westerly winds can cause the mass transport of solid particles through the air. These particles are then deposited elsewhere, potentially unfavorably altering soil nutrient levels and structure. Strong westerlies can trigger wind erosion, damaging soil structure (e.g., by removing the topsoil layer)

401 Possible definition: Burton, T. (2011). *Wind energy handbook*. Wiley.

and reducing soil fertility. Westerlies are also the most frequent and intense winds at the soil sampling sites, and they can influence overall weather conditions in those areas.

Various measurement techniques are used to analyze wind behavior, which can be grouped as follows:

a. Wind speed measurement indicates how fast air molecules move through a given space, commonly measured in meters per second (m/s). Different types of anemometers are typically used for this purpose.

b. Wind direction is determined using a compass, expressed in degrees (e.g., 0° for north, 90° for east, 180° for south, 270° for west), often with the help of a weather vane.

c. Gust measurement provides data on variability and intensity, measured in m/s (e.g., using an anemometer or the Beaufort scale, which ranges from 0 to 12).

d. Wind chill measurement helps assess the perceived drop in temperature due to wind, useful for estimating the severity of temperature changes.

e. Wind energy density estimation is based on data regarding wind speed and air density. These findings can be used to evaluate potential for wind energy production (similar to determining a wind energy class).

f. Threshold wind speed measurement reveals critical wind speeds that may have destructive effects and cause undesirable soil erosion.

In the following section, some measurements taken with an anemometer will be presented.[402]

402 Measurements were performed using an Extech thermo anemometer.

5.6.4.1 Figure 485: Measuring wind speed using an anemometer

Figure 485 shows an example of measuring wind speed in meters per second (m/s) using an anemometer, which also measures ambient air temperature. In the following section, wind speed measurements taken in a garden environment will be presented.

5.6.4.2 Table 209: Measurements of maximum wind speeds in the movement phase

Temperature (°C)	*Movement/Stillness*	*Duration (s, min)*	*Maximum wind speed (m/s)*
20.7	M	00:00:14	0.00
20.7	SUG	00:03:20	0.29
20.7	SUG	00:01:45	0.59
20.7	SUG	00:02:33	0.51
20.7	SUG	00:00:25	0.31
20.7	SUG	00:00:16	0.39
20.7	SUN	00:00:15	0.62
20.7	SUG	00:00:59	0.45
20.7	SUG	00:00:34	0.34
20.7	SUN	00:00:48	0.19
20.7	SUN	00:00:15	0.72
20.7	SUG	00:00:20	1.20

Table 209 presents measurements of peak wind speeds during movement phases in a garden environment. The measurements were conducted in sunny weather and in the shade, with an air temperature of 20.7 °C. During the measurement period, only one phase of stillness (M) was recorded, lasting 14 seconds with a wind speed of 0.00 m/s.

This was followed by five consecutive movement phases in a clockwise direction (see Table SUG), with maximum wind speeds ranging from 0.29 m/s to 0.59 m/s. Subsequently, a short (15-second) movement phase occurred in a counterclockwise direction (see Table SUN), with a peak wind speed of 0.62 m/s.

After this, two additional clockwise movement phases occurred, lasting between 34 and 59 seconds, with wind speeds ranging from 0.34 m/s to 0.45 m/s. Then, two counterclockwise wind movement phases followed, lasting between 15 and 48 seconds, with maximum recorded speeds between 0.19 m/s and 0.72 m/s. Finally, a clockwise movement phase was recorded with a duration of 20 seconds and a peak wind speed of 1.20 m/s.

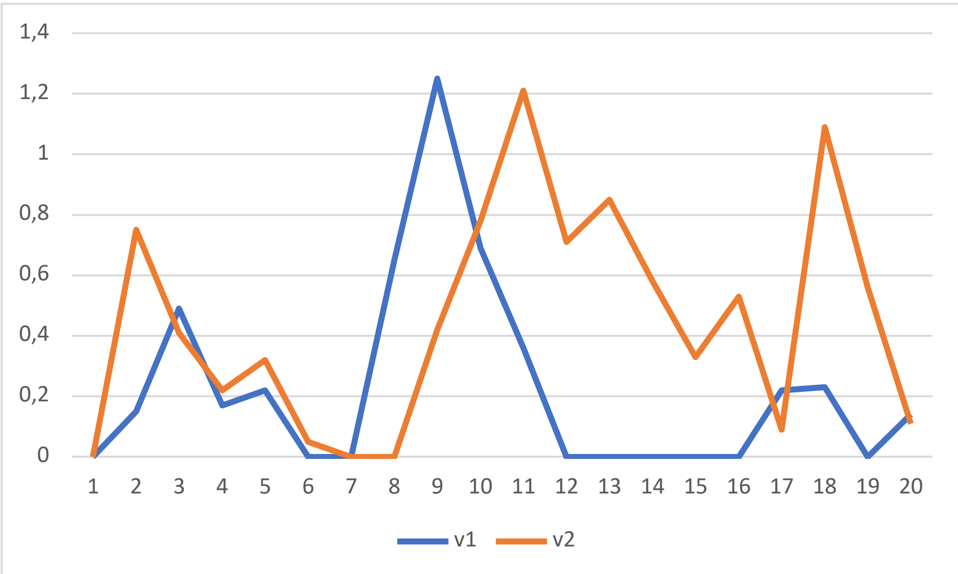
From these limited measurements, we can infer that wind follows a certain rhythm and direction. This rhythm and direction frequently change, depending on atmospheric conditions (e.g., air temperature, pressure, gas composition of the atmosphere) and Earth's rotation on its axis. At certain times, the wind may enter a still phase, during which the speed is 0 m/s. Wind speed constantly fluctuates between minimum and maximum values (e.g., from 0.19 m/s to 1.20 m/s).

Wind is a moving mass of air that follows a characteristic "breathing" pattern. It acts both as a cooling and heating mechanism. In general, wind can have a positive impact on climate regulation (e.g., distributing heat), weather patterns (e.g., precipitation), temperature control, agricultural productivity, ecosystem balance, energy potential, and air quality (e.g., dispersing harmful gases, mostly from industrial activity).

In the next experiment, wind speeds will be measured based on two temporal granularities: one-minute intervals and 30-second intervals. The measurement period for the one-minute granularity will be 20 minutes, while for the 30-second granularity it will be 10 minutes.

5.6.4.3 Table 210: Wind speed measurements on two time scales

t (1 min.)	T (°C)	v_1 (m/s)	D1	t (30 sec.)	v_2 (m/s)	D2
1	28.1	0.00	NS	0.5	0.00	NS
2	28.1	0.15	SUG	1	0.75	SUN
3	28.1	0.49	SUN	1.5	0.41	SUN
4	28.1	0.17	SUN	2	0.22	SUN
5	28.1	0.22	SUN	2.5	0.32	SUN
6	28.1	0.00	NS	3	0.05	SUN
7	28.1	0.00	NS	3.5	0.00	NS
8	28.1	0.65	SUN	4	0.00	NS
9	28.1	1.25	SUN	5.5	0.42	SUN
10	28.1	0.69	SUN	6	0.78	SUN
11	28.1	0.36	SUN	6.5	1.21	SUN
12	28.1	0.00	NS	7	0.71	SUN
13	28.1	0.00	NS	7.5	0.85	SUN
14	28.1	0.00	NS	8	0.58	SUN
15	28.1	0.00	NS	8.5	0.33	SUN
16	28.1	0.00	NS	9	0.53	SUN
17	28.1	0.22	SUN	9.5	0.09	SUN
18	28.1	0.23	SUN	10	1.09	SUN
19	28.1	0.00	NS	10.5	0.56	SUN
20	28.1	0.14	SUN	11	0.11	SUN



5.6.4.3.1 Figure 486: Line graph of two wind speeds

Table 210 presents measurements of wind speed on two different time scales, while Figure 486 illustrates both wind speeds (v1 and v2). On the coarser time resolution (wind speed measured every minute), we observe that the number of calm phases is more frequent compared to the finer resolution of 30-second intervals. It can also be seen that higher wind speeds are less frequent with the coarser time resolution. The finer time resolution allows for better tracking of gradual decreases and increases in wind speed. This also enables a more precise determination of the wind speed rhythm.

In both measurement cases, the wind direction is predominantly counterclockwise (with only one instance of clockwise wind movement in the one-minute measurements).

These results primarily involve moderate winds, which generally do not have enough force to move larger objects. Moderate winds offer several advantages, such as reducing atmospheric turbulence (leading to better nighttime visibility) and improving the efficiency of gardening. They are also highly beneficial for stabilizing soil, preventing erosion, reducing the rate of water evaporation from the ground, and ventilating the soil.[403]

These positive contributions of moderate winds to the soil ultimately lead to better plant growth and development, and also stimulate the activity of beneficial microorganisms in the ground. This, in turn, has a positive effect on primary consumers—those that feed on plants—and consequently also on secondary consumers, such as carnivores, who require an adequate intake of proteins. Within the macrocosmic plane, various types of winds are present, including:

a. Solar wind: A large stream of charged particles such as protons and electrons, which carry high energy and a magnetic field. These influence Earth's magnetosphere (e.g., the already mentioned phenomenon of the aurora borealis).

b. Stellar wind: Similar to the solar wind, stellar wind also consists of large numbers of protons and electrons. Their energy and magnetic fields impact the cosmic environment and contribute to the formation and evolution of celestial bodies (e.g., planets and asteroids).

c. Planetary wind: This also occurs on Earth and, as already mentioned, affects weather patterns and the climate system.

d. Galactic wind: Refers mainly to the outflow of gases, dust, and other particles from a galaxy. It results from the explosions of massive stars and causes the transfer of matter at high speeds, influencing the development of galaxies and the interstellar medium.

e. Interstellar wind: Consists of vast masses of gas and dust moving in strong flows. These affect galactic magnetic fields and thereby the overall structure of galaxies and the distribution of matter in the interstellar medium.

f. Intergalactic wind: Originates from even larger masses of matter located between galaxies. This type of wind influences the shape of galaxy clusters and the distribution of matter in the macrocosm.

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403 Shao, Y. (2009). *Physics and modelling of Wind Erosion*. Springer.
Smagin, A. V., & Karelin, D. V. (2021). Effect of wind on soil-atmosphere gas exchange. *Eurasian Soil Science*, 54(3), 372–380. https://doi.org/10.1134/s1064229321030133.

Based on these brief descriptions of winds on both mesocosmic and macrocosmic levels, we can conclude that there is an interconnection between these two cosmic planes. These are large systems and subsystems that, on one hand, operate autonomously with a high degree of energy entropy, and on the other, larger systems and subsystems influence smaller units. These mutual interactions, which can be interpreted as specific patterns, reduce energy entropy.

Globally, energy entropy is constantly increasing, while at local levels, it can sometimes decrease. It seems that a proportional balance of energy entropy is emerging between the global and local levels. In this context, our conceptual idea of the "local level" refers to a vast number of sets, while the "global level" represents only one set. The global level could be understood as the integration of different operators (e.g., addition, multiplication, division, exponentiation) applied to local sets or levels.

Despite this, it is important to emphasize that the origin of local sets lies in the activity of stars and our Sun, which—as mentioned—spread energy entropy. In every regard, we are dealing with at least two dynamic processes: dispersion and assembly. Between these two processes, a phase of stillness repeatedly occurs.

One could also conditionally speak of winds at the microcosmic level, where we deal with extremely small particles and their motion. These so-called winds are only loosely comparable to winds on the mesocosmic and macrocosmic levels—unless we apply the conceptual framework of interconnection. As has been emphasized multiple times, all levels are interwoven in such a way that, within our cosmic model (micro-, meso-, and macrocosm), neither the mesocosm nor the macrocosm could exist without the microcosm.

Winds at the microcosmic level could be described as follows:

a. Brownian wind: Refers to the movement of particles within a fluid (e.g., a solution or liquefied gas), where the dynamics of their collisions cannot be predicted with certainty. These particles can be observed under a microscope. Their movement can exhibit patterns somewhat similar to winds at the mesocosmic level.

b. Gas diffusion: Creates wind-like patterns as gas molecules move from areas of higher concentration to areas of lower concentration.

c. Fluid convection: Temperature differences within fluids can cause convection currents, leading to the rising and sinking of particles due to temperature variations. These effects initiate the movement of individual particles throughout the fluid mass.

d. Electron drift: In conductive materials, an electric field can produce collective movement patterns of electrons, which in some ways resemble the dynamics of winds at the mesocosmic level.

e. Quantum wind: Particles at the micro- and femto-scale move in specific directions through quantum tunneling or wave-like behavior. These could, in a conditional sense, be interpreted as wind-like patterns, somewhat analogous to mesocosmic winds.

Soil-Level Wind Analogues (conditionally interpreted) may include:

a. Soil erosion: The displacement of soil particles, mainly due to the action of water and wind. This results in the removal of surface particles and subsequent erosion.

b. Capillarity: The upward movement of liquid through tiny capillary spaces in the soil, defying gravity. This is somewhat similar to the upward movement of water caused by mesocosmic wind, where water also appears to resist gravitational pull.

c. Root absorption: The process by which plant roots extract water and nutrients from the soil. This can be loosely compared to the suction or transfer of particles under the influence of mesocosmic wind.

d. Soil creep: The slow movement of soil particles under the influence of gravity. This can be caused by freeze-thaw cycles or changes in soil moisture. In certain aspects, it resembles the gradual shifting of particles by mesocosmic winds.

e. Microscopic soil wind: Caused by the movement of living organisms in the soil (e.g., ants, earthworms, microorganisms), which create small tunnels and enhance air circulation.

f. Solifluction (surface flow): The slow downhill movement of soil and sediment caused by cyclical freezing and thawing. This process is, in some respects, similar to the particle movement driven by mesocosmic winds.

One could also conditionally speak of winds produced by the respiratory systems of many living beings (e.g., in humans). The respiratory system in the human body involves the movement of air, which can conditionally be compared to the movement of wind. The flow of air through the respiratory system is essential for gas exchange, particularly the intake of oxygen and the expulsion of carbon dioxide. Breathing generally occurs as follows:

1. With inhalation, we bring in more or less fresh air containing various gases, the most important of which for the body is oxygen. With exhalation, we expel excess carbon dioxide. This process is driven by the contraction and relaxation of the respiratory muscles in the chest and diaphragm. As a result, air flows in and out (air is pushed out). This pattern of air movement can, in a metaphorical sense, be seen as a kind of internal wind, as it resembles atmospheric air movement in certain respects.

2. The airflow enables gas exchange between the blood and air in the lungs, where oxygen is absorbed into the blood and carbon dioxide is removed.

3. The respiratory system then transports oxygen through the circulatory system to various parts of the body, including the brain, while carbon dioxide is eliminated from the body. The rhythmic inhaling and exhaling is regulated by the respiratory center in the brainstem, which is crucial for maintaining a continuous supply of oxygen and the removal of excess carbon dioxide. This conditional comparison between the respiratory system and wind at the mesocosmic level serves as a smooth transition into the next subchapter, which highlights the essential role of air—particularly in connection to neurophysiological and cognitive processes in humans.

Neurophysiological functions are closely related to psychological or cognitive processes such as sensation, perception, attention, memory, learning, thinking, language processing, emotion, decision-making, and understanding. This subchapter will be supported mainly by empirical research investigating the effects of breathing on sleep efficiency and energy utilization.

5.6.5 Air, breathing, sleep, and energy efficiency

The vital importance of air is closely tied to the breathing of living beings, their functions of rest or sleep, and the energy efficiency of biological systems. Special emphasis is placed on the optimal balance between rest and stress phases, as both excessive relaxation and excessive stress can lead to energy loss in a given biological system. This optimal equilibrium heavily depends on the quality and energy efficiency of sleep in living organisms.

It is clear that there are significant differences between humans and other living beings (e.g., plants, algae, fungi, microorganisms, animals). The concept of stress is difficult to apply to wild animals, as their life rhythms are generally understood to be aligned with natural hierarchical and associative systems. In contrast, humans—especially those in legally and technologically advanced societies—are often assumed to live in partial disconnection from natural laws, with their behavioral patterns overly oriented toward prestige.

An intellectually intriguing challenge would be to compare humans and other living beings through the lens of the balance between rest and stress, though this seems less feasible at present. Therefore, the following section will focus, with the help of empirical data, on a more detailed examination of the human relationship with air, breathing, sleep, sleep quality and efficiency, and the optimal balance between rest and stress phases throughout the day.

5.6.5.1 Air and breathing

The relationship between air and breathing represents a fundamental existential aspect for humans, realized through the respiratory system. Breathing is primarily the process of gas exchange between the surrounding air and the respiratory system, involving the intake of oxygen and the removal of carbon dioxide. In the first phase, air is inhaled and enters the lungs. Oxygen then moves from the lungs into the bloodstream, where it is distributed to numerous cells throughout the body. During this exchange, oxygen binds to hemoglobin in red blood cells, while carbon dioxide—a byproduct of cellular metabolism—travels from the blood back into the lungs. It is then expelled into the environment through exhalation. This process repeats continuously for as long as a person is alive. This process is essential for health and proper bodily function. Oxygen is crucial for energy production, while carbon dioxide is a waste product that must be expelled, as its accumulation would lead to breathing and metabolic issues. The quality of the air is also important, since polluted air may contain harmful substances that reduce energy efficiency by negatively affecting the respiratory system and the optimal exchange of gases. For this reason, living, working, and sleeping spaces must be adequately ventilated. There are also air purification devices that can filter out dust particles, ions, bacteria, viruses, and mold, thereby improving air quality and contributing to better sleep.

In a healthy individual, breathing is generally automatic and uninterrupted throughout the day and night. However, this is not the case for people with pulmonary diseases (e.g., chronic bronchitis, asthma), heart conditions, or sleep-related breathing disorders (e.g., central, obstructive, mixed apnea, and hypopnea). In this context, the heart plays an important role in maintaining proper breathing and quality sleep. While heart rate and breathing are not directly connected, they are linked through the autonomic nervous system, which regulates many physiological processes in the body, including breathing rate and heart rate.

The autonomic nervous system consists of two parts: the sympathetic and parasympathetic systems. The sympathetic system is associated with the “fight or flight” response, often causing an increased heart rate, dilated pupils, and the release of larger amounts of stress hormones (e.g., adrenaline). This also affects breathing by causing it to become faster and shallower. On the other hand, the parasympathetic system operates on the “rest and digest” principle, lowering the heart rate, constricting pupils, and promoting the release of calming hormones, which lead to slower and deeper breathing. Based on the above, we can conclude that both heart rate and breathing rhythm influence the balance between a state of restfulness and stress in an individual throughout the day. This balance is closely linked to the body's overall energy efficiency. The general energy efficiency of the body during the day is heavily dependent on the quality and effectiveness of sleep. When sleep is optimal, a person has more energy to cope with stressors during the day, regardless of their level of activity.

5.6.5.2 Sleep and energy efficiency

When considering sleep and energy efficiency, we are dealing with the temporal balance between recovery and distress phases throughout the day. Ideally, a person would spend around 16 hours in a recovery phase and eight hours engaged in various activities, which include both eustress and distress. This implies that two-thirds of the day would be spent in a state of rest or relaxation, and one-third in active engagement that may also include negative stress. However, such an ideal scenario does not account for individual differences, lifestyle, types of responsibilities, gender, age, health conditions, body constitution, temperament, or one's actual ability to achieve this balance. People differ in their needs and tolerance for various stressors. Each individual must find the most favorable balance between the two phases during the day. The key goal should be to establish an appropriate equilibrium that optimally supports health, productivity, and well-being.

For individuals over the age of 60, the ideal balance between recovery and activity (including both eustress and distress) is considered to be around 8–9 hours of recovery and 6–7 hours of activity. Older adults need sufficient sleep and activities that do not excessively strain their health and well-being. Maintaining physical activity remains important for seniors, as it helps preserve mobility, muscle strength, and cognitive function. Typically, older individuals require more frequent short periods of rest following different phases of activity. It is crucial to find a balance that aligns physical capabilities, health needs, and personal preferences.

For individuals over 60 suffering from severe central sleep apnea, maintaining this balance is especially challenging. Central sleep apnea is problematic because it leads to repeated interruptions in breathing during sleep, significantly degrading sleep quality and energy efficiency. The brainstem fails to send proper signals to the respiratory muscles, resulting in ongoing pauses in breathing during sleep. Consequently, the body receives insufficient oxygen, which can lead to fatigue and an increased risk of heart attack or stroke, as well as serious psychological issues such as irritability, depression, bipolar disorder, and anxiety.

For those affected by this condition, it is recommended to have 8–9 hours of recovery (including sleep) and 4–5 hours of activity involving both eustress and distress. Despite these recommendations, they face many obstacles in achieving high-quality and energy-efficient sleep, making adequate rest essential. Frequent breathing interruptions can be mitigated with the use of CPAP (Continuous Positive Airway Pressure) or BIPAP (Bilevel Positive Airway Pressure) devices. The main difference between the two is that CPAP provides a constant level of air pressure during inhalation, while BIPAP offers different pressure levels for inhalation and exhalation.

Individuals with this condition must adhere to disciplined and well-timed behavioral patterns. It is essential to create an optimal sleep environment, which includes clean air, minimal exposure to strong electrical and magnetic fields, and low noise levels. Physical activity remains important but should be tailored to the individual's energy levels and health status. Generally, light to moderate physical activity is recommended to promote better circulation, increase the sense of vitality, and improve overall well-being.

The following section will present empirical measurements related to sleep quality and energy efficiency in a person over 60 years of age who suffers from severe central sleep apnea. It will also include an overview of the devices and tools used for data collection, visualization, and analysis.

Before presenting the results of the measurements, a brief overview of the devices and tools used for data collection, visualization, and analysis is provided:

a. Suunto 3 smartwatch and Suunto app

This device enabled the measurement of sleep sessions, including the following parameters:

- Time of falling asleep
- Total sleep duration
- Duration of deep sleep (in minutes and seconds)
- Sleep quality (in %)
- Energy reserves gained after sleep (in %)
- Depletion of energy reserves throughout the day (in %)
- Average heart rate during sleep and throughout the day (in beats per minute or bpm)
- Duration of recovery phases (in hours and minutes)
- Duration of distress phases (in hours and minutes)

These data could be collected, visualized, and further processed using the Suunto mobile app.

b. Extech temperature, humidity, and CO_2 monitor

This device was used to measure CO_2 concentrations before and after sleep sessions (in ppm or mg/l).

c. Prisma 25 ST BIPAP device and Prisma Journal software

Since its initial use, this device has been collecting data on:

- Breathing interruptions (AHI in events/hour)
- RERA index (respiratory effort-related arousals during sleep)
- Snoring (in hours and minutes)
- Types of sleep apnea (e.g., obstructive, central)
- Percentage of controlled or mandatory breathing
- Breathing rate (in bpm)
- Air leakage from the facial mask (in %)
- Minute ventilation volume (in liters per minute)

- Tidal or lung breathing volume (in milliliters)

Using the Prisma Journal software, data could be imported via an SD card, visualized, analyzed, and exported in .csv format for further analysis with other software tools.

d. Additional Measuring Devices and Tools Related to Sleep and Breathing

-Mettler Toledo 5 Easy Plus pH meter-(for measuring the pH value of 24-hour urine),

-Greisinger multimeter-(for measuring conductivity of 24-hour urine in mS),

-TDS meter-(for measuring the total dissolved solids or hardness of 24-hour urine in ppm),

-ATH refractometer-(for measuring the density of 24-hour urine in g/cm³),

-Zeiss Primostar 3 light microscope-(for studying crystals and potential microorganisms in 24-hour urine),

-Chemical analysis kits-(for determining $(SO_4)^{2-}$, Cl^-, and NO_3^- anions in 24-hour urine),

-Electromagnetic field meter-(for measuring electric and magnetic fields in sleeping and other environments),

-UFESO air purifier and ionizer.

Particularly noteworthy are the 24-hour urine measurements, as they may reflect the impact of the breathing device on the composition and values of urine (further details are provided in the relevant measurement sections).

e. Assessment of Sleep Quality and Energy Efficiency

The key evaluation of sleep quality and energy efficiency is based on a rating scale from 1 to 10. The evaluation is conducted using measurements from the Suunto 3 smartwatch and the following criteria:

Falling asleep speed – subjective evaluation of how quickly deeper sleep is reached:

-15 to 30 minutes → fast falling asleep,

-30 minutes to one hour → moderate falling asleep speed,

-more than one hour → very slow falling asleep.

-Duration of light and deep sleep phases – subjective assessment of time distribution (e.g., one hour of light sleep and five hours of deep sleep indicates better sleep quality and efficiency).

-Length of REM phases with conscious dreams – auxiliary criterion; longer REM phases may suggest excessive brain activity during sleep, which negatively affects sleep quality and energy efficiency.

Number and intensity of negative symptoms during and after sleep – symptoms that disrupt healthy sleep architecture and may impair cerebral circulation:

-extremely dry mouth and throat,

-headaches,

-muscle stiffness and tension,

-difficulty with bowel movements,

-mosaic migraines or visual auras, frequently occurring upon waking.

These migraines used to occur during long commutes to work. During episodes, the person could only partially perceive their surroundings, which is particularly unpleasant—especially while driving on highways. Notably, these symptoms were absent during an eight-month medical leave before starting CPAP therapy.

-Time required for full awakening – subjective assessment of alertness after sleep, without significant negative symptoms. This includes a hypothetical evaluation of the person's ability to handle long drives.

-Additional criteria (minimal weight) – measurements of pH, TDS, density, and conductivity of 24-hour urine.

Results after using the BIPAP device often show:

-Lower pH values (below 5.6),

-High conductivity (around 30 mS),

-High TDS levels (between 12,000 and 13,000 ppm).

It is possible that the BIPAP device acts as a dehydrator (e.g., causing denser stool and urine). However, this is merely an observation and was not a primary factor in evaluating sleep quality.

To summarize: Based on the criteria for evaluating sleep quality and energy efficiency, along with measurements from the Suunto 3 smartwatch and other devices and tools, a final rating of sleep quality and energy efficiency was established on a scale from 1 to 10. The scale is interpreted as follows:

- Ratings from 1 to 5 indicate a -very poor outcome-,
- Ratings from 5.5 to 6.5 indicate a -below-average outcome-,
- Ratings from 7 to 7.5 indicate an -average outcome-,
- Ratings from 8 to 10 indicate a -good to very good outcome-.

This scale is specifically adapted for individuals suffering from severe central sleep apnea. For healthy individuals, the scale is slightly different:

- Ratings from 9 to 10 indicate a -very good to excellent outcome-,
- Ratings from 8 to 8.5 indicate a -good or average outcome-,
- Ratings from 7 to 7.5 indicate a -below-average outcome-,
- Ratings from 1 to 6.5 indicate a -very poor outcome-. Therefore, the evaluation scale is conditionally comparable between affected and healthy individuals in terms of sleep quality and energy efficiency. For both groups, the percentage-based outcomes are interpreted as follows:

- 80% to 85% – average,

- 86% to 90% – good,

- above 90% – very good or excellent,

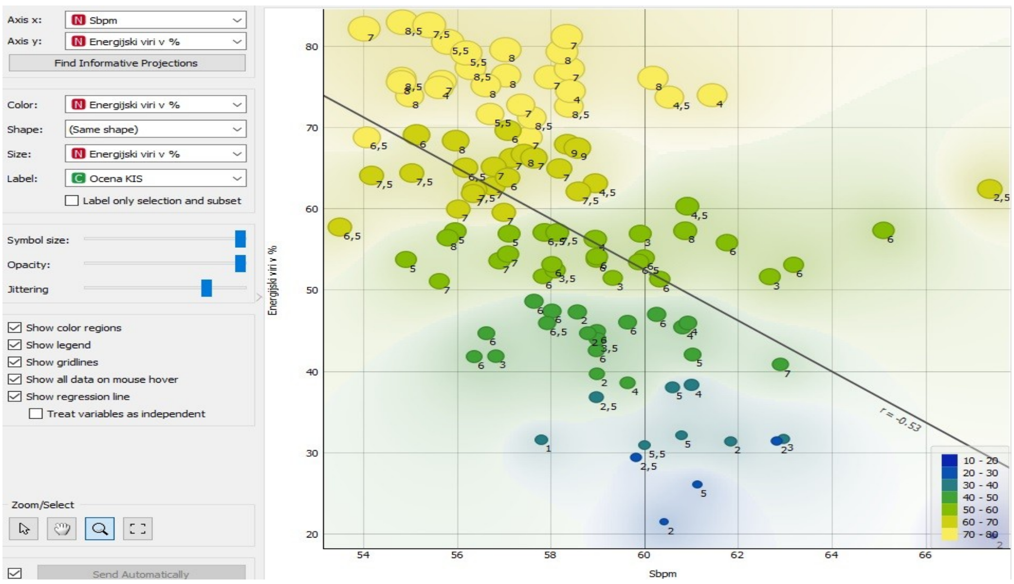
- below 80% – below average.

Accordingly, the rating categories will be adjusted to align the results with those of healthy individuals, ensuring consistency in interpretation.

As previously mentioned, we will now present a portion of the data obtained from the measurements and evaluations.

5.6.5.2.1 Table 211: Sleep quality and energy efficiency ratings based on criteria and measurements with the Suunto 3 smartwatch

Date	*t_u (h,m)*	*t_g (h,m)*	*t_b (h,m)*	*t_c (h,m)*	*Sbpm*	*t_p (h,m)*	*t_s (h,m)*	*W_r (%)*	*Q (%)*	*OKIS*
27.4.23	03:15:00	01:02:00	00:00:00	04:27:00	67	02:00:00	00:30:00	63	56	2.5
28.4.23	01:52:00	01:41:00	00:00:00	04:11:00	61	02:00:00	00:00:00	73	66	4.5
29.4.23	00:17:00	01:54:00	00:00:00	05:50:00	58	00:05:00	04:00:00	81	79	8.0
30.4.23	00:27:00	03:22:00	00:00:00	05:36:00	61	00:05:00	04:00:00	59	76	8.0
1.5.23	01:49:00	02:17:00	00:00:00	04:18:00	61	02:00:00	00:30:00	59	54	4.5
2.5.23	00:19:00	02:22:00	00:00:00	06:50:00	60	00:30:00	04:00:00	78	92	8.0



5.6.5.2.2 Figure 487: Example of a scatter plot based on given data

Table 211 presents a small selection of data obtained through assessments based on set criteria and measurements using the Suunto 3 smartwatch. Figure 487 illustrates one example of a scatter plot showing the relationship between the average heart rate during sleep (x-axis) and the utilization of energy reserves gained after sleep (y-axis). To maintain clarity, not all diagrams will be shown in this section—only trends in dependency and/or influence among various indicators will be presented.

a. Relationship and/or influence between the utilization of energy reserves during the sleep session (Wr in %) and the average heart rate during sleep (Sbpm in bpm or beats per minute): Better utilization of Wr (%) is achieved when the average Sbpm during sleep is in the range of 55 to 58 bpm. Typically, sleep quality is also better in this range.

b. Relationship and/or influence between the utilization of Wr (%) and the transition into a stress state (ts in hours and minutes) after sleep: The higher the Wr (%), the longer the transition ts period. This usually corresponds to better sleep quality and a lower likelihood of wakefulness during sleep.

c. Relationship and/or influence between wakefulness duration (tb in hours and minutes) during sleep and Wr utilization (%): The shorter the tb during sleep, the better the Wr utilization. This also positively affects sleep quality.

d. Relationship and/or influence between the time of full awakening (tp in hours and minutes) and Wr utilization (%): The tp is shorter when Wr utilization is higher. Higher Wr typically indicates better sleep quality.

e. Relationship and/or influence between ts (transition to stress) and Sbpm: ts is longer when Sbpm is in the range of 55 to 58 bpm. This may indicate better Wr and improved sleep quality (Qs).

f. Relationship and/or influence between tp and ts: The longer the tp, the shorter the ts. This could indicate poorer Wr and lower sleep quality (Qs).

g. Relationship and/or influence between time to fall asleep (tu in hours and minutes) and ts: The longer the tu, the shorter the ts. This may mean lower Wr and poorer sleep quality.

h. Relationship and/or influence between tu, tp, and Wr (%): Shorter tu and tp lead to better Wr utilization. This often positively influences sleep quality (Qs).

i. Relationship and/or influence between deep sleep duration (tg in hours and minutes), ts, and Wr (%): The shorter the tg, the shorter the ts and the worse the Wr. This often suggests poorer sleep quality.

j. Relationship and/or influence between total sleep time (tc in hours and minutes), tp, and Wr (%): The longer the tc, the shorter the tp and the better the Wr. This often also results in better sleep quality.

k. Relationship and/or influence between tb and ts: The shorter the tb during sleep, the longer the ts. This may be linked to better Wr and Qs outcomes.

l. Relationship and/or influence between tc, ts, and Wr (%): The longer the tc, the longer the ts and the better the Wr. This often results in improved sleep quality.

m. Relationship and/or influence between tu, tc, and Wr (%): tu is shorter when tc is longer, often indicating better Wr and positively affecting sleep quality.

n. Relationship and/or influence between tu and Sbpm: Time to fall asleep is shorter when Sbpm is between 55 and 58 bpm, which positively affects Wr and sleep quality (Qs).

o. Relationship and/or influence between tb, tp, and Wr (%): Wakefulness (tb) during sleep can affect tp and result in lower Wr, negatively influencing sleep quality (Qs).

p. Relationship and/or influence between tg, Qs, and Wr (%): The longer the tg, the better the Qs outcome, which often means improved Wr.

q. Relationship and/or influence between tg, tp, Wr, and Qs (%): A longer tg can positively affect a shorter tp, which improves Wr and sleep quality.

r. Relationship and/or influence between tg and Sbpm: An adequate tg is often associated with an optimal average Sbpm between 55 and 58 bpm.

s. Relationship and/or influence between Sbpm and tc: An appropriate average Sbpm can have a positive impact on total sleep time (tc).

t. Relationship and/or influence between tu and tg: A shorter tu can positively influence the duration of tg.

u. Relationship and/or influence between tb and tg: A longer tb can negatively impact the appropriate length of tg.

v. Relationship and/or influence between tb and tu: A longer tu can increase the occurrence of tb.

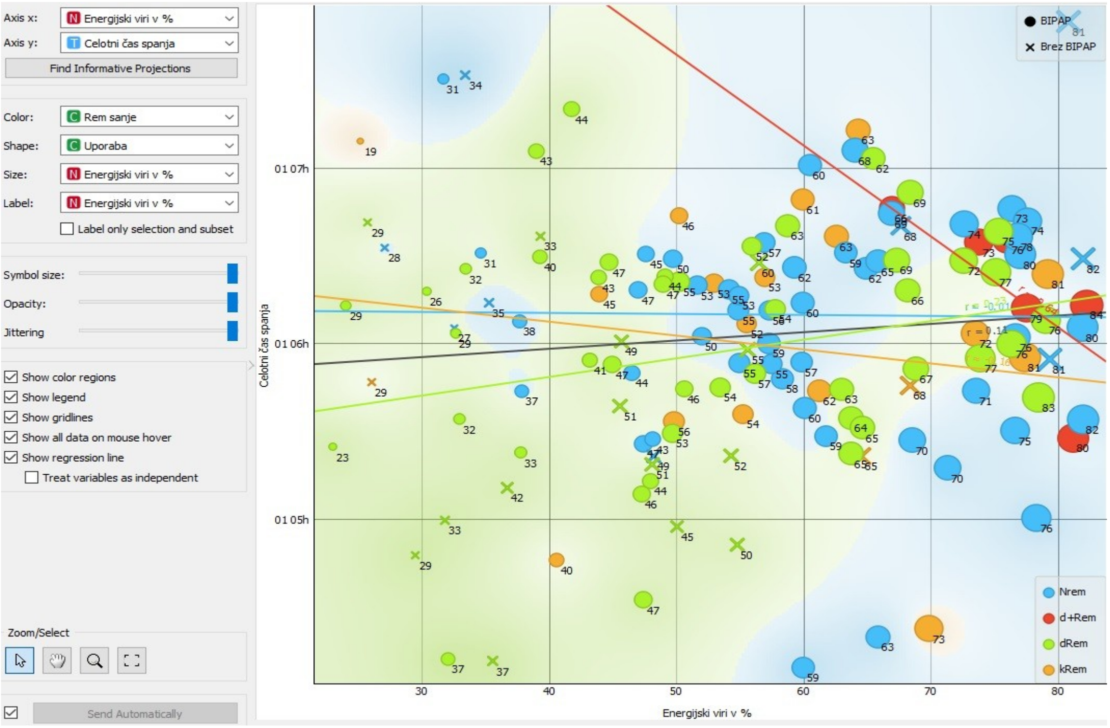
w. Relationship and/or influence between tc and tb: A longer tc can result in a longer tb, which may indicate worse Wr and Qs outcomes.

x. Relationship and/or influence between tc and tg: A longer tc can promote a longer tg, which may positively impact Wr and sleep quality.

Based on the dependencies and influences described, it is evident that the utilization of sleep session energy reserves (Wr) and sleep quality (Qs in %) are strongly dependent on various parameters, particularly average heart rate during sleep (Sbpm) and various time categories. The obtained Wr values (%) can also be strongly connected to the type and duration of REM dream phases that reach consciousness. These include short REM phases of conscious dreaming (kRem), long REM phases with negative or demanding content (dRem), and long REM phases with positive content (d+Rem). Sleep is predominantly composed of NREM phases, the dreams of which we are not consciously aware. These consist of background thoughts active even during the day. From an energy perspective, NREM phases are less demanding, while dRem and kRem phases consume significantly more energy. A relevant example based on the collected data will be presented.

5.6.5.2.3 Table 212: A small part of the data regarding the dependence of energy reserves obtained after sleep on sleep phases

Date	*t_c (h,m)*	*Sleep phases*	*W_r (%)*
15.5.2023	06:31:00	dRem	63
16.5.2023	06:15:00	dRem	44
17.5.2023	06:13:00	dRem	47
18.5.2023	06:08:00	dRem	29
19.52023	05:55:00	dRem	54



5.6.5.2.4 Figure 488: Scatter plot showing the relationship between energy reserves gained after sleep and sleep phases

Table 211 presents a small portion of data on energy reserves gained after sleep (total sleep time – tc in hours and minutes) in relation to sleep phases, while Figure 490 illustrates (140 measurements) the different sleep phases (NREM, kREM, dREM, and d+REM) and the corresponding gained energy reserves (Wr in %) within tc (total sleep time).

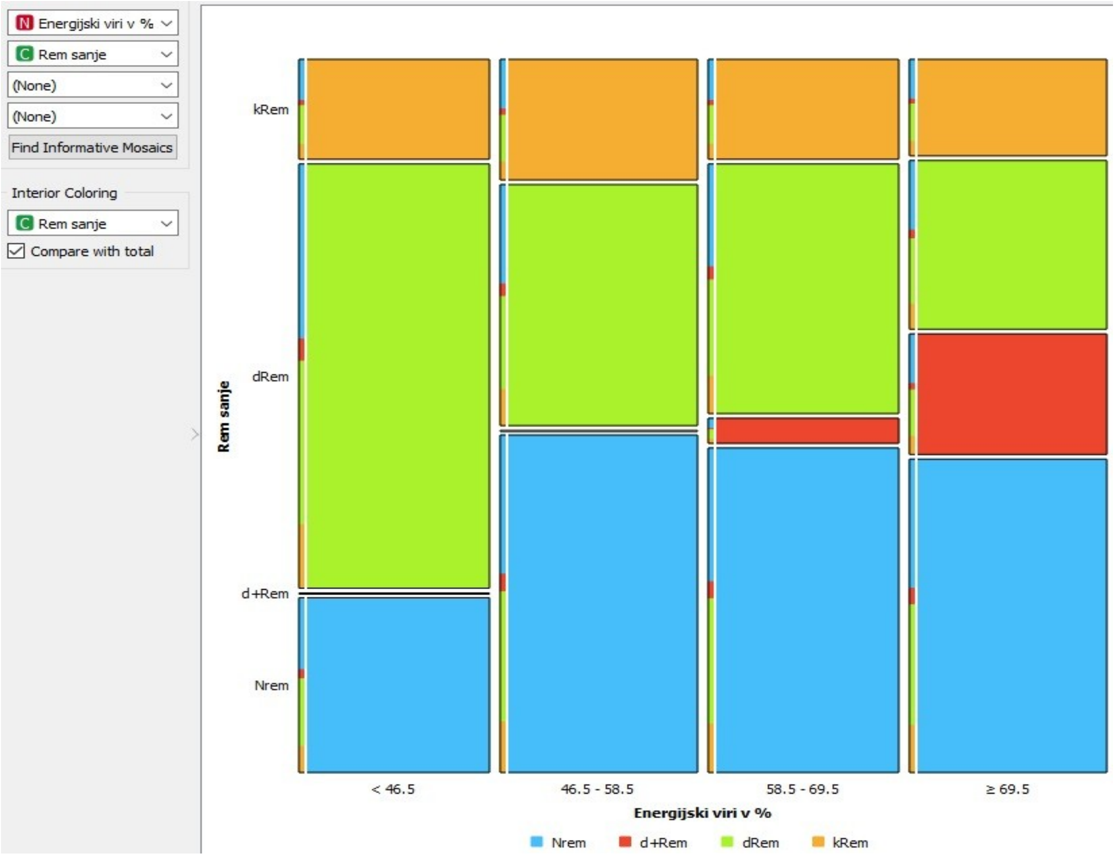
First, it is necessary to categorize poor and good Wr (%) values. Generally, any outcome where Wr utilization does not reach at least 70% can be considered poor, while Wr values of 80% or higher can be considered good. A clear trend is noticeable: long REM sleep phases with negative or demanding content (dREM) tend to negatively affect Wr utilization (although there are some exceptions). In contrast, long REM phases with positive content (d+REM) positively influence Wr utilization (see red circle symbols, e.g., values of 84% and 79%).

For short REM sleep phases (kREM), a lower frequency of occurrence during sleep is observed, along with no clear trend toward either a positive or negative influence (some good outcomes are visible, see the “+” symbol, e.g., 81% and 76%).

Sleep sessions consisting only of NREM phases without conscious dreams generally have a positive impact on Wr utilization (see blue circles and their Wr % values).

Without the use of a BIPAP breathing device, the Wr % outcomes are even worse (see the “X” symbol), which is logical—individuals with severe central sleep apnea experience frequent interruptions in breathing during sleep, resulting in significantly less air reaching the lungs and consequently less oxygen reaching the brain.

Now, let’s look at the scenario with the use of a BIPAP breathing device only.



