D1.2 REVIEW PAPER OF SCIENTIFIC LITERATURE

WP1 – Getting insights on mistrust in science and challenges to science society co-creation

T1.1 – Systematic Literature Review

Prepared by Antonis Antoniou and Kalypso Iordanou (UCLan Cyprus)

Reviewed by Evan Fisher (TRI IE), Evren Yalaz (TRI IE), Agata Gurzawska (TRI IE), and Lisa Häberlein (EUREC)

Funded by the European Union

Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

Project summary

Different 'machines of trust' in science have been identified in the literature: research ethics, research integrity, science communication, benefit sharing and technology assessment. Previous EU funded projects have focused on particular actors of the trust in science ecosystem (e.g., scientists, research funding organisations, research ethics committees) to explore the impact of particular 'machines' (e.g., science communication, research ethics). VERITY goes beyond the state of the art by conceptualising 'stewards of trust' as the actors of the ecosystem that are responsible for upholding societal trust in science and facilitating science-society co-creation, either this refers to formally responsible organisations like research funding organisations and higher education institutions, or it refers to de facto responsible organisations like social media companies and video streaming platforms which influence societal perceptions of science and innovation. VERITY combines multidisciplinary expertise, both from the social sciences and engineering, to synthesise existing knowledge to evaluate tools and methods for enhancing trust in science through original research and small-scale participatory activities, before producing the VERITY Protocol of Recommendations for 'stewards of trust'. VERITY brings forward interdisciplinary expertise to perform network analysis and execute interventions on social media, to validate the VERITY Protocol and alleviate practical barriers for its uptake in practice by different stakeholders. VERITY findings will be widely disseminated to different 'stewards of trust', such as policymakers, research funding and performing organisations, higher education institutions and other research and innovation actors, to enhance societal trust in science and facilitate science-society co-creation.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Project information

Project full title: deVEloping scientific Research with ethIcs and inTegritY

Acronym: VERITY

Project ID: 101058623

Funding Programme: HORIZON-WIDERA-2021-ERA-01

Topic: HORIZON-WIDERA-2021-ERA-01-44

Start and end date: 1 September 2022 – 31 August 2025

Duration: 36 months

Website: https://www.VERITYproject.eu/

Consortium partners:

Logo	Partner	Abbreviation	Country
TRILATERAL RESEARCH	TRILATERAL RESEARCH LIMITED	TRI IE	IE
eurec	EUREC OFFICE GUG	EUREC	DE
SCIENCE|BUSINESS®	SRL SCIENCE BUSINESS PUBLISHING INTERNATIONAL	SB Int	BE
ZSI	ZENTRUM FUR SOZIALE INNOVATION GMBH	ZSI	AT
1828 University of Central Lancashire UCLan Cyprus	UCLAN CYPRUS LIMITED	UCLAN CY	CY
	PANEPISTIMIO DYTIKIS ATTIKIS	UniWA	EL
TRILATERAL RESEARCH	TRILATERAL RESEARCH LTD	TRI UK	UK

About D1.2. Summary of Systematic Literature Review

Authors: Antonis Antoniou, Kalypso Iordanou (UCLan Cyprus)

Contributors: Rea Roje, Agata Gurzawska (TRI IE); Gabor Szüdi, Pamela Bartar (ZSI); Panagiotis Monachelis (UniWA)

Reviewers: Evan Fisher (TRI IE), Evren Yalaz (TRI IE), Agata Gurzawska (TRI IE), and Lisa Häberlein (EUREC)

Due date of deliverable: 30 April 2023

Submission date: 28 April 2023

Dissemination level: PU - Public

CONTENTS

EXECUTIVE SUMMARY

The present deliverable provides a summary of a systematic literature review on the topic of trust in science, and it has been produced for the purposes of *T1.1. Systematic Literature Review* of the VERITY project.

The performed systematic literature review is based on a total of 83 articles, carefully selected after screening 546 articles. The selected articles provide empirical results from various scientific disciplines (e.g., social and educational psychology, medicine, science education, science communication), which were carefully collected and analysed in order to answer the following research question:

RQ: What factors are associated with public trust in science in the literature?

The results of the analysis performed for the purposes of the systematic literature review revealed the presence of 26 different factors associated with public trust in science, which can be divided in the following three categories:

i. Characteristics of the public
ii. Science communication
iii. Scientific method, scientists, and scientific institutions

The first category concerns the factors related to the profiles of various individuals who tend to have lower or higher trust in science. The second category concerns the ways in which science communication strategies increase or decrease the perceived trustworthiness of science. The third category concerns the characteristics of the scientific method and research processes, as well as the characteristics of the researchers and institutions producing scientific knowledge, which jointly increase or decrease the perceived trustworthiness of science.

The aim of this task is to provide a state-of-the-art literature review, which reflects the current knowledge on the factors associated with the public's trust in science and identifies gaps in our current understanding of the issue. A more detailed presentation of the results of the performed systematic literature review will be provided in an open access scientific article to be submitted for publication in due course. The article will provide further information on the evidence supporting the various factors related to trust in science, as well as a more elaborate discussion on the main research directions, theoretical claims, and methodological approaches. It will also point to existing uncertainties, contradictions, and research demands, distinguishing between consensual and contested claims.

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS/ABBREVIATIONS

Abbreviation	Explanation
HDI	Human Development Index
GNI	Gross National Income
RFOs	Research Funding Organisations
RPOs	Research Production Organisations
RQ	Research Question
UNDP	United Nations Development Programme
WP	Work Package

Table 1. List of acronyms/abbreviations

Funded by the European Union

Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

GLOSSARY OF TERMS

Term	Explanation
Ecosystem of trust	The conceptual space within which societal trust in science is constructed, negotiated, enhanced or reduced, as well as science-society co-creation and open science are sought.
Human Development Index	An indicator of the well-being of a country's residents, which goes beyond economic growth, and includes measures of life expectancy at birth, expected years of schooling, mean years of schooling, and gross national income (GNI) per capita, created by the United Nations Development Programme.
Narrative Synthesis	An approach to the systematic review and synthesis of findings from multiple studies that relies primarily on the use of words and text to summarise and explain the findings of the synthesis.
Open Science	An approach to the scientific process that focuses on spreading knowledge as soon as it is available using digital and collaborative technology.
Stewards of trust	The organisations and persons that are responsible for guiding societal trust in science and facilitating science-society co-creation. Their responsibility emanates either from their official mandate and mission, or from their de facto power and influence.
Systematic Literature Review	A systematic review is a scholarly synthesis of the evidence on a clearly presented topic using critical methods to identify, define and assess research on the topic.

Table 2. Glossary of terms

1. INTRODUCTION

This deliverable has been produced for the purposes of 'Task 1.1. Systematic Literature Review' for 'WP1: Getting insights on mistrust in science and challenges to science society co-creation' of the VERITY project. It summarises the main results of a systematic literature review on trust in science and includes a narrative synthesis of the main findings from 83 articles from various scientific disciplines in which research on trust in science is being carried out, such as social and educational psychology, medicine, science education, and science communication.

The aim of this task is to provide a state-of-the-art literature review, reflecting current knowledge on the factors that positively or negatively influence the public's trust in science and identifying gaps in our current understanding of the issue. To achieve this, the following research question was established as a guiding principle for the determination of the most appropriate search strategy and the selection criteria for the eligible studies:

> **RQ**: What factors are associated with public trust in science in the literature?

The results of the analysis performed for the purposes of the systematic literature review revealed the presence of 26 different factors associated with public trust in science, which can be divided in the following three categories:

i. Characteristics of the public

ii. Science communication

iii. Scientific method, scientists, and scientific institutions

The first category concerns the factors that are related to the different profiles of various individuals who tend to have lower or higher trust in science. The second category concerns the ways in which science communication strategies increase or decrease the perceived trustworthiness of science. The third category concerns the characteristics of the scientific method and research processes, as well as the characteristics of the researchers and institutions producing scientific knowledge, which jointly increase or decrease the perceived trustworthiness of science. In the following sections, each of these categories is presented separately and a brief description of the various factors included in each category is given.

