MINDGRAPHY

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SUMMARY:
In this article I raise a number of issues related to the possibility of capturing mental content as visually perceptible images. The images are created using linguistic and synaesthetic methods and find that this mindgraphy can be used for biofeedback or simply as an artistic product, with all the benefits that this concerns.

Concept

When I use the term mindgraphy, I am not referring to being able to use the mind directly, through sensors, to create certain images. What I mean here is the possibility of looking somewhat inside yourself, in seeing your mind literally. Certainly any communication, written or visual or otherwise, is based on a convention between the sender of the message and the receiver of the message.

The basic problem, then, is that it is difficult to identify the structure of the brain in some way, and that this identification should be made using a system of perceptible and communicable signs.

I'll start by noting that every brain is different and there are plenty of studies on the subject. Over the past few decades, neuroimaging has become a ubiquitous tool in basic research and clinical studies of the human brain. However, no reference standards currently exist to quantify individual differences in neuroimaging metrics over time, in contrast to growth charts for anthropometric traits such as height and weight. Brain charts are an essential step towards robust quantification of individual variation benchmarked to normative trajectories in multiple, commonly used neuroimaging phenotypes [1].

The term "brain activity" refers to a wide range of mental faculties that can be assessed either on anatomical/functional micro-, meso- and macro- spatiotemporal scales of observation, or on intertwined cortical levels with mutual interactions [2].

Then, as noted by Nasios [3], communication in humans activates almost every part of the brain. Of course, the use of language predominates, but other cognitive functions such as attention, memory, emotion, and executive processes are also involved. However, in order to explain how our brain "understands," "speaks," and "writes," and in order to rehabilitate aphasic disorders, neuroscience has faced the challenge for years to reveal the responsible neural networks. Broca and Wernicke (and Lichtheim and many others), during the 19th century, when brain research was mainly observational and autopsy driven, offered fundamental knowledge about the brain and language, so the Wernicke-Geschwind model appeared and aphasiology during the 20th century was based on it. This model is still useful for a first approach into the classical categorization of aphasic syndromes, but it is outdated, because it does not adequately describe the neural networks relevant for language, and it offers a modular perspective, focusing mainly on cortical structures. During the last three decades, neuroscience conquered new imaging, recording, and manipulation techniques for brain research, and a new model of the functional neuroanatomy of language was developed, the dual stream model, consisting of two interacting networks ("streams"), one ventral, bilaterally organized, for language comprehension, and one dorsal, left hemisphere dominant, for production. This new model also has its limitations but helps us to understand, among others, why patients with different brain lesions can have similar language impairments. Furthermore, interesting aspects arise from studying language functions in aging brains (and also in young, developing brains) and in cognitively impaired patients and neuromodulation effects on reorganization of brain networks subserving language. In this selective review, we discuss methods for coupling new knowledge regarding the functional reorganization of the brain with sophisticated techniques capable of activating the available supportive networks in order to provide improved neurorehabilitation strategies for people suffering from neurogenic communication disorders.

If neuroimaging does not seem to be helpful in identifying the connections between mental structures and language, this means that their identification can only be done by methods related to language and cultural patterns in general. I then assume that each linguistic compound (individual term and connection of individual terms) has a certain specific meaning for the bearer, but also includes related elements that make communication possible for other people belonging to the same cultural group. Whatever is not included in (expressible) language is part of a dark area of the mind, which cannot be communicated through language, but has a strong influence on the meanings attributed to the individual.

Every term of language that is communicable is accompanied by a whole range of sensations that I assume should involve all the senses. So a linguistic term can be identified by synaesthetic procedures.

Language as mental content

For the identification of mental content it seems useful to identify linguistic points of convergence, concrete terms and their placement in communication, the grammar rules.

Grammar, usually taken to consist of the rules of correct syntactic and semantic usage, becomes, in Wittgenstein's hands, the wider—and more elusive—notion which captures the essence of language as a special rule-governed activity.

The idea of a private language was made famous in philosophy by Ludwig Wittgenstein, who in §243 of his book *Philosophical Investigations* explained: *"The words of this language are to refer to what only the speaker can know — to his immediate private sensations. So another person cannot understand the language."* This is not intended to cover cases of recording one's experiences in a personal code, for such a code, however obscure in fact, could in principle be deciphered. What Wittgenstein had in mind is a language conceived as *necessarily* comprehensible only to its single originator because the things which define its vocabulary are necessarily inaccessible to others.

As Biletzki A. observes, throughout the *Philosophical Investigations*, Wittgenstein returns, again and again, to the concept of language-games to make clear his lines of thought concerning language. Primitive language-games are scrutinized for the insights they afford on this or that characteristic of language. Thus, the builders' language-game (*PI* 2), in which a builder and his assistant use exactly four terms (block, pillar, slab, beam), is utilized to illustrate that part of the Augustinian picture of language which might be correct but which is, nevertheless, strictly limited because it ignores the essential role of action in establishing meaning. 'Regular' language-games, such as the astonishing list provided in *PI* 23 (which includes, e.g., reporting an event, speculating about an event, forming and testing a hypothesis, making up a story, reading it, play-acting, singing catches, guessing riddles, making a joke, translating, asking, thanking, and so on), bring out the openness of our possibilities in using language and in describing it [5].