5.6.5.2.5 Figure 489: Mosaic diagram of gained energy reserves in relation to different sleep phases

Figure 489 illustrates the gained energy reserves (Wr in %) depending on the duration of various sleep phases (see legend at the bottom of the figure: NREM, d+REM, dREM, and kREM). It is immediately apparent that long REM phases involving dreams that reach conscious awareness have a significant negative impact on the efficiency of gained Wr in % after sleep (see the x-axis values of the mosaic diagram: <46.5%, 46.5% to 58.5%, and 58.5% to 69.5%). There are rare exceptions within the >69.5% range (e.g., a value of 83% on May 10, 2023).

Long REM phases with positively themed conscious dreams are rare and, in this case, were achieved only with the use of a BIPAP breathing device. In contrast, long REM phases involving complex and unpleasant conscious dreams consume a significant amount of energy in the brain. Instead of allowing the brain to rest adequately, these phases place it in a state of intense processing of vast amounts of data, focused on various concepts and mental constructs.

We recognize that oxygen from the air is a key element that provides the body—and especially the brain—with the energy required to perform various tasks and solve problems. Therefore, it would be meaningful to examine in more detail the path of oxygen from the air into the bloodstream and then into various parts of the body, particularly the brain.

Before we begin that discussion, we will first present different types of respiratory systems found in microorganisms, plants, insects, fish, amphibians, reptiles, birds, and mammals. All known respiratory systems rely on increasing surface area to enhance diffusion, which enables more efficient gas exchange. During respiration, oxygen and carbon dioxide are exchanged: oxygen enters the body during inhalation, while excess carbon dioxide is expelled during exhalation.[404] This is the basic breathing pattern found in living organisms, although there are some exceptions, which will not be addressed in this section.

a. Respiratory systems of microorganisms

Microorganisms use direct diffusion of gases through their cell membranes for respiration. They release carbon dioxide and absorb oxygen. This gas exchange is possible mainly because the cell membranes of most microorganisms are semi-permeable, allowing small molecules like oxygen and carbon dioxide to pass through concentration gradients (movement from areas of higher to lower concentration until equilibrium is reached). This exchange provides microorganisms with the oxygen needed to produce energy and carry out life functions, while also removing harmful carbon dioxide molecules, ensuring smooth metabolism.

b. Respiratory systems of plants

The respiratory system of plants differs significantly from those of microorganisms and animals. During the day, especially under sunlight, plants actively perform photosynthesis, during which they absorb carbon dioxide from the air and release oxygen into the atmosphere. At night, when photosynthesis ceases, plants absorb oxygen and release carbon dioxide. Cellular respiration in plants allows them to produce energy in the form of sugars and other organic molecules, supporting essential life functions, including metabolism.

c. Respiratory systems of insects

404 Hsia, C. C., Schmitz, A., Lambertz, M., Perry, S. F., & Maina, J. N. (2013). Evolution of air breathing: Oxygen homeostasis and the transitions from water to land and Sky. *Comprehensive Physiology*, 849–915. https://doi.org/10.1002/cphy.c120003.

Insects breathe independently of their circulatory system via a tracheal system. This system consists of a network of tiny tubes that deliver oxygen directly to tissues throughout the body. It is a highly efficient method of respiration, as oxygen is supplied directly to cells, and carbon dioxide and water vapor are regulated through diffusion. Air enters and exits the tracheal system through special openings called spiracles, allowing rapid energy acquisition needed for vital functions, including metabolism.

d. Respiratory systems of fish

Fish breathe using gills located on both sides of their heads. Each gill consists of filamentous structures rich in blood vessels. Oxygen is extracted from water—during gas exchange, carbon dioxide in the blood is replaced by oxygen molecules, which then enter the bloodstream and bind to hemoglobin in red blood cells. The heart pumps oxygenated blood to various parts of the body, where it supports cellular respiration and energy production.

e. Respiratory systems of amphibians

Amphibians breathe in different ways depending on their stage of development: through gills (e.g., in the tadpole stage), lungs (in adulthood), and through their skin (also in adulthood). Their mode of breathing thus depends on their developmental phase. Regardless of the method, all amphibians obtain oxygen from air or water and release carbon dioxide. This gas exchange provides the energy necessary for basic life processes such as metabolism.

f. Respiratory systems of reptiles

Reptiles breathe using lungs that are well-adapted for efficient oxygen intake from the air. Gas exchange occurs in the lungs—oxygen is used to produce energy, and carbon dioxide is expelled as a waste product. The oxygen obtained through the lungs supports uninterrupted bodily functions and vital activities.

g. Respiratory systems of birds

Birds breathe through lungs, but face a unique challenge during flight due to their high energy demands. They have developed air sacs to meet this need. Their respiratory system operates in a two-stage inhalation and exhalation process, allowing more efficient gas exchange. This system enables birds to extract oxygen from the atmosphere very effectively and use it to produce energy required for flight and other life functions.

h. Respiratory systems of mammals

Mammals possess a highly developed respiratory system that ensures proper ventilation, oxygen supply, and carbon dioxide removal. Oxygen is transported throughout the body via the circulatory system and supports energy production necessary for organ function and other vital processes controlled by the brain. The brains of mammals are particularly energy-intensive—especially in humans, who have extremely high oxygen demands due to complex cognitive processes, problem-solving, learning, and social interactions.

Following this brief overview of various respiratory systems—each fundamentally serving to supply the body with energy for life functions—we will now focus on the journey of oxygen molecules to different parts of the body, with special emphasis on oxygen consumption in the human brain.

As previously mentioned, when we inhale, air—composed of approximately 78% nitrogen, 21% oxygen, 0.9% argon, 0.04% carbon dioxide, and trace amounts of other gases—primarily enters the body through the nasal cavity, then travels down the trachea into the lungs. Breathing through the nose allows for the filtration of larger particles that are present in the air in varying amounts. During exhalation, the composition of gases changes—the exhaled air contains about 78% nitrogen, 16% oxygen, 4.5% carbon dioxide, 0.9% argon, and other trace gases. The main reason for the increased CO_2 concentration is that it is a byproduct of the body's metabolic processes. The presence of CO_2 in the body is crucial for regulating the pH of bodily fluids, facilitating breathing, and aiding in the elimination of other cellular waste. However, excessively high levels of CO_2 in the blood can negatively affect respiratory function. Inhaling relatively clean air allows the body to expel excess CO_2. Oxygen molecules from the air displace carbon dioxide from the blood, with the oxygen being used for energy production essential for sustaining life functions. Thus, oxygen serves as a key raw material for energy generation.

During inhalation, the diaphragm and intercostal muscles contract, enabling air to enter the lungs. Gas exchange then occurs as the inhaled air reaches the alveoli, or tiny air sacs. In this space, oxygen molecules pass through thin membranes into the bloodstream, where they bind to hemoglobin in red blood cells. The oxygen-rich blood is then transported via the pulmonary veins to the heart, which pumps it through the left atrium and left ventricle into the main artery—the aorta. From there, the aorta branches into a network of smaller arteries that deliver oxygen to various tissues and organs. This sets the stage for capillary gas exchange.

In the capillaries—tiny blood vessels with thin walls—oxygen is released from hemoglobin and diffuses into surrounding tissues. Cells use this oxygen for cellular respiration, a process essential for producing energy in the form of ATP (adenosine triphosphate). During this process, glucose and other substances are oxidized with the help of enzymes that speed up biochemical reactions. Carbon dioxide, a byproduct of cellular metabolism, diffuses from the cells into the bloodstream and is expelled from the body through the lungs during exhalation.

This simplified description of the path of oxygen molecules from the air into the body provides a clear understanding of the process and serves as a foundation for discussing oxygen consumption in relation to energy production and usage.

ATP molecules are used to carry out various processes—ranging from physiological (e.g., muscle movement, synthesis of macromolecules, transmission of nerve impulses) to psychological and cognitive functions (e.g., thinking, problem-solving). The rate of oxygen consumption strongly depends on various factors, such as the body's oxygen needs, the speed of metabolic processes, and the functioning of the respiratory and cardiovascular systems. Rapid breathing and an increased heart rate contribute to greater oxygen delivery to cells, especially during physical activity.

The continuous processes of oxygen consumption and cellular respiration are essential for maintaining vital life functions, and thus, for sustaining life itself. Even the slightest disruption in the body's oxygen supply can lead to problems at the cellular level, negatively impacting both physical and mental health. Breathing is a crucial process for oxygen supply—if impaired by physical or psychological factors, all other processes described above are also affected.

In individuals with severe central sleep apnea, breathing during sleep is significantly impaired. The main issue is that breathing is not as optimally controlled during sleep as it is while awake. If there is damage to or dysfunction in the brainstem or other parts of the central nervous system, frequent and prolonged breathing interruptions may occur. This means the body is inadequately supplied with oxygen, resulting in extremely poor energy efficiency throughout the body.

Due to insufficient energy reserves gained during sleep, such individuals struggle to cope with daily challenges in the same way a healthy person can. Long-term energy deficiency can lead to serious consequences for both physical (e.g., stroke, heart attack) and mental health (e.g., depression, suicidal thoughts, anxiety, bipolar disorder, psychosis, obsessive-compulsive disorder). In all such cases, the body’s energy efficiency is severely compromised.

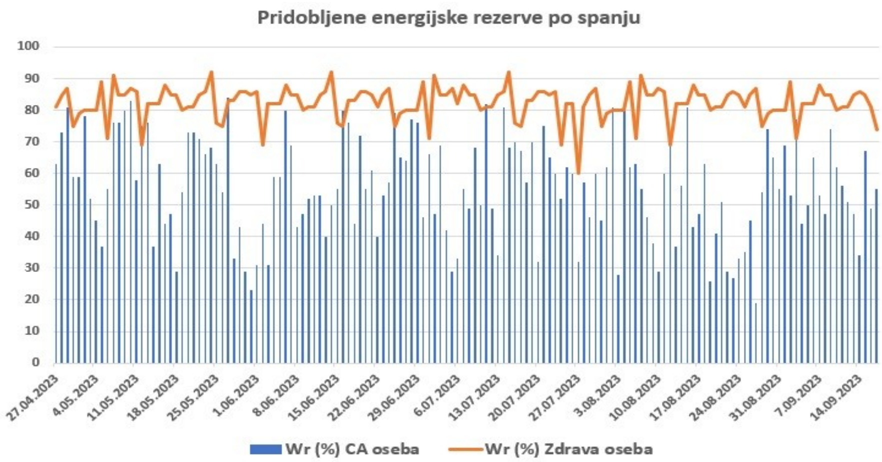
This problem can be further aggravated by long and intense REM sleep phases with vivid dreams, as the brain is almost as active during REM sleep as it is while awake. The negative effects cannot be completely prevented even by using breathing devices such as CPAP/BIPAP, which are otherwise effective in reducing breathing interruptions during sleep. Although oxygen from the air optimally enters the lungs, bloodstream, heart, and tissues in these cases, the brain remains an exceptionally high energy consumer, which further complicates the process of building sufficient energy reserves for everyday life.

In daily life, we encounter many stimuli, including negative stressors. In individuals with severe central sleep apnea syndrome, even mild stressors can negatively affect mood and impair mental health. In such cases, the stress tolerance threshold is extremely low. As a result, the individual spends most of the day in a state of distress, which further depletes vital life energy. The body's reactions to distress can affect blood pressure, heart rate, oxygen levels in the blood, and blood flow speed. A low stress tolerance threshold can also negatively impact other bodily systems, including the digestive system, skin, urogenital system, and hormonal balance.

In healthy individuals, energy efficiency after sleep should exceed 80%. It would be worthwhile to compare the energy reserves gained after sleep in individuals with severe central sleep apnea and healthy individuals.[405]

5.6.5.2.6 Table 213: A small part of the data on the acquired energy reserves between two people

Datum	*W_r (%) people with severe CNA syndrome*	*W_r (%) healthy people*
27.4.2023	63	81
28.4.2023	73	85
29.4.2023	81	87
30.4.2023	59	75



5.6.5.2.7 Figure 490: Energy reserves gained after sleep in a person with severe central sleep apnea syndrome compared to a healthy individual

Table 213 shows a small portion of the data on energy reserves gained after sleep (Wr in %) in a person with severe central sleep apnea (CSA) and in a healthy individual, while Figure 490 provides a visual representation of this data. The average Wr value in the CSA patient is only 55.80%, whereas in the healthy individual it is significantly higher, at 82.36%. The Wr data for the person with CSA is particularly concerning because they are undergoing treatment with a BIPAP breathing device, which can reduce frequent and prolonged breathing interruptions from 64 events per hour to normal levels between 0 and 5 per hour. Despite this, the person with CSA does not receive enough

405 Simulated data will be used to determine energy efficiency in a healthy person, while data obtained from Suunto 3 smartwatch measurements will be taken into account in a person with central sleep apnea. Although these measurements do not achieve high scientific accuracy, they can still serve as a good estimate.

oxygen into the bloodstream—and subsequently into tissues and organs—for the Wr values to fall within the normal range (80–85%).

Another possible explanation is that the person with CSA might be receiving a sufficient amount of oxygen into the bloodstream, but their brain consumes it excessively during sleep in the form of ATP (adenosine triphosphate) energy molecules due to intense cognitive activity. In this context, attention can again be drawn to excessively long and complex REM sleep phases, which involve dreams that reach the level of consciousness. The intensity and vividness of these dreams are close to those experienced in the waking state, suggesting that the brain processes numerous concepts during sleep typically associated with wakefulness. In healthy individuals, such complex cognitive processes during sleep are not as pronounced.

Efficient energy utilization—both during sleep and wakefulness—is directly linked to effective breathing, the elimination of waste products from the body, and optimal, pragmatic, adaptive, and rational cognitive processes. In the animal kingdom, such cognitive functions are mostly limited to existential behavioral patterns that ensure survival, lead to hierarchical structures, and form mutualistic relationships. In humans, this basic survival drive is further burdened by the need for prestige, which increases energy demands, especially in the brain. As a result, humans are more dependent on high-quality air, efficient breathing, and optimal conversion of oxygen molecules into energy than most other living beings (with a few exceptions, such as archaea).

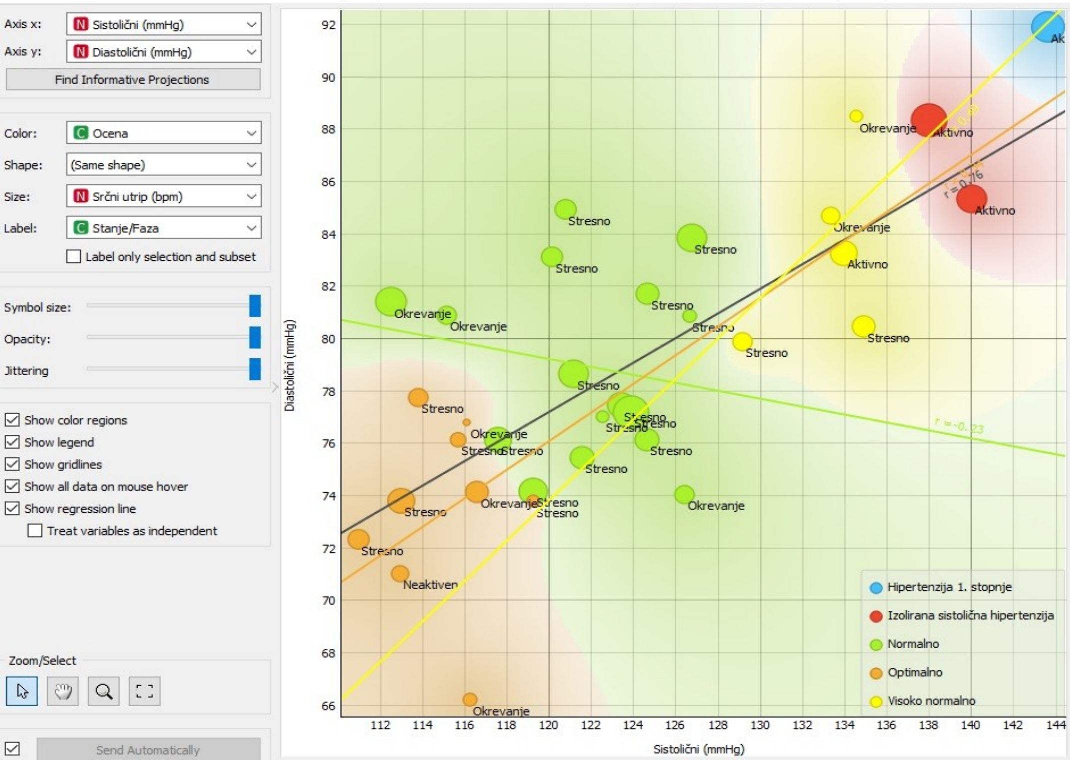
The human brain is heavily burdened by various thought processes aimed at problem-solving and achieving prestige in different forms—both material and conceptual. This mental load increases the secretion of stress hormones that regulate blood pressure and blood flow throughout the body. The increased production of stress hormones is not only due to cognitive overload but also environmental factors (e.g., air pollution, noise, unpleasant odors, digital overstimulation) and social factors (e.g., interpersonal conflicts over existential or status-related interests, overcrowding, social pressure). These factors may act as negative stressors or even critical stimuli that are frequent, intense, and repetitive, potentially leading to chronic distress and ultimately burnout.

Distress has a profoundly negative impact on both mental and physical health. Elevated or lowered blood pressure also depends on an individual's diet and lifestyle. For example, it is known that drinking coffee typically increases blood pressure and heart rate, similar to intense physical activity, which accelerates breathing, heart rate, and blood pressure. Additionally, both blood flow speed and blood oxygen concentration can fluctuate—often decreasing during sedentary or lying-down activities.

In the following sections, measurements of blood pressure, heart rate, blood oxygen saturation (%SpO2), and blood flow velocity will be presented.[406]

5.6.5.2.7 Table 214: A small portion of data on blood pressure, heart rate, blood oxygen percentage, and blood flow velocity measurements

Date	*Time*	*Systolic*	*Diastolic*	*Heart rate*	*Rating*	*State/Phase*	*Note*	*%SPO₂*	*Flow*
21.9.2023	17:09	118	76	80	Optimalno	Stresno	Zmerne aktivnosti.	95	7.8
21.9.2023	07:04	121	73	74	Normalno	Okrevanje	Ura po prebujanju.	97	2.2
20.9.2023	17:13	125	78	78	Normalno	Stresno	Po kratkem počitku.	95	7.4
20.9.2023	07:24	114	66	69	Optimalno	Okrevanje	Ura po prebujanju.	93	9.7
19.9.2023	19:52	124	78	68	Normalno	Stresno	Zmerne dejavnosti. Pisanje.	98	1.2
19.9.2023	09:11	126	77	76	Normalno	Stresno	Striženje in masaža glave.	96	7.7
19.9.2023	06:58	112	73	74	Optimalno	Stresno	Ura po prebujanju.	95	4.5
18.9.2023	17:45	133	81	75	Vis. norm	Stresno	Ob 13:00 pitje kave.	95	6.9
18.9.2023	06:50	127	75	73	Normalno	Okrevanje	45 minut po prebujanju.	94	6.9
17.9.2023	17:30	123	77	80	Normalno	Stresno	Pet minut po umivanju las.	94	6.0
17.9.2023	07:31	118	80	73	Normalno	Okrevanje	Ura po prebujanju.	95	7.1



5.6.5.2.8 Figure 491: Scatter plot of blood pressure, heart rate, evaluations, and states/phases

Table 214 displays only a small portion of the data collected from measurements of blood pressure, heart rate, evaluations of the recorded values, and the identified states/phases using a smartwatch. Additionally, the table shows the measured blood oxygen saturation levels (%SpO$_2$), blood flow rate (PR), and textual notes describing the circumstances under which the measurements were taken. Figure 491 presents a scatter plot that visualizes the relationship between systolic (upper) and

406 Blood pressure and heart rate measurements were taken using the M700 Intelli IT device, while blood oxygen percentage and blood flow velocity measurements were taken using a Mediblink pulse oximeter.

diastolic (lower) blood pressure, relative to heart rate—represented by the size of the data points. Each point is marked with a state or phase such as active, inactive, recovery, or stress, and color-coded according to evaluations like optimal, normal, high-normal, isolated systolic hypertension (systolic pressure 140 mmHg, diastolic 86.5 mmHg, heart rate 82 bpm), and stage 1 hypertension (systolic 142 mmHg, diastolic 90 mmHg, heart rate 82 bpm).

Both cases of hypertension were triggered by coffee consumption and intense physical activity. A similar pattern was observed in the "high-normal" evaluation, occurring over a longer time interval after coffee consumption and intense activity, but differing in the accompanying state/phase—either stress or recovery. Blood pressure was higher in these cases (average systolic 132.4 mmHg, diastolic 83.4 mmHg), while the heart rate remained relatively normal (average 83.4 bpm).

The “normal” blood pressure classification (average: systolic 122.2 mmHg, diastolic 78.5 mmHg, heart rate 76 bpm) occurred most frequently after moderate activity or during periods of rest. Interestingly, normal blood pressure values were most often observed during stress (13 measurements) and less frequently during recovery (4 measurements).

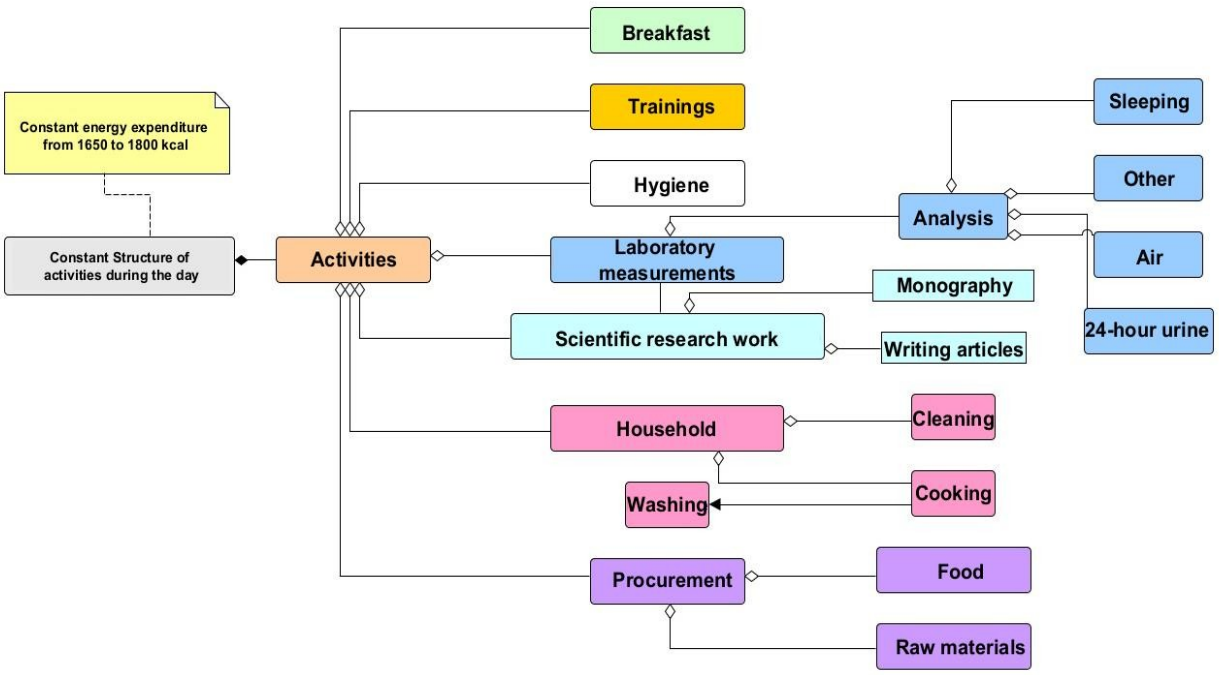
Finally, the “optimal” evaluation—characterized by lower blood pressure and heart rate (systolic 115.1 mmHg, diastolic 73.5 mmHg, heart rate 72.2 bpm)—was recorded mostly during stress (6 times), followed by recovery (3 times), and only once during inactivity. These optimal measurements mainly occurred following moderate activity, after waking, and during rest.

Individuals who are more sensitive to negative stress factors (e.g., stress hormone cortisol) may experience elevated or even lowered blood pressure (fight-or-flight response) and heart rate fluctuations (e.g., due to the hormone adrenaline). In healthy individuals, the influence of many stressors is negligible. Stress hormones such as adrenaline can impact breathing rate, which in turn affects blood oxygen levels and blood flow rate. However, both oxygen saturation and blood flow rate are more directly dependent on the respiratory system. The measured average values of blood oxygen saturation (95.16%) and blood flow rate (6.98) fall within normal ranges.

Low oxygen saturation and reduced blood flow can negatively affect blood pressure and heart rate, often causing increases in both. It is a fact that negative stress states lead to energy loss within the biological system. The test subject, who suffers from severe central sleep apnea syndrome (CSA), shows relatively normal values in blood pressure, heart rate, $\%SpO_2$, and blood flow rate. However, due to frequent stress states, this person rapidly loses energy and quickly depletes the energy reserves gained during sleep. These measurements and evaluations of energy reserves gained (Wr in %) during sleep, and the comparison between the healthy and affected individual, are clearly illustrated (see only 55.80% Wr gained during sleep for the affected person).

Efficient energy use from sleep is existentially important for coping with external stressors and internal stress states throughout the day. If energy recovery during sleep is poor, it cannot be significantly compensated for during the day. Amid the complex interdependence of various indicators, the optimal use of oxygen from air should always be emphasized. Air provides the primary raw material for effective energy output in biological systems. Whether oxygen is efficiently converted into ATP (energy molecules) depends on the potential of the biological system. It is also crucial to emphasize the role of "software" or cognitive processes within this biological system. As established, complex mental concepts can significantly reduce energy efficiency—especially in the human biological system (see dREM or prolonged REM phases during sleep). Such complex or unpleasant cognitive processes can also manifest during the day, consuming large amounts of energy, particularly in the human brain. From a physiological standpoint, physical activities throughout the day—especially in intellectually active individuals—are closely tied to mental processes.

Next, we will present a customized UML model of daily physical activities for a person with CSA who is primarily engaged in scientific research.



5.6.5.2.9 Figure 492: Adapted UML model of physical activities of an individual affected by Central Sleep Apnea (CSA)

Figure 492 presents a possible adapted UML model of the physical activities of an individual affected by CSA. It can be observed that most activities fall into the category of moderate physical exertion, which tends to slow down breathing and limits the amount of air reaching the lungs and other parts of the body. This also indicates that the individual's body does not act as a major consumer of oxygen—except for the brain.

The activities can be categorized into:

- Basic daily activities (e.g., housework, shopping, eating, hygiene),
- Physical activities (e.g., exercise, laboratory work), and
- Mental activities (e.g., scientific research, writing academic papers).

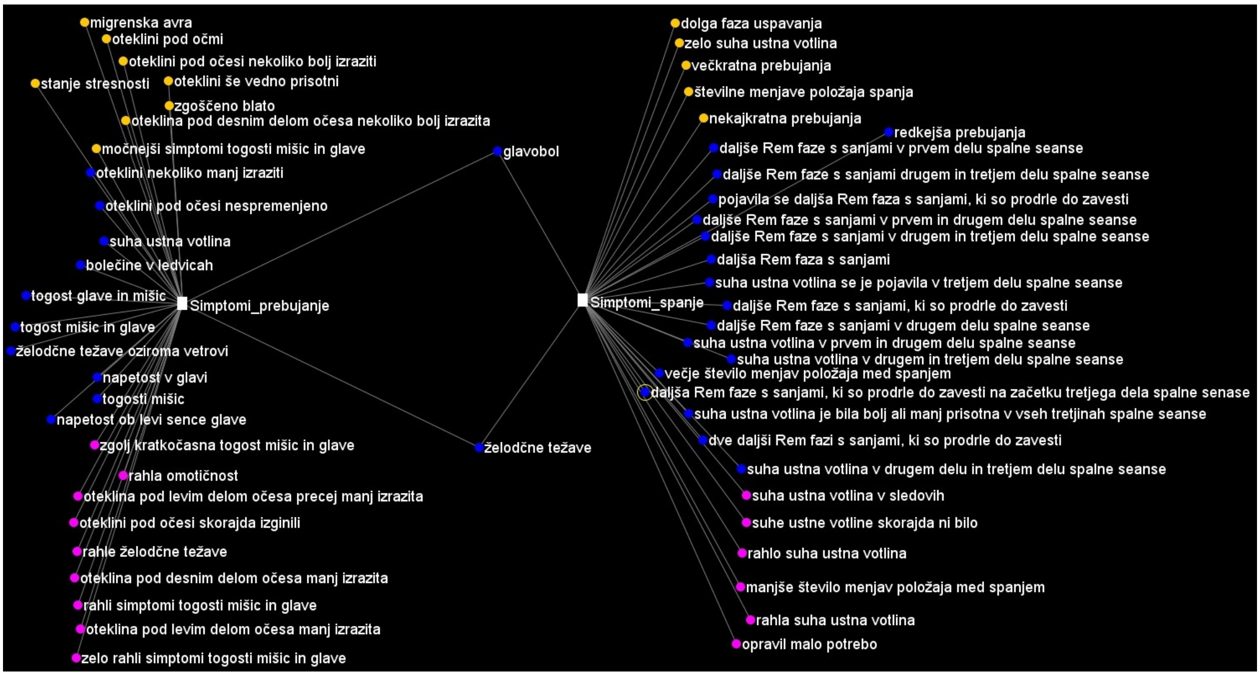
The most intense periods of activity occur in the morning from 6:00 AM to 10:00 AM and in the evening from 6:00 PM to 8:00 PM. Morning hours are slightly more focused on physical activities (mostly in a standing position), whereas evening hours are more focused on mental activities (mostly in a seated position). Afternoon periods are characterized by frequent rest in a lying position.

From this model, a rough estimate of the individual's daily energy expenditure in kilocalories (kcal) can be made. In the top left corner of the figure (see yellow sticky note), there is a note stating that the daily energy expenditure is very low—between 1650 and 1800 kcal. However, this may not be accurate, as the smartwatch likely did not assess this value with sufficient precision.

In the following section, energy expenditure in kcal will be estimated using known ergonomic measurements that determine average energy use in lying, sitting, and standing positions for adult males. Additionally, estimates of the intensity level of specific activities (e.g., heavy physical work, light exercise, office work) will be taken into account.

Based on data about stress factors during sleep and a list of stress-inducing activities throughout the day for this individual, the total stress load value will be calculated. The same method used in the study on everyday life stress will be applied here, with the key difference being that only one individual will be analyzed.

The purpose is to determine energy loss in kcal for this individual. First, we will present the negative symptoms experienced by the individual during sleep and upon waking. These symptoms can be highly distressing and will be meaningfully categorized within an established classification of stress factors (refer to the study on everyday life stress).



5.6.5.3 Figure 493: Overview of negative symptoms during sleep and upon waking

Figure 493 illustrates the negative symptoms that occur both during sleep and upon waking. It is immediately evident that most of these symptoms are related to performance-related and health-biological stress factors. Creating a list of distress factors based on this diagram provides a solid foundation for identifying other types of distress factors, including partial social, social, and individual psychological ones. In addition to compiling a list of distress factors, two more lists will be created: one for positive factors and another for recommendations to reduce and/or eliminate distress factors.

Main negative symptoms during the sleep session:

a. Prolonged sleep onset phase: This involves excessive initial psychophysical effort by the individual to fall asleep. It can be classified as a performance-related distress factor.

b. Multiple awakenings: This represents a severe sleep disturbance, leading to psychophysical strain due to interrupted sleep. It is also considered a performance-related distress factor, potentially caused by attentional, psychological, and/or physiological stimuli.

c. Frequent position changes during sleep: This is a form of psychophysical effort made by the individual to find an optimal sleeping position. It also falls under performance-related distress factors.

d. Extended REM phases with vivid dreams reaching consciousness: These cause intense psychophysical stress, nearly at the level of wakefulness energy consumption. Complex or unpleasant dreams, in particular, can result in significant brain strain. The causes can be psychological, partially social, social, biological-health-related, or in some cases, attentional-physical. This symptom is classified as a performance-related stress factor.

e. Frequent urination or defecation during sleep: Frequent satisfaction of primary physiological needs leads to awakenings and physical strain. This is another performance-related distress factor.

f. Very dry mouth during sleep: This uncomfortable symptom results from a lack of saliva and may stem from physiological or psychological issues and/or the use of CPAP/BIPAP breathing devices and facial masks. When related to device usage or mask leaks, it is considered a biological-health-related side effect.

g. Headaches during sleep: When related to the use of breathing devices, this symptom falls under biological-health-related distress factors.

h. Stomach issues during sleep: Similar to headaches, stomach problems can indicate mild to severe health issues and are classified under biological-health-related distress factors.

Both headaches and stomach issues can also persist into the waking phase after sleep.

Negative symptoms upon waking (lasting from a few minutes to several hours):

a. Migraine aura: Triggered by poor sleep quality, forced neuro-physical strain, and often unpleasant lighting. Classified as a biological-health-related stress factor. It may include additional neurological symptoms like nausea and dizziness.

b. Under-eye swelling ("eye bags"): Can be caused by a poorly fitting face mask leaking air from a breathing device. Falls under biological-health-related distress factors.

c. Stressful state upon waking: This may occur immediately after waking and is considered a biological-health-related distress factor.

d. Kidney pain: May follow sleep with a CPAP/BIPAP device and is categorized as a biological-health-related distress factor.

e. Head and muscle stiffness: Typically caused by poor sleep efficiency, indicating physical effort in transitioning to full wakefulness. This is a performance-related distress factor.

f. Head tension: Like the previous symptom, this is classified as a performance-related distress factor.

In summary, the above negative symptoms during sleep and upon waking can be categorized into distinct groups of distress factors.

Additional distress factors present during the day:

a. Attentional-physical distress factors: Unpleasant lighting, excessive rain, cold, noise.

b. Performance-related distress factors: In addition to those related to sleep, these include attending medical checkups, experiencing excessive fatigue after only four hours of moderate activity, and managing financial tasks like paying bills.

c. Individual psychological distress factors: Health-related fears, intrusive thoughts following ineffective sleep, melancholy, mental strain, psychological tension.
d. Partial social distress factors: Discomfort from perceived forced isolation from social life and the feeling of being underutilized by the employer.
e. Social distress factors: Written communication with the employer and social isolation.
f. Biological-health-related distress factors: In addition to those already mentioned, this includes a low tolerance threshold for even mild stressors, migraine auras, and headaches.
Following the brief overview of distress factors during the night and daytime, we can now also present the positive factors this individual experiences:
a. Attentional-physical positive factors:
- Pleasant scents
- Quiet without excessive noise
- Gentle hum of the breathing device during sleep sessions
- Warmth of the sun
b. Performance-related positive factors:
- Light exercise during the day
- Pleasant rest periods throughout the day
- Purchasing materials and equipment for a laboratory
- Scientific research
- Playing chess
c. Individual psychological positive factors:
- Inner peace
- Enjoyment of pleasant thoughts
- Sense of freedom in spending free time
- Feeling of inner fulfillment
d. Partial social positive factors:
- Feeling of contributing to important health-related research
- Sense of reward for having free time available
e. Social positive factors:
- Friendly communication with others
- Good relationships with service providers
- Building a useful scientific network
f. Health-biological positive factors:

- Therapy with a breathing device has significantly reduced breathing interruptions and strain (e.g., snoring) during sleep
- Satisfaction with good therapy outcomes
- Proper heart function
- Normal blood pressure
- Appropriate blood oxygen levels

Finally, after listing all these factors, suggestions for reducing or eliminating distress factors should be presented:

a. Attentional-physical suggestions:
- Aromatherapy
- Airing the room to improve sleep quality
- Better ergonomic pillows for more comfortable rest
- Avoidance of harmful electromagnetic radiation

b. Performance-related suggestions:
- Walks in nature
- Gradual increase of physical activity (e.g., suitable sports)
- Encouraging a healthy competitive spirit
- Breathing exercises (e.g., yoga)
- Massages

c. Individual psychological suggestions:
- Mental relaxation
- Neutralizing intrusive thoughts
- Creating inner happiness scenarios
- Neutralizing negative thoughts using personal autobiographical memory and life purpose

d. Partial social suggestions:
- Rationalizing feelings through analysis of positive, negative, and average scenarios

e. Social suggestions:
- Constructive communication with a psychologist
- Attending interesting events to meet positive-minded people
- Spending more time with friends
- Neutralizing negative thoughts about the employer
- Organizing scientific video conferences to connect with other researchers

f. Health-biological suggestions:
- Taking helpful medications to combat excessive fatigue

- Harmless energy supplements
- Natural sleep aids for faster falling asleep
- Avoidance of harmful substances (e.g., coffee, cigarettes)

In conclusion, the distress and positive factors and suggestions for mitigation or elimination have been categorized. The next step is to determine the frequency of each factor and suggestion by category and calculate the total frequency.

Since this method of measuring stress intensity was previously applied in a study on the daily stress levels of public employees, only the final values will be shown here (as calculating individual units requires a larger sample size).

Frequency Summary:

1. Distress factors:

- Attentional-physical: 4
- Performance-related: 10
- Individual psychological: 5
- Partial social: 2
- Social: 2
- Health-biological: 10

Total: 33

2. Positive factors:

- Attentional-physical: 4
- Performance-related: 5
- Individual psychological: 4
- Partial social: 2
- Social: 3
- Health-biological: 6

Total: 24

3. Suggestions:

- Attentional-physical: 4
- Performance-related: 5
- Individual psychological: 4
- Partial social: 1
- Social: 5
- Health-biological: 4

Total: 23

Overall total of various opinions: 80.

These frequencies also represent the opinion density per person, since only one individual is being analyzed. The total opinion density is 80 per person. The maximum possible opinion density for this subject is 100 per person (with larger sample sizes of 100–200 people, this would be about 10 per person). Therefore, this case represents the maximum possible opinion complexity, which equals 1. The opinion complexity per category corresponds to their frequencies and also equals 1.

To determine the total stress intensity, the real factor must be calculated:

- Distress factors: 0.33
- Positive factors: 0.24
- Suggestions: 0.23

The total stress intensity for the examined individual is 34.22 °S, which falls into the range of moderate stress intensity (from 30.05 °S to 45.04 °S).

From this, it follows that the effective energy expenditure for this individual is 1,549.4 kcal, indicating an energy loss of 950.6 kcal per day. This means the effective daily energy efficiency is only 61.98% for this individual.

It is clear that these calculated values are only loosely indicative and primarily serve to show that the individual under examination—someone affected by central sleep apnea—is not excessively exposed to distress factors typically faced by people with numerous family and work obligations. However, a person with central sleep apnea likely has a very low tolerance threshold even for mild distress factors, as their energy reserves, gained during sleep, are quickly depleted.

Additionally, they experience very rapid shifts from a state of rest/recovery to a state of distress. This means that, despite the relatively low overall stress intensity, even these weaker distress factors accelerate the loss of energy reserves and lead to persistent excessive fatigue throughout the day.

Therefore, let us examine the measurements of restfulness in relation to stress levels throughout the entire day for this affected individual.

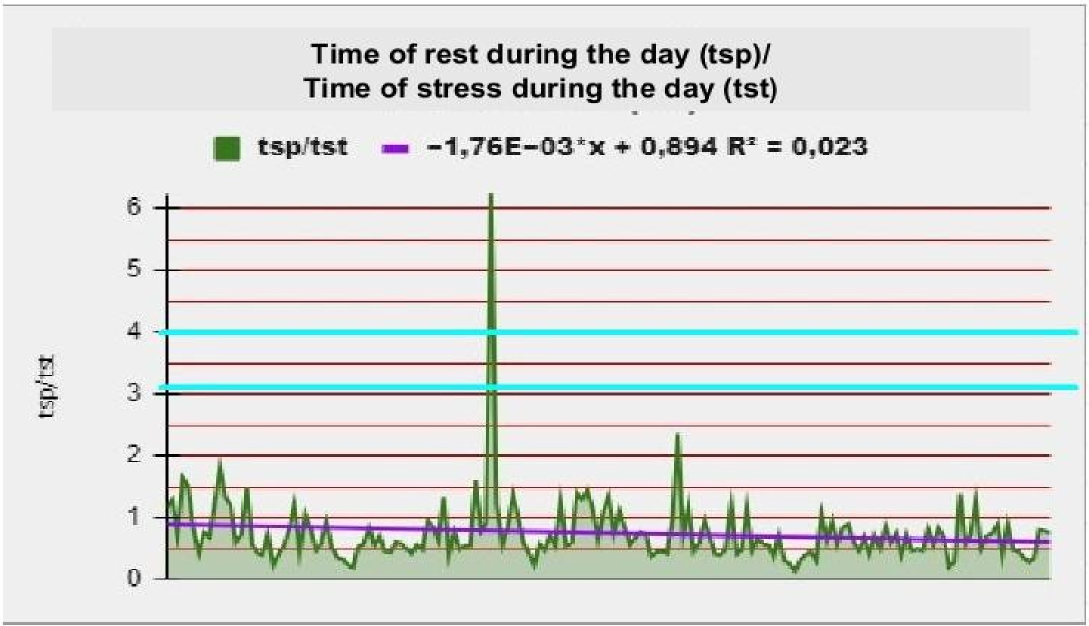
5.6.5.3.1 Table 215: Relationship between resting and stress levels by day

Date	*Duration of resting state (h)*	*Duration of stress state (h)*	*Ratio between both*
27.4.2023	11:00:00	09:30:00	1.16
28.4.2023	11:00:00	08:30:00	1.29
29.4.2023	08:30:00	11:30:00	0.74
30.4.2023	11:30:00	07:00:00	1.64
1.5.2023	13:30:00	09:00:00	1.50

Table 215 presents only a very limited selection of measurements regarding periods of restfulness and stress (167 measurements), along with the calculated ratios between the two states.

It can be observed that the calculated ratios are very low, even though the data shown here reflect some of the better outcomes. The next visualization, which includes all measurements, will reveal significantly worse results.

A relatively normal ratio between restfulness and stress throughout the day should be around three to four. This means that a healthy individual is expected to spend the majority of the day in a state of restfulness, and only one-third to one-quarter of that time in a state of stress.



5.6.5.3.2 Figure 494: Surface diagram of the ratio between restfulness and stress throughout the day

Figure 494 clearly illustrates the extremely low ratios between restfulness and stress levels on a day-to-day basis. With the exception of a single value of 6.25 recorded on June 27, 2023, all other values fall significantly below the range of normal values (as indicated by the two light blue boundary lines).

This primarily indicates that the observed individual expends a large amount of energy during the day, even for relatively undemanding physical activities. Similarly, intellectual or scientific research work, although limited to just four hours per day, also consumes considerable energy.

During sleep sessions, even with the aid of a BIPAP breathing machine, the individual rarely manages to replenish enough energy reserves to effectively cope with daily distress factors. As a result, energy reserves are quickly depleted, leading to a state of excessive fatigue after just four hours of more or less active wakefulness.