Further findings of the analysis concern the definition of trust in science and the distinction between trust in science in general, and trust in scientists as communicators of scientific information. In general, the concept of trust has been widely studied (especially in philosophy) and it is commonly defined in the relevant literature as a three-way relationship between the trustor, the trustee, and the object of trust: A person (the trustor) trusts another person (the trustee) with something (the object of trust), which can be an action, a state of affairs, or a proposition (Baier, 1986; Hardin, 2002). In our systematic literature review, we identified different definitions of 'trust in science' which, nonetheless,

Funded by the European Union

Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

share some common elements. These elements concern the inability of the trustor to have first-hand access to the credibility of a communicated scientific proposition, an expectation of good intentions from the trustee, and a form of vulnerability, in that the trustor takes some sort of risk by accepting as true a statement that might have detrimental consequences to them if false. Regarding public trust in science, the trustor is embodied by members of the public that are non-experts and therefore, do not have direct access to scientific results and the methods that produce them, whereas the trustee is embodied by science as an enterprise for the production of knowledge. To trust science, is to accept that scientific knowledge is evidence based and to make decisions based on scientific knowledge, even though there is no first-hand access to the methods producing this knowledge. Further, this implies a degree of vulnerability and a form of risk taking.

However, when it comes to the distinction between trust in science in general and trust in scientists as communicators of scientific messages, it should be noted that in many studies on trust in science, the trustee concerns not science as an enterprise, but rather, researchers and scientists as the agents and representatives of science. In other words, while examining the factors correlated to trust in science, participants in many surveys were often asked to evaluate the characteristics of trustworthy scientists and determine the most trustworthy source of scientific information regardless of the content of the message. In evaluating the factors that affect the public's trust in science, it is therefore important to distinguish, where possible, between the factors affecting the public's trust in science as an enterprise, and the public's trust in individual scientists.

The present deliverable is organised as follows. In Section 2 an overall description of the methodology followed to produce the literature review is given. Section 3 follows with a presentation of the main results of the review organized in four parts. The first subsection provides a short description of the characteristics of the selected articles (e.g., year and country of the studies in the selected articles), and the following three subsections provide a brief presentation of the various factors corresponding in each one of the aforementioned three categories. Finally, Section 4 provides a critical discussion of the main findings of the systematic literature review and some preliminary corresponding recommendations. Section 5 concludes the discussion.

2. METHODOLOGY

The methodology for the completion of the Systematic Literature Review was based on the PRISMA protocol (Page et al., 2021), which provides an evidence-based minimum set of criteria for reporting in systematic reviews and meta-analyses. PRISMA is widely used as a basis for reporting systematic reviews and it was selected due to the high level of rigour it provides and its wide recognition as one of the best protocols for standardising the literature review processes. In the following subsections, the four stages of the PRISMA methodology for selecting and analysing eligible sources for this review are described in detail: Eligibility Criteria, Search Strategy, Data Collection and Analysis, and Synthesising the Collected Evidence.

2.1 ELIGIBILITY CRITERIA

To identify the most appropriate studies for our research questions, the eligibility of the articles to be included in the systematic literature review was determined by the following two main criteria:

1. Only studies directly examining the correlation and causal relationship of various factors to the levels of public trust in science were considered.

2. The factors correlated and affecting the public's trust in science had to be investigated empirically, without any restrictions on the methodology.[1]

Moreover, to ensure the credibility, integrity, and feasibility of the literature review, three criteria were added:

3. The surveys are based on participants aged at-least 16 years old (research based on young children was excluded).

4. The study is written in English.

5. The study appears in a peer-reviewed journal as an article.

2.2 INFORMATION SOURCES AND SEARCH STRATEGY

The review began with a comprehensive search for articles in three electronic databases: Scopus, Web of Science and PsycInfo. The selection of Scopus and Web of Science was based on their widely recognized impact indices containing high-calibre scholarly literature published worldwide and across a wide range of scientific fields. PsycInfo was selected as the premier abstracting and indexing database covering the behavioural, social, and psychological sciences.

The selected search strategy was based on the two core concepts of our main research question, namely, 'trust' and 'science'. After careful consideration, the following query string was established utilizing Boolean operators (AND, OR):

(trust* OR distrust* OR mistrust*) AND (scien*) in TITLE

[1] The studies found in the 83 selected articles for the review were based on several different methodologies which cannot be fully described here. Indicatively, these methodologies include online surveys, postal surveys, telephone surveys, computer-based experiments, and physical experiments.

Funded by the European Union

Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

This query string was adjusted to the search tools of each database. A search was performed in all three databases on 3rd October 2022 to derive an initial list of articles for further screening.

2.3 DATA COLLECTION AND ANALYSIS

The combined search in the three databases resulted in an initial corpus of 935 articles. After removing duplicates (n:389), the titles and abstracts of the remaining 546 articles were screened by two independent researchers from UCLan Cyprus, Trilateral Research IE and the Centre of Social Innovation, in order to reduce the effect of personal bias in article assessment. At this stage, the researchers separately assessed the eligibility of each article by marking it as 'eligible', 'ineligible' or 'maybe eligible' based on the aforementioned five selection criteria. Out of the 546 articles screened at this stage, the researchers disagreed on 65 out of 546 (i.e., one researcher classified an article as eligible and the other as not eligible), reaching a consensus level of ~ 88%. For these 65 articles the researchers jointly made a decision on whether they should be included in the literature review by further discussing the content of the research and examining the texts more carefully.

This procedure reduced the number of eligible papers to 87, which were then analysed by at least one researcher who read the text and extracted the following data for each study:

- research question(s)
- findings
- definition of trust
- examined factors
- type of study (correlational/experimental)
- methodology
- intervention (yes/no)
- country(-ies)
- sample size
- scientific discipline examined
- presence of controlled group (yes/no)
- funded research (yes/no)

During the analysis of these 87 articles, 12 more articles were excluded for not satisfying the inclusion criteria, and 8 additional articles identified through the analysed texts and references were added to the final pool. This process resulted in a total of 83 articles, from which the results of the present systematic review were derived. Annex A provides a table of the 83 articles included in the systematic literature review, along with some basic information about the content of the studies.

Figure 1 depicts a word cloud constructed from the titles of the 83 selected articles, providing an overall picture of the most frequent terms appearing in the titles. The size of each word reflects the number of times it appears in the titles, and hence, as expected, 'trust' and 'science' along with their variants ('trustworthiness', 'scientific', 'scientist' etc.)

Funded by the European Union

Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

are the most dominant terms, followed by terms such as 'health', 'vaccines', 'climate', 'media', 'information' and 'communication', that are indicative of the overall context in which research on trust in science is conducted.

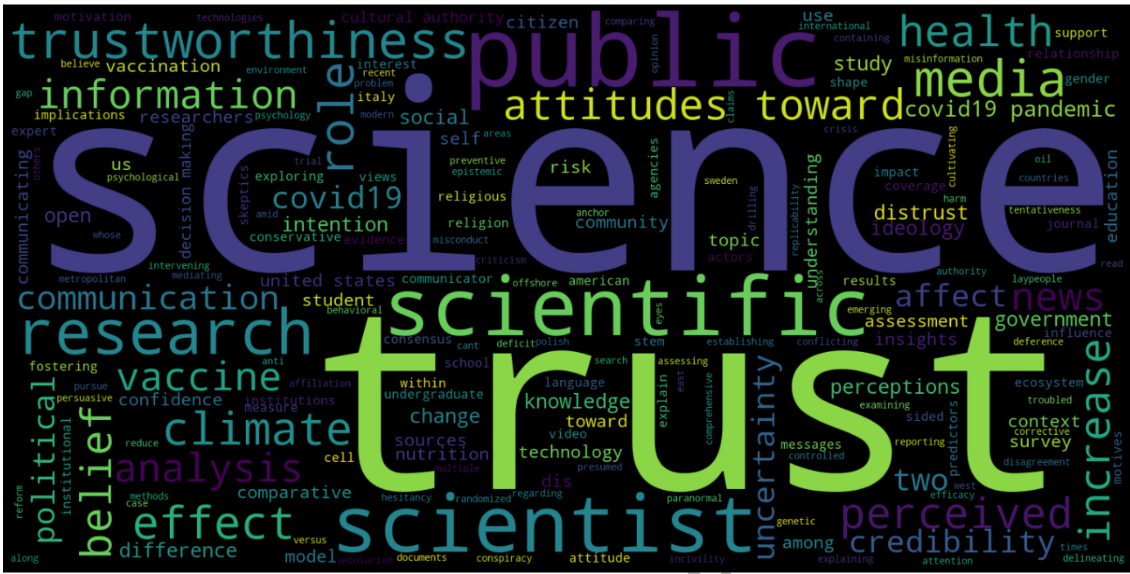

Figure 1. Word cloud from article titles

2.4 EVIDENCE SYNTHESIS AND PRODUCTION OF REPORT

After collecting data from the 83 eligible articles, the data were synthesised following the narrative synthesis methodology as outlined in Popay et al. (2006). Narrative synthesis is a widely used method for summarising evidence from qualitative data in systematic reviews. According to Popay et al., it 'refers to an approach to the systematic review and synthesis of findings from multiple studies that relies primarily on the use of words and text to summarise and explain the findings of the synthesis' (2006, p. 5). Given the diversity of studies found in the selected articles and the qualitative nature of the collected data, narrative synthesis was selected as the most appropriate method for combining the results of these studies in order to build a story that summarizes the most important factors correlated to public trust in science based on the current scientific literature.