Language-games are, first, a part of a broader context termed by Wittgenstein a form of life (see below). The concept of language-games points at the rule-governed character of language. This does not entail strict and definite systems of rules for each and every language-game, but points to the conventional nature of this sort of human activity. Still, just as we cannot give a final, essential definition of 'game,' so we cannot find "what is common to all these activities and what makes them into language or parts of language" (id).

One of the issues most associated with the later Wittgenstein is that of rule-following. Rising out of the considerations above, it becomes another central point of discussion in the question of what it is that can apply to all the uses of a word. The same dogmatic stance as before has it that a rule is an abstract entity—transcending all of its particular applications; knowing the rule involves grasping that abstract entity and thereby knowing how to use it (id).

Huo, S. [4] argues that, Since Frege, mental content (conscious content) has been distinguished from the meaning of natural language and not regarded mental content as the meaning of language expression. This anti-psychological view cuts off the connection between the meaning of language and mental content, giving rise to the failures in solving the problems of mind. Instead of thinking about linguistic meaning and mental content separately, philosophers of mind put more emphasis on mental content and even equate the meaning of linguistic expressions with it. Therefore, the issues that what the relationship between linguistic meaning and mental content is and how they are connected are not well answered so far. The author argues in this paper that: 1) People attach meaning to symbols through communication activities when they have mental contents, thus forming the language, which is also a process of achieving psychological certainty in turn; 2) the relationship between linguistic meaning and mental content is similar to the interdependent relationship between monetary value and the use value of commodities. Without the latter, the former will lose its source, and the former also affects the latter. Philosophers of mind pay little attention to the interplay between language and mental content. Based on the above arguments and previous theories, this paper conceives a general model of the generation of linguistic meaning.

Reception of mental content

Synesthesia is a neurological condition in which stimulation of one sensory or cognitive pathway (for example, hearing) leads to automatic, involuntary experiences in a second sensory or cognitive pathway (such as vision). Simply put, when one sense is activated, another unrelated sense is activated at the same time. This may, for instance, take the form of hearing music and simultaneously sensing the sound as swirls or patterns of color.

Synesthesia is a condition where presentation of one perceptual class consistently evokes additional experiences in different perceptual categories. Synesthesia is widely considered a congenital condition, although an alternative view is that it is underpinned by repeated exposure to combined perceptual features at key developmental stages. Here we explore the potential for repeated associative learning to shape and engender synesthetic experiences. Non-synesthetic adult participants engaged in an extensive training regime that involved adaptive memory and reading tasks, designed to reinforce 13 specific letter-color associations. Following training, subjects exhibited a range of standard behavioral and physiological markers for grapheme-color synesthesia; crucially, most also described perceiving color experiences for achromatic letters, inside and outside the lab, where such experiences are usually considered the hallmark of genuine synesthetes. Collectively our results are consistent with developmental accounts of synesthesia and illuminate a previously unsuspected potential for new learning to shape perceptual experience, even in adulthood [6].

Any mental object can be useful if it is given a name and put into a conventional grammatical framework. The name and the gearing can only have their source around sensory perceptions, all sensory perceptions. Then a particular colour can suggest depth, in certain cases, and a sound can create celestial images. Combinations of the perceived intensity of sensations, expressed in predetermined circumstances, may indicate a mental object approximated by word.

Graphic representation

If we identify words that are relevant to a person at a given time, it is possible to create images that may be representative for that person.

Some works has shown that it is possible to take brain images of a subject acquired while they saw a scene and reconstruct an approximation of that scene from the images. An article show that it is also possible to generate *text* from brain images. There it started with images collected as participants read names of objects. Without accessing information about the object viewed for an individual image, the authors were able to generate from it a collection of semantically pertinent words. Across images, the sets of words generated overlapped consistently with those contained in articles about the relevant concepts from the online encyclopedia Wikipedia. It is claimed that the technique described, if developed further, could offer an important new tool in building human computer interfaces for use in clinical settings [7].

I take a different approach and consider that a combination of intensities of sensations expressed in a controlled environment can indicate mental objects with specific functions, communicable through words. The word list identified as relevant can be used for image generation.

To generate images from the words communicated you can use, for example, DALL·E, which generates more realistic and accurate images with 4x greater resolution. DALL·E is a 12-billion parameter version of GPT-3 trained to generate images from text descriptions, using a dataset of text–image pairs. We've found that it has a diverse set of capabilities, including creating anthropomorphized versions of animals and objects, combining unrelated concepts in plausible ways, rendering text, and applying transformations to existing images. DALL·E is a transformer language model. It receives both the text and the image as a single stream of data containing up to 1280 tokens, and is trained using maximum likelihood to generate all of the tokens, one after another. A token is any symbol from a discrete vocabulary; for humans, each English letter is a token from a 26-letter alphabet. DALL·E's vocabulary has tokens for both text and image concepts. Specifically, each image caption is represented using a maximum of 256 BPE-encoded tokens with a vocabulary size of 16384, and the image is represented using 1024 tokens with a vocabulary size of 8192.

The images are preprocessed to 256x256 resolution during training. Similar to VQVAE,1,2 each image is compressed to a 32x32 grid of discrete latent codes using a discrete VAE3,4 that we pretrained using a continuous relaxation.5,6 We found that training using the relaxation obviates the need for an explicit codebook, EMA loss, or tricks like dead code revival, and can scale up to large vocabulary sizes.

This training procedure allows DALL·E to not only generate an image from scratch, but also to regenerate any rectangular region of an existing image that extends to the bottom-right corner, in a way that is consistent with the text prompt.

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