Even in rare cases where the use of energy reserves after sleep falls within normal efficiency levels, there is often a rapid decline shortly thereafter. The causes of this anomaly are less physiological and more psychological or cognitive in nature—stemming from the mental effort involved in processing complex concepts. These arise both from the scientific research the individual is engaged in and from the cognitive struggle with managing a complicated illness. Both processes occur quite intensely during both nighttime and daytime.

In any case, it is strongly recommended that periods of activity be followed by rest phases until a state of recovery is achieved. This state provides a good foundation for engaging in light physical exercise, which can even increase energy levels by 20% or more. Conversely, performing even light physical exercise while in a stressed state can lead to an energy loss of up to 20%.

There are, in fact, several methods and techniques (e.g., autogenic training, yoga, the aforementioned light exercise, nature walks) that can help more effectively manage distress factors and aid in energy restoration during the day. However, it should be noted that these benefits can only be realized if the energy reserves acquired during sleep are adequate. If this prerequisite is not met, restoring energy during the day becomes significantly more difficult.

It is also worth mentioning that healthy food and water intake, while important, cannot compensate for inadequate energy recovery during sleep—vitamins and supplements alone will not deliver optimal results if sleep-based energy restoration is insufficient.

As the next step in this study, it would be advisable to analyze the breathing patterns of this individual during sleep sessions with the BIPAP machine. These patterns are essential for oxygen intake and the generation of ATP (adenosine triphosphate) energy molecules. Therefore, relevant data would include breathing volume, mandatory breaths, mask leakage, apnea events, sleep-related respiratory effort, and the duration of device usage.

5.6.5.4 Respiratory flow

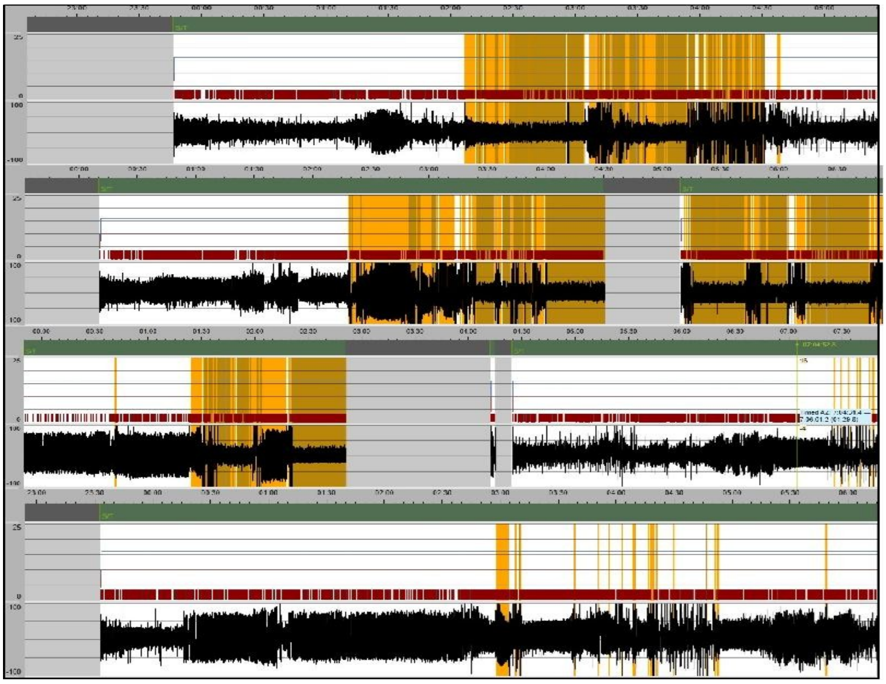
Respiratory flow consists of inhaling fresh air into the lungs and exhaling used air back into the atmosphere. It is dependent on tidal volume, which refers to the amount of air entering and exiting the lungs during each breathing cycle. Respiratory flow is measured in liters per minute (l/min), while tidal volume is measured in milliliters (ml).

For a 60-year-old male, normal respiratory flow values typically range between 6 and 10 l/min. This corresponds to 12–20 breaths per minute, with a tidal volume of approximately 0.5 liters per breath. Higher breathing amplitudes indicate greater intensity of breathing, while lower minimum values suggest reduced breathing intensity.

In studying respiratory flow, it is useful to identify recurring patterns and potential irregularities both in the short term (e.g., over one minute) and long term (e.g., over an hour or more).

Respiratory flows are visualized using a wave spectrogram, which is somewhat similar to a spectrogram used in speech analysis.

When interpreting respiratory wave spectrograms, it’s important to understand that the x-axis represents time, while the y-axis shows the frequency of breathing, either in hertz (Hz) or breaths per minute (bpm). As an introduction to interpreting respiratory spectrograms, we will first present several examples of respiratory flow patterns.



5.6.5.4.1 Figure 495: Examples of respiratory flow spectrograms

Figure 495 presents examples of respiratory flow spectrograms recorded during sleep sessions using a BIPAP respiratory device. These are recordings from the last four sleep sessions, showing notable differences as well as some similarities.

It should be noted that all four sessions yielded a modest amount of energy reserves, with the overall quality and efficiency of sleep rated relatively low (scores ranging from 5 to 6.5). The final two recordings include long REM phases (dREM) with dreams that reached conscious awareness, whereas the first two sessions lacked such dREM phases, and only NREM phases were present in the context of highlighted dreaming.

The values for mandatory breathing ranged between 65% and 77%, which are relatively high considering the assistance provided by the respiratory device. The rates of significant mask leakage ranged from 4% to 39%, which are fairly high. In particular, the mask leak values of 39% and 29% had a notably negative impact on the effectiveness of energy recovery after sleep.

During the four-day recording period, no major obstructions were observed, as confirmed by snoring duration data — snoring only occurred in the penultimate sleep session and lasted for two minutes. Breathing interruptions (AHI) remained within normal limits, between 0/h and 5/h, indicating there were no prolonged apneas. In summary, AHI anomalies did not significantly contribute to the poor energy recovery after sleep.

It is evident that various respiratory flow patterns can lead to similarly poor post-sleep energy efficiency, as clearly illustrated by the wave spectrograms. This raises an intriguing question: Which specific respiratory flow patterns can contribute to better utilization of energy reserves gained during sleep?

All four respiratory flow patterns can be classified as normal. However, it is worth noting that the patterns in the third and fourth spectrograms are less optimal, primarily indicating possible high-frequency muscular or overall bodily activity, which could negatively impact the quality and energy efficiency of sleep. Air inflows and outflows were as follows:

a. Top (first) respiratory flow spectrogram:

Inhalation: 221 l/min,

Exhalation: -231 l/min,

Duration: 5 hours, 40 minutes, and 16 seconds.

The obstruction rate ranged from 0% to 100%, with an average of 12.20%.

b. Second respiratory flow spectrogram:

Inhalation: 227 l/min,

Exhalation: -208 l/min,

Duration: 6 hours, 45 minutes, and 8 seconds.

The obstruction rate ranged from 0% to 100%, with an average of 13.40%.

c. Third respiratory flow spectrogram:

Inhalation: 228 l/min,

Exhalation: -203 l/min,

Duration: 6 hours, 43 minutes, and 0 seconds.

The obstruction rate ranged from 0% to 100%, with an average of 9.10%.

d. Bottom (fourth) respiratory flow spectrogram:

Inhalation: 227 l/min,

Exhalation: -219 l/min,

Duration: 8 hours, 31 minutes, and 52 seconds.

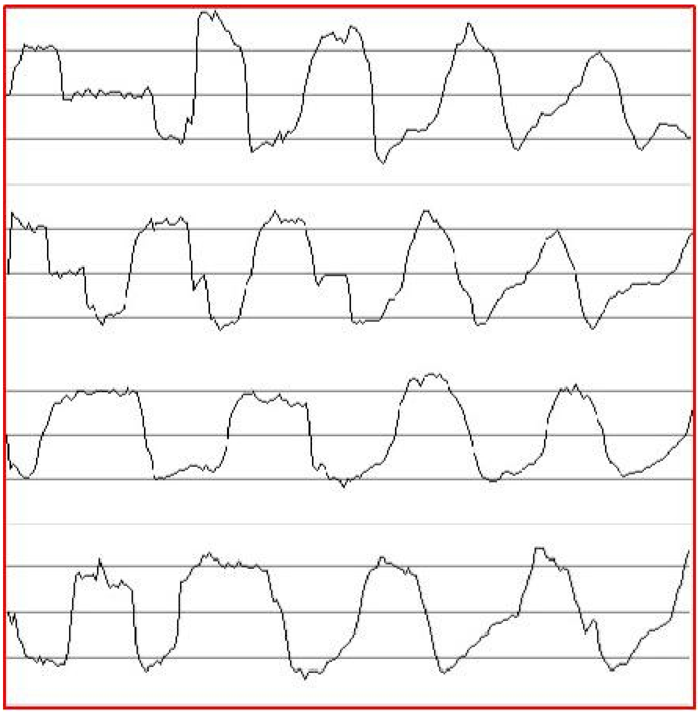
The obstruction rate ranged from 0% to 100%, with an average of 11.50%.

From an overall perspective, the average values across the analyzed respiratory flow spectrograms show no major differences. This is supported by the consistently low final scores for sleep quality and energy efficiency, ranging from 6 to 6.5.

As the saying goes, "the devil is in the details," which means these respiratory flow spectrograms will now be analyzed in greater depth using higher temporal resolution. The earlier patterns were examined based on a broad 8-hour time frame, which provided some general feedback but amounted mostly to a macro-level assessment. This gave us average values over large statistical samples but did not yield deeper insight into specific patterns, such as anomalies, irregularities, outliers, and recurring features.

It is precisely the identification of such finer-grained patterns that can help explain the low energy yield after the sleep sessions.

Let us therefore now examine selected respiratory flow patterns at a more detailed time scale, focusing specifically on the beginning of the same sleep sessions.



5.6.5.4.2 Figure 496: Examples of respiratory flow spectrograms at one-minute time resolution

Figure 496 shows examples of respiratory flow spectrograms recorded at the beginning of sleep sessions, with a time resolution of one minute. These are the same sleep sessions as depicted in the previous figure, which used a broader eight-hour time resolution.

It is evident that the respiratory flow patterns differ significantly from each other even at the very start of the sessions. The respiratory measurements for each minute (listed from top to bottom) are as follows:

a. Duration: 19 seconds

Inhalation volume per minute: 97 l/min

Exhalation volume: -80 l/min

Obstruction range: 0% to 50% (average: 6.2%)

b. Duration: 20 seconds

Inhalation volume: 73 l/min

Exhalation volume: -66 l/min

Obstruction range: 0% to 7% (average: 3.6%)

c. Duration: 21 seconds

Inhalation volume: 71 l/min

Exhalation volume: -60 l/min

Obstruction range: 0% to 13% (average: 4.2%)

d. Duration: 19 seconds

Inhalation volume: 71 l/min

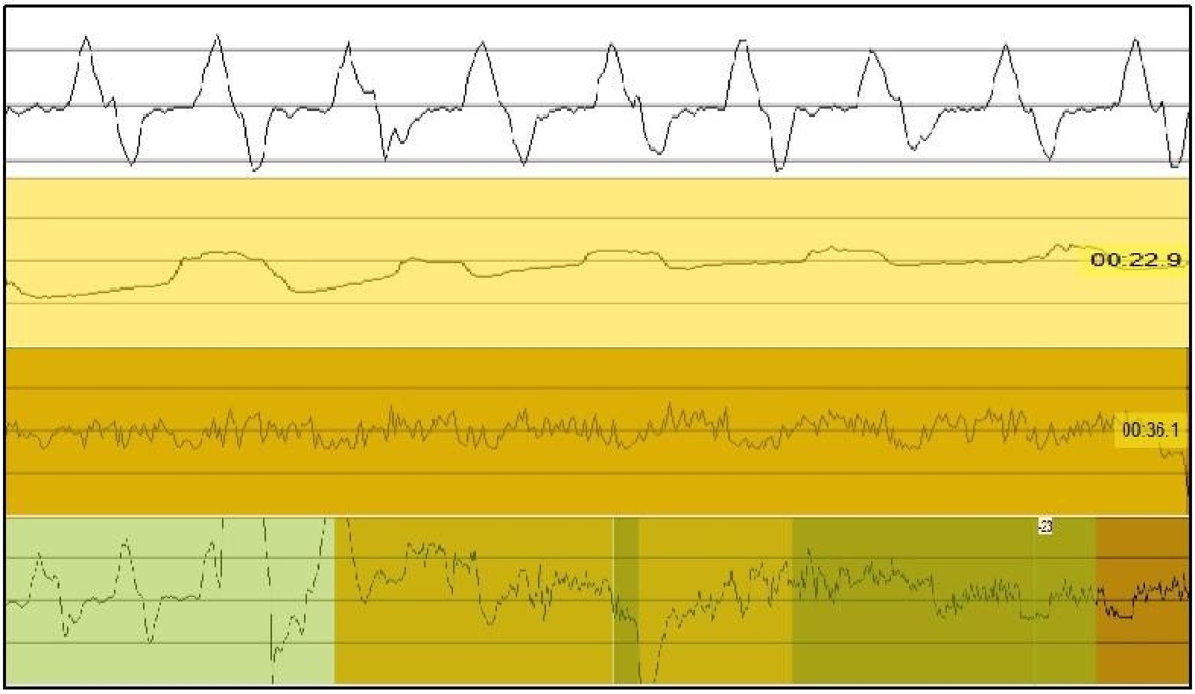
Exhalation volume: -74 l/min

Obstruction range: 0% to 33% (average: 11.2%)

It should be emphasized that these respiratory flows fall within normal breathing frequencies, ranging between 12 and 18 breaths per minute (bpm). The breathing signals are relatively stable, which is not surprising, as the individual had already adapted to the BIPAP respiratory device at the start of the sessions.

Short breathing pauses are observed, particularly in the first and second spectrograms. Overall, these respiratory flow patterns can be classified as optimal.

In the following analysis, we will look for patterns that deviate to a greater or lesser extent from the expected control provided by the BIPAP device.



5.6.5.4.3 Figure 497: Examples of respiratory flow spectrograms at one-minute resolution with a focus on anomalies

Figure 497 presents examples of respiratory flow spectrograms with a time resolution of one minute, emphasizing anomalies. The top diagram in the figure is assumed to represent a deep sleep phase, with relatively high inhalation and exhalation amplitudes. These anomalies in respiratory flow could be one of the key factors contributing to the poor utilization of energy reserves following sleep sessions.

In the first diagram, the air intake (65 l/min) and air outflow (60 l/min) are well balanced, indicating a relatively normal breathing pattern. Additionally, there are no noticeable airway obstructions in this segment, nor is there any detected air leakage from the facial mask. Breathing occurs relatively slowly, without major exertion, but includes short pauses.

The second spectrogram shows signs of increased respiratory effort, as the values for air intake (19 l/min) and air outflow (44 l/min) are significantly unbalanced. The primary causes of such breathing difficulties in this segment could be psychological (e.g., anxiety), motor-related (e.g., involuntary body movement during sleep, excessive muscle activity), or medical (e.g., sleep apnea).

The third diagram most likely reflects a REM sleep phase, where breathing is typically shallower and faster, accompanied by an increased breathing frequency.

The fourth diagram might indicate a sudden transition from deep sleep into REM sleep, which could be unusual. Additionally, interruptions in airflow are observed, as the airflow is not entirely regular.

These patterns highlight how specific anomalies in respiratory flow—despite appearing brief or minor—can significantly impact sleep quality and energy recovery. These are just examples of short sequences of respiratory flow. For a more comprehensive understanding, it is necessary to identify the different sleep phases in relation to pressure, duration, and breathing obstructions. A complete sleep session consists of four recurring phases: NREM 1, NREM 2, NREM 3, and REM.

- NREM 1: The first phase of the sleep cycle or the light sleep phase, usually lasting from 1 to 7 minutes.
- NREM 2: The light sleep phase, lasting from 10 to 25 minutes.
- NREM 3: The deep sleep phase, lasting from 20 to 40 minutes.
- REM: The final phase in the first sleep cycle, lasting from 10 to 60 minutes, associated with rapid eye movement and dreaming.

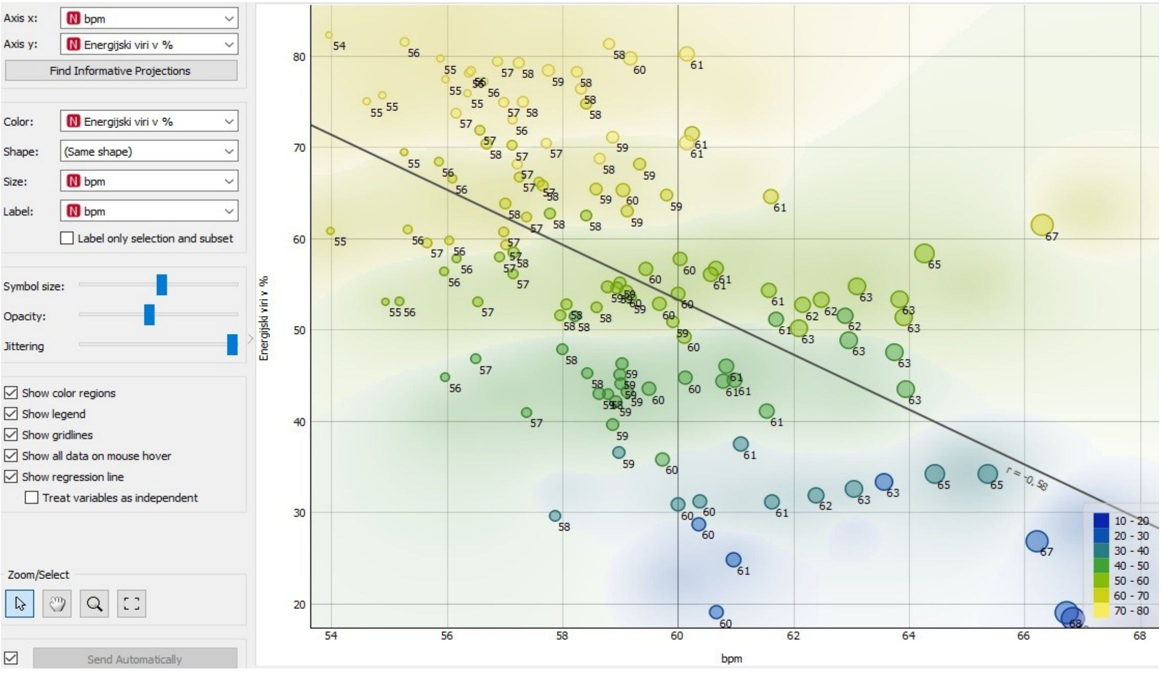
This cycle can repeat four to five times in one sleep session.

In addition to breathing patterns, heart rate (beats per minute – bpm) also plays an important role in replenishing energy reserves:

- NREM 1 and NREM 2: 60–80 bpm (similar to the awake state).
- NREM 3: 45–55 bpm (reduced heart activity).
- REM: 60–130 bpm (increased heart activity again).

The average heart rate during the entire sleep session is crucial and should be lower than during wakefulness. A heart rate above 60 bpm is often a good indicator of poorer energy recovery. However, this value varies between individuals.

In a case study of a person with severe central sleep apnea syndrome treated with BIPAP respiratory therapy, it was found that a lower average heart rate (55–58 bpm) actually contributes to better energy recovery after sleep. We will present this case based on a larger number of measurements (134), all conducted exclusively with BIPAP therapy.



5.6.5.4.4 Figure 498: Strong dependence of Wr% on heart rate

Figure 498, presented as a scatter plot, clearly shows a strong dependence of the efficiency of recovered energy reserves after sleep (Wr%) on heart rate (bpm). The highest Wr% after sleep (70–80%) is observed in the heart rate range between 55 bpm and 58 bpm (see yellow circles with labeled bpm values). In contrast, higher average heart rates during sleep are associated with lower Wr% (see green and blue circles with labeled bpm values).

A close relationship was observed between breathing rate and heart rate, as an increase in breathing frequency generally results in an increase in heart rate. This can occur during increased physical activity and/or emotional states such as fear, anger, or excitement. During sleep, body movement and these emotional states can affect not only heart rate but also the breathing flow itself. The breathing flow may become denser, increase or decrease in volume, meaning both the frequency and amplitude of breathing can rise or fall.

Given the strong presumed dependence of energy reserve recovery after sleep on breathing flow, it seems reasonable to study breathing patterns more closely during different sleep phases. Disruption of optimal breathing patterns during therapy with a BIPAP device can be influenced by several factors, such as:

- Air pressure settings,
- Limited airflow (e.g., due to poor breathing technique),
- Physiological obstructions (e.g., narrowed nostrils, improperly fitting face mask),
- Degree of airway obstruction (e.g., breathing interruptions),
- Medical conditions (e.g., apnea, lung diseases),
- REM sleep phase (which involves long and complex dreams).

We will analyze a full sleep session of an individual with critical central sleep apnea syndrome who regularly uses a BIPAP device. It is clear that such analysis primarily falls under the domain of pulmonologists and sleep specialists, so we will not delve into certain technical details. The goal of the analysis is straightforward:

- Identify different sleep phases based on breathing flow curves,
- Estimate the duration of each phase,
- Examine airway obstructions,
- Analyze pressure across sleep phases,
- Check for air leakage through the face mask,
- Assess the presence of anomalies within specific sleep phases.

In addition, heart rate assessments from a Suunto 3 smartwatch will be included for various sleep stages. Based on the collected data and analysis, it will be possible to evaluate why the efficiency of recovered energy reserves after sleep is still low – despite a successful reduction in the number of breathing interruptions due to the critical central sleep apnea syndrome (AHI reduced from 64 events/hour to 3 events/hour).

It is important to emphasize that the individual in question is otherwise completely healthy:

- No elevated levels of LDL (bad) cholesterol in the blood,
- No issues with blood sugar regulation,
- Normal heart function,
- No lung impairment,
- Stomach and intestines function normally,
- The brainstem shows no major anomalies, except for mild ischemic changes attributed to aging.

There are assumptions that the condition may originate from microvascular brain damage caused by a traumatic birth and/or ischemic changes (such as deposits in capillaries or blockages). However, the exact cause of the condition will likely never be determined with certainty.

Despite appropriate treatment, a significant concern remains: the patient's subjective assessments and measurements indicate unsatisfactory results, which fall well below the minimum average. This suggests that sleep quality is generally poor, and energy reserves are quickly depleted, leading to excessive fatigue. Additionally, the patient often experiences rapid transitions into a state of stress, which may indicate a low tolerance threshold even for minor stressors (commonly referred to as Post-Traumatic Stress Disorder – PTSD).

5.6.5.4.5 Table 216: Respiratory flows and sleep stages

Sleep phases	*Pressure (hPa)*	*Difference respiratory flow (l/min)*	*Average obstruction (%)*	*Average descent (l/min)*	**Duration of phases**	**Heart rate assessment (Hbpm)**
N1+N2	11.7	26	3.7	2.7	00:37:06	65
N3	11.7	134	10.5	10.5	00:46:44	60
N1+N2	11.7	35	11.8	9.3	00:03:45	59
N3	11.7	6	9.7	15.2	00:47:20	58
N1+N2	11.8	1	7.9	58.1	00:03:45	57
N3	11.7	113	11.3	21.0	00:08:35	58
dRem(s)	11.8	-50	4.5	126.1	00:11:40	61
N1+N2	11.8	34	5.2	8.4	00:22:44	61
N3	11.6	2	4.8	12.0	00:54:47	58
dRem(s)	11.8	75	11.9	12.1	00:07:58	59
N3	11.7	36	5.4	26.7	00:06:18	61
dRem(s)	11.8	1	9.4	8.7	00:07:15	61
N3	11.7	35	9.0	25.1	00:06:57	58
Rem(bzs)	11.6	87	27.8	126.8	00:40:19	58
N1+N2	11.8	35	5.3	1.8	00:29:12	64

Table 216 presents data from a sleep session, including pressure values (in hPa), differences in airflow (in L/min during inhalation and exhalation), average obstruction (in %), average air leakage through the face mask (in L/min), the duration of each sleep phase (in hours, minutes, and seconds), and heart rate estimates during different sleep phases (in bpm).[407] The individual sleep stages were identified based on known patterns of breathing flow and the granularity of the spectrogram, analyzed in five-minute intervals. Differentiating between NREM stages 1 and 2 proved difficult, so they were combined into a single N1+N2 stage. In contrast, identifying NREM stage 3 (deep sleep) and REM sleep—including dream phases that reached consciousness—posed no major issues.

The sleep session began appropriately. After the initial N1+N2 stage (duration: 00:37:06), a deep sleep stage N3 followed (duration: 00:46:44). A short N1+N2 stage then reappeared (00:03:45), although based on the expected sleep cycle, a REM phase should have followed. Instead, there was a solid transition into another long N3 stage (00:47:20). Later, another short N1+N2 phase occurred (00:03:45), followed by a short N3 phase (00:08:35). Only then did a longer REM phase appear, with dreams reaching conscious awareness (duration: 00:11:40), which can be considered a normal duration.

As expected, this was followed by another N1+N2 phase (00:22:44), then a deep N3 phase (00:54:47). A shorter REM phase with conscious dreams occurred later (00:07:58). According to the expected pattern, this should have been followed by a light N1+N2 phase, but instead, another short N3 phase appeared (00:06:18), followed by another REM phase with conscious dreams (00:07:15).

407 Heart rate assessments were performed using the Suunto app for tablets and mobile phones.

Surprisingly, a deep N3 phase followed instead of a light one (00:06:57). This was followed by a long REM phase (00:40:19), in which dreams did not reach conscious awareness. The sleep session ended with the expected light N1+N2 phase (00:29:12), which is favorable since waking up from deep sleep tends to be less pleasant.

In total, five light sleep phases, six deep sleep phases, and four REM phases were recorded. The dreams in the REM phases were intense, with three of them reaching conscious awareness and containing complex thematic content—energetically similar to wakefulness.

Regarding pressure, it remained relatively stable across the various sleep stages. In contrast, the airflow was significantly unbalanced, especially in the first long REM phase with conscious dreaming, where a difference of -50 was observed. This indicates a stronger tendency to exhale than inhale during that phase, which may represent an energetically inefficient anomaly. In general, differences between inhalation and exhalation were noticeable in nearly all sleep phases, with a few exceptions (e.g., the first deep sleep phase with a difference of 6 L/min, the third light N1+N2 phase with a 1 L/min difference, the fourth N3 phase with a 2 L/min difference, and the third REM phase with a 1 L/min difference). This breathing imbalance—favoring inhalation—may be linked to reduced carbon dioxide expulsion, which lowers the efficiency of post-sleep energy recovery, expected to be between 80% and 85%.

Airway obstructions were, as expected, most prominent during deep sleep phases (e.g., 11.3%, 9%) and REM phases with dreaming (e.g., 11.9%, 27.8%), when breathing control is limited. Smaller average obstructions were noted in light sleep stages (e.g., 3.7%, 5.2%, 5.3%). However, obstructions alone are not as problematic as the unbalanced airflow and elevated heart rate during sleep, which further reduce energy efficiency.

Even more impactful on the reduced energy recovery is air leakage through the face mask. The highest leakage rates were recorded during REM phases (e.g., 126.1 L/min, 126.8 L/min), and partially in deep sleep phases as well (e.g., 25.1 L/min, 26.7 L/min). Increased air leakage was also observed in the third light sleep phase (58.1 L/min).

The heart rate during sleep is also highly problematic, ranking in importance alongside unbalanced airflow. During deep sleep phases, heart rate was too high, ranging between 58 bpm and 60 bpm—well above the expected values for this stage (45–55 bpm). Since deep sleep is crucial for energy restoration, such elevated heart rates result in higher energy consumption and poorer energy reserve recovery. In other sleep stages, the tolerance for higher heart rates is slightly broader (e.g., 60–80 bpm in light sleep, and 60–130 bpm in REM sleep).

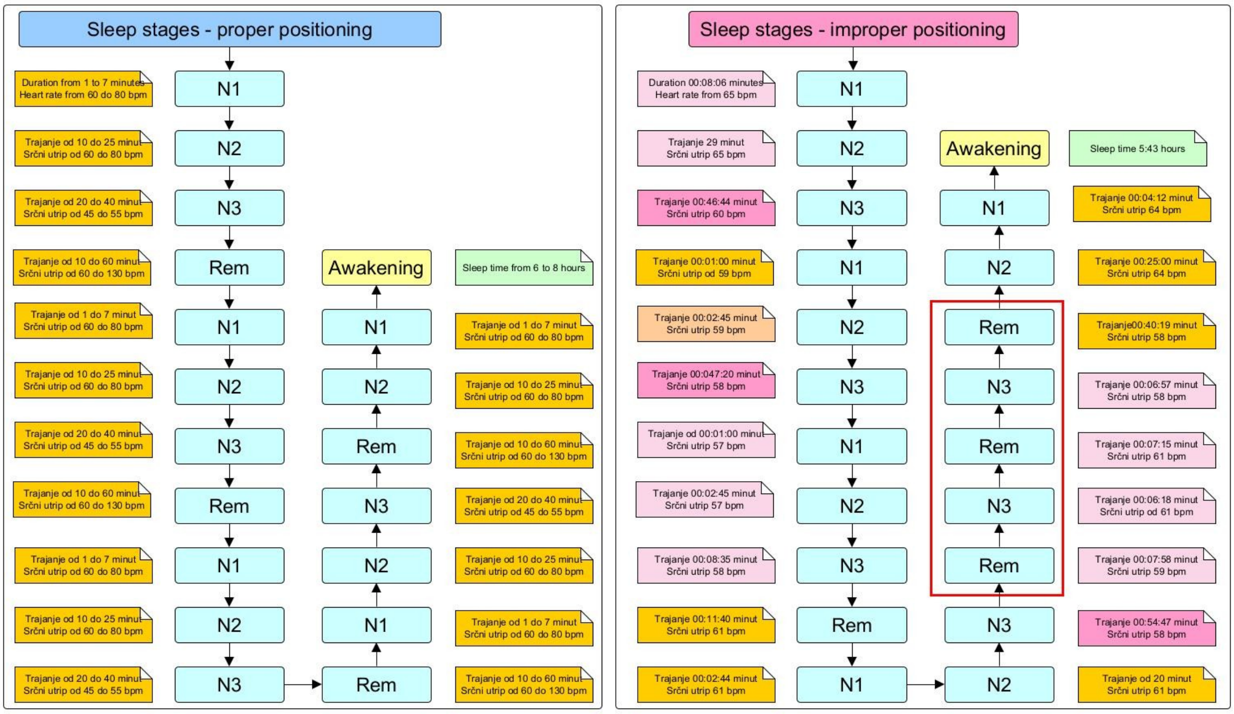
Based on these findings, the main contributors to poor post-sleep energy reserve recovery are:

- Unbalanced airflow,

- Elevated heart rate during deep sleep,
- Inadequate sequencing of sleep stages,
- Sleep stages that are too short or too long,
- Intense dreams with complex thematic content.

As a result, the individual is likely to experience frequent distress during the day, due to insufficient energy reserves for effectively handling daily stressors. They may also struggle to fulfill their intellectual potential and be more vulnerable to psychological issues.

In the next section, we will illustrate appropriate and inappropriate distributions of sleep stages.



5.6.5.4.6 Figure 499: Comparison of proper and improper sleep phase arrangement

Figure 499 presents a comparison between an optimal and a suboptimal arrangement of sleep phases, highlighting the ideal sequence of sleep stage progression. In sleep following the optimal order—namely N1, N2, N3, and REM—heart rate values and the duration of each phase are expected to remain within previously established normal ranges.

In contrast, in a sleep session with an improper sequence of sleep stages (see the right side of the figure), various deviations and anomalies are observed, most notably an elevated heart rate during the N3 (deep sleep) phase, and either overly short or excessively long durations of individual sleep phases (indicated by pink fields next to the sleep stages). An improper arrangement of sleep phases, especially when combined with abnormal durations and/or heart rate levels, can lead to reduced energy production and increased energy consumption, ultimately resulting in poor recovery of energy reserves after sleep.

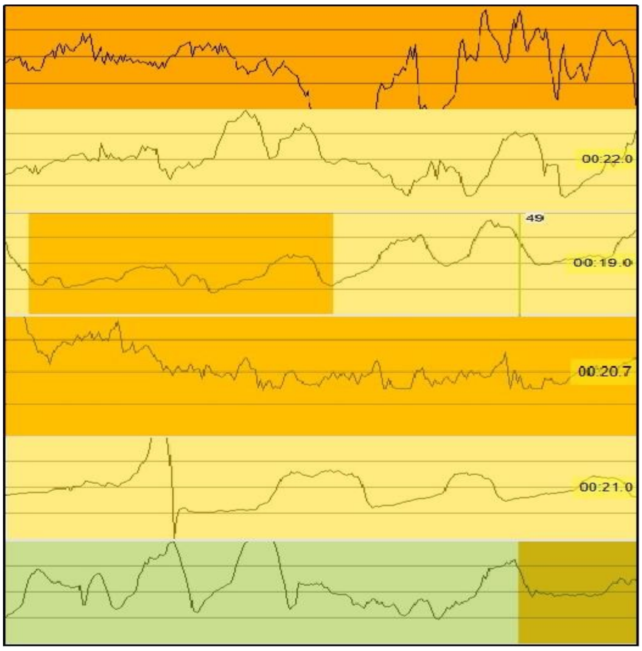
Particularly inefficient is the repeated pattern of transitioning directly from deep sleep (N3) into a REM phase with dreams that reach conscious awareness. In such cases, the individual first conserves energy during deep sleep, only to spend most of it again during the intense REM phase—meaning energy efficiency cannot be optimal. According to the principle of energy conservation during sleep, it is advisable for light sleep phases (N1, N2) to follow the first REM phase, rather than a return to deep sleep.

In the analyzed case, the N3–REM pattern repeated three times, which is energetically irrational. As a result, the energy reserve recovery after sleep was only 61%. It's important to note that this was just one sleep session and not among the worst cases (where recovery rates of 19%, 21%, 23%, or 29% were recorded). If we were to analyze sleep sessions with significantly worse outcomes, the results would be even more concerning.

Various breathing anomalies also contribute significantly to reduced energy reserve recovery. These do not occur as isolated incidents but accumulate over the course of the sleep session, gradually disrupting the balance of the respiratory cycle during specific sleep stages, leading to major differences between inhalation and exhalation. This imbalance also causes excessive energy expenditure, which even longer deep sleep phases cannot fully compensate for.

Even if the overall session appears to show a relatively balanced outcome between inhaling and exhaling, this cannot offset the energy consumed—especially during REM phases with mentally taxing dreams that reach conscious awareness. Breathing anomalies can result from interrupted airflow, increased effort during breathing, elevated heart rate, breathing techniques (inhalation/exhalation patterns), obstructions in the nasal or oral cavity, bodily pain, environmental noise, bladder pressure, vivid dream content, dry mouth, thirst, hunger, etc.

In short, there are numerous causes of breathing anomalies, all of which contribute to the disruption of airflow balance. This means that air, as an energetic resource, cannot be optimally utilized, which leads to diminished energy recovery from sleep. Below, we present a selection of breathing anomalies observed during the analyzed sleep session.



5.6.5.4.7 Figure 500: A small selection of breathing anomalies during a sleep session

Figure 500 presents a selection of breathing anomalies recorded during the analyzed sleep session. These anomalies include obstructions, breathing patterns, intense dreams, breathing interruptions, shallow breathing, deep breathing, as well as accelerated and slowed breathing. The key finding is a significant imbalance between the volume of inhaled and exhaled air.

One anomaly during the REM dreaming phase (see the top of the figure) consists of two opposing patterns. The breathing flow on the left side, before the interruption, indicates rapid and shallow inhaling and exhaling, while the flow on the right suggests faster and deeper inhaling, and to some extent, exhaling. Both patterns resemble the "fight or flight" response, a common reaction of living beings to stress. The breathing interruption resembles the "freeze" response, which can also result from a stress trigger. The air balance in this segment is highly skewed—air intake measured 91 l/min, while air output was -180 l/min. This indicates that the air entering the lungs was significantly less than the air exiting, resulting in a breathing pause lasting two seconds. Importantly, this pattern repeated multiple times throughout the sleep session. Breathing interruptions at the end stage result in reduced air intake and thus less oxygen available for producing ATP energy molecules.

The second recording also appears related to various stimuli, especially stress-related ones caused by intense dream content and/or environmental factors. The initial sequence resembles a flight response, characterized by shallow, rapid breathing. This is followed by a brief phase resembling a freeze response, then another flight-like pattern emerges. Suddenly, a reactive shift occurs—breathing becomes deeper and slower, which could indicate a fight response or the perception that the threat has passed. Nevertheless, the shallow and fast breathing pattern returns briefly before transitioning again to deeper breathing, typical of a fight response. This entire breathing sequence lasted about 20 seconds, with an air intake of 98 l/min and an output of -74 l/min. These values again reflect an imbalance between air intake and output.

The third recording initially shows shallow, slower breathing, which then shifts to deeper, even slower breathing. During this brief 19-second interval of light sleep, a short breathing pause also occurs before the previous pattern resumes. Here too, a significant imbalance is observed—air intake measured 86 l/min, and output -74 l/min.

The fourth recording depicts a 19.7-second breathing flow. It shows very shallow, rapid breathing during REM sleep with intense dreams, again likely tied to a flight response. A pronounced imbalance is seen—air intake was 147 l/min, while output was only -28 l/min.

The fifth recording shows a short sequence of atypical light sleep lasting 21 seconds. After a phase of fast and shallow breathing, a brief breathing interruption occurs, followed by a deep inhale and exhale. Another short breathing pause follows, then breathing stabilizes into evenly formed waves. Due to anomalies such as obstructive apnea, this sequence also shows imbalance—air intake was 196 l/min, output -115 l/min.

The final recording presents a transitional phase between light and REM sleep, lasting approximately 20 seconds. Extremes are observed—shallow, rapid breathing followed by slower, deeper breathing. Toward the end of this sequence, another breathing interruption appears, caused by obstructive apnea. Unsurprisingly, this pattern also reveals imbalance—air intake was 129 l/min, output -54 l/min.

As previously noted, breathing anomalies were frequent in this sleep session, with some patterns repeating. Certain breathing flow anomalies may form hierarchical associative networks, triggered by causal factors (e.g., environmental noise, stressful daily experiences) and conditioned factors (e.g., disconnection of a breathing device due to a pinched air hose, lack of distilled water in the humidifier chamber).

An interesting question that arises here is the influence of imbalanced breathing flows on intense dreams that reach conscious awareness during REM sleep. It is known that excessive carbon dioxide concentration during wakefulness can impair mental focus and cause extreme fatigue. This can lead to dreamy states that promote dreaming or, in some cases, even hallucinations (e.g., auditory hallucinations). A similar effect can be expected with a significantly elevated oxygen concentration. An imbalanced ratio of these gases can result in energy losses, ultimately affecting overall biological stability.

Heart rate may be indirectly linked to breathing, particularly in connection with different states of activity and rest. The same applies to brain waves, which can influence breathing patterns and even heart rate. During intense dreams or nightmares that break through to consciousness, heart rate and breathing frequency can significantly increase, typically due to disrupted biological equilibrium.
As previously indicated, the next section will examine the impact of using a BIPAP breathing machine on 24-hour urine values. A brief selection of data will illustrate the indirect connection between breathing flow and the excretion of waste products such as urine.

5.6.5.4.8 Table 217: Effect of BIPAP breathing apparatus on lower 24-hour urine pH values

Datum	*Ph*	*Inspiration (l/min)*	*Expiration (l/min)*	*Emission CO_2 (ppm)*	**Sleep duration**	**Average heart rate (bpm)**
1.10.2023	5.31	204	-161	3291	06:52:00	63
2.10.2023	5.21	218	-265	2744	05:26:00	59
3.10.2023	5.32	227	-228	2642	05:31:00	60
4.10.2023	5.91	206	-197	2553	05:43:00	62
5.10.2023	5.36	202	-95	2409	06:06:00	66
6.10.2023	5.14	180	-113	3093	06:44:00	63
7.10.2023	5.17	201	-133	2613	05:50:00	67
8.10.2023	5.27	227	-177	2871	07:00:00	61
9.10.2023	5.14	156	-97	2623	06:02:00	61
10.10.2023	5.36	216	-235	3360	06:52:00	62

Table 217 presents a highly limited selection of data on the pH levels of 24-hour urine samples, respiratory flow (inhalation and exhalation in liters per minute), CO_2 emissions in the bedroom, sleep duration, and average heart rate during sleep under the influence of a BIPAP respiratory device.
The pH values of 24-hour urine samples are considerably lower due to the influence of the BIPAP device, indicating a state of bodily acidosis. A higher intake of air into the lungs (i.e., oxygen to various parts of the body—see inhalation in l/min) also triggers a greater expulsion of carbon dioxide from the body (i.e., through the lungs—see exhalation in l/min), as a result of gas exchange. This is one of the main reasons why the pH levels are acidic (e.g., pH values of 5.3, 5.2, etc.). Another contributing factor is air leakage from the face mask, which can significantly dry out the oral cavity, resulting in a substantial loss of saliva. This in turn leads to denser 24-hour urine. Additionally, the BIPAP device itself contributes to increased CO_2 emissions into the bedroom air, especially when the window is closed (see CO_2 concentrations exceeding 3000 ppm).
An indirect influence on respiratory flow, breathing frequency, and CO_2 emissions may also stem from an elevated heart rate, which causes breathing to become faster and more shallow. Another

potential factor, not highlighted in the table, is mandatory breathing enforced by the BIPAP device—particularly when the device's influence exceeds 60%.

The BIPAP machine can have both positive and negative effects on kidney function, and thereby influence the acidity of 24-hour urine. Improved oxygen flow to different parts of the body—especially in individuals with sleep apnea—can support better kidney function, as kidneys require sufficient oxygen to function properly. Both oxygen deficiency (hypoxia) and excess oxygen (hyperoxia) in the kidneys can cause serious health issues. In both cases, kidneys experience additional strain, potentially leading to negative symptoms such as headaches, dizziness, nausea, shortness of breath, choking sensations, or chest pain.

These symptoms may be caused by underlying conditions such as acute respiratory distress syndrome, chronic obstructive pulmonary disease (COPD), heart disease, blood clots, chronic kidney disease, diabetes, or high blood pressure (hypertension). Blood oxygen concentration and blood flow rate can be measured or estimated using simple devices like a pulse oximeter. If oxygen saturation is between 95% and 99%, it is unlikely that the individual is experiencing either hypoxia or hyperoxia.