Our analysis identified 26 different factors associated with trust in science, grouped in three main categories:

i. Characteristics of the public
ii. Science communication
iii. Scientific method, scientists, and scientific institutions

The identified factors in the performed systematic literature review are summarised in Table 4, where each number in the right column corresponds to the article providing evidence for this factor. The corresponding number for each article can be found in Table 6 in Annex A.

Funded by the European Union

Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

Factors	Supporting Articles
CHARACTERISTICS OF THE PUBLIC	
Political Ideology	2, 15, 16, 17, 27, 32, 52, 35, 44, 48, 49, 50, 54, 56, 60, 66, 72,28
Religious Beliefs	2, 11, 15, 32, 49, 65, 76, 53, 62
Level of education	1, 16, 17, 60, 67, 9, 63
Gender	56, 67, 68, 72, 75, 81, 53, 9, 36, 63
Prior attitude and core values	4, 20, 31, 33, 58, 72, 71
Interest in Science	6, 38, 68, 82
Exposure to news media and use of social media	7, 53, 42
Reflexive mindset	1, 37
Belief in conspiracy theories	19
Geographic Residency	49
Social Development of country of residence	26
SCIENCE COMMUNICATION	
Communication of uncertainty in scientific results	37, 50, 73, 78, 83
Communication of high consensus	21, 22
Communication of ethical implications and two-sided messages	38, 40
Use of aggressive and/or enthusiastic language	21, 45, 46

Funded by the European Union

Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

Presence of hyperlinks in social media science posts and user's comments	33, 80
Presence of information about scientific method	3
Channel of scientific information	14, 15, 59, 63
Messenger of scientific information	45, 47, 59, 67, 79
Scientists' characteristics as science communicators	25, 46, 57, 67
Widespread news coverage	41, 50
SCIENTIFIC METHOD, SCIENTISTS, SCIENTIFIC INSTITUTIONS	
Scientific field/topic	9, 60, 66
Scientists' incentives / Conflict of Interests	13, 25, 28, 29, 55, 67
Open Science	69, 74, 77
Citizen Science / Outreach Activities / Involvement in decision making	12, 51, 64
Replicability of results	8

Table 3. Identified factors associated with trust in science and corresponding articles.

3. RESULTS

This section provides an overview of our main findings. It begins with some descriptive statistics of the 83 selected studies and continues with a brief account of the three categories of factors. A more detailed analysis of our findings will be presented in a scientific article to be submitted for open access publication as a Systematic Literature Review on Trust in Science, in due course.

3.1 DATA OF INCLUDED STUDIES

Figure 2 provides a bar chart of the time distribution of the 83 eligible articles included in the Systematic Literature Review per year of publication. Even though no time constraints were imposed in the selected search queries, our search yielded results dating back to 1995, our screening process resulted in articles published from 2000 onwards, with the exceptions of years 2003, 2005, and 2006 during which no articles were found to satisfy our selection criteria. The results also show that research on trust in science has increased dramatically in the years following the Covid-19 pandemic, with 10 articles published in 2020, 14 articles in 2021, and 15 articles in 2022.

Nevertheless, the chart does not provide a complete picture of every published article on the topic of trust in science from 2000 onwards, nor does it suggest that no research on trust in science was carried out prior to this year. The chart only includes the 83 articles retained for review and, as such, it can only be interpreted as a general indication of trends in our corpus.

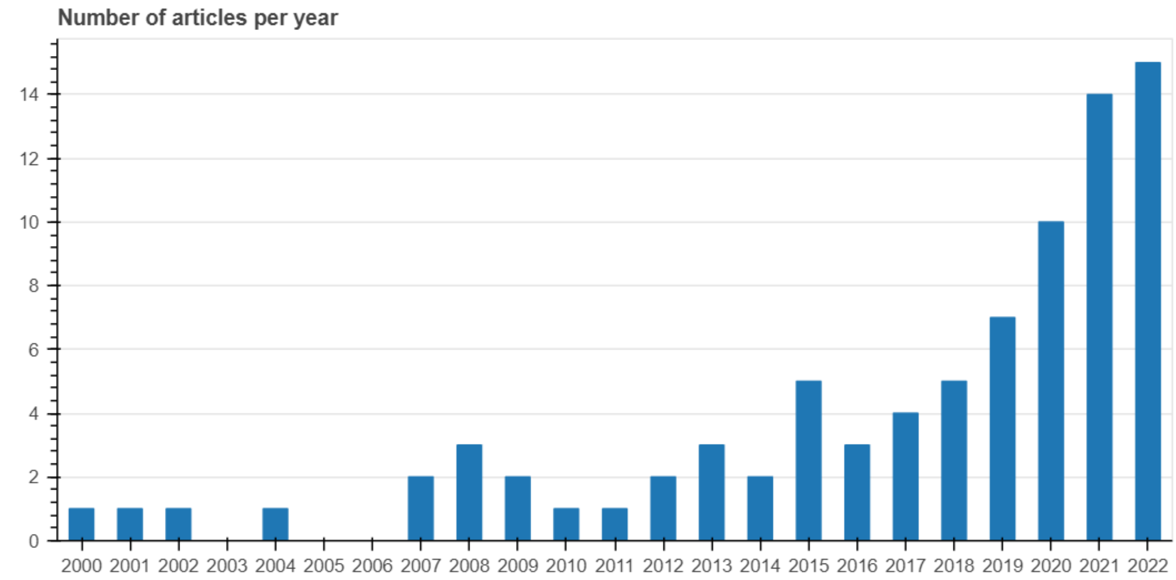

Figure 2. Bar chart of included articles per year of publication

Figure 3 provides a heat map of the countries in which the studies in the selected articles were performed. The exact numbers are given in Table 4 in descending order for better readability. The majority of the selected articles were based on one study conducted in one country, however, there were also five multinational studies including data from participants from more than one country (e.g., de Zúñiga et al., 2019; O'Brien et al. 2018; Huber et al. 2019). For these articles, if the number of participants was provided separately for each country, a study was assigned in the heat map and the table for each one of the corresponding countries. If only a total number of participants is given in the article, the study is marked as multinational in Table 2, and is not recorded on the heat map due to missing information. As a result, the final number of studies recorded in the heat map and the table below (89) is slightly higher than the number of the selected articles for the systematic literature review (83).

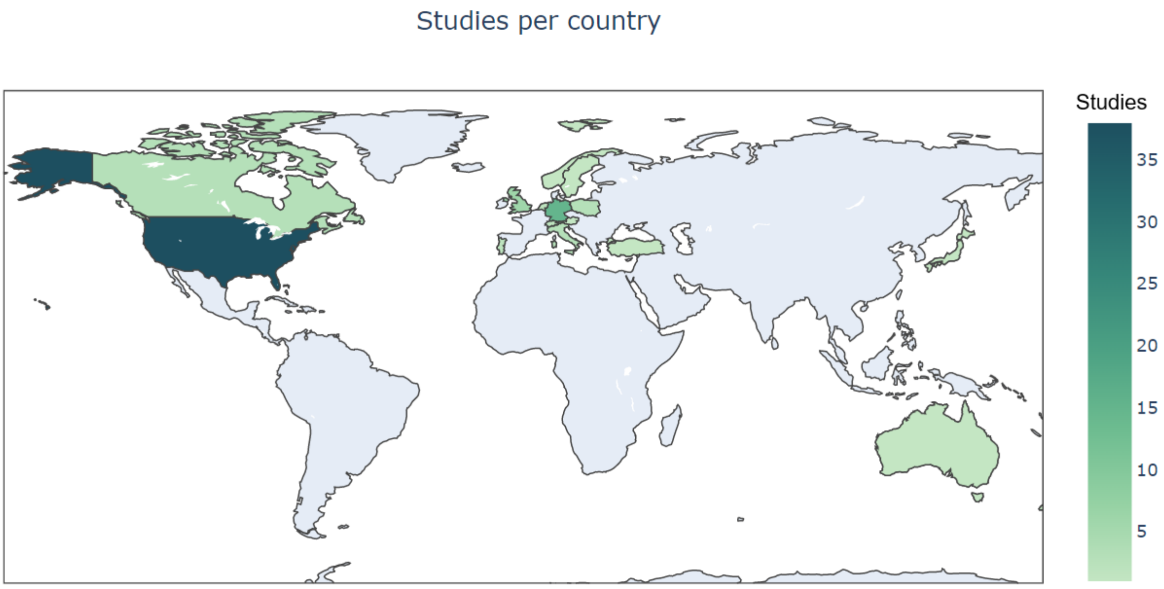

Figure 3. Heat map of countries indicating the number of studies in the selected articles

