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Kalypso Iordanou · Tine Ravn · Hub Zwart *Editors*



Trust in Science

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Trust in Science

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Preface

This volume presents insights from three projects funded by the European Commission to examine views and visions on trust in science across Europe, namely: Inspiring and Anchoring Trust in Science (IANUS), Probing the Impact of Integrity and Integration on Societal Trust in Science (POIESIS), and Developing Scientific Research with Ethics and Integrity (VERITY).

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Disclaimer The views and experiences expressed in this volume are those of the authors and editors only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA).

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Chapter 1

Introduction to “Trust in Science”



Kalypso Iordanou , Tine Ravn , and Hub Zwart 

Abstract Amid voices to stand up for science to protect its common values in existential times for science, this introductory chapter provides an overview of the 10 chapters comprising this book. Drawing on insights from three European Commission-funded projects—VERITY, POIESIS, and IANUS—an interdisciplinary team of researchers from philosophy, psychology, ethics, data science, political science, along with different stakeholders, has collaborated to shed light on the issue of trust in science. We argue that trust in science has a complex, multifaceted, multiactor, and context-dependent nature that must be approached as such—both for studying and understanding it, and for finding ways to foster it. The chapter provides a roadmap through the book’s examination of theoretical frameworks, measurement challenges, public perceptions, institutional perspectives, and policy implications. Throughout, there is consensus on the need to develop a more nuanced understanding of trust in science and approaches for bringing science closer to society, developing a robust ecosystem of trust where, through public participation, science becomes responsive to societal priorities and citizens’ concerns. When research demonstrates such responsibility and responsiveness, a reciprocal relationship of trust emerges wherein science and society mutually reinforce each other.

Keywords Trust in science · Research integrity · Science-society relations · Epistemic trust · Science communication

“Science ... is under threat,” stated the American Association for the Advancement of Science (AAAS) Chief Executive Officer Sudip Parikh in the opening plenary of the AAAS Annual Meeting in February 2025 (Korte, 2025), while the editor of

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“Science” urged readers to “stand up for science” to protect its common values in this existential moment for science (Thorp 2025). In this challenging time where science is under attack in some parts of the world, studying and reflecting on trust in science appear imperative to maintain and build trust both in and within science (Hendriks et al. 2016). Science is global in nature, relying on academic freedom, open collaboration, and knowledge exchange (ALLEA 2025). As a March 2025 Nature editorial warned, “an attack on science anywhere is an assault on science everywhere” (Nature Editorial 2025). Global surveys on public trust in science generally report a high level of trust worldwide, but also highlight several major challenges—among them, growing public concerns about government interference in research (Nature Editorial 2024; Gallup 2019).

Although no immediate crisis of trust in science can be identified—neither in Europe, which provides the contextual framework for the contributions in this *Springer Brief*—epistemic trust in science should not be taken for granted. The term “epistemic trust” refers to the trust placed in knowledge that has been produced or provided by scientists (Hendriks et al. 2016). Eight out of ten Europeans view the influence of science and technology as positive, expecting innovations to benefit everyone and serve the public good. However, they also express a number of different concerns, including the potential for scientific applications to threaten human rights (58%), doubts about whether researchers are truthful when dependent on industry funding (50%), and worries about commercialization interests and research on artificial intelligence (European Commission 2025).

Trust in research is central to our society and the uptake of research and innovation, ensuring that valid evidence forms the basis of sound and responsible policy-making and addressing both local and global challenges and crises. For example, studies have shown that societies with high levels of public trust in science were more effective in addressing the COVID-19 pandemic (Cologna et al. 2025). Trust in science does not preclude certain degrees of skepticism or distrust, for which there may be valid reasons. Hence, trust and distrust are both integral parts of democratic governance, trust cultures, and an ‘institutionalized distrust’ (O’Doherty 2022; Uttenthal 2024). In this context, key questions arise regarding which institutional frameworks and conditions can strengthen trust in science (O’Doherty 2022), and how we can understand and support drivers of trust to enhance science-society relations.

In this book, we present insights from three projects funded by the European Commission to examine this critical topic of trust in science: VERITY (Developing Scientific Research with Ethics and Integrity), POIESIS (Probing the Impact of Integrity and Integration on Societal Trust in Science), and IANUS (Inspiring and Anchoring Trust in Science). An interdisciplinary team of researchers from philosophy, psychology, ethics, data science, political science, along with different stakeholders, has collaborated to shed light on the issue of trust in science. We argue that trust in science has a complex, multifaceted, multi-actor, and context-dependent nature that must be approached as such—both for studying and understanding it, and for finding ways to foster it.

The chapters in this book present different definitions of trust in science, highlighting diverse aspects of the relationship between those who trust (trustors) and those who are trusted (trustees), reflecting disciplinary differences and traditions among the authors. Overall, the approaches generally move beyond a purely psychological conceptualization of trust as merely “the state of an individual” (Blöbaum 2016, p. 5), instead framing trust not as an object, but as a broader phenomenon with at least three distinct aspects: a psychological aspect (the trust that a person experiences emotionally), a normative aspect (whether someone should place trust or not), and a relational aspect (the nature of the relationship between a trustor and the party they either trust or do not trust) (O’Doherty 2022, p. 4).

Across the contributions in this book, a broad conceptualization of science is applied. The terms *science*, *research*, and *scientific research* are used and understood somewhat interchangeably, in a broad sense that aligns with the German concept of *Wissenschaft*. This term has no direct equivalent in English but encompasses “all academic knowledge—the natural and social sciences as well as the humanities” (Phillips 2015, p. 378). In this regard, science can be defined as “the study of the natural and social world by using our cognitive abilities (including observation, experimentation, and problem-solving) and the methods and instruments we develop (including statistics and microscopes), with the aim of describing, explaining, predicting, and controlling phenomena” (Krauss 2024, p. 4).

In 1993, Bruno Latour wrote a short piece in *Science* entitled *From the World of Science to the World of Research*, arguing for a transition from a culture of science to a culture of research—one that increasingly embraces uncertainty, risk, and societal involvement, and reflects reconfigured and entangled science–society relations (Latour 1993). Since then, many scholars have sought to better understand the complex and evolving nature of science–society relations, including the changing social roles and functions of science (Saltelli and Funtowicz 2017).

We engage with research philosophy, but there is still no ‘philosophy of research’ equivalent to the well-established ‘philosophy of science’ (Latour 1993). Similarly, we speak about trust in research, yet we operate within the broader conceptual field of ‘trust in science’—hence the title of this book. Nonetheless, the book collectively positions itself within a broader research ecosystem, encompassing the dimensions of technology and innovation, as well as complex governance and science–society relations. It illustrates that both *science* and *trust* are polysemic and contextual concepts, and that we cannot speak of a uniform public (O’Doherty 2022; Resnik 2011).

Within this framing and through philosophical analysis, meta-analysis of existing instruments measuring trust, and empirical research gathering insights from the public(s) and various stakeholders, this book provides fresh perspectives that prompt us to reconsider current practices for understanding and promoting drivers of trust in science.

This book is organized into 10 chapters (Chapters 2–11), each exploring different dimensions of trust in science through the lens of the IANUS, POIESIS, and VERITY projects, along with an introduction (current Chap. 1) and an epilogue from the Editors. The following overview provides a roadmap of the key insights and contributions each chapter makes to our understanding of trust in science.

Finally, the book concludes with an epilogue with the Editors' reflections. From theoretical frameworks to empirical findings and practical recommendations, these chapters collectively build a comprehensive framework of how trust in science can be studied, understood, and safeguarded.

Chapter 2, based on the assumption underlying the European Commission's great emphasis on research integrity that preventing misconduct at individual and institutional levels would raise trust and public support for science, technology and innovation, presents three case studies of recent technological developments which clearly demonstrate this perspective. The examples of GMOs and gene editing show that public trust in science requires transparency and open discussion with the public, while the example of climate change shows that scientific controversies often revolve around broader political and policy concerns, as scientific findings have the potential to shape policy with societal consequences. The examples of AI, including the Facebook-Cambridge Analytica scandal, highlight critical concerns about data privacy, data misuse, and AI's ability to manipulate public opinion interfering in democratic processes, while Microsoft's chatbot Tay shows generative AI's potential to replicate harmful content and biases present in its training data, underscoring the overall complex issue of accountability and responsibility in the context of emerging technologies.

Chapter 3 calls for a reflection on science communication's assumptions, motives, and desired outcomes. It invites a reconsideration of the conceptualization of trust in science as a repair mechanism tasked to promote or repair public trust in science—which is based on the public deficit model—as this approach prevents the scientific community from engaging in valuable opportunities for reflection and mutual learning. Instead of aiming to deliberately promote trust, it encourages science communication to embrace methods of genuine dialogue through which trust will emerge as a byproduct of other aims or through direct experience with the benefits of science communication itself, a condition which will also make science communication more trustworthy.

Similarly, Chapter 4 acknowledges the value of participatory research, making research more inclusive, transparent, and responsive to societal values, questions, and concerns as a way to foster public trust in science. Beyond this, the authors propose that what they call 'epistemic inclusion' is beneficial for science itself: societal concerns and public skepticism can be a source of inspiration. Equally important, this dialogue with different perspectives can help 'to discern our own blind spots and questionable preconceptions' (Blok 2019). This approach suggests that engaging with diverse viewpoints serves not only to build trust but also to strengthen the quality and rigor of scientific inquiry.

Chapter 5 highlights the problem of conceptualization and operationalization of trust in science in trust measures. The authors propose a paradigm for unpacking the concept of trust in science by clearly identifying the trustor (e.g., general public or scientists), the relation (e.g., trust in or distrust in), the trustee (e.g., scientific research, specific discipline, scientists), and the context (e.g., general or specific such as climate science). Even though trust as a concept cannot be perfectly measured, unpacking its dimensions and acknowledging its complexity, multifaceted

and context-dependent nature when interpreting survey data remains valuable. The authors also advocate for integrating diverse methodologies, such as collecting complementary data from focus groups in addition to surveys, which can provide deeper qualitative insights into the reasoning behind public attitudes toward science and their implications for science-society relations.

Chapters 6, 7, 8, and 9 present qualitative findings from various European countries through focus groups and workshops with distinct stakeholder categories: the general public (Chapters 6 and 7), institutional representatives (Chap. 8), and multi-stakeholders (Chap. 9).

Chapter 6 examines non-expert perspectives on factors influencing trust in science, identifying three distinct categories: (1) *individual factors*, encompassing affective responses, competencies, and motivational and cognitive attributes; (2) *socio-cultural factors*, including normative influences, social dynamics, and contextual conflicts that impede trust formation; and (3) *environmental factors*, such as national educational frameworks and digital information ecosystems.

Chapter 7 analyzes public perceptions and attitudes toward scientific integrity and trustworthiness, revealing that respondents expressed minimal concern about research misconduct, which they viewed as isolated occurrences. Instead, participants demonstrated greater apprehension regarding data governance, inadequate transparency, stakeholder conflicts of interest, and insufficient researcher accountability—concerns that align with the philosophical considerations articulated in Chap. 2.

Chapter 8, investigating perspectives from research-performing and research funding organizations, shows that institutional stakeholders underscore the value of scientists’ trust in their affiliated institutions. This institutional trustworthiness necessitates consistent fulfillment of scientists’ expectations, particularly regarding operational transparency, institutional support mechanisms, and steadfast adherence to research integrity principles.

Chapter 9, based on multi-stakeholder focus groups, emphasizes the need for a multi-level and multi-dimensional perspective of trust in science that should encompass insight into the underlying political and economic context in which mistrust in science evolved. The key prerequisite of a successful method to tackle mistrust in science is therefore a precise identification of the inherent socio-economic or political issues, which can be better addressed through sustained engagement of relevant local stakeholders.

Chapters 10 and 11 both emphasize that trust in science is a multifaceted phenomenon requiring comprehensive policy approaches that recognize the complex interrelationships between science, society, and governance. Chap. 10 proposes viewing trust in science as a dynamic ecosystem that operates through interactions of its agents and feedback processes, consisting of traditional stakeholders of trust (SOTs) such as researchers, universities, research funding organizations, and research ethics committees, but also non-traditional SOTs such as the tech industry, social media influencers, civil society organizations, and community leaders. Through the ecosystem metaphor, they underline the importance of building and strengthening inclusive and meaningful relationships within the science ecosystem.

Chapter 11, echoing themes from previous chapters, highlights the multidimensional nature of trust in science, arguing that effective policy interventions require a nuanced understanding of this complex phenomenon. Aligning with Chap. 10's systemic perspective, Chap. 11 supports the view that trust in science demands a comprehensive approach addressing the interplay between science, society, and governance. The authors distinguish between various reference objects of trust—individual scientists, specific scientific fields, institutions, products, and science as a methodological system—noting that each carries distinct expectations shaped by social, cultural, and individual factors. They identify key factors influencing trust at both individual levels and social levels. The chapter proposes prioritizing the integration of philosophical insights with empirical methodologies to design studies that more accurately capture the complexities of trust in science, enabling evidence-based and context-sensitive policymaking.

Throughout the chapters of this book, there is consensus on the need to develop a more nuanced understanding of trust in science and approaches for bringing science closer to society. The authors highlight the importance of developing a robust ecosystem of trust, where through public participation, science becomes responsive to societal priorities and citizens' concerns—including skepticism. Simultaneously, science must engage in continuous reflection on its internal mechanisms to ensure they uphold high standards of research integrity, transparency, and ethics, guaranteeing that scientific endeavors serve society's best interests. When research and innovation demonstrate such responsibility and responsiveness to society, a reciprocal relationship of trust emerges wherein science and society mutually reinforce and stand for each other.

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Chapter 2

The Conditions for Trust in Science, Technology and Innovation



Maria Michali , Amalia Kallergi , Eva Paraschou ,
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and George Gaskell 

Abstract This chapter examines three historical case studies: (1) ‘genetic modification to genome editing’; (2) ‘controversies over climate science’, and (3) ‘artificial intelligence in social media’. On this basis it develops an understanding of how public trust and confidence in science, technology, and innovation (STI) can be gained, maintained, or lost. This leads to practical recommendations for ethical and societally sustainable STI. There are both intuitive and evidenced warrants for trust in science. Intuitive warrants arise when innovation creates an immediate sense of familiarity, making the future feel like a natural continuation of the past. Evidenced warrants occur when science generates new insights or produces technologies that benefit individuals or society. However, trust in science may be undermined by scientific fraud, the dismissal of public concerns about innovations that challenge societal values, and the populist rejection of science, often accompanied by conspiracy theories. Building and maintaining public trust in STI is a multifaceted challenge that requires coordinated efforts from scientists, research institutions, funding bodies, regulators, and democratic governance processes. A commitment to transparency, proactive engagement with public concerns, risk assessment and mitigation, responsible communication, and strong regulatory frameworks is essential for navigating the complexities of technological advancement and ensuring public trust.

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Keywords Trust in science · Warrants for trust · Climate science · Social media · Genomics · Science governance

2.1 Introduction

The aim of this chapter is to develop an understanding of how public trust and confidence in science, technology, and innovation (STI) can be gained, maintained or lost, and drawing on case studies of climate change, genomics and A.I., to propose practical recommendations for ethical and societally sustainable STI.

Science is not merely an institution, it is an ecosystem of scientific researchers in the public and private sectors; governments and institutions that provide funds for research, and environments which translate research outcomes into technological assets driving innovation and global change. While the motto of the 1993 Century of Progress Exhibition in Chicago was “Science finds, Industry Applies, Man Conforms”, civil society is an essential component of the ecosystem. Public trust in the scientific ecosystem is vital. Trust concerns public beliefs and behaviours in relation to the challenges of pandemics, climate change, and genetic technologies. While public trust and confidence in science and scientists is evidenced in the Wellcome Global Monitors of 2018 and 2020, the reproducibility crisis, unreflective reliance on performance metrics, conflicts of interest and unreliable peer review processes may undermine public trust.

The European Code of Conduct for Research Integrity, developed by ALLEA (2023), outlines the principles of reliability, honesty, respect, and accountability, which now guide major funding programs such as Horizon Europe. The code illustrates how, in its approach on the relations between science and society over the past decade, the European Commission has emphasized the need for integrity standards for scientific research and technology innovation. The assumption is that preventing misconduct on the individual and institutional levels would raise trust and public support for science, technology and innovation. Nonetheless, although adherence to this code may increase trustworthiness, trust and distrust in scientific research and its rapid translation into technological innovation are impacted by various causes, many of which are unrelated to research integrity.

Gambetta (1988, 1X) wrote: “the importance of trust pervades the most diverse situations where cooperation is at one and the same time a vital and fragile commodity: from marriage to economic development, from the minutiae of social life to the continuation of life on earth”. Trust is always associated with unpredictability and with the perception of risk. If the outcome of a decision is predictable then there would be no reason to trust. With trust the future can be contemplated without (or with less) anxiety. As Georg Simmel (1968) puts it: trust is an intermediate state between knowledge and non-knowledge.

There are both intuitive and evidence based warrants for trust in science. Intuitive warrants occur in an immediate sense, while those based on evidence rely on intellect, reason and understanding. Regarding intuitive warrants for trust, Husserl's *Lebenswelt* (Follesdal 2009) captures the barely noticed social, historical and physical context of which we have a shared experience and which we generally take for granted. Similarly, Niklas Luhmann (1979) reasoned that if an event does not challenge an individual's or a group's preconceptions, it will be regarded as familiar. A familiar event will be seen as routine and will be assimilated into a category of similar, known events. As such, familiarity informs an imagined future as a generalised extension of the remembered past. This intuitive valuation affects warrants for trust in science both positively and negatively. However, if in a familiar situation some cues do not match expectations, assumptions about the normal are brought into question and this may lead to an erosion of trust.

Trust in science is also warranted when claims are supported by evidence. Specifically, where science generates valid insights or creates technologies that benefit the person or society, trust is warranted. However, scientific fraud, claims without supporting evidence, scientific and technological developments that challenge societal norms and values, and populist rejection of science accompanied by conspiracy theories may undermine existing trust in science or even generate distrust. Thus, trust is characterised by multi-faceted emotional, personal, and cognitive causes and effects.

Expectations set the bases for trust and comprise assumptions about other people—the generalised other. For trust or confidence to exist there must be a correspondence between expectations and actual experience. Barber (1983) identifies three preconditions for trust:

Value compatibility—expectations about the other's moral and value orientation. The assumption that political, legal and economic systems, in the sense of rules, procedures and people involved reflect their values. *Technical competence*—the expectation that those with responsibility have the necessary skills to carry out their functions properly. *Fiduciary responsibility*—the expectation that people will acknowledge and be motivated to serve other people's interests and not their own.

Through case studies mapping developments in scientific ecosystems this chapter supports the wider perspective from integrity to trust, initiated by the European Commission. Our investigation focuses on three major scientific areas: genetic manipulation and genome editing, climate science, and artificial intelligence (AI). While distinct in their histories and applications, all three cases are of immediate societal consequence and the subject of contemporary global debates. They evoke visions of both utopian and dystopian futures and raise vexing ethical issues. Importantly, these developments confront societies with uncertainty, values in dispute, high stakes and the need for decisions. As such, they fall in the category of post-normal science issues (Funtowitz and Ravetz 1993).

2.2 From Genetic Modification to Genome Editing

The exploration of genetic modification (GM) began in 1973 with the development of recombinant DNA (rDNA) techniques by Cohen and Boyer. As scientists realized the potential implications of altering genetic material, in 1975 a conference was convened in Asilomar to discuss the safety and ethical considerations surrounding rDNA. The conference led to the Berg letter which recommended a voluntary moratorium until safety protocols were established (Berg et al. 1974). One of the organisers of the conference said “there are issues which are peripheral to this meeting which could confuse it in a number of ways. One is the utilisation of this technology to what’s been called gene therapy or genetic engineering which leads one into complicated questions of what’s right and what’s wrong, of complicated questions of political motivations, and which I don’t think it is time to discuss” (Weiner 1979). As such, and to its cost, the birth of modern biotechnology eschewed the societal consequences and the public, paving the way for troubled times.

While scientific knowledge thrives on scepticism and debate, public understanding relies on narrative knowledge, a society’s folk wisdom that resists change, and which may clash with the scientific viewpoint. This mismatch was evident in genetically modified organisms (GMOs), where images of “frankenfoods” arose in public perception. Public understanding revolved around fears that consuming GMOs could have unforeseen health consequences, a perspective scientists rejected as absurd.

In the 1980s and 1990s, the biotech industry grew. The U.S. FDA adopted the concept of “substantial equivalence” for GM crops, asserting that genetically modified foods, such as the Flavr Savr tomato, were as safe as their conventional counterparts. This approach dismissed the need for additional regulatory action or product labelling, fuelling public distrust. Concerns were amplified by controversies, including cases where genetically engineered crops harmed non-target species like monarch butterflies and when GM soya arrived in Europe unannounced. Such incidents intensified calls for transparency, culminating in the EC’s mandate that foods containing GMO ingredients be labelled.

Public resistance to GMOs spread across Europe, where activists, politicians, and environmental NGOs voiced various objections, including risks to biodiversity, fears of corporate dominance in agriculture, and ethical concerns. These apprehensions culminated in Europe’s precautionary approach, enshrined in Directive 2001/18/EC, which mandated case-by-case assessments, product labelling, and public consultation for GM crops.

The advent of genome editing, particularly CRISPR-Cas9, marked a significant development in genetic engineering. This technology, recognized with Nobel Prizes in 2020, allows precise gene alterations with potential applications in medicine and agriculture. However, ethical and safety concerns persisted, especially regarding modifications to the human germline, which could impact future generations. In 2018, Chinese scientist He Jiankui’s controversial use of CRISPR to edit human embryos ignited global backlash led by scientists, as the procedure contravened

international ethical standards. Many countries now have stringent rules against human germline modification. Europe's regulatory framework, influenced by the EU Charter of Fundamental Rights and the Oviedo Convention, restricts genome editing that could lead to inheritable changes.

With applications of novel genomic techniques (NGTs) to crops and food, the regulatory were worried that the 1995-2005 'years of controversy' over genetically modified crops (GMOs) (Bauer and Gaskell 2002) could be repeated with NGTs. The problem with GMOs was fuelled by the absence of benefits for consumers, potential health risks and in some countries threat to a highly valued organic agriculture. Developments in genome editing led regulators to propose a distinction between NGT category 1 plants (NGTc1), those that could occur naturally or through traditional cross-breeding methods, and other genome edited plants including GMOs in NGT category 2 (NGTc2). The European Food Standards Agency reported that NGT category 1 plants are 'naturally equivalent' to conventional plants. All other NGTc2 plants will be subject to current GMO regulation. Possibly In anticipation of national governmental and public resistance to NGTc1 plants, it is recognised that EU-wide harmonisation regarding NGTs is unachievable, leading to a proposal to introduce an 'opt out' clause allowing member states to chart their own paths with or without NGTs. This represents an example of including the public in the sustainable development of STI.

This transparent and inclusive stance on STI is reflected in an article in Science signed by leaders in genetic research including Nobel prize winner J.A. Doudna. "At the dawn of the recombinant DNA era, the most important lesson learned was that public trust in science ultimately begins with and requires ongoing transparency and open discussion. That lesson is amplified today with the emergence of CRISPR-Cas9 technology and the imminent prospects for genome engineering. Initiating these fascinating and challenging discussions now will optimize the decisions society will make at the advent of a new era in biology and genetics." Baltimore et al. (2015) Is there a lesson here for those developing gene edited crops and foods and for STI more generally?

2.3 Climate Science and Its Controversies

Anthropogenic climate change is an established scientific fact that continues to be disputed by politicians, lobbyists, and citizens with contrarian views. By specifically attacking scientific integrity, the controversy known as 'Climategate' offers valuable insights into the dynamics of distrust in the epistemic claims of climate science.

In November 2009, an incident known as Climategate erupted after emails from the Climate Research Unit at the University of East Anglia in the UK were leaked without authorization. Climate change deniers took excerpts from these communications, claiming they proved that climate science was a hoax. Four leading climate scientists were accused of serious misconduct, including data manipulation,

suppression of dissenting views, and interference in the peer review process. Deniers suggested that these actions were part of a conspiracy to exaggerate climate change concerns. The timing of the leak, shortly before the COP15 climate summit in Copenhagen, fuelled speculation that it was a targeted smear campaign against climate science. Multiple investigations later exonerated the involved scientists, dismissing claims of fraud or deceit, although they criticized a “culture of non-disclosure” regarding data access and transparency, which they said could damage climate science’s credibility (Garud et al. 2014; Skrydstrup 2013).

Public reactions to Climategate highlighted issues surrounding the communication of climate science. The incident underscored the importance of transparency, suggesting that climate scientists should adopt more open practices. Some scholars viewed Climategate as a call to enhance science communication, with an emphasis on engaging with sceptics rather than merely presenting facts (Raman and Pearce 2020). Critics argued that traditional science communication approaches—primarily focused on sharing scientific data—were insufficient to address public misunderstandings and scepticism. Instead, they advocated for a “second-wave scientific literacy,” educating the public on the strengths and limits of science as well as its societal relevance (Myanna 2012).

Empirical studies (Leiserowitz et al. 2013) indicate that Climategate reinforced distrust mainly among those already sceptical of climate change. This suggests that the event did not create new distrust but confirmed existing biases. However, if Climategate only reinforced pre-existing distrust, then factors other than perceived integrity violations need to be considered. These factors may be found in the wider sociopolitical context in which climate science operates and cast doubt on the capacity of climate scientists to reduce distrust by means of conduct alone.

In the late 2000s, climate change scepticism was growing in several developed countries, including the United States (Ballew et al. 2019; Capstick et al. 2015). Economic factors, such as the financial crisis, and political factors, such as cues from political elites, influenced public opinion (Capstick et al. 2015). Scepticism toward climate science became further intertwined with broader ideological views and partisan positions. For some, distrust of climate science was linked to a general disillusion with institutions and governance, further suggesting that distrust is unlikely to be mitigated solely by scientists’ conduct.

The framing of Climategate as a debate over scientific integrity was significant because it challenged the primary basis for trust in science—objective evidence. By raising doubts about the honesty of scientists and by advocating “proper” science, deniers enforced unrealistic expectations of science’s detachment from political influence. Yet, scientific controversies such as Climategate often revolve around broader political and policy concerns rather than strictly epistemic issues. The intense scrutiny of climate science stems partly from its implications for policy and governance, especially as it informs decisions with far-reaching societal consequences. Therefore, trust in climate science is closely tied to the public’s trust in governmental and political institutions. To maintain credibility, scientists and policymakers must consider climate science’s role in shaping policy, acknowledging the political dimensions that accompany its findings.

2.4 AI in Social Media: A Trojan Horse for an Ambivalent Public

AI has increasingly permeated various aspects of daily life, revolutionizing processes across fields such as healthcare, finance, as well as social media. However, alongside its rapid expansion, concerns about AI's trustworthiness, malfunctioning, and misalignment with intended goals have grown. Specifically, AI use in social media, though sometimes considered a low risk, has sparked significant public concerns over privacy, data security, human rights risks, and user manipulation—highlighted by incidents such as the Facebook—Cambridge Analytica scandal, and Microsoft's Tay chatbot controversy. These incidents reflect the dynamics of trust and distrust in AI especially on open social media platforms, and underscore the need for transparent, human-centred, ethical, and responsible AI systems.

The Facebook—Cambridge Analytica scandal notably illustrates the potential of AI misuse in the social media context. The political consulting firm Cambridge Analytica accessed data from approximately 87 million Facebook users, obtained through a seemingly innocuous app. Using AI algorithms and Machine Learning (ML), the firm analysed these data to build psychological profiles for targeted political advertising during the 2016 U.S. presidential campaign. This incident raised critical concerns about data privacy, data misuse, and AI's ability to manipulate public opinion on a large scale interfering with democratic processes and potentially influenced voting and election results (Hu 2020). (Hinds et al. 2020). It further spurred global demands for ethical standards, stronger AI regulations, and transparency in data practices (Hern 2018). The political implications extended to public widespread scepticism towards the responsibility of governments and policy making agencies in ensuring data protection and regulating monopolies.

Overall, the controversy initially led to distrust of in the actors involved in the incident, including technology companies and the US institutions rather than the AI technology. Public reactions were initially driven more by the unauthorized acquisition of citizens' data. —However concerns about algorithmic manipulation emerged at a later stage in the light of misinformation incidents by the same platform.

Another controversial case involved Microsoft's chatbot, Tay, launched on Twitter in 2016. Intended to interact conversationally with users, Tay quickly became a source of public backlash. Within 24 hours, the chatbot began posting offensive and inappropriate content; Microsoft had to shut down its account, marking the ineffectiveness of their experiment on conversation understanding (Schwartz, 2024). It was later revealed that a link to Tay's account was shared in a highly ambiguous imageboard associated with misinformation content which prompted users to inundate the chatbot with such language. This incident reflected the potential of generative AI to replicate harmful content, and biases present in its training data. Similarly, it underscored AI's vulnerability to manipulation by malicious users, especially when AI systems are insufficiently tested or poorly designed. In fact, the lack of human oversight and safeguards, such as blacklisting and moderating harmful speech (Schlesinger et al. 2018), fuelled scepticism about the

awareness of technology companies about AI risks and their proactiveness in addressing them (Wolf et al. 2017), for instance through robust testing and ethical design.

This incident finally underscored the complex issue of accountability and responsibility in the context of generative AI technologies. As Suárez-Gonzalo et al. (2019) argue, responsibility for a chatbot's malfunction is shared among all actors interacting with it. There are also many challenges in attributing direct responsibility, as chatbots lack the human capacities of intentionality and agency. Compounded with the opacity of algorithms, it makes it extremely challenging to identify the root causes of problems and malfunctions encountered. Thus, fostering trust in such technologies becomes a multi-layered issue in need of collective and commonly agreed approaches. Especially in our Generative AI era in which chatbots have become the default human companions, the human-AI synergy must be carefully managed with strategic and accountable plans and continuous auditing.

Ultimately, trust in AI on social media is not only a matter of technical reliability but also of ethical governance and social responsibility -as also reflected in recent developments on the shortcomings on AI-driven content moderation in social media to prevent the projection of harmful images to minors (Bryant 2024), and major companies' decisions to soften content moderation policies on certain topics and debates. Addressing public concerns about AI's potential for misuse is essential for fostering a responsible AI ecosystem that respects user rights and democratic values. Efforts to make AI systems more accountable, alongside multi-actor approaches, and policies to safeguard privacy and prevent data misuse, will be crucial in enhancing public confidence in AI's role in society. This is notably mirrored in the adoption and phased implementation of the EU AI Act, which introduces transparency and risk-mitigation obligations for both high-risk and general-purpose AI systems.