It has become evident that a BIPAP device can affect bodily organs and, consequently, bodily fluids (e.g., saliva, urine, blood). The acidity of 24-hour urine remains an issue, which can be slightly regulated through diet and fluid intake, though this is not a complete solution.

Urine is produced in the kidneys through a process that involves three steps: filtration (blood pressure pushes fluid, including waste products, from the blood into a small network of capillaries and then into Bowman’s capsule), reabsorption (nutrients like water and glucose are reabsorbed), and secretion (waste products like urea, creatinine, and uric acid are expelled). The entire process of urine formation takes about 45 minutes. On average, people excrete one to two liters of urine per day, depending on fluid intake, activity levels, and potential medication use. Most of the urine consists of water, with waste products accounting for just about 5%. In addition to the previously mentioned waste substances, urine may also contain various electrolytes, hormones, and vitamins.

There is a close link between blood pressure and kidney function. If blood pressure is abnormal (too high or too low), the kidneys cannot function optimally, leading to frequent serious health problems. As we know, blood pressure largely depends on heart function, since the heart circulates blood throughout the body. This general overview shows that breathing is closely tied to various bodily organs and that air is a driving resource that enables their operation. Breathing is essentially a method of acquiring air—or oxygen—for energy production. From this perspective, it becomes clear that inorganic substances like pure air sustain life. Air, in fact, holds a dominant role over biological systems (with a few exceptions among living beings).

With this conceptual foundation, we proceed to examine hierarchical associative networks of factors that positively, neutrally, or negatively affect the efficiency of energy reserves restored during sleep. Before developing a model, it is useful to outline the most important mental concepts that influence energy efficiency both during sleep and wakefulness.

1. Air quality – entering the lungs. Ideally, this air should contain low CO_2 concentrations, roughly between 300 ppm and 800 ppm. It should be free of impurities and have an optimal oxygen concentration. Oxygen is the component that enables the production of the energy molecule ATP.

2. The respiratory system – facilitates gas exchange and is a prerequisite for energy production and the elimination of waste gases like carbon dioxide.

3. Environmental conditions – the living environment should be as low-stress as possible, meaning free from excessive distress-inducing factors.

4. The heart – operates with an optimal heart rate. This is directly linked to:

- Blood circulation and
- Blood pressure, both of which are essential for proper metabolism and are associated with adequate blood flow rate and oxygen content.

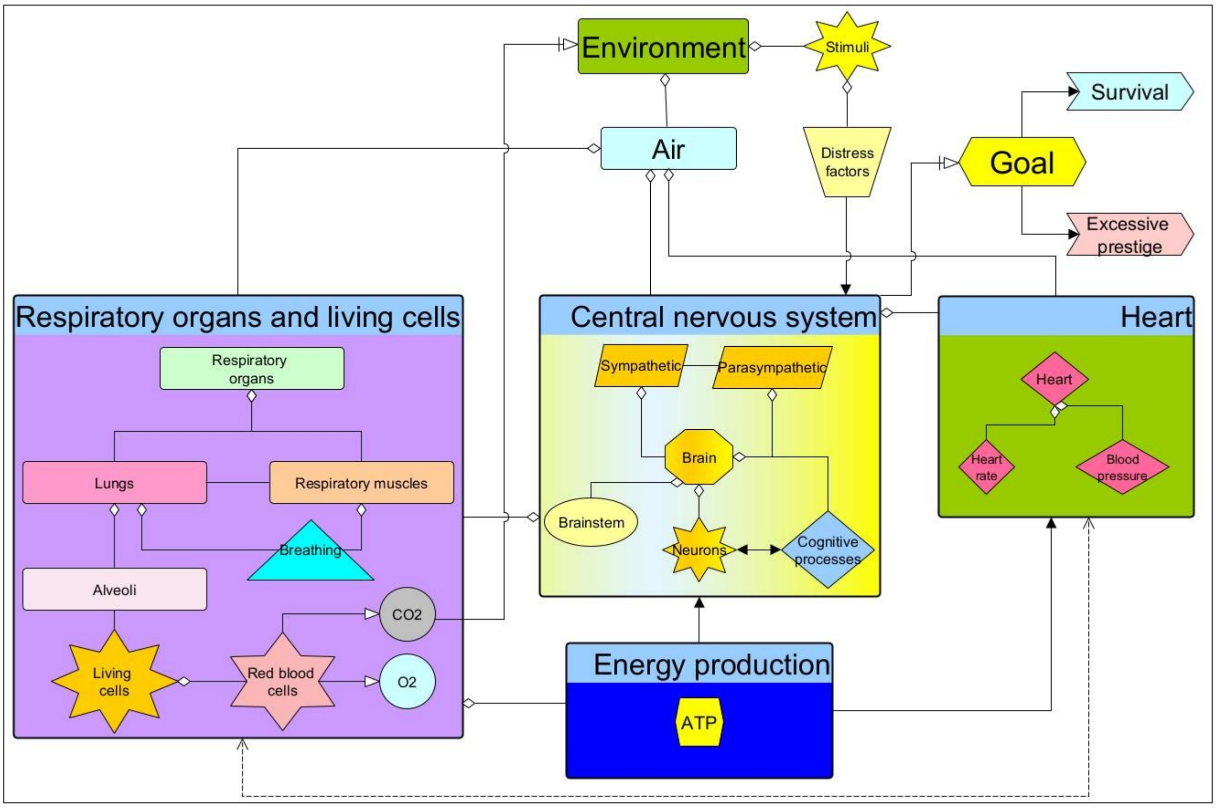
5. The nervous system – regulates breathing and heart rate and ensures proper responses to stressors. This involves:

- The sympathetic nervous system ("fight or flight") and
- The parasympathetic nervous system ("rest and digest").

6. The brain – within the central nervous system, it plays a vital role in controlling respiratory muscles and developing behavioral and cognitive responses tied to survival instincts and status-seeking drives.

7. Activity – includes sleep, cognitive processes (e.g., thinking, feeling, attention, emotion, learning), and physical movement (e.g., sports, work duties, household chores).

It is useful to categorize these mental concepts further in order to construct a hypothetical hierarchical associative network.



5.6.5.4.9 Figure 501: Hierarchical associative network of air and energy production in living beings for survival with excessive prestige

Figure 501 presents a hierarchical associative network of air and energy production in living beings aimed at survival with excessive prestige. This simplified model is particularly applicable to humans in technologically and legally advanced societies. Other living organisms are generally less concerned with achieving excessive prestige, as they possess fewer and more consistent mental constructs over the long term. Their primary drives are usually survival and reproduction—ensuring they have enough food for themselves and future generations. This doesn’t mean that other species completely forgo prestige, but they are not burdened by it as a mental concept. Nonetheless, a certain prestige value in terms of food, offspring, and territory can be a beneficial added value for these species.

For humans in developed societies (with chimpanzees being relatively similar in their pursuit of prestige), survival often includes striving for excessive prestige. This tendency is particularly strong among two sociological groups. Individuals within the "extreme hierarchical complex" group pursue power, influence, wealth, and additional living space. Meanwhile, those in the "progress group" seek additional knowledge, skills, and recognition—either during their lifetime or posthumously. The "majority group" tends to follow these goals to varying degrees, while those in the "anomaly group" are somewhat isolated subjects, often monitored or studied.

As previously discussed, modern human societies are complex and characterized by enormous energy consumption. It's clear that all humans—regardless of their sociological group—require energy. Air is the raw material that allows the body to extract oxygen, which is then used in biochemical processes to produce ATP (adenosine triphosphate) molecules. These ATP molecules are ultimately what support the mental construct of survival through excessive prestige.

ATP production differs among living beings. The highest ATP output is typically found in organisms that utilize cellular respiration—humans and other mammals, as well as birds, fall into this category. Other groups—such as reptiles, amphibians, fish, insects, and arachnids—produce significantly less ATP due to their lower body temperatures. Plants also produce less ATP because photosynthesis provides only limited energy levels. Additionally, plants are mostly stationary and lack a brain as understood by current science.

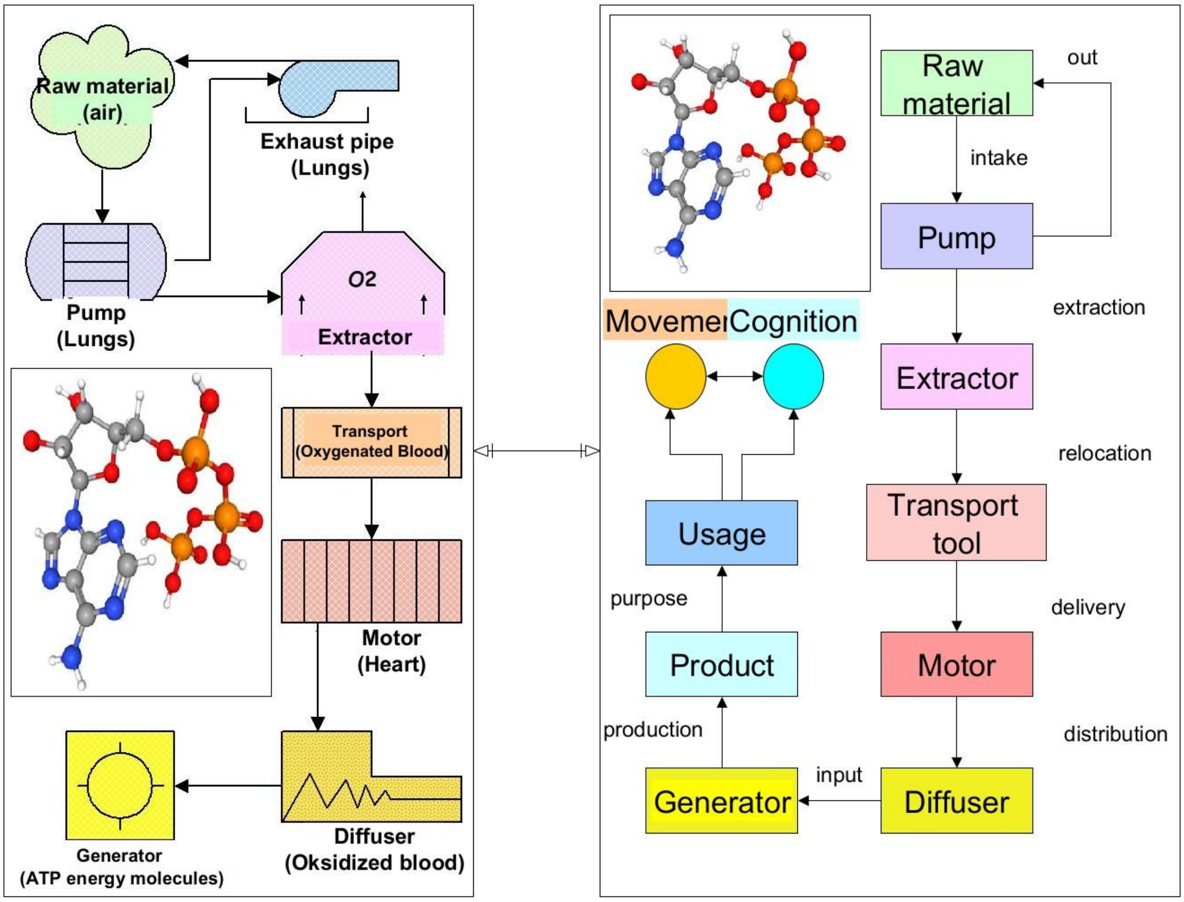
Warm-blooded organisms with more complex physiology and advanced brains are the highest consumers of ATP. Activities like food gathering, home building, child rearing, and forming social bonds require large amounts of energy. This overview suggests that the human species in developed, legal-technological societies is likely the most energy-demanding organism.

ATP molecules are primarily obtained from nutrients—sugars, fats, proteins, vitamins (even sunlight, in the case of vitamin D), and cellular respiration (most efficiently via oxygen). While sleep doesn’t directly produce ATP, it creates favorable conditions for ATP synthesis by allowing for the repair and regeneration of mitochondria.

Based on this associative network, a mechanical model will be developed. In this model, air functions as the raw energy source, while the respiratory muscles and lungs act similarly to a pump and exhaust system. Oxygen is extracted from air via gas exchange and binds to red blood cells. The heart, functioning as a pump-engine, then circulates this oxygen-rich blood to various parts of the body—muscle tissues and vital organs like the brain, stomach, kidneys, liver, spleen, and intestines.

Through cellular respiration, these organs generate ATP molecules, effectively functioning as energy generators (comparable to battery towers). This method of abstraction allows for a simplified descriptive model of the hierarchical associative network, forming a solid foundation for constructing a mechanical model focusing on energy production.

This mechanical model will be important because it illustrates how all known living beings that rely on ATP molecules generate the energy necessary for feeding, metabolism, reproduction, rest, and responding to stress factors (fight, flight, freeze)—in short, for sustaining life. It will visually represent a shared framework for energy acquisition, underpinning survival—a universal drive common to all life forms, from microorganisms and animals to plants, algae, and fungi. However, there are significant differences in how various species pursue excessive prestige.



5.6.5.4.9.1 Figure 502: Derived construct of the mechanical model and metamodel of energy production

Figure 502 illustrates the derived construct of a mechanical model (see the left side of the figure) and a metamodel of energy production (see the right side). This represents a significant simplification of the previously discussed hierarchical associative network on energy production, with the metamodel offering a particularly effective level of abstraction. Both models capture the core principles of energy production in all known living beings, with the metamodel especially highlighting the common foundation of movement and cognitive processes.

Based on its core components, the model reveals the fundamental principles of biological systems, which can be conditionally compared to mechanical systems (e.g., electricity generation) or more complex application systems.

The principles employed by various biological systems are, in essence, quite similar to those found in innovations across chemical engineering, mechanical engineering, and electrical engineering.

The process typically starts with a raw material or resource, which, in addition to pure substances, often contains impurities or less usable elements. These need to be removed through separation processes, and if possible, reused through recycling.

The concept of delivery is also well known—achieved through pumping or injection mechanisms. A commonly used principle in technology is extraction, which isolates useful components from a substance. These components must then be positioned or transported to a specific location for further processing (e.g., an engine) and dispersion. Diffusion is a frequently used principle in many industrial processes.

To generate energy, a specific device (e.g., a generator) is often required to convert the processed materials into added value—in most cases, a useful product. This product serves a specific function or goal in achieving a desired outcome.

Most living beings use gaseous air as a raw material, which is processed within the body into the white powder known as ATP. ATP enables all motor and cognitive activity within natural hierarchical associative systems. This “battery of life” has been successfully used and refined by nature for millions of years.

Our shared universal ancestor, LUCA (Last Universal Common Ancestor), already contained the basic building blocks of life, including ATP, RNA, DNA, sugars (like glucose), proteins, ribosomes, membranes, and ion channels. LUCA represents the simplest known cell, found in all known living organisms.

Our cognitive processes are grounded in reflecting on bodily and environmental systems, often synthesizing various internal and external events. This synthesis—especially in humans—is performed by the brain to construct concepts that support a comfortable and even excessive form of survival. However, this drive often leads us down a path of discomfort and dissatisfaction. From the brain’s perspective, this creates a demand for more sugar to trigger pleasure responses. As previously mentioned, our brains are the body’s largest consumers of sugar.

This leads to the compelling notion that the food industry is geared toward maximizing sugar content in various products (e.g., ketchup, juices, condiments, meat, sweets, chocolate). In recent decades, humanity has become superficially aware of the problem of excessive sugar consumption, which is tightly linked to the broader human tendency toward seeking excessive prestige.

There are some alternatives to sugar in food products (e.g., monk fruit), but these remain largely unavailable or expensive on the market. As a result, the food industry continues to mass-produce sugar-enriched food. This drive for survival through excessive prestige is also evident in the growing pollution of the natural environment, in which these industries play a key role. This leads to increasingly poor air quality—despite air being a fundamental raw material for ATP production.

In short, it appears that the collective mind of humanity in technologically advanced societies is not mentally balanced. As a result, we continuously create new concepts that serve the pursuit of excessive prestige more than actual survival. Alongside water, soil, and sunlight, air is a crucial survival factor.

Cellular energy production can be significantly reduced by various factors, including mitochondrial dysfunction, poor air quality and oxygen deficiency, improper nutrition, dehydration, illness, medications, stress, and lifestyle habits (e.g., alcohol use, smoking, physical inactivity, and lack of sleep).

Mitochondria are specialized cellular organelles that play a key role in life by producing energy for different bodily systems. They are present in all cells of the body except red blood cells.

Mitochondrial dysfunction can result from numerous factors, including genetic mutations, environmental influences (e.g., pesticides, herbicides, toxic gases, allergens), improper nutrition (e.g., too little or too much of certain vitamins and nutrients), unhealthy lifestyles (e.g., excessive physical or mental strain, substance abuse), chronic stress, and aging—since mitochondrial energy efficiency declines significantly over time.

As we can see, mitochondrial dysfunction can be either the primary cause or a significant contributing factor to reduced energy production. Energy output is influenced by both external factors—such as social stress, poor air quality, and other environmental effects—and internal ones, such as lung diseases. Mitochondria are therefore essential for life and represent both the cause and consequence of energy efficiency.

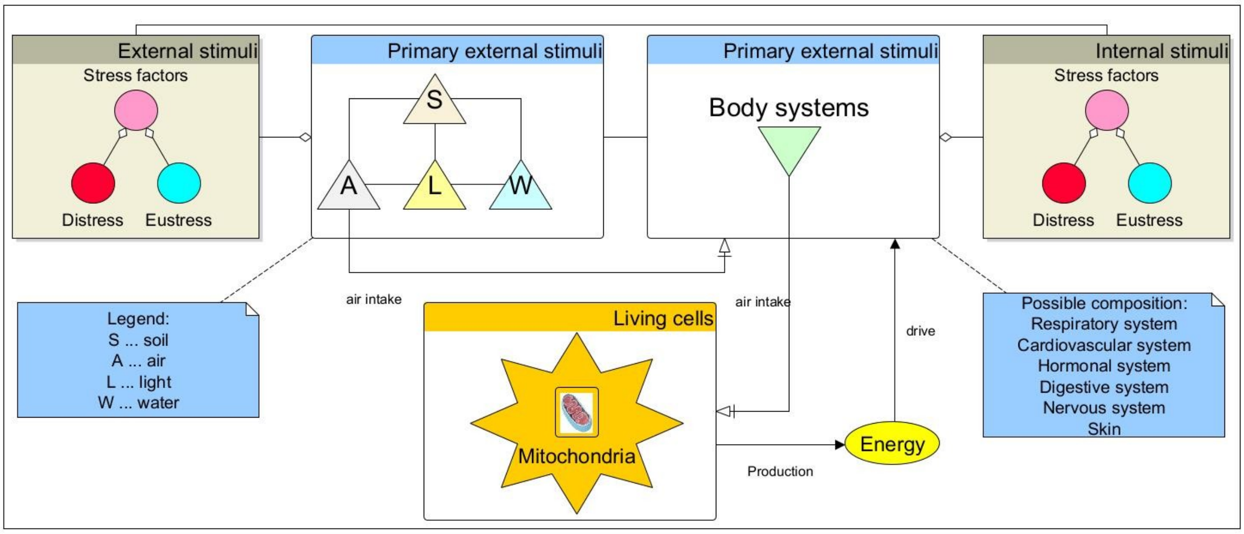
There seems to be a complex interplay between causal (cause-effect) and conditional (condition-outcome) hierarchical associative network systems.

The primary conditions for proper mitochondrial function are internal factors, such as appropriate body temperature, blood pressure, sufficient oxygen levels, and healthy organs, as well as external factors, including clean air, fertile soil (for growing food), adequate water supply, light, and heat.

The relationship between these internal and external factors is not hierarchical but mutualistic (interdependent).

In a broader context, we encounter mutualistic connections between water, soil, air, light, and heat. Water, air, and light directly influence animal body systems, while the influence of soil is indirect—though this does not apply to plants, and to some extent, also not to algae and fungi. There are both direct and indirect relationships between the animal and plant kingdoms (e.g., in food chains). The key conditions for proper mitochondrial function arise from internal factors (e.g., healthy lungs, adequate oxygen levels in the blood) and external conditions (e.g., clean air, pure water, fertile soil, appropriate light and warmth).

What, then, are the effects and consequences? From this perspective, effects and consequences become equivalent, which also implies that causes and conditions are of equal importance. This leads to a merging of causal and conditional perspectives.
It would therefore be meaningful to proceed with modeling a system of mitochondrial energy efficiency.



5.6.5.4.9.2 Figure 503: The influence of factors on mitochondrial energy efficiency

Figure 503 illustrates the influence of various factors on the production of mitochondrial energy efficiency. At the forefront are the previously mentioned primary external (see the figure legend) and internal factors (see the potential composition shown in the figure). Primary external factors are positioned above external stimuli, which include stressors categorized into distress (negative stress) and eustress (positive stress). The same applies to primary internal factors, which are hierarchically above internal stimuli and follow the same categorization.
The primary external factor – air – is delivered into the body via physiological systems, where oxygen is transported to living cells and enables cellular respiration. Within these cells, mitochondria, specialized organelles, produce energy in the form of ATP molecules, which serve as the fuel source for living organisms. For optimal function, most biological systems require air, light/heat, water, and solid food (the latter often indirectly dependent on soil), as only under such conditions can mitochondria effectively produce energy.
A deficiency in primary external factors directly leads to a reduction in mitochondrial energy production. Additionally, various external and internal stimuli—especially those linked to negative stress—can further impair energy output. This can lead to situations where primary external conditions are optimal, yet intense negative external or internal stressors still cause poor energy

efficiency in bodily systems. It is also possible for mitochondria to produce large amounts of energy that are rapidly depleted due to the body’s constant struggle with stressors.

Thus, mitochondrial energy efficiency largely depends on the balance between primary external factors, external stimuli, primary internal factors, and internal stimuli. Even minor imbalances can lead to energy losses and/or reduced production. The regulation of energy production is also critically influenced by various hormones, which can either amplify or mitigate the effects of negative stressors.

From the current perspective (see figure), it is evident that a mutualistic (cooperative) relationship exists between primary external and internal factors—indicating a positive connection between the inorganic and organic worlds. This viewpoint can also be reinterpreted in a more rigid hierarchical way, emphasizing the dominance of primary external factors over internal ones.

The following section presents an assessment of ATP production and consumption in correlation with the mass of selected, previously described organisms.

5.6.5.5 Production and consumption of ATP energy molecules in living organisms

Based on 199 described aquatic and terrestrial species (including microorganisms, plants, insects, other invertebrates, fish, amphibians, reptiles, birds, and mammals), an estimate of ATP molecule production and consumption will be conducted using an energy unit scale from 1 to 100. Additionally, an estimate of the relative mass dependence of each organism type will also be presented on the same 1 to 100 scale.

The main goal of this simulation is to enable further assessment of oxygen production and consumption by living organisms and their impact on the atmosphere. A distribution pattern of oxygen production and usage among different organism types is expected, which will also reveal their energy distribution. Most known living organisms rely on oxygen to produce ATP molecules, with the exception of some anaerobic organisms, such as archaea. All known life operates on the basis of ATP molecule production and consumption, which serves as a universal denominator of life.

There is a correlation between energy output and body mass in living organisms—generally, the larger the organism, the more ATP molecules it tends to produce and consume. When considering the total biomass of organism groups (e.g., mammals, microorganisms, plants), this trend is largely confirmed. However, comparing metabolic processes across organisms such as plants, fungi, algae, and others presents challenges. Similarly, comparing movement and brain activity among species is difficult, since microorganisms, plants, fungi, and algae lack brains as defined by modern science.

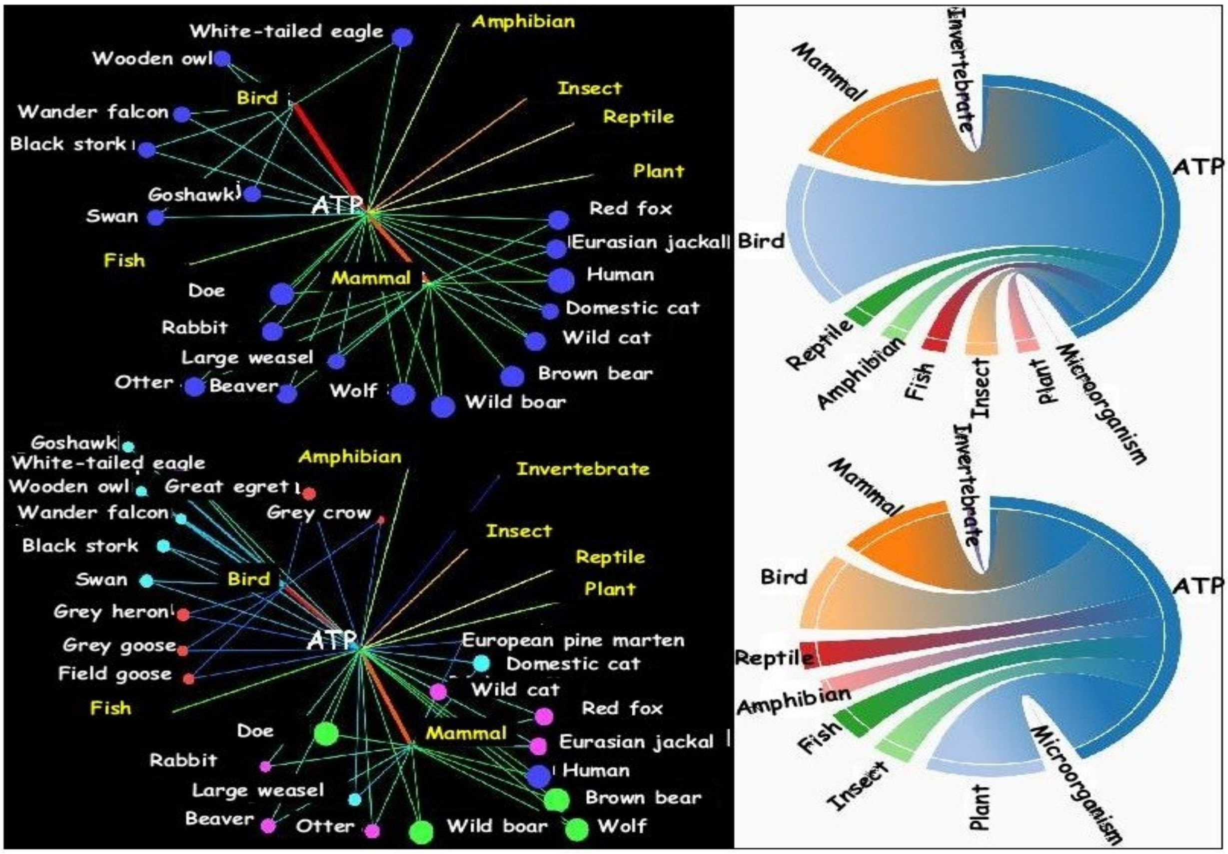
Organisms like plants, algae, and largely fungi primarily use ATP molecules for the growth of roots, branches, leaves, flowers, and fruits, as well as for oxygen production. These organisms typically produce more oxygen than they consume.

It is important to emphasize that this simulation provides only a rough estimate of ATP production and consumption. This is currently the only feasible approach, as data on ATP dynamics for individual species is either unavailable or inconsistent. Based on current assumptions:

- Microorganisms, plants, algae, and fungi are estimated to produce and consume the smallest amounts of ATP.
- These are followed by various invertebrates (e.g., insects, spiders, earthworms), fish, amphibians, and reptiles.
- The highest ATP production and consumption is attributed to birds and mammals.

5.6.5.5.1 Table 218: A truncated selection of data on estimates of the production and consumption of ATP energy molecules in 199 living organisms and their masses

Glavno vozlišče	*Type of organism*	*ATP score*	*Mass score*	*Class of organism*
ATP	Amoeba	1	1	Microorganism
ATP	Yellow water lily	6	6	Ptant
ATP	Water strider	10	10	Insect
ATP	White-tailed eagle	85	50	Bird
ATP	Human	95	80	Mammal



5.6.5.5.2 Figure 504: Estimation of energy production, consumption, and biomass of living organisms based on motor and brain activity

Table 217 presents a portion of statistical data on estimated ATP energy molecule production and consumption (expressed in energy units from 1 to 100) for individual species of living organisms, as well as their biomass (in mass units from 1 to 100). Figure 504 visualizes these data using a network graph (left side of the figure) and a customized chord diagram (right side of the figure). The primary focus of the ATP molecule estimates is on the motor and brain activity of the organisms studied. The custom chord diagram shows the distribution of ATP molecules and biomass across different classes of organisms (e.g., mammals, birds). The highest ATP producers and consumers, in terms of movement and brain activity, are birds and mammals.

Out of the 199 described species capable of living in the environments studied, 31 bird species and 22 mammal species were analyzed. Species with less than 80 energy units (< 80 Eu) were excluded from the analysis—this included organisms from the classes of microorganisms (7 species), plants (36 species), insects (44 species), other invertebrates (11 species), fish (15 species), amphibians (16 species), and reptiles (17 species). The network graph thus only displays birds and mammals that produce and consume more than 80 energy units (> 80 Eu).

The main ATP node has two prominent connections: one to birds (see thick red link with approx. 2141 Eu) and one to mammals (see thick orange link with approx. 1742 Eu). On the third level of the network, larger and smaller nodes are visible. The largest producer and consumer of ATP in this sample is the human (see the largest dark blue node with a value of 95 Eu), followed by the brown bear, wolf, roe deer, and wild boar (see larger light green nodes with values of 90 Eu). From this, we can infer that larger body mass often corresponds to greater ATP production and consumption. This principle is often used within natural hierarchical associative systems (> mass → > ATP). However, there are exceptions, such as many tree species, which produce and consume large quantities of ATP molecules for the growth of roots, stems, branches, and leaves, but not for movement or brain activity.

Next in line among mammals are the red fox, Eurasian jackal, European hare, beaver, otter, and wildcat (see pink nodes with values of 85 Eu). In the second-to-last tier are the domestic cat and European polecat (see light blue nodes with values of 80 Eu), while the pine marten (see small red node with value of 75 Eu) ranks last.

Among birds, the top position is held by the white-tailed eagle (see larger pink node with value of 85 Eu), followed by the peregrine falcon, goshawk, swan, black stork, and tawny owl (see light blue nodes with values of 80 Eu). The lowest ATP values were found in the grey heron, great egret, bean goose, greylag goose, and hooded crow (see small red nodes with values of 75 Eu).

From the perspective of the law of conservation of mass and energy in food chains, it could be expected that prey loses as much energy and mass as the predator gains (e.g., a European hare with 85 Eu eats grass with 5 Eu, then a fox with 85 Eu eats the hare, and finally a wolf with 90 Eu eats the fox). Food chains or networks are diverse, but the law of conservation of mass and energy suggests that the input-output energy ratio is roughly proportional.

Metabolic processes within food webs are highly dynamic, influenced by causal and conditional factors whose relationships are not yet fully understood. Our current understanding of these processes is still limited, relying on an idealized model of proportional conservation of mass and energy, which is not always predictable in nature. In this context, we often encounter the concept of randomness, stemming from incomplete knowledge of all causal and consequential relationships within ecosystems. To estimate oxygen consumption in parts per million (ppm) from air per day for selected species of living organisms, additional data would be needed—such as population size, metabolic rate, activity level, and environmental conditions.

1. Mammals, such as humans, brown bears, wolves, wild boars, roe deer, beavers, otters, domestic cats, wildcats, European hares, red foxes, Eurasian jackals, and European polecats.

a. Humans:

The global human population is approximately 7.8 billion. The average resting metabolic rate for an adult human is about 6000 kcal/day. Activity levels vary significantly among individuals and include dynamic postural changes such as sitting, walking, running, and performing light to heavy physical tasks. In addition, metabolism is influenced by environmental factors such as altitude, temperature, and air quality.

As is evident, this is not a straightforward calculation, but rather a rough estimate. In this section, we will not conduct detailed calculations but will instead provide approximate numerical estimates in ppm.[408] Oxygen Consumption from Air by the Human Population is Estimated at Approximately 544 ppm per Day (mg/L)

b. Brown bear:

The global population of brown bears is significantly smaller than that of humans, estimated at around 225,000 individuals. Despite their relatively high daytime activity and faster metabolism, the small population size greatly reduces their total oxygen consumption. Their estimated oxygen consumption from air is approximately $2.28 \cdot 10^{-5}$ ppm per day, which is even lower in winter due to hibernation and reduced metabolic activity.

c. Wolf:

With an estimated population of around 50,000, wolves are generally more active than both humans and brown bears. As mostly carnivorous animals, they also have a higher metabolic rate. Despite this, their overall oxygen consumption remains significantly lower than that of humans. The approximate average oxygen consumption for wolves is $3.19 \cdot 10^{-3}$ ppm per day.

d. Wild Boar:

The wild boar population is estimated at around 100,000 individuals. Their metabolism is slower than wolves, but still nearly three times faster than that of humans. Their average estimated oxygen consumption is approximately $6.82 \cdot 10^{-3}$ ppm per day.

e. Roe deer (Doe):

An estimated 200,000 roe deer exist globally. Their average oxygen consumption from air is approximately $4.54 \cdot 10^{-3}$ ppm per day.

408 Assessment of oxygen consumption and utilization from air was performed using Chat GPT.

f. Beaver:

The beaver population is estimated at 50,000 individuals. Their oxygen consumption is approximately $2.83 \cdot 10^{-3}$ ppm per day.

g. Otter:

With a population of around 30,000 individuals, otters consume approximately $3.05 \cdot 10^{-3}$ ppm of oxygen per day.

h. Domestic cat:

There are approximately 100 million (10^8) domestic cats worldwide. Due to their large population, their total estimated oxygen consumption from air is around 45.4 ppm per day.

i. Wildcat:

The European wildcat population is estimated at about 100,000 individuals, with an oxygen consumption of approximately $3.98 \cdot 10^{-3}$ ppm per day.

j. European hare:

Estimated at around 1 million individuals, the oxygen consumption for European hares is approximately $4.54 \cdot 10^{-3}$ ppm per day.

k. Red fox:

There are around 500,000 red foxes, and their oxygen consumption is estimated at $3.75 \cdot 10^{-3}$ ppm per day.

l. Eurasian jackal:

With a population of around 100,000, the Eurasian jackal's oxygen consumption is also approximately $3.75 \cdot 10^{-3}$ ppm per day.

m. European polecat:

An estimated 10,000 individuals of European polecat consume about $5.45 \cdot 10^{-3}$ ppm of oxygen per day.

Based on these approximate estimates, it is evident that mammals collectively consume only small amounts of oxygen from the atmosphere. The human population (544 ppm/day) and the domestic cat population (45.4 ppm/day) represent the highest estimated values due to their sheer numbers. All other mammal species examined have significantly lower values, primarily due to their smaller population sizes.

Certain bird species included in the filtered network of living organisms

Some bird species were also included in the filtered network of living organisms, such as the white-tailed eagle, tawny owl, peregrine falcon, common buzzard, swan, and black stork.

a. White-Tailed Eagle:

The estimated population of these birds is approximately 10,000 individuals. The average estimated oxygen consumption from the air for white-tailed eagles is about 2.28 ppm per day.

b. Tawny Owl:

The estimated population is also around 10,000 individuals, with an average oxygen consumption of approximately 0.18 ppm per day.

c. Peregrine Falcon:

With an estimated population of about 10,000 individuals, their average oxygen consumption is roughly 2.27 ppm per day.

d. Common Buzzard:

This bird species has an estimated population of 5,000 individuals, and an oxygen consumption of approximately 1.84 ppm per day.

e. Swan:

Swans have an estimated population of 10,000, with an oxygen consumption of about 0.023 ppm per day.

f. Black Stork:

Their population is estimated at around 5,000 individuals, with an oxygen consumption of approximately 0.049 ppm per day.

Despite their relatively low body mass and small population sizes, these birds consume a proportionally large amount of oxygen relative to their size.

Biomass Comparison and Broader Context

The populations of mammals and birds represent only a tiny fraction of Earth's total biomass when compared with that of plants and bacteria. To illustrate, here are approximate biomass figures in gigatons (GT):

- Plants: 450 GT
- Bacteria: 70 GT
- Fungi: 12 GT

In total, Earth's biomass is approximately 550 GT. Of this, animals account for just about 2 GT, with humans contributing only 0.06 GT. Therefore, mammals and birds together represent only about 1% of all biomass. Consequently, both their oxygen consumption and CO_2 emissions through respiration are nearly negligible when compared to atmospheric levels.

Not all living organisms are essential for the functioning of a planet. This is evident from celestial bodies like Mercury, Jupiter, and Saturn, which exist and operate in the macrocosmic ether without any known life forms.

A similar perspective can be applied to climate systems in Earth's various climate zones. However, important exceptions exist—such as phytoplankton, plants, algae, and the human population in legally, technologically, and socially advanced societies:

a. Phytoplankton, plants, and algae have a strongly positive impact on the climate. They:

- Produce large amounts of oxygen via photosynthesis.
- Affect light absorption and reflection across surfaces.
- Facilitate carbon sequestration and water cycling (from soil to atmosphere through transpiration).

b. In contrast, the human impact is mostly strongly negative, as it:

- Accelerates the greenhouse effect.
- Pollutes the atmosphere extensively.

Although the biomass of humans is relatively small, the population exerts a disproportionately large negative influence on the natural hierarchical associative system of Earth.

Chemical compounds also influence the planet's climate, especially substances like NaCl (salt) and $CaCO_3$ (calcium carbonate). The total inorganic mass of Earth is estimated at around 5,972,000,000,000 GT, which vastly exceeds total biomass, accounting for roughly $9.21 \cdot 10^{-9}$ % of it.

Currently, the human population is exponentially producing additional inorganic mass, which has already surpassed the total biomass on Earth (>550 GT).

Toward an Expanded Perspective

Based on these considerations, it would be appropriate to emphasize the importance of both living organisms and inorganic matter on our planet. This calls for presenting various models that interpret this importance from different perspectives:

- Anthropocentrism
- Functionality
- Informational-communicative value
- Collective effects

Each of these perspectives is likely to produce entirely different hierarchical associative structures. Within these, living organisms—including humans—are not always central, and may in some cases represent only a negligible portion of Earth's natural systems.

As a starting point, we will now examine the anthropocentric perspective as a model with a hierarchical associative structure. This view can be rigidly structured or more loosely defined, depending on its emphasis.

5.6.5.6 Hierarchical associative structure of the importance of living beings from an anthropocentric perspective

A strongly pronounced anthropocentric worldview asserts that humans are the most important living beings in the entire universe and fundamentally different from all other life forms on our planet. Humans are placed above all other organisms, believed to possess a soul and therefore the potential to enter an afterlife in paradise or heaven. Conversely, individuals who commit unethical or malevolent acts during their lives may fall into the fiery abyss of hell, where they are said to suffer for eternity.

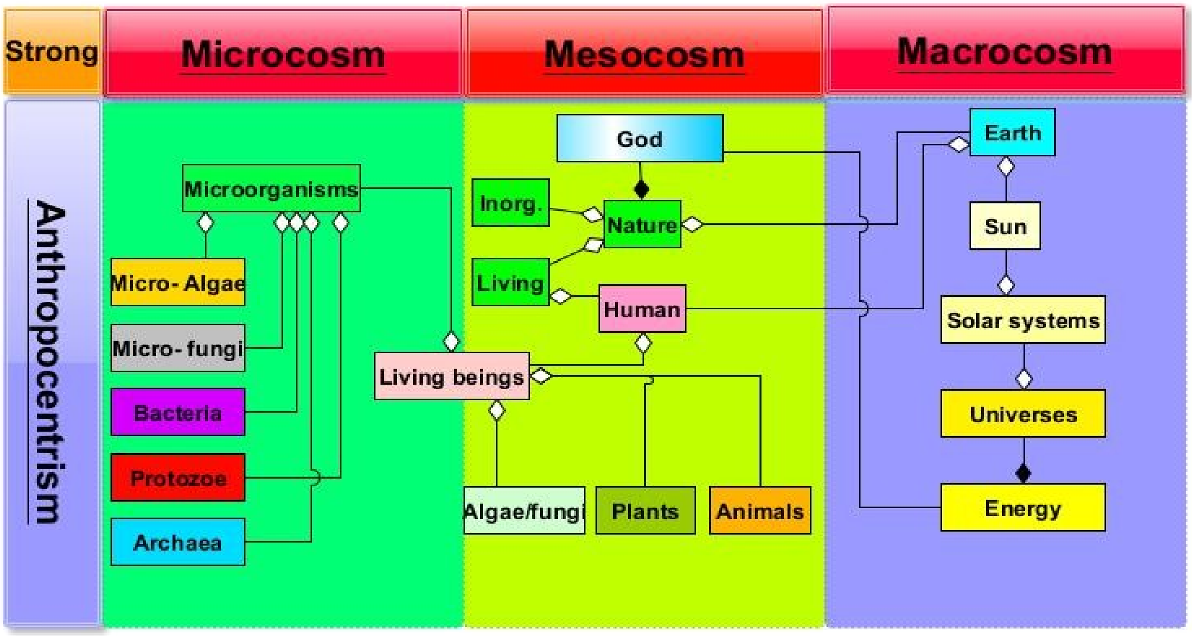
This deeply entrenched anthropocentrism has its roots in Greek mythology, but is especially prominent in the Christian religion. From a strictly anthropocentric point of view, humans are seen as rulers over all other living beings and over nature itself. Within this framework, there are few associative connections to other life forms or to inorganic matter. Instead, relationships are primarily hierarchical, based on a rigid system of dominance.

According to this strict anthropocentric view, all other life forms operate purely on instinct and lack true consciousness—which is considered a prerequisite for having a soul. Inanimate nature is regarded merely as dead matter and not nearly as significant as the human being. It is worth remembering that many past philosophical and scientific theories were based on a strict anthropocentric understanding of life and the universe. Before the discoveries of Kepler, Copernicus, and Galileo, it was even believed that the Earth—and by extension, humanity—was the center of the universe, with the Sun being a subordinate celestial body.

This strict anthropocentric view of living beings and the universe persisted even after these scientific breakthroughs and continued into the 17th and 18th centuries. Only during the Enlightenment did philosophy and science begin to shift toward a more comprehensive understanding of the cosmos (e.g., Descartes, Locke, Kant). Even then, there remained a strong emphasis on human reason, which was considered unique in nature, with the idea that all other creatures functioned mainly through instinct.

A more gradual, differential view of life began to emerge in the second half of the 19th century, following the publication of Darwin’s On the Origin of Species. During this period, the belief that humans were the most intelligent beings—and still dominant over others—persisted. However, from that point on, anthropocentric emphasis began to soften, with increasing recognition that humans differ from other living beings only in degree, not in kind. This shift also led to the development of biological classifications that identify humans as animals, specifically as primate mammals.

