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The Role of Stewards of Trust in Facilitating Trust in Science: A Multistakeholder View

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Abstract
Trust in science post-Covid appears to be a complex matter. On the one hand, the COVID-19 pandemic added value to the epistemic trustworthiness of scientific opinion and its potential to drive evidence-based policies, while it also spurred scientific distrust and societal polarization (e.g., vaccines), especially on social media. In this work we sought to understand the ways in which trust in science might be bolstered by adopting a multistakeholder perspective. This objective was achieved by considering stakeholders' views on (a) *how* perceived key actors affect trust in science, and (b) *what* proposed actions can be taken by each actor identified. Data were collected using 16 focus groups and 10 individual interviews across different European contexts with general public ($n=66$), journalists ($n=23$) and scientists ($n=35$), and were analysed using thematic analysis. Regarding *how* perceived key actors affect trust in science, participants viewed policymakers, media, scientific and social media actors as occupying a dual function (facilitators and hinderers of trust in science), and pointed to the value of multi-actor collaboration. Regarding *what* actions should be taken for enhancing trust in science, participants indicated the value of enhancing understanding of scientific integrity and practices, through science literacy and science communication, and also pointed to social media platform regulation. Implications stemming from the data are discussed, considering how multiple identified stewards of trust can contribute to an ecosystem of trust.

Keywords Trust in science · Trust · Epistemic trust · Science literacy · Science communication · Stewards of trust

Introduction

The recent COVID-19 pandemic illuminated the complexity of safeguarding trust in science. On the one hand, scientists' concerted efforts led to the design and delivery of vaccines that met safety requirements, while on the other, the controversial issue of vaccination was politicized, fostering skepticism and distrust towards science. A recent global study with

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over 70,000 participants conducted by Cologna et al. (in press) found a link between political affiliations and trust, indicating the potential influence that other actors could exert on science. Ejaz et al. (2024) also support this link and indicate it may also influence misinformation belief. The influence that political actors have on trust in science is evidenced in the context of public health (Goldberg et al., 2012), such as scientific claims towards vaccine safety (Savoia et al., 2021), and has also been documented for other politicized issues such as climate change (Sarathchandra & Haltinner, 2023). One strategy for bolstering trust in science has been the take-up of open science practices (e.g., publicly available data, transparency and accountability in data collection and reporting, and in peer review practices) (Rosman et al., 2022; Song et al., 2022). However, transparency might backfire, as indicated by Climategate, whereby leaked emails between climate scientists resulted in fuelling climate skeptics (Garud et al., 2014). Open science practices can work when there is a shared understanding of how science works; in its absence suspicion and mistrust lurks (John, 2018), which may be amplified by other actors, such as social media (Gierth & Bromme, 2020). This suggests that beyond examining who is trusted, and what actions can bolster trust, we must also attend to the connections between actors that broker trust in science (O'Doherty, 2023).

The societal impact of science hinges on the trust that citizens place on it. This trust is epistemic in nature, since it entails deferring to expert sources, while being cognizant of the dangers of being misinformed (Hendriks et al., 2016). Yet, vigilance against being misinformed might also result in skepticism, which can foster distrust in scientists, especially in the context of scientific uncertainty (Heyerdahl et al., 2023). The presence of misinformation during the COVID-19 pandemic facilitated misperceptions about science (Bridgman et al., 2020), illustrating how fragile trust can be, but also pointed to the importance of recognizing the value of multiple actors whose direct or indirect role is to convey science to a general public. These actors include: (a) scientists or academic institutions, who act as knowledge-brokers for a general public; (b) policymakers, who, ideally, develop evidence-based policies; (c) traditional and new media organisations, who provide the channels for the dissemination of science to the public; (d) research funding organisations (RFOs), who decide what science to fund, and whether funds are allocated for public engagement activities, and (e) civil society organisations (CSOs), who can act as multipliers for scientific practices, as well as findings. These actors operate as stewards of trust — a term we use for actors who bear responsibility for guiding societal trust in science — and their complementary role can inform what an ecosystem of trust — whereby societal trust in science is constructed and negotiated — might look like. Rather than viewing the aforementioned institutions as unilateral actors that influence trust in science (e.g., de Zúñiga et al., 2019), we adopt the concept of stewardship, grounded in the notion of care (West et al., 2018), whereby all involved actors hold responsibility for attending and safeguarding trust in science.