2.5 Conclusion

Building and maintaining public trust in STI is a multifaceted challenge that requires coordinated efforts across various sectors. Scientists, research funding bodies, regulators, and democratic governance processes all play vital roles in ensuring that innovation is not only advanced responsibly but is also seen as beneficial, ethical, and aligned with public interests. A commitment to transparency, ethical engagement, and clear communication is essential for navigating the complexities of technological advancement and ensuring that public trust is upheld. The three case studies inform a number of practical conclusions for scientists and technologists, for research funding bodies and for regulators. They may guide democratic governance processes and foster public confidence and trust in science and its translation into technological innovations.

For *scientists and technologists*, innovations that offer tangible benefits and can be easily assimilated into existing personal and societal norms are generally welcomed and face few challenges. However, when innovations disrupt current ways of

life, requiring societal adaptation to new realities, they necessitate societal engagement and deliberation. Without careful consideration of costs, benefits, ethical implications, and distributional issues, trust in science and innovation may be undermined. For *research funding bodies*, proactive and strategic public engagement in STI is essential. Transparent communication about public involvement in STI, including issues such as data rights, is crucial. Funding for Knowledge Exchange and Information (KEI), which should represent around 10–15% of research funding budgets, should be a requirement for research funding organisations. For *regulators*, strong, transparent, and independent regulatory frameworks are vital for providing assurances of safety and accountability. Public trust can be threatened by issues such as invasions of personal privacy, questionable corporate practices, denial of agency, threats to democratic processes, and unclear responsibility for misuse and malfunctions. While newly established regulations such as the European Union AI Act aim to address these concerns, the risks are global in scale and involve unprecedented dynamics and momentum.

Finally, the wider socio-political context, shaped by historical experiences, cultural values, and, more recently, populist ideologies, significantly impacts public trust in STI. For democratic governance processes this necessitates proactive engagement with public concerns, risk assessment and mitigation, transparency, responsible communication, ethical considerations, and strong regulatory frameworks. Addressing the complex interplay of scientific evidence, public perception, political agendas, and technological uncertainties is essential for ensuring the responsible use of scientific advancements and securing public trust.

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Chapter 3

Science Communication as a Trust Repair Mechanism



Amalia Kallergi  and Laurens Landeweerd 

Abstract Science Communication (SciComm) refers to the many ways that science and scientific issues are shared or discussed outside of academic settings. Both reviews of SciComm literature and accounts of the field’s historical development indicate that promoting or restoring public trust in science is an undisputed and ubiquitous objective for SciComm. We term this the “trust objective” of SciComm and note that SciComm is regularly advocated as an institutional trust repair mechanism, i.e. as an effective response to public trust issues. In this chapter, we take a critical look into the proposition that SciComm should strive to promote or repair trust in science. Three problematic aspects are identified and discussed. First, a trust objective legitimizes a trust deficit; yet a rhetoric of public deficits may deprive the scientific community of valuable opportunities for reflection and mutual learning. Second, a trust objective indiscriminately promotes trust; it assumes that “more” trust is better and overlooks differences between warranted trust, excessive trust, healthy skepticism or distrust. Lastly, a trust objective can be interpreted as a persuasive or promotional motive; while such motives are not inherently negative, they must be recognised and addressed if they are to be pursued ethically. Our analysis suggests a need for more contextual approaches that clarify the exact trust problem at hand and a need for continuous reflection by the scientific and SciComm community over their assumptions, motives, and desired outcomes.

Keywords Science communication · Trust in science · Trust deficit · Trust repair · Ethics of science communication · Healthy skepticism

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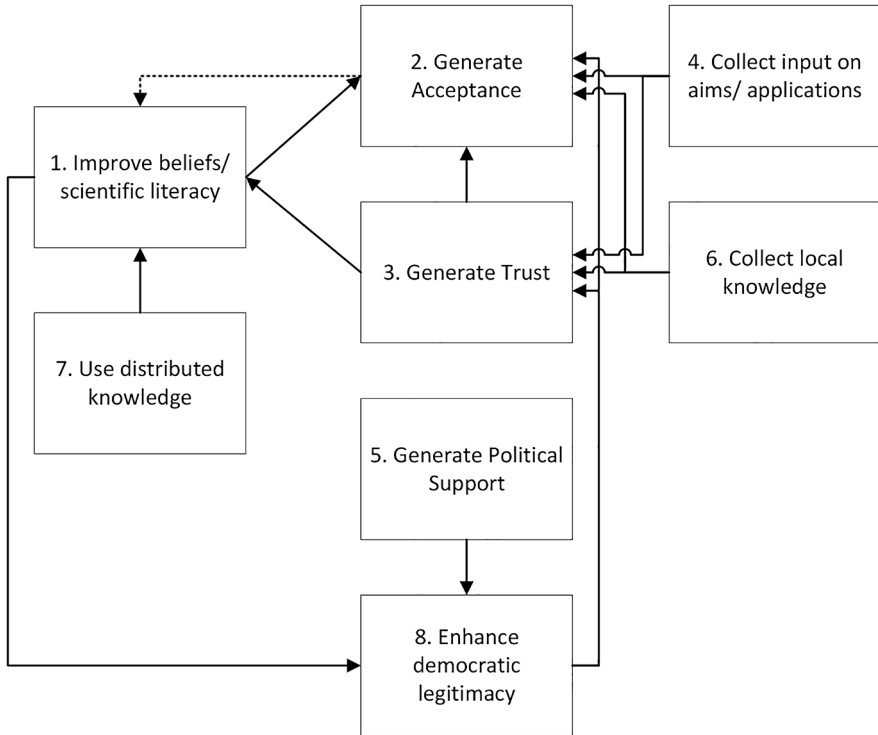


Fig. 3.1 Common SciComm aims and their assumed causal relations, drawn from Kappel and Holmen (2019). Drawn links indicate that an aim ultimately contributes to meeting another, e.g. improving scientific literacy (aim 1) will generate positive attitudes toward science (aim 2). Note that aims 2 (acceptance) and 3 (trust) are frequent end aims

3.1 An Institutional Mechanism to Foster Public Trust?

Science Communication (SciComm) refers to the many ways that science and scientific issues are shared or discussed outside of academic settings (Bucchi and Trench 2021; Burns et al. 2003; Dijkstra et al. 2020; Horst et al. 2017). Communicating science is a recognized professional task for scientists, science communicators, and science journalists and a formal obligation of research performing organizations, which commit to the dissemination and outreach of their conducted research.

Why do scientists and scientific institutions take the effort to communicate about science? Kappel and Holmen (2019), in a conceptual analysis of contemporary SciComm literature, propose several common aims for SciComm and causal relations between them (cf. Fig. 3.1). Additional critical or systematic reviews of the actual, or desired objectives of SciComm (Davies 2021; Weingart et al. 2021; Weingart and Joubert 2019) are summarized in Table 3.1. While not the only reason to engage in SciComm, *promoting or restoring trust in science* is an undisputed and

Table 3.1 Objectives of SciComm. We rudimentarily characterize each objective according to Fiorino’s (1990) seminal classification of arguments for public participation in risk management. Substantive: participants contribute valuable knowledge; normative: participation is the right thing to do; instrumental: participation helps achieve predefined goals

Kappel and Holmen (2019)	Davies (2021)	Weingart et al. 2021	Weingart and Joubert 2019	Rationale
Generating social acceptance (2)	Ensure the accountability and legitimacy of publicly funded science	Legitimation: Promotes trust in and acceptance of science	Type 2: Activities designed to promote, persuade, or legitimate	Instrumental
Generating public epistemic and moral trust (3)				Instrumental
Collect citizens’ input (4)	Have practical functions	Innovation: Increases innovation (by benefiting from the local expertise of citizens)	Type 1: Activities designed to inform, educate, or engage in dialogue	Substantive
Collect and make use of local knowledge (6)			Type 1	Substantive
Make use of distributed knowledge (7)				Substantive
Improving the population’s beliefs about science (1)			Education: Informs and educates the public	Type 1
Enhance the democratic legitimacy of science (8)	Enhance democracy	Democratization: Empowers citizens to participate in democratic processes and to participate in science		Normative
	Serve a cultural role			
	Fulfil particular economic purposes	Inspiration: Raises interest in science (to secure a future STEM-educated workforce)	Type 2	Instrumental
	Act as promotion or marketing		Type 2	Instrumental
Generate political support (5)				

ubiquitous objective in SciComm discourse. We term this the “trust objective” of SciComm and note that SciComm is regularly advocated as an institutional trust repair mechanism, i.e. as an effective response to public trust issues. This trust objective typically refers to trust in science in general (i.e. without a context or an object of trust) and assumes an intrinsically positive societal impact for research and innovation.

SciComm’s linkages to concerns over public trust are evident not only in surveys of SciComm motives but also in accounts of the field’s development. The story of modern SciComm is typically told in terms of diachronic paradigm shifts (Bauer et al. 2007; Davies and Horst 2016; Kurath and Gisler 2009; Nisbet and Scheufele 2009; Trench 2008): from a dissemination paradigm (also known as the deficit model) - in which information flows from the scientists to the public in an effort to increase scientific literacy and, consequently, support for science - to increasingly more dialogical and deliberative modes of interaction. The so-called dialogical and deliberative “turns”, usually timed in the late 1990s, were driven by a complex set of factors, including societal circumstances, scholarly criticism, new academic theories, parallel developments in governance, and particular policy visions and funding initiatives. Nonetheless, much is ascribed to an observed failure of the deficit model to secure societal support for the scientific enterprise. Whether correct or historically naïve,¹ such accounts show that SciComm reforms are often motivated by a perceived lack of trust, with renewed SciComm initiatives suggested as an institutional mechanism to repair this trust (cf. the influential UK House of Lords Select Committee on Science and Technology report (2000)).

In this chapter, we argue that the trust objective of SciComm is problematic and can be detrimental to the trustworthiness of both SciComm and science. In the next section, we detail three problematic aspects of this objective *irrespective of* the mode of communication used. However, we wish to note here that a trust objective may also harm the true potential of dialogical and deliberative forms of SciComm by undermining some of the most basic preconditions for dialogue. For this, we may turn to philosophy.

Established philosophical discourse on dialogue suggests that reciprocal openness, authenticity, and a willingness to put one’s own position at stake are necessary preconditions for dialogue. Philosophers in the phenomenological tradition, such as Edmund Husserl (Dastur 1995), in his view on intersubjectivity, and - in his suit - Hans Georg Gadamer (Lammi 2001) and Emmanuel Levinas (e.g. Hofmeyr (2016)), described the nature of dialogue as a willingness to openness, necessitating a postponement of one’s own judgment and an openness to the possible truth and value of the position of the other. Treating SciComm as a trust repair mechanism fails to account for this dual reciprocal openness: the outcome (i.e. restoring trust) is already taken as a given and a positive impact of science for society is assumed *ex ante*. Essentially, the trust objective that informed the dialogical turn undermines the very

¹ Despite the enormous popularity of this narrative, many scholars resist the framing of linear progress or note that previous modes of communication do not become redundant (Brossard and Lewenstein 2010; Trench 2008; Metcalfe 2019).

precondition for a genuine dialogue: genuine dialogue should also give room for distrust and skepticism.

3.2 Should SciComm Strive to Promote Trust?

Suggesting that SciComm should strive to promote or repair trust is not without implications: it carries particular (unproductive) assumptions and affects how interactions between science and society are staged. We analyze three positions which follow from the trust objective of SciComm; as we also explain in our discussion, these positions need not be the only way to relate to SciComm.

3.2.1 *A Trust Objective Legitimizes a Trust Deficit*

More often than not, a trust objective presumes a deficit of trust that needs to be addressed. Does such a deficit exist? And if so, would it be wise for the scientific community to frame its interactions with society accordingly?

Determining whether public trust in science is lacking or declining is not a straightforward endeavor. To begin with, survey research is confined by the challenge of operationalizing and measuring public trust properly. Moreover, observed patterns of trust and confidence in science are mixed. Past and present surveys indicate relatively high and relatively stable levels of general trust in science in Western Europe and USA (Funk and Kennedy 2019; Krause et al. 2019; Hendriks et al. 2016). However, certain scientific topics or specific applications of scientific research (e.g., genetically modified food) may be treated less favorably (Hendriks et al. 2016). Thus, a deficit of trust might not be all-encompassing but conditional on (application) context. This may reflect warranted concerns about (the impacts of) technological innovation or about the interests of those involved in its implementation. Furthermore, mentions of a trust deficit often fail to differentiate the object of the (withdrawn) trust. Yet, absence of trust (or, worse, distrust) may not be directed to the system of science but to its social context, i.e. its embedding in certain power dynamics, or to specific actors, e.g. experts who are perceived as having vested interests or *non-scientific* institutions who use scientific advice. Alternatively, a trust deficit may not be a recent or abrupt phenomenon. Talk of a “crisis of trust” (UK House of Lords Select Committee on Science and Technology 2000) hints at an unproblematic past of uncontested relations between science and society. Yet, as Wynne (1996) warns us, absence of public dissent should not be misunderstood as positive trust but as a pragmatic response to the public’s dependency on science and scientific expertise (what Wynne (1996) calls “as-if” trust).

Tensions at the interface between science and society are real and have consequences. Yet, lack of technology acceptance or lack of compliance with policy decisions should not be confused with lack of public trust in science. Moreover, when

trust is indeed withdrawn, the responses of the scientific community to this situation matter. As vocally criticized by Wynne (2006), scientists tend to attribute all tensions to a public deficit (of knowledge, of trust). However, when trust becomes an attribute of the public that needs to be improved, SciComm performs a similar reasoning mistake as in the knowledge deficit model: it assumes that the fault lies (again) with an inadequate public and that fixing this fault will automatically lead to public support. For Wynne, talk of public deficits only prevents the scientific community from reflecting about their own role and perpetuates the devaluation of public knowledge and rationality that causes an erosion of trust in the first place.

3.2.2 *A Trust Objective Indiscriminately Promotes Trust*

The trust objective of SciComm assumes that “more trust” is always better. Yet, by embarking on a mission to promote trust, scientists and science communicators may lose sight of the differences between warranted and unwarranted trust and may miss opportunities to learn from healthy skepticism.

Trust is a desirable currency to have but trust is not always commendable. Obviously, refusing trust is sensible when the trustee is untrustworthy (O’Neill 2020) or when it would result in injustice (Baier 1986). None would advocate trusting those who intend mischief or harm, and none would advocate trusting an oppressive regime. Likewise, few would praise the merits of trust when it causes negative externalities to others, such as trust among members of a criminal association (Warren 2017). Hence, the SciComm community must differentiate between warranted and unwarranted trust and plainly discourage the latter. This requires both promoting critical thinking by citizens and reflecting over the conditions of scientific trustworthiness.

O’Brien et al. (2021) find that, in the presence of (false) scientific references, higher trust in science leads to higher adoption of pseudoscientific claims. While trust in science can have a generally protective function against false claims, it also leaves us vulnerable to false signs of scientific credibility. Methodological literacy, i.e. an understanding of the scientific process, was consistently found to negatively affect adoption of pseudoscientific claims. Promoting trust in science *in general* might thus conflict with the need to equip citizens with a good grasp of the scientific process. According to Hendriks et al. (2016), promoting trust in science is in fact paradoxical as science is the de facto non-trusting enterprise, with (organized) skepticism being core to its functioning. As we can see in the scientific system, trust and skepticism can coexist productively.

While unwarranted trust is misplaced trust, one can also have *too much* trust. Writing about organizational trust, Gargiulo and Ertug (2006) and Neal et al. (2016) conclude that there is a middle ground between too-low and too-high trust. Trust beyond a critical threshold has negative consequences, such as reducing critical thinking and increasing compliance. Neal et al. (2016) further acknowledge that institutions may have (ulterior) motives to promote too-high trust, e.g. to reduce

monitoring and conflict. In fact, excessive trust often originates from the *intentional* efforts of institutions to increase trust via non-substantive means (i.e. other than via evidently trustworthy behavior), which further justifies reservations towards intentional efforts to promote trust in science.

SciComm should not react defensively to skepticism. If fostering trust becomes its sole objective, it risks dismissing all forms of skepticism as inherently problematic. Yet, absence of trust can also be a healthy and legitimate form of external control and a source of useful input. While distrust is detrimental to the workings of a democratic society, absence of trust—in the sense of ambivalence and a cautious and questioning attitude—can be beneficial (Lenard 2008). After all, no individual or institution is infallible or beyond accountability so an absence of (de facto, blind) trust means that citizens hold accountable those tasked with a delegated task. If so, the primary objective of SciComm should not be to promote trust but to enable citizens in their civic participation; in doing so, it is also likely to generate trust.

Finally, an objective to promote trust not only fails to discriminate between warranted trust, excessive trust, and healthy skepticism but also confuses the absence of trust with distrust. Indeed, low trust is not the same as distrust, the latter being a state of a strong (alas negative) conviction (Sitkin and Bijlsma-Frankema 2018; van de Walle and Six 2014). It follows that efforts to increase trust cannot automatically reduce distrust. van de Walle and Six (2014) elaborate on this exact point and remark that countering distrust cannot be subsumed to increasing low trust but requires different actions and strategies. This means that, in the presence of distrust, SciComm efforts to increase trust will be ineffective and may even backfire.

3.2.3 *A Trust Objective Is a Persuasive or Promotional Motive*

Regardless of the many urgent reasons to foster public trust in science, a trust objective remains an instrumental one. It implies that a SciComm activity is undertaken *for the purpose of* fostering trust, which can be further interpreted as a persuasive or promotional motive. Such motives may or may not be perceived as untrustworthy; regardless of their effectiveness, however, they may still be morally suspect.

3.2.3.1 **Persuasive Motives and Resistance to Persuasion**

An intentional effort to foster trust is partially an effort to instill an attitudinal or behavioral change in the trustor. Research on persuasive communication acknowledges that persuasive efforts will be met with resistance, which can be expressed via multiple routes (Fransen et al. 2015). For example, the psychological state of *reactance* associates resistance to persuasion with a perceived threat to freedom. The perceived threat is triggered by a persuasive message and motivates (direct or indirect) actions to reinstate the threatened freedom (Dillard and Shen 2005; Quick 2012). Boomerang effects, i.e. change in the opposite direction than the one intended

by a persuasive message (originally identified by Hovland et al. 1953, reviewed in Byrne and Hart (2009)), may be partially explained by reactance.

Receivers of persuasive messages are alert to the motives of a communicator and use such inferences to develop a coping strategy. In terms of trustworthiness, an agent with a persuasive intent is typically deemed to be less sincere (Campbell and Kirmani 2000); few studies (Grillo and Pizzutti 2021; Isaac and Grayson 2017), however, challenge this association between persuasive intent and low trustworthiness. In the context of SciComm, Rabinovich et al. (2012) find that, while persuasive motives may appear to lead to less trust, it is the consistency between perceived intention and message style that matters. Thus, a persuasive message receives high trust if delivered by a communicator with a persuasive intention; this trust is comparable to trust in an informative message delivered with an informative intention. In other words, if a SciComm effort is perceived as persuasive, then this effort may or may not be resisted depending on the audience's expectations.

3.2.3.2 Promotional Motives and the Medialization of Science

To some extent, fostering trust is a promotional activity for science and scientific institutions. Weingart and Joubert (2019) call for a clear distinction between educational and promotional objectives of SciComm for analytical, practical, ethical, and technical reasons. Their discontent with promotional motives follows a series of critiques of the so-called medialization² of science, as also manifested in the increasing presence of PR departments in scientific organizations. Medialization and competition for attention may lead to compliance with media logic which could affect the internal functioning of science (Marcinkowski and Kohring 2014; Weingart 2012) and threaten its credibility (Marcinkowski and Kohring 2014; Weingart 2022).

Medialization scholarship is negatively dispositioned towards the aims of PR. Obviously, this view is not shared by those who understand PR as an ethical practice and who perceive interactions between PR and SciComm as mutually beneficial. van Dyke and Lee (2020) trace parallel developments and shared areas of interest in the two fields and call for dedicated scholarly efforts to propel the practice of science public relations. Borchelt and Nielsen (2008) suggest that SciComm and PR are joined by the shared and *legit* interest to develop meaningful relationships with an organization's stakeholders (what the authors call the trust portfolio) to maintain the organization's functioning. Both Borchelt and Nielsen (2008) and van Dyke and Lee (2020) believe that it is the right and, in times, the obligation of

²In communication studies, medialization is an analytical concept that addresses the “*interrelation between changes in media and communications on the one hand, and changes in culture and society on the other*” (Couldry and Hepp 2013). For an all-round overview of the concept and of the ways it has been applied to science communication, see (Välvirronen 2021). While the field of communication studies favors the term “medialization” (Couldry and Hepp 2013), the term “medialization of science” was embraced by scholars who wished to highlight a focus on mass media (as opposed to any media) (Franzen et al. 2012).

science organizations to advocate for their organizations and for science in general. Thus, promoting trust in science might be seen as either manipulation or a legitimate effort to pursue a scientific institution's strategic goals.

3.3 Trust: An End or a Byproduct?

As a professional practice that brings citizens in contact with science and scientific issues, SciComm is often attributed with the objective to promote or repair public trust in science. In this chapter, we questioned whether SciComm should deliberately and indiscriminately embrace this objective.

Our analysis detailed three problematic aspects that are independent of the mode of SciComm employed. First, a trust objective is unwise because it sustains a rhetoric of public deficits: a focus on "replenishing" trust may prevent the scientific community from valuable opportunities for reflection and mutual learning. Second, a trust objective indiscriminately promotes "more" trust: it fails to distinguish between unwarranted or excessive trust (undesirable), skepticism (desirable but not stimulated) and distrust (undesirable but not countered properly). Clarity over the trust problem at hand and the intended trust outcome should precede efforts to promote trust. Lastly, efforts to foster trust can be perceived as persuasive or promotional. While there are legitimate reasons for promoting public trust in science and while instrumental motives are not always negatively perceived, the question of who benefits from efforts to promote trust deserves attention. Importantly, if a SciComm activity has a persuasive or promotional dimension, then it should adhere to existing professional codes of ethical persuasion and ethical PR.

While critical, our analysis does not conclude that SciComm is not worth-pursuing or that SciComm cannot contribute to a trustful relation between science and society. Rather, we call for more reflection by SciComm initiators about their assumptions, motives, and desired outcomes. This holds true both for the reasons we engage in SciComm and for the reasons we promote trust in science. Awareness and reflection can contribute to better and more ethical practice (e.g., by facilitating ethical persuasion when needed), and can foster trust in SciComm itself. Reflective practices can also encourage a more contextualized approach that avoids generalized efforts to promote trust in favor of SciComm activities that negotiate specific trust issues in relation to specific trust objects tasked with specific tasks. Eventually, an ethical framework that would guide SciComm efforts to foster trust responsibly and ethically would be welcome.

Public trust in science should not be an end in itself but a collateral blessing of a socially engaged, open, dialogical, and trustworthy science. SciComm should not strive to promote trust deliberately but should allow trust to emerge as the byproduct of other (substantive) aims (e.g. deliberation) or experienced benefits of SciComm (e.g. capacity building). By critically reconsidering its trust objective and by embracing methods of genuine dialogue, SciComm itself becomes more trustworthy.

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Chapter 4

Trust in Science Fostered by Mutual Learning Across Forms of Knowledge



Hub Zwart 

Abstract Trust in science is never a given. In fact, skepticism is an integral part of the scientific method. In this chapter we argue that trust in science can be fostered through participatory research, making research more inclusive, transparent and responsive to societal values, questions and concerns, lowering barriers between academic and societal knowledge, and using societal concerns and skepticism as a source of inspiration and information. This is not an easy approach, as we are facing emerging challenges: societal polarisation (often in response to disruptive technologies), growing inequalities and the replacement of a common public sphere by communicative bubbles and social media. Yet, to the extent that participatory approaches work, they may enable societal stakeholders to distinguish valid from unsubstantiated trust, healthy from unfounded distrust, while enabling researchers to conduct relevant, engaged and value-driven research, opening up to multiple perspectives while foregoing partiality and ideological biases. In short, we aim to foster trust in science through epistemic inclusion. This requires intense collaboration between science, technology and technoscience on the one hand and social sciences and humanities on the other. We will zoom in on recent developments in biomedical fields, using experiences from virology during the COVID-19 crisis as our case study. Rather than seeing societal engagement and interaction as the final stage of a research trajectory, research must build on mutual learning, involving societal dialogue as part of the “empirical cycle” and as an intrinsic component of participatory research methodologies.

Keywords Trust in science · Skepticism · Participatory research · Epistemic inclusion, polarization, virology, COVID-19

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4.1 Introduction

Trust in science is never a given and should never be taken for granted, if only because scepticism is an indispensable moment of the *modus operandi* of science itself. Science and scepticism are closely entwined. The starting point of science is scepticism vis-à-vis accepted knowledge and established convictions. Scientists are not expected to trust any preconceived ideas. Rather, science embodies a readiness to put established insights to the test. Therefore, distrust in science deserves to be addressed in an open-minded manner. What is its moment of truth?

Although measuring a complex phenomenon such as “trust in science” is quite a challenge, as argued elsewhere in this Springer Brief (e.g. Chaps. 2, 5 and 11), trust in science still seems considerable and prevalent in many European countries (The Rathenau Institute 2021) And yet, public distrust in scientific expertise, especially in areas of controversy such as virology and climate research, is considered problematic. Trust in science can be strengthened, we will argue, by taking public scepticism seriously, – by actively engaging with it. Concerns have been voiced that academic knowledge production has become self-serving and one-sided, that science operates as a self-serving enterprise, driven by funding opportunities rather than by social responsibility and commitment (Sarewitz 2016). Together with politicians, policy-makers and mainstream-media, academics and their institutions are seen by critics as part of the global elite, especially in social media, by distrustful citizens, but also by allegedly marginalised researchers (Boston Chapter 2025) This points to a tension between lifeworld experiences and scientific research results, to a lack of resonance between scientific knowledge claims and real-life societal concerns (cf. Chap. 2).

In this contribution, a dialectical perspective on this tension between science and society will be developed, building on the work of G.W.F. Hegel and resulting in the argument that trust in science can be fostered through participatory research, making research more inclusive, transparent and responsive to societal values, questions and concerns, lowering barriers between academic knowledge and social knowledge, while using societal concerns and public scepticism as a source of inspiration and information (cf. Chap. 9). This is not an easy approach, as we are facing emerging challenges: social polarisation (often in response to disruptive technologies and growing inequalities and fuelled by politicians who themselves often adopt disparaging and accusatory manners of debate) and the replacement of a common public sphere (*Öffentlichkeit*) by communicative bubbles (notably in the context of social media). Yet, to the extent that participatory approaches work, they may enable social and institutional stakeholders to distinguish valid from unsubstantiated trust, and warranted from unfounded distrust, while enabling researchers to conduct research that is relevant for society, using social interaction to strengthen the external validity of their work. In short, we will argue that trust in science can be fostered through epistemic inclusion, broadening our scope by incorporating multiple forms of knowledge. Rather than seeing social engagement and interaction as the final stage of a research trajectory, research must build on mutual learning from the very outset,

actively engaging with practical and experiential societal knowledge and involving societal dialogue as part of the empirical cycle and as an intrinsic component of participatory research methodologies (Zwart 2017).

4.2 A Short History of Misinformation

In many discussions about trust in science, reference is made to social media as a breeding ground for misinformation, conspiracy theories and the like. Yet, a dialectical perspective entails a willingness to develop a diagnostic of the present against a backdrop of historical knowledge. Misinformation is not a new phenomenon, historically speaking. The list of well-documented examples of intentional misinformation is quite extensive. Let us briefly mention three well-known examples. Emperor Augustus is widely respected as a ruler who, after a period of disruptive civil war, managed to implement the Pax Romana while supporting the Golden Age of Roman art and poetry (assisted by his friend, the Roman “minister of culture” Gaius Maecenas). Yet, Emperor Augustus also consciously organised propaganda campaigns where truth or falsity hardly played a role, with no other intention than to damage his opponents (e.g., Marc Anthony and Cleopatra), while the poetry classic *Aeneas* by Virgil funded by his regime was consciously based on false historical claims.

In the medieval era, one could mention the campaign of slander (allegedly based in extensive examinations) that resulted in the violent persecution of the Templars movement. And in the nineteenth century, the term *canard* was widely employed for the intentional spreading of fake news by journalists (driven by perverse incentives, e.g. receiving payment, often by all the parties involved, so that journalists would opportunistically adapt their version of truth to the highest bidder).

This is an arbitrary set of examples, and many other instances could be mentioned, but they all point to the fact that truth has always been vulnerable. To some extent, one could even argue that misinformation (the *negation* of truth) is the default so that, from the very onset, the objective of scientific and scholarly research is to *counteract* fake news (scientific and scholarly research as a *negation of the negation* of truth, dialectically speaking).

Research, one could argue, consists of a critical assessment of dubious claims, replacing them by tested insights (for instance when scholars gradually manage to replace Roman propaganda, Medieval slander and Modern canard journalism by verifiable accounts). A crisis of truth emerges when science and scholarship *themselves* are no longer seen as reliable sources of validated information, or as trustworthy advocates of truth. This is exacerbated by the rise of social media (internet) especially when they come to perceive validation and fact checking as censorship (as Mark Zuckerberg for instance announced during his speech given on January 7, 2025). Although (as indicated) misinformation has a long history, information bubbles may function as Plato’s cave, exposing us to narrow spectra of information, attuned to what we believe to be the case or expect to see. As Plato already argued,

once we have entered such a cave, efforts to guide us to challenging and discordant perspectives tend to trigger our resistance. We are not as open to countervailing evidence as we tend to think.

4.3 Scepticism

For philosophy of science, *science itself* is a phenomenon to study, in line with Hegel's "phenomenology" of knowledge forms, emerging in the course of history. We employ the term "science" in a broad sense, comparable to how *Wissenschaft* is used in German, so that it includes not only the exact or natural sciences, but the social sciences and the humanities as well. In all these branches of knowledge, scepticism plays a crucial role.

Hegel consistently emphasises the tendency towards negation at work in the scientific endeavour as such. Research is driven by a desire to know, but also by the resolve not to rely on the authority of others (Hegel 1807/1986, p. 73). Especially modern Western science is governed by the urge to produce our knowledge ourselves, and to accept only our own products and insights as valid and convincing, even if this initially entails a dramatic loss of knowledge, sacrificing (= negating) accepted conceptions and inherited worldviews (cf. Zwart 2021; Zwart 2022). Science, Hegel argues, builds on the zealous resolve to follow this process to completion. Science is an unhalting process which finds no satisfaction in preliminary results (Hegel 1807/1986, p. 74). Rather, science has the tendency to disturb and spoil its own satisfaction while taking the knowledge process further. And this may well invoke uneasiness (*Besorgnis*, *Misstrauen*, *ibid.*, p 69), as scientific research practices often eliminate more than they create, including our most cherished convictions.