In the 20th century, various philosophical anthropologists (e.g., Scheler) proposed that humans occupy a medius locus—a middle ground—between the microcosm and the macrocosm, situating humanity in a central position called the mesocosm. Both the strict and more moderate forms of anthropocentrism limit human cognitive ability and, as a result, hinder a deeper understanding of both nearby and distant realms. This "mental cage" remains deeply ingrained today, but its influence is expected to gradually diminish with the ongoing development of humanoid intelligent robots.



5.6.5.6.1 Figure 505: Strict hierarchical associative anthropocentric model of the importance of living beings on our planet

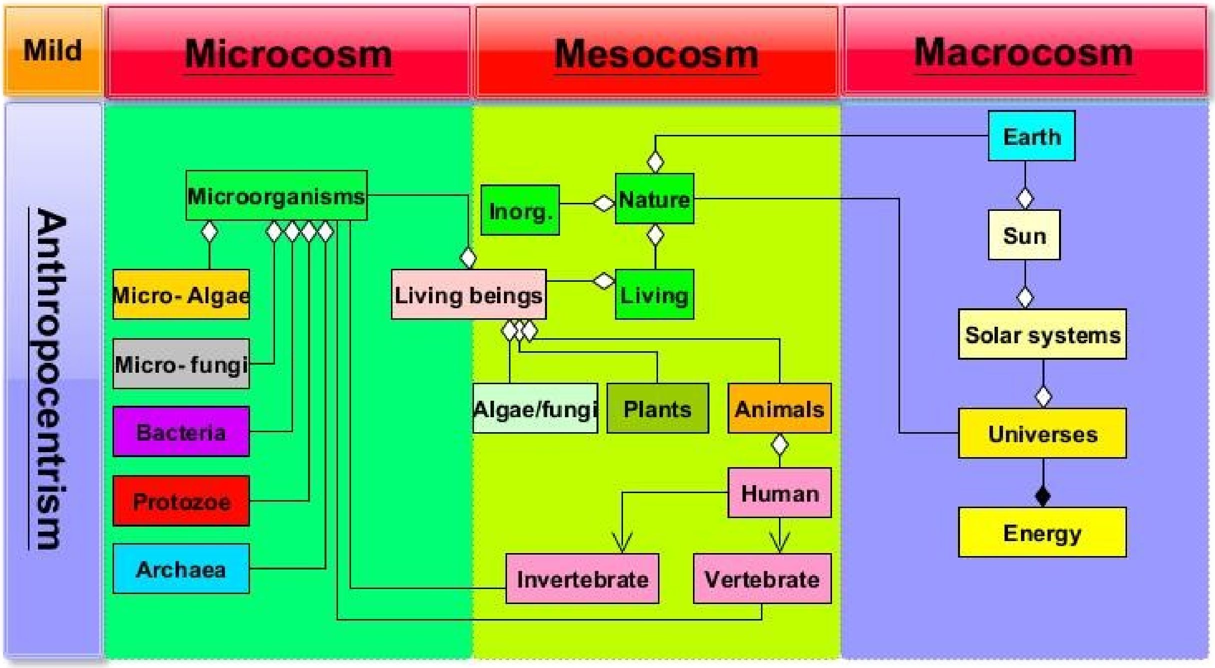
Figure 505 illustrates a strict hierarchical associative anthropocentric model of the importance of living beings on our planet. This model strongly emphasizes superior (e.g., energy in relation to the universe, and God in relation to nature) and dominant connections (e.g., the human relationship to other living beings). Within this framework, there is only one associative link—the connection between God and energy. God is energy, and energy is God. However, from the human perspective, God is placed more within the mesocosmic realm, whereas energy is more closely associated with the macrocosm.

Living beings, except for humans, are considered relatively unimportant in this model. The central role is occupied by the human being, situated on the mesocosmic level. Even more important is our planet, which is viewed as the center of the entire universe and located on the macrocosmic level. Inanimate nature holds no intrinsic value; it exists solely to serve human needs (e.g., for making tools, performing religious rituals, or as a means of payment). Within this model, humans are the masters of both living and non-living nature.

According to this model, humans are also the most functionally, informationally, and communicatively advanced beings and produce the most influential collective effects. This worldview had a significant impact on both art and emerging sciences, particularly on autocratic social structures, which were marked by stark black-and-white contrasts. Human societies were organized in extremely rigid hierarchies, where individuals were categorized as very important, important, or unimportant. Those labeled as unimportant were expected to serve the important and very important figures unconditionally.

Humans were believed to be created in God's image, and although they were expelled from paradise, God continued to devote great attention to them.

In the next section, a less rigid anthropocentric model will be presented—one that still places humanity at the center, but with a more moderate approach.



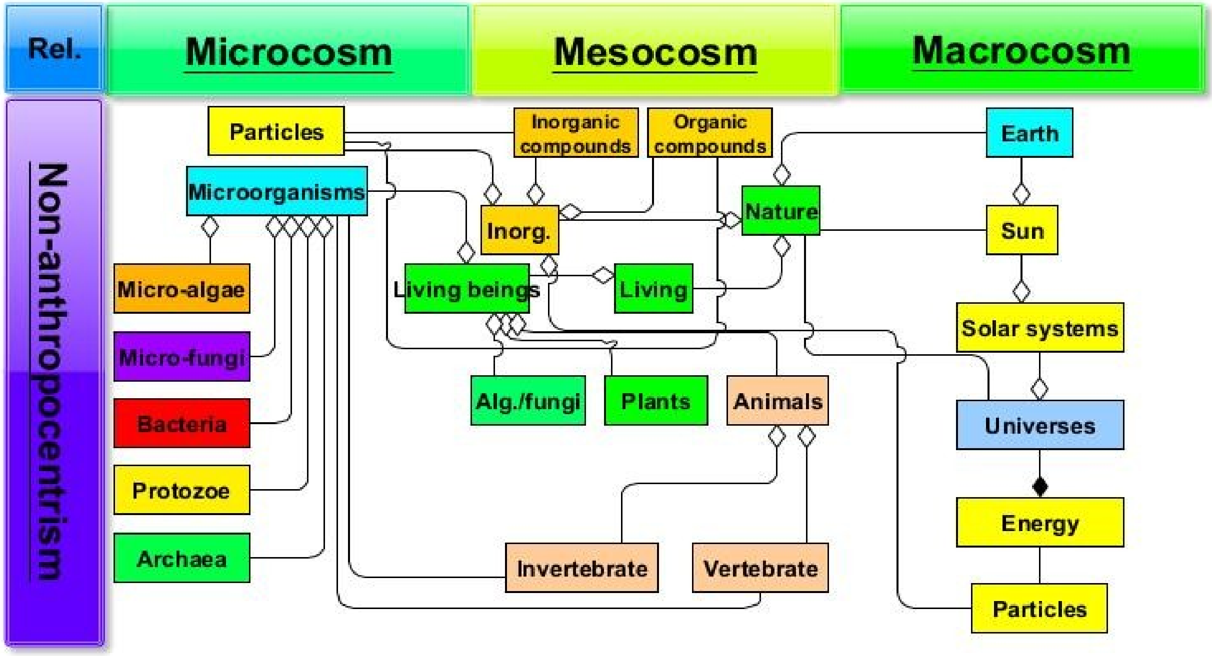
5.6.5.6.2 Figure 506: Mild hierarchical associative anthropocentric model of the importance of living beings on our planet

Figure 506 illustrates a mild hierarchical associative anthropocentric model of the importance of living beings on our planet. Compared to the previous model, several notable differences emerge:

a. The significance of God is considerably reduced and is not included in this model.

b. There is only one superordinate connection, representing the relationship between energy and the universe (see the straight connection with the black diamond). This implies that the entity "Energy" is the most important and superior to all other entities. This result is not surprising, given that the 18th, 19th, and 20th centuries were marked by industrial revolutions, which focused heavily on energy acquisition.

c. This model displays a greater number of associative connections among living beings (see the straight lines).
d. Humans differ from other living beings (except microorganisms) only in degree. They are no longer viewed as the absolute rulers of nature, although their role remains significant (see arrow connections to invertebrates and vertebrates). Humans are considered rational beings, while other living creatures operate mainly on instinct. In this model, humans function more as mentors of nature.
e. The geocentric model of the universe has largely been abandoned and replaced with the heliocentric model. Earth is no longer viewed as the center of the universe, but rather as a celestial body orbiting the Sun. It is no longer superior to the Sun but subordinate to nature. In this regard, Earth has been repositioned to a planar level within the mesocosm.
f. The importance of inanimate nature has not significantly changed in this model. It still serves human needs for quality survival—often excessively, in the form of prestige or status.
Based on these observations, we can conclude that humans are still considered the most important living beings, as they are the most functional (acting as nature's mentor), the creators of the greatest informational and communicative value, and the initiators of the most powerful collective effects (e.g., building machines for energy production). However, human activities are already showing negative consequences in the form of biomass destruction and air pollution on our planet. Biomass, in particular, has been noticeably declining since the 18th century.
In the following section, we will present several relatively non-anthropocentric models that place far less emphasis on the importance of humans within cosmic levels.



5.6.5.6.3 Figure 507: Relatively hierarchical associative non-anthropocentric model of the importance of living beings on our planet

Figure 507 depicts a relatively hierarchical associative non-anthropocentric model of the importance of living beings on our planet. In this model, the boundaries between cosmic levels are less distinct and significantly more intertwined. This perspective allows for greater freedom in scientific research and opens the door to an exponential expansion of possibilities. The key differences compared to the previous models are as follows:

a. There is a significantly larger number of associative connections, while the number of hierarchical connections has only slightly increased (e.g., connections between particles, inorganic and organic compounds).

b. This model includes chemical substances and their particles, which exist across all cosmic levels, with particular emphasis on the microcosm and macrocosm. These particles are highly diverse, countless from our perspective, and invisible to the naked eye, including atoms, ions, protons, neutrons, electrons, pions, photons, and others. Therefore, the associative connection between particles in the microcosmic and macrocosmic levels is not surprising. The connection between energy and particles is also logical, as energy is composed of particles (e.g., light energy contains energy packets called photons).

c. In this model, humans are no longer the absolute rulers of nature, nor are they significantly superior to other living beings. Rather, they are classified within a broader group of vertebrates, which includes mammals, birds, fish, amphibians, and reptiles.

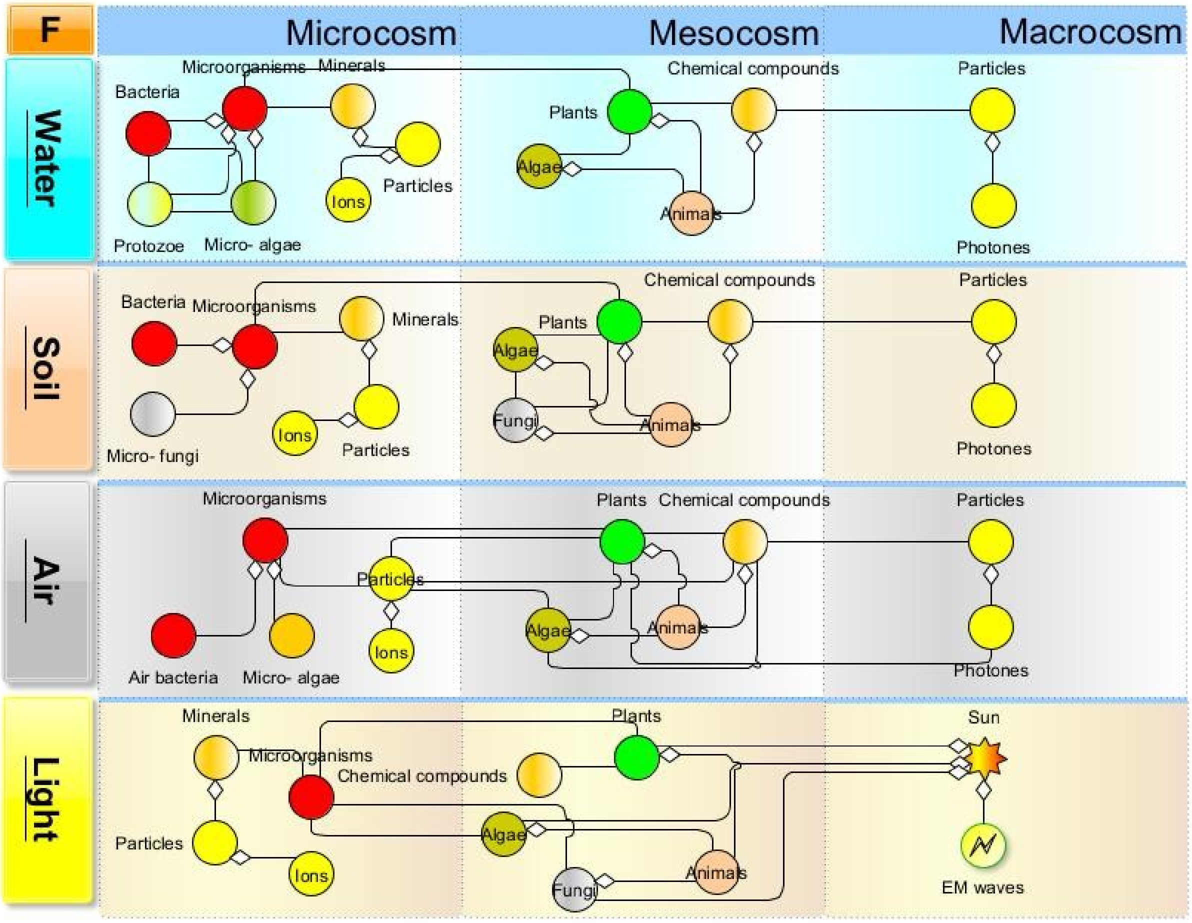
d. Non-living nature—and consequently chemical compounds and their particles—are not directly connected to living beings in this model, indicating a high level of abstraction.

e. The entity “Energy” is superior to all other entities (see the hierarchical connection or composition marked by a black diamond).

f. Although living beings, including humans, still take a central position in this model (as seen from our perspective), the anthropocentric emphasis is less pronounced. Therefore, the model is considered relatively non-anthropocentric, even though it still retains informal anthropocentric elements at its core.

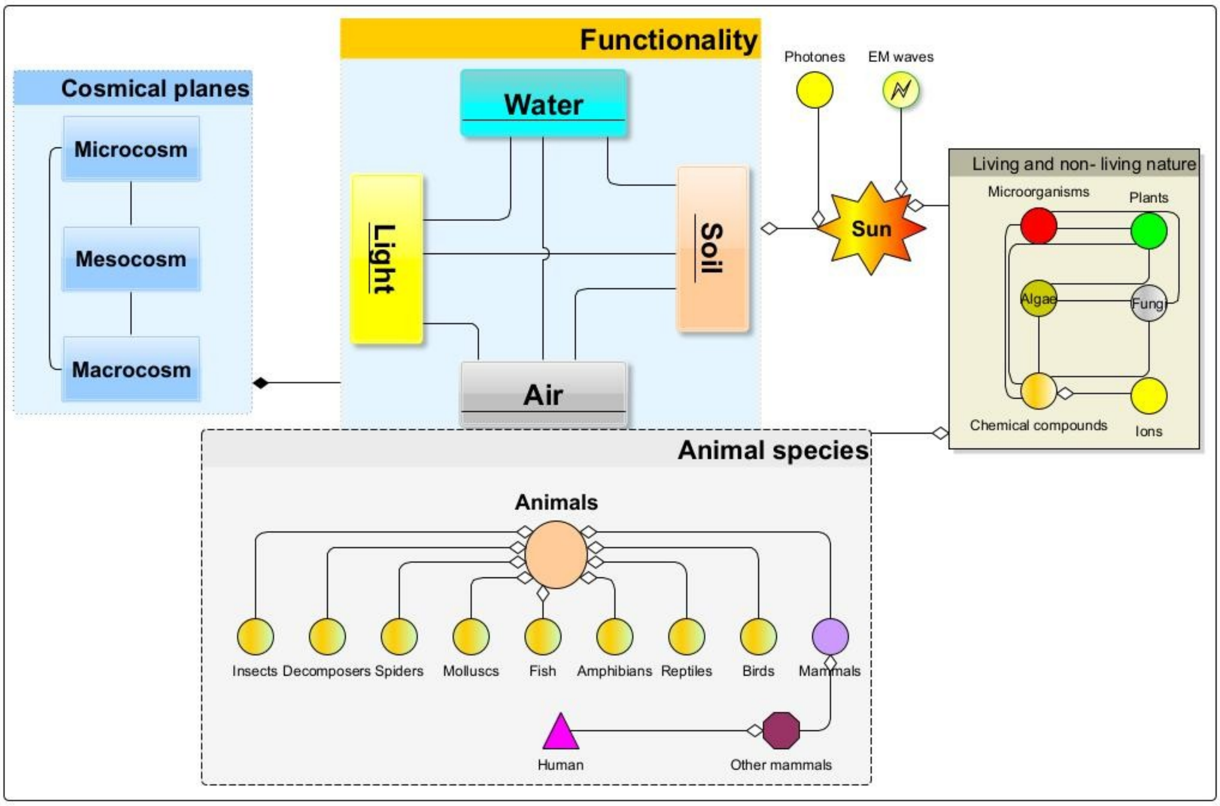
From an intellectual standpoint, this model is significantly more complex than the previous ones. As a result, the following sections will need to explore in greater detail the relationships between water, soil (earth), air, and light. Based on this, additional models will be developed that incorporate aspects such as:

- Functionality (e.g., air),
- Information and communication value (information production and communication complexity),
- Collective effects (the impact of living and non-living systems on nature, energy production and consumption, and their consequences).



5.6.5.6.3.1 Figure 508: Network matrix of the relatively hierarchical associative non-anthropocentric model from the perspective of the functionality of living beings on our planet

Figure 508 illustrates a network matrix of the relatively hierarchical associative non-anthropocentric model from the perspective of functionality (see label F in the orange frame) of living beings on our planet. It can be observed that animals, within the cosmic levels, exert the least positive functional impact on water, soil, air, and light, as they are subordinate to plants, algae, fungi, microorganisms, and even to chemical compounds and various particles such as ions and photons. The human contribution to positive functionality is negligible, as human activity within these cosmic levels has a distinctly negative impact on water, soil, air, and light (e.g., pollution of water, soil, air, and light). Based on this visual network matrix, a synthesis and abstraction of all components was carried out, resulting in a simplified model of positive functionality in the form of a bundled network diagram.



5.6.5.6.3.2 Figure 509: Bundled network diagram of positive functionality

Figure 509 presents a bundled network diagram of positive functionality, which places the celestial body—the Sun—with its electromagnetic radiation (EM) and energy packets (photons) at the forefront. This is because the Sun's overall influence on water, soil, air, as well as light and warmth, is by far the greatest and most positive. This conclusion is supported by the hierarchical connections (see straight lines with a white diamond), which can also be stated for the bundle representing the living and non-living nature.

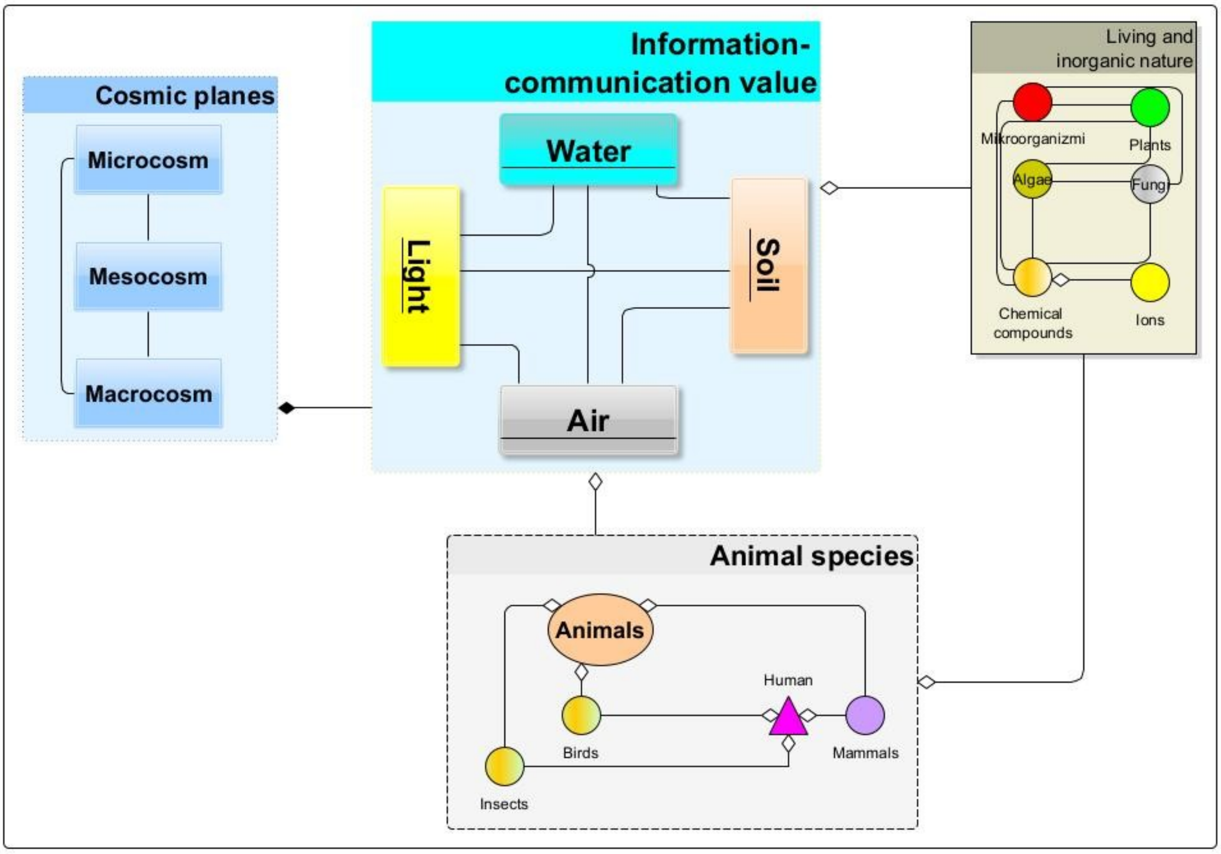
It is important to emphasize that all these positive functionalities operate within the framework of cosmic levels, which are associatively interconnected and consequently intertwined (see the cosmic levels bundle). The bundle of cosmic levels is superordinate to all other entities, including the Sun itself (see the connection with a black diamond or composition).

Looking at the bundle of animal species, we observe a pattern similar to that in the previous diagram, with the exception that humans are placed at the very bottom in terms of positive functionality toward water, soil, air, and light. We can conclude that within the natural hierarchical associative system, the human being is the least functional in terms of positive contributions and thus ends up at the bottom of the hierarchy—entirely subordinate.

It could now be said that humans attempt to resist this position through negative functionality in an effort to escape complete subordination. Despite everything stated, it can still be argued that the human species, within legally, socially, and technologically advanced societies, is something unique. It comprises an exceptionally small biomass, yet still exerts a negative impact not only on our planet but also on the atmosphere.

In terms of various traits—such as genome size, physical size, mass, bioenergy consumption, brain size, etc.—humans are not particularly exceptional. What truly sets them apart are their informational, communicational, and technological skills, and above all, an extraordinarily strong survival drive coupled with an extreme pursuit of prestige.

We now continue with a hierarchical associative model from the perspective of the informational and communicational value of living beings.



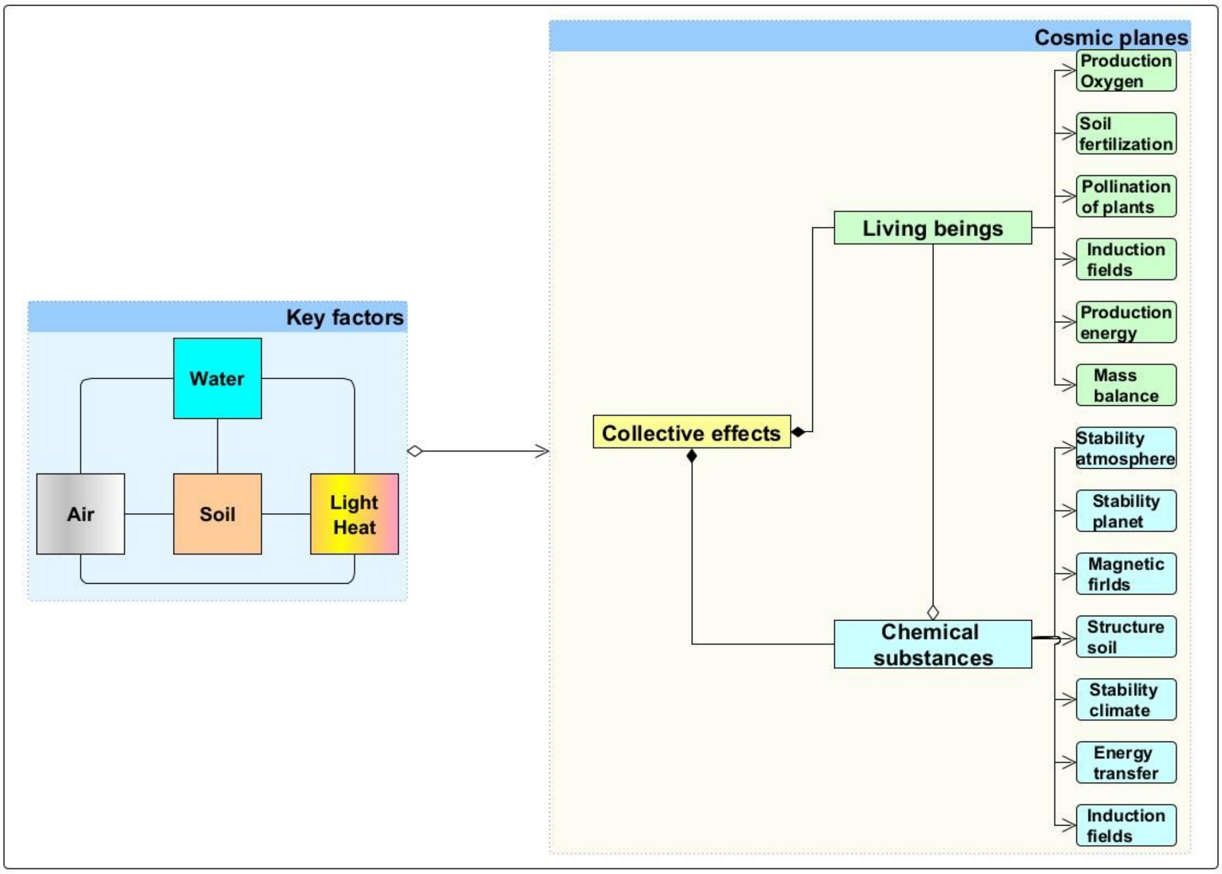
5.6.5.6.4 Figure 510: Packet network diagram of information and communication value

Figure 510 illustrates a packet-based network diagram of informational and communicational value, which also includes the technological aspect. On one hand, it refers to the social skills involved in connecting and communicating among members of a given society in the broadest sense. On the other hand, it involves the production of technologies geared toward communication, the processing of acquired information into knowledge, and the development of various tools for utilizing that information and knowledge.

Broadly speaking, it concerns sociotechnical capabilities, which are highly dependent on key entities such as water, soil, air, and light. In the previous hierarchical associative model, humans were placed at the bottom of the hierarchy. However, from the perspective of informational and communicational value, humans are positioned above all other living beings and inanimate aspects of nature. Based on our understanding of the world, it can be asserted that humans are the greatest producers of information and complex social structures. Furthermore, humans have developed the most complex system of diverse communications—ranging from language to communication between different devices.

This placement of humans at the top of the hierarchy does not inherently imply anything negative. However, the consequences of human actions tell a different story. The establishment of various infrastructures (urban and transport systems, information systems, artificial satellites, factories, etc.) requires the destruction of significant biomass and leads to various types of pollution. If we also consider the excessive drive to maximize profit, the extent of the damage caused becomes completely clear and undeniable.

From this perspective, one could report on the negative collective impacts of a specific entity—namely, the human species. Based on this premise, the following section will present a hierarchical associative model from the viewpoint of realized positive collective effects, which also includes the energy aspect.



5.6.5.6.5 Figure 511: Packet-based network tree diagram of the collective effects of chemical substances and living beings

Figure 511 presents a packet-based network tree diagram of the positive collective effects generated by chemical substances and living organisms. Particularly, ions from chemical compounds (e.g., $CaCO_3$, NaCl, KCl) have a significant influence on the atmosphere, climate, planetary stability, induction fields, oxygen production, and various forms of life. This is why, from a hierarchical perspective, chemical substances and their ions are placed above living beings (see the connection marked with a white rhombus). Based on what we know, neither life forms nor planets can exist without these ions.

All existing and newly formed collective effects of chemical substances and living beings are stimulated by key environmental factors such as water, soil, air, and light/heat. This creates a hierarchical relationship between the two groups, which is further strengthened by the direction of influence (see the arrowed link with the white rhombus).

Through the description of 199 living organisms and selected chemical compounds, it became possible to understand the varying degrees of influence they exert on our planet, climate, atmosphere, and their interactions with one another.

From an energy perspective, it is essential to highlight that the primary sources of energy on our planet are water, soil, air, light/heat, and internal Earth processes (e.g., magnetic fields, gravity), as well as macrocosmic influences of the Sun on Earth (e.g., electromagnetic fields, gravitational forces). According to current understanding, energy is dispersed with a high degree of entropy, although this is somewhat moderated by the formation of chemical substances, and to a lesser extent, by living beings.

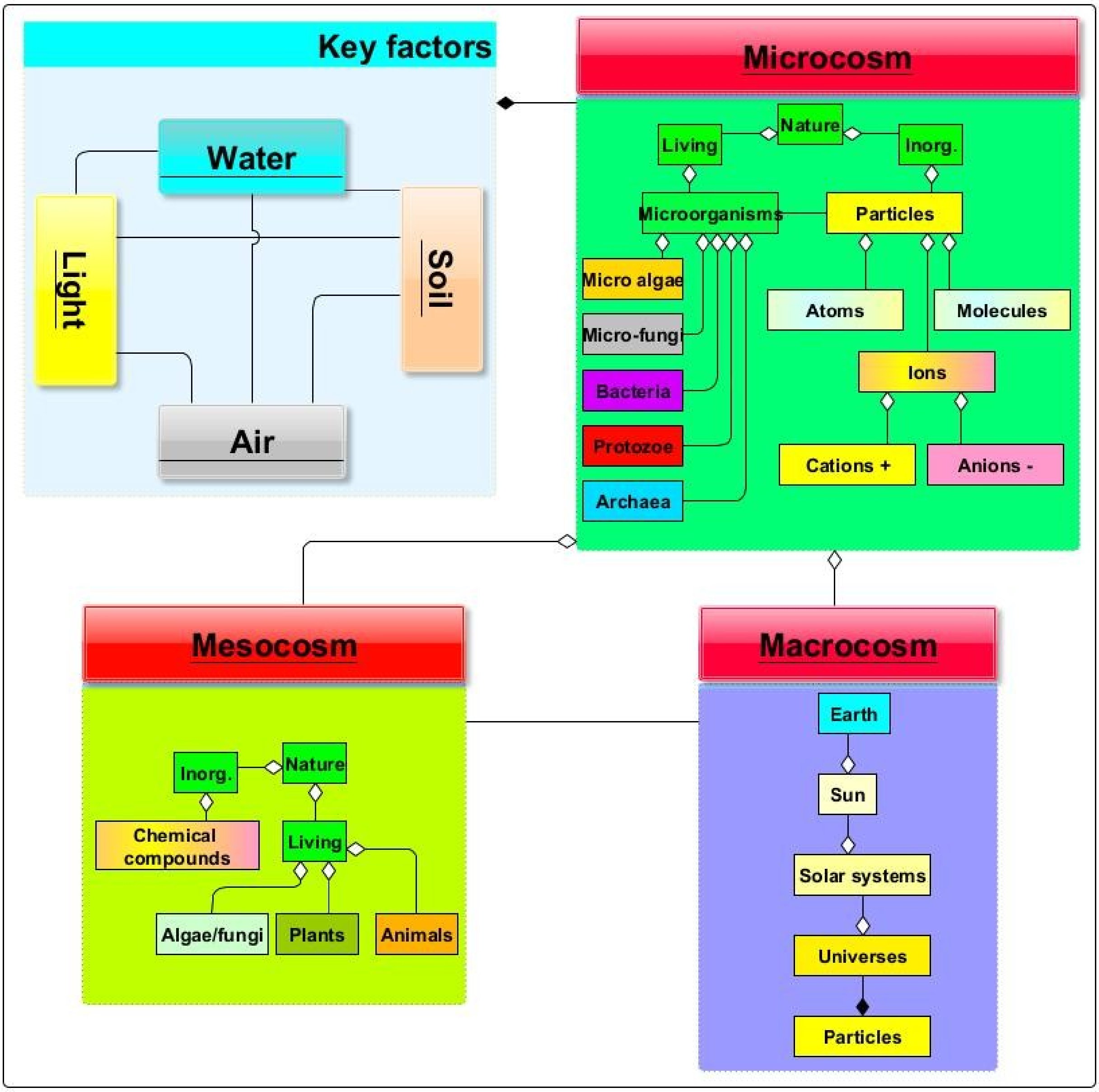
Energy is not considered alive or intelligent, meaning science currently does not recognize the existence of intelligent energies. If such intelligent energies did exist, it would imply that they not only act with high entropy but also operate in an organized way, pursuing plans and implementations—approaching, or even entering into, the realm of life in the form of dynamic energies.

These could be thought of as intelligent energy beings, structured as nodes and connections (direct and indirect networks), somewhat reminiscent of neurons in the human brain.

The main difference is that these energy neurons would not be as limited, since they are not confined to small spaces or trapped in mass, such as crystalline structures. Based on these bold assumptions, one could ask: Does air provide the foundation for the emergence of intelligent energies on our planet? And if so, can these energies integrate into living beings?

One cannot deny that air essentially serves as raw material for the development of more or less intelligent life forms.

We now continue with the presentation of a hierarchical associative model, this time focusing on the microcosmic perspective.



5.6.5.6.6 Figure 512: Packet-based network diagram with emphasis on the microcosm

Figure 512 presents a packet-based network diagram focused on the microcosm, offering a non-anthropocentric view of the world. In this model, the microcosmic level is positioned above both the mesocosmic and macrocosmic levels. The latter two are in a relatively equal relationship with each other (see the associative connection represented by a straight line).

Animals, plants, algae, and fungi from the mesocosmic level are, within this model, considered subordinate to microorganisms and various small particles such as atoms, micromolecules, and ions. The same applies to the macrocosmic level, which, from this perspective, is fundamentally composed of tiny invisible particles at the nano- and femto-scale.

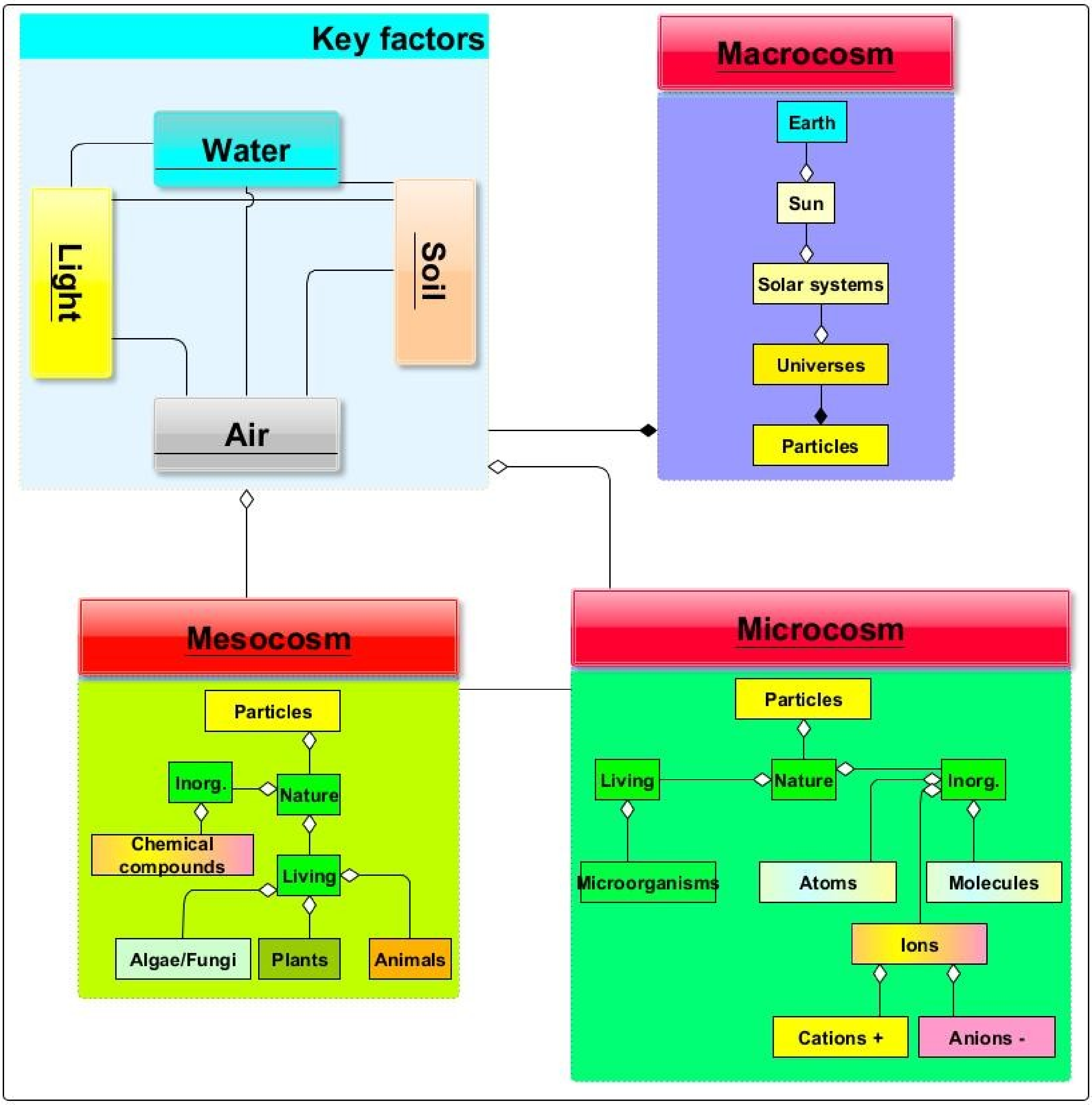
In essence, these small particles are the true rulers of the universe (see the superior relationship or composition marked by a straight line with a black rhombus between particles and universes). The main driving forces are key environmental factors such as water, soil, air, and light (see the straight-line connection with a black rhombus or composition). These key factors also exhibit mutual associative connections, indicating that their interaction results in strong collective effects.

The primary agents behind these collective effects are in fact the small particles—such as small molecules, atoms, ions, photons, and so on. From this perspective, both these particles and microorganisms are the most functional and dominant in terms of information and communication. This also implies that the majority of energy creation and consumption originates in the microcosmic realm.

Based on this model, one might conclude that the microcosm is the most organized and least chaotic, exhibiting the lowest level of entropy compared to the other two cosmic levels. However, the challenge is that we are currently unable to calculate entropy within the microcosmic level, so this remains a hypothesis, revealing a limitation of both this model and our understanding.

According to this view, the human being is simply a living organism made up of various particles, chemical compounds, and microorganisms, which might suggest that consciousness itself emerged from these small building blocks. This perspective poses a significant challenge for humans, but not for future humanoid intelligent robots, which will likely be able to abstract away the factor of subjectivity, something humans are inherently unable to do.

We now continue with the next non-anthropocentric hierarchical associative model, this time with an emphasis on the macrocosm.



5.6.5.6.7 Figure 513: Packet-based network diagram with emphasis on the macrocosm

Figure 513 illustrates a packet-based network diagram with a focus on the macrocosm, presenting a non-anthropocentric perspective in which the macrocosmic plane is placed above the key environmental factors such as water, soil, air, and light (see the composition indicated by a black rhombus in the diagram). This package of key factors is in turn superior to both the mesocosm and microcosm, which are considered to be in a relatively equal relationship with one another (see the associative link shown as a straight line).

Microorganisms, animals, plants, algae, and fungi from the micro- and mesocosmic planes are, in this model, viewed as equal to small particles. The same applies to the macrocosmic level, which, from this perspective, is also made up of tiny, invisible particles on the nano and femto scale. In short, these small particles are once again seen as the true rulers of the universe (see the superordinate relationship or composition represented by a straight line with a black rhombus between particles and universes).

The main driving force is attributed to particles within the macrocosmic plane. The key environmental factors mentioned above show interconnected associative relationships, indicating that their interaction results in strong collective effects. The primary generators of these effects are, once again, small particles—such as small molecules, atoms, ions, photons, and others.

It's important to emphasize that these key factors operate within the space of the macrocosm, which means their influence differs from their function in the previous model. In this view, galaxies, universes, solar systems, and celestial bodies, as well as microorganisms, plants, algae, fungi, and animals, are all seen as small particles—the most functional and dominant in terms of information and communication. This also implies that the greatest amount of energy production and consumption comes from the macrocosmic domain, due to the greater strength and quantity of particles.

From this model, we might conclude that the macrocosm is the least organized and most chaotic, with the highest degree of entropy when compared to the other two cosmic planes. This is due to the strongest and most intense forces and energies acting within it. It is easier to compare the micro- and mesocosmic planes with each other than with the macrocosm.

The macrocosmic level contains very different types of atmospheres (e.g., mixtures of unfamiliar gases) that are not comparable with those in the meso- and microcosmic levels. The same applies to the variety of electromagnetic radiation: in the macrocosm, we find abundant gamma rays, microwaves, radio waves, infrared light, visible light, ultraviolet light, X-rays, and more. Many of these are rare or absent in the micro- and mesocosmic realms.

Soils in the macrocosm are also not comparable. While water is abundant in the macrocosmic plane, it is mostly found in frozen form or as vapor. In summary, key factors like water, soil, air, and light within the macrocosm are fundamentally different from those in the other two planes, which is why entirely different natural laws (such as time, space, energy, and mass) prevail in the macrocosm.

Processes within the macrocosmic level may be interpreted in connection with the other two planes or even primarily as separate. A holistic interpretation may seek connections and similarities, but it's important to recognize that the macrocosm does not exist solely because of the micro- and mesocosm. Rather, it may also be more or less connected to other worlds we have not yet discovered.

To this uncertainty, we can add the interpretation of order and disorder. According to the presented model, order may be a result of disorder transferred from the macrocosm (e.g., the scattering of solar rays reaching our planet). However, this assumption may be too limited, as it excludes the possibility of intelligent energies, which are not yet scientifically recognized. If such energies were acknowledged, we could also consider that order itself might be consciously transmitted from the macrocosm.