COUNTRY	STUDIES
USA	38
Germany	15
UK	6
Multinational	5
Canada	3
Italy	3
Poland	3
Unspecified	3
Netherlands	2
Portugal	2
Switzerland	2
Australia	1
Austria	1
Japan	1
New Zealand	1
Norway	1
Sweden	1
Turkey	1
Total	89

Table 4. Number of studies per country

Funded by the European Union

Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

The heat map and the table indicate that out of the 89 studies recorded in the selected articles, approximately half of them were conducted in the European region, with Germany having, by far, the highest number of studies (15), whereas six studies were carried out in the United Kingdom. Most of the studies carried out outside Europe were found in the USA (38), while no study was found in the African region, and only one study was found in Asia (Japan). One study was found in Australia, and one in New Zealand. The heat map clearly indicates the lack of English-language research on the perception of the trustworthiness of science in most parts of Europe, including major countries such as France and Spain. It also highlights the emphasis given on this issue in Germany, mainly due to a group of researchers at the University of Münster (Friederike Hendriks, Dorothe Kienhues, Rainer Bromme, Regina Jucks, and Lars König).

3.2 CHARACTERISTICS OF THE PUBLIC

The first and most-well studied group of factors related to trust in science concerns the characteristics of individuals that seem to be positively or negatively correlated with trust in science. The performed analysis identified the following eleven sociodemographic factors:

Political ideology: The political ideology/orientation of individuals was by far the mostly studied factor related to trust in science with 18 articles presenting empirical data indicating that **right-wing, conservative and populist political beliefs** are predictors of low levels of trust in science. However, the majority of these studies (11) were conducted in the USA. 5 studies were conducted in Europe, and 1 study was international.

Religious beliefs: Another widely studied factor concerns the religiosity of individuals with respect to their attitude towards science. In particular, 8 studies provide results indicating that **high religious commitment and church attendance** is correlated with lower levels of trust in science, with 6 of these studies carried out in USA, 1 study conducted in South Korea, Austria and Denmark, and 1 global study with results from 37 countries.

Level of education: A total of 7 studies examined the correlation between individuals' level of education and trust in science, yielding **mixed findings**. The results in these studies are less uniform and remain open to interpretation. 4 studies indicate that less educated people appear to have lower levels of trust in science. However, these results are contested by evidence from 3 studies indicating that low levels of education are not necessarily related to lower levels of trust in science.

Gender: The correlation between gender and trust in science was considered in 10 studies, indicating that **men tend to trust science more than women**, and, in general, have more favourable views towards it.

Prior attitude and core values: The prior attitude of individuals towards a scientific topic was another well-studied factor in the examined articles, with 7 studies presenting results

Funded by the European Union
Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

suggesting that **individuals tend to trust reports of scientific studies that support their values and prior beliefs** more than studies that contradict them.

Interest in science: A similar result comes from a group of 4 studies indicating that individuals with **positive pre-existing attitudes and high interest** in science tend to have high levels of trust in science.

Exposure to news media and use of social media: The **exposure of individuals to news related to science and scientific news in social media** has also been found to be positively correlated with higher levels of trust in science, indicating the importance of science communication in order to maintain high levels of public trust.

Reflexive mindset: Two studies found that having an intellective **epistemic style** characterised – for example – by an appreciation for dealing with complex issues, is highly correlated with higher levels of trust in science.

Belief in conspiracy theories: One study presents findings showing that **belief in anti-vaccine conspiracy theories** significantly affects the intention to get vaccinated against COVID-19, both directly and indirectly, by decreasing trust in science, trust in government, and attitude toward COVID-19 vaccination.

Geographic Residency: One study found that **rural residents** exhibit comparatively low levels of trust in science, compared with residents of urban areas.

Social development: A global study in 22 countries explored the correlation between trust in science and the stage of social development of these countries, as measured through the Human Development Index (HDI).[2] The results of this study suggest that trust in knowledge producers is inversely related to the HDI at the aggregate level, i.e., higher HDI relates to lower trust and low HDI relates to higher levels of trust. For reference, the four clusters are organised as follows:

- Cluster 1 – 'highest HDI': Germany, United States, New Zealand, United Kingdom, Korea, Japan, Taiwan, Spain, Italy, and Estonia
- Cluster 2 – 'very high HDI': Poland, Argentina, Chile, and Russia
- Cluster 3 – 'high HDI': Turkey, Brazil, Ukraine, and China
- Cluster 4 – 'medium HDI': Indonesia, Philippines, South Africa, and India

[2] The Human Development Index (HDI), created by the United Nations Development Programme (UNDP), is an indicator of the well-being of a country's residents, which goes beyond economic growth, and includes measures of life expectancy at birth, expected years of schooling, mean years of schooling, and gross national income (GNI) per capita (http://report2015.archive.s3-website-us-east-1.amazonaws.com/).

3.3 SCIENCE COMMUNICATION

The second cluster of factors relates to science communication and the ways in which science is communicated to the public. Our analysis revealed the presence of ten factors.

Communication of uncertainty in scientific results: Three studies present evidence indicating that communicating the **uncertainty** of scientific results to the public either does not affect the perceived trustworthiness of the results or it has slightly negative effects, leading to lower levels of trust.

Communication of high consensus: On the contrary, a study shows that the **communication of high levels of consensus** in results is highly correlated with higher levels of trust.

Communication of ethical implications and two-sided messages: **Introducing two- sided information** (i.e., communicating the advantages *and* disadvantages of a research project and results) instead of one-sided information (only advantages), as well as **communicating the ethical implications** of scientific research has also been found to be correlated with higher levels of public trust.

Use of aggressive and use of enthusiastic language: The **use of aggressive and/or enthusiastic language** in science communication was examined in two studies and was found to be negatively correlated with trust in science.

Presence of hyperlinks in social media science posts and user's comments: One study suggests that the **presence of hyperlinks** in social media science posts directing users to scientific sources lead to higher degrees of trust.

Presence of information about scientific method: In one study, a brief **exposure to** an infographic describing **the main scientific principles**, caused a small aggregate increase in participants' overall trust in science.

Channel of scientific information: A well-studied factor concerns the channel in which scientific information is presented to individuals. Sources directly related to scientific studies such as **textbooks and scientific articles**, are the most trusted sources of information, with **science television, science magazines, and science websites** also receiving relatively high scores of trustworthiness.

Messenger of scientific information: A similar group of studies examines the trustworthiness of various messengers of scientific information, regardless of the source via which this information is transmitted to the public. The clear consensus in these studies is that the most trustworthy source of scientific information are **scientists and researchers**. These results are also in line with the results of the 2021 Eurobarometer survey on European citizens' knowledge and attitudes towards science and technology, in

Funded by the European Union

Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

which EU citizens indicate scientists as the best qualified people to explain the impact of scientific and technological developments on society (Figure 4).

Scientists' characteristics as science communicators: Several studies examine the characteristics of scientists that make them appear more or less trustworthy when they are presented as conveyers of scientific information to the public. They found that **scientists working in the public sector** are perceived as more trustworthy when compared to scientists working in companies. Another study finds that **older scientists** are trusted more than younger scientists, and so are **female scientists** compared to male scientists.

Widespread news coverage: Finally, another factor that appears to be positively correlated with short-term higher levels of trust in science is the widespread news coverage of scientific achievements. A largescale study in the USA with data from 34,266 participants found that the widespread news coverage of the first human trial of the Zika vaccine was associated with a significant, albeit short-term, increase in trust in science.