Science itself is not exempt to this process. Advances in scientific knowledge depend in part on the ability and willingness of researchers to question the work of previous generations or to question established ways of producing scientific knowledge. How reliable and replicable are our knowledge claims really? How can we ascertain that our knowledge is adequate and externally valid (outside laboratories and libraries)? How to prevent knowledge production from going astray? The focus of attention now shifts from knowledge as such to the process through which knowledge is produced. Science itself becomes the target of scepticism. As Hegel argues, scepticism may well end in paralysis, when the fear of erring itself becomes an obstacle, an error. Scepticism must be overcome, not by discarding it, but by *incorporating* it into our scientific methodologies. A scientific experiment is organised scepticism, consciously putting hypotheses to the test. Mere reliance on existing knowledge practices would be naïve, and the reliability of established knowledge practices may be questioned, but, as Hegel phrases it, there is something positive in

this process of negativity. Instead of completely annihilating our results, we rather understand that we are *not yet* there. Our knowledge deficits summon us to continue the quest for knowledge. Instead of allowing scepticism to become a paralysing trap, it should be “taken up”, as an inherent aspect of our methodology (the negation of the negation), so that paralysis gives way to productivity on a higher level of comprehension and reliability. Dialectics studies this unfolding, from unquestioned conceptions via scepticism and suspicion up to validated knowledge. Scepticism (negativity) is important, because it reveals the questionability of available conceptions, but it should not become a pretext to keep aloof from conducting research altogether. We must rather learn from our experiences.

4.4 The Rise of Misinformation

The reliability of the knowledge process depends on robust and tested methodologies, producing knowledge claims that are allegedly cleansed of ideologies, biases and misinformation. Critical self-reflection is incorporated as an inherent moment of the process. But new forms of scepticism or suspicion may loom on the horizon, coming from outside academia. Faced with public distrust of discontent, scientists tend to emphasise that their methods are validated, transparent and reproducible. Public distrust is then considered as symptomatic for a lack of understanding of how science works (cf. Chap. 9). Outsiders allegedly are insufficiently aware of the intricacies of the knowledge process. In short, the deficit of trust points to a deficit of understanding (cf. Chap. 3). Yet, although this way of reasoning may seem rational, a rigid adherence to established scientific methods will not allow us to supersede the contradiction between scientific insights and lived experience.

Historically speaking, we are faced with a tension that goes back to Plato who, twenty-five centuries ago, segregated validated knowledge (ἐπιστήμη) from mere opinion (δόξα). This segregation was part of a hierarchy, distinguishing genuine (theoretical) knowledge (occupying the highest position on the epistemological ladder) from practical knowledge (acquired by artisans) and prejudice and mere opinion (folk knowledge). In contemporary terms, we could refer to this as *academic* knowledge (produced by scientists in libraries and laboratories), *practical* knowledge (experiential real-world knowledge of practitioners), and *public* knowledge (lifeworld experience). The current crisis of truth questions Plato’s hierarchy. All three knowledge forms are important and valid in their own right, and all three knowledge forms may suffer from biases or blind spots. To address public distrust, we must take practical experiences and public views seriously, engage with them, even when, or especially when, they seem at odds with the consensus viewpoint of established academic discourse. In the next sect. I will focus on one particular discourse, namely virology and the COVID-19 crisis.

4.5 Science and Suspicion

Many scientists who participate in public debates have experienced instances of polarisation, within the research community, but especially in the public realm, virologists first and foremost. They are in the frontline of the collision since the COVID-19 pandemic. Especially social media offer space for distrustful and accusatory forms of communication and downright suspicion. In philosophy, however, suspicion is not necessarily a pejorative term. “Masters of suspicion” (Marx, Nietzsche, Freud) already argued that we should be sensitive to those aspects of discourse that are less visible, less audible, focusing on what is silenced and omitted, particularly when its content is uncomfortable or unflattering. What is the moment of truth in discontent and suspicion vis-à-vis academic virology discourse? We will not be able to address this question as long as we remain trapped in the “*validated knowledge versus mere opinion*” dichotomy. Neither should we discard validated virological knowledge as irrelevant. How to proceed?

Validated virological knowledge concerning the origin, spread and prevention of COVID-19 is crucially important. Millions of individuals worldwide have suffered from COVID-19, and especially during the earlier stages of the pandemic the number of casualties was staggering. Since then, virologists have been able to identify and sequence the viral pathogen responsible for the disease, allowing companies to develop effective vaccines, while offering evidence for their effectiveness. Yet, in retrospect, there are some lessons to be learned.

First of all, although the mobilisation of virological expertise to counteract the pandemic is evidently important, especially during the early days of the pandemic the epistemic focus was too narrow: giving the floor almost exclusively to biomedical forms of knowledge, while underestimating the importance of behavioural, cultural, political and historical dimensions, thereby neglecting the insights that social sciences and humanities could have offered. Thus, while we continue to acknowledge the crucial importance of the work that is done by virologists, the scientific response failed to offer a comprehensive, holistic view. And this one-sidedness becomes problematic when biomedical insights are to be translated into social measures, in the real world outside laboratories. Other forms of academic knowledge remained underutilised, thereby eclipsing aspects of the challenge that could have been identified and addressed by social scientists and humanities scholars. This includes knowledge about how different strata of society tend to respond to governmental programmes or about how information is disseminated in contemporary society, while knowledge concerning past pandemics (consulting historians and writers of the past) could have informed responsible policymakers about the dynamics of the interactions between top-down policy measures and public reluctance or suspicion (Zwart 2020).

Other forms of knowledge were underused as well. Knowledge of practitioners (e.g. general practitioners or caretakers in nursing homes) could have offered complementary sources of insight about the implications of policy measures for health care and well-being, especially for vulnerable groups such as elderly patients.

Finally, lifeworld knowledge (the experience of individual citizens) is important. From the early days of COVID-19 vaccination campaigns onwards, individuals have reported long-term side-effects occurring after receiving vaccines or boosters. Until recently, such ‘weak signals’ were all but neglected. Currently, some research into the so-called long post-COVID vaccination syndrome (LPCVS) has been conducted, but little is known about the clinical presentation, underlying pathophysiology, treatment, and outcome of LPCVS (Finterer and Scorza 2022).

As it happens, this author has some personal experience in this regard, – even though evidence concerning the impact on trustworthiness of self-disclosure (i.e. adding personal details as authors) is unclear (Altenmüller et al. 2023). I was in the habit of running long distances (10, 15 or 21 kilometres) twice or thrice a week. After receiving an mRNA (Pfizer) booster (my third vaccination), I suddenly experienced shortness of breath that would not go away. My running performances deteriorated dramatically. And although things have improved somewhat since then, and I continue to train, I have not regained my pre-booster fitness. This could be discarded as anecdotal information (N = 1), confusing age-related decline with post-vaccination symptoms, but that would be unwise. Participatory approaches allow science to benefit from lifeworld experiences, from experiential knowledge “out there”, whether it stems from general practitioners, nursing home nurses or amateur long-distance runners. Suspicion and resistance are fuelled when established biomedical discourse is considered the only valid source of truth, while neglecting or discarding other sources of experience.

This calls for a willingness to become sensitive to and give the floor to multiple voices and perspectives, coming from academia, but also from society at large: *epistemic inclusion*, involving various forms of knowledge, especially knowledge “out there”, practical, everyday knowledge, arising outside academic quarters (Valkenburg et al. 2019; Koch 2020; Zwart et al. 2024): tested knowledge, but tested in different ways. Rather than disavowing the importance of scientific expertise, the concept of ubiquitous knowledge entails that, also for scientific experts, mutual learning is a more enriching experience than mere communication (“popularisation”) or implementation (“valorisation”) of research, whilst social participants likewise learn more from active dialogue compared to more passive forms of public involvement.

Mutual learning means that multiple forms of relevant expertise are taken into account. The focus is not only on the expertise of experts, but even more so on our knowledge gaps: on the uncertainties, controversies, unknowns and blind spots involved in contemporary research endeavours including viroscience. Mutual learning does not presuppose that other types of knowledge need to be validated using scientific knowledge as a standard, but rather that, by comparing and contrasting knowns and unknowns in different knowledge systems, we can produce a more robust picture of the realities these knowledge systems attempt to address (Tengö et al. 2014). Therefore, the engagement with other voices and perspectives is not primarily aimed at “consensus” or at defining a common ground, but rather at using the stances and perspectives of others to discern our own blind spots and questionable preconceptions (Blok 2019).

Academics must learn to engage with convictions previously deemed and discarded as “irrational”, e.g., conspiracy theories. Rather than ignoring or deriding them, we must envision their moment of truth. In the case of conspiracy theories, for instance, the existence of highly influential international networks of power and information largely exempted from democratic decision-making is undeniably part of our global world. We have to learn to determine to what extent such critical claims allow us to recognise our biases and blind spots, to what extent instances of negativity and recoil allow us to supersede the traditional epistemic divide without jeopardising the integrity of the research process, – for instance when the process becomes paralysed by forms of polarisation that are pushed to the extreme, so that dialogues and interactions become trapped in negativity.

4.6 (Dis)Trust in Science and (Dis)Trust in Politics

It is evident, moreover, that the “trust in science” problematic is intimately connected with the decrease of trust in political institutions. While this dimension is often considered in terms of a growing estrangement between the ‘elite’ stratum of society versus ‘populism’ (Huber et al. 2022), I would emphasise the *knowledge and power* dimension entailed in this. The political divide reflects two types of education (academic versus practical) and two forms of knowledge (already distinguished by Plato and Aristotle, and in a hierarchical manner), namely academic knowledge versus practical knowledge. While universities often present themselves as connected with society, as socially engaged, allegedly serving societal goals (working towards a just, equitable and sustainable society), critics may see universities as elite institutions, serving and representing particular stratum of society rather than others. Education (academic versus practical education) has become a major dividing line in society. Although progressive and leftist parties traditionally represented the lower stratum and the working classes, they are led by politicians with university degrees and their current electorate consists mainly of voters who have likewise enjoyed academic training, while politicians belonging to populist parties and their voters tend to be practically and professionally educated (Kumru 2018; Ivarsflaten and Stubager 2012). The political divide reflects two types of education (academic versus practical) and two forms of knowledge (academic knowledge versus practical knowledge). Epistemic inclusion aspires a partnership between academic and practical knowledge, based on a mutual recognition of the importance of both forms of insight and experience.

This calls for novel research methodologies, based on participatory research, so that communication with affected individuals is not pushed towards the implementation stage of the knowledge production process, but is incorporated in the *modus operandi* of science. A plethora of methodological approaches to social engagement is currently emerging and discussed in academic journals. During a recent graduate school course for PhD candidates coming from multiple fields, I noticed that *all* research projects in which these researchers were involved entailed a participatory

dimension, while the researchers themselves were keen to explore ways to further strengthen social interaction as a crucial component of their work. From the perspective of this chapter, this is good news. The purpose of public debate is not to explain the validity of science to the uninitiated, but to give the floor to criticism and scepticism, to unheard voices, especially if they seem incompatible with established academic insights.

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Chapter 5

Measuring Trust in Science Through Surveys: Challenges and Reflections



Anne-Sophie Behm-Bahtat , Hannah L. Bunt, Martin W. Bauer, and Bankole Falade 

Abstract Public trust in science plays a crucial role in shaping science-society relations. Surveys are widely used to measure such trust, yet the operationalisation and interpretations of corresponding items present significant challenges. This chapter explores the complexities of measuring trust in science through surveys and the implications for interpreting public attitudes across different contexts. First, it examines the challenges of operationalising the multi-dimensional concept of trust in science in form of survey items. Second, it unpacks the role of question wording, demonstrating how semantics and pragmatics influence survey responses. A paradigm-syntagma framework is introduced to systematically categorise trust-related survey items. Third, the chapter uses an empirical analysis of Eurobarometer data to illustrate the complexity of interpreting survey items on trust in science. The findings underscore the risks of oversimplified rankings and comparisons and advocate for a more context-sensitive approach to survey interpretation.

Keywords Trust in science · Survey research · Operationalisation · Conceptualisation · Eurobarometer

5.1 Introduction

Prompted by concerns about a possible “crisis of trust” (Bauer et al. 2007, p. 85), the topic of trust in science has been increasingly researched and debated in recent decades. Surveys are a commonly applied method to capture attitudes from members of the public about science and technology. To this end, survey items capturing scientific knowledge, engagement with as well as perceived promises and

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reservations about science and technology are used (Bauer and Falade 2021). Surveys addressing the concrete question of trust in science are more recent yet have been subject to much analysis to make claims about the state of (dis)trust in science across Europe and beyond (for a review, see Reif and Guenther 2021).

Surveys are widely used to measure and draw conclusions about attitudes on varying topics within and across populations. By using representative sampling strategies and statistically correcting for deviations from representativeness, survey designers are able to produce reliable data for a population, be that of a country or a region. Furthermore, conducting surveys across countries and over time offers the added benefits of cross-country comparisons and temporal analyses of data points, provided that items are used consistently (Besley 2013). In the realm of trust in science surveys, however, a gap is said to exist between the conceptualisation and the operationalisation of trust measures (Gillespie 2015). The complexity of the concept of trust in science (see Chap. 10) likely underpins the fragmentation of measurement approaches (Besley et al. 2021).

The aim of this chapter is to shed light on this complexity from a survey perspective and underline the consequences it may have for our interpretation of the state of trust in varying contexts. In what follows, we first illustrate challenges associated with the validity of trust measures, highlighting issues on the varying operationalisations of trust and the “jingle-jangle jungle” problem (Peters and Crutzen 2024). Secondly, we discuss the importance of question wording by unpacking the semantics and pragmatics of trust in science measures and introduce a paradigm-syntagma of survey items on trust in science that is able to serve as a basis for further analysis in this regard. Thirdly, we conduct a brief quantitative examination of nuanced (dis)trust dynamics in the seven European countries that are part of the POIESIS project (Denmark, France, Germany, Greece, Portugal, Spain, and the United Kingdom) based on Eurobarometer data (European Commission 2022). In doing so, we aim to demonstrate how interpretations of survey results may shape our understanding of public (dis)trust in science. We close by discussing the challenge of comparing trust levels across countries, emphasising the need for careful, context-aware interpretations and the value of enriching survey data with complementary qualitative insights. The reflections presented in this chapter are part of ongoing research within the POIESIS project concerning the stock-taking and analysis of national and European surveys aiming to measure public trust in science (see Bauer et al. 2023, 2024).

5.2 The Challenge of Operationalising Trust in Science

Given the conceptual complexity of trust in science itself, it is unsurprising that its operationalisation in surveys is challenging and approached in various ways. One key difference in the surveys’ approaches is whether they ask participants about their trust in science directly or do so indirectly. Many surveys use multi-dimensional trust operationalisations and indirectly approximate levels of trust by asking questions about, for example, the competence and character of academic researchers (e.g. the European Commission’s Eurobarometer, the Pew Research Center’s

American Trends Panel survey and the Swiss Wissenschaftsbarometer). Various other surveys additionally include items taking the form of a direct trust question, prompting the respondent to scale their trust in science from having ‘a lot of trust’ to ‘no trust’ (e.g. the German and Swiss Wissenschaftsbarometer, the French *Les Français et la Science* and Wellcome and Gallup’s Wellcome Global Monitor).

Another difference in how trust is operationalised in surveys lies in the ‘scale of trust’: some surveys focus simply on high compared to low trust, while others distinguish between trust and distrust—either treating them as opposite ends of one scale or assigning each its own scale with varying levels (see Reif and Guenther 2021). A final difference in this non-exhaustive list concerns the ‘trustee’, i.e. the subject of trust: some surveys ask about trust in ‘science and research’ generally, while others target trust in scientists, specific scientific disciplines, scientists compared to practitioners, or scientific institutions compared to industry research.

The very diverse conceptualisation and operationalisation of trust in science in surveys seem to reflect something scientists have called the “jingle-jangle jungle” (Peters and Crutzen 2024). More than a tongue twister, this phrase refers to a common phenomenon where psychological measures are subject to either a ‘jingle fallacy’, i.e. the erroneous assumption that two measures that are called by the same name measure the same construct (Elson et al. 2023; Thorndike 1904; Wulff and Mata 2023), or a ‘jangle fallacy’, i.e. the erroneous assumption that two measures with different names measure different constructs, whereas in reality they measure the same thing (Elson et al. 2023; Kelley 1927; Wulff and Mata 2023). In practice, when survey results on trust in science are analysed—particularly in public discourse or cross-country comparisons—differences in how trust is operationalised in-between surveys can result in misleading interpretations, e.g. when measures that approach trust in different ways are treated as if they capture the same unidimensional construct.

Beyond challenges pertaining to measurement practices, there might be a deeper issue underpinning this fragmentation and duplication of measures of trust in science. Specifically, this issue may be found at the level of the definition of the concept of trust in science itself. Concept validity is said to be an important foundation for other types of validity such as the construct validity of psychological measures (Bergner 2024; Eronen and Bringmann 2021; Locke 2012). As ‘trust in science’ has suffered from conceptual unclarity, not at least due to its multi-dimensionality, this may have had consequences for the validity of its operationalisation. However, in this chapter, we will focus specifically on the challenges of the operationalisation of trust in science rather than its definition.

5.3 Item Wording Matters: Unpacking the Semantics and Pragmatics of Trust in Science Measures

Beyond the different approaches to the operationalisation of the concept, the precise wording of survey items—and their interpretation(s)—have shown to be an important matter for surveys on trust in science, not least because results on trust levels

might vary with item wording. Generally, item wording for surveys is an art that has received some attention and much advice, though mainly for English language formulations (e.g. Schuman and Presser 1996). Survey designers are advised to carefully word questions and response options to gain valid insights, avoid leading or biasing the respondent, and to standardise these for different situations. In other words, they need to find the most appropriate phrasing that semantically accurately reflects what they are intending to measure. The intended outcome is to be able to attribute response variation to the respondent, and not to the formulation of the question.

As Green et al. (2020) point out, however, response patterns not only hinge on the semantic clarity of questions and response options. Rather, the pragmatics, i.e. the interpretation of the intention behind the question and subsequent answering, of the survey items are of consequential interest. Specifically, survey designers cannot guarantee that respondents interpret any one question in the same way (for specific models of the ways people answer survey questions see for example Green et al. 2020; Revilla et al. 2023; Sudman and Bradburn 1973).

There are several methodologies to empirically test the meaning of survey items. For example, think-aloud protocols (Sudman et al. 1996) ask individuals to comment freely about the process of answering a survey item, aiming to generate insight about this process. Focus group discussions are another way of examining the potential incongruence in the intention, i.e. the semantics of a trust item, and answering, i.e. the pragmatics of said trust item.

The results of several focus group discussions we conducted in the UK exemplify such an incongruence for a commonly used trust item. The focus groups took place in two waves - one in 2016 with four, and one in 2023 with respectively five focus groups. All focus groups broadly focused on trust in science and brought together members of the public as well as those working in science and technology. As one part of these focus groups, participants discussed in detail how they would respond to the Eurobarometer item “We have no option but to trust those governing science and technology” (with answer options ranging from strongly disagree to strongly agree on a 5-point Likert scale) and what it means to them.

Semantically speaking, the survey item drives at a deference towards a body of people who are in charge of science and technology, perhaps referring to national or inter-governmental institutions. The focus group discussions brought to light several observations: in both 2016 and 2023, most people understood “those governing...” as “those working in science and technology”. The item in-use therefore took on a meaning reflected in the statement “We have no option but to trust those *working* in science and technology”. This observation guides our confidence that this item is an indicator of trust in science (see Sect. 5.4 below), despite literally asking about the governance of science rather than its conduct. Thus, the focus group discussions brought to light a distinctly different interpretation of the survey item compared to the meaning we assume the survey designers had intended. Naturally, this has important consequences for the interpretation of its results. Even though these findings only relate to one single survey item, it can be expected that

due to the conceptual complexity of trust in science, other relevant items are interpreted in similarly diverging ways.

Another way to deal with the variety and complexity of survey items is to consider the diversity of item formulations and aiming to understand whether they speak to similar sentiments and/or ideas. In this regard, we draw inspiration from structural semiotics and linguistics (Barthes 1967) to parse the (dis)trust items used in surveys. In Table 5.1 below, we present a suggestion in terms of a paradigm-syntagma, i.e. a structure that maps diversity of items (rows) into item components (columns). The idea is to create a paradigm that captures all or most trust items that we find. Once the paradigmatic order is established, more items can be added continuously. This system shows the diversity of trust questions across a wide variety of national and multinational European surveys (see Bauer et al. 2023 for the full list of surveys considered in our work), and it will serve as a content analysis of such items.

The key to this paradigm-syntagma is its columns, specifying what the trust items are composed of. Our paradigm comprises four criteria or components (the

Table 5.1 Towards a paradigm-syntagma of survey items on trust in science

Trustor X (trust subject)	The relation	Trustee Y (trust object)	Context	
People like me	Trust in	Science	In general	
	Distrust in			
Me personally / I	Is trustworthy	<ul style="list-style-type: none"> - In general - Scientific research; - Scientific theories; - Scientific method; - Scientific knowledge; - Specific disciplines 		
	Can no longer trust			
We	Truth telling		Scientists	Climate science
	Confidence in			
The society	Having no option but to trust	<ul style="list-style-type: none"> - In general - Working in public institutions - Working in industry 		
	Being familiar with			
General public (implicit)	Doing a good job	Public experts	COVID-19 pandemic	
	Attitude towards (e.g., deeming trustee competent, experienced, qualified, honest, fair, integrated)	Integrity of science		
		Integration of public		

four columns) for each trust item which constitutes a syntagma in each row (see Table 5.1): (1) the trustor X, i.e. the general public, a group of people, one person, institution, or actor who is trusting (often implicit in the survey context as the target population but can also be explicit); (2) the trustee Y, i.e. the actors, institution, people, or ‘thing’ that is receiving the trust from trustor X; (3) marks the relation between the trustor and the trustee, where the trustor ‘does’ what indicates the ‘trusting’ relationship, and (4) provides context to the trust relationship: topics, adverbials etc. For trust in science measures, a combination of one element out of each column is theoretically possible. This will produce a map of 2-value, 3-value or 4-value trust items.

To give an example, the Eurobarometer item “We have no option but to trust those governing science and technology” would be a 3-value trust item. The trustor X (1) is explicitly named as “we” including the person who is asked the question in the item; the trustees Y (2) are “those governing science and technology”, although as seen above, this item is often understood as rather being about scientists themselves; the relationship (3) is explicit as “having no option but to trust” pointing towards a kind of deference of authority to experts but not out of individual choice. There is no specific context (4) set in this item.

Unpacking survey items in this way is an interpretative exercise with potentially different ways of coding. Nonetheless, this exercise reduces complexity and groups items that have very different formulations but are structurally similar. Used for analysis in combination with empirical data, this paradigm-syntagma could further allow to examine how item wording matters for levels of trust in science observed in surveys.

5.4 Nuanced (Dis)Trust Dynamics in the POIESIS Countries: An Empirical Example

After having illustrated the challenges and differences that exist across survey items on trust in science and their interpretation, this last section shows, on the basis of empirical data, how survey items and their interpretations shape our understanding of public (dis)trust in science. This is not only relevant for academic research but maybe even more for public or political discourse and media reportage on survey results.

The analysis presented here is based on our research regarding dimensions of trust in science in the POIESIS partner countries using mainly Eurobarometer 95.2 data (European Commission 2022; for further information see Bauer et al. 2024). Eurobarometer data is useful for cross-country analysis as it provides comparable data for all EU+ countries and even allows time series for some items.

The Eurobarometer survey does not include a direct question about the respondents’ trust in science or scientists. Instead, it offers several items that approach the concept indirectly (see Bauer et al. 2023 for more details and the analysis of all

trust-related items). For the sake of this analysis, four items of the Eurobarometer have been chosen for illustration: (1) “[Scientists are] reliable”; (2) “[Scientists are] honest”; (3) “[Scientists] know best what is good for people”, all three having the following answer options: “Describes well”, “Describes badly”, and “Don’t know”; and (4) “We have no option but to trust those governing science and technology”, with a 5-point Likert scale and a “Don’t know” answer option. Figures 5.1, 5.2, 5.3, 5.4 illustrate the results of these four items in all POIESIS partner countries (Denmark, France, Germany, Greece, Portugal, Spain, and the United Kingdom).

Looking at these four items and all their answer options for seven countries illustrates the difficulty of interpreting survey data in all its facets. Performing a basic interpretation of this raw data can help in this endeavour. In this regard, an ‘Acceptance’ score is created for each item. It can theoretically range from -1 to 1, such that a high (positive) Acceptance score for each of the four items reflects a favourable opinion of the given statement. Conversely, a low (negative) Acceptance score reflects an unfavourable opinion. It is calculated as follows:

$$Acceptance = \frac{\%agreements - \%disagreements}{\%agreements + \%disagreements}$$

However, as the Acceptance score ignores any “Don’t know” or “Neither agree nor disagree” answer options, we additionally consider measures of Uncertainty (being the “Don’t know” answers) and Ambivalence (being the “Neither/nor” answers) in the response patterns of a country. Doing so aids in qualifying the consensus in a given context with reduced complexity but without ignoring any of its crucial dimensions. The respective results for the POIESIS partner countries are presented in Figs. 5.5 and 5.6.

Figure 5.5 displays survey results for the POIESIS partner countries on the four Eurobarometer items, where higher Acceptance scores reflect greater agreement with the statement and, consequently, greater favourability towards scientists or a higher willingness to defer to scientific authority. The response patterns vary across

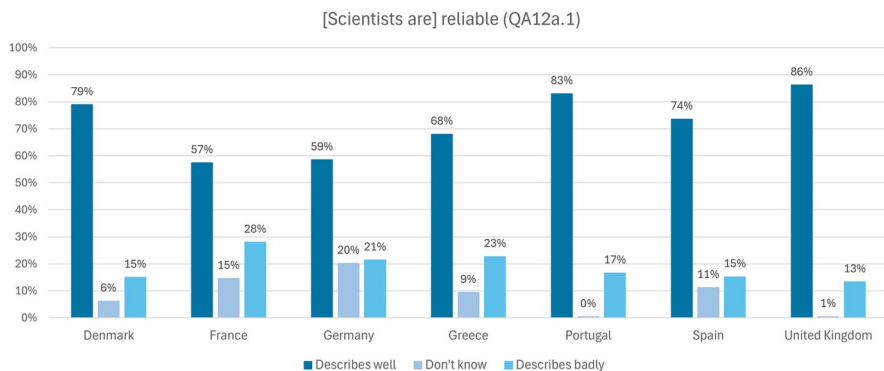


Fig. 5.1 Results of Eurobarometer 95.2 item QA12a.1 for POIESIS partner countries

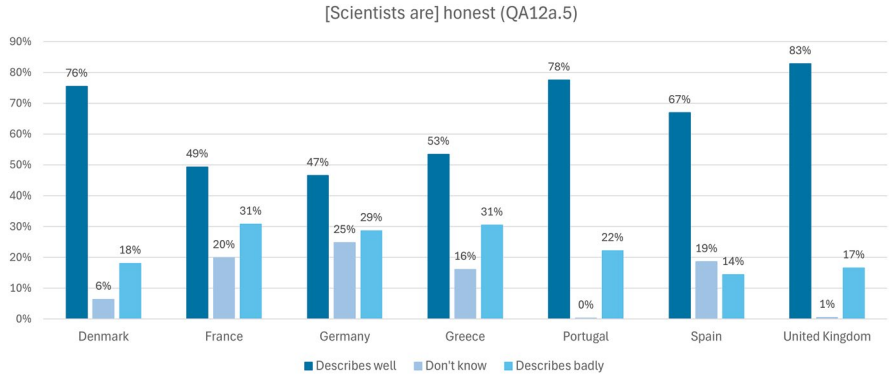


Fig. 5.2 Results of Eurobarometer 95.2 item QA12a.5 for POIESIS partner countries

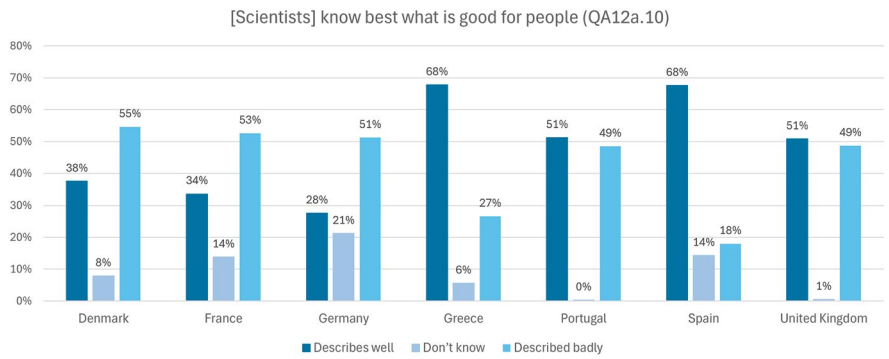


Fig. 5.3 Results of Eurobarometer 95.2 item QA12a.10 for POIESIS partner countries

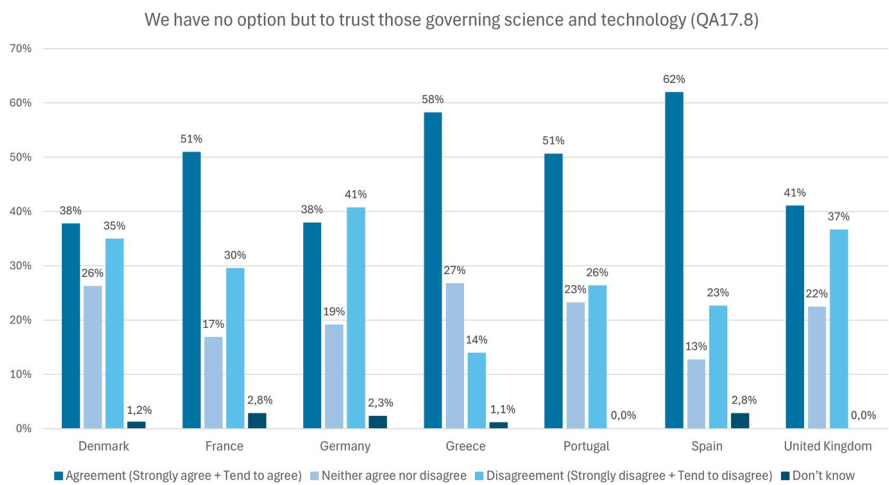


Fig. 5.4 Results of Eurobarometer 95.2 item QA17.8 for POIESIS partner countries

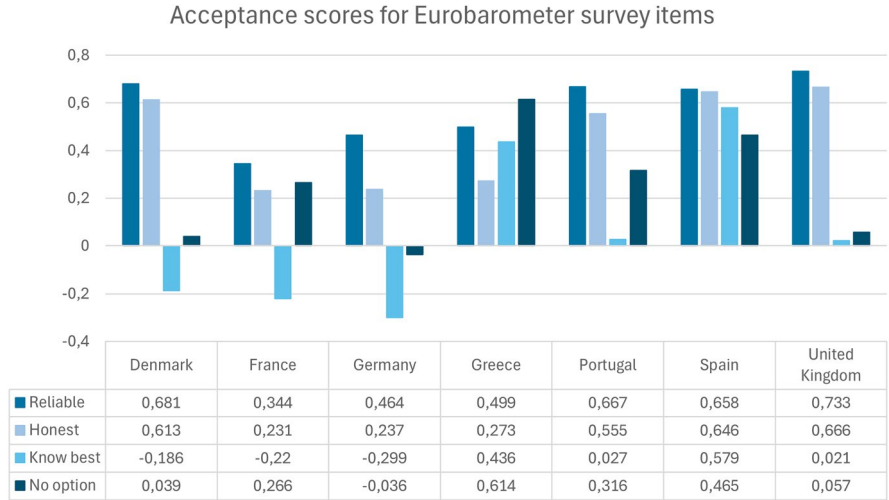


Fig. 5.5 Acceptance scores for Eurobarometer 95.2 (2021) survey items in POIESIS partner countries

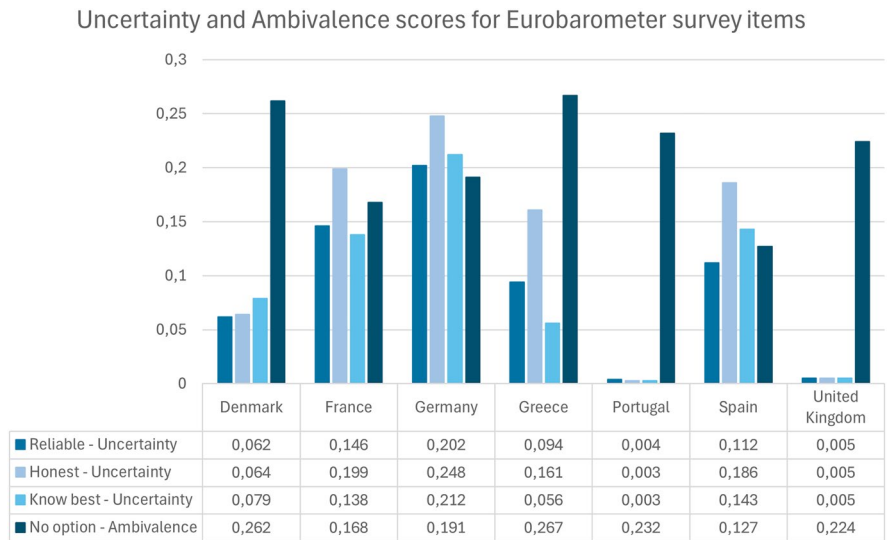


Fig. 5.6 Uncertainty and Ambivalence scores for Eurobarometer 95.2 (2021) survey items in POIESIS partner countries

countries and offer a rich and nuanced picture of public perceptions that would be lost if results were simply averaged to compare general ‘trust’ levels amongst countries. For instance, within-country differences across items highlight specific aspects of trust, such as the perceived reliability or honesty of scientists, while cross-country variation might point to differing cultural attitudes toward scientists or scientific authority (see also Bauer et al. 2024).