An open mind leads to many more possibilities and combinations. Conversely, if we minimize our thinking—as science often unconsciously does—we end up with far fewer possibilities and combinations, resulting in a more closed or limited model of understanding cosmic levels.

Although many other models could be introduced to influence scientific thinking and practice, that is not the main goal of this section. These models have primarily served as a gentle transition to the next chapter, which focuses on light.

5.7 Light

Many scientific disciplines—including physics, optics, astronomy, chemistry, biology, spectroscopy, various branches of engineering, medicine, environmental science, meteorology, and others—study the phenomenon of light, which means its scope is inherently interdisciplinary. We distinguish between different types of visible and invisible light, each occurring at specific wavelengths.[409]
The invisible light spectrum includes gamma rays, X-rays, and ultraviolet (UV) radiation. Light becomes visible to the human eye only within wavelengths ranging from 400 nm to 700 nm. Within this range, we distinguish the following colors:

- Violet (400–450 nm)
- Blue (450–495 nm)
- Green (495–570 nm)
- Yellow (570–590 nm)
- Orange (590–620 nm)
- Red (620–700 nm)

Beyond 700 nm, we return to the invisible spectrum, which includes infrared light, radio waves, and microwaves. In short, the human visible spectrum spans 400–700 nm, while all other types of radiation can only be detected with the help of modern technology.
Light plays a crucial role in the plant world, and consequently in the survival of all living beings that feed on plants or use them for shelter. Light waves significantly influence plant growth and development. For a long time, there was debate over whether light is a wave or a collection of particles. Today, the dominant view is that light has a dual nature—it behaves both as a wave and as a particle. This compromise, backed by extensive research, is widely accepted, since light always originates from matter. Without matter as we know it, light would not exist.
Sunlight is produced through the nuclear fusion of hydrogen into helium, a process that releases vast amounts of heat and light. The same principle applies to a candle: without wax and a wick, there would be no flame. Likewise, all other light sources rely on matter (e.g., flashlights, batteries, firefly phosphorescence). Light is a form of energy, often correlated with thermal energy (e.g., sunlight, visible light, UV, infrared).

409 The chapter was compiled based on the following sources:
Colson, M. (2016). *The Science of Light*. Gareth Stevens Publishing.
Arcand, K., & Watzke, M. (2024). *Light: The visible spectrum and beyond*. Black Dog & Leventhal Publishers.
Santoso, J., Suhardjono, H., & Wattimury, A. (2020). The study of color spectrum curs value against sunlight color and artificial light for plant growth. *Nusantara Science and Technology Proceedings*, 11–22. https://doi.org/10.11594/nstp.2020.0602.
Holick, M. F. (2014). Sunlight, ultraviolet radiation, vitamin D and skin cancer. Sunlight, *Vitamin D and Skin Cancer*, 1–16. https://doi.org/10.1007/978-1-4939-0437-2_1.

This chapter focuses on sunlight and its effects on water, soil, and air, as we examine the hierarchical relationships among these elements. These interactions influence climate and the development of living organisms, and in turn shape natural food chains. Sunlight heats water, soil, and air, affecting dynamic changes and ultimately local and global climate. Although sunlight directly warms the air, it has a stronger effect on heating the soil and water sources, which in turn indirectly warm the air. This heating causes warm air to rise and cool air to descend, a process known as convection, which plays a major role in weather patterns.

Ultraviolet radiation triggers photochemical reactions in the atmosphere, producing ozone and photochemical smog. Sunlight's effect on soil is especially strong in darker and more humid soils, where it promotes water evaporation, influencing humidity and local weather conditions. It also supports plant growth, which is impossible without soil. Sunlight affects water as well, causing it to heat up, evaporate, and circulate, impacting both ecosystems and climate.

These facts clearly demonstrate that this is a system that supports life. Small changes in the system can increase or decrease biomass on the planet. At present, it appears that biomass is declining, a topic that has been addressed in numerous studies.

The Sun, as a celestial body, does not act with intent to promote biomass growth. Its operation is automatic, yet it contributes to the balance of the planetary system. The sun’s rays reach Earth randomly, without a specific goal or purpose, but they nonetheless enable life, which functions according to its own collective intelligence and follows the laws of natural systems. The basic goals of living beings are survival (including reproduction), achieving a certain status, and maintaining energy and mass balance.

From our perspective, natural phenomena often appear purposeful. This suggests that even the Sun’s activity might be seen as meaningful, despite lacking intentionality. The interactions between the living and non-living worlds can be explained by fundamental physical and chemical principles, such as attractive and repulsive forces, the law of conservation of mass and energy, food chain relationships, and behavioral patterns of organisms.

Our worldview assumes that goals and purposes in living beings arise from random events. This is supported by the observation that no life has been found on other known planets. Therefore, we operate with an open model of interpretation based largely on coincidence, reflecting our limited understanding of the universe.

Still, despite its randomness, the Sun enables the development of goal-directed life. This also applies to much of the inorganic world. If we set aside our ignorance, we might conclude that randomness and purpose are constantly intertwined.

This mental compromise allows us to go beyond our limitations and adopt a broader perspective. Our insight into the universe is always partial, even within the mesocosm—the cosmic level closest to us. If we focus solely on human consciousness, we can observe certain phenomena in the universe, try to make sense of them, and use them meaningfully.

Our interpretations of the Sun and universe are subjective. We can either define them clearly or keep the issue open. An interdisciplinary approach may help us expand our intellectual horizons.

We know the Sun is superior to Earth and to us. Paradoxically, this "goal-less leader" compels us to act with purpose. In doing so, we often make mistakes that harm both ourselves and the larger living system. The system displays a certain degree of control and a high level of self-organization, which makes it difficult to continue labeling it as entirely purposeless. Ultimately, we might simply not understand our leadership and fail to see the bigger picture.

This line of thinking brings us closer to the idea of a "big picture" or a grand design by a creator of life and non-life. The drive toward self-organization is, at its core, a drive toward equilibrium, though both are subject to change and eventual return to balance. This is largely due to the many types of energy we have identified and defined. Energy is dynamic, variable, persistent, and indestructible.

The wide range of known energy forms enables a drive toward self-organization and balance, which begins even at the particle level (e.g., muons, pions, ions) and their charges (attractive and repulsive forces). These forces exist because of matter and energy, or rather due to the intermediary states between them—possibly a form of potential energy and matter. In short, we are dealing with many unknown potentials.

When these potentials interact, they may cause motion or at least oscillation, which resembles wave behavior. A certain type of wave may emerge from the encounter of two particles, whether they attract or repel each other. Charges, then, could be seen as a form of potential energy that enables oscillation and wave formation.

Our Sun is primarily composed of gases and plasma, held together by various forces (e.g., gravity, electromagnetism, internal pressure, radiation), which prevent the gases from dispersing or collapsing into the cosmic ether. As a result, electromagnetic waves are generated and, depending on the Sun's internal conditions, radiate outward into space. Some of these rays reach our planet.

The Sun could be described as a self-organizing and balanced celestial body that produces electromagnetic waves and generates a strong gravitational force, influencing the planets and establishing a system of attractive and repulsive forces. It attracts the planets just enough to keep them in orbit while simultaneously repelling them just enough to prevent them from falling into its core.

From this perspective, it is difficult to claim that the Sun's activity is entirely purposeless, and consequently, its rays are not completely without intent. The Sun's activity creates a system governed by strict hierarchical and associative relationships. These relationships are especially evident on our planet, where sunlight interacts with water, soil, and air, enabling the emergence and development of life. From our viewpoint, some conditions remain relatively stable over long periods, significantly shaping established hierarchical and associative relationships.

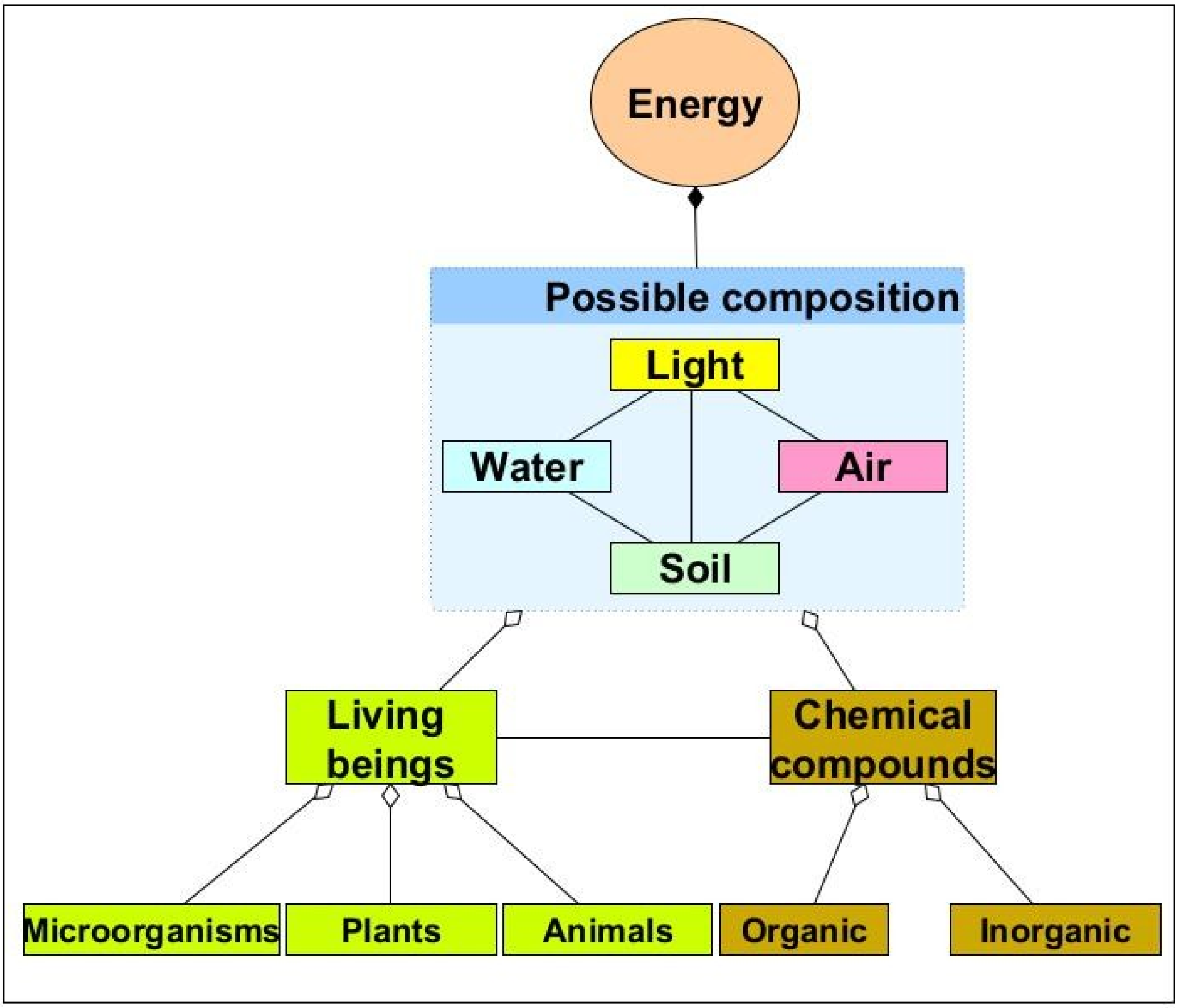
From a strictly mechanistic standpoint, one might argue that the various gases, shaped by different forces, act as a kind of "conductor" of life. From a strictly organicistic perspective, however, the Sun could be seen as the work of a creator guiding the development of living beings. Once again, we arrive at a point where we must choose an interpretation. It is known, however, that overly rigid interpretations are often flawed and rarely completely accurate.

In every view, there are higher forces—possibly in the form of living beings—that we will likely never know, as they exist at a much higher wavelength than ours. These beings might approach us or even enter our frequency range. However, the hierarchical associative laws of the universe prevent humans from reaching the levels of these higher beings.

The Sun's influence—or more precisely, the energy it emits (heat, light, etc.)—on the soil is immense. The soil can become either excessively heated or cooled, which critically affects microorganisms and plants. Without the Sun, photosynthesis would not occur—a process that converts light energy into chemical energy, allowing plants to produce food and release oxygen into the atmosphere.

The Sun also strongly affects the evaporation of water from various sources, which determines the moisture or dryness of the soil. Its energy significantly influences weather and climate, which in turn affect the amount of water vapor in the atmosphere and soil fertility. This also impacts the composition of the atmosphere, which can be rich or poor in oxygen and water vapor—again reflected in weather and climate conditions.

We are thus dealing with a square or triangular associative and cooperative relationship between water, soil, air, and sunlight/the Sun. These relationships, in connection with other entities (e.g., living organisms, chemical substances, forms of energy), define the structure and content of our world as we perceive it. For better illustration, it would be useful to represent these relationships in a model.



5.7.1 Figure 514: Associative hierarchical model of the double triangle

Figure 514 illustrates the associative hierarchical model of the double triangle, which highlights the relatively balanced associative—or cooperative—relationships between water, soil, air, and light. The further hierarchical connections to living organisms and chemical substances are merely a consequence of these relatively equal foundational relationships.

These cooperative relationships are composed of various forms of energy (e.g., water, wind, solar, and chemical energy in the soil), which in turn establish hierarchical structures. From this perspective, the consumers of these energies (living organisms and chemical substances) occupy a distinctly subordinate position. According to this model, strictly hierarchical structures are relatively rare, while associative or cooperative relationships dominate. It represents a relatively flat platform, from which pyramid-like structures occasionally emerge.

Considering certain exceptions in the living world—such as organisms that do not require light and, in some cases, not even oxygen but do require water—one could argue that water holds a hierarchically superior role compared to soil, air, and light. However, these are rare exceptions (e.g., archaea) that contribute to the biodiversity of our world. It is important to emphasize that this model primarily reflects the core principles of how nature functions and abstracts from less prominent cases. The Sun, which produces and emits light and heat energy, plays a vital role in the survival of animals and is of immense importance for plants, as no known plant can survive without solar energy. In terms of biomass production, the Sun holds an equally important role as water, air, and soil.

5.7.2 Color perception

The way living beings perceive color can be studied through optical, physical, meteorological, physiological, and psychological principles. The dominant colors during sunrise and sunset are typically red, orange, and yellow, corresponding to wavelengths between 570 nm and 750 nm. Around midday, the light or color spectrum is more balanced, although red, orange, and yellow tones still tend to stand out more prominently.

At night, due to the absence of sunlight, light sources are limited to the Moon and possible artificial lighting, which leads to the dominance of blue light in the range of 450 nm to 495 nm. This bluish light, especially caused by the reflection of sunlight from the Moon, is what we perceive with our eyes. This shows that color perception is largely dependent on our vision and brain function.

Plants possess an even more refined system for detecting light, as successful photosynthesis is vital for their survival. They detect light through special pigments and photoreceptors that allow them to respond optimally to environmental changes. Similarly, microorganisms have specialized photoreceptors in the form of proteins that help them detect light, which is essential for their functioning and development. This also applies to many insects.

Amphibians rely on rod and cone cells in their retinas to perceive color. Fish use photoreceptors and specialized cells that allow them to distinguish between various colors. Reptiles also perceive light through photoreceptors and adapted cells in their eyes. Birds typically have extremely advanced vision, supported by cones and rods, allowing them to see ultraviolet light and perceive remarkable visual detail.

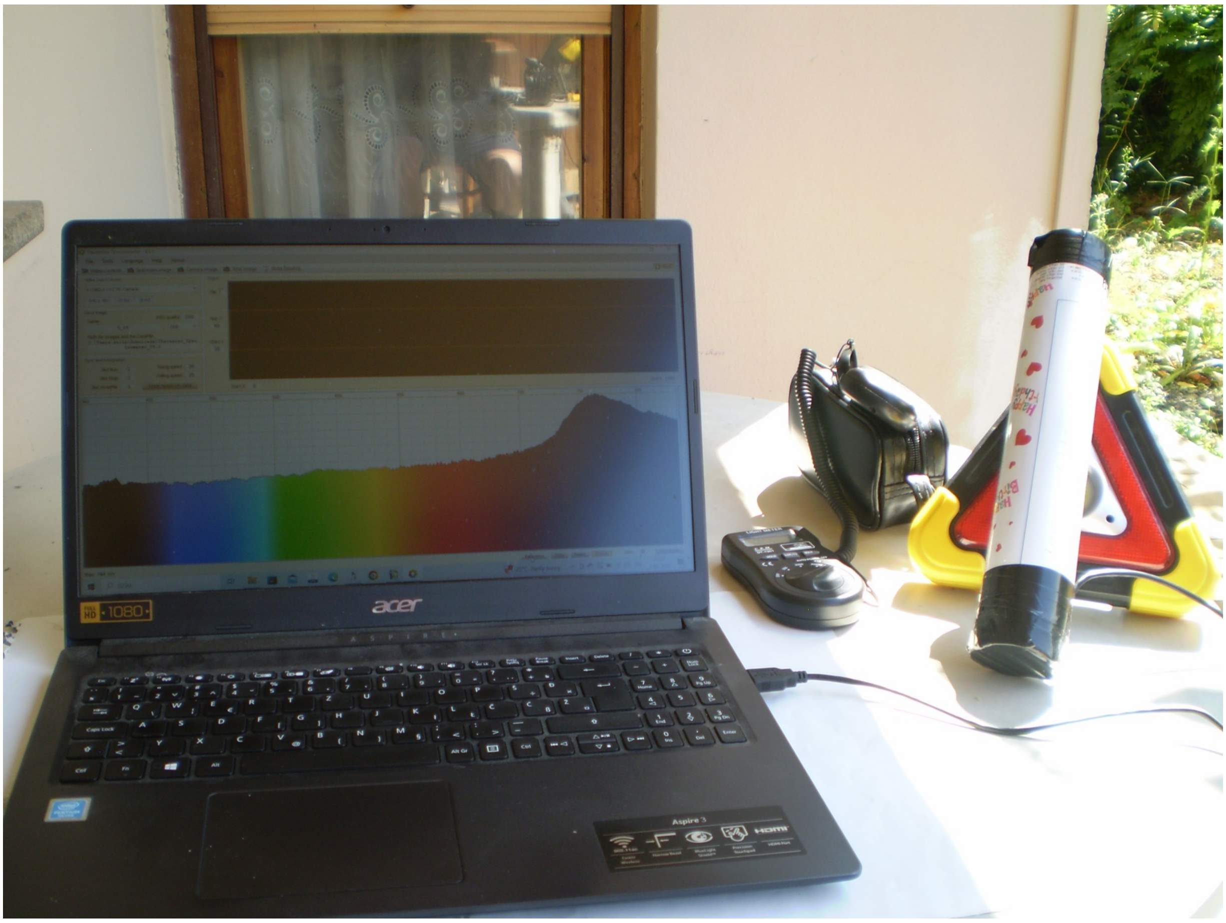
Among mammals, humans have relatively well-developed color vision, though many birds surpass our ability to perceive color. However, aside from color perception, there are other visual systems across species that differ in complexity, field of vision, and adaptation to low light. While some similarities exist, each species' visual system is adapted to its specific needs and lifestyle, aiding survival.

The influence of solar energy on living organisms is highly diverse, but a common factor remains the drive for survival, which the Sun enables, though it does not directly initiate it. That drive comes from individual and collective consciousness. This leads to an important question about the causes of color perception. If the Sun emitted entirely different types of light, living beings would likely perceive colors very differently. Many species can perceive color only because they have evolved special visual sensors or color vision over time through natural development. However, color vision is not a universal trait among living beings—some species, such as certain ants, many reptiles, and some nocturnal mammals, do not perceive color at all. Their eyes only detect different intensities of light, which is a sufficient adaptation for survival and energy efficiency. This is typical for environments such as deep-sea zones or dark caves.

On the other hand, organisms that have developed color vision did so to enhance survival. The ability to perceive color helps them locate food more effectively, reproduce successfully, communicate better, and react faster and more appropriately to environmental stimuli—whether it's prey, a mate, a predator, or shelter. Color perception is the result of interactions between light, photoreceptors, and various types of cells. In humans, color vision is created when light hits the cones in the retina. These convert light information into electrical signals, which the brain processes and interprets. Color perception is therefore the outcome of a complex interplay of physical, chemical, and electrical processes, as well as cognitive learning, which includes neurological development, cultural influences, and personal experience. In the brain, light stimuli and visual receptors create color patterns that allow for meaningful categorization of different colors such as blue, red, green, yellow, orange, and countless shades in between. Science has assigned specific wavelengths to colors based on precise measurements. However, scientific knowledge of light and color is not static—science continuously evolves and adapts to the dynamic processes of perception, influence, and transformation of light.

Technology has enabled the discovery of various types of light that the human eye cannot directly perceive and the brain cannot process. Although the Sun did not consciously trigger the development of color perception in living beings, this process arose from the individual and collective awareness of organisms adapting for survival and development throughout evolution. Different types of light—and thus various color spectra—consciously and subconsciously influence the behavioral patterns of organisms. The spectrum of sunlight is highly dynamic and constantly changing, as are its intensity and luminous flux. The most balanced color spectrum usually occurs at noon, while in the morning and evening, blue, green, and yellow tones tend to dominate. Nevertheless, solar spectra can vary greatly depending on factors such as atmospheric disturbances, cloud cover, precipitation, the Sun’s angle, and other weather conditions. These variations in color throughout the day likely affect the growth and development of plants, as well as the feeding

behaviors of animals and microorganisms. Sunlight, in fact, functions as a natural metronome for life processes, even though it may seem like the Sun shines on Earth randomly.
In the next section, an experiment will be presented involving the measurement of the solar spectrum using a self-made spectrometer. The spectrometer is built from a 30 cm long tube, a USB webcam, a piece of a CD-ROM, and black insulating tape. The software tool Spectrometer Theremino was used to measure and display the spectrum of sunlight. Details of this measurement will be provided later in this subsection.



5.7.2.1 Figure 515: Measuring the color spectrum and illuminance of sunlight

Figure 515 shows the measurement of the sunlight color spectrum using a self-built spectrometer, along with illuminance measurements using a lux meter. The measurements were conducted multiple times on different days and at various times of day. The most recent measurements were taken in the morning, three minutes apart. A portion of these measurements will be presented later. The homemade spectrometer is very simple in design. A thick cardboard tube, approximately 30 cm long, was used. A webcam was installed at one end, with a piece of a standard CD-ROM placed on top of it. The lower part of the tube opening was covered with paper and black insulating tape. On the opposite end of the tube, a round piece of paper with a slit—about 2.5 cm long and 0.5 cm wide

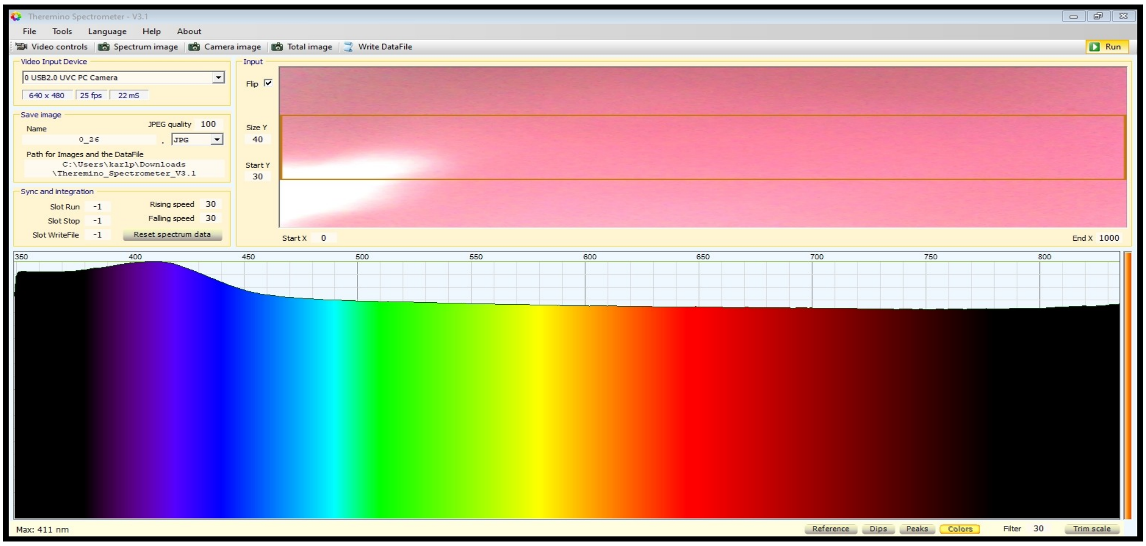
—was inserted. This slit and the surrounding area were sealed with more paper and black insulating tape. The webcam's USB cable was connected to a laptop.

The Theremino Spectrometer software was then launched, where the USB camera had to be selected and its resolution configured. Measurements of the solar spectrum were taken in the field. The angle of the spectrometer depended significantly on the position of the Sun. Before and after noon, the angle was set between 30° and 45°, while around noon it was adjusted to approximately 75°. Correct angle adjustment was crucial for optimal light capture. Sunlight entered the spectrometer through the narrow slit at the top, passed down the tube, reflected off the CD-ROM fragment, and was captured by the webcam. The resulting spectrum was projected within the Theremino software.

Simultaneously, illuminance was measured in lux using a lux meter. The data were exported from Theremino as spreadsheet-formatted .txt files. These files included information about wavelengths (in nanometers) and the percentage representation of each wavelength in the sunlight spectrum. The data were further enriched by categorizing the color spectrum as follows:

- Ultraviolet (UV): 349 nm – 379.4 nm
- Violet (V): 380.2 nm – 450.1 nm
- Blue (B): 450.9 nm – 480.5 nm
- Light Blue (LB): 481.3 nm – 490.4 nm
- Cyan Blue (CB): 491.2 nm – 500.3 nm
- Green (G): 501.1 nm – 570.3 nm
- Yellow (Y): 571 nm – 590.1 nm
- Orange (O): 590.8 nm – 620.5 nm
- Red (R): 612.2 nm – 750.5 nm
- Infrared (IR): 751.3 nm – 843.9 nm

Based on these wavelength ranges, we can assume that the most extensive dataset will be obtained in the red and infrared spectrum. As an introduction to the measurements, the solar spectrum results obtained using the spectrometer and software will be presented.



5.7.2.2 Figure 516: Example of a sunlight color spectrum measurement

Figure 516 shows an example of a measurement of the sunlight color spectrum taken in the afternoon, around 4:35 PM. This particular solar spectrum is not entirely balanced, as ultraviolet, violet, and blue light dominate, while the other colors are relatively evenly distributed. The intensity of the solar spectrum is highly dependent on illuminance—the higher the illuminance, the broader the spectrum of sunlight.

Although multiple measurements are available, they will not all be presented here. Instead, the focus will be on the most recent measurements taken in the morning at three-minute intervals, between 10:15 and 10:36. The illuminance ranged between 680 and 730 lux (lx).

The purpose of these measurements is to demonstrate the dynamic nature of the color spectrum over a short period of time, as the emphasis on specific light wavelengths—or colors—shifts, influencing the behavior and activities of living organisms. In humans, this is particularly evident in changes in mood, which can be very dynamic, relatively stable, relatively unstable, or more or less intense. At first glance, mood may seem constant, but on a subconscious level, it is constantly shifting.

More on this will be discussed later, following the analysis of the measurements.

5.7.2.3 Table 219: A small part of the data obtained using the spectrometer and categorization

Wavelengths (nm)	*Percentage of wavelengths (%)*	*Type of light*
349.3	94.0	UV
350.5	99.7	UV
380.2	94.0	V
380.9	93.8	V
450.9	95.4	M
452.0	95.4	M
481.3	96.2	SM
482.8	96.1	SM
491.0	96.8	CM
492.7	97.0	CM
501.1	96.4	Z
502.6	96.5	Z
571.0	95.9	Ru
572.6	96.0	Ru
590.8	95.4	O
592.3	95.4	O
621.6	95.1	Rd
622.8	95.3	Rd
752.0	91.0	IR
753.6	91.1	IR

Table 219 represents an extremely small portion of the data obtained using a spectrometer and the subsequent categorization of light colors.

It involves measuring the percentage share of wavelengths that fall into specific light categories, such as UV (ultraviolet light), V (violet light), B (blue light), LB (light blue light), CB (cyan blue light), G (green light), Y (yellow light), O (orange light), R (red light), and IR (infrared light).

The percentage shares of individual wavelengths were measured within a range from 349.0 nm to 834.9 nm. The categorization of colors in the light spectrum was based on the well-established classification of wavelengths in nanometers. It was considered useful to first explain the meaning of the data before presenting various visualizations, as this allows for a better understanding of the results displayed.

The data in question are relatively straightforward – the percentage shares of specific wavelengths depend on the illuminance and intensity of sunlight, which the software tool and spectrometer display in the form of a color spectrum. The wavelengths and their categorization are predefined to a certain extent, while the percentage values are experimentally measured and calculated.

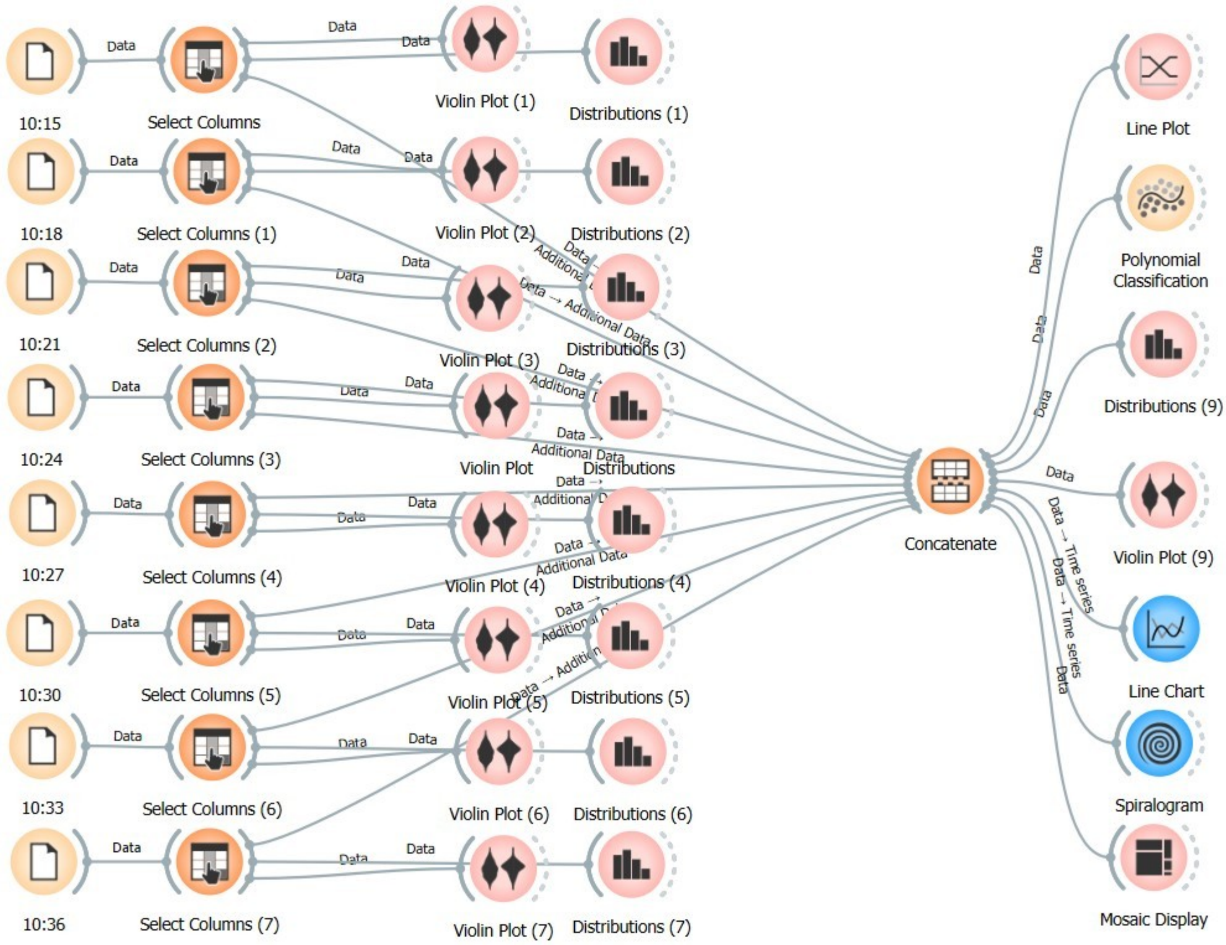
In this case, we have two independent variables:

- X_1: Wavelengths in nanometers
- X_2: Categorization of wavelengths into color groups

And one dependent variable:

Y: Measured percentage shares of individual wavelengths

The data were then visually processed using the software tool Orange Canvas.[410] The goal of the data (categorization of light colors) and the measurement variables in the form of numerical values (wavelengths in nm and percentage shares) were defined. The presentation of the visual programming model follows.



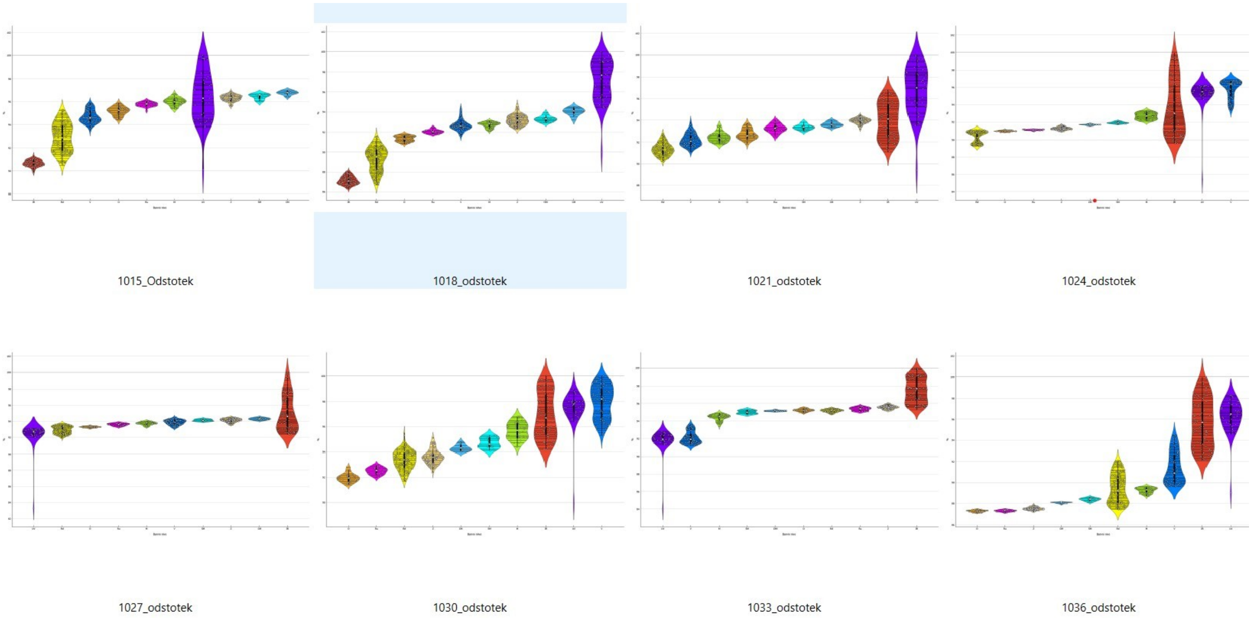
5.7.2.4 Figure 517: Visual programming of wavelength, percentage share, and color categorization data

Figure 517 presents a predictive visual programming model for data on wavelengths, percentage shares, and the categorization of colors in the light spectrum. The first part of the model consists of files named according to the time of measurement (e.g., 10:15, 10:18, 10:21, 10:24, 10:27, etc.). This section connects to an interface that allows users to define the meaning of each column in the dataset. The target variable was set as the color categorization of the light, while the numeric variables were defined as the wavelengths in nanometers and their corresponding percentage shares.

410 Peker, M., Özkaraca, O., & Şaşar, A. (2018). Use of Orange Data Mining Toolbox for Data Analysis in Clinical Decision making. *Advances in Bioinformatics and Biomedical Engineering*, 143–167. https://doi.org/10.4018/978-1-5225-5149-2.ch007.

Next comes the visualization of individual data sets from each file (e.g., violin plots, distribution graphs). These individual data sets were then combined (see the Concatenate interface) and re-visualized using various techniques such as violin plots, distribution charts, polynomial classification, line graphs, and more. These measurements are particularly interesting because they were taken in short intervals of three minutes, allowing the observation of subtle changes despite their overall similarity. This effectively demonstrates the high dynamic variability of solar radiation entering the spectrometer’s slit.

Before analyzing the visualizations from the combined data file (violin plots and distributions), the visualizations of individual violin and distribution plots for each measurement taken between 10:15 and 10:36 will be presented. The focus will be on the percentage shares of wavelengths within the solar light spectrum, as the wavelengths themselves are constant and predefined.



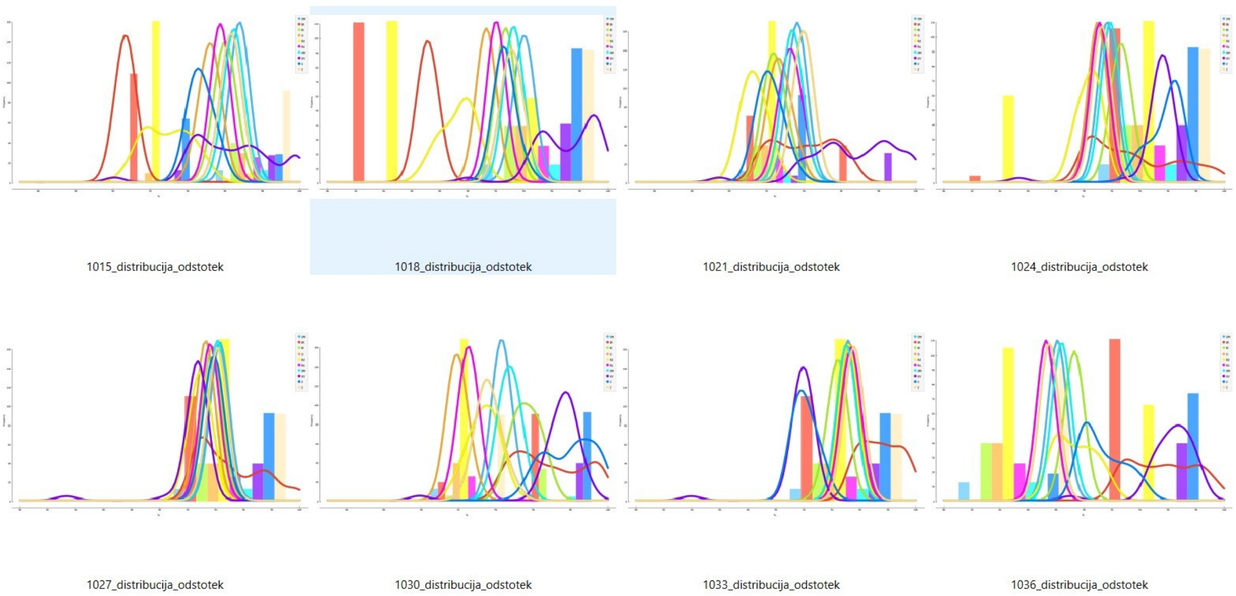
5.7.2.5 Figure 518: Violin plots of percentage shares of individual wavelengths

Figure 518 presents violin plots showing the percentage shares of individual wavelengths between 10:15 and 10:36. Significant changes in the color spectrum of sunlight can immediately be observed over this short period. The shape of the "violins" in each plot indicates the data density at various percentage levels—wider violins represent a higher density of data points at certain percentages, while narrower ones indicate lower density. The width of the violins varies between different plots. For example, in the violin plot labeled “1015_Percentage,” a broad distribution is visible within one specific color, whereas in “1018_Percentage,” the distribution is more spread out across several colors. The maximum and minimum data densities (reflected in violin width) vary across the plots, indicating that certain color wavelengths dominate more in some measurements than in others.

Some plots, such as “1021_Percentage” and “1027_Percentage,” show a concentrated distribution around a few colors, while others display more evenly spread densities across a wider color range. While the violin plots share a similar structural layout and follow the sequence of the color spectrum, the actual distribution of wavelength percentages differs from plot to plot. During the first six minutes, there is a noticeable dominance of the red and ultraviolet parts of the spectrum. As the measurements progress, this dominance shifts toward the infrared and, to a lesser extent, the ultraviolet spectrum. The final measurement suggests a more balanced distribution of colors, especially among the red, blue, infrared, and ultraviolet regions.

Even within such short time intervals, relatively significant changes in the color spectrum can be detected, caused by the interaction between the prism on the USB camera and sunlight. These variations are most likely due to dynamic changes in solar radiation, which influence the spectral composition of the light. No environmental or technical disturbances were present during the measurements, and the angle of the spectrometer was consistently adjusted to optimally align with the Sun, ensuring that sunlight passed through the slit effectively.

Next, a general overview of the wavelength distribution of light colors and their percentage shares will be presented.



5.7.2.6 Figure 519: Distribution of wavelengths by color and their percentage shares

Figure 519 illustrates the distribution of individual color wavelengths (Y-axis: frequency) and their percentage shares (X-axis). Below is a summary of key findings:

1. Distribution at 10:15 AM:

- Red (yellow curve): A sharp, narrow peak indicates a high concentration of specific percentage wavelengths in the red range.

- Infrared (red curve): Broad distribution with a peak at higher percentages, suggesting dispersed infrared wavelengths at those levels.
- UV (violet curve): Lower peak and broader spread, showing more distributed UV wavelengths.
- Other colors: Green, blue, and orange show moderate distribution with dispersed peaks.
2. Distribution at 10:18 AM:
- Red: Noticeable peak, but less sharp than at 10:15, indicating a wider range of red wavelengths.
- Infrared: Very broad distribution peaking at mid-percentages, suggesting varied infrared wavelengths.
- UV: Similar broad spread as before, with slightly higher frequency, indicating increased UV presence in mid-percentage ranges.
- Other colors: Green and blue show lower frequencies, suggesting less presence.
3. Distribution at 10:21 AM:
- Red: Narrow, sharp peak indicating a highly specific percentage range.
- Infrared: Scattered distribution with multiple smaller peaks—infrared wavelengths spread across different percentages.
- UV: Wider peak indicating a broad UV distribution.
- Other colors: Blue and green show more focused peaks compared to previous distributions.
4. Distribution at 10:24 AM:
- Red: Wider peak suggesting a more dispersed red wavelength range.
- Infrared: Clear peak at mid-percentages with high frequency, indicating a strong concentration.
- UV: Moderate peaks with a wide spread, showing various UV wavelengths.
- Other colors: Light blue and cyan show narrow peaks, indicating focused wavelength distributions.
5. Distribution at 10:27 AM:
- Red: Sharp, high peak pointing to a specific dominant wavelength percentage.
- Infrared: Broad spread with a noticeable peak.
- UV: Moderately spread with a defined peak, indicating specific UV range.
- Other colors: Blue and green are more focused with clearer peaks.
6. Distribution at 10:30 AM:
- Red: Tall, narrow peak marking a dominant red wavelength.
- Infrared: Wide distribution with a distinct peak—suggesting a broader yet defined infrared range.
- UV: Scattered with several smaller peaks, showing varied UV wavelengths.
- Other colors: Blue has a wide spread, green shows a narrow, sharp peak.
7. Distribution at 10:33 AM:

- Red: Strong peak suggests a focused wavelength range.
- Infrared: Moderate spread with a clear peak.
- UV: Broad distribution with visible peaks.
- Other colors: Blue and green have distinct peaks, pointing to concentrated wavelength ranges.