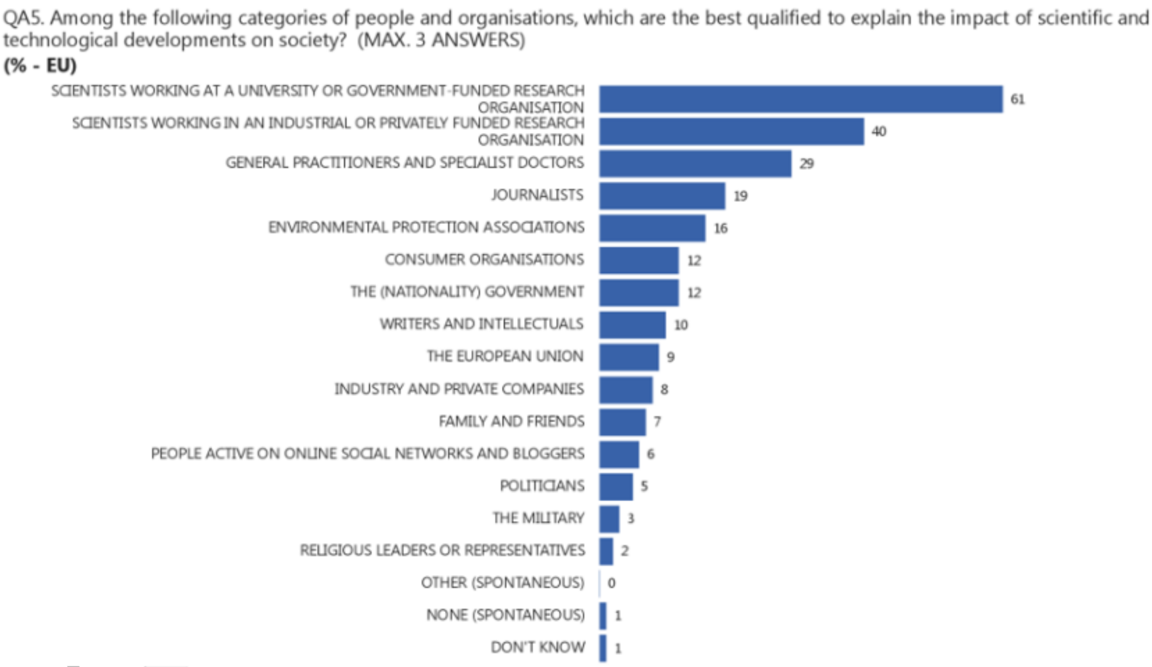

Figure 4. Eurobarometer results on the best qualified source of scientific information

3.3 SCIENTIFIC METHOD, SCIENTISTS, SCIENTIFIC INSTITUTIONS

The third group of factors related to trust in science concerns the characteristics of the scientific method and its processes, as well as the characteristics of scientific institutions and scientists as researchers (not as science communicators). Analysis of the selected studies revealed that the following seven factors have been identified in the scientific literature.

Scientific field / topic: One of the most important – yet underexplored – finding concerns the **varying levels of trust in science depending on the scientific field or topic** under consideration. While there is a considerable volume of studies exploring various factors related to trust in science in general, there is little work examining how these factors vary across scientific disciplines and topics. Most of the relevant research exploring topic-specific trust in science is focused on medicine (Agley, 2020; Andersson, 2015; Hilgard and Jamiesson, 2017, Kreps and Kriner, 2020) and climate science (Diehl et al., 2021; Fiske and Dupree, 2014, Hendriks and Jucks 2020). However, no comparison is made with other scientific fields within these studies. On this issue, we stand in full agreement with Pechar et al. (2018, p.307) who stress that 'scholars should not consider public trust in science as a single, homogenous construct. Individuals may trust science on some issues but not others, depending on how the source and implications of that science correspond to the individual's prior attitudes and values.'

Scientist's incentives / conflict of interests: Another important factor relates to scientist's incentives and the possible presence of conflicts of interest in research settings. In agreement with recent Eurobarometer results (Special Eurobarometer 516, Figure 4), findings clearly indicate that **privately funded research is perceived as less trustworthy** compared to publicly funded research, and that the presence of conflict of interests negatively affects the trustworthiness of scientific results.

Open Science: **Open science is positively correlated to greater trust in science**. This conclusion is supported by three studies clearly indicating that the public perceives open science research and researchers both as more credible and trustworthy than non-open science counterparts.

Citizen science / outreach activities / involvement in decision making: The accessibility of science to citizens, the popularisation of science via outreach activities and the involvement of citizens in science-related decision making is also a group of related factors positively correlated to greater trust in science.

Replicability of results / replication failures: As expected, the results of one study exploring the effect of replication failures in scientific research suggest that **being informed about replication failures and criticisms of questionable research practices reduces the public's trust in research.**

Funded by the European Union

Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

4. DISCUSSION

In this section, we provide a discussion on how the results of the systematic literature review can be exploited by Horizon Europe programmes aiming to enhance the public's trust in science and bring science closer to society. The discussion is divided in three parts, corresponding to the three categories of factors described above. We consider the key findings of our review, their implications, and recommendations for future actions. The key findings of these review and corresponding recommendations are summarised in Table 5.

Characteristics of the public

The results from this category can be interpreted as identifying the various groups of people that tend to have lower levels of trust in science, regardless of the underlying mechanism responsible for this. Current research shows that **people with conservative political ideology and strong religious beliefs tend to trust science less** than people with liberal political ideology and less religious people. These results suggest two possible courses of action. The first is to examine the relevant research more thoroughly to better understand the underlying mechanisms responsible for this phenomenon, that is, why right-wing politics and religiosity are associated with lower trust in science. The second course of action is to develop trust-building strategies that target these groups to enhance their trust in science through appropriate communication strategies (Kahan, 2015).

Another important finding relates to gender, which shows that **women tend to have lower levels of trust in science than men**. However, consensus on this finding is not high. Some studies indicate that women are more charitable in their emotional assessment of scientists as acting with integrity and benevolence, which further relate to trust. On this issue, we agree with Nisbet et al. (2002, p. 63), who claim that a possible explanation for the fact that women are more likely to have reservations about science comes from their lower levels of scientific knowledge in general (regardless of education), along with a number of other social and cultural influences that are not examined in these studies, and which, in our opinion, result from an overall lower exposure to science compared to men.

These conclusions are in line with the finding that prior attitudes, lower levels of knowledge about scientific issues – regardless of the level of education – and less exposure/involvement with scientific practices are associated with lower levels of trust in science. In this respect, we believe that the EC's efforts to promote science co-creation and to bring women closer to science are supported by the current state of the art.

Science communication

Science communication as a tool for enhancing the public's trust in science is studied in many of the analysed articles. The overarching conclusion is that the public appreciates **transparency, integrity, benevolence, and expertise**. This is evident from the fact that the communication on high consensus, the ethical implications of research, and two-sided messages are positively correlated to higher levels of trust in science. Therefore,

Funded by the European Union

Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

communication strategies should remain aligned with these findings. However, transparency is a value to be pursued for itself, since communication on uncertainty in science tends to reduce trust.

Moreover, there is high consensus in the literature, also reflected in the 2021 Special Eurobarometer Survey, that the public believes that **the most appropriate and most trustworthy source of scientific information are publicly funded scientists**. The emphasis given throughout the Horizon 2020 and Horizon Europe frameworks in the dissemination of scientific results from EU funded researchers is supported by the state of the art. Publicly funded research is regarded as being more trustworthy than privately funded research.

This result has a double reading. First, EU- and member state-funded research should take advantage of this and communicate clearly that funding sources are public. Second, action should be taken to improve the trustworthiness of privately funded research by emphasizing the expertise of researchers working in the private sector, and by better communicating on the transparency of privately funded research, its ethical implications, potential conflicts of interest, etc.

The VERITY project will use the results of the systematic literature review as a starting point to study the relevant literature deeper and develop its science communication and outreach actions accordingly. In particular, the project will employ the results of the literature review in its science communication strategy to engage in constructive discussions with various stewards of trust (i.e. policy makers, RFOs, RPOs, Higher Education Institutions, other R&I actors, and non-traditional stakeholders like education and knowledge platforms, museums or social media platforms) as well as other relevant stakeholders (e.g. citizens) who have the capacity to influence people either via social media or via other traditional media (Task 1.3., Focus Groups with Citizens and Task 3.2., Focus groups with the stewards of trust in the VERITY project). Similar EU-funded projects like POIESIS and IANUS engaging with trust in science and science communication are also expected to benefit from these findings.

Scientific Method, Scientists, Scientific Institutions

Analysis of factors related to scientific practice and its practitioners shows that **measures enhancing the transparency of these practices are correlated with higher levels of trust** in science. Open science approaches, absence of conflict in science and public engagement via citizen science, outreach activities and public involvement in decision making should continue to be developed. In this respect, the emphasis of the Horizon Europe framework on open science policies and science-society co-creation is once again supported by the literature. The VERITY project has included a partner from the ROSiE project on responsible open science in Europe on the VERITY Advisory and Impact Board as a steward of trust.

Nevertheless, it should be noted that compared to the amount of research on sociodemographic factors and science communication strategies, research on the characteristics of the scientific method is scant and more studies should be carried out to assess the impact of citizen science, outreach activities and public involvement in science-related decision making on the perceived trustworthiness of science.