Against this background, this work adopted a multistakeholder perspective to understand how actors might bolster trust in science, by considering the views of those who communicate science to the public (scientists and journalists) and the recipients of that communication (i.e., a non-expert general public). Using this multistakeholder lens, the study was guided by research questions focused on stakeholders' views on (a) the role of different stewards of trust hold in relation to each other, and (b) on the most important actions that should be undertaken to deal with mistrust in science.

Actors Operating as Stewards of Trust

This section reviews how different actors — policymakers, public and private research funders, academic institutions, civil society and media — affect the public's trust in science.

Policymakers

Policymakers play a key role in facilitating trust in science, particularly due to the complex and triangled nature of public trust as dependent on its condition of 'attachment' to either specific governments, politicians or scientists acting in the public sphere (Pechar et al., 2018). The correlation between trust in government and trust in science is nuanced in research. Political capacity to shape trust in science is unclear (Canlas & Molino-Magtolis, 2023), yet in particular social contexts, policymaking is a good predictor of public trust in science (Pechar et al., 2018; Bundi & Pattyn, 2023). However, politicians could refer to ambiguous evidence if their goal is to persuade people to adopt a particular policy (Schneider et al., 2022). These findings point to the entangled relationship that policymakers and scientists are involved in, which ultimately influences the public's trust in science.

This entangled relationship is made strenuous by the fact that each actor communicates in different languages, which can result in an inadequate translation of scientific findings into policy due to improper inference (Bradshaw & Borchers, 2000). Moreover, factors such as limited material time, or differences in professional trajectories provide the basis for mutual mistrust or lack of cooperation between scientists and policymakers (Gollust et al., 2017). An additional challenge centers on scientific uncertainty, which may be misunderstood by policymakers, especially during crises when there is a need for immediate policies, and by extension, clear-cut answers (Landström et al., 2015). This may act as a mutual driver of distrust, with politicians questioning research credibility, and scientists disputing politicians' willingness to develop policies based on scientific evidence (Gollust et al., 2017; Bundi & Pattyn, 2023). This points to the essential role of intermediaries, such as advocacy actors, specialized journalists, who may broker trust by facilitating communication between policymakers and scientists through translating scientific language (Bultitude et al., 2012; Gluckman et al., 2021). On the issue of uncertainty, the role of communication is vital, especially in capturing the complexity of nature and the warranted trust we can place on it (Landström et al., 2015; Gluckman et al., 2021).

Trust in science can also be promoted through deliberation and open communication between policymakers and the public. For instance, participatory science and participatory governance of scientific organizations are acknowledged as crucial factors that could — and should — be boosted to bolster trust (Krick & Holst, 2021; Burgess, 2014). Advisory bodies and ad hoc committees including scientific experts are particularly important in this context (Krick & Holst, 2021; Gundersen & Holst, 2022).

Public and Private Research Funders

Public funding from government agencies is crucial for legitimizing scientific research. The positive perception of scientific research is closely linked to the public funding it receives (Critchley & Nicol, 2011), as it reassures that the research aligns with societal values. Publicly funded projects undergo stringent oversight, rigorous peer review, and high

ethical standards, contributing to research integrity. Open applications in the research process promote transparency and fairness in funding (Horbach et al., 2022), making scientific processes more accessible to the public. Transparency strengthens public trust in scientific knowledge (Rosman et al., 2022), though it cannot counteract the trust-damaging effects of private research funding, which can introduce conflicts of interest. The commercialization of research presents challenges for researchers, research participants and funders (Caulfield et al., 2014). Private funding may lead to perceived bias, undermining public trust, particularly when political attitudes are involved. To address these concerns, private funders must adhere to principles of research integrity, including honesty, reliability, respect, and accountability (ALLEA, 2023). Disclosing funding sources and potential conflicts of interest is essential for maintaining trust, helping to mitigate the negative effects associated with private funding.