8. Distribution at 10:36 AM:

- Red: Prominent, sharp peak indicates a dominant red wavelength percentage.
- Infrared: Broader peak with high frequency in mid-range percentages.
- UV: Wide spread but with a defined peak.
- Other colors: Green and blue show clear, concentrated peaks.

General Observations:

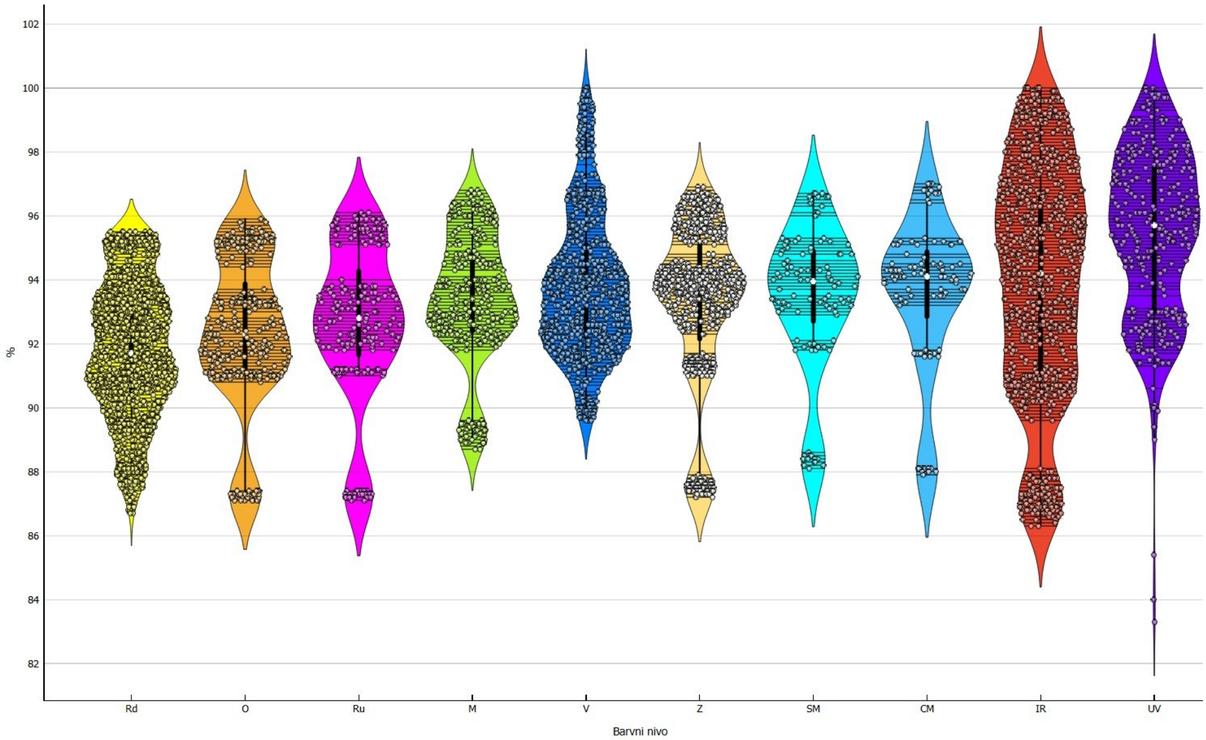
- Red (yellow curve): Typically shows sharp peaks, indicating a narrow range of dominant wavelengths.
- Infrared (red curve): Generally broader distributions with key peaks, showing a wider spread of infrared wavelengths.
- UV (violet curve): Often features broad distributions with various peaks, indicating a diverse presence of UV wavelengths.
- Other colors (green, blue, cyan): Tend to show moderate to sharp peaks, with concentration varying by distribution.

This analysis highlights how different color wavelengths are distributed across percentage ranges, offering insights into the concentration and spread of each color over time.

Dominant colors by time:

- 10:15: Red, Infrared, Violet
- 10:18: Red, Infrared, UV
- 10:21: Red, Infrared, Green
- 10:24: Red, Infrared, Light Blue
- 10:27: Red, Infrared, Blue
- 10:30: Red, Infrared, Green
- 10:33: Red, Infrared, UV
- 10:36: Red, Infrared, Green

Based on these preliminary findings, we can conclude that the color spectrum of light continuously changes even over short time intervals. Red and infrared, in particular, tend to dominate, as they exhibit the broadest range of wavelengths. Other colors—such as green, UV, violet, light blue, and blue—occasionally become more prominent within the solar light spectrum, but these changes are constantly shifting. What remains is an analysis of the combined data from these distributions (see the visual programming diagram, i.e., the violin and distribution plots).



5.7.2.7 Figure 520: Violin plot of combined data

Figure 520 illustrates a violin plot of the combined data from all eight measurements taken between 10:15 and 10:36. The plot displays the distribution of wavelengths for different color levels. The x-axis represents individual color categories (Rd, O, Ru, M, V, Z, SM, CM, IR, UV), while the y-axis shows the percentage representation of these wavelengths.

Violin Plot Analysis:

- Red (Rd):

The distribution is broad, with emphasis on higher percentages, indicating a strong presence of red in the spectrum. Peaks are concentrated around 94% to 98%.

- Orange (O):

Orange shows a relatively wide distribution, with prominent percentages between 90% and 96%. Peaks are slightly lower than red but still signify a notable presence.

- Yellow (Ru):

Yellow has a slightly narrower distribution compared to orange, with peaks also between 90% and 96%. Presence is moderate but noticeable.

- Blue (M):

Blue shows a narrower distribution, with peaks between 92% and 96%. It is less prevalent than red and orange.

- Violet (V):

Violet has a similar distribution to blue but with slightly higher concentration in the mid-percentage range.

- Green (Z):

Green demonstrates a relatively wide distribution, with peaks between 92% and 96%. Presence is moderate and evenly spread.

- Light Blue (SM):

Light blue exhibits a more focused distribution with peaks around 94% to 96%. Presence is lower but concentrated.

- Cyan Blue (CM):

Cyan blue has a distribution similar to light blue, with emphasis on higher percentages. Presence is moderate and comparably focused.

- Infrared (IR):

Infrared shows the widest distribution, with peaks between 92% and 96%. Presence is very pronounced, indicating strong dominance in the spectrum.

- Ultraviolet (UV):

Ultraviolet has the narrowest distribution, with peaks around 94% to 96%. Although presence is minimal, it is very focused.

Dominant Colors in the Combined Spectrum:

1. Infrared (IR)
2. Red (Rd)
3. Orange (O)
4. Yellow (Ru)
5. Green (Z)
5. Blue (M)
6. Violet (V)
7. Cyan Blue (CM)
8. Light Blue (SM)
9. Ultraviolet (UV)

Infrared and red are the most dominant in the spectrum, whereas ultraviolet and light blue are the least represented.[411] Next, we will provide an overview analysis of the combined color distribution in the solar light spectrum.

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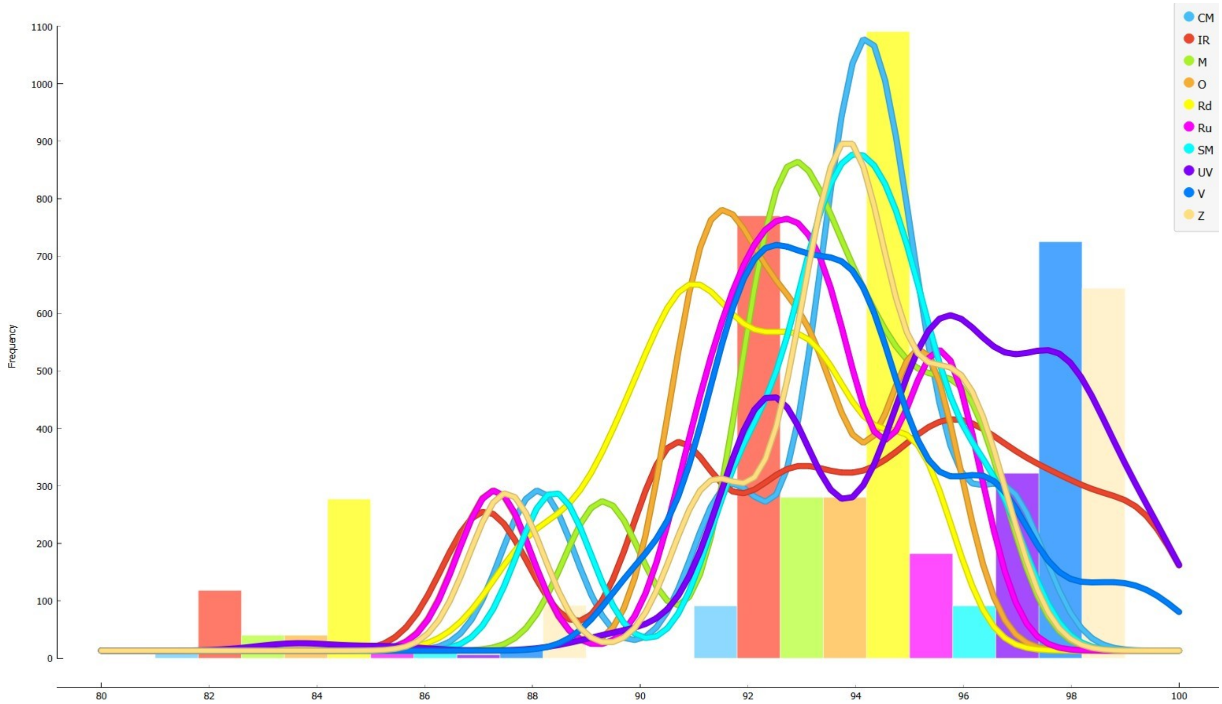
411 The previous framework analyses were supported by the ChatGPT assistant



5.7.2.7.1 Figure 521: Combined distribution of wavelengths and their percentage shares

Figure 521 presents the combined distribution of wavelengths across different colors and their respective percentage shares. In this figure, each distribution corresponds to a specific color spectrum. The y-axis represents frequencies, while the x-axis indicates the percentage representation of wavelengths. Each color on the graph corresponds to a specific spectral range. Here's a breakdown of the distributions:

- Yellow distribution -(represents the red wavelength range)-:

This distribution is wide, with a peak around 94% and another more prominent peak near 98%, indicating a strong presence of red in the spectrum, with multiple peaks.

- Red distribution -(represents the infrared wavelength range)-:

Peaks appear between 82% and 84%, with a larger peak around 90%. This suggests a significant presence of infrared light, especially at lower wavelength percentages.

- Purple distribution -(represents the UV wavelength range)-:

Shows a single, focused peak near 98%, indicating a concentrated presence of ultraviolet light at higher percentages.

- Blue distribution -(represents the violet wavelength range)-:

Exhibits several peaks, mostly concentrated between 92% and 96%. Violet is relatively spread out with multiple peaks (depicted as a dark blue distribution).

- Light blue distribution -(represents the light blue wavelength range)-:

Peaks are clustered around 92% to 94%. This color is moderately present, with a few focused peaks.

- Cyan blue distribution -(represents the cyan blue wavelength range)-:
Has strong peaks between 92% and 96%. Cyan blue is well represented, with a few high peaks.
- Pink distribution -(represents the yellow wavelength range)-:
Highly focused, with peaks between 92% and 96%. Yellow has a moderate to strong presence with well-defined peaks.
- Pale yellow distribution -(represents the green wavelength range)-:
Shows a single prominent peak around 92%, indicating the presence of green with one notable peak.
- Green distribution -(represents the blue wavelength range)-:
Has multiple peaks between 92% and 96%. Blue is well represented with several peaks.
- Orange Distribution -(represents the orange wavelength range)-:
Peaks appear between 90% and 94%. Orange is moderately present but with more dispersed peaks.
Key Findings:
- Infrared (Red distribution) has a unique presence at lower percentages, while UV (Purple distribution), Cyan Blue (Blue distribution), and Yellow (Pink distribution) are concentrated at higher percentages.
- Blue, violet, and light blue show multiple peaks, indicating a broader spectral presence.
- Red (Yellow distribution) and cyan blue (Blue distribution) also display multiple peaks, suggesting a strong presence in the spectrum.
Based on the analysis of the combined color distributions, a ranking of dominant colors in the solar light spectrum can be established. This ranking reflects the relative dominance based on the height and width of the observed peaks:
Dominance Ranking of Colors:
1. Cyan blue (CM):
Very distinct and wide peak between 94% and 98%, indicating strong dominance.
2. Red (Rd):
Displays a very high peak between 92% and 96%, confirming a strong presence.
3. Infrared (IR):
Two clear peaks—one at lower percentages (\~82%) and another at higher (\~94%)—highlighting its significance.
4. Blue (M):
Multiple peaks between 90% and 96%, showing a moderate but stable presence.
5. Violet (V):
Several smaller, scattered peaks between 92% and 98%.

6. Green (Z):
One prominent peak around 94%, showing a moderate role in the spectrum.
7. Light blue (SM):
Several smaller peaks, but without strong dominance.
8. Ultraviolet (UV):
A sharp peak at the highest percentage (\~98%) but less widespread than other colors.
9. Orange (O):
One distinct peak around 90%, but less dominant overall.
10. Yellow (Ru):
Lower peaks, mostly between 86% and 92%, suggesting reduced presence.
Comparison of individual vs. combined distributions:
a. Differences
- Individual distributions vs. combined distribution:
The eight individual distributions show data from specific measurements, each reflecting a unique set of data points and conditions. Each individual graph reveals specific variations and frequencies for different colors in particular cases.
- Combined distribution:
Merges all individual datasets into a single comprehensive graph. This results in a more complex visualization with overlapping distributions, potentially obscuring details that were more clearly visible in the separate graphs.
- Distribution overlap:
In the combined graph, overlapping of different color distributions is more pronounced. This makes it harder to distinguish individual distributions—especially when the colors are similar or their peaks are closely aligned.
Dominant Peaks:
In the combined distribution, certain colors may appear more dominant due to the merging of data from multiple sources. This can result in peaks being either amplified or diminished compared to those seen in the individual distributions.
Visual Complexity:
The combined graph is visually more complex, making it harder to identify specific trends or anomalies that would be easier to spot in individual graphs.
b. Similarities
Color Representation:

Both the individual and combined graphs use consistent color coding for different wavelengths, ensuring uniformity in data visualization.

Overall Trends:

Despite the added complexity of the combined distribution, general trends—such as the percentage range for specific colors—remain visible and are also reflected in the individual distributions.

Key Findings:

- The combined distribution provides a comprehensive view and facilitates the analysis of overall trends across multiple data sets, but it sacrifices some clarity in fine detail.
- Individual distributions are clearer when it comes to showing specific patterns and variations but do not offer a holistic overview of the data.

In summary, the combined distribution brings together data into a unified, comprehensive visualization, while the individual distributions offer a clearer view into separate data sets. This analysis helps us understand which colors or wavelengths are most characteristic of different measurement phases and what their relative importance is within the overall distribution.

We are also aware of the significant psychological, social, and cultural importance of color perception in humans. Colors signal danger, opportunity, weakness, strength, and strongly influence cognitive processes such as learning, perception, language development, and thinking (logical, symbolic, etc.).

For instance, although we cannot see UV light, it keeps us alert—its absence at night contributes to our sleepiness. In short, UV light affects our brain activity and, consequently, our thoughts and behavior (e.g., we sleep at night and are active during the day).

We also cannot see infrared (IR) light, but we perceive it as heat. This heat influences our bodily responses, mental processes, and activities (e.g., strong heat exposure compels us to seek shade).

The red spectrum of light has an even stronger effect on both individual and collective cognitive processes. Red can evoke extremely intense emotions, whether negative (e.g., hatred, violence) or positive (e.g., love, warmth). It is rarely perceived as neutral. It is not surprising, then, that major dictators such as Stalin, Hitler, and Mao Zedong—or rather, their regimes—chose red as the color of their national flags. Similarly, it’s no coincidence that many musical compositions focus on love or that film productions frequently feature themes of violence and romance (e.g., war films, crime thrillers, love dramas).

Analysis shows that red was one of the dominant colors in the light spectrum. This color significantly influences our thinking and behavior, often at a subconscious level. However, its impact is not limited to the subconscious—red is also actively processed in our conscious mind. In

any case, it stimulates our emotions and thought processes, with effects that can be positive, negative, or a combination of both.
Green has a calming effect, similar to light blue, which can even promote emotionally neutral thinking. In the next phase, it would be meaningful to study how different living beings perceive color—such as microorganisms, insects, fish, amphibians, reptiles, birds, and mammals, including humans. For some organisms, color itself is not the key factor; rather, it's the intensity and strength of light that matters. Many creatures rely more on smell, touch, or hearing than on vision, and some are not dependent on light at all.
Before diving into this extensive exploration, we must first conduct an analysis of the measurements of illumination, UV radiation, temperature, and humidity.

5.7.2.8 Figure 522: Data logger for temperature, humidity, illumination, and UV radiation

Figure 522 shows a data logger (Testo 160 THL), equipped with four sensors capable of measuring temperature, air humidity, illumination, and UV radiation intensity. The device is located in a relatively shaded area, which means it will not be able to directly measure illumination and UV intensity from direct sunlight. Despite this limitation, it will still be possible to monitor the dynamic changes in illumination and UV radiation over time (specifically from July 20, 2024, to August 19, 2024).
In addition to these two primary measurements, changes in air humidity and temperature can also be analyzed. Both variables are closely linked to illumination and UV intensity, as lower humidity and

higher temperatures are generally associated with increased light exposure and stronger UV radiation.

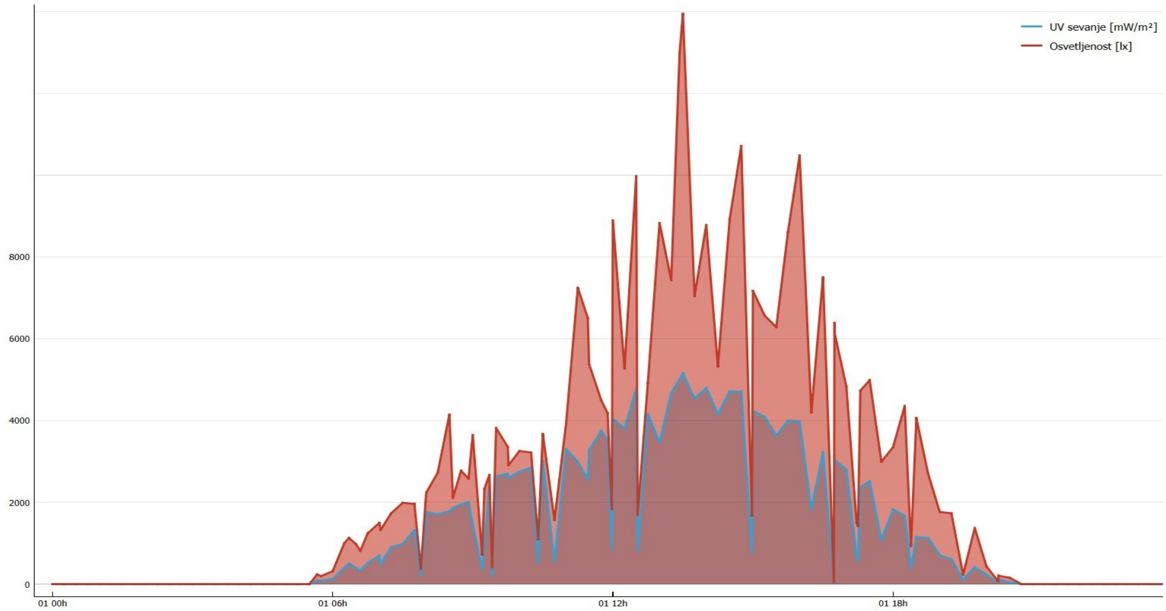
Before presenting the data and visualizations, it's useful to explain why we measure illumination and UV intensity in the first place. The reasons for such measurements vary and are often related to plant and human health, the efficiency of photosynthesis, growth optimization, climate impact studies, pest prevention, yield improvement, and more.

Excessive UV radiation can damage plant cells and their DNA, whereas optimal levels of UV promote plant growth. Measuring illumination helps determine whether plants are receiving enough light to grow successfully, as insufficient light leads to stunted growth and reduced fertility. On the other hand, overexposure to light and excessively strong UV radiation can negatively affect various animal species, which in turn impacts food webs.

The main goal of these measurements is to understand the dynamic changes in illumination and UV intensity, which indirectly affect the color spectrum of sunlight. This, in turn, influences the dominance of specific colors that may guide certain cognitive processes and behavioral patterns in living organisms.

5.7.2.8.1 Table 220: Small part of the data on illuminance and UV radiation measurements

Date	*Time*	*Illumination*	*UV radiation*
20.7.2024	09:00:00	768	358
20.7.2024	09:15:00	655	313
20.7.2024	09:30:00	696	319
20.7.2024	09:45:00	1145	505
20.7.2024	10:00:00	894	390
20.7.2024	10:15:00	971	432



5.7.2.8.2 Figure 523: Line surface diagram of illuminance and UV radiation

Table 220 shows a small portion of the measured statistical data on illumination and UV radiation from July 20, 2024, to August 19, 2024, while Figure 523 illustrates a visualization of this data using a line surface chart.

The data logger with four sensors recorded illumination (lx) and UV radiation (mW/m²) values every 15 minutes throughout the day. Measurements were also taken for temperature, dew point temperature, relative and absolute humidity, but these are not the main focus here.

UV Radiation (blue line):

- Initial UV radiation values are zero, as expected, since there is practically no UV radiation at night.

- With the start of the day, UV radiation values begin to rise and peak around midday (approximately 12 PM), when the sun is highest in the sky.

- After the peak, UV radiation gradually decreases until it reaches nearly zero again at the end of the day.

Illumination (red line):

- Similar to UV radiation, initial illumination values are low or zero, reflecting nighttime conditions.

- Illumination increases alongside UV radiation but has more pronounced and erratic peaks, indicating variability caused by weather changes such as cloud cover, shade, or other atmospheric conditions.

- Despite following a trend similar to UV radiation, illumination reaches higher values and shows greater variability throughout the day.

Findings:

There is a clear correlation between UV radiation and illumination; however, illumination shows greater variability. The red surface representing illumination often overlaps and exceeds the blue surface for UV radiation, indicating that illumination is not directly proportional to UV radiation.

This is influenced by various factors such as natural and artificial light sources, weather conditions, and atmospheric effects. The line surface chart displays characteristic daily patterns of UV radiation and illumination. Although both parameters exhibit similar daily dynamics with noticeable midday peaks, illumination (lx) demonstrates higher variability.

- The highest recorded UV radiation value was 5492 mW/m², which is very high and can damage some plants if exposure is prolonged.

- The average UV radiation value was 1390.52 mW/m², which still represents an elevated level that can negatively affect certain plant species.

5.7.3 Color perception in microorganisms

Microorganisms perceive the color spectrum of sunlight through various photoreceptors or proteins that absorb specific wavelengths of light. These photoreceptors allow microorganisms to adapt to environmental conditions, optimize photosynthesis, regulate their internal clock, and avoid harmful UV radiation.

Microorganisms have specialized photoreceptors sensitive to certain wavelengths:

- Chlorophylls are present in photosynthetic organisms like cyanobacteria and algae; they mainly absorb red and blue light. They absorb red light (around 660 nm) and blue light (around 430 nm) most effectively, which is why these organisms often appear green, as they reflect the green part of the spectrum.

- Carotenoids are pigments that absorb light in the blue and green parts of the spectrum but reflect yellow, orange, and red light. They also protect cells from damage caused by excessive light.

- Phycobiliproteins, found in cyanobacteria and some algae, absorb light in the orange-red to blue-green spectrum, enabling these organisms to efficiently use a broader range of light for photosynthesis.

Some microorganisms, especially archaea like Halobacterium, contain rhodopsin-like proteins that sense green and blue light. These proteins help with phototaxis, meaning the organism moves toward or away from light.

Dominant colors in sunlight

Sunlight covers a wide range of wavelengths, but not all wavelengths are equally accessible or absorbed by microorganisms:

- Blue light (450–495 nm): Highly energetic and abundant; many microbial photoreceptors are sensitive to it.

- Red light (620–750 nm): Crucial for photosynthetic microorganisms as chlorophyll absorbs it efficiently.

- Green light (495–570 nm): Less important for most microorganisms but some with special pigments can use it for biological processes.

In general, microorganisms detect the solar light spectrum with various photoreceptors sensitive to specific wavelengths. Blue and red light are biologically the most important as they directly affect photosynthesis and other biological functions.

In microbial food webs, blue and red light play key roles:

- Blue light can increase prey visibility.

- Red light influences prey growth and nutrient production.

- Green light may reduce the visibility of some organisms, affecting predator-prey relationships.

- UV light impacts protective mechanisms and organism visibility.

Effect of Light on Biological Processes

Although viruses (except for UV light) are not directly affected by other wavelengths, light influences host cells. Light affects many biological processes in living cells, including those in humans:

- Blue light: Affects melatonin production and accelerates wound healing.

- Red light: Promotes cell growth and regeneration and supports neuron energy.

- Infrared light: Strengthens blood cells and neurons.

- UV light: Can damage DNA but also plays a role in vitamin D synthesis.

- Green light: Improves blood circulation and raises the pain threshold.

Thus, different colors of light have important biological effects on both microorganisms and larger organisms, including humans. Below is a summary of how different light spectra affect various microorganism groups:

a. Bacteria: UV and blue light usually have destructive effects on many bacteria, while red, infrared, orange, and green light often positively influence their growth and development.

b. Protozoa (e.g., amoebas, paramecia, vorticella, didinium, flagellates): Similar to bacteria; UV and blue light can damage their DNA and cause cellular stress, while red, infrared, and green light generally promote growth and development.

c. Archaea: Many archaea are not directly dependent on light. For those that use light for energy, UV and blue light have negative effects, while red, infrared, and green light have positive effects.

d. Microglia: Light effects on microglia are very similar to those described for other types.

e. Microalgae: Blue light can have negative effects (e.g., causing stress) but also positive effects by promoting photosynthesis. UV light strongly harms microalgae. Red, infrared, and partly green light positively influence their growth, development, and photosynthesis efficiency.

f. Tardigrades: Biologically not microorganisms but spatially part of the microcosm. They are highly resistant to various light radiation, but prolonged UV and blue light exposure can negatively affect them. Red, infrared, and green light can indirectly support their growth and development. It is unknown if tardigrades perceive colors; they likely detect only light intensity, temperature changes, and chemical effects in their environment.

g. Nematodes: Considered microorganisms in the microcosm context. Like tardigrades, they probably detect only light intensity, not colors.

Summary: UV and blue light generally negatively affect microorganisms, while red, infrared, and partly green and orange light positively influence their growth and development.

5.7.3.1 Color perception in insects

Insects perceive colors via specialized photoreceptors, and their compound eyes are adapted to detect different parts of the color spectrum. Insect color vision can involve three spectral ranges, allowing them to see UV, blue, and green light. Some insects perceive two primary colors and their combinations, while others can see three colors and their combinations. Many insects can also detect polarized light.

a. Aquatic insects: Responses of aquatic insects such as water striders, dragonflies, and mosquito larvae to different light spectra are linked to behavior, survival, and development. Light spectra influence their navigation, feeding, reproduction, and survival. UV light (e.g., DNA damage) and blue light (e.g., interference with orientation) harm aquatic insects, while the full light spectrum positively affects their growth and development. For some species like water striders, mosquito larvae, mayfly larvae, and aquatic beetles, green and red light promote more effective behavior.

b. Terrestrial insects: Similar to aquatic insects. UV light can damage their DNA, while stronger blue light can disrupt navigation, threatening survival. White light (full spectrum), green light (important for mating, feeding, and predator avoidance), red light (especially for nocturnal activities), and infrared light (for feeding) positively influence their growth and development. Green light mainly benefits aphids, butterflies, grasshoppers, leaf beetles, ants, bees, etc. Red light positively affects nocturnal moths, ants, termites, cockroaches, nocturnal beetles, etc. Infrared light benefits some dragonflies, mosquitoes, fleas, ticks, termites, and others.

5.7.3.2 Color perception in fish

a. Freshwater fish: They usually live in environments where light is often scattered and absorbed by algae, plants, and sediments. Blue light, which has a shorter wavelength, is less common in freshwater. Longer wavelengths like red and green dominate. Freshwater fish have receptors more sensitive to red and green light, helping them better perceive colors in their environment. Some fish also have UV receptors, aiding in food search and species recognition.

b. Saltwater fish: Marine environments, especially deep sea, differ greatly from freshwater. Blue light penetrates deeper in saltwater, while red light fades quickly with depth, so marine fish mostly live in the blue light spectrum. Saltwater fish have receptors more sensitive to blue and green light. Some deep-sea fish have limited color vision due to near-total darkness and often rely on bioluminescence detection.

UV and excessively strong blue light can severely negatively impact the growth and development of both freshwater and saltwater fish. Fish generally require a full light spectrum for healthy development. Green and red light, as well as infrared light, positively affect freshwater fish growth. Similarly, saltwater fish benefit from these wavelengths but also need a certain amount of blue light for healthy growth and development.

5.7.3.3 Color perception in amphibians

Some amphibians, such as frogs, toads, newts, and salamanders, have special abilities to perceive colors, which depend on the challenges of their environment. Their eyes contain photoreceptors made up of rods (for better vision in the dark) and cones (for better vision in brighter light and color differentiation). Most amphibians have trichromatic vision, meaning they are sensitive to different parts of the color spectrum, such as blue, violet, green, and red light. Some amphibians can also detect UV light, which helps them find food and choose mates.

a. Aquatic amphibians: Colors like blue and green are more noticeable to aquatic amphibians, so they often have cones that are more sensitive to these colors.

b. Terrestrial amphibians: Their vision is adapted to detect colors in daylight. Green and red light are important, as these help them recognize prey, plants, and other key elements in their environment.

Prolonged exposure to UV and excessively strong blue light can be extremely harmful to the growth and development of both aquatic and terrestrial amphibians. Amphibians, in general, require a full spectrum of light for optimal living conditions. Green light especially benefits terrestrial amphibians, while red light positively influences the growth and development of aquatic amphibians. Infrared light typically improves amphibian metabolism.

5.7.3.4 Color perception in reptiles

Both aquatic and terrestrial reptiles have developed color perception abilities that vary according to species and habitat. Their ability to perceive colors is essential for finding food, choosing mates, avoiding predators, and navigating their environment. They perceive colors through specialized photoreceptor cells in their eyes, primarily cones that are sensitive to different wavelengths of light. Some snake species even have special filters in their eyes that block certain wavelengths, allowing them to distinguish colors more precisely.

a. Aquatic reptiles: Their vision is often adapted to underwater conditions, where light penetrates differently than in air. They generally perceive blue and green light better, while red light is less visible to them.

b. Terrestrial reptiles: They are mostly adapted to perceive colors across the full light spectrum, which helps them in finding food, hiding from predators, and selecting mates. They have excellent color vision, enabling them to distinguish very subtle color shades. They can even detect UV and infrared light, which aids in locating and tracking prey.

Excessive exposure to UV and overly strong blue light can seriously harm the growth and development of both aquatic and terrestrial reptiles. Optimal UV exposure can positively affect reptile health (for example, in the synthesis of vitamin D3). They thrive best in a full spectrum of light. Red light can also have a positive effect, improving sleep quality, and infrared light helps stimulate appetite and regulate body temperature.

5.7.3.5 Color perception in birds

Birds have an exceptional ability to perceive colors, which helps them with better orientation, food searching, predator avoidance, and mate selection. Their vision is among the most developed in the animal kingdom. Many birds have tetrachromatic vision, meaning they have four types of cones or photoreceptors in their eyes. This allows them to perceive a wider range of the light spectrum. They are sensitive to various wavelengths, from blue-violet, green, red, to UV light. Additionally, their eyes contain special filters or oil droplets that further enhance color perception and the differentiation of shades. The retina is densely packed with numerous cones, allowing for high resolution and sharp images.

a. Aquatic birds: Their living conditions in and around water differ from those of terrestrial birds. Because of this, they perceive red light less and are more sensitive to blue and green light. This helps them hunt food more effectively or detect approaching dangers. They can also perceive UV light, which aids in food searching.

b. Terrestrial birds: They can detect UV light, which helps them recognize other members of their species and find food. Different color light spectra play an important role in the behavioral patterns of terrestrial birds, as colors often dictate mating rituals. Additionally, they can more easily recognize different territories and various predators.

Excessive UV and blue light, as well as extremely strong light of different wavelengths causing glare, are very harmful to both aquatic and terrestrial birds. Positive effects on bird growth and development can be seen with UV-A and the full natural light spectrum. These influences affect their health and promote effective behavioral patterns essential for survival. Red and infrared light can also positively affect birds (e.g., warming and reducing stress effects).

5.7.3.6 Color perception in mammals

Most mammals have dichromatic vision, while primates and humans have trichromatic vision, enabling them to perceive a broader color spectrum.

a. Aquatic mammals: They have a limited color spectrum and perceive mainly blue and green colors well. For aquatic mammals, it is usually more important to detect shapes and contrasts rather than relying heavily on colors. This is especially important for their orientation, navigation, and food searching in aquatic environments.

b. Terrestrial mammals: Most terrestrial mammals, such as dogs, cats, and various rodents, have limited color perception and see their environment mainly in shades of blue, gray, and yellow. They perceive red and green colors less well. The situation differs with primates and humans, who can perceive many colors and shades. In some mammals (e.g., hedgehogs), night vision is important, allowing better sight in the dark, but except for shades of gray, they do not perceive other colors or shades.

Excessive exposure to both blue and UV light generally has harmful effects on mammals, as it can worsen their vision and cause negative stress. Similar to birds, extremely strong light of all wavelengths can negatively affect mammal vision. Mammals typically benefit from the full spectrum of natural light (e.g., growth and development, effective behavioral patterns), red light (e.g., better cell regeneration, faster wound healing), infrared light (e.g., maintaining body temperature), and green light (stress-reducing and relaxing effects). Infrared light has a generally smaller impact on aquatic mammals.

5.7.3.7 Color perception in plants

Plants perceive colors through pigments, but the composition of these pigments differs between terrestrial and aquatic plants. Essentially, plants use the pigment chlorophyll, which most efficiently absorbs blue and red light while reflecting green light. Plants also contain other pigments, such as orange, yellow, blue, and red pigments, which help absorb light of different wavelengths.

a. Aquatic plants: They contain pigments that can absorb light especially in the blue and green parts of the spectrum. Some species of aquatic plants can absorb the entire spectrum of sunlight. They are adapted to a narrower spectrum of sunlight.

b. Terrestrial plants: These plants are more often exposed to a wider spectrum of sunlight, so chlorophyll absorbs a larger amount of blue and red light. Terrestrial plants found in shaded areas produce more chlorophyll to better absorb diffuse light. They are adapted to a broader spectrum of sunlight.

Adaptation to a narrower or broader spectrum of sunlight affects the appearance and shape of plants. Excessive UV light (causing DNA damage), red light (stress), infrared light (overheating), and green light (less efficient photosynthesis) negatively affect plants. Positive effects on plants come mainly from the full spectrum of white light (optimal growth and development), green light (regulating the sunlight spectrum), blue light (promotes leaf and stem growth), and red light (stimulates flowering and photosynthesis).

5.7.3.9 Color perception in macroalgae

Macroalgae use special pigments for effective light perception and absorption. These pigments include chlorophyll, phycobilins, and carotenoids, which allow better absorption of blue, red, orange, and green light.

a. Aquatic macroalgae: These are adapted to different depths in the water, allowing optimal absorption of light that penetrates through water. This means that the absorption of blue and green parts of the light spectrum varies among different algae species (e.g., red algae, brown algae).

b. Terrestrial macroalgae: These are often exposed to the full spectrum of sunlight, so their pigment composition differs from aquatic macroalgae. They capture the full spectrum of sunlight and are particularly sensitive to the blue and red parts of the spectrum. Terrestrial macroalgae also effectively adapt to shaded environments.

Excessive UV light (DNA damage) and infrared light (negative stress, overheating) negatively affect macroalgae. Their optimal growth and development are positively influenced by light in the blue, red, and green spectra (better photosynthesis, reproduction, flowering).

5.7.3.9.1 Color perception in macrofungi

Their color perception differs significantly from plants and algae, as they detect light using special photoreceptors such as cryptochromes and phototropins. They primarily perceive blue and red light, and some fungal species can even perceive UV light. Excessive exposure to UV light (DNA damage) and infrared light (heating, stress) is extremely harmful to both aquatic and terrestrial macrofungi. Blue light (promotes growth and development) and red light (increases spore production) positively influence aquatic and terrestrial macrofungi.

As can be inferred from these brief descriptions of the effects of the light spectrum on living organisms, this influence is greater than one might expect. It essentially dictates physiological and mental health, feeding, metabolism, and even gene transfer. A common denominator of negative effects on living organisms is excessive exposure to UV and blue light, while red, infrared, green, and full-spectrum light mostly have positive effects. Individual spectra and full-spectrum light can even influence the respiratory functions of living beings, which is a kind of response to processing colors to which certain organisms are more sensitive.

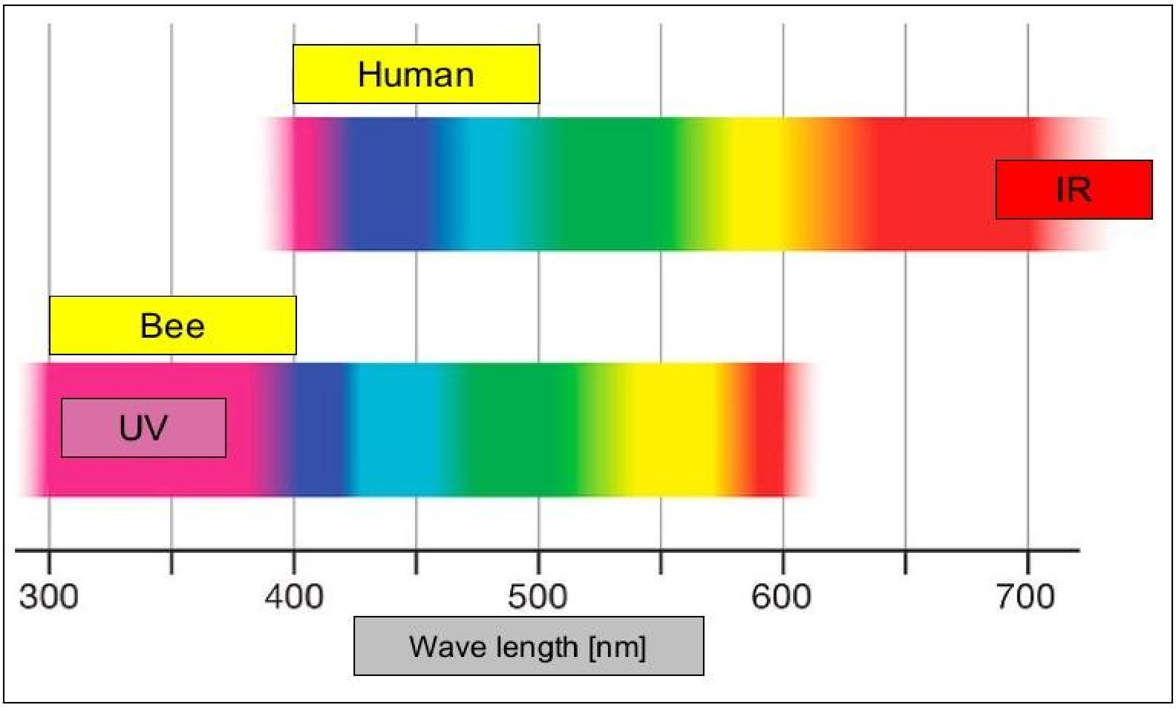
In more complex living beings with more developed nervous systems, it can be said that colors are merely an interpretation of the full spectrum of light and its individual wavelengths. There are certain behaviors in how individual animal species perceive colors, though their mental processes—beyond feeding, metabolism, seeking shelter, escaping predators, detecting prey, and gene transfer—are less known. In this regard, the human species is somewhat of a mystery, as we are well aware of the influence that different light spectra, and thus colors and their shades, have on human cognitive processes (e.g., economic and political propaganda, popular music enhanced with visual effects, art, science, sports, governance, military, police).

The vision of living beings, and thus color perception, mainly depends on their lifestyle in a specific environment, which requires skills in navigation, orientation, food searching, communication, coping with stress, and gene transfer. For example, bees and ants perceive humans very differently; details of the face are not important, but rather shapes, contrasts, scents, and movements. From the perspective of these insects, a human is seen more as a swarm of moving points or a moving fog with a different color spectrum of perception. Bees and ants do not perceive red color but can detect UV light, which is invisible to humans. UV light perception does not benefit humans but is harmful to health, while for bees and ants it is crucial for survival (e.g., finding food, gene transfer).

Our household pets, such as dogs and cats, see the world quite differently, even though the structure of their eyes is similar to that of humans. Dogs and cats also do not perceive the color red but are more sensitive to blue, green, and yellow. They do not focus as much on facial details but rely more on scents and movement, although dogs and cats can recognize human faces and interpret various emotional states. In short, we are dealing with different color perception settings within the light spectrum.

Dogs and cats have a limited color range, perceiving mostly blue and yellow light, while having difficulty detecting red and green colors. Ants perceive light within a narrower spectrum, so they do not recognize red and green shades but are oriented towards detecting UV and blue light. Bees perceive shorter wavelengths, whereas humans are more oriented towards perceiving longer wavelengths of light. Similar to ants, dogs, and cats, bees do not perceive red but are more sensitive to UV, blue, and green light.