Moreover, our analysis suggests that while there is considerable research on the perceived trustworthiness of science, **most studies tackle this issue without distinguishing between different scientific fields**. Rather, the analysed studies examine either the perceived trustworthiness of science in general, or the perceived trustworthiness of specific scientific fields, without comparing these fields with other fields. **The focus of a significant number of such studies on medicine, genetics, climate and environmental sciences implies that these fields might be facing a more severe 'trust crisis' than other scientific fields such as physics and chemistry for instance**. However, there is clear need for further research aiming to better distinguish those scientific fields - and even the specific scientific areas in those fields - which seem to be less trusted than others to identify the factors affecting their perceived trustworthiness. Future work within the VERITY project, especially in Task 1.3., Focus Groups with Citizens and Task 3.2., Focus groups with the stewards of trust, will move in this direction.

Finally, as mentioned in the introduction, **research on trust in science does not clearly distinguish between trust in science as a whole, and trust in scientists as the messengers of scientific results**. In many studies on trust in science, the trustee concerns not science as an enterprise, but rather, researchers and scientists as the agents and representatives of science. In other words, while examining the factors correlated to trust in science, participants in many surveys were often asked to evaluate the characteristics of trustworthy scientists and determine the most trustworthy source of scientific information regardless of the content of the message. This is another important dimension that needs to be taken into consideration in future actions since trust in researchers – as persons – does not necessarily imply trust in the scientific method and the knowledge it produces, and vice versa. That is, trust in science as a human activity that leads to reliable knowledge does not necessarily imply trust in scientists as sources of scientific information.

KEY FINDINGS	KEY RECOMMENDATIONS
CHARACTERISTICS OF THE PUBLIC	
• People with conservative political views and higher religiosity tend to have lower levels of trust in science. • Women seem to trust science less than men. • Prior positive attitudes towards science are highly positively correlated with higher levels of trust in science.	• Further research is needed to understand the mechanisms responsible for lower trust in science from certain groups of people (i.e. conservatives, religious people, women). • Trust building strategies specifically designed to target groups of people with lower levels of trust in science should be developed.
SCIENCE COMMUNICATION	
• Transparency, integrity, benevolence, and expertise are highly appreciated in science communication. • Publicly funded scientists are regarded as the most trustworthy source of scientific information in science communication.	• Public communication of EU funded research should indicate that the research is publicly funded via the EU. • Strategies for increasing the trustworthiness of privately funded research must be developed. • Science communication via science journalism should focus on the values of transparency, integrity, benevolence, and expertise. • Scientists and researchers should be given incentives to communicate their research to the public.
SCIENTIFIC METHOD, SCIENTISTS, SCIENTIFIC INSTITUTIONS	
• Transparency of scientific research via open science, public engagement, and absence of conflicts of interest is positively correlated with increased levels of trust. • The focus of research on trust in science is in the fields of medicine, genetics, climate and environmental science. • There is no clear distinction between trust in science and trust in scientists.	• Further research is needed to identify the scientific fields and/or topics that suffer from lower levels of public trust. • Further research is needed to better understand the distinction between trust in science and trust in scientists and how these two different forms of trust are related. • Open science, citizen science and involvement of the public in science-related decision making should be continuously supported and promoted.

Table 5. Key findings and recommendations

Implications for the Stewards of Trust

The VERITY project conceives stewards of trust as the organisations, groups or individuals who have extensive expertise and commitment in trust in science, as reflected in their official mandate and mission, or their de facto power and influence. VERITY appoints stewards of trust to be Ambassadors and Advisors and serve to constitute the Advisory and Impact (ADIM) Board. In this role, they drive the direction and collaborate with partners, advise, and are involved in the development of resources and data. The results of this systematic literature review will be used to guide the future actions of the VERITY project, especially the development of a Protocol of recommendations for the stewards of trust to increase societal trust in science, research and innovation, which is one of the major results of the project (R4.1).

Based on the findings of the systematic literature review, Research Funding Organisations (RFOs) and Research Production Organisations (RPOs), policy makers, Higher Education Institutions and other Research & Integrity actors will be encouraged to focus their agenda on open science practices and on actively promoting the values of benevolence, transparency, integrity and expertise via Responsible Research and Innovation practices. Individual researchers will be encouraged to engage in more transparent scientific practices, and to actively seek to establish high consensus levels on their findings. More emphasis should also be given to the possible ethical implications of scientific research and the involvement of the public in science-related decision making, since the review shows that the public appreciates clear communication on the possible ethical implications of scientific practice and being given the opportunity to participate in decision-making processes which influence their well-being and concern the possible benefits of society from science.

Moreover, the results of the systematic literature review are particularly illuminating with respect to the communication of scientific results to the public. The abundance of research studies on science communication and trust in science shows the former is central to the enhancement of public trust in science and suggests what the best strategies for promoting the trustworthiness of science to the public are. Science journalism actors, and scientists with significant presence in social and traditional media as influencers, will be informed about the best strategies for promoting scientific findings based on the results of this review.

The findings of the systematic literature review will also be used to inform science educators and educational institutions. Even though there is no clear evidence correlating higher levels of education with higher levels of trust in science, there is, nonetheless, clear consensus that the prior attitudes of individuals towards a topic, along with an inherent interest in science and a reflexive mindset, are correlated with higher levels of trust in science. Science education plays a central role in shaping prior attitudes on certain issues and developing interest in science. The VERITY project will employ these findings in their recommendations for stewards of trust working in science education. They will be advised to develop educational practices that are not restricted in providing ready-made knowledge to students and potential researchers, but that also highlight the overall value of science, the rigorousness of the scientific method, the importance of carrying out scientific research for shared benefits and the value of citizen science, within the context of Responsible Research and Innovation. Such value-driven educational approaches in science are especially important in shaping a positive attitude towards the trustworthiness of science and can thus play a central role in enhancing science – public relations.

5. CONCLUSION

The results of the performed literature review provide valuable insight on the current state of the art regarding the perceived trustworthiness of science by the public. The analysis of the literature indicates that the factors associated with public trust in science vary significantly. Our categorisation aimed to classify these factors in three different categories in order to describes the current state of the art. Our results indicate that (a) certain sociodemographic characteristics found in individuals are correlated with trust in science, (b) certain strategies and channels in science communication seem to be better than others in enhancing the perceived trustworthiness of scientific results, and (c) there are certain attributes of the scientific method (e.g., open science) and the characteristics of researchers and research institutions that play a significant role in the perceived trustworthiness of science. Moreover, our review indicates that the first category is the most studied one, followed by research on science communication. Research on scientific practices is less present in the literature. However, this may be due to the emphasis of our search strategy and selection criteria on the perceived trustworthiness of science by the public. That is, it is possible that the trustworthiness of the scientific method and the reliability of scientific results has been systematically studied in articles not captured by our research criteria.

Finally, regarding the robustness of the presented results and the limitations of our review, it should be noted once again that, for reasons of accessibility, only research articles written in English were considered for this review. It is possible that further research published in languages other than English exists and would provide additional findings and perhaps covers European countries not included in our data. As mentioned, approximately half of the selected studies were conducted outside Europe (mainly in the USA), and the studies carried out in Europe mainly come from data collected in Germany and the United Kingdom. Research should therefore be pursued that is more representative of the European public, especially with regard to the connection between political ideology and trust in science, since research on this issue has been carried out almost exclusively in the USA. Finally, we acknowledge that our screening strategy may be biased towards published peer-reviewed studies, which are most likely to include only statistically significant results. Nevertheless, given the large number of eligible studies for this review, we decided against the inclusion of further grey literature which might be used to mitigate this bias (e.g., theses, conference proceedings, preprints, working papers etc.). The 83 selected studies are sufficiently broad to allow the derivation of reliable and representative conclusions regarding the current state of the art on the study of various factors related to the public's trust in science.

REFERENCES

Baier, A. (1986). Trust and antitrust. *Ethics*, 96(2), 231-260.

Hardin, R. (2002). *Trust and trustworthiness*. Russell Sage Foundation.

Jensen, J. D. (2008). Scientific uncertainty in news coverage of cancer research: Effects of hedging on scientists' and journalists' credibility. *Human communication research*, 34(3), 347-369.

Kahan, D. M. (2015). The politically motivated reasoning paradigm. *Emerging Trends in Social & Behavioral Sciences*.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *International journal of surgery*, 88, 105906.

Popay, J., Roberts, H., Sowden, A., Petticrew, M., Arai, L., Rodgers, M., ... & Duffy, S. (2006). Guidance on the conduct of narrative synthesis in systematic reviews. *A product from the ESRC methods programme Version*, 1(1), b92.