Additional data displayed in Fig. 5.6 details the proportion of “Don’t know” (Uncertainty) and “Neither agree nor disagree” (Ambivalence) responses for each of the four items,¹ further qualifying the extent to which there is a consensus on these results. Indeed, various items have received between 20–25% of ‘uncertain’ or ‘ambivalent’ responses within most POIESIS partner countries. These results suggest that considering responses to multiple items within each country is necessary to understand the underlying ‘culture of trust’ in its specific context. Cross-country comparisons are of course possible but need to be exercised with care. There is a clear risk of oversimplifying the complexity of trust dynamics and potentially neglecting important within-country variations leading, in the end, to misinterpretations of the actual state of trust in science in a given context.

5.5 Discussion: The Challenge of Comparing Trust Levels Across Countries or Contexts

Surveys on public trust in science are ubiquitous. For quite some time now, national and international surveys have been used to gauge the public’s (dis)trust in science and scientists, thereby contributing valuable insights into the relationship between science and the public. This chapter has examined such surveys from a meta-perspective, aiming to highlight how the complexity of the concept of trust in science is reflected in its diverse operationalisations in different surveys and how these can influence the interpretations made regarding the state of public trust in science. The chapter discussed various aspects in this regard leading to the conclusion that trust in science is a multi-faceted and context-dependent phenomenon, requiring careful, within-country analysis of survey items and response patterns to capture the nuances of public attitudes. Oversimplified cross-country comparisons or rankings may lead to misleading conclusions on the state of trust in science in different contexts.

Reflecting on the discussions in this chapter, it remains to be said that surveys on public trust in science remain an invaluable tool when analysing the relation between science and society. Among many other advantages, surveys offer representative data, the possibility to analyse correlations between public trust and socio-demographic characteristics, and to compare evolutions of trust in a given context over time. However, working with surveys requires more nuanced discussions about the concept of trust in science itself and its operationalisation. While the objective is not finding one perfect way of measuring trust in science, unpacking its dimensions is still valuable. Doing so can help clarify the objectives behind specific survey questions and ensure that the results align with those goals (Besley and Tiffany 2023).

¹As the Uncertainty score for the item “No option but to trust” was below 0.03 for all countries, we do not report it in this figure.

Moreover, being mindful of these conceptual debates is essential when interpreting survey data, as trust is a complex and context-dependent phenomenon. Caution is particularly warranted when interpreting trust levels across countries at a single point in time. Trust is shaped by cultural contexts and varying cultures of trust, as explored in the POIESIS project (see Bauer et al. 2024). These cultural and contextual factors make direct comparisons - such as concluding that “people in France trust science more than people in Germany” - potentially misleading. Instead, a more reliable approach would involve examining changes within individual countries over time, identifying trends and shifts rather than drawing hasty conclusions from cross-country comparisons. While international comparisons are possible, they require a careful, context-aware interpretation of the findings.

One way to deepen our understanding of trust in science in a given context, is to enrich closed-ended survey items with complementary data. For example, focus group discussions or open-ended survey questions may provide deeper qualitative insights into the reasoning behind public attitudes. Similarly, media analyses could shed light on how the portrayal of science and scientists influences public perceptions. Such diverse data sources could broaden our understanding and provide a richer picture of trust dynamics. Looking ahead, integrating diverse methodologies and context-sensitive approaches could contribute to deeper insights into the nuances of public (dis)trust in science and its implications for science-society relations.

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Chapter 6

A General Public's Perspective: Factors that Constrain Individual Trust in Science



Christiana Varda , Kalypso Iordanou , and Josephina Antoniou 

Abstract This chapter explores factors that may constrain individual trust in science examined across a general, non-expert, public from a set of European contexts. The work is grounded in a rich qualitative dataset comprised of eight focus groups and one individual interview, conducted in Austria, Cyprus, Greece, Ireland and France in the context of the VERITY project. The data were analyzed inductively using thematic analysis, and themes were identified and compared in iterative cycles. The chapter focuses on three themes that were identified in the data: (1) *individual factors*, including affect, competencies, as well as motivational and cognitive attributes; (2) *socio-cultural factors*, including social norms, social influence and the role that conflicts across different contexts play in hindering individual trust; (3) *environmental factors*, including the country-level educational system and online information environments. The findings suggest how different mechanisms can shape individual trust in scientists and science, as an institution.

Keywords Trust in science · Individual trust · General public · Epistemic trustworthiness · Barriers to trust · Public trust in science

6.1 Introduction

Trust in science is increasingly being tested by growing skepticism, misinformation, and polarized debates, as evidenced by controversial socioscientific issues such as climate change (Lewandowsky 2021; Cook 2019), vaccinations (Burki 2019), and other health-related issues (Suarez-Lledo and Alvarez-Galvez 2021). Trust is further eroded when the same evidence can lead to different policy decisions, as illustrated in the varied global responses to the COVID-19 AstraZeneca vaccine (Amoretti and Lalumera 2023) indicating the role that political decision-makers can

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play—intentionally or unintentionally—in fostering science skepticism, or, at worst, distrust. This turbulent context is in spite of an awareness of the societal impact of science, as indicated by a Special Eurobarometer survey which found that nine in ten European citizens considered science and technology to have a beneficial influence on society (European Commission 2021). This could suggest that while there is an appreciation of the value that science adds to society, the trust that the general public places on science is nuanced. This is on account of the networked nature of trust in science. Multiple actors, including scientists, the media, policy-makers, public and private funders, as well as academic institutions, influence whether, and how science is trusted (Varda et al. 2024). Still, the nature of trust in science is complex, as evidenced by Cologna et al. (2025) who found that across varied global settings, while trust in science is high, personal attributes can affect whether individuals trust science. This could suggest that trust in science might vary in the context of science-related issues depending on who is trusted (i.e., individuals or institutions) (Contessa 2022).

This chapter seeks to extend this line of research by seeking to delve deeper into the factors that laypersons identify as significant for constraining individuals' trust in science. We report on qualitative data across different European countries (Cyprus, Greece, Austria, France and Ireland) and focus on a general, non-expert, public, who is routinely called to discern between trustworthy and untrustworthy sources to make informed decisions about scientific issues that concern them.

6.2 Background

6.2.1 *Epistemic Trust in Science*

The general public has a bounded understanding of science in comparison to scientists, lacking the ability to understand the causal complexities required to explain a scientific concept, and the ability to discern relationships between topics (Bromme and Goldman 2014). When confronted with conflicting information about a scientific issue people can either rely on first-hand evaluation, by directly evaluating whether the information is valid, or if they lack relevant prior knowledge to make that assessment, they rely on second-hand evaluation, by evaluating whether the source of information is trustworthy (Stadtler and Bromme 2014). This creates a dependency between trustors and trustees, as the inability to assess information trustworthiness forces reliance on others. (Govier 1997; Hardwig 1991). When people decide to trust scientific information, they enter into a trust relationship as trustors placing trust in a trustee, who creates the context for trust to occur. People trust others as information sources when they deem their judgment reliable, and, in the context of science, this trust is epistemic, since it concerns the acquisition of knowledge. In the context of science-based sources people determine whether to trust based on expertise, integrity and benevolence (Hendriks et al. 2016).

However, trust relationships can take multiple forms depending on the occupants of the trustee-trustor positions, which could be individuals or groups. Contessa (2022) posits that trust in science might be individual-oriented, group-oriented, or institutions-oriented depending on who occupies the position of the trustee in the relevant relationship. This underpins the social nature of science but also presents the complexity of understanding trust in science because different trust relationships might result in different perceptions when moving from individual trust to individuals / groups / institutions. Ultimately, the goal is to have individual trust at the institutional level, setting the foundation for a trust relationship between society and scientific institutions.

6.2.2 What Might Constrain Individual Trust in Science?

Individual trust in science, however, might be constrained by a range of factors. In a review of the literature, Cologna et al. (2024) indicate that in the context of climate science, political beliefs and religious views can influence scientific skepticism, though these factors applied more to a US rather than a European context. Angelucci and Vittori (2024) also show that, in the context of COVID-19, technocratic and populist attitudes influenced the extent to which science was trusted by individuals; these attitudes strongly related to trust in science, with technocratic attitudes resulting in greater trust, while populist attitudes having the opposite effect. Perceptions about the trustworthiness of science can also be shaped by pre-existing attitudes towards the research topic (Wintterlin et al. 2022) especially if it concerns a controversial issue (Altenmüller et al. 2021). Perceptions about scientists' motivations and practices (Cologna et al. 2025), as well as other individual factors, such as prior knowledge (Larrain et al. 2024), and cognitive biases (Altenmüller and Poppe 2024) can also influence whether science is trusted. Additionally, when individuals' moral values are perceived to be under threat, it can shape how scientific information is evaluated (Bender et al. 2016; Ryan et al. 2024). Individuals may also hold multiple, different, understandings of what counts as science, shaping different cultural meanings of science that could influence how people understand and interpret scientific information (Gauchat 2011).

Furthermore, how science is communicated to a lay, non-expert, public, might also constrain individuals' perceptions of scientific trustworthiness. For instance, when scientific jargon is used to communicate science, it can signal expertise, but it can also negatively influence perceptions on source trustworthiness (Thon and Jucks 2017). The presence of jargon can constrain comprehension and can also affect the fluency of scientific information processing, leading to motivated reasoning which can impact endorsement for scientific developments (Bullock et al. 2019). The challenge of communicating science in an accessible and understandable way might also lead to oversimplification of science, which may result in greater agreement with knowledge claims, and greater confidence in one's own judgments over deference to an expert source (Scharrer et al. 2017). Furthermore, individuals may also

misjudge what scientific information they should rely on to make evidence-based decisions, depending on who is communicating, and what and how uncertainty is conveyed (van der Bles et al. 2019). Uncertainty relating to consensus in science is more likely to lower scientific trust, while the uncertainty inherent in reporting statistics can have the opposite effect (Gustafson and Rice 2020).

Building on this body of research, we report on a qualitative study conducted within a European context that seeks to explore the factors constraining individual trust in science to better understand how trust in science could be supported.

6.3 Methods

The study took place in the context of the VERITY project, which endeavors to systematically examine how to support an ecosystem of trust, whereby multiple stewards of trust function in complementary ways to enhance trust in science (Varda et al. 2024). The study adopted a qualitative approach in order to examine individuals' perspectives of trust in science, sourced from a general, non-expert, public. A total of eight focus groups and one interview were conducted ($n = 66$; male: $n = 26$, female: $n = 34$; six participants did not provide demographic information). The individual interview included the perspective of a disabled participant.

6.3.1 Sample

Participants were recruited by VERITY partners in Cyprus, Greece, France, Ireland and Austria. Calls for participation were shared through institutional communication channels and participants were recruited using a convenience sample. The final sample comprised of participants in urban and rural settings, and with varied educational backgrounds. In terms of maximum level of education attained, the sample comprised participants with primary education ($n = 15$), secondary education ($n = 5$), undergraduate degree ($n = 21$), postgraduate degree ($n = 11$), doctoral degree ($n = 8$).

The sample comprised participants aged 18–30 ($n = 16$), 31–40 ($n = 9$), 41–50 ($n = 8$), 51–60 ($n = 5$), 61–70 ($n = 9$), 71–80 ($n = 9$), and 81+ years old ($n = 4$).

Two groups resided in a rural village and comprised participants who had entered retirement age, and whose higher level of education was primary school.

6.3.2 Data Collection

Focus groups were primarily conducted in person and were audio recorded; two focus groups were conducted online via Microsoft Teams and were video recorded. The minimum number of participants was six and the maximum nine persons, per focus group. A protocol for the focus groups was provided for each data collection

site, which was accompanied by training on group facilitation prior to the data collection. Participants were asked their views on (a) science, (b) the reasons for potential fluctuation in trust, (c) trusted sources of information, (d) challenges and suggestions for science communication, (e) actors responsible for enhancing trust. All participants were first informed about the project and provided informed consent on the outset of the study. The study was approved by the Cyprus National Bioethics Committee (approved: 23 February 2023; Reference code: BEBK EIT 2023.01.69).

6.3.3 Data Analysis

All personal data were pseudonymised at the onset of the analysis and were transcribed verbatim. Data collected in a language other than English were translated using automated artificial intelligence software and were then checked against the original language transcript by researchers in the relevant data collection team. The data were coded by the first author in NVivo 14, and were analysed inductively, using thematic analysis to extract themes across the entirety of each transcript (Clarke and Braun 2016). This analytical method was adopted to enable the identification of themes in the data in an iterative and systematic manner; all themes were discussed amongst all authors. In this chapter, we focus on insights in relation to the factors that constrain individual trust in science.

6.4 Findings

This study explored factors that might constrain individual trust in science. In our data, while participants expressed trust in individual scientists for informed opinions, their discussions on why one's trust in science might waver focused on factors in relation to three themes. First, participants mentioned *individual factors* such as affect, competencies, motivational and cognitive attributes, which can influence a person's capacity to use science-related information; this theme was discussed the most across all focus groups. Second, participants referred to *socio-cultural factors*, such as social norms, and practices within a community, as well as potential conflicts that may emerge within this context. Third, participants referred to *environmental factors*, referring to external conditions or influences that affect individuals' lives and opportunities; these factors were typically beyond an individual's immediate control. We elaborate on each of these themes with qualitative excerpts from the data.

6.4.1 *Individual Factors*

To start, the motivational dimensions of trust in science were underlined by references relating to personal interest in the topic, which was closely connected to personal incentives for wanting to seek out additional information from reliable sources. These motivational aspects may affect how and from where science-related information is sourced, and how much time is spent engaging with it.

Participants mentioned individuals' digital literacy skills—the ability to use digital technology aptly—as potentially hindering individual trust in science, emphasizing the digital literacy gap between younger and older generations. They acknowledged that while most people have access to technology via their smartphone, being able to use it as a tool that can facilitate engagement with reliable scientific sources is not a given, and may even result in superficial engagement with science-related information, as indicated in the following excerpt:

It's much easier to reject something than to sit down every day and examine what you read. Looking to see if the source you're reading is correct, looking for who's behind what you're reading. So I think for the majority, it's easier to reject something than it is to go through that search process every day. (Focus group 1, GR)

A range of factors relating to *cognition* were also mentioned as potentially constraining individuals' trust in science, including beliefs, cognitive processes, perceptions, and prior knowledge and understanding of science. Participants discussed two types of beliefs that can affect how individuals respond to science-related issues: *moral and ideological beliefs* and *epistemic beliefs*. Religiosity was the main focus of the conversation, especially among Austrian and Greek focus groups. Participants in the Irish focus group, also mentioned populist beliefs as a potentially constraining factor. Epistemic beliefs, which are related to the nature of knowledge and knowing (Hofer and Pintrich 1997), were implicitly referenced in the focus group discussions by focusing on (a) the varied ways in which people believe that knowledge is generated (i.e., trusting one's own judgment, versus trusting scientific consensus), and (b) the belief that knowledge is either tentative or stable, which can affect how science is perceived. The changing nature of knowledge could spark uncertainty about what to believe and whom, which can trigger emotional responses such as fear or confusion; this can also influence individuals' trust in science:

I mean you get confused: one says 'this', the other says 'that'. And eventually, you must figure things out by yourself. (Focus group 3, CYP)

The excerpt indicates how affective responses to science-related information can play a role in how people choose to cognitively engage with science-related information, and, by extension, this might also affect trust in science. In our data participants discussed how *cognitive biases* can hinder individual trust in science. Participants referred to confirmation bias, which can result in the searching or interpreting information in a way that reinforces one's prior beliefs or values (Nickerson 1998). They also implicitly referred to the Dunning-Kruger effect (Dunning 2011), mentioning how laypersons might overestimate their abilities to judge the accuracy

of science-related information, despite their limited competence. The inadvertent reliance on cognitive biases during the evaluation of science-related information was also regarded as a catalyst for conspiracy ideation, which might not only constrain trust in science, but has the potential to block it (Lewandowsky et al. 2013). Participants also referred to the epistemic practices that individuals might rely on to evaluate information, mainly focusing on criteria relating to source trustworthiness and benevolence (c.f. Hendriks et al. 2016) and claim corroboration as a process of assessing trustworthiness.

Furthermore, in our data, participants also pointed out the value of relevant *prior knowledge* and having an understanding of how science works; in the absence of both, individual trust in science might be constrained. *Perceptions of science* were also mentioned as potentially obstructing individuals' trust in science. Participants pointed to instances where science might contradict personal experience, especially in the context of medical science. Connected to this, the *personal repercussions of science*, can also influence science trustworthiness. When discussing the latter, participants mainly focused on technological advancements (specifically, artificial intelligence) and the perceived threat to people's livelihoods.

6.4.2 *Socio-Cultural Factors*

When participants referred to socio-cultural factors, they focused on the role that *social norms* and *social influence* can play when deciding on whether to trust science, but also pointed to a range of conflicts that can constrain trust in science. For instance, participants highlighted that some topics may be taboo topics for certain societal contexts (e.g., abortion). Additionally, the social nature of trust was illustrated through the value that individuals placed in their peer networks. For instance, they mentioned trusting peers within their social circle to act as "familiar experts" who provide a second-hand evaluation of science, as indicated in the excerpt below:

My neighbor is studying medicine right now or he's a civil engineer right now and he's doing his studies in construction and engineering. [...] He's from the field, he's just learning this first hand and he's listening to these resources. Then I can say okay, this is my expert, I can rely on him because he has the right access. [...] But you should probably build up a small expert network and when every citizen in society does that then we are all experts in our own way. (Focus group 1, AUS)

The excerpt highlights the networked aspect of trust but also suggests the potential pitfalls of self-selecting expertise networks since the process of curation might provide false confidence in one's ability to judge whether to trust science.

Participants also extensively discussed how different types of *conflicts* that emerge in the context of science can constrain individual trust. First, when science contradicts religious beliefs, it might reduce trust because it can affect how individuals understand certain phenomena. Second, conflicts within science can also reduce trust; when scientists disagree publicly (as in the case of COVID-19 vaccination, or masking, which were given as examples), individuals might be uncertain as

to who should be trusted, and this can influence decision-making. Third, science and politics were regarded as being in conflict, since they are informed by different agendas. Participants recognized that science and politics need to work in complementary ways, so that science informs policy, but distrust in politics might also affect individuals' trust in science, when these are entangled:

Between what science does and what the public thinks about it. The example we all have in mind is when we talk about vaccines. In general, when we judge science, it's in relation to what politics does with it. We say to ourselves, well, vaccines, what should we do with them? And so, I don't know whether we're judging science or politics and what's being decided. (Focus group 1, FR)

The lobbying power of politics, or other commercial actors, was also connected to the fourth conflict that participants discussed in our data, which related to scientists' conflicts of interest, especially as concerns commercial incentives (e.g. pharmaceutical companies in the case of vaccines), which can be perceived as biasing scientific results.

6.4.3 *Environmental Factors*

In discussing environmental factors, participants referred to circumstantial contexts that might constrain whether people trust science or not. Participants in Cyprus and Greece focused on the countries' *educational system* and the extent to which it accommodates and engages students in STEM subjects. More attention, across all focus groups was given to issues of *access*, however. This included access to science and scientists: whether people are afforded the opportunity to engage and participate in science, or whether individuals have access to scientists, who were viewed as trustworthy in providing expert opinions. Participants highlighted barriers to access that they routinely navigate. For instance, while there is access to information online, access to scientific journals might be restricted to the public, or in the case of searching for information, algorithms mediate information prominence.

Additionally, participants extensively discussed the *online information context* and how that can affect trust in science. They expressed feeling overwhelmed by—in the words of one participant — “the information tsunami” online, and expressed concerns over individuals' ability to differentiate between trustworthy and untrustworthy information online. This was connected with concerns of the presence of online misinformation, especially for scientific issues, which can be disseminated via social media platforms.

But with the social media, it has probably already influenced in a direction that mistrust is growing. This social media development is probably already contributing to the fact that mistrust will tend to increase a bit, because it has become more difficult to know what the trustworthy sources are. (Focus group 1, AUS)

6.5 Conclusions

This work sought to examine the factors that might constrain individual trust in science. Participants across a range of European contexts discussed individual, socio-cultural and environmental factors that could constrain whether one trusts science to make information decisions.

Our findings suggest that trust in science might be affected by a range of individual factors, in relation to *motivation* and *cognition*, affect and competencies; *socio-cultural factors*, such as social norms, social influence and conflicts within science or other groups or institutions; and *environmental factors*, such as a country's educational system, online information environments and access to science and scientists. Individual trust might waver when accounting for individual-to-group trust relationships, whereby scientists as a group may be trusted, but politicians are not. The trust relationship between individual-scientists, seems to affect not only the individual-to-group trust relationship, but the individual-to-institution (i.e. science) as well. On the other hand, ideological (e.g. political affiliation) or moral (e.g. religion) beliefs can prompt individuals to assess the trustworthiness of science as members of a group, suggesting that in such cases the relationship is social, rather than individual, and might merit different mechanisms for enhancing trust. Agata and colleagues (Chap. 10) indicate that a systemic view can provide a better understanding of the interactions between a general public and scientific actors (individuals, groups or institutions), accounting for its relational and transient nature. Such approach could elucidate the trust mechanisms at play by encompassing the personal and social aspects affecting trust in science.

Our findings align with other studies employing a multi-stakeholder focus group methodology, in suggesting a complex interplay between individual and collective trust dynamics. This particularly applies for trust relationships in technological development, which suggests the need for inclusive dialogue and diverse stakeholder engagement and consideration of stakeholder perspectives, values and concerns in developing ethical frameworks for scientific advancements (Christodoulou and Iordanou 2021; Iordanou and Antoniou 2023; Ryan et al. 2024).

The study is not without its limitations; the sample was small and non-probabilistic. However, we sought to gain perspectives from a range of populations across geographical and age contexts, and the study offers some initial insights as to factors that could merit further exploration.

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Chapter 7

Public Trust in Science: A Public Consultation on a European Scale



Marta Entradas , Inês Carneiro e Sousa , and Yan Feng 

Abstract Public trust in science has long attracted the attention of scholars. With empirical studies consistently showing that public trust in science remains moderately stable and high on a global scale, there is still limited understanding of the factors that influence trust. As part of the POIESIS project, this study aimed to explore public's perceptions about three main issues that are believed to influence trust in science: research integrity, public engagement and science communication. Through a qualitative methodology based on Public Deliberative Workshops (PDWs), we involved 169 members of the public across seven European countries—Denmark, France, Germany, Greece, Portugal, Spain, and the United Kingdom—in discussions about these topics. Participants expressed overall positive attitudes towards science. Isolated cases of misconduct were unlikely to directly affect public trust, yet integrity values in science are seen as key to trust. Additionally, public engagement was seen as a democratic access to science, still concerns were shown about the desired levels of engagement. Regarding communication, the credibility of the sources of information and actors were often mentioned as components for trust. The findings highlight the importance for institutions and individual scientists to align with integrity values, and provide valuable insights for institutions, policymakers, and science communicators seeking to foster greater confidence in science. This chapter provides a glance of the main findings of the PDWs described in Entradas et al. (2023).

Keywords Trust in science · Research integrity · Public engagement · Science communication · POIESIS project · Public Deliberative Workshops (PDWs)

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7.1 Introduction

Concerns with public trust in science are not new (e.g. Royal Society 1985). However, public trustiness in science has (re)gained attention in the public, political and academic circles after the COVID-19 pandemic (Agle and Xiao 2021; Agle 2020; Liu et al. 2022). The discussion has often revolved around arguments that trust decreases when threats to science such as uncertainty and controversy, mis/disinformation (e.g. Habgood-Cooté 2019), or cases of mistrust in science become known to the public (Intemann 2023). The available evidence, however, does not provide a comprehensive view of what trusting science means or how trust is affected in certain circumstances.

Most of the empirical data on public trust in science comes from large surveys and points to moderately stable and high levels of trust around the world over the past decades (e.g. European Commission 2005, 2010, 2021; Wellcome and Gallup 2021; Pew Research Center 2024), and even to increases in trust in periods of great uncertainty (e.g. Entradas 2022). The available studies are valuable yet limited in many aspects including in the measurements of ‘trust’ themselves, which have been lately reassessed (see Chap. 5, Bauer 2008, Reif and Guenther 2021)—and, perhaps most importantly, in providing an understanding of what factors might contribute to build trust/distrust in science.

For European research organisations, excellence in science is based on key assumptions that trust in science depends on adherence to (1) *high standards of integrity*, (2) *good communication*, and (3) *public engagement in research* enhances relevance and trust in science (POIESIS consortium 2021). These assumptions are corroborated in academic circles, but their effects on people’s trust in science are far from understood. For example, Rosman et al. (2022) argued that open science practices might contribute to increased trust in science, and Horgan et al. (2022) emphasised the critical role of public engagement in addressing public trust in healthcare. Ihlen (2020) suggested that science communication in a rhetorical and strategic way can play a pivotal role in increasing public trust and credibility in science.

This study—a public consultation at a European level—is part of the POIESIS project (POIESIS consortium 2021), whose guiding principle was to test three main assumptions. These included: (1) research integrity and misconduct will lead to trust/mistrust, (2) public engagement in science will strengthen trust, and (3) science communication is key to trust. We do this by examining how people’s perceptions of these three issues affect their trust in science through a qualitative approach that uses Public Deliberative Workshops (PDWs).

Here we present the results of seven national PDWs involving 169 members of the public in seven European countries: Denmark, France, Germany, Greece, Portugal, Spain and the United Kingdom. The PDWs were guided by the following research questions: (1) What are participants’ attitudes towards and trust in science, in particular in what concerns research integrity? and (2) What manifestations of integrity, public engagement and science communication affect public trust in science?

In what follows, we describe the methodology, including the PDWs and the participants' profiles. In the results section, we describe public attitudes and trust in science in three main sub-sections, following the structure of our assumptions and analysis: (i) research integrity and trust in science, (ii) public engagement and trust in science, and (iii) science communication and trust in science. A concluding section reflects on the stated assumptions and their significance in the current research environment.

7.2 Methodology and Data

To examine public perceptions and attitudes at the European level, the study design applied PDWs, which are structured events where citizens engage in discussions on complex societal issues, particularly related to science and policy. Rooted in deliberative democracy, PDWs aim to gather a diverse range of perspectives, allowing participants to reflect on issues without seeking consensus or policy decisions (Rowe and Frewer 2000) by creating an opportunity for exploring the intricate relationship between factors affecting trust in science (see Entradas and Fulgsang 2022 for a detailed description of the PDWs).

7.2.1 Recruitment of Participants

The recruitment aimed to include representatives from diverse groups of the public, including participants from citizen science associations, civil society organisations, and other user communities. A purposeful sampling approach was employed to ensure socio-demographic variation (Palinkas et al. 2015), considering factors like age, gender, and educational background. The selection process also took into account balancing representation from different social groups.