It should also be noted that bees perceive green shades differently than humans, as they are more focused on plant life. This is especially important for recognizing different types of plants and their flowers, as well as distinguishing between various environments. For humans, colors found in wavelengths longer than UV and shorter than infrared light are very important. To provide additional clarity, we include a visual comparison of the color perception spectrum between bees and humans, which is interesting because both bees and humans have trichromatic vision.

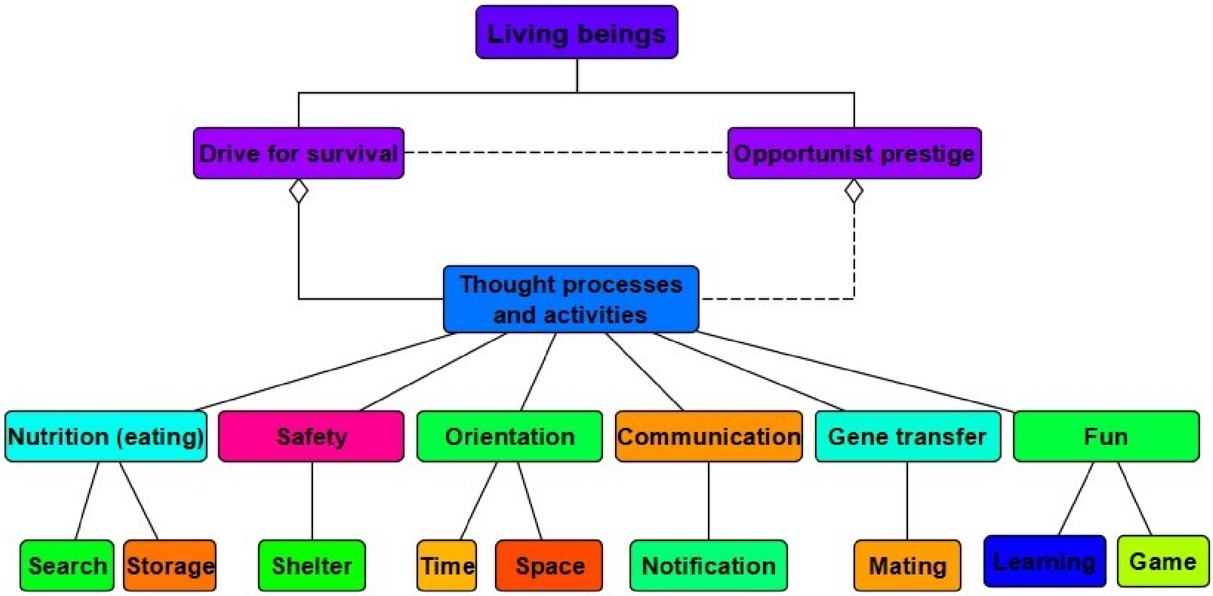


5.7.4 Figure 524: Comparison between the visible spectrum of bees and humans

Figure 524 illustrates a comparison between the visible spectrum of bees and humans. It reveals that the visual spectrum in bees is oriented toward shorter wavelengths, while in humans it is more attuned to longer wavelengths. The visual spectra differ significantly, as do the lifestyles and interests of these two species. Both bees and humans have learned to perceive the light spectrum, or colors, based on genetic makeup, physiological structure, cognition, survival instincts, and environmental challenges.

For many animal species, the color red holds little to no importance, whereas in many primates and most humans, red carries significant meaning in terms of lifestyle and mental concentration or focus. The dominance of red light can, at times, trigger increased readiness for aggression and more intense emotional reactions, particularly in human societies and among higher primates. In this context, it is likely that breathing rhythm and heart rate also increase, which may suggest a heightened readiness to make various decisions.

Let us sketch out the way of thinking and functioning in living beings more broadly in comparison to humans.



5.7.4.1 Figure 525: The mental world of living beings in a broader sense

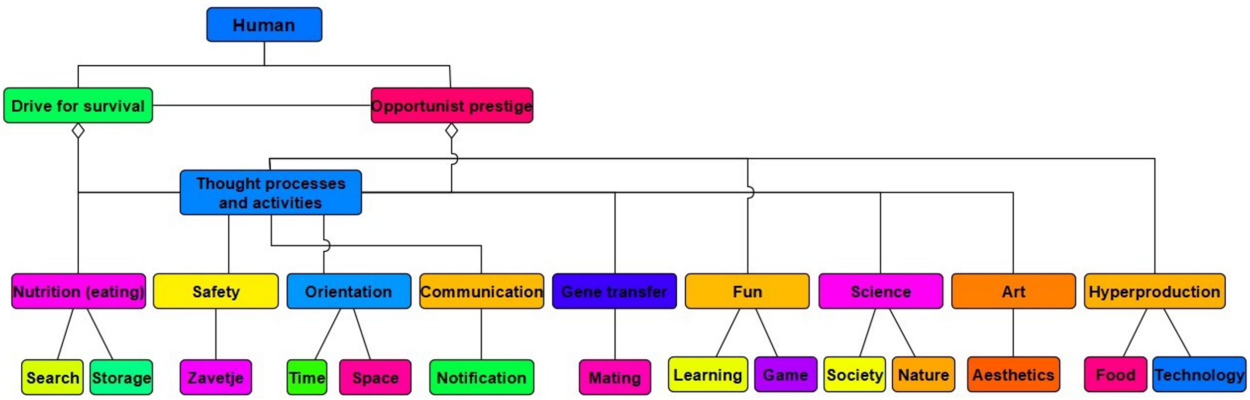
Figure 525 presents a diagram of the mental world of living beings in a broader sense, as the details are not yet fully understood. However, we can identify certain common denominators. The primary common denominator among all living beings is the instinct for survival, which may occasionally be accompanied by a desire for prestige. In essence, the mental processes and activities of other living beings are quite similar to those of humans. It is not entirely exaggerated to say that many humans on our planet live according to the model shown in this diagram.

The mental processes and behaviors are oriented toward key goals such as acquiring food (searching for food, with some species even storing it), living safely (seeking shelter, home, protection), orientation (responding to sensory input, spatial awareness, internal clocks), communication (sharing information about food sources or danger, raising offspring), reproduction (finding a mate, mating), and entertainment (through play, young animals learn and develop skills).

It is worth highlighting ants and bees, which are among the rare species in the animal kingdom that produce their own food. Because this is an exception, food production is not included in the general diagram. The next diagram will illustrate the human mental world, which is more complex. It includes additional mental processes and activities that support the survival instinct through the pursuit of excessive prestige.

The human mental world also includes overproduction of food and technology, engagement with the arts (which includes aesthetics), and science. Science serves as a means of monitoring events in society and nature, providing additional tools for survival with elevated prestige. Furthermore, humans also exert control over themselves, which has led to the establishment of fairly precise standards for what is considered normal or abnormal thought and behavior.

Technology, as an application of survival through excessive prestige, is often the result of scientific research. In comparison to the global population, the number of scientists is relatively small, yet still sufficient for humanity to fulfill its drive for excessive prestige. In truth, only about 10% of the world's population enjoys a life of moderate to excessive prestige. The rest of humanity lives on the edge or in absolute poverty.



5.7.4.2 Figure 526: The Mental world of humans

Figure 526 presents a more elaborate diagram of the human mental world. Humans are beings that rely heavily on color perception, even more than on other senses. Although the human visual spectrum is limited and does not include ultraviolet (UV) or infrared (IR) light, nature has endowed humans with a rich ability to perceive colors and their various shades.

The spectrum of sunlight is not just a means for obtaining food, ensuring safety, orientation, communication, gene transmission, and entertainment. It also serves as a source for scientific and artistic activities, which in turn have led to the development of modern technology. All these activities further reinforce the instinct for survival through the pursuit of excessive prestige.

Light affects not only the living world but also the non-living world—such as water, soil, and air. These effects, in turn, have a significant impact on the living world. Let us now take a closer look at how sunlight influences the non-living environment in connection with the living.

5.7.5 The influence of sunlight on the inanimate world in connection with the living world

We will focus on the influence of sunlight on water, soil, and air, and highlight some of the consequences for the living world.

a. Excessive UV radiation in the sunlight spectrum can affect water by causing chemical changes, negatively impacting organisms and ecosystems (e.g., lower water quality, disruptions in food webs, overgrowth of algae).

b. Excessive UV radiation can affect soil by threatening the survival of microorganisms, triggering unwanted chemical processes, breaking down essential organic matter, and degrading soil structure and fertility.

c. In the atmosphere, excessive UV radiation can alter chemical reactions, increase air pollution, boost ozone production, and harm living organisms and ecosystem function.

d. Excessive violet light can reduce photosynthesis efficiency in aquatic environments, increase stress on aquatic organisms (e.g., deteriorated water quality, poor health), accelerate the breakdown of organic compounds, disrupt chemical balance, and impair food web function.

e. Excessive dominance of blue light can harm soil by affecting microorganisms, triggering undesirable chemical processes, degrading soil structure and health, and disrupting ecosystem function. This may alter organic composition, water retention, and soil fertility, negatively affecting plant growth.

f. Excessive blue light in the air can encourage harmful photochemical reactions, contribute to air pollution (e.g., photochemical smog), alter climate conditions, and negatively impact the health of many living organisms.

g. Excessive light-blue light in water can harm photosynthesis, alter temperature and chemistry, encourage algal blooms, disrupt food webs, and change the water's optical properties, affecting its appearance and ecological balance.

h. In soil, light-blue light can threaten certain microorganisms (e.g., cyanobacteria) and plants, stimulate harmful chemical processes, degrade essential organic matter, disrupt nutrient balance, harm root structures, and reduce water retention, ultimately affecting fertility and plant health.

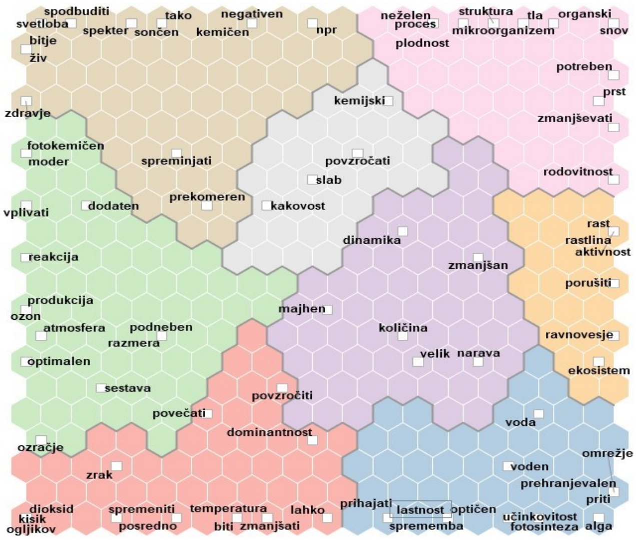
i. In air, dominant light-blue light increases light scattering, enhances harmful photochemical reactions, alters aerosol composition and movement, and affects climate. This can lead to more ground-level ozone, reduced visibility, and shifts in the atmosphere's optical properties, impacting health and ecosystem stability.

j. Excessive cyan-blue light can overstimulate photosynthesis in water, leading to changes in plants and algae. It can also trigger harmful chemical processes (e.g., breakdown of essential organic matter), change water temperature, and alter color and optical properties, which affects biodiversity and ecosystem dynamics.

k. In soil, cyan-blue light indirectly harms plant growth and microbial activity, altering soil structure, organic content, and nutrient availability. These chemical changes can reduce soil fertility and disturb ecosystem balance.

l. In air, cyan-blue light enhances light scattering and stimulates undesirable photochemical reactions, altering aerosol dynamics and atmospheric composition. This impacts visibility, ozone formation, environmental conditions, and living organisms' health.
m. Excess green light in water can, over time, reduce photosynthetic efficiency in aquatic plants and algae (lower biomass production), trigger unwanted chemical reactions, and change optical properties and temperature—leading to imbalances in aquatic ecosystems.
n. In soil, excessive green light can suppress plant growth, resulting in less organic input. This affects microbial activity, nutrient availability, soil structure, fertility, and plant support—potentially disrupting ecological balance.
o. In the atmosphere, too much green light reduces photosynthesis efficiency, which lowers CO_2 and O_2 production in water. Changes in volatile organic compound emissions can trigger chemical reactions, increasing aerosols and ozone, degrading air quality and altering climate.
p. Excess yellow light can decrease photosynthesis efficiency in aquatic plants and algae, reduce microorganism productivity, disrupt food webs, and alter water's temperature and optical properties. Unwanted photochemical reactions may further harm aquatic ecosystems.
q. In soil, yellow light can suppress photosynthesis, degrade essential organic matter, alter surface temperature and stability, and reduce microbial populations—thus affecting soil quality and fertility.
r. In air, yellow light may indirectly reduce CO_2 absorption and O_2 production, altering air composition. Emissions of volatile organic compounds can encourage harmful chemical reactions, and local temperature changes can degrade air quality and climate.
s. Excess orange light in water can impair photosynthesis, affect plant and algae growth, disrupt food chains, and change water temperature and optics. Photochemical reactions may also increase water pollution and ecosystem imbalance.
t. In soil, orange light can suppress photosynthesis and plant growth, reduce essential organic matter, microbial activity, and heat surface layers—negatively impacting fertility, structure, and biodiversity, thus disrupting ecosystems.
u. In air, orange light may alter temperature, leading to local warming and climate shifts. Decreased plant photosynthesis may raise CO_2 and lower O_2 levels, altering atmospheric chemistry and contributing to air pollution and climatic changes.
v. Excess red light can indirectly warm water (increasing evaporation), lower photosynthesis efficiency, and change optical properties—potentially disrupting aquatic ecosystems.
w. In soil, red light can increase temperature, alter microbial activity, suppress plant growth, reduce moisture, and degrade structure—impacting fertility and ecosystem balance.

x. In air, red light may raise air temperature and alter photochemical reactions, influencing air quality, weather, plant growth, and the balance of atmospheric gases (ozone, CO_2, O_2).
y. Excess infrared light has strong thermal effects on water, raising surface temperatures, increasing evaporation, stressing aquatic organisms, altering water mixing dynamics, and reducing oxygen solubility. These changes significantly impact ecosystem balance, biodiversity, oceans, and climate.
z1. In soil, infrared light increases temperature and evaporation, accelerates microbial activity (e.g., bacteria, fungi), inhibits some plant growth, and degrades structure—negatively affecting fertility, climate (e.g., drought, erosion), and ecosystem stability.
z2. In air, infrared dominance raises temperature, enhances the greenhouse effect, alters weather patterns, and increases pollution—degrading air quality, intensifying extreme weather, and contributing to less favorable global climate conditions.
Measurements of the solar light spectrum have shown considerable variation in the dominance of different colors at various times of day. However, it has also been found that these dominances are not long-term phenomena. Essentially, the solar spectrum tends to self-organize or balance itself.
The following diagram summarizes the potential long-term effects of dominant color bands within the sunlight spectrum.



5.7.5.1 Figure 527: Summary of the effects of dominant color spectra

Figure 527 presents a visual summary of the effects of dominant color spectra within the full spectrum of sunlight. It highlights key terms that emphasize the primary impacts of prolonged exposure of water, soil, and air to the dominance of specific colors in the solar spectrum.
These effects include reduced efficiency of photosynthesis in algae, plants, and fungi, leading to greater carbon dioxide absorption and reduced oxygen production. As a result, the composition and quality of the air deteriorate. Simultaneously, the quality of soil declines due to unsuitable

photochemical reactions, which hinder the optimal development of microorganisms and degrade soil structure and fertility.

Over time, optical changes in water sources occur, along with harmful chemical reactions and rising water temperatures, which accelerate evaporation into the air. This, in turn, contributes to increased atmospheric temperatures. Collectively, these effects alter weather patterns and climate, significantly disrupting the optimal balance of ecosystems.

The main outcome of these changes is a reduction in biomass and biological (biodiversity) variety.

In short, sunlight profoundly impacts not only the living world but also the non-living environment, which vastly dominates the Earth's surface. Moreover, the living world is far less resilient and highly sensitive to even small changes in water, soil, and air—such as a slight temperature increase that can already reduce existing biomass.

There are also many indirect effects related to the dominance of certain colors in the sunlight spectrum. For example, rising temperatures can increase the solubility and lower the pH of specific chemical substances, such as calcium carbonate ($CaCO_3$), which may affect the health of living organisms, climate conditions, and soil stability.

The following section presents several sunlight spectrum measurements taken at three-minute intervals. The primary purpose of these measurements is to illustrate the dynamic changes in individual colors within the solar light spectrum.

5.7.5.2 Table 221: Representation of individual colors in the solar light spectrum

BN	%1015	%1018	%1021	%1024	%1027	%1030	%1033	%1036
UV	96,4	97,1	96,7	95,3	92,4	97,5	91,8	96,3
V	94,7	92,7	92,2	95,8	93,9	97,9	92,1	91,4
M	96	92,7	92,5	92,7	93,7	95,7	94,4	89,2
SM	96,4	93,3	93,4	91,9	94,1	94,7	95	88,4
CM	96,8	94	93,6	91,7	94,3	94,3	95,2	88,1
Z	96,3	93,2	93,9	91,3	94,1	93,6	95,6	87,5
Ru	95,8	92,1	93,3	91,1	93,6	92,5	95,4	87,3
O	95,2	91,4	92,7	91	93,3	92	95,2	87,3
Rd	92,9	89,3	91,3	90,4	92,9	93,3	95,2	89,4
IR	90,7	87,1	94	93,6	95	96,9	97,5	95,7

Table 221 illustrates the dynamics of changes in the representation of individual colors in the sunlight spectrum over three-minute intervals. The values shown are averages expressed as percentages. It can be observed that these average values change quite noticeably over relatively short time spans, indicating that the distribution of colors in the sunlight spectrum is variable and not consistently balanced.

This applies more or less to all visible colors, as well as to infrared and ultraviolet light, which humans cannot perceive visually. Between 10:15 and 10:36, ultraviolet (UV) light had the highest average representation at 95.43%. It was followed by violet light (93.84%), infrared (IR) light (93.81%), cyan blue (93.5%), light blue (93.40%), blue (93.36%), green (93.19%), yellow (92.64%), orange (92.26%), and finally red (91.84%).

From these results, it could be inferred that during the measurement period, cool colors (cyan, light blue, and blue) were more dominant than warm colors (yellow, orange, and red), while green acted as a neutral color.

For animals and plants, UV and IR light often hold greater functional value than they do for humans, who—as previously noted—cannot visually detect either type of light. In the human context, this distribution of colors in the solar spectrum could suggest a reduced level of emotional engagement and possibly more rational cognitive activity.

In any case, the specific composition of colors in the solar light spectrum can influence the mood of many people and other living organisms. As discussed in previous sections on natural hierarchical associative systems, the majority of living beings require optimal levels of oxygen, carbon dioxide, temperature, humidity, and pH. Only a small number of organisms can survive in conditions that

deviate significantly from these optimal values (e.g., archaea, desert reptiles, desert insects, penguins, polar bears).
From this perspective, we essentially observe a bell-shaped (Gaussian) distribution of living beings that can survive in extremely cold, optimal, and extremely hot environments.
Going forward, it would be useful to focus only on the average values of cool, warm, and neutral (green) colors in the sunlight spectrum.

5.7.5.3 Table 222: Average representation of cool and warm colors and green in the sunlight spectrum

10:15	*10:18*	*10:21*	*10:24*	*10:27*	*10:30*	*10:33*	*10:36*	*Celota*
96.060	93.960	93.680	93.480	93.680	96.020	93.700	90.680	93.907
93.650	89.975	92.825	91.525	93.700	93.675	95.825	89.925	92.637
96.300	93.200	93.900	91.300	94.100	93.600	95.600	87.500	93.187

Table 222 presents the average percentages of cool colors (first row), warm colors (second row), and green as a neutral color (third row) in the spectrum of sunlight. During the time frame from 10:15 to 10:36, some variation is observed among the values of cool, warm, and green light. However, the overall distribution remains relatively balanced, with the respective values—93.907%, 92.637%, and 93.187%—being fairly close to one another.
In general, the color spectrum of sunlight remains relatively stable and balanced throughout the day. This balance is not only important for human well-being but is particularly vital for the plant and animal kingdoms, including microorganisms.
For plants, blue and red light are especially crucial (e.g., for photosynthesis and growth). Insects rely primarily on UV, blue, and green light, as these wavelengths assist them with orientation and food searching. Most microorganisms also depend significantly on UV, blue, and red light for orientation, communication, and photosynthesis in their respective environments.
Birds have the most advanced ability to perceive a wide range of spectral colors, including UV, blue, green, and red light. These colors play a key role in mate selection, locating food, navigating their environment, and communication.
Reptiles require adequate amounts of UV-A and UV-B light for vitamin D3 synthesis and environmental orientation. They also need sufficient blue, green, and red light, as the combination of these colors is essential for their survival and proper functioning.
For most amphibians, blue and green light are particularly important, as an optimal presence of these wavelengths regulates their biological rhythms. The same applies to fish, with the addition that UV and red light are especially significant in shallow-water habitats.

Mammals vary greatly in their perception of light, but emphasis can generally be placed on blue, green, and red wavelengths—particularly for primates. Humans require a relatively balanced full-spectrum exposure to sunlight for optimal health and well-being.

In summary, a severely disrupted balance in the color spectrum of sunlight would threaten the existence of most living organisms, including humans. Just like the optimal composition of air, ideal pH levels, temperature ranges, humidity, chemical composition of soil, and proper magnetic fields, a balanced color spectrum is essential for sustaining life on Earth.

Measurements indicate that despite minor fluctuations, the overall balance of light colors in sunlight is preserved and that excessive deviations do not occur. It must be emphasized again that while a few rare organisms can survive without air, light, or soil, none can survive without water. (Some so-called intelligent energies may exist without water, but by current definitions of life, they are difficult to categorize as living beings.)

In such a world, the human species would not exist. From a general perspective, water stands above light/heat, air, and soil as the superior entity, though this prioritization does not necessarily apply to all living beings. Particularly from the human point of view, the hierarchy of key life-supporting elements—water, air, soil, and light—is more associative than fixed.

Essentially, we are dealing with a polyhierarchy of key entities, which are associatively and cooperatively interconnected, while each forms its own vast hierarchical network. This concludes the final chapter of this section. A final chapter should follow to synthesize the most important findings from this extensive work.

6. Small summary of the key insights from all chapters in this section

1. Interdisciplinarity and the synthesis of knowledge

Hierarchology (along with hierarchography) is an interdisciplinary science that studies hierarchical associative systems and their connections within individuals, society, and the natural world. The aim is to establish a platform for interdisciplinary scientific research that would enable the measurement and evaluation of phenomena and events within individuals, in society, and in nature, with the primary objective of synthesizing theoretical—particularly practical—knowledge, including through the use of artificial intelligence systems (e.g., language models). It addresses complex social, natural, and psychological aspects of hierarchical associative systems.
Hierarchography is the descriptive and visual methodology used to represent and outline hierarchical associative systems.

There is a strong emphasis on studying human behavior in relation to social structures, environmental impacts on living beings, and various types of societal anomalies. Within this context, hierarchology also considers the energetic aspect of these systems, including energy loss, particularly in legally and technologically advanced human societies, as a consequence of aforementioned social anomalies.

By examining water, soil, air, and light, it explores various cosmic levels and forces that affect the Earth and living beings. It also deals with different types of inductions within networks of interrelations among living organisms in various ecosystems. Hierarchology strives to create more comprehensive representations of diverse hierarchies and associations between the inorganic and organic world. Central to this are so-called strict hierarchical relationships and relatively equal collaboration, with a strong focus on mutualism.

It is not solely about the survival of the fittest, but also about pronounced mutual cooperation between the organic and inorganic, where the focus is not on individual power. In short, understanding the interrelations among water, earth, air, light, energies, forces, and living beings is key to comprehending the hierarchical associative systems studied by hierarchology across different cosmic planes (micro-, meso-, and macrocosmos).

2. The development of science

Tracing the development of science from ancient Greece reveals that scientific achievements actually declined from that era to the late Middle Ages. In antiquity, sciences were primarily developed within philosophy and practical applications that often intertwined with social, political, and cultural aspects of life. During the early and high Middle Ages, science evolved mostly within church institutions, monasteries, and later universities.

Only in the late Middle Ages did a more dynamic and diverse scientific activity emerge, blending theological, philosophical, practical, and social elements. The Renaissance, Baroque, and Rococo periods brought even greater scientific development, integrating politics, economics, natural sciences, and technology. The Enlightenment laid the groundwork for the further development of science and the industrial revolutions.

Industrial revolutions provided the foundation for modern science and technology, contributing to the transformation of society and the economy in the 19th and 20th centuries. Modern science continues to research, innovate, and seek solutions to complex challenges faced by humanity in the 21st century. This trend is further amplified in the postmodern era, where science and technology operate in a complex, dynamic environment that recognizes the subjectivity of knowledge, shaped by context and cultural/social interactions. This reflects a broader shift toward valuing plurality and diverse perspectives.

Today, there are more than 1,000 scientific disciplines, with new branches and fields constantly emerging. This could imply the existence of over a thousand distinct scientific gardens that, through a relatively narrow, 'tunnel-like' approach, attempt to explain the functioning of living beings, society, nature, and galaxies across different cosmic levels. The main issue is not the sheer number of sciences but the relatively weak synthesis of knowledge and the fragmented approach to interdisciplinary collaboration. Many sciences tend to be inward-focused, reinforced by the egocentric tendencies of some leading scientists. This hinders more effective and organized interdisciplinary cooperation and, consequently, the successful synthesis of knowledge across scientific domains.

Science has not done enough to leverage social and psychological resources in society. Historically, and even today, science often serves profit rather than the common good or nature. Science has always lacked sufficient decision-making power, leading to inadequate political decisions. There is a lack of science dedicated to correcting or mitigating such shortcomings.

In summary, the main obstacle to more effective knowledge synthesis and better-organized interdisciplinary collaboration lies in human intellectual limitations. The production of information and knowledge is immense, and even highly organized communities of top scientists cannot efficiently and quickly synthesize all human knowledge. This insight opens the door to the further development of artificial intelligence and the potential role of scientific humanoid intelligent robots, which could process the entirety of human knowledge faster and more objectively. This would enable a more efficient synthesis of knowledge across disciplines and the discovery of hidden existing knowledge, serving as a springboard for solving problems in areas such as:

- Humanities (e.g., moral dilemmas),

- Individual development (e.g., positive intelligence),
- Society (e.g., social conflicts),
- Technology (e.g., intelligent decision-support systems),
- Nature (e.g., reducing pollution, increasing biomass).

Progress in these areas would contribute to a better energy utilization of hierarchical associative systems in the broadest sense, achievable within current capacities and capabilities.

3. The complexity of knowledge

Knowledge is a complex concept that is difficult to define precisely, as its meaning depends on subjective perception and social consensus. It can be understood through a hybrid approach that includes words, images, sounds, touch, and movement. Knowledge can be divided into factual (linear) and non-factual (nonlinear) types. In the hierarchy of information, it ranks just below wisdom and comprises interconnected data and information.

Due to the influence of intuition, it is difficult to measure and evaluate knowledge accurately, yet it is invaluable because it enables problem-solving. This is precisely why scientists and experts use it in the interpretation and processing of data, in order to gain new useful knowledge.

4. The individual, the family, and society as complex constructs

We can recognize that even a single individual is an extraordinarily complex construct shaped by both social and natural forces. Although the term "individual" typically refers to a human being, it can also be used in the context of plants and animals. In this section, the term "individual" refers specifically to a human being, who can be studied from various perspectives: psychological (e.g., personality), medical (e.g., physical and mental health), biological (e.g., the organisms within our body), physical (e.g., movement), chemical (e.g., biochemical reactions), geographical (e.g., location and climate), sociological (e.g., social roles and influence), systemic (e.g., interactions within natural hierarchical associative systems), and so on.

From a psychological standpoint, personality is considered the core of the individual. It includes mental (e.g., cognition, emotions, motivation), behavioral (e.g., temperament, character), and physical traits (e.g., physical abilities). The primary force shaping personality is the drive for survival, often linked to the pursuit of status or prestige, which tends to dominate one's mental focus.

Our senses act as receptors, detecting both internal stimuli (e.g., pain, increased heart rate) and external stimuli (e.g., unpleasant sounds, threats, bad smells). These stimuli, and how they are processed, significantly influence the individual’s physiological and mental responses, ultimately shaping the overall tone of mental focus—whether positive or negative. In addition to stimuli, personality can also be affected by various biochemical processes, chemical compounds and elements, genetic material, microorganisms, electromagnetic and magnetic fields, the movement of celestial bodies, social norms, rules, air quality, and other factors.

This complexity is not unique to humans; it applies to other living organisms as well—plants, algae, fungi, microorganisms, and animals. Understanding personality and individuality is therefore inherently interdisciplinary, as viewing it only through a psychosocial lens is an oversimplification. The formation of personality is influenced not only by the mesocosmic level (human-scale experiences) but also by micro- and macrocosmic levels. For instance, microorganisms and light spectra can affect mood and behavior in both humans and other organisms. These factors also influence chemical reactivity, both in organic and inorganic compounds.

Personality constitutes only a small part of human individuality. While animals may not have personalities in the human sense, they do display tendencies and instincts. It is clear, especially in domestic animals, that individuals can differ in temperament. The idea of "personality" is a socially constructed concept used primarily in psychosocial contexts. In reality, the electro-biochemical reactions in the human body, shaped by chemical compounds and genetic inheritance, predetermine many personality traits. Individuals generally have little control over these factors, which can be seen as part of their fate across different levels of the cosmos.

Without food and water, humans cannot obtain the necessary ions to regulate the nervous system and ensure its proper function. This also applies to blood cells, which are crucial to the functioning of blood as a life-sustaining fluid. The structure of an individual's physical body is largely predetermined by their parents' genetics and prenatal behavior. Thus, the human body is a complex, hierarchically organized, associative system that enables survival, functioning, and interaction with the environment. The body is an essential component of personality. To fully understand this system, one must consider both internal and external influences, including environmental and microcosmic factors (e.g., biochemical reactions, bacterial networks).

Individuals have varying degrees of influence over the factors that affect their lives. Some factors are under their control (e.g., willpower, reactions to stress, attitudes), others only partially (e.g., events, destiny), and some are entirely out of reach (e.g., genetic makeup, climate, microorganisms, international agreements, celestial bodies). These all shape personality and one's awareness of their place in the cosmos.

The relationship between an individual and the family is multi-layered and can be understood from various viewpoints. The individual is the smallest unit in the family, taking on roles such as parent, caregiver, relative, child, adoptee, friend, acquaintance, or even adversary. The family, as a larger unit, influences the individual, and vice versa. Families affect society through knowledge, labor, and taxes, while society shapes families through norms and policies. As the number of individuals and families grows, new family models emerge, often diverging significantly from the traditional nuclear family. In smaller societies, tribal family models were once sufficient.

Family leaders, especially parents, have a major role in decisions, particularly in child-rearing, which is shaped by collective values. On one hand, families influence society through the socialization of children, cultural transmission, economic activity, and social stability. On the other, the state plays a key role in regulating family relationships through legal, financial, and social policies. The state has a vested interest in children's education and positive development, as this supports future economic productivity.

Family formation—whether through blood relations or other forms—is primarily about survival within larger societal and natural systems. Some individuals within these systems strive for survival through excessive pursuit of prestige, reflecting the broader survival dynamics of humanity. Like individuals, families can be studied from more than just a psychosocial perspective—genetically, geographically, bacteriologically, medically, physically, biochemically, and in terms of information and communication.

Families consist of individuals with diverse genetic materials, microbiological compositions, health statuses, energy potentials, biochemical reactions, knowledge bases, and who live in different geographic and climatic zones. Thus, family research must be interdisciplinary, requiring a synthesis of knowledge from various fields. The same holds true for broader social structures—hierarchical associative systems—which are even more complex.

This section roughly classifies individuals into behavioral categories, such as those with submissive tendencies, those driven to constantly prove their intelligence, those who excessively seek dominance, and those with psychological pathologies. Many individuals in social hierarchies fall into these groups. Some have both personal and collective missions, visions, and goals. Research suggests that without hierarchically minded groups, human societies would never have achieved the organizational sophistication necessary for large urban centers. Their strong drive for dominance and expansion has built these systems.

While the psychosocial aspect is emphasized, other influences—genetic, hormonal, environmental, and social—are often hidden. Group tendencies also stem from genetic factors (e.g., "warrior gene," dopamine receptors), hormonal makeup (e.g., testosterone-cortisol ratios, oxytocin, vasopressin), and environmental and social influences (e.g., upbringing, societal conditions, pollution). Thus, people are not just products of psychosocial conditions but also of the inanimate world. This non-living or inorganic world—particularly chemical compounds—strongly affects personality traits. Without specific genetic and hormonal profiles, we would not see dominant or submissive personality groups.

Ions such as K^+, Na^+, Ca^{2+}, and Mg^{2+}, acquired through food and water, also influence these traits. Similar patterns are found in other advanced organisms, like birds and mammals. However, there is a key difference: in animals, the survival instinct focuses on optimal strength, while in humans it often manifests as a pursuit of excessive prestige. With 90% of the world's population living in extreme poverty and only around 10% enjoying excessive luxury, it is clear that most people suffer deprivation and barely survive. Many live near or within massive waste sites, often created or imported by more developed legal-technological societies. This highlights the inefficiency of using human potential in current hierarchical social systems. Poverty is a global problem and reflects poor societal organization.

Supporters of racial purity theories have argued—and some still do—that nations function better with genetically "pure" populations. However, the issue with this belief is that it limits genetic diversity and stagnates improvement. Human DNA has evolved slowly, and some suggest it may be reaching a dead end. In contrast, certain primates like chimpanzees and bonobos have shown genetic improvement over millennia. Overly homogeneous societies risk excessive inbreeding, which can cause genetic anomalies in offspring. In practice, such theories have failed. Ethnically diverse countries—such as the U.S., Germany, the U.K., France, the former USSR, Australia, and Canada—are among the world's most technologically advanced. Even Japan is not entirely ethnically homogenous, as it includes several ethnic minorities.

Human DNA differs only slightly from that of other species, making the concept of human races scientifically meaningless. Genetic mixing likely improves offspring up to a certain "critical mass," analogous to the saturation point in chemical solutions. Up to a point, ion concentration increases conductivity and efficiency, but beyond that, effectiveness declines.

Thus, greater integration of ethnic groups within a nation can be seen as a natural process. However, it is not certain that ethnic diversity alone improves DNA, as human DNA is nearly identical regardless of nationality.

5. Hierarchical associative systems

Neither individuals, families, nor societal hierarchical associative systems—such as those witnessed throughout human history—can function without the inanimate world. This implies that natural hierarchical associative systems, of which social systems are just a small part, also cannot function in support of the living world without the non-living. Without the material inanimate world, all cosmic levels would consist solely of different forms of energy, with potential energy being dominant.

Based on current knowledge, life cannot arise without air, soil, light/heat, and especially water. Even the most resilient organisms, such as certain species of archaea and tardigrades, cannot survive without water. The hierarchical associative structure of water molecules is most pronounced in liquid form, as it allows for their constant bonding and separation. This is largely due to the polarity of oxygen and hydrogen charges and the favorable bond angle between the hydrogen atoms and oxygen.

Water significantly influences the behavior and cognitive processes of living beings. It also plays a crucial role in shaping landscapes and creating various climate conditions. One of its ideal characteristics is its adaptability and its ability to influence both homogeneous chemical compounds and heterogeneous (bio)chemical mixtures.

Without water, many living organisms would lack flowing blood, which is essential for red blood cells to transport oxygen molecules to living cells, enabling the production of the energy compound ATP. Water can rightly be considered an abiotic super-producer of food within food webs.

It is important to note the existence of active and, from our perspective, precise hierarchical associative interactions and processes among water, soil, air, and light/heat, which together make life as we know it possible. In this sense, soil, air, and light/heat are also key abiotic super-producers of food. Without the active support of the inanimate world in the form of chemical compounds, their ions, and both inorganic and organic chemical mixtures across different cosmic levels, living beings could neither emerge nor develop.

6. The inanimate world and biomass

We have also found that the inanimate world greatly dominates the living, and that human industrial activities are further accelerating the growth of inorganic, or non-living, mass—which already exceeds the existing biomass. This raises a hypothetical question: is development occurring in favor of the inanimate world?

Considering the current and future production of humanoid intelligent robots, which might one day replace humans, the thought arises: could the living world become obsolete?

A modified periodic table has highlighted current and future threats, such as the reckless use of carbon, global warming, disruptions in photosynthesis, and a significant continued decline in the planet’s biomass. To this we can add the depletion of magnesium and phosphorus due to the mass production of smart devices.

These are three extremely important and essential elements (C, Mg, P), which play a key role in the existence and development of biomass.

7. Critical interconnections

Let’s return to the crucial interconnections between water, soil, air, light/heat, and chemical compounds. Light—especially sunlight—is a form of energy that affects water, soil, and air. For example, excessive UV radiation can cause chemical changes in water and negatively impact organisms and ecosystems.

An overabundance of red light can raise soil temperature, alter microbial activity, and inhibit plant growth. Similarly, too much infrared light can increase soil temperature, accelerate evaporation, and speed up microbial processes.

Different types of soil have varying properties such as aeration, water retention, and nutrient content. Soils affect air quality, and erosion can cause pollution by releasing particles into the air. Soil pH influences plant growth and insect development. Forest soils are known for supporting a wide variety of plants exceptionally well.

Winds can carry soil particles and salts over long distances, affecting plant growth. Meanwhile, excessive warming of the atmosphere increases water evaporation and contributes to climate change. Chemical substances dissolved in water are vital for the life of many organisms. Salts like chlorides, carbonates, and sulfates influence our planet and climate.

Water, soil, air, and light are interconnected within a complex system that affects climate and the development of living organisms. Plants depend on a balanced relationship among sunlight, air, water, and soil. Aquatic ecosystems rely on water quality, which is influenced by factors like pH, hardness, and pollution levels.

Amphibians need water to keep their skin moist, which is essential for breathing and movement. Water birds are closely linked to aquatic plants that provide them with food, shelter, and nesting materials. Aquatic insects depend on water temperature, oxygen levels, and pH.

Many living organisms contribute to soil fertility and biodiversity by aerating the soil, promoting biological diversity, and storing carbon in the soil.

8. Optimal conditions for life

Most living beings survive best under balanced conditions, such as an appropriate light spectrum, air composition, pH, temperature, humidity, and chemical makeup of the soil. Access to water, air, soil, and light is essential for survival.

A Gaussian curve can illustrate optimal conditions, where the central part represents ideal physical and chemical conditions, access to resources, symbiosis, and efficient metabolism. The edges of the curve represent extreme conditions for hardy organisms that tolerate a wide pH range (4–12), temperatures from –50 °C to 50 °C, and in some cases, archaea can survive even without oxygen.

Characteristics of the most resilient organisms include resistance, adaptability, efficient feeding, mutualistic symbioses, social behavior, effective respiration, pollution tolerance, and a positive impact on their ecosystems.

9. Energy content of living organisms

The energy content of living organisms is important because it determines the balance or imbalance of the entire ecosystem. The distribution of energy content within the microcosm and mesocosm serves as the basis for various decisions made by living beings—both in terms of producing and consuming food, as well as establishing mutualistic symbioses aimed at achieving a more comfortable and secure mode of survival.

Based on a rough estimate from a limited selection of living beings, trees such as hornbeam, oak, maple, alder, mosses, and spruce have the highest energy content. They are followed by mammals such as badgers, humans, and brown bears. Among birds, the eagle is notable in this regard.

10. Cosmic planes and energy efficiency of social and natural hierarchical associative systems

The micro-, meso-, and macrocosm represent three cosmic spaces or levels, with emphasis on causes and effects within the mesocosmic level.

Mass and energy are the common denominators of all three cosmic levels, but their distribution varies, causing incomparability between these worlds. Inorganic mass predominates over organic mass, while the energy of the macrocosm influences the mesocosm and microcosm.

Energy density is highest in the microcosm, where energy is concentrated in particle bonds, predominantly as chemical energy, but radiant, thermal, and kinetic energy are also important. The mesocosm focuses on the collective behavior of particles in different states of matter, while the macrocosm is dominated by large-scale energy transfer processes where inorganic substances like rocks, minerals, and gases play a key role.

The sun is a crucial source of light and heat energy, enabling plant life and influencing climate and soil moisture. Energies in the cosmos are dynamic, constant, and indestructible, with gravity, electromagnetism, and internal pressure shaping the structure and function of cosmic bodies.

The energy efficiency of social and natural hierarchical associative systems is complex and depends on many factors. In social systems, much energy is lost due to social factors—materialistic profit logic benefits only a few, while most lose valuable resources. Furthermore, systemic flaws, rigid hierarchies, various social anomalies (such as pollution, intrigue, crime, distress, stigma, mental illness), and the underuse of intellectual potential lead to inefficiency and high energy consumption. Countries can generate large profits, but these are often unevenly distributed, reducing actual energy efficiency.

Natural systems operate based on principles of self-regulation and self-organization, which optimize energy consumption. Various types of inductions play a key role in creating, transferring, and transforming energy within different systems, influencing their function and balance. Inductive processes enable the efficient functioning of ecosystems, with water being a crucial element for sustaining food webs.

Nevertheless, hierarchical associative food systems operate with only about 10% energy efficiency, although the diversity of plant species improves ecosystem functionality.

In short, both social and natural hierarchical associative systems experience energy loss, but natural systems self-regulate and self-organize to reduce unnecessary consumption. Maintaining balance between hierarchical and associative relationships is essential for the optimal functioning of both systems. Human activity can negatively impact the energy efficiency of society and nature, so addressing these challenges requires coordinated efforts involving technological, organizational, legal, communication, and social innovations. Reducing negative factors, encouraging cooperation, and seeking innovative solutions are key steps toward improving the energy efficiency of these systems.

7. Concluding remarks

Several concepts presented in this work have not yet been fully realized, prompting the need for future editions. Rough estimates of the energy content of living organisms were primarily generated using the ChatGPT assistant, as such data is not yet widely available. The bibliography is now organized and placed at the end of each chapter.

At times, the text may be less readable due to the inclusion of research and numerous interdisciplinary experiments. These elements were essential for the learning process and the application of information from various scientific domains. Ultimately, they contributed to a more effective synthesis of knowledge, aided by tools such as LM Notebook and Perplexity.

The translation from Slovene to English and subsequent proofreading were supported by various artificial intelligence tools, including ChatGPT-4o, Perplexity, and, in part, Gemini 2.5 Flash.

The original Slovenian work was developed over approximately 35 years: very intensively between 1990 and 1995, moderately intensively from 1996 to 2015, and once again very intensively between 2016 and 2025. It represents a fully revised and expanded edition of the first part of Hierarchology, which was self-published in 1995.

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