Funded by the European Union

Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

ANNEX A: TABLE OF ELIGIBLE ARTICLES

No.	Authors	Year	Main Research Question(s)	Country	n = total sample size (component sample sizes in parentheses)
1	Achterberg, P., De Koster, W., & Van der Waal, J.	2017	Are the level of education, modern-reflexive values, and the level of cultural discontents (anomie) related to trust in scientific institutions, scientific methods, and scientific gap?	USA	n = 2006
2	Agley, J.	2020	Do religious commitment and political orientation have an effect on trust in science during COVID-19?	USA	n = 242
3	Agley, J., Xiao, Y., Thompson, E. E., Chen, X., & Golzarri-Arroyo, L.	2021	What is the effect of a brief informational infographic about the scientific process on trust in science?	USA	n = 1000
4	Altenmüller, M. S., Lange, L. L., & Gollwitzer, M.	2021	When does a researcher's personal affection by a research topic ("me-search") impact public perceptions regarding the trustworthiness of their research?	Germany	n = 621 (314+307)
5	Altenmüller, M. S., Nuding, S., & Gollwitzer, M.	2021	What is the effect of self-criticism and reform intentions in the perceived epistemic trustworthiness of researchers?	Germany	n = 702

6	Anderson, A. A., Scheufele, D. A., Brossard, D., & Corley, E. A.	2012	How are differences to scientific authority and science knowledge, media use, nanotechnology knowledge and nanotechnology information exposure through mass media related to trust in scientists and governmental agencies as sources of information about nanotechnology.	USA	n = 1015
7	Andersson, U.	2015	Is there a (positive or negative) connection between public trust and news content?	Sweden	n ≈ 6360
8	Anvari, F., & Lakens, D.	2018	How would public trust in past and future psychological research be impacted by being informed about replication failures, questionable research practices and proposed reforms?	Multinational	n = 1100
9	Bak, H. J.	2001	What is the relationship between education and public attitudes toward science?	USA	n ≈ 10000 (5x2000)
10	Barnett, J., Cooper, H., & Senior, V.	2007	How does a belief in the effectiveness of public involvement in decision making about genetic science relate to trust in decisionmakers and attitudes toward new genetic technologies?	UK	n = 3272
11	Beauchamp, A. L., & Rios, K.	2020	Is the trustworthiness of the religious scientist would associated with trust in science?	USA	n = 881 (372+290+219)

Funded by the European Union

Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

12	Bedessem, B., Gawrońska-Nowak, B., & Lis, P.	2021	Does the participation of laypersons or citizen scientists in the research process increases the trust that the public places in the social science research results?	Poland	n = 496 (174+164+158)
13	Benson-Greenwald, T. M., Trujillo, A., White, A. D., & Diekman, A. B.	2021	Does perceived prosociality of scientists and motivational focus predict trust in science?	USA	n = 1148 (478+367+180+123)
14	Bråten, I., Braasch, J. L., Strømsø, H. I., & Ferguson, L. E.	2015	How do college undergraduate students distinguish the trustworthiness of multiple, contradictory documents on a scientific topic?	Norway	n = 53
15	Brewer, P. R., & Ley, B. L.	2013	What explains trust in science regarding the environment?	USA	n = 851
16	Bromme, R., Mede, N. G., Thomm, E., Kremer, B., & Ziegler, R.	2022	1. Have trust in science and other science-related beliefs changed in Germany from before to during the pandemic? 2. What are the explanatory factors of public trust in science and its variability?	Germany	n = 4063 (1017+1009+1021+1016)
17	Cadeddu, C., Daugbjerg, S., Ricciardi, W., & Rosano, A.	2020	What are the profiles of people according to their belief towards vaccination?	Italy	n = 26262
18	Cadeddu, C., Sapienza, M., Castagna, C., Regazzi, L., Paladini, A., Ricciardi, W., & Rosano, A.	2021	How trust in the scientific community and attitudes towards vaccines have changed in the period from 2017 to 2019?	Italy	n = 5371 (2626+2745)

19	Capasso, M., Caso, D., & Zimet, G. D.	2022	Is the relationship between anti-vaccine conspiracy beliefs and intention to get vaccinated mediated by attitude, trust in science, or trust in government?	Italy	n = 822
20	Carlisle, J. E., Feezell, J. T., Michaud, K. E., Smith, E. R., & Smith, L.	2010	How do individuals decide which scientific claims and experts to believe when faced with competing claims regarding a policy issue?	USA	n = 1475
21	Chinn, S., & Hart, P. S.	2022	How do news stories containing civil scientific disagreement, uncivil scientific disagreement, or scientific agreement affect (a) attention to scientific issues, (b) evaluations of scientific research, and (c) trust in science?	USA	n = 1995
22	Chinn, S., Lane, D. S., & Hart, P. S.	2018	How do different levels of consensus shape perceptions of scientific certainty? How does trust in science moderate the relationship between levels of scientific consensus and perceptions of scientific certainty?	USA	n = 1160
23	Clobert, M., & Saroglou, V.	2015	What is the relationship between religiosity, paranormal beliefs, and distrust in science across different religious groups and among similar religious groups across cultural contexts	Korea, Austria, Denmark	n = 2618 (884+715+1545)
24	Cobern, W. W., Adams, B. A., Pleasants, B. A., Bentley, A., & Kagumba, R.	2022	What are the students perceptions on the veracity, durability, tentativeness, and trustworthiness of science?	USA	n = 500
25	Critchley, C. R.	2008	Is the public less supportive of stem cell research when conducted in a private compared to public research context?	Australia	n = 1208

26	de Zúñiga, H. G., Ardèvol-Abreu, A., Diehl, T., Patiño, M. G., & Liu, J. H.	2019	What are the levels of trust in different institutional actors (e.g., knowledge producers) across different societies?	Multinational	n = 22033
27	Diehl, T., Huber, B., Gil de Zúñiga, H., & Liu, J.	2021	How does getting news from social media relate to people's beliefs about anthropogenic climate change?	Multinational	n = 18785
28	Eiser, J. R., Stafford, T., Henneberry, J., & Catney, P.	2009	How do the residents of two English urban regions rate their trust in six potential sources of information about the risk of contaminated land in their neighbourhood?	UK	n = 951
29	Fiske, S. T., & Dupree, C.	2014	How much do citizens trust climate change scientists and what influences the level of trust?	USA	Unspecified
30	Fukasawa, M., Kawakami, N., Umeda, M., Akiyama, T., Horikoshi, N., Yasumura, S., ... & Bromet, E. J.	2020	Does post-traumatic stress and other psychological distress affect trust in government and science?	Japan	n = 927
31	Gauchat, G.	2011	How does a general attitude toward science and attitudes about specific science controversies influence overall public trust in science?	USA	n = 810
32	Gauchat, G.	2012	How do group differences influence public trust in science?	USA	n = 30802

33	Gierth, L., & Bromme, R.	2020	How do user comments in social media affect the perceived trustworthiness and credibility of science?	Germany	n = 304 (144+160)
34	Groeniger, J. O., Noordzij, K., Van Der Waal, J., & De Koster, W.	2021	What are the effects of the Dutch lockdown measures imposed in March 2020 on trust in government and trust in science and whether these differ across social groups?	Netherlands	n = 2219
35	Hamilton, L. C., & Safford, T. G.	2021	How did political ideology and elite cues influence public trust in science during COVID?	USA	n = 2764 (650+1155+959)
36	Hayes, B. C., & Tariq, V. N.	2000	What is the relationship between gender, scientific knowledge and attitudes toward science?	United States, Canada, Great Britain, New Zealand	n = 5576 (1577+1467+1261+1271)
37	Hendriks, F., & Jucks, R.	2020	Does scientific uncertainty in News articles affect readers' trust and decision-making?	Unspecified	n = 456 (286+170)
38	Hendriks, F., Janssen, I., & Jucks, R.	2022	How does presenting one- vs. two-sided messages affects ratings of scientists' and politicians' trustworthiness?	Germany	n = 603
39	Hendriks, F., Kienhues, D., & Bromme, R.	2016a	Does the disclosure of a study's flaw have effects on trustworthiness assessments?	Germany	n = 90