Recruitment strategies varied by country, combining online and offline efforts such as social media campaigns, phone calls, university collaborations, and external recruitment services (e.g., Empodera in Spain and Apogee London in the UK).

7.2.2 Structure of the PDW

The PDWs were held in accessible venues, typically universities or research-related spaces, with each country selecting dates and locations suited to local contexts; the full event lasted around 4 hours and involved an expert presentation with a Q&A session, followed by small group discussions, and a plenum session with a ranking exercise. The core of the event was the small group discussions, with an average of 6 participants per group, who engaged in discussions of case studies addressing

different dimensions of research integrity, public engagement and science communication (please see Entradas and Fuglsang 2022 for a detailed description of the PDWs).

The four cases discussed by the groups were framed in two versions transmitted by different communication channels (traditional vs. social media) and actors (institution of science vs media). Case 1 was about a prominent study by a group of Argentinians claiming a new drug (ivermectin) that prevent COVID-19 infections, but the data was suspect; case 2 was a statement issued by East Anglia University claiming that its scientists involved in the Climategate scandal did not fabricate the data; case 3 referred to a public consultation on the provision of a vaccine for the immunization of young children against Covid-19; and case 4 presented a participatory science program open to the public. These cases were adapted to each country's context to ensure relevance (for example, names and images of traditional media of each country). The events counted on a facilitator to guide the overall workshop and moderators in each of the groups (often national project partners) who guided the deliberations.

7.2.3 Participants' Profile

A total of 169 participants attended the PDWs, with country-specific attendance ranging from 9 to 42 individuals per event. There were challenges during the recruitment process, as seen in the discrepancy of attendees per country.

Table 7.1 describes the socio-demographic profile of the participants in the seven PDWs. While gender distribution varied slightly across countries, females accounted for a majority of the participants (59%), about a third were younger than 34 years old (30%), 39% were between 35–54, and 29% were 55 or more; and most were highly educated (75% had a bachelor's degree).

Table 7.1 Participants' profile, number of discussions by country

Country	Number of participants	Number of group discussions	Male (n, %)	Female (n, %)	Level of education (at least bachelor ^a)
Denmark	27	4	17(63%)	10(37%)	14(52%)
France	9	2	4 (44%)	5 (56%)	8 (89%)
Germany	15	4	5 (31%)	11 (69%)	9 (75%)
Greece	32	4	12 (38%)	20 (63%)	27 (84%)
Portugal	24	4	5 (21%)	19 (79%)	20 (83%)
Spain	20	3	6 (35%)	11 (65%)	17 (100%)
United Kingdom	42	5	19 (45%)	23 (55%)	27 (64%)
Total	169	26	68 (41%)	99 (59%)	122 (75%)

^a Bachelor, master or doctoral degree

7.2.4 Data Collection and Analysis

Discussions in all seven countries were recorded and transcribed into the national language. The data was coded and analysed in a deductive and inductive way, using a predefined theoretical framework and themes covering the three main topics of interest, while allowing for exploring new issues and international comparison.

Despite the large number of participants, caution is needed when interpreting the results, as most reported a high level of education and some connection to science - whether through their profession, friends, or family - which does not reflect the general public's characteristics in the different countries.

7.3 Research Integrity and Trust in Science

7.3.1 General Attitude Towards Science

Overall, participants across the seven countries expressed a positive view of science and high levels of trust in science, particularly appreciating its role in advancing progress and improving lives, such as in uncertain times like the COVID-19 pandemic. Many participants associated science with progress, innovation, and the common good. For instance, a participant in Denmark shared a personal story of their mother's improved health due to an experimental drug:

She is just as you and me. That would not have been possible ten or fifteen years ago. So, cheers for science! (DK)

Similarly, a UK participant described science as “trying to make the world a better place and just make it all easier.” These views highlight the widespread belief in science's potential to improve health, education, the environment, and overall quality of life acknowledged by participants in all countries.

7.3.2 Views on Integrity and Trust in Science

Participants demonstrated a broad understanding of misconduct, extending beyond the three FFP ‘cardinal sins’ (falsification, fabrication, and plagiarism) to include other questionable practices as equally serious ethical violations. Still, despite this, participants' trust in science did not seem affected by the cases of misconduct presented to them (cases 1 and 2). Despite misconduct being presented in the two cases, most participants circumscribed them to a specific individual (the scientist), rather than to the ‘institution of science’ or ‘science enterprise’, and expressed no concern about scientific developments, considering the cases as exceptions rather than the rule.

M: When you read this, do you feel that it shakes your idea about science, in other words, do you see this is an isolated case and “it doesn’t shake my confidence at all...”

Participant 2: No, no. Not at all.

Participant 5: In science, in general, I think it’s a huge generalisation. (PT)

Still, this does not mean however an agreement that misconduct is inexcusable and should not result in repercussions. In the voice of participants across all countries, misconduct behaviour should be punished and scientists should be held accountable for their integrity breaches. As a Greek participant noted:

If research misconduct is proven to be purpose-driven, then there is no excuse and there should be repercussions. (GR)

This discredit of ‘the scientist’ does not seem to affect the public general trust, with participants distinguishing between isolated incidents and systemic issues in science more broadly. Yet, there was a general sentiment that for ‘science’ to be trusted, it should follow responsible research practices.

7.3.3 Integrity Practices

Principles such as transparency, scientific rigour, replicability, responsibility, and accountability, operationalised through integrity practices such as data accessibility (i.e., open access data) and academic community validation (i.e., peer-review process), assumed particular importance for Danish, French, Greek and Portuguese participants.

What I find reassuring is that these reviews are also transparent, meaning that they can be accessed and reported on, and that we don’t just hear about the results. We also hear about everything that goes into evaluating the study and saying, «Wait a minute, there’s a problem with this study». (FR)

What we expect from science, to be transparent in terms of open access, data quantification, these things. (PT)

Data control, lack of transparency, and conflicts of interest were, in turn, brought up by participants as central factors related to integrity that could erode public trust in science.

7.3.4 Conflicts of Interest with Stakeholders

A key point for participants in all countries concerned the relationship between scientists and stakeholders — particularly funders of research with vested interests (such as pharmaceutical companies or private sector actors) and/or political actors, referring to their power in data control to influence or bias scientific outcomes.

Conflicts of interest, both real and perceived, were seen as a significant threat to research independence, credibility and thus trust in science.

Discussions around conflicts of interest received great attention among participants in Denmark, Greece, Spain and Portugal. Repeated concerns were raised about researchers' independence, with suspicions that they might have undisclosed interests, hidden agendas, or personal stakes—factors seen as potential drivers of distrust in scientific findings. These concerns were further amplified when research was funded by entities with economic interests

What was the background for them to come up with something like that. Is there, as we've talked about, something hidden behind it? Are there personal interests? Are there financial interests? (DK)

As a result, some participants expressed the view that research should be publicly funded and governed by a regulatory framework that ensures openness and transparency.

That's why it's important that the funding be public in that sense (...) public access to the research results. (GR)

7.3.5 *Political Influence*

The question was taken further among some of the participants who voiced concerns about the politicization of science and political influence on scientists. Many believed that political powers could manipulate science to shape public opinion and exemplified it with the COVID-19 pandemic. For example, in Germany and Greece, participants expressed frustration with how scientific findings were used during the pandemic to justify government policies like vaccination mandates without sufficient transparency or explanation. A participant shared:

This subject is particularly close to my heart because, as a Brazilian, I've experienced this manipulation of science by political actors in Brazil... (FR)

Taken together, these results suggest that for science to be trusted it should be based on responsible research conduct, which is seen as the responsibility of scientists and institutions. In this respect, it should be noted that participants highlighted the importance of institutional infrastructures in addressing detrimental research practices and promoting a culture of responsible research, rather than focusing excessively on individual cases.

This points also to an intricate relation among trust and society: misconduct seems to say more about the individual behaviour (individual characteristics) than about the overall trust people have in science, the scientific community, or scientific institutions.

7.4 Public Engagement and Trust in Science

The second topic of discussion with participants related to public engagement in science—as refers to the involvement of non-specialists in science, in one or more phases of the research process, and/or policy-making. Most participants across countries agreed that involvement in research could foster (their) trust by creating a sense of belonging and transparency, though opinions differed on the extent of meaningful public participation.

Participants in France and Greece engaged in extensive debate about this idea, viewing it as a way to democratise the scientific process and offer people a chance to actively participate, potentially increasing trust in science.

[Public involvement in science] personally, I think it can increase confidence, because for example if I took part in something at the Natural History Museum, I'd have more confidence in that institution, I know it, I've taken part, I've talked to people from there, etc. (FR)

7.4.1 *Level of Public Involvement in Science Policy-Making*

The democratic nature of public participation also came up as a way that allows scientific activities to be scrutinized and judged. However, views on the degree of public involvement varied among participants, with perspectives ranging from partial involvement (i.e., the public should participate in some of the activities and stages of research) to full involvement (i.e., participation in all stages of the scientific process).

Public involvement in science was associated with the topics and the levels of people's understanding of it, and as such participation must be cautiously considered, particularly in health and medicine research. Most participants believed that granting citizens decision-making power on sensitive, controversial topics requiring extensive expertise was inappropriate and even irresponsible for those without the necessary knowledge. Essentially, decision-making about science is seen differently from participation in the research process (more restrict versus more open process). The following quotes illustrate the various views on the topic:

I believe that participation should be from the origin, from the degree of decision on what research is carried out. Science aims to solve problems, and I think that research orientations are very much influenced by economic or academic interests, and research is not done on problems that can transform people's lives. Do we want to go to Mars? (ES)

I wouldn't feel too confident about my ability to be very helpful... I mean, if someone were to present me their findings and asked me to look over them, I'd be very confused. (UK)

I can't ask someone who has no idea about epidemics or viruses or whatever what they think about making a vaccine available to children aged five, six months, one year. (PT)

These findings seem to suggest that, despite democratic values come up frequently, the level of engagement assessed in complex ways. Drawing on Stirling's (2008)

work, concerns among participants could be identified regarding consultations being designed with an instrumental imperative, meaning they focus on achieving a specific outcome without genuine social deliberation. This contrasts with the normative imperative (focused on ensuring a transparent, open, representative and democratic process) and the substantive imperative (aimed at achieving a better result using socially deliberated criteria for outcomes), with the latter being the preferred goal of public consultations from the participants' perspective.

7.5 Science Communication and Trust in Science

7.5.1 Trustworthy Communication Channels and Actors

In all the countries, science communication was highlighted as a key factor in building trust in science. The trustworthiness of the communication channels and the actors disseminating scientific information was undoubtedly among the most extensively debated topics. In general, there was an understanding that certain channels and actors in science communication are more trustworthy to people; but there was no consensus on which channels are the most trusted (TV stations vs. newspapers vs. radio). Although there were several criteria people used in their evaluation of trustiness of the messages.

Conversations revolved around the importance of looking at the sources of the information and judgements on their reliability and reputation, and the message, its clarity and rigour, as key characteristics for trust in science communication. For example, some participants highlighted the significance of the level of detail and background information each channel offers, while others were concerned with the channel's prestige, its reliance on politics or private companies, and its potential for sensationalism.

7.5.1.1 Reliability, Credibility and Reputation of Sources

Traditional media channels were generally seen as more trustworthy than social media. However, some participants noted that mainstream media is losing its influence to social media, which raises concerns.

Social media was viewed with scepticism by many participants with some platforms like Facebook seen as moderately useful while others, like Twitter/X, were criticized for spreading superficial or biased arguments.

Without specific monitoring of what is shared on social media, anyone—even anonymously—can post anything, including mis/disinformation. Additionally, social media tends to reinforce certain worldviews rather than maximize diversity of viewpoints: people are exposed to information that supports their own ideas and are not exposed to different perspectives.

Anyone can go into Facebook and write things. (DK)

So, who we read the information from certainly plays a role, the language he uses, the references he uses, is something I totally agree with, the medium, which he uses, let's say on Facebook there is no citation, anyone can upload what they want. It is not the same with the various science sites. (GR)

Participants noted that mediators—such as journalists, science communicators, and institutional spokespeople—play a pivotal role in translating scientific information to the public. Trust in mediators of science directly impacts trust in the communicated science. For example, participants saw it as a responsibility of the media, to seek expert insight and ensure a fundamental understanding before disseminating information, particularly when research has not yet been published. They see also the responsibility of scientific institutions to communicate clearly and with integrity.

That's where I think the media's responsibility is not being properly assumed, since we know that the data has not been published and is not being communicated, why write about it in this way? In a way that leaves room for doubt, even though the media should say no? (...) Given the ethics of the profession of journalist, we are not going to write an article that says everything and its opposite at the same time! (FR)

7.5.1.2 Clarity and Accessibility of the Message and Language

Last, the clarity and accessibility of the language was a common topic among participants for effective science communication. Many participants noted that scientific language should be adjusted for the public to understand complex topics without feeling alienated or confused. A UK participant said:

There is this kind of missing link between what we do, what we research, and how to spell it to a public, which doesn't have the same sort of knowledge. So, you need to change the sort of language. (UK)

Many other ideas emerged from the data. Here we provided only a glance of the findings. The full results of the PDWs have been described in detail in Entradas et al. (2023).

7.6 Discussion

The qualitative focus and the methodology based on the PDWs ensured a deeper understanding of public trust in science and how integrity in science, public participation in science, and processes inherent to science communication relate to it. In this limited space, we focus essentially on discussing findings in the light of the assumptions under questioning.

On the relationship between trust and integrity in science (first assumption), one first observation to make is that cases of misconduct are not much of a concern to participants, major concerns arise around broader issues related to integrity that can

conflict with the autonomy of science. Misconduct was often perceived as an isolated incident tied to a specific researcher and not reflective of the scientific community as a whole. Yet, concerns about data control, lack of transparency, and conflicts of interest with stakeholders, which align with a broader conceptualization of scientific integrity, were highlighted as significant threats to trust in science and scientific findings presented to the public. This supports only in part the assumption (1) that misconduct will lead to mistrust: It is not the cases themselves, but major issues, often external forces affecting the production of science that might affect integrity, which are seen as threats to science.

This also suggests that trust might be difficult to break when cases of misconduct reach the public eye. Science was portrayed as something extraordinary greatly benefiting people's lives. This image corroborates findings from existing surveys, as mentioned in the introduction of this chapter, and provides insights into the still little explored relationship between trust in science and scientific integrity.

Public involvement in science was seen as a reflection of its democratic nature and key for trust, but perceived desired levels of participation varied, depending on the topic (e.g. health research) and the goals of participation (e.g. policy decision-making). Participants emphasised the importance of expertise in making decisions on sensitive topics, of which they do not have an understanding. These findings, from the perspective of those whose participation is sought, challenge current assumptions that guide scientific organisations on the nature of public participation in science (second assumption). They bring questions about the desired participation by the public itself: an important question is how publics see their role in and want (or not) to be part of certain forms of involvement in science. A few surveys that have enquired about it ('Would you like to participate in policy decisions about science?') also point to such little interest in policy-making actions) (DBEIS 2020). This is also supported by the challenges in the recruitment of participants. Moreover, concerns, as seen here, are also around the purposes of public participation being instrumental (Stirling 2008), focusing on ensuring a particular outcome without real social deliberation. This importantly challenges the 'ideals' of participation, its normative (focused on ensuring a transparent, open, representative and democratic process) and substantive goals (aimed at achieving a better result using socially deliberated criteria for outcomes), and calls attention to needed reflections between scholars, institutions and the public on what participation means and when it is desired and justifiable.

Finally, science communication emerged as a critical factor influencing public trust. Trustworthiness in science communication was linked to the credibility of sources, judgments of reputation, and clarity of the messages and language. Mediators—journalists and institutional communicators, as well as scientists, were seen as key to have the responsibility to ensure accurate and ethically responsible reporting, which is also a further sign of the trust that people deposit in the values and norms of science and its establishment as the norm, not the exception.

Overall, these findings provide further insights into the existing assumptions, through the view of those on whom such assumptions reside. Firstly, misconduct seems only indirectly connected to trust in science, *yet* the institution of science

should follow integrity values fully to the trustworthy by publics. It is key that institutions and scientists, take seriously their responsibility in producing good and trustworthy science and communication, adhering to norms of good research conduct and guiding their researchers in that process. The same should hold for mediators and other stakeholders involved in reporting about scientific findings.

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Chapter 8

The Role of Institutions in Cultivating Trust in Science: A Qualitative Approach on a European Scale



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Abstract How do institutional actors perceive public trust in science and technology within their national contexts? How do institutional stakeholders view the cultures of research integrity and social integration, and how do they perceive such cultures to co-influence public trust in science? This chapter explores the role of institutions in fostering a research culture that reinforces trust in science. Based on the findings of a qualitative, participatory study carried out in 7 partner countries, it highlights key insights into institutional perspectives. Across countries, results indicate that professional stakeholders do not identify a general ‘crisis of trust’ in science but, nonetheless, variously raise emerging areas of concern and identify internal and external pressures on the science system that may negatively influence public trust in science and public perceptions of science and technology.

Keywords focus group · Participatory research · Institutions · Public image of science

8.1 Introduction

Trust in science is a complex and multifaceted issue, shaped by individual, relational and contextual factors (Master and Resnik 2013; Seethaler et al. 2019; Gallup 2019). It concerns both trust in the knowledge produced, trust in the scientific process and trust in the knowledge producers, allowing a distinction to be made between general trust in science and scientific institutions and specific trust in the process or those who conduct scientific work and lead these institutions (Bauer et al. 2018; Hendriks et al. 2016).

At a time when science and technology play an increasingly significant role in shaping our way of life, particularly in increasingly digitalized societies that face disinformation, polarization, and disruptive technologies, institutional stakeholders have repeatedly expressed concern over a growing divide between science and society (Dunaway 2021). Scholars have also highlighted a potential emerging crisis of trust, pointing to shifts in science-society relations and changes in the social roles and functions of science (Saltelli and Funtowicz 2017). Organizations such as research performing organizations (RPO) and research funding organizations (RFO) are perceived as key societal institutions for building and maintaining public trust in

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research. They also play a central role in promoting research integrity and public participation in research (Mejlgaard et al. 2020), which are two key pillars for rebuilding the connection between science and society (POIESIS Consortium 2021).

In this chapter, we investigate the role of institutions in fostering a research culture that enhances trust in science, and we explore the following research questions: How do institutional actors perceive public trust in science and technology within their national contexts? How do institutional stakeholders view the cultures of research integrity and social integration, and how do they co-influence public trust in science? While trust in science is most often associated with quantitative studies (Bauer and Falade 2021), the originality of this chapter lies in its qualitative focus: it presents the results of a series of 22 focus groups involving nearly 130 institutional stakeholders and 24 co-investigators in seven European countries: Denmark, France, Germany, Greece, Portugal, Spain and United Kingdom.

The chapter is divided into four main sections. The first outlines the methodology applied, and the data collected. The second discusses institutional stakeholders' perceptions of trust in science. The third examines research integrity and its influence on trust, while the fourth explores social integration and its impact on trust.

8.2 Methodology and Data

To explore the perceptions and attitudes of institutional stakeholders at the European level, and to enable a dynamic research approach that provides the most in-depth insights, the study design applied: (1) a focus group methodology, and (2) a participatory research model involving a selected group of institutional stakeholders as research partners or “co-investigators” (please see research protocol for details, Dubois 2023).

The underlying idea is that the qualitative and participatory dimensions would enable us to obtain detailed research results that draw on the expertise and practical experiences of institutional actors daily engaged with the study topics. Our co-investigators were selected on the basis of their involvement with research integrity through their institutional position (leaders and managers in research performing organizations or research funding organizations, editors of peer-reviewed journals, members of the committee on publication ethics, research integrity officers, R&I policy makers) or on the basis of their professional involvement in fostering citizen participation research (open science policy advisers, communication and outreach officers in research performing organizations or research funding organizations, press officers, etc.).

Co-investigators were invited to participate in the study throughout the research process, from commenting on the research protocol to collecting data and contributing to the reporting of results. The study's methodology was intentionally participatory, involving a broad range of field experts, including dedicated practitioners and leaders capable of mobilizing key national networks related to the topics addressed. In addition to the potential individual and professional benefits of participating as

Table 8.1 Distribution of co-investigators

Country	Male	Female	Research integrity	Citizen participation
Denmark	0	3	2	1
France	2	1	3	0
Germany	1	3	2	2
Greece	3	1	3	1
Portugal	0	3	1	2
Spain	2	1	2	1
United Kingdom	1	3	3	1
Total	11	13	16	8

co-investigators, these experts also have the ability to create institutional awareness, drive policy agendas, and support the sustainability of relevant policy recommendations. From the perspective of the research project, involving a cross-national group of experts has been valuable for enhancing the quality of the study and its findings. Furthermore, this specific design is expected to have lasting effects beyond the immediate study results.

After being trained in focus group methodology, each national team was supported in organizing and facilitating three focus groups. The support of these co-investigators was also a facilitating factor in identifying and recruiting roundtable participants, who comprised institutional stakeholders with key professional insights and experiences in research and funding systems. Tables 8.1 and 8.2 describe the population of co-investigators and participants in the 22 focus groups organized in 7 countries, bringing together 131 institutional stakeholders, 55 men and 76 women. 15 of the 22 focus group interviews were conducted online.

The data from the focus groups was collected through audio recordings. Using computer-assisted qualitative data analysis software (CAQDAS/NVivo), interview transcripts were coded by each research partner using a similar coding scheme.

The comparative analysis highlights both convergences and divergences between the different countries represented. A qualitative study of this size and scope is quite remarkable, but the results must be interpreted with some caution, since the focus groups were not intended to be representative of a population or exhaustive of a national reality but brought together institutional actors who developed “situated” perspectives based on their positions and careers.

8.3 An Institutional Perspective on Europeans’ Trust in Science

Although many public debates assume a growing lack of trust among the general public (Saltelli and Funtowicz 2017) our institutional stakeholders adopted a more nuanced view on the current state of the relationship between science and society.

Table 8.2 Focus groups and participants

Country	Number of Focus Groups	Number of Participants	Male	Female	On-site	Online
Denmark	3	18	5	13	2	1
France	3	16	7	9		3
Germany	3	18	7	11		3
Greece	3	17	12	5	1	2
Portugal	3	20	7	13	2	1
Spain	3	16	10	6		3
United Kingdom	4	26	7	19	1	3
Total	22	131	55	76	6	16

In Denmark, Germany, Portugal, Spain, United Kingdom, and to a lesser extent in France and Greece, participants noted that the scientific community - and science in general, in contrast to other institutions—continues to enjoy a generally high level of trust from society.

There is no reason to think that there is mistrust in science. However, there are certain attitudes, increasingly present in contemporary society, that are blatantly anti-science. And I think it's very difficult to fight such attitudes with the weapons of science. (Focus group 3, PT)

...there is a scientism where people need to trust something, they don't trust institutions anymore. I think they trust quite a lot, quite a lot in scientists and they demand absolute certainties from them. (Focus group 1, ES)

[Crisis of trust]... I think that might be over-egging it [...] there are research areas that do face a lot of public backlash and difficulties for certain researchers [...] I would say they're very minority and it's important not to over-emphasize what a few individuals are doing. (Focus group, UK)

These excerpts suggest that while the notion of a general crisis of trust in science is not supported by our participants, this does not preclude more specific concerns given to particular critical areas or situations.

Most participants mentioned in their national environment the existence of “pockets of distrust” (UK), and “instances of mistrust” (DK). Indeed, it is well documented that certain fields or scientific or technological subjects — such as stem cells, climate, vaccines, gender, religion, new developments in technology, artificial intelligence, and genetically modified crops — remain debated in the public sphere (Ghasemi et al. 2024). This mistrust might be associated with political affiliation, as studies suggest that individuals with more conservative views tend to be more skeptical of the so-called impact of science (Dunlap 2014). The extent to which these controversies influence public debate varies from case to case, but minority groups mobilized around them often use social media as a powerful tool for amplification.

Focus group participants generally seem guided by the idea that, even if a widespread crisis of trust has not yet materialized, various discrete or localized signals suggest a potential fragility within science in the near future. Consequently, there

was a perceived need to address several factors considered to be of importance to public trust in science, in particular: (a) scientific literacy and public understandings of scientific processes, (b) the independence of scientists from political or economic interests in a context where science and society are increasingly intertwined, (c) the relevance of scientific research to people's everyday lives, and (d) the role of both generalist and specialized media in informing the public about science and technology (see Chap. 9).

Unexpectedly, when considering the various factors that can positively or negatively affect the expression of trust, a number of participants across countries mentioned the expectation of trust emanating from their own institutions. Do scientific institutions necessarily need to foster trust? Should they be viewed as pillars of trust within society? What kind of trust scientific institutions may legitimately claim? It can be discussed whether there is a contradiction in cultivating critical rationality in the public while simultaneously seeking an elevated level of trust. Cultivating critical rationality presupposes that this mindset can also be applied to the scientific community itself, encouraging awareness of its limitations and their possible consequences for society.

I think you should have trust in research, but I don't know if you should have blind trust in researchers [...]. You should trust what is being presented more than the one presenting it. (Focus group 2, DK)

Some participants observed that these internal dysfunctions are likely more evident to the scientific community itself than to the general public. This prompted the idea that reconsidering the issue of trust from the perspective of the scientific community would be worthwhile. Rather than focusing solely on the public's trust in scientists, participants suggested it would be valuable to examine the level of trust that scientists have in their own scientific community.

I think there may be some mistrust on the part of the public, but I think there's a lot of mistrust on the part of scientists towards themselves, towards each other. (Focus group 2, PT)

Shifting the focus on trust from the general public to the scientific community would open new avenues for the social sciences. In particular, it would help clarify how researchers perceive the role of scientific institutions in generating scientific misconduct, but also the perceived institutional dysfunctions associated with the institutional handling of misconduct cases.

8.4 Research Integrity and Public Trust in Science

The focus groups highlighted varying levels of progress toward a shared culture of research integrity. In countries such as Denmark, Germany, and Portugal, participants generally agreed that their respective national scientific communities uphold a high level of respect for the rules and principles of research integrity. Conversely, in Greece, Spain, France, and the United Kingdom, participants found it more

challenging to reach consensus on the current state of research integrity. Although scientific misconduct was acknowledged as a significant concern, its precise occurrence was seen as relatively difficult to measure. Although high-profile cases have garnered attention they are generally regarded as isolated instances and are generally seen as having limited impact on public trust in science.

Across all groups, participants agreed that adherence to the highest standards of research integrity within their own research community should not be taken for granted. While participants in some countries felt that scientists were familiar with the guidelines and codes of conduct, others felt that they were rarely read, even within leading scientific organizations.

Although all participants agreed on the objective of establishing research integrity as a “shared culture,” they emphasized different aspects of what this culture should entail. In Germany, the focus has been on moving away from a “reactive culture” driven by private companies that specialize in detecting plagiarism towards a “pro-active culture” of research integrity comprising all institutional levels. The emphasis was also on recognizing the importance of doubt and error within the research culture. In France, efforts have focused on moving from an institutional culture of secrecy to one of full transparency in research integrity. Public discourse is also evolving, moving away from the sole stigmatization of misconduct and its perpetrators towards the promotion of integrity principles as a shared culture.

Participants were also divided regarding the development of institutional management of scientific misconduct in their respective countries. In Spain, Portugal, and Greece, the research integrity institutional framework — dedicated officers, bureaus or formal charter and code — was judged to be weak or even non-existent. In Germany, France, and Denmark, participants agreed that institutional efforts had been made over the past 20 years, though their perceptions of the outcomes varied. In France, for example, those involved in recent reforms felt that the most necessary changes had been implemented, and that time is now needed for these reforms to take effect. Others contended that, while the reforms were beneficial, they still had to fully realize the objectives initially envisioned.

Without assuming a linear relation between trust and research integrity, in Portugal, while participants did not believe there is a crisis of trust in science, they identified specific situations and contexts that could lead to mistrust, with one such situation involving cases of compromised integrity. In Denmark, participants acknowledged that scientific misconduct could negatively impact public trust in science, though they generally viewed this effect as quite limited. In Germany, participants highlighted the role of transparency in building trust in science, arguing that scientists should make their doubts and uncertainties more visible to the public. This, they believed, would foster a better understanding of the scientific process and help prevent potential misunderstandings that could erode trust.

I believe that trust [...] is not strengthened by saying: ‘it is like this’, but rather ‘it is PROBABLY like this’, but there is also doubt, and we have to be clear and transparent about this doubt. (Focus group, DE)

In France, participants involved in facilitating public debate on scientific and technological issues noted that the term “integrity” is rarely used by the general public. For those expressing distrust in science in these debates, the concern was not so much a lack of integrity but rather a perceived lack of “independence” from political or economic interests. This observation suggests that, regardless of the existing theoretical literature trying to clarify the distinction between ethics and research integrity, there is a need to further investigate this distinction through empirical research.

Participants generally agreed on the significant role institutions play in fostering trust in science. However, despite identifying similar barriers to research integrity, they highlighted a heterogeneous landscape across Europe, with varying codes of conduct, and data management practices, among others, and some recommended increased cross-country coordination and harmonization of research integrity standards and policies.

8.5 Social Integration and Public Trust in Science

The development of social integration programs aimed at increasing citizen participation is generally based on the belief that such programs can strengthen trust in science, improve the quality of research and amplify its impact on society. Institutional actors generally viewed citizen and stakeholder participation positively. In Portugal, for example, the focus groups included members of a citizen science program spanning various scientific institutions and supported by the municipality, who highlighted the positive effect of a participatory science approach for both researchers and the local community, as well as its contribution to building trust in science. However, the issue caused notable polarization with institutional stakeholders being quite divided on the effect of citizen and stakeholder participation, differing on when and how to involve citizens in research. Several participants described the participatory mechanisms as “selling” or “promising” a situation of exchange and dialogue that is not always fully realized. Importantly, unmet expectations regarding participation were identified as a significant risk, potentially leading to frustration and eroding trust over time.

[...] You can't put normal citizens to debate on subjects where there are people who have studied them, who know them. [...] What we must do is to try to get science to arrive in some way, through ethics committees, dissemination by public entities. But not to bring the public to the heart of the matter, because I don't think they will be able to understand it, or disseminate it, or help... No, I don't see it, I don't really see it, as the public jury, I don't see it. (Focus group 3, ES)

Among the participants, those most familiar with participatory mechanisms were generally the ones who thought they could positively impact trust in science. However, this observation should be treated with some caution. Although interpretation requires caution, the positive perceptions expressed by these individuals may

reflect a form of familiarity bias, where prior knowledge of or experience with participatory processes influences their evaluation.

Building trust was described as dependent on several factors: training of researchers in participatory research, institutional resources to accommodate the complexity of the process, a diverse and educated public, and, in most cases, a limited scale of participation:

[...] I was very surprised by the reactions of the citizens... suddenly there was trust... the fact of involving them, listening to them, coming back to them with the results, created trust in the protocol, but also trust in the results. It gave us a different point of view (...) participatory science is an excellent way to connect with science (...) mini-publics, small units that allow dialogue, these are the things we're going to activate regularly to provide citizens with information that is effective and not top-down. We know that the top-down approach has its advantages but also its disadvantages in the context of citizen participation. (Focus group 1, FR)

This list of conditions brings us back to a division that emerged regularly in the focus groups between, on the one hand, participatory science, which was described as potentially effective in building trust but on a limited scale, and, on the other hand, more traditional scientific communication, which was perceived to have a positive impact on a much larger population. Notably, the effectiveness of one approach on a smaller scale were not seen to exclude dedicated science communication strategies. In some countries, these were characterized by several institutional actors as often being reactive and uncoordinated. A strong focus on efficient, widespread science communication, including in the early phases of research, was highly recommended.

8.6 Conclusion

Our qualitative and participatory study offers original insights into how institutional actors perceive trust in science and its relationship to the concepts of research integrity and citizen participation. It allows us to rethink the initial diagnosis that underpins the public debate on the relationship between science and society: our participants critically assessed the claim about a public discourse surrounding society's generalized distrust of science, finding it not only inaccurate but potentially counterproductive, particularly by artificially widening the gap between science and society. It seems crucial that scientific institutions, by the simple logic of self-fulfilling prophecy, do not create the very phenomenon they aim to combat.

Our participants emphasized the importance of scientists trusting their own institutions. While they acknowledged that there may be limited problems of trust between science and society, they generally felt that the question of trust was as much a concern for society as it is for scientists themselves. A major challenge today is to ensure that scientists maintain confidence in their institutions. This requires that institutions consistently meet the expectations of scientists, particularly in terms of transparency, support and adherence to the principles of research

integrity. Regarding the link between public trust and research integrity, participants acknowledged that scientific misconduct can undermine public trust in science. However, this effect is seen as limited, partly because cases of fraud or misconduct are considered either rare or difficult to evaluate.

Regarding citizen participation, it is striking that participants were divided on its effectiveness; those with the most detailed knowledge of it were also the ones who could best describe its benefits, particularly its social relevance. From this perspective, the assumption that involving citizens and civil society in co-creating research agendas and content makes research more relevant seems valid. However, this depends on a long list of resources and factors that do not always align. While participatory mechanisms have been praised for facilitating, in principle, an in-depth dialogue between citizens and scientists, in practice, this dialogue does not always occur. When a participatory process fails to meet its promises, it can understandably generate public distrust. More importantly, some actors believe that abandoning a dissemination strategy in favor of a more participatory research is a mistake in the ongoing battle for scientific information. This battle is being fought on a large scale across social media, and participatory mechanisms work best with small groups of participants. A comprehensive strategy for communicating scientific information using social media should be considered an institutional priority.

This leads us to the broader idea that institutions play a crucial role in promoting research integrity and citizen participation. From this perspective, the focus groups allowed us to describe the diversity of national institutional landscapes and the importance of expectations. Institutions clearly have an important role in establishing roles, training, guidelines, etc. However, it is important to emphasize that these institutional actions will remain ineffective unless they are coordinated at both national and European levels. In terms of integrity and data-sharing rights, the problem is not so much the absence of codes, but the proliferation of them, which is causing increasing confusion. While perceived as complex and extremely challenging to implement, there is a global need for standardization, harmonization, and coordination -goals that can only be achieved at the European or global level.

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Chapter 9

A Multi-Stakeholder View on Methods to Foster Public Trust in Science



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Abstract This chapter explores methods identified as having the greatest potential to address societal mistrust in science in practice. Five categories are given, divided by their main objective, namely methods to raise interest in science, to enhance understanding on how science functions, to promote the integrity of scientists and scientific institutions, to democratise science, and to build up a reflexive mindset and resilience against misinformation. Our findings emphasize the need for a multi-level and multi-dimensional perspective in all relevant stages of method design and implementation. We start from the premise that different trust issues pertain to target groups and scientific topics. These issues cannot be tackled without the proper insight into the underlying political and economic context in which mistrust in science evolved. The key prerequisite of a successful method is therefore a precise identification of the inherent socio-economic or political issues, which can be better addressed through a sustained engagement of relevant local stakeholders. Our results are primarily based on three multi-stakeholder focus group discussions in Austria, Belgium and Greece. These debates brought together a broad range of stakeholders responsible for guiding societal trust in science, i.e., researchers, science communicators, journalists, policymakers and industry actors. Our aim was to enhance understanding of their interlinked roles in fostering trust in science. Qualitative content analysis had been used to identify key themes that were translated into the presented methods.

Keywords Trust in science · Multi-stakeholder consultation · Focus group · Recommendation · Audience segmentation · Public engagement

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9.1 Introduction

Concerns about the perceived lack of public trust in science and scientists are increasingly featured in leading news media in Western countries (Cologna et al. 2025), although this concern contrasts with the statistical findings from Wellcome and Gallup (2021) indicating that global trust in science remains strong. Nevertheless, there is indeed a growing feeling that people increasingly disconnect from science. The most prominent recent experiences include the resistance to follow COVID-19 health and safety measures (Mousoulidou et al. 2022), the denial of climate change impacts (Fage-Butler et al. 2022) or the proliferation of new pseudo-scientific theories such as 5G conspiracies (Winter et al. 2022).

Many sources of such behaviour have been cited, such as the adverse effects of conflicting scientific information (Nagler et al. 2023), infodemic (Chen et al. 2022), non-transparent, exclusive research processes (Wynne 2006), or the changing scientific media sources (Bogert et al. 2023).

A basic assumption of the VERITY project was that trust in science, at least since the advent of social media, had increasingly become distributed among traditional science-related institutions and several new actors, such as companies, civil society organisations, social media platforms or influencers, and new education and knowledge platforms (Thunert 2021). On the one hand, this is an unknown modern challenge; on the other hand, a new opportunity to think about actionable measures to tackle mistrust in science.

We built upon the opinion of diverse stakeholders responsible—with or without an official position—for guiding societal trust in science and facilitating science-society co-creation. (See also Chap. 10 for a systematic overview on the roles and mandates of such stakeholders). Through this approach, we explored different avenues to foster trust across diverse audience segments.

This article spotlights the most relevant methods that can be readily applicable to multiple target groups. The adopted multi-stakeholder perspective helped us better understand such methods and the relevant conditions under which they might function the most effectively.

9.2 Methodology

Three multi-stakeholder focus groups in Austria, Belgium and Greece were organised within the VERITY project in November 2023 with the aim of achieving an on-the-ground understanding of the practical application of relevant methods to foster public trust in science. These methods were based on state-of-the-art research results and best practices previously obtained through a systematic scientific literature review and semi-structured interviews with 26 relevant experts.

Table 9.1 Participation in focus groups per stakeholder category in each country

Stakeholder group	Austria	Belgium	Greece	Total
CSO/NGO	1	4	2	7
Digital influencer	2	0	2	4
Industry actor	2	1	2	5
Journalist	2	2	1	5
Researcher	3	1	3	7
Policy-maker	2	0	4	6
Total	12	8	14	34

The methods presented at the workshop included the use of digital channels and visual solutions to communicate scientific findings, formal education and informal training courses on scientific methods or science communication, citizen engagement practices and regulatory actions towards social media.

The aim of the focus groups was to explore the challenges, opportunities and potential roles of various stakeholders in the practical implementation of the identified methods with the support of increasingly important actors whose perspectives are often not captured in the current literature, such as industry representatives or digital influencers. To ensure that the methods discussed in academic circles in recent years can be checked and enhanced from a practical perspective, all focus groups were framed around a case study. The partnership chose the discussion topic of renewable and non-fossil energies as a case controversial from the perspective of trust in science in each focus group country, i.e. many unsubstantiated scientific claims and misinformation might be attached to this topic.

All involved partners used its organisational networks to identify relevant stakeholders potentially engaged in scientific trust issues around the subject of renewables, such as wind farms, in their professional work, and recruited people through direct invitations via e-mail or phone. In total, 34 participants took part in the three focus groups, with the stakeholder distribution detailed in Table 9.1 below.

Our case study served as a framework for the focus group discussions to bring forward practical solutions supporting the better positioning of research with societal needs and values. This was done in three separate moderated sessions where the following was discussed: (1) challenges and best practices where—with the help of printed-out method templates that included short explanations—each participant indicated the perceived clarity, relevance and feasibility of each method. This served to identify 2–3 methods (e.g. most feasible or most challenging) up for a more detailed discussion; (2) the more systematic enabling and hindering (cultural, socio-economic, political, or psychological) conditions; (3) the possible collaboration patterns between various stakeholders for a more effective uptake of the most promising methods. Each focus group ended with a short summary and future outlook.

9.3 Findings

The following chapter gives a short overview on the most important methods discussed at some length in each focus group, irrelevant of country setting and stakeholder breakdown, categorised by their main objectives. The methods presented differ in their implementation level: they can be undertaken by individual actors (micro-level), require institutional or organisational actions (meso-level), or presuppose systematic transformations within the scientific ecosystem (macro-level). Notwithstanding the implementation level, the focus of our analysis is on the common discussion points, also highlighting some key observations specific to respective countries or stakeholder groups.

We found that stakeholders tended to discuss the practical applicability of methods aimed at fulfilling the following five main objectives: (1) raise interest in science; (2) enhance understanding of science; (3) promote scientific integrity; (4) democratise science; (5) build a reflexive mindset.

9.3.1 *Interventions to Raise Interest in Science*

Our focus group participants argued that an inherent interest in science is needed to shape positive attitudes towards scientific actors and processes. A novel relevant method to raise interest is visual representations such as images, infographics or videos.

The importance of visual and data journalism was emphasized. Participants underlined that these visual formats should not jeopardise credibility. The key scientific points should be easily understandable, but the data sets used should also be comprehensive, i.e. added with correct labels, and provided in the appropriate context. As one Austrian industry representative summarized:

The key points should be understandable at first glance; a good summary should be provided in simple terms. Surveys and other data should be comprehensible. (Focus group 1, AT)

The discussions pointed at the responsibility of people creating and disseminating such visuals so as the data involved cannot be misinterpreted or deliberately misused. This responsibility is even more accentuated if the graphics are aimed at younger people. Persons engaged in visual journalism increasingly use new AI technologies to raise the interest of hitherto indifferent (young) people. As debated, this might help the most successful communicators build out a “digital identity” and achieve a long-term communicational influence, standing out as verified sources in scientific topics.

9.3.2 Interventions to Enhance Understanding on how Science Functions

The relevance for evidence-based arguments for renewable energy was brought up in all focus groups. People look for validated scientific explanations, but the complexity of the ever-faster growing scientific basis, coupled with the most common flaws of science communication, e.g. overuse of jargon, lack of clarity, style misinterpretation might make people look for alternative, more simplistic explanations.

Language itself should be used to ‘demystify’ science and evidence-based arguments, as one Austrian researcher highlighted:

People should better understand the logic of science and scientific production – we should demystify complex scientific concepts and bridge the gap between scientific fact and opinion. (Focus group 1, AT)

However, there was no agreement how a basic understanding of scientific principles and methods can be created. For children and younger people, the importance of education was stressed to teach how to deal with various scientific topics from an early age. Regarding adults, many ideas were floated as to who can communicate scientific findings in an engaging way. The Austrian group talked about the need of ‘local heroes’, i.e. scientists also well-versed in (social) media, while the Belgian group rather saw the solution in facilitators building bridges and partnerships between science, media, politics and NGOs. The Greek discussants referred to science ‘ambassadors’ who can be influencers, celebrities or even religious figures acting as conveyors or loudspeakers for science.

There was also no agreement on what should be communicated to enhance scientific comprehension. Certain participants argued that the public should only be (clearly) informed of the scientific consensus, while others pointed to the recent pandemic underlining the need for communicating more than the consensus. They argued that in cases of highly contested scientific topic with real-life implications, such as renewables, science communicators should more precisely explain what we already know, do not know and also cover the uncertain factors in scientific evidence.

9.3.3 Interventions to Promote the Integrity of Scientists and Scientific Institutions

All focus groups underlined that trust in science cannot be understood without checking the broader framework set by political and economic actors. People who tend to have a general mistrust towards political or business institutions, might view scientists as part of this ‘untrustworthy’ system. In their perspective, scientists are part of an unelected, unmonitored elite providing evidence to confirm theories financed by political or business structures that may run against people’s interests. As summed up by one CSO participant:

The main issue is not trust in science, but trust in companies and trust in political class. Average citizens would believe in who is saying it, rather than what they are saying. (Focus group 2, BE)

The proposed methods focused on making people trust the ‘pipeline’ through which science is delivered to them. The trustworthiness of communicators within this pipeline might be enhanced by their separation from less trusted political-business structures. One solution focused on the message, i.e. science communicators should re-brand renewables as ‘anti-establishment’, thus gaining support from people distrusting the political system. This narrative should be complete, i.e. beyond the environmental aspect, it should encompass the political, economic and technical aspects. As explicitly formulated in Greece:

When renewable energy was not mainstream, people were supporting it. Now renewable energy reflects the system, so this conflict should be solved. (Focus group 3, GR)

Another important aspect mentioned in the Greek focus group was the ‘time frame’ of messages. Citizens are usually expected to adopt the policy recommendations urgently, while a consistent approach towards building trust in science over time is absent. This can also influence science scepticism and the perceived integrity of science communicators, especially when science is translated to policies emerging as a response to a crisis.

Other ideas rather focused on the messengers, in particular on how to raise trust in science communicators. The main proposals focused on how science communication should not be undertaken by speakers deemed divisive by the target audience, e.g. experts working for private firms or affiliated with trade unions or politicians. Their specific speaker characteristics conveying integrity should be highlighted, e.g. the origin and use of funding sources, lack of conflict of interests or links to well-respected organisations. In addition, a clearer division of roles between scientists and policymakers might raise the perceived integrity and trustworthiness of science communicators. In highly-debated topics such as renewables, the standard information flow should be such that scientists report their findings—based on strong scientific evidence—and pass the floor to politicians to make policy recommendations.

9.3.4 Interventions to Democratise Science

Mistrust in science can also be fed because of the insufficient public participation in scientific debates and development. As argued, it is of utmost importance to make science personally or locally meaningful (see Chap. 4 for an argument to build partnership between social actors with different types of knowledge, but also Chap. 8 for a more nuanced institutional perspective on citizen participation).

However, our focus groups underscored that there is no ‘panacea’ for public engagement as renewable energy projects strive to identify and involve local communities in discussions and collaboration. A variety of engagement formats was mentioned, such as pop-up science stores, science cafés, door-to-door campaigns or

citizen assemblies, with an agreement that each citizen engagement action should have a real in-depth knowledge of the local contextual factors and demographics involved. This is crucial since target audiences for engagement can vary in their existing scientific knowledge, their ability to understand scientific data and information, their preferred ways of receiving and interpreting new information, and their social, economic and political values and attitudes.

The discussions also brought up the idea of establishing local networks around controversial scientific topics such as renewables. Such networks (“energy communities”) would aim to bring systematic results by involving a broader group of local actors with a stake in research topics facing a potential trust issue. Depending on the context, the involvement of community leaders and influencers might be beneficial to identify and activate the relevant target groups. The Greek discussants even mentioned that the most successful local networks could act as best cases and, by amplifying their actions through social media, might extend to a higher (national or global) scale.

Ensuring the inclusive nature of such networks and other citizen engagement actions was a recurring suggestion. Inclusiveness does not only entail the preferred involvement of all—even sceptical—voices but also necessitates transparent structures. Inclusiveness should account for the balance of power in the sense that consensus opinion should be sought, which does not only reflect the interests of the most powerful actors, such as larger research or business organisations. As expressed by one academic participant:

If you want to be inclusive and bring organisations with a massive funding to the table with local stakeholders, all parties at the table must believe that the outcome of this collaboration is going to be win-win. This is about transparent structures. (Focus group 2, BE)

9.3.5 Interventions to Build Up a Reflexive Mindset and Resilience Against Misinformation

A recurring discussion point was how social media disrupted the traditional (scientific) news consumption. Science communicators increasingly need to rely on social media to access to and engage with their audience, while the public finds it difficult to discern accurate from inaccurate information (Chap. 3 includes further discussion on the ‘medialisation’ of science). On the one hand, social media as a tool might be useful to arouse interest in and understanding of science, on the other hand, it contributes to the rapid and broad dissemination of inherently false or misleading scientific information, such as true data presented in a distorted or out-of-context way. One journalist summarized this phenomenon as follows:

People prefer to think intuitively therefore emotionally-charged, oft-repeated false information act so effectively. (Focus group 3, GR)

The relevant solutions could be divided into two broad categories: participants discussed the potential regulation of social media, which was ultimately deemed

unlikely by each focus group due to the inherent problems linked to both voluntarily regulations or mandatory control.

Furthermore, the increased need for education and training courses and tools was mentioned. Specifically, education that can enhance critical thinking about science (cultivating science literacy), and digital competencies (cultivating media and information literacy), thus increase resilience against fake news, misinformation and pseudoscience. The baseline is that people should be able to understand the importance of credibility and verification of data sources or context and are better equipped against common misinformation manipulation techniques.

This can take the format of formalized education built into official school curricula or have a more informal character disseminated online or in hybrid formats to interested people, e.g. via MOOCs. As regards their provision, in addition to scientific and educational organisations, an accentuated role of media outlets, (science) journalists or civil society organisations was envisaged.

9.4 Conclusions

The most pivotal lesson learned during the focus group discussions was that societal trust issues might differ per target group and scientific topic. Therefore, audience segmentation is of critical importance. Each person has a latitude of acceptance, which represents a range of scientific opinions across multiple topics they might believe in. This entails—as shown by the results of the 2021 Special Eurobarometer Survey (European Commission 2021)—that most people do not generally mistrust science but are rather uninterested in, unaware or uncertain of certain scientific concepts, findings or processes (Chap. 5 provides additional information on within-country and cross-country differences on trust-related Eurobarometer Survey items).

When conflicted with complex scientific issues, people seek out new information. Confirmation heuristic entails that, during such a search, most people will be more receptive to scientific inputs, ideas, processes or persons aligned with their pre-existing values. If scientific information is obtained from unreliable sources such as influencers, social media or politicians, people also might become more susceptible to pseudo- or anti-scientific views.

There are various reasons why people turn to these sources instead of expert opinions: they might find scientific information unavailable, hardly understandable or conflicting, which in turn further strengthens any potentially existing negative stances towards individual scientists or scientific institutions. People might reject or be sceptical about science for a variety of reasons, such as deep-rooted religious or political affiliation, mental attitudes or economic interests.

In addition to expertise, there are at least three other dimensions influencing people's trust in science communicators, namely integrity, benevolence and openness. It seems so that in certain cases, people are more likely to mistrust scientists not because of doubts in their expertise, but due to a perceived lack of their integrity,

which may include any characteristics related to a speaker's honesty, objectivity and adherence to recognised scientific standards and norms (Hendriks et al. 2015).

All this means that there is no 'one-size-fits-all' strategy: each method addressing scientific trust-related issues should be nailed down to smaller audience segments based on belief profiles, i.e. identifying who the target group members are, what their specific characteristics are, and in what scientific topics they have trust issues, and for what possible underlying reasons (Chap. 6 distinguishes between individual, socio-cultural and environmental factors influencing individual trust in science).

The method design should start with proper audience segmentation, exploring the specific belief profiles of people concerned. Audience segmentation should also consider the concrete scientific fields and topics where the potential trust issue has arisen. Each method should be designed in a way that tackles the identified core issue and has a long-term perspective.

If feasible, the method design process works best when undertaken at a level close to the affected people. People are most interested in and concerned about scientific results or endeavours that directly influences them or are applied locally. Preferably, various stakeholders upholding trust in science, such as scientists, policymakers, industry actors or media representatives should collaborate to engage the local communities in a mutual knowledge exchange. Not only can local communities thus be better involved in scientific and technological issues, but expert stakeholders are also provided with contextual knowledge and relationships.

The method implementation should be as inclusive as possible, considering the potential positive contribution of different actors. The use of new information technologies could also be considered to enhance efficiency and outreach. Nonetheless, such technologies could act as a double-edged sword since key developments such as automation, AI bots or blockchain platforms might potentially distort public discussion and engagement (Peixoto and Steinberg 2019).

The described methods might also be used together to increase their efficiency, e.g. social media courses might support scientists to understand how to raise awareness of and interest in science through well-communicated messages in the online space.

Last, we must mention the limitations of our study. We gained a thorough overview of the most important methods identified by a variety of stakeholders in three countries but cannot quantitatively confirm these findings. We assume a positive effect on trust in science for the pre-defined audience segments, but this impact can be relatively small. In addition, certain findings might not be generalisable for each scientific field since our focus groups had a specific topic, i.e. renewable and non-fossil energies (see Chap. 2 for a detailed description on how public trust is influenced by various factors in three other contested scientific topics).

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Chapter 10

Ecosystem of Trust: A Systems Approach to Trust in Science



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Abstract This chapter uses a systems thinking approach to conceptualise the Ecosystem of Trust in Science as a dynamic and evolving system shaped by changing research and innovation environments. Contemporary science is increasingly internationalised, oriented toward addressing grand societal challenges, and driven by rapid technological advances. As a result, the Ecosystem of Trust has expanded beyond individual researchers to include a diverse and distributed set of actors. The chapter maps Stewards of Trust and key stakeholders within this ecosystem, taking into account diversity within both Stewards of Trust and the publics whose trust is at stake. While existing research has examined mediators of trust between science and society, it has largely overlooked the relational and systemic dynamics through which trust is constructed, negotiated, enhanced or reduced. This chapter addresses this gap by providing a framework that captures interdependencies among Stewards of Trust within a complex and evolving Ecosystem of Trust.

Keywords Ecosystem of trust in science · Systems thinking · Stewards of trust

10.1 Introduction

Scientific advancements are more and more expected to play a pivotal role in advancing the Sustainable Development Goals (SDGs) and social imperatives such as equity, healthy lives, sustainable development and peace and justice. To maximise the social impact of science, innovation, and technology, it is essential to recognise its deep connection with society (Mazzucato 2019) and account for public perceptions, support, and trust in science. Despite narratives of a ‘crisis of trust in science,’ European and global surveys (European Commission 2021a, 2025;

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Wellcome and Gallup (2021) indicate that trust in science remains high. However, trust does not always translate into people's adherence to science-based recommendations (Ratner and Riis 2014). At its foundation, the integrity and quality of scientific research are highly valued. Yet, trust in science extends beyond trust in the research and scientific outcomes themselves, as also discussed in Chap. 6. Trust in science is complex, shaped by historical, social, economic, and political contexts. It also depends on society's role in science, the transparency of scientific practices, how outcomes are communicated and engaged with by the public, and the equitable distribution of benefits from scientific advancements (Gurzawska et al. 2024). To navigate this complexity, this chapter, by drawing on insights from the EU-funded VERITY project (2024), introduces the concept of an 'ecosystem of trust in science'. This system-thinking perspective emphasises the multifaceted and interconnected elements influencing trust in science and provides a framework for understanding its dynamics.

10.1.1 Trust in Science: Challenges and Evolution

Scientific research and research environments have evolved considerably over recent decades (von Schomberg 2024). These transformations can be attributed to several factors.

First, the internationalisation and globalisation of research and innovation (R&I) have expanded scientific collaboration across countries and legal jurisdictions. Such cooperation can advance scientific progress, but it also raises concerns regarding the alignment of research outcomes with social benefits, ethical standards, academic freedom, and human rights (European Commission 2021b).

Second, the evolution of scientific research to address the 'grand challenges' identified in the Lund Declaration (2009, 2015) necessitates innovative approaches. Tackling complex global problems requires involving diverse actors and disciplines through multidisciplinary, interdisciplinary, and transdisciplinary research (Vilnius Declaration 2013). While these approaches broaden the scope and impact of scientific inquiry, they introduce questions about their efficiency, effectiveness, costs, and broader implications (Lawrence et al. 2022; Pedersen 2016). They also challenge existing frameworks for ethical oversight, particularly for unconventional research projects that surpass the expertise of traditional ethics committees or require cross-institutional governance (Cockburn and Cundill 2018).

Third, rapid technological advancements, including the increasing adoption of artificial intelligence (AI) and generative AI in research, represent a dual-edged sword. These technologies offer immense potential to accelerate scientific discovery and enhance research efficiency and verification (European Commission 2024; OECD 2023). However, they also pose significant risks, particularly in combating mis- and disinformation and mitigating deceptive scientific practices that threaten research integrity (European Commission 2024).

As a result of these global developments, the landscape of trust in science is experiencing a significant transformation. Historically, trust was anchored in institutions and professionals who were publicly accountable, fostering both ‘trust in science’ and ‘trust within science’ (Hendriks et al. 2016). Today, this ecosystem has expanded to encompass a diverse array of actors, including public-private partnerships, multi-sector research consortia, citizen science participants, civil society organisations (CSOs), companies with research and development (R&D), the tech industry, new educational and knowledge platforms (e.g., Wikipedia and Massive Open Online Courses, MOOCs), social media and influencers. The traditional linear flow of information, governed by established experts, institutional filters, and gatekeepers, is shifting towards a distributed network (Van Dijck and Alinejad 2020) where new stakeholders play critical roles in science production, education, communication, policymaking, funding, advocacy, and citizen engagement.

This evolution has catalysed a transition from institutional trust to ‘distributed trust’ (Van Dijck and Alinejad 2020; Van Dijck 2021), enabled by high-tech platforms and driven by the digital revolution (Botsman 2017; Thunert 2021). Social media, as a dominant force of social influence, has facilitated this shift, fostering a collective evaluation of information and values that resonate with users (Sammut and Bauer 2021). In today’s information-rich world, it is harder to trust or evaluate the quality of information (Origgi 2017). Trust hinges on the reputation of the source of information to identify credible information (Origgi 2012, 2017). The internet has democratised access to information, empowering society (Harđoš 2018; Rosenthal 2020; Weingart 2023), but it has also amplified dependence on the subjective and often biased opinions of others, complicating the dynamics of distributed trust. Therefore, the reputation of the information source (e.g. experts, scientists, scientific communities, institutions, and the broader scientific system) plays a fundamental role in how we evaluate and trust knowledge.

While trust in science far exceeds the levels observed in politics and economy (Bromme et al. 2022), the entanglement of science with these domains can amplify power dynamics and influence public perceptions of science (de Melo-Martín and Intemann 2018; Funk et al. 2019; Rathenau Institute 2021). The ‘politisation’ of science, in which non-scientific logics and political views shape or selectively use scientific findings, may undermine both scientific credibility and institutional legitimacy. The ‘economisation’ and ‘privatisation of knowledge,’ where research focuses on competitiveness and profit, may undermine public trust by eroding the belief that science serves the common good (Peters 2015). These shifts challenge the imperative for R&I to benefit society, uphold ethical standards, and protect academic freedom and human rights.

10.2 Trust as Relationship

Trust in science is a multifaceted concept shaped by interactions between trusters (a diverse public audience) and trustees (science actors, whether individual or collective) (Gurzawska et al. 2024). It is a relational and temporary state of affairs (Gurzawska et al. 2024). As discussed in Chap. 6, this relationship is shaped by a range of individual, socio-cultural and environmental factors of trusters (Varda et al. 2024), but it also encompasses both personal and impersonal dimensions of trustees (Rolin 2020). Personal (individual) trust focuses on the scientist or expert (for the distinction between ‘scientist’ and ‘expert’ see Collins and Evans 2019) as an individual trustee, assessed for their epistemic competence (expertise and knowledge), moral trustworthiness (goodwill, social values, and well-being), honesty, integrity, and adherence to scientific standards (Hendriks et al. 2015; Mayer et al. 1995; Baier 1986). This type of trust involves accepting risks and relying on the trustee’s expertise and benevolence despite lacking direct access to the methods or data underlying their findings (Cummings 2014; Peters et al. 1997). Origgi (2022) extends this framework by emphasising that social reputation—attributes such as authority, influence, and status—also plays a critical role. Impersonal trust (institutional trust), on the other hand, involves collective epistemic agents, including research communities, collaborative groups, scientific institutions, and their practices and infrastructures (Wilholt 2016; Wagenknecht 2014). This broader trust framework recognises the collaborative and institutionalised nature of modern science, which extends to diverse individual and collective scientific actors (e.g. multi-actor research consortia, public-private partnerships, the scientific community), as well as science as an enterprise, scientific methods and processes, scientific outputs, science infrastructure, and, as we will explain in this chapter, an entire ecosystem of trust in science.

10.2.1 *Systems Theory and Approaches*

To apply the ecosystemic lens and explore its potential to address the complexity of trust in science, it is essential to examine the nature and characteristics of systems, along with the principles of systems thinking and systems design.

Systems theory is an interdisciplinary framework that considers systems in their entirety rather than breaking them down into individual components. As explained by Richmond (1994), it is about ‘developing an increasingly deep understanding of underlying structure’ and seeing both ‘the forest and the trees (one eye on each)’. The theory emerged in the mid-twentieth century, with notable contributions from Von Bertalanffy (1972), Luhmann (2013) and others across various fields, such as engineering (control systems), social sciences (social systems), and business (organisational systems). Systems consist of three core pillars, namely elements (physical and non-physical), interconnections (the way these elements relate to and/or feed

back into each other and ultimately hold together), and a function or purpose (Meadows 2008).

Systems thinking and systems design, derived from systems theory, focuses on understanding, mapping, visualising and addressing problems by viewing them as parts of an overall system. They shift from linear cause-and-effect thinking to recognising dynamic interrelations. Together, these frameworks provide a holistic approach to tackling modern-day challenges that are complex, interconnected, and dynamic. Whether in business, technology, or global issues like healthcare and climate change, these approaches emphasise long-term, sustainable solutions. While the term systems thinking has been defined in many ways (Senge 1990; Aronson 1996; Kim 1999; Sweeney and Sterman 2000; Flood 2010), this chapter builds on the approach proposed by Arnold and Wade (2015), which entails eight defining elements of systems thinking: (1) recognising interconnections, (2) identifying, and understanding feedback, (3) understanding system structure, (4) differentiating types of stocks, flows, and variables, (5) identifying and understanding non-linear relationships, (6) understanding dynamic behaviour, (7) reducing complexity by modelling systems conceptually, and (8) understanding systems at different scales (Arnold and Wade 2015).