40	Hendriks, F., Kienhues, D., & Bromme, R.	2016b	Does discussing ethical implications of preliminary scientific results in a science blog impact the readers' perception of the responsible scientist blogger's epistemic trustworthiness?	Germany	n = 209 (101+108)
41	Hilgard, J., & Jamieson, K. H.	2017	Does a scientific breakthrough increase confidence in science?	USA	n = 34266
42	Hmielowski, J. D., Feldman, L., Myers, T. A., Leiserowitz, A., & Maibach, E.	2014	What are the relationships between media use, trust in scientists and perceptions of global warming?	USA	n = 3533 (2497+1036)
43	Huber, B., Barnidge, M., Gil de Zúñiga, H., & Liu, J.	2019	What is the relationship between social media use and public trust in science?	Multinational	n=21321
44	Huber, R. A., Greussing, E., & Eberl, J. M.	2022	So through which mechanisms does populism relate to climate attitudes?	Austria	n = 1237
45	König, L., & Jucks, R.	2019a	How does aggressive language influence the credibility of scientific claims and the trustworthiness of science communicators?	Germany	n = 221
46	König, L., & Jucks, R. (2019)	2019b	How does enthusiastic language influence the credibility of health information and the trustworthiness of science communicators?	Germany	n = 270

47	König, L., & Jucks, R. (2019)	2019c	How are information seekers' judgements of a source's credibility, trustworthiness, and instructional quality affected by the source's professional affiliation and involvement in supporting studies?	Germany	n = 189
48	Kossowska, M., Szwed, P., & Czarnek, G.	2021	Do those from opposite ends of the political spectrum look increasingly to academics for advice in equal measure, and does this trust shape their responsiveness to public health measures, such as vaccination programmes?	Poland	n = 1072 (312+391+369)
49	Krause, N. M., Brossard, D., Scheufele, D. A., Xenos, M. A., & Franke, K.	2019	What is the citizen confidence in science, scientists, and science knowledge?	USA	n = 1000
50	Kreps, S. E., & Kriner, D. L.	2020	How do the cue giver and cue given about scientific uncertainty regarding COVID-19 affect public trust in science and support for science-based policy?	USA	n = 6817 (2038+1008+1771+1001+999)
51	Krüger, J. T., Höffler, T. N., & Parchmann, I.	2022	What is the impact of outreach activities on the development of trust in science among secondary school students?	Germany	n = 776 (443+333)
52	Hamilton, L. C., Hartter, J., & Saito, K.	2015	Does political orientation influence trust in climate change and vaccine science?	USA	n = 2813 (1061+1752)
53	Liu, H., & Priest, S.	2009	What factors shape public attitude towards stem cell research?	USA	n = 1200

Funded by the European Union

Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

54	Mann, M., & Schleifer, C.	2020	Is there an increasingly negative relationship between conservative identity and trust in the scientific community over time?	USA	n = 35266
55	McComas, K. A.	2008	How does conflict of interest and other biases influence public trust in scientists?	USA	n = 1306
56	McCright, A. M., Dentzman, K., Charters, M., & Dietz, T.	2013	How do conservatives and liberals vary in their trust in both production science and impact science?	USA	n = 798
57	Millar, E., Melles, S., Klug, J. L., & Rees, T.	2022	What are the citizen scientists perspectives on community trust in science?	Canada	n = 40
58	Motta, M.	2018	Will pre-teens more interested in science & young adults with high levels of science comprehension be more likely to trust climate scientists as adults?	USA	n = 3116
59	Muğaloğlu, E. Z., Kaymaz, Z., Mısır, M. E., & Laçin-Şimşek, C.	2022	How did participants who trusted in scientists and those who did not trust in scientists about getting the COVID-19 vaccine report their source of information and health-related behaviors during the three defined periods of the pandemic between March 2020 and January 2021?	Turkey	n = 1307

60	Myers, T. A., Kotcher, J., Stenhouse, N., Anderson, A. A., Maibach, E., Beall, L., & Leiserowitz, A.	2017	Which demographics are related to trust in the scientific research of federal organisations?	USA	n = 1510
61	Nisbet, E. C., Cooper, K. E., & Garrett, R. K.	2015	Does political ideology influence trust in some organisations more than others?	USA	n = 1500
62	Nisbet, M. C., & Goidel, R. K.	2007	What is impact of value predispositions, schema, political knowledge, and forms of mass media use in shaping public perceptions of science?	USA	n = 407
63	Nisbet, M. C., Scheufele, D. A., Shanahan, J., Moy, P., Brossard, D., & Lewenstein, B. V. (2002).	2002	What are the effects of media for public perceptions of science?	USA	n = 1882
64	Nwebonyi, N., Silva, S., & De Freitas, C.	2022	How important is the connection between trust in science and the value attributed to public involvement in data governance?	Portugal	n = 651
65	O'Brien, T. L., & Noy, S.	2018	Does exposure to science, as measured by educational attainment, or religiosity, as measured by the frequency of attendance at religious services, affect trust in science and religion internationally?	Multinational	n = 48059
66	Pechar, E., Bernauer, T., & Mayer, F.	2018	How does motivated reasoning drive trust in the science in climate change and GMOs?	Germany, USA	n = 3000 (1500+1500)

Funded by the European Union

Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

67	Reif, A., Kneisel, T., Schäfer, M., & Taddicken, M.	2020	1. Do scientific experts differ in their perceived trustworthiness (expertise, integrity, benevolence) when appearing in TV interviews compared to sciencetubers? 2. What role do different video formats as well as emotional assessments of scientific experts play? 3. How do emotional assessments mediate the perceived trustworthiness of scientific experts appearing in different video content (TV interviews vs. YouTube videos)?	Unspecified	n = 155
68	Roberts, M. R., Reid, G., Schroeder, M., & Norris, S. P.	2013	Does perceived knowledge of science affect trust in science and technology?	Canada	n = 1217
69	Rosman, T., Bosnjak, M., Silber, H., Koßmann, J., & Heycke, T.	2022	Do open science practices positively affect public trust in science?	Germany	n = 1092 (504+588)
70	Rowland, J., Estevens, J., Krzewińska, A., Warwas, I., & Delicado, A.	2022	What are the citizens' perceptions of trust in several sources of scientific information related to climate change and vaccines?	Portugal, Poland	n = 202
71	Sarathchandra, D., & Haltinner, K.	2020	Which sociodemographic factors influence climate skeptics's (dis)trust in climate science?	USA	n = 33

Funded by the European Union

Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

72	Sarathchandra, D., & Haltinner, K.	2021	Which sociodemographic factors influence climate sceptics' (dis)trust in climate science?	USA	n = 1000
73	Schneider, C. R., Freeman, A. L., Spiegelhalter, D., & van der Linden, S.	2022	What are the effects of communicating scientific uncertainty on trust and decision making in a public health context?	UK	n = 6489 (1942+2155+2392)
74	Schneider, J., Rosman, T., Kelava, A., & Merk, S.	2021	Do Open-Science Badges Increase Trust in Scientists Among Undergraduates, Scientists, and the Public?	UK	n = 257
75	Schoor, C., & Schütz, A.	2021	What is the association between science-utility and science-trust, as well as the explicit beliefs about science in a sample of university students?	Germany	n = 261
76	Simpson, A., & Rios, K.	2019	How do perceived science–atheism associations affect U.S. Christians' attitudes toward science?	USA	n = 761 (171+297+124+169)
77	Song, H., Markowitz, D. M., & Taylor, S. H.	2022	Does open science increase trust in science for the public and academics?		n = 1017
78	Steijaert, M. J., Schaap, G., & Riet, J. V. T.	2021	What is the impact of uncertainty communication on trust in a scientist?	Netherlands	n = 88

Funded by the European Union

Project ID: 101058623
Funding Programme: HORIZON-WIDERA-2021-ERA-01
Topic: HORIZON-WIDERA-2021-ERA-01-44
Deliverable: D1.2 Review Paper of Scientific Literature

79	Thompson, J. L., Kaiser, A., Sparks, E. L., Shelton, M., Brunden, E., Cherry, J. A., & Cebrian, J.	2016	1. What do coastal community stakeholders already know about ecosystem services and related conservation and restoration efforts? 2. Who is a trustworthy messenger for coastal community, and why?	USA	n = 427 (201+226)
80	Verma, N., Fleischmann, K. R., & Koltai, K. S.	2017	What factors influence trust in scientific claims posted via social media?	Unspecified	n = 69
81	von Roten, F. C.	2004	What is the extent to which sociodemographic background and scientific knowledge explain gender differences in attitudes toward science?	Switzerland	n = 1000
82	Wintterlin, F., Hendriks, F., Mede, N. G., Bromme, R., Metag, J., & Schäfer, M. S.	2022	What are the roles of basic orientations towards science, perceived trustworthiness of scientists, and experiences with science?	Switzerland	n = 1050
83	Jensen, J. D.	2008	Does hedging affect the perception of scientific news by news consumers?	USA	n = 601

Table 6. Articles included in the Systematic Literature Review