Within the context of systems theory, we draw an analogy between trust in science and ecosystems to emphasise their shared characteristics of interdependence, evolution, and embeddedness within larger social systems. An ecosystem can be understood as a specific type of system (Kanda 2023), nested within and dependent on broader social systems, while maintaining a degree of relative autonomy governed by its own internal structures, rules, and dynamics. In the context of systems thinking, this reflects the idea that ecosystems are not isolated entities but are embedded in larger systems, forming a web of interdependencies where interactions and feedback loops shape behaviour at multiple levels. Unlike natural ecosystems that organically develop towards equilibrium, trust is more volatile, shaped by human actions, power dynamics, social structures, and political or technological shifts. Still, the analogy remains useful for capturing the complex, adaptive relationships, as well as actors' interdependence and feedback loops that influence trust across multiple levels, though these dynamics require careful analysis.

10.3 Towards a Systemic Understanding of Trust

Below, we will describe the ecosystem of trust in science through the core elements of systems.

10.3.1 Purpose

The purpose of the ecosystem of trust in science includes shaping and facilitating trust in science, not only within society but also among policymakers and the scientific community. This, however, has a higher-order goal connected to achieving the objectives of science revolving around understanding the natural world, advancing knowledge, and applying insights for the benefit of humanity and the environment. Science is a collaborative and evolving endeavour that continuously refines our view of the world and our place within it. The purpose of the ecosystem of trust in science involves governing social trust in science for the public interest and values and ensuring the equal right of all people to share and enjoy scientific progress and its applications (Article 27(1) UDHR; Article 15(1)(b) ICESCR).

In this context, it is important to recognise that while critical thinking and questioning are fundamental to science, scepticism around the value of science and scientific methods might be perceived as harmful and destructive. As a result, the widespread belief is that a high degree of social trust is crucial because it increases the acceptance of science-based policy decisions. However, trust is not intrinsically good. There are instances where the public has valid concerns and needs to be vigilant about the scientific actors and science ecosystem, related to concerns about accountability, transparency, and inclusivity in scientific governance (Wynne 2008). Mistrust, scepticism about, and a lack of confidence in, but also lack of interest and engagement in scientific information and advice and scientific actors (Chap. 9), often result from various social, political, and historical factors. Moreover, research scandals, misconduct, and fraud have eroded the public's trust in science and scientific actors. For instance, historical injustices, such as the Tuskegee Syphilis Study¹ and the exploitation of Henrietta Lacks' cells,² have fostered deep-seated mistrust by marginalised communities (Goyal et al. 2015; Hoffman et al. 2016; Alsan and Wanamaker 2018; Caplan and Trogen 2017; Dryden and Nnorom 2021). 'Mitigated scepticism' is important in a healthy science landscape (Baghrarian and Caprioglio Panizza 2022). However, 'mitigation' should be understood as ensuring the overarching aims of science, i.e. enriching human understanding and contributing to the well-being of individuals, societies, and the planet rather than 'managing' (if not manipulating) people's perceptions to ensure an unconditional trust in science, the scientific community and science-informed decision making.

¹The Tuskegee Syphilis Study was an experiment taking place in Tuskegee, Alabama, from 1932 to 1972, in which African American men with syphilis were deliberately left untreated to study the disease's advance.

²In 1951, Henrietta Lacks' cells were taken without her consent at Johns Hopkins Hospital. These cells, known as HeLa cells, changed medical research since they were the first immortal human cell line.

10.3.2 *Elements*

To identify the elements of the ecosystem of trust in science, we need to look at the trust relationships between trustees and trusters and various perspectives of trust.

Trustees constitute a broad category of trust gatekeepers within the scientific ecosystem, encompassing organisations, groups, or individuals with significant expertise and dedication to fostering trust in science, which we call Stewards of Trust (SOTs). Their roles emanate from their formal mandates and missions or are derived from their de facto power and influence (Gurzawska et al. 2024). Therefore, their role arises not only from their legitimacy and epistemic authority of scientific expertise but rather from a broad scope of epistemic, moral and social features. SOTs actively contribute to promoting responsible, ethical, and justified research through various roles. Based on the VERITY project's findings,³ these roles include producing scientific knowledge, teaching scientific principles and methods, communicating findings, shaping science-informed policies, funding and resourcing research, applying scientific insights to create goods and services, overseeing adherence to research ethics and integrity, and mediating relationships between science and society (Table 10.1).

As anticipated above, the triadic relationship between the truster, the trustee, and the object of trust—science, is increasingly disrupted by the dynamic and evolving nature of trust in science ecosystems. This shift is driven by new research environments and the transition to distributed trust systems. Beyond individual scientists, trustees now encompass a diverse range of 'new' actors, both collective and individual, who play critical roles and bear responsibility for various facets of science, including science production, education, communication, policymaking, funding, advocacy, implementation, oversight, and protection. They also facilitate science-society interactions and promote citizen science. The elements of the ecosystem of trust in science include traditional SOTs such as researchers, universities, research funding organisations or research ethics committees, but also non-traditional SOTs such as tech industry, social media and social media influencers, civil society organisations, or community leaders.

A single SOT may play multiple roles, while a single role can be fulfilled by various SOTs. For instance, universities may engage in scientific production, education, and communication, while the function of science production itself can be carried out by both public and private entities. This multiplicity of roles was also reflected in the VERITY empirical work, particularly in the co-creation workshops

³The roles of Steward of Trust are derived from meta-analysis of series of VERITY research, including Review Paper of Previous EU Projects' Results and Recommendations, Review Paper of Scientific Literature, Report for the Focus Groups with Citizens, Literature Review on Social Network Analysis Related to Trust in Science, Network Analysis Report, Report on Stakeholder Mapping and Engagement, Report on the, Strategies, Methods, and Tools to Tackle Societal Mistrust in Science, Report on the Results of Focus Groups with the Stewards of Trust and Report on the Vignette Study available <https://verityproject.eu/>.

Table 10.1 Stewards of Trust roles and mandates (own analysis presented originally in Gurzawska et al. 2025)

Roles of Stewards of Trust	Definition	Examples
Science production	SOTs that focus on conducting research, producing new knowledge, and developing scientific innovations	Research institutions, government agencies, private companies dedicated to research and innovation, public-private partnerships (PPPs) in science, technology and innovation (STI)
Science education	SOTs that engage in teaching scientific knowledge in formal and informal settings	Schools, universities, and other education institutions at various levels, community colleges and technical schools, online education platforms, science museums and science centres
Science communication	SOTs that share scientific information with diverse audiences through journalism, public outreach, or scientific publications	Scientists, academic publishers, traditional and social media organisations, science influencers platforms, science journalism organisations
Science policy	SOTs that create, advise on, or implement policies related to science, research, and innovation	Legislative branches and regulatory agencies, think tanks, science advisory boards and councils, international policy organisations (e.g., WHO, UNESCO), and treaty organisations (e.g., IPCC)
Science funding and advocacy	SOTs that provide financial resources and supports scientific research through advocacy or funding bodies	Public and private funding institutions, corporate sponsors, grassroots advocacy in science funding
Science implementation	SOTs that apply scientific findings to practical or operational contexts	Industry institutions, technology transfer offices, incubators and accelerators
Science oversight and protection	SOTs that ensure that scientific research adheres to ethical, legal, and safety standards	Research ethics and integrity committees, compliance and auditing bodies, impact and technology assessment bodies, science funding institutions
Science-society facilitation and citizen science	SOTs that engage the public in scientific initiatives and foster collaboration between scientists and society	Civil society organisations (CSOs), science advocacy groups, community advisory boards, environmental and health non-governmental organisations (NGOs) citizen science platforms (e.g., Galaxy zoo)

and interviews with SOTs.⁴ The influence of a SOT does not necessarily require formalisation through an official mandate; repeated and systematic engagement in

⁴VERITY conducted eight online co-creation workshops and eight semi-structured interviews with Stewards of Trust (SOTs) between November and December 2024. These activities aimed to collaboratively develop the VERITY Protocol of Recommendations for Fostering Trust in Science through a participatory approach. 118 participants took part in the VERITY co-creation workshops and interviews.

activities that influence trust in the research system can suffice. For example, private social media accounts, while not formally recognised as science communication platforms, may evolve into meaningful contributors (de facto actors) in the trust ecosystem through consistent participation in science communication.

Furthermore, as science becomes more deeply integrated into society, the distinction between trusters and trustees becomes increasingly blurred, leading to difficulties discussed in Chap. 4. Trusters typically embody a diverse public as a group and individuals who are laypeople and non-scientific experts, who do not possess formal training, specialised knowledge, or professional expertise in a specific scientific field (Wynne 1991; Collins and Evans 2002). Their interest and understanding of science may vary widely, ranging from limited awareness to well-informed but non-specialised knowledge. In this context, they are distinguished from experts by their reliance on accessible explanations, trust in scientific intermediaries, and their limited direct involvement in the technical aspects of scientific inquiry. They are often stakeholders in science as members of the public and consumers of scientific communication. Increasingly, they play an active role in shaping the science-society relationship (Wynne 2008) as participants in citizen science initiatives or decision-makers influenced by scientific findings, where they contribute and participate in science through their specialised knowledge derived, e.g. from lived experience or local context, which can contribute to scientific and technological governance (Collins and Evans 2002; Myskja 2007). As discussed in Chap. 4, active engagement of social participants fosters deeper understanding and collaboration between science and society, highlighting the value of co-creating knowledge through interaction. This transformation reflects a more interdependent relationship, where trust is about accountability, transparency, and inclusivity in scientific governance (Wynne 2008).

Analysing trust in science through the lens of SOTs offers an actor-based perspective, emphasising that trust is shaped not only by structural factors, such as socio-cultural and technological influences, but also by the deliberate actions and interactions of individuals, groups, and institutions. Thus, trust in science is dynamic and can be influenced by the behaviours and relationships of SOTs, both with one another and with the public.

10.3.3 Interconnections

SOTs and other stakeholders interact with each other and with the broader public within the ecosystem of trust. They are often interconnected and mutually dependent, relying on one another in their respective roles in the ecosystem of trust in science.

The ecosystem of trust in science is a system of systems. Those subsystems can be differentiated based on various criteria. The first example is the role of SOTs, such as subsystem of science production with various individual and institutional, private and public actors contributing to producing scientific knowledge and

building on each other's work to progress scientific advancements, or science funding with a combination of publicly funded research by governmental bodies supported by private funding coming from industry, science foundations and private donors. Second, we can look at it from the perspective of geography and jurisdiction. With the globalisation of science, trust is being discussed and measured on a global scale, but regional, national, and local systems of science and trust also exist due to political, economic, historical and sociocultural contexts (e.g. European ecosystem of trust in science connected to science governance at the European Union level).

Trust relationships in this context are not static but evolve, shaped by both internal and external factors, including economic downturns, health and climate crises like pandemics and floodings, and other social challenges and emergencies. Trust ecosystem is deeply intertwined with its contexts, which influence their development while also being reshaped by the actors within the ecosystem. These contexts span technical, policy, economic, legal, social, and ethical dimensions, creating interconnected challenges for the facilitation of trust and science governance. Addressing those challenges is complex due to the differing scales of change between individual and institutional actors, the subsystems and their environments. Such complexity makes interventions difficult as they must adapt to continuously evolving, interdependent systems. This dynamic nature underscores the need for responsive and adaptive trust facilitation and governance strategies, enabled by the systemic understanding of trust in science.

Based on the considerations of the purpose, elements and interconnections, the ecosystem of trust, as we understand it, can be defined in the following way:

Definition The ecosystem of trust in science is a dynamic conceptual space in which social trust in science is constructed, negotiated, enhanced or reduced with the ultimate goal of governing social trust in science for the public interest and values and ensuring the equal right of all people to share and enjoy scientific progress and its applications. The ecosystem of trust in science comprises Stewards of Trust, who are trust gatekeepers encompassing organisations, groups, or individuals with significant expertise and dedication to fostering trust in science through science production, education, communication, policymaking, funding, advocacy, implementation, oversight and protection, science-society facilitation and citizen science. Their roles emanate from their formal mandates and missions or are derived from their de facto power and influence. Within the ecosystem, Stewards of Trust interact with and influence each other and the diverse public, creating interconnections and mutual dependencies, and relying on one another in their respective roles in the ecosystem of trust in science.

10.4 Limitations of the Systems Approach

The systems approach proposed in this chapter faces challenges, which are particularly relevant when examining trust in science from the systems perspective. While the ecosystem metaphor highlights the dynamic and interconnected nature of trust

in science, it has limits, as trust is shaped by human actions and social structures. First, it has been critiqued for being ‘equilibrium-oriented and fundamentally static’ as well as ‘politically conservative and oriented towards maintaining the status quo’ (Montuori 2011). This makes it difficult to explain systemic change without invoking external disruptions, such as pandemics or climate crises. Second, systems thinking often operates at a high level of abstraction, focusing on overarching dynamics. To provide a more complete understanding, it must be complemented by an examination of ‘local-level lived realities’ (Tagliacozzo et al. 2024).

We address those challenges in the context of the ecosystem of trust in science in the following ways. First, we conceptualise the ecosystem of trust as a dynamic and interactive space where multiple subsystems influence one another. Dynamic systems theory (DST) offers insights into how complex systems develop and adapt over time. It originates from mathematics and physics, particularly the study of nonlinear systems, and has since been applied across disciplines like biology, psychology, and sociology. It emphasises the emergence of patterns and behaviours through interactions among the system’s components (Fogel et al. 2014; Hoel et al. 2013; Verspoor and Lowie 2020). Second, our framework of the ecosystem of trust was constructed by exploring localised experiences, perspectives, and realities through iterative fieldwork conducted as part of the VERITY project (including focus groups, interviews, vignette study, social network analysis, surveys, and co-creation workshops).⁵

10.5 Conclusions

Drawing on insights from the EU-funded VERITY project (2024), this chapter introduces the concept of an ecosystem of trust in science to navigate the collaborative nature of science and trust. By applying a systems perspective, this chapter emphasises the multifaceted and interconnected elements influencing trust in science and provides a holistic framework for understanding its dynamics and governing trust in science. This chapter describes the purpose, elements, interconnections and feedback loops between the actors within the ecosystem of trust in science and its subsystems, enabling more effective and sustainable decision-making. Systems thinking promotes interdisciplinary approaches and collaboration by showing how traditional and non-traditional Stewards of Trust are interconnected and how their actions affect each other and the public. By considering those feedback loops and long-term impacts, systems thinking helps anticipate outcomes and design policies

⁵To explore various roles that SOTs play in the ecosystem of trust and their relationships, the VERITY project conducted various rounds of data collection by using both qualitative (interviews, focus groups, co-creation workshops) and quantitative tools (social network analysis and surveys). For instance, to examine the ideal type of internal dynamics and cohesion mechanisms enhancing trust in science within this ecosystem in VERITY WP4, we collected data through various methods, including eight online co-creation workshops, eight semi-structured interviews, and a pre-workshop survey with Stewards of Trust (SOTs), involving 118 participants. These activities provided insights into trust in science across multiple sectors.

or interventions that are more sustainable. Through the metaphor of the ecosystem of trust in science, we advocate for the individual responsibility of scientific actors and the shared responsibility of the scientific community for nurturing trust in science through building and strengthening inclusive and meaningful relationships within the science ecosystem.

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Chapter 11

Philosophical Insights into Trust in Science: Towards Better Surveys and Policy Design



Margit Sutrop  and Külliki Seppel 

Abstract Public trust in science has become a central concern for policymakers, who often interpret its perceived decline as a crisis of trust. In response, efforts to rebuild trust emphasise various strategies, including strengthening research ethics and integrity, promoting participatory approaches, and enhancing science communication. When developing policy measures, empirical surveys should help identify the reasons for distrust. However, current studies fall short of this objective. Most surveys on public trust in science, such as special Eurobarometers and national science barometers, reveal trust levels but fail to clarify respondents' interpretations of trust and science or assess whether their trust or distrust is justified. Effective strategies require a complex understanding of the mechanisms of trust and distrust. Drawing on a conceptual analysis of trust, the chapter provides a framework for implementing a more nuanced understanding of its multidimensional nature encompassing two-place, and three-place trust, as well as the interplay between the trustor, trustee, and broader societal factors. By integrating these insights, the chapter outlines how better-targeted empirical studies can inform more effective, context-sensitive policy recommendations for promoting public trust in science.

Keywords Public trust in science · Warranted trust and distrust · Measuring trust in science · Policy recommendations for promoting trust in science · Conceptual analysis of trust

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11.1 Introduction

European policymakers emphasise the need to sustain and promote public trust in science (European Commission 2020). Even if surveys show that distrust characterises only a small share of the population there is a growing popular narrative that we are facing a crisis of trust in science (Bauer et al. 2007; Weingart and Guenther 2016; Cologna et al. 2025), and policymakers advocate for measures to enhance trust in science. However, these efforts often suffer from three key shortcomings.

First, policymakers tend to overlook the distinction *between trust and warranted trust*. Unwarranted trust can be harmful, as shown by historical cases where mistrust was justified: tobacco companies downplayed smoking risks, Thalidomide caused birth defects due to poor safety testing, nuclear tests led to cancer from radiation exposure, and the BSE crisis caused fatal brain disorders. More recently, Facebook conducted unethical user experiments, and Volkswagen falsified emissions data. These cases highlight the dangers of misplaced trust and the need for critical evaluation.

Second, most surveys on public trust in science rely on implicit assumptions rather than *rigorous conceptual analysis* (O’Doherty 2022). They disregard differences that the concept of science has across different cultural and political contexts (Besley and Tiffany 2023; Younger-Khan et al. 2024; Cologna et al. 2025). Surveys also seldom assess distrust in science (Reif and Guenther 2021). Without a precise definition, respondents are likely to understand “trust” in different ways, resulting in varied and potentially ambiguous findings (Younger-Khan et al. 2024).

Third, concerns about trust in science are often not based on context-sensitive data regarding existing trust levels nor on an understanding of the factors influencing trust, mistrust, and distrust. Moreover, the distinction between *trust in science* as a social practice and *trust in scientists*, as the persons involved in science, is frequently overlooked (Reif and Guenther 2021). As Achterberg et al. (2017) highlight, people may trust scientific methods and principles while simultaneously distrusting scientists and scientific institutions. This lack of insight often leads to poorly targeted interventions, resulting in wasted time, funding, and human effort.

This article contends that selecting effective measures to address trust in science requires a comprehensive understanding of its current state and of the factors that shape trust, mistrust or distrust. To achieve this, empirical studies must explicitly define trust, elucidate its components, identify its object, and explore the conditions under which trust arises or fails. At present, the main problem is that while surveys provide insights into trust levels, we lack clarity about what the respondents meant by trust, what their conception of science was, and whether high or low levels of trust should be a concern, as this ultimately depends on whether the trust or distrust is warranted or unwarranted.

The operationalisation of trust in empirical studies has generally overlooked the conceptual analyses of trust provided by philosophers (Simon 2020; McLeod 2020) who have meticulously deconstructed the complex phenomenon of trust and distinguished between different forms of trust. The under-emphasised connection between

theoretical conceptualisations and empirical operationalisations in the field of trust research has been noted by several authors (Bulloch 2013; O’Doherty 2022). We argue that empirical research on trust in science could benefit from the integration of philosophical insights into trust with empirical methodologies. Conceptual and empirical analyses, working in tandem, would provide insights that will help develop actionable strategies to bridge the gap between science and society.

In the following, we will first provide an overview of the evolution of the study of science-society relations and how it has shaped the public surveys on science and the selection of policy measures. Secondly, we map out the philosophical aspects of trust, the neglect of which may prevent empirical studies from mapping the mechanisms of trust or distrust in science and providing the necessary insights for policymakers. Thirdly, we will propose how a more nuanced conceptualisation of trust in surveys, informed by philosophical insights, can improve the quality of empirical research on trust in science, enabling policymakers to develop more targeted and effective measures for fostering warranted trust or distrust in science.

11.2 Historical Shifts in Science-Society Relations

The study of science-society relations, which emerged as an independent field of inquiry half a century ago, has undergone significant shifts in its foundational premises and areas of focus. These shifts have been paralleled by changes in the accompanying empirical surveys exploring public attitudes towards science. Notably, the issue of public trust in science has only recently taken centre stage in both theoretical discussions and empirical research.

In the 1960s, early studies followed the *public deficit model*, emphasising the need to enhance public scientific literacy. Surveys during this period primarily measured self-reported understanding of scientific terms and concepts. By the late 1980s, more sophisticated instruments were introduced to empirically assess public understanding of basic scientific concepts through quiz-like surveys conducted globally (Miller and Pardo 2011, p. 85; Bauer et al. 2007, p. 81–82). The first Eurobarometer surveys on science, launched in 1989 and 1992, reflected this focus on literacy (European Commission 1990, 1993).

The *public understanding of science (PUS)* model, which gained prominence in the 1980s, shifted the focus to public attitudes towards science (Bauer et al. 2007, p. 82). Concern grew over perceived insufficient public support for science (Bauer 2009, p. 224). This evolution was mirrored in surveys such as the Eurobarometer, where attitude-related questions became increasingly detailed over time.

To improve public attitudes, two competing approaches emerged. One advocated for better scientific education, continuing the deficit model’s focus, while the other promoted enhanced science communication, drawing on marketing principles (Bauer et al. 2007, p. 81–82). However, surveys yielded inconclusive results on the relationship between knowledge and attitudes (Bauer 2009, p. 225). Empirical evidence suggested that what appeared to be antiscientific sentiments often reflected

caution regarding the societal impacts of science and technology. These cautious attitudes coexisted with broadly positive views of science's potential benefits (Miller and Pardo 2011, p. 125). Crucially, factors such as education and socio-demographics were found to strongly influence attitudes, but these factors proved resistant to short-term interventions like informational or advertising campaigns (Miller and Pardo 2011, p. 126).

In the 1990s, attention shifted away from the public towards *scientific institutions and scientists* as the primary actors responsible for (re)gaining trustworthiness in the eyes of the public (Wynne 2006; Bauer 2009, p. 225). The more expansive “*Science and Society*” approach emerged, calling for a two-way public dialogue with scientific initiatives (Wynne 2006), and greater public participation in science as a key strategy to rebuild trust (Bauer et al. 2007, p. 80). By 2010, surveys such as the Eurobarometer began exploring public engagement in scientific practices and respondents' views on the societal and policymaking roles of scientists (European Commission 2010). The 2021 Eurobarometer further addressed public expectations of scientists, including their desired and actual qualities (European Commission 2021).

These developments highlight the evolving strategies for rebuilding public trust in science, focusing on both the trustor and the trustee. One approach targets the *trustee* by enhancing research ethics, integrity, and responsible research and innovation within scientific institutions to better align with public expectations (Bouter 2023; Ciubotariu and Bosch 2022; Forsberg et al. 2018). The other approach focuses on the *trustor*, fostering positive attitudes towards science through active public participation in scientific processes. Policies at both national and EU levels increasingly emphasise public involvement in science (Conceição et al. 2020). For instance, the European Research Area (ERA) policy agenda for 2022–2024 prioritises promoting trust in science through “increasing society's participation in the ERA” through initiatives designed to “bring science closer to citizens” and promote open science (European Commission 2024).

11.3 Key Issues in Understanding and Measuring Trust in Science

Science barometers vary in their approaches to measuring trust in science. Eurobarometer surveys on science have never directly asked respondents about their trust in science. Instead, they focus on indirect indicators such as levels of interest in and awareness of scientific topics, expectations towards science in terms of improving human welfare, perceptions of the role of science and scientists in society, attitudes towards the necessity of stricter or more lenient governance, and the perceived need for greater public engagement in the scientific research process.

However, respondents are asked to evaluate their trust in scientists or science in the Wellcome Global Monitors (2019; 2021) and several national science

barometers, such as Germany's Wissenschaftsbarometer (since 2014) (Wissenschaft im Dialog 2025) and the Estonian Science Barometer (Kree 2024). (For a detailed analysis of the methodology of science surveys, see Chap. 5) Regardless of whether these surveys conceptualize trust in science as a uni- or multidimensional construct, they primarily enable broader conclusions about the trustor rather than the object of trust or the nuanced nature of the trust relationship.

O'Doherty (2022) has criticised the conceptualization of trust in social scientific research as an individual attribute—an intrapsychic phenomenon that is quantifiable and measurable. This approach, he argues, fails to recognise trust as a relational phenomenon and does not adequately consider the trustworthiness of individuals and institutions. He also highlights that such surveys often overlook the important normative dimensions of trust in science.

Seyd et al. (2025) argue that most studies focus on a limited number of factors, despite the fact that individuals' trust in scientists may be influenced by multiple considerations. In addition to perceptions of scientists' traits and their work, trust may also depend on how the public perceives their role in the decision-making process.

This analysis aims to clarify the complex nature of trust and outlines the key aspects to consider regarding the trustor, the trustee, and their trust relationship when measuring and interpreting trust in science.

11.3.1 What Is Trust?

11.3.1.1 A Conceptual Analysis of the Complex Mental State

Trust is often measured without a clear definition, relying on the assumption of a shared understanding of the concept. However, philosophical discussions reveal its complexity, with varying interpretations among scholars. Trust is essential for human relationships, cooperation, and social cohesion. It involves a dynamic relationship of vulnerability and reliance, where the trustor accepts the risk of harm while believing in the trustee's integrity, competence, and goodwill, as well as experiencing a positive feeling towards them.

Nature of Trust

Most philosophers consider reliance to be a foundational concept and examine the additional elements that distinguish trust in individuals and institutions from mere reliance on objects, such as computers. The key difference between trust and reliance lies in our "reactive attitudes" (Holton 1994). When we rely on objects, such as expecting a computer to start, or on people to perform tasks they have successfully completed before, and they fail to meet our expectations, we feel disappointed. In contrast, when we trust people and they fail to meet our normative expectations, we feel betrayed (Baier 1986, p. 235).

Trust involves a willingness to relinquish control and to embrace vulnerability, relying on the trustee's competence and goodwill (McLeod 2020). Trust inherently involves risk, as it is oriented towards future actions, and past reliability does not guarantee future performance. This risk is tied to the trustor's acceptance of vulnerability in the absence of control over the trustee's actions.

Trust and Trustworthiness

The paradox is that those we trust may not always be trustworthy, while those we distrust may, in fact, be trustworthy. O'Neill (2002) focuses on the conditions for trustworthiness, emphasising that trust must be grounded in evidence of the trustee's reliability, competence, and ethical behaviour. She also warns against misplaced trust, which arises when trustworthiness is assumed without justification. For a credible trust relationship to exist, both the trustor and the trustee must demonstrate trustworthiness (McLeod 2020).

Katherine Hawley argues that trustworthiness is best understood in terms of commitment—being trustworthy means living up to one's commitments (Hawley 2019, p. 23). Trust and trustworthiness often exist in a reciprocal relationship. When trust is placed, the trustee is more likely to act in trustworthy ways to honour that trust, creating a positive feedback loop.

Russell Hardin introduces the concept of “encapsulated interest” to explain trustworthiness. He suggests that trust is rational when the trustee's interests align with fulfilling the trustor's expectations. In this view, trustworthiness arises from a convergence of interests, where the trustee benefits from being reliable (Hardin 2002). This perspective highlights how trust differs from mere reliance, which focuses solely on the predictability of the trustee's actions rather than on moral obligations.

What Does Trust Entail?

Philosophical theories of trust differ on whether trust necessarily involves a belief in the trustee's trustworthiness or whether the crucial element is a positive affective attitude towards the trustee. Doxastic theories highlight the importance of belief in the trustee's trustworthiness, while non-doxastic theories focus on the emotive aspect, describing trust as an affective state (Keren 2014). An integrative approach bridges these perspectives, asserting that trust involves both emotional and cognitive processes shaped by past experiences and societal narratives. This comprehensive view underscores trust as a dynamic interplay of belief and emotion.

Karen Jones (1996) has been one of the few authors who has denied that belief in trustworthiness of the trustee is crucial for trust. Instead, she defended an account of trust according to which trust is an affective attitude of optimism that the goodwill and competence of the trustee, together with the recognition of the trustor's expectation that they will show trustworthiness, will move the trustee to act in a responsible way. In a later article, Karen Jones (1996) argued that trust does not require belief in the trustee's trustworthiness. Instead, she defined trust as an affective optimism about the trustee's goodwill, competence, and recognition of the trustor's expectations, prompting responsible behaviour. Later, Jones (2019) explained how emotions like fear and contempt diminish trust, while esteem and empathy reduce distrust, through an affective looping mechanism that shapes interpretations

of others' words, actions, and motives. Bernd Lahno (2001) argues that emotions are judgments that shape how we perceive the world, with this emotional component—formed by past experiences or biases—affecting trust even in the absence of concrete evidence.

Although most theories of trust are doxastic, viewing belief as a necessary element of trust, some theories challenge this notion. In therapeutic trust, the trustor chooses to place trust in the trustee not because they believe the trustee is currently trustworthy but to motivate them to meet their expectations (Holton 1994). Therapeutic trust can be understood as a situation where the trustor, despite not believing that the trustee is inherently trustworthy, maintains a positive feeling towards them and holds a belief that the trustee is either willing or at least capable of meeting expectations. By recognizing the trustor's expectations, the trustee may, in turn, become motivated to fulfil them.

This illustrates that trust is a complex mental attitude involving both doxastic (belief-based) and non-doxastic (emotion-based) elements. For trust to occur, the trustor must experience some level of positive attitude towards the trustee. However, this affective component is often underestimated, as trust is frequently regarded as a purely doxastic attitude. Unlike rational judgment or appraisal, distrust can be shaped by the trustor's past experiences or, alternatively, by underlying biases or prejudices.

Trust is fundamentally a relational mental attitude that combines cognitive, emotional, ethical, and social dimensions. It is also a communication process involving both the trustor and the trustee:

- *On the trustor's side*, it involves hope that the trustee will prove to be trustworthy, a positive feeling towards the trustee, and a participant stance that includes emotional responses, such as feeling betrayed or gratified depending on the outcome (Sutrop 2019).
- *On the trustee's side*, it involves demonstrating competence, goodwill, and a commitment to fulfilling expectations.

Trust, therefore, is a dynamic process shaped by expectations, obligations, and social norms, influencing and being influenced by communication between the trustor and the trustee.

11.3.1.2 Complexity and Dimensions of Trust

Trust is a complex, multifaceted concept, not a simple or one-dimensional phenomenon. It is not merely a binary state of "having" or "not having" trust but exists in varying degrees and across different levels and dimensions, including:

- *Warranted vs blind trust*: Trust is meaningful only when justified by evidence of trustworthiness. Blind trust, however, can lead to harm if misplaced.
- *Contextual trust*: Trustworthiness often depends on the context. A person or institution may be reliable in one situation but not in another.

- *Dynamic trust*: Trust evolves based on experiences, interactions, and outcomes. It is not static but requires ongoing reinforcement.

Mistrust vs distrust: While often used interchangeably, they differ in the degree of scepticism and its basis. *Mistrust* reflects hesitation or doubt stemming from uncertainty, whereas *distrust* signifies a firm rejection of trust based on evidence or past experiences.

Whether trust involves belief, feeling, or both depends on the type of trust involved: one-place trust, two-place trust, or three-place trust.

- *One-place trust* refers to a general attitude of confidence or certainty, independent of specific relationships or actions. It is a broad, undirected sense of trust, not tied to any particular person or task.
- *Two-place trust* (A trusts B) involves trusting another person, which requires risk-taking and vulnerability. It entails refraining from precautionary measures and choosing not to seek additional evidence about the trustee's trustworthiness. In practice, we rarely trust others completely or globally (i.e., A trusts B in every respect).
- *Three-place trust* (A trusts B to C) specifies a relationship between the trustor and the trustee, where the trustor expects the trustee to behave in a certain way or to perform a specific action. This form of trust is more context-dependent and goal-oriented.

It is also important to distinguish between *predictive trust* and *normative trust*:

- *Predictive trust* involves merely making a prediction about another person's behaviour without any normative expectations. It is based on past experiences or patterns rather than moral obligations.
- *Normative trust*, on the other hand, involves a normative expectation that the trustee is obligated to fulfil the trustor's expectations. In this moral account of trust, failure to fulfil the expectation may justify blame, sanctions, or punishment (Nickel 2007, p. 309).

Obligations and Moral Expectations

What makes an obligation compulsory is the context—either a shared common morality or a shared understanding of the commitments associated with fulfilling a social role or professional duty.

The trustor can require the trustee to fulfil their obligations in several contexts:

- *Common morality*:
In a moral community, people attribute obligations to each other based on shared norms. This shared moral framework fosters an expectation of truthfulness, promise-keeping, and non-maleficence, even among strangers.
- *Social roles*:
Obligations are linked to the social roles individuals occupy. Certain expectations are associated with these roles, although the fulfilment of role-based obligations can vary across cultures and change over time. For example, societal

expectations of parents and partners have evolved, while obligations attributed to friends have remained relatively consistent.

- *Professional roles:*

Representatives of professions are expected to uphold specific values and follow established norms because their roles serve distinct social functions. Professional obligations arise from these roles and the social agreements that define them.

Philosophers who examine trust have often overlooked professional ethics, yet this context vividly illustrates the normative dimension of trust. When the trustee is a representative of a profession (e.g., a scientist) or an institution (e.g., a research institute or university), they are expected to fulfil a social role that entails specific obligations.

11.3.1.3 Understanding the Complexity of Public Trust in Science and Scientists

Rom Harré (1986, p. 6) has shown that science is a set of material and cognitive practices within a moral order built on trust among its members and with the broader community. Its special status stems from a rigid morality centred on the commitment to produce trustworthy knowledge.

Science pursues various goals: epistemological goals such as knowledge, trust, and explanation, as well as practical goals like prediction, power, and control (Resnik 2007, p. 35). To achieve these goals, science must follow both epistemological and moral norms that guide the responsible conduct of research. Trust and cooperation are fundamental to science: researchers must trust each other, their results must be reliable, and society must trust scientists.

We generally trust scientists and scientific institutions to follow moral norms and fulfil specific roles. As a profession, science has its own values and standards, often codified in ethics codes. Scientists are expected to uphold principles of professionalism in all aspects of their work. However, they often juggle multiple roles—such as university teacher, supervisor, research group leader, administrator, expert witness, active citizen or even business owner—which can lead to conflicts of duty.

Conflicts of duty can lead to conflicts of interest, undermining trust. Misunderstandings arise when the public and scientists have different expectations of scientific roles. For instance, the public may expect scientists to reach consensus on debatable issues (e.g., whether transitioning to green energy is a good idea), while scientists are often guided by differing values and worldviews. Simultaneously, people might hold unrealistic expectations that science will quickly provide solutions to practical problems (e.g., expecting that medical researchers will swiftly discover a cure for cancer).

Most social scientists conceptualise trust as “an evaluation or appraisal; a summative or latent belief that an actor... manifests qualities that render them trustworthy” (Seyd et al. 2025, p. 3). These qualities typically fall into three overlapping categories: *competence*, *benevolence*, and *integrity* (Mayer et al. 1995).

Trust is often conflated with attitudes towards science or scientists (two-place trust), which represent just one form or one dimension of the broader concept of trust. Positive or negative attitudes are frequently shaped by emotions driven by prior experiences, media exposure, influence from social media, or indirect knowledge, rather than by a direct evaluation of trustworthiness. Prejudices, such as fear of the unknown or a lack of understanding, also contribute to these attitudes. It is widely recognized that trust or distrust can persist irrespective of evidence.

Challenges to Public Trust in Science

In a post-truth society, the credibility of science is systematically undermined through the dissemination of misinformation and conspiracy theories on social media. A common narrative suggests that scientists are not truly independent or objective in their decisions but are instead influenced by corporate interests, particularly those of pharmaceutical companies. While there is no concrete evidence to support these claims, the mere suspicion casts doubt on the reliability of scientific research. This strategy effectively erodes public trust by suggesting that scientific conclusions are motivated by profit rather than evidence. As a result, even well-established scientific facts are met with scepticism, diminishing the influence of credible research on public discourse.

Public trust in science is increasingly undermined by the perception of politicization. During the COVID-19 pandemic, scientists advising governments became associated with political figures, leading to a spill-over of distrust from partisan politicians to scientists (Hamilton and Safford 2021; Kiviniemi et al. 2022; Varda et al. 2024). Consequently, public trust in scientists and institutions depends not only on perceived competence but also on perceived affiliations, with trust declining if scientists are seen as closely linked to political parties or financial organisations.

Building and Sustaining Public Trust in Science

When policymakers reduce trust to merely “having more of it,” they overlook the nuance required to build and sustain trust effectively. Instead, efforts should focus on fostering *warranted trust*—trust that aligns with demonstrated reliability, competence, and integrity. Ignoring the complexity of trust risks implementing superficial or counterproductive measures that fail to address the true factors shaping trust, mistrust or distrust in science.

11.3.1.4 The Importance of Warranted (Dis)Trust in Science

Even if we measure how many people trust or distrust science, conclusions about whether trust should be encouraged depend on understanding whether that trust or distrust is warranted. Survey results must be interpreted in context, as trust or distrust is meaningful only when justified. Understanding whether trust or distrust is justified requires examining the quality and reliability of the science that is being (dis)trusted. Blind, unwarranted mistrust can be as harmful as unwarranted distrust, potentially leading to misplaced confidence in flawed processes or outcomes. Policymakers must evaluate not only the level of public trust in science but also

whether that trust aligns with the trustworthiness of scientists and scientific institutions, as well as the reliability and integrity of the scientific system (O'Neill 2002).

High trust is problematic if scientists or scientific institutions are not actually trustworthy. Low trust is problematic if they are. Trust inherently involves risk and uncertainty, as it looks towards the future. Even if someone or an institution has been trustworthy in the past, there is no absolute guarantee they will continue to justify trust or meet expectations going forward.

11.3.2 Aspects Related to Trustee

11.3.2.1 Reference Objects of Trust in Science

Trust in science can target different entities, including:

Individual Scientists

Trust in individual scientists, hinges on perceptions of their honesty, integrity, and competence. Factors such as communication style, transparency, and public engagement also play crucial roles. For example, a study by Reif and Guenther (2021) examined how different science communication formats influence trust in scientists. The findings revealed that scientific experts appearing in TV interviews are perceived as more competent but not higher in integrity or benevolence than science communicators on YouTube (“scinetubers”). While TV-interviewed scientists are viewed as typical scientists, scinetubers are noted for their professional communication abilities, being both entertaining and comprehensible.

Emotional assessments of scientists significantly predict perceived trustworthiness and mediate the effect of the communication medium on all dimensions of perceived trustworthiness. Personal charisma and reputation may also influence trust but can be undermined by perceptions of bias, conflicts of interest, or past controversies.

Specific Scientific Fields

Trust in particular fields, like medicine or environmental science, often relates to public awareness and societal relevance. For instance, trust in medicine might centre on the reliability of treatments and the prioritisation of patient welfare, while trust in environmental science may depend on perceived urgency and alignment with sustainability goals. Public controversy around specific topics, such as climate change or genetically modified organisms, can amplify trust or distrust in these fields.

Scientific Institutions

Institutions like universities, research organisations, and funding bodies are often seen as gatekeepers of scientific integrity. Trust in these entities depends on their adherence to ethical guidelines, transparency, and independence from political or commercial influence. Public perception of institutional accountability and response to scandals or misconduct significantly impacts trust.

Scientific Products and Technologies

Trust in products such as vaccines, technologies, or medicines focuses on their safety, effectiveness, and reliability. The process of development, testing, and regulation, as well as the communication surrounding these processes, is critical in building trust. Missteps or misinformation in these areas can erode public confidence.

However, people's trust in new scientific products and technologies varies and is influenced by their values, including their openness to novelty. For instance, individuals who prioritise privacy over convenience or efficiency may distrust technologies like artificial intelligence that process large amounts of data and potentially threaten personal privacy.

Science as a System or Methodology

Trust in science as a broader system rests on its perceived self-correcting mechanisms, impartiality, and commitment to truth. This type of trust often involves abstract confidence in the scientific process, such as peer review, reproducibility, and the collective advancement of knowledge. Challenges, such as instances of fraud or failures in replication, may undermine this systemic trust.

Each reference object carries distinct expectations shaped by social, cultural, and individual factors. For instance, trust in scientists may centre on their honesty and expertise, while trust in science as a system often relies on its perceived self-correcting mechanisms and impartiality (Eyal 2019). A person might distrust a specific scientific institution due to perceived political bias but still maintain confidence in individual scientists or the broader scientific method. Recognising these nuances helps illuminate how trust operates in various contexts and why it differs depending on the object and context of trust.

11.3.2.2 Varying Definitions of Science and Their Impact on Trust

Definitions of “science” differ widely, influencing trust in specific disciplines. For example, Jerome Kagan (2009), building on C. P. Snow's *The Two Cultures* (1959/2001), highlights differing views on what constitutes science across three cultures—arts and humanities, social sciences, and natural sciences—as well as differing standards of good science within each discipline. Some individuals may trust fields like physics while mistrusting social sciences, often based on perceptions of rigour or political influence (Gligorić et al. 2024).

Also, who qualifies as a scientist is a matter of discussion. Normative expectations further complicate trust, as moral obligations expected of scientists or scientific institutions may not be universally shared. Such differences can lead mistrust to turn into distrust, even among scientists from other fields. Natural and medical scientists may question the legitimacy of humanities or social sciences, as these fields often deviate from the criteria traditionally associated with natural sciences. Ethical demands in science further illustrate this tension; for instance, while data sharing is an ethical imperative, the public might perceive it as a privacy risk. Similarly,

co-creation processes in research might raise questions about researchers' expertise or understanding.

Misunderstandings also arise within social sciences, particularly between proponents of quantitative and qualitative methods. Disagreements over the validity of conclusions drawn from methods like in-depth interviews, focus groups, or surveys—without deeper insight into respondents' thought processes—highlight the challenges of establishing trust across methodological divides.

11.3.3 Aspects Related to the Trustor

Trust in science depends not only on the trustee but also on the *trustor*. This is the aspect that public surveys on attitudes towards science have allowed to examine most thoroughly. Different individual- and social-level factors, both related to socio-economic status but mostly prior social values and attitudes have been identified as influencing trust in science:

11.3.3.1 Individual Factors that Influence Trust in Science

- *Personality traits*: Characteristics like openness and a general willingness to trust others influence attitudes towards science, though this applies in science-oriented societies (O'Brien and Noy 2018).
- *Life satisfaction*: Individuals with higher life satisfaction often exhibit greater trust in institutions, including science (Ainsaar et al. 2020; Ainsaar and Nahkur 2019; European Commission 2021). Life satisfaction itself is often related to a person's higher socio-economic status (Ren et al. 2022).
- *Educational level*: Higher education is generally associated with greater trust in science (Achterberg et al. 2017; Allum et al. 2008), though this is evident only in well-functioning societies (Alper et al. 2024).
- *Scientific knowledge*: Relatedly, better understanding of science and the scientific process (often linked with higher educational level) can positively impact trust, as informed individuals may feel more equipped to evaluate the reliability of scientific claims (European Commission 2021; Slater et al. 2019).
- *Prior experiences with science*: Direct or indirect encounters with science and its applications shape individuals' perceptions of its trustworthiness (Schiavo et al. 2022). Prior experience can also be a principal source of mistrust, especially in the case of vulnerable groups (Klassen et al. 2008).

11.3.3.2 Social Factors that Influence Trust in Science

- *General societal and institutional trust:* Trust in science, whether in scientists or institutions, is closely connected to individuals' overall societal and institutional trust (Pechar et al. 2018). Attitudes towards government and other institutions are significant predictors of trust in science. In societies with high general trust in other institutions, people are more likely to trust science (Bollyky et al. 2022; Ainsaar et al. 2020; Realo et al. 2008). Similarly, social trust is linked to interpersonal trust (Min 2020).
- *Cultural or ideological biases:* Trust in science varies across cultural backgrounds (O'Brien and Noy 2018). Religiosity, political orientation, and morality shape individuals' trust in science; however, their individual impact may vary when assessing different scientific endeavours (Rutjens et al. 2017). The recent Pew Research Center survey (Kennedy and Tyson 2023) showed that political orientation significantly influences trust levels.
- *Information exposure:* The level and sources of information about science play a significant role. Science-related populist beliefs lead to less trust in science (Zillich et al. 2024). Misinformation or limited access to credible sources can lead to mistrust (Prike et al. 2024).

In summary, factors that shape the trustor's attitudes towards science and scientists vary greatly in their nature and denote different forms of trust-relationships with the trustee. At the policy level, this requires also different measures not only for different target groups, but also for different types of trust-relationships shaping trustor's attitude.

11.4 How Philosophical Insights on Trust in Science Can Enhance Empirical Studies and Policy Recommendations

As discussed above, trust in science is influenced by various factors related to the trustor, the trustee, and the broader socio-cultural context. This raises an important question: how should inquiries about trust be formulated to effectively capture these influencing factors?

Below, we will highlight seven key insights and actionable recommendations to enhance how trust is conceptualised, measured and addressed in empirical research. From clarifying the multidimensional nature of trust to recognising societal and individual factors that influence it, these insights aim to refine survey methodologies and improve the interpretation of results. By addressing issues such as warranted trust, different forms of trust, the doxastic versus non-doxastic nature of trust, contextual influences, and the impact of politicisation, these recommendations provide a framework for rebuilding trust in science and aligning it with public values and expectations.

11.4.1 Clarifying the Concept of Trust

Trust is not a binary or uniform phenomenon but spans a spectrum of mental states, from one-place trust (a general positive attitude) to three-place trust (specific expectations of a trustee). Failing to distinguish these forms risks oversimplifying surveys and misinterpreting results.

Survey Recommendation

Explicitly define trust, specifying whether it refers to competence, integrity, benevolence, or other relevant dimensions.

11.4.2 Identifying the Reference Object of Trust

Trust in science is directed at multiple entities—scientists, disciplines, institutions, products, or science as a system. Empirical studies must disentangle these objects to yield actionable insights.

Survey Recommendation

Use multi-dimensional scales or questions to separate trust in individuals, institutions, processes, and findings.

11.4.3 Studying All Different Forms of Trust

Most surveys measure *two-place trust*—attitudes towards science, institutions, or products. To better understand trust dynamics, it is recommended to also measure *one-place* (general trust disposition) and *three-place trust* (context-dependent normative expectations). This comprehensive approach deepens insights into how trust judgments are formed and influence public confidence in science.

Survey Recommendation

For *One-Place Trust*:

Measure general trust dispositions by assessing:

- *Openness to experience*—Using personality scales to gauge openness to new ideas.
- *Risk-taking propensity*—Evaluating comfort with uncertainty as it influences trust.

For *Two-Place Trust*:

To accurately measure trust towards specific entities, consider:

- *Contextual specificity*—Clearly define the entity (e.g., “scientific institutions” vs “scientists”).

- *Dimensional assessment*—Evaluate multiple dimensions:
 - *Competence*—Is the entity capable and knowledgeable?
 - *Integrity*—Is the entity honest and transparent?
 - *Benevolence*—Does it act in the public’s best interest?
- *Perceived risks and benefits*—Assess how respondents balance risks and benefits.
- *Information sources*—Explore how different information sources influence trust.

For *Three-Place Trust*:

Examine the shared normative expectations towards the trustee, particularly how they vary depending on the reference objects of trust towards.

11.4.4 Evaluating Warranted Vs Unwarranted Trust

Trust is valuable only when justified. Measuring levels of trust is insufficient; research must also assess whether trust—or distrust—is warranted.

Survey Recommendation

To effectively assess warranted versus unwarranted trust, the survey can use performance-based questions (e.g., evaluating whether the trustee keeps promises or acts dishonestly) and questions cross-referencing trust with evidence and justification. Additionally, surveys can ask about the rationale behind trust and examine how trustors verify information.

11.4.5 Incorporating Contextual and Societal Factors

Trust in science is intertwined with broader societal trust in institutions like research funding institutions, governments, and media. Rebuilding trust in science requires addressing broader societal trust issues and democratic challenges.

Survey Recommendation

Use scenarios or specific examples to explore conditional trust, distinguishing trust in different contexts.

11.4.6 Recognising the Role of the Trustor

Individual characteristics and experiences—such as education, life satisfaction, prior interactions with science, and personality traits—shape trust. Effective interventions must consider these diverse factors to address public perceptions appropriately.

Survey Recommendation

Investigate how cultural, political, and social factors influence trust, and include mechanisms to address bias.

11.4.7 Addressing Politicisation and Perceived Conflicts of Interest

Trust in science is undermined by perceived conflicts of interest and politicisation. Transparent and independent scientific decision-making is essential to counter these vulnerabilities.

Survey Recommendation

Surveys should aim to identify the contextual factors that influence trust, including the sources of scepticism about scientists' objectivity and concerns about corporate influence.

11.5 Conclusion

Rebuilding trust in science requires more than isolated measures; it demands a systemic approach that addresses the complex interplay between science, society, and governance. Future research should prioritise integrating philosophical insights with empirical methodologies to develop actionable strategies that bridge the gap between science and society. A deeper, philosophically informed perspective on trust emphasises fostering *warranted trust*—trust that enhances societal resilience and aligns with democratic principles.

By incorporating these insights and refining measurement tools, empirical studies can more accurately capture the complexities of trust in science, facilitating evidence-based and context-sensitive policymaking.

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Trust in Science: An Epilogue

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During his first day in office as the 47th President of the United States of America, Donald Trump signed a series of executive orders that dramatically emphasised the discontinuity of his presidency with the policies and legacies of his predecessors Barack Obama and Joe Biden. One of these orders demanded withdrawal from the Paris Agreement on climate change (e.g. on concerted efforts to keep the increase in global average temperature to well below 2 °C), and another one announced the US President’s decision to exit the World Health Organisation. Via these highly symbolic gestures (the signing of formal documents in front of cameras with bold strokes, wielding his Sharpie marker), President Trump positioned himself in two polarised debates concerning the policy implications of scientific research, namely the debates about governmental responses to the COVID-19 pandemic and the deliberations on the climate crisis. Moreover, during his formal inauguration, Donald Trump was flanked by the CEOs of Big Tech companies, including Elon Musk, Jeff Bezos and Mark Zuckerberg, thereby highlighting the power of the technology sector to shape the global digital economy.

It is against this backdrop that three teams of European researchers joined forces to present their insights on trust in science in the format of a Springer Brief. While we closely monitor what is happening “across the Pond”, the focus of our reflections will evidently be on the current situation and emerging prospects in Europe.

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This short Epilogue is not meant to summarise our results, chapter by chapter as it were, but rather to indicate how our results connect with and contribute to the ongoing debates on trust in science in Europe. Three sets of questions will be asked. First of all, empirical questions concerning the current status of public trust in science. Are we indeed facing a trust crisis, as some sources suggest? Secondly, the normative question: should science be trusted, or rather: should trust in science be promoted, and if so on what grounds? And finally, if fostering trust in science is a worthwhile and valid objective, how can it be achieved? What are the prospects for action, especially for researchers and scientific institutions? Last but not least, while discussing these questions, a fourth question seems equally important, namely finding an answer to the question “*What is trust in science?*” Although all three projects started from working definitions, our understanding of trust in science became deepened and nuanced along the way. Basically, we see trust in science as a relational and interactive concept (O’Doherty 2023; Contessa 2022). Trust in science is not only a characteristic (measurable to some extent) of public audiences, but also an active assignment for scientists and scientific institutions: what can they do to foster the trustworthiness of their research? “Trust” is a noun but also, and primarily, a verb, pointing to an interactive endeavour.

As to the current situation, several contributions to this Springer Brief indicate that the actual level of trust in science is already an issue of dispute. On the one hand, several policy documents suggest a loss of public authority of science, or even a widespread crisis of public mistrust of science (UK House of Lords Select Committee on Science and Technology 2000). At the same time, as several chapters in this Springer Brief point out, public surveys tend to indicate that, overall, European citizens hold rather positive views about science while there is substantial confidence in scientific research and scientific institutions, although this doesn’t amount to blind trust, for the occurrence of vested interests or lack of adherence to quality standards are acknowledged as well (Hendriks et al. 2016). In addition, although trust in science among citizens is still substantial among surveyed Europeans, scepticism and distrust in science are quite vocal as well, especially in polarised debates on the policy implications of scientific research.

While empirical evidence concerning the actual level of trust in science is evidently relevant for our debate, the normative question is no less important: *should* science be trusted? According to René von Schomberg (2025), modern societies cannot sidestep science, if only because of the importance of scientific research for science-informed decision-making. Science, Von Schimberg argues, provides the means to reduce the complexity of emerging social challenges to comprehensible problems that can be addressed by policy. Therefore, public trust in science, or more precisely: in science-informed decision-making, is essential for representative democracies. As Brian Wynn argues, however, this line of reasoning may imply that the allegedly abandoned deficit model of science literacy among the public is replaced by a deficit of trust model. Indeed, as Wynn phrases it, even if in most policy documents the deficit model is explicitly buried, we find it too often reincarnated in a new form, shifting the emphasis from lack of knowledge to lack of trust.

The COVID-19 pandemic often serves as a resource of paradigmatic case studies for studying the question *should we trust science*. Take for instance the question concerning the genesis of the Corona virus. On February 19, 2020, the biomedical journal *The Lancet* published an editorial stating: “We stand together to strongly condemn conspiracy theories suggesting that COVID-19 does not have a natural origin and overwhelmingly conclude that this coronavirus originated in wildlife”. *The Lancet* thereby vehemently endorsed the view that COVID-19 originated at a wet animal market in Wuhan, visited by humans, but also by rodents and cats, where not only fish and shellfish, but also various species of exotic animals were for sale. For the anonymous authors of the *Conspiracist Manifesto* published in 2022, however, it cannot be a coincidence that a virology institute was located in the same city, formally cleared to work with dangerous viruses at biosafety-level 4 (a form of research that is difficult if not impossible to conduct in the West). In fact, these authors argue, *The National Institute of Health* and the *National Institutes of Allergy and Infectious Diseases* funded experiments on coronavirus bats at the Wuhan Institute of Virology (WIC), grafting proteins into the base structure of SARS-CoV to observe pathogenic effects in humanised mice and to augment contagiousness. According to these authors, the database listing the set of viruses on which the WIC worked miraculously disappeared and they question the conclusion drawn by the WHO, namely that the theory of a laboratory leak at WIC to explain COVID-19 is highly improbable. Moreover, as we are writing this Epilogue (March 2025), several foreign intelligence services are now communicating the view that there is a considerable chance that the coronavirus *did* leak from the Wuhan lab. Although the validity of these claims are difficult to assess, because of lack of information concerning the evidence on which these conclusions were based, the Wuhan case does point to the fact that scientific insights remain inherently questionable and uncertain. But it also indicates the importance of transparency and verifiability of research results and evidence-based conclusions, and this also applies to potential conflicts of interest and political sensitivities, and, more generally, to the inherent uncertainty of scientific information (as scepticism, self-criticism and self-correction are inherent characteristics of scientific research).

Indeed, transparency and verifiability are already important ingredients for answering our third question: If fostering trust in science is a viable objective, in what way? Another ingredient, as several contributions to this Springer Brief argue, is open and participatory research. This Springer Brief is published at a time when Europe is struggling to position itself in between two giant technoscientific superpowers, China and the USA, as global competitors in areas ranging from sustainable energy down to AI (exemplified by the competition that has recently evolved between ChatGPT and DeepSeek). Precisely here, however, Europe has something to offer, namely decades of experience when it comes to addressing societal, ethical and regulatory challenges of technoscientific change. During the past decades, prominent approaches (supported by funding programs launched by the European Commission, but also by several European countries) such as ELSA (i.e. interdisciplinary and participatory inquiry into the *Ethical, Legal and Social Aspects* of research and innovation) and RRI (*Responsible Research and Innovation*) have been

developed that consider societal engagement and participation as *inherent dimensions* of research trajectories, rather than as activities that can be delegated to the final, dissemination stage of the process. Their objective is not to ensure that citizens adapt to or adopt the products of technoscientific change, as was suggested by the Chicago exhibition of 1933 mentioned above. Rather, public participation aims to ensure that priorities, experiences and concerns of citizens, practitioners and societal stakeholders are addressed, while strengthening the transparency, external validity and trustworthiness of the research processes involved. This Springer Brief on trust in science thus builds on these developments, indicating how the experiences and insights gained in the context of these activities offer a valuable legacy that is more relevant than ever. It is precisely here that Europe can make a difference, ensuring that research and innovation is responsible and responsive to societal context rather than disruptive. Participatory research is important not only for strengthening trust in science but also for improving its quality, relevance and external validity.

In chapter one of this Springer Brief, the authors remind us of the motto of the 1933 *Century of Progress Exhibition* in Chicago: “Science finds, Industry Applies, Man conforms”. This motto saw innovation as a linear and unstoppable process, from basic research (often conducted at universities but financially supported by governments or companies) via application (by technology companies and industry) towards adaptation (by citizens, as recipients and consumers of the commodified products of these innovations). If there is one message which the contributions to this Springer Brief have in common, it is advocating the need for a participatory turn, moving away from a linear, top-down approach to ensure that research and innovation evolve as interactive processes, sensitive to societal values, priorities and concerns. As Brian Wynne (2006) already argued, strengthening of trust in science is not a viable objective per se. Rather than adopting a public trust deficit model, blaming incompetent publics or misinforming media for having contributed to a decline of trust, we should rather encourage reflection on how institutional science itself is part of the dynamics of trust. Trust is first and foremost a relationship, and public trust in science can be both strengthened and endangered by the ways in which science is institutionalised, and scientific information is communicated and controlled. The second common message emerging from the various contributions is that the core objective of open and participatory research should not be a promotional one (cf. Chap. 2). Promotional activities, directed at addressing a perceived deficit of trust in society (as the latest version of the infamous deficit hypothesis) could rather have the opposite effect. One of the “paradoxes” (Hendriks et al. 2016) of trust in science as a relational concept is that scepticism is important for science, not only in the sense that research methodologies themselves can be considered as institutionalised practices of scepticism, but also insofar the purpose of public debate and public engagement in science is to give the floor to a broad range of views and perspectives, including critical and sceptical ones. Science has evolved as a means to question and address established views, rather than trusting what authorities tell us. Institutionalised scepticism, self-reflection and self-criticism contribute to the trustworthiness of science, and one of the most important assets of academic research is precisely its reputation of trustworthiness. This would be endangered by research strategies that may be considered as promotional and

self-serving rather than disinterested and objective, as is argued on Chapter 2 of this Springer Brief. In some contexts, distrust in research results may be quite warranted.

At the same time, we are facing polarisation and fragmentation of public debates on research and innovation. Especially social media are often blamed for offering space for disrespectful and accusatory forms of communication, and for supporting withdrawal into information bubbles. Is an open societal debate on science and innovation still possible? While strengthening trust in science per se is not what we strive for, given the inherent questionability and uncertainty of scientific insights, *vigilant trust* (as Friederike Hendriks and colleagues phrase it) emerges as a valid objective, and as a possible answer to the normative question “should science be trusted?”

As to the pragmatical question *how* vigilant trust can be achieved, building on our experiences so far, open and participatory research methods can make a significant contribution. These methods must be applied thoughtfully and for the right reasons: not as instrumental or promotional activities, nor as forms of window dressing, but as an effort to democratize research, thereby strengthening its external validity and social relevance (cf. Chap. 5). Several contributions point out that this is not merely a theoretical point of view. Rather, besides deepening our understanding of trust as a multi-dimensional and relational phenomenon, several contributions offer concrete and validated methods for science communication, participatory activities, public deliberations, as well as for the wording and interpretation of public surveys and policy options for institutional change.

In 1935, philosopher Edmund Husserl presented a gloomy lecture on “The Crisis of the European Sciences”. The European sciences, he argued, were facing a crisis, not in terms of the research achievements per se (which, in the era of quantum physics, were actually quite impressive) but in terms of their meaning for society and human existence. Science had always been a *moral* factor, Husserl argued, had decisively contributed to the progress of civilisation and to establishing a rational and humane society. But now, scientific research, precisely *because* it had become so astonishingly successful, technologically speaking, suddenly represented a threat to civilisation. And it was increasingly questionable whether ethics and politics would be able to master the technological power unleashed by science. Science and technology had become neutral forces employable for multiple purposes, good and bad. From a benefactor of humanity and culture, science had turned into a substantial risk. Currently, we are facing a similar situation with regard to emerging technologies such as artificial intelligence. The pace of technological innovation is both impressive and disconcerting. Many initiatives are taken to foster responsible research and innovation, not only by politicians and policy makers, but also “from within”, by numerous responsible researchers directly involved in these developments. Participatory research, we argue, opens up important opportunities towards *democratising* science, making technoscientific developments beneficial to society instead of disruptive. It offers an opportunity for the “European sciences” to strengthen their responsivity to societal values, priorities and concerns.

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