Academic Institutions

Scholarly articles typically discuss academic institutions' trust in science from two perspectives: (a) the trustworthiness of institutions, including competence, integrity, and benevolence (Hendriks et al., 2016); and (b) perceived transparency, fairness, effectiveness, and efficiency (Law & Le, 2023). Factors like exclusionary research, misconduct, or commercialization can erode this trust (Ivani & Dutilh Novaes, 2022). Academic institutions can enhance trust through public engagement in science, involving the public in bidirectional activities (Wynne, 2006; Ferretti, 2007; Conceição, 2020). Engagement formats include face-to-face, mediated engagement through media professionals, and online interactions (Yuan et al., 2019; Roedema et al., 2021). While the primary institutional motivation of public engagement is to build trust (Weingart et al., 2021), scientists' motivation is often to inform or educate (Dudo & Besley, 2016), which can also foster trust by explaining how science works. For effective engagement, individual traits like trust levels (Koswatta, 2023), political ideology (Saarinen et al., 2020; Santoro & Sydnor, 2024), deference to scientific authority (Wintterlin et al., 2022), and education level (Achterberg et al., 2017) should be considered.

Barriers to public engagement exist, however. These include scientists' lack of communication skills due to insufficient training (Ho et al., 2022), limited funding, time constraints, low recognition, and peer disapproval (Woitowich et al., 2022). Therefore, academic institutions play a key role by creating support structures for communication training and recognizing public engagement in promotion decisions (Yuan et al., 2017), thus facilitating effective public engagement with science.

Civil Society

Millar et al. (2023) argue that citizen science (i.e., non-expert public participation in scientific research) can boost public trust in science. Research and innovation aid citizen scientists by developing tools that promote environmental awareness and biodiversity conservation (Preece, 2016). Citizen science initiatives aim to restore public trust by involving citizens in scientific processes, addressing societal issues, and promoting democratic governance of science (Bäckstrand, 2003). CSOs can also act as intermediaries, simplifying complex scientific information for the public, thereby enhancing transparency and

research integrity. CSOs can advocate for scientific literacy and critical thinking (Lee & Roth, 2003), improving public understanding and trust by demonstrating the practical benefits of research. This trust is crucial for both theoretical and practical reasons (Goldenberg, 2021). For example, environmental groups conducting climate change workshops illustrate how civil society participation strengthens public understanding and acceptance of science (Albagli & Iwama, 2022). Additionally, civil society can also embody a monitorial role, e.g., the European Code of Conduct for Research Integrity (ALLEA, 2023) monitors compliance with ethical standards, ensures researcher accountability, thereby enhancing research quality and credibility.

Media

How scientific research and funding are reported in the media can significantly impact public trust, therefore accurate media reporting is crucial (Elliot, 2019). Beyond accuracy, the changing media landscape of scientific news consumption and the rise of social media as a primary source of scientific information (Brossard, 2013) has also played a role in trust in science. This shift reduces the role of traditional science journalism and increases the importance of science communicators on social media (Weingart & Guenther, 2016), potentially shifting focus to reputation control over knowledge transfer (Schäfer, 2017). However, social media can boost trust in science by making it more accessible (Mousoulidou et al., 2022) and enabling direct communication with scientists (Reif et al., 2020). They also promote interactions with sources perceived as trustworthy (Collins et al., 2016; Huber et al., 2019) or counteract mistrust in sources through social recommendations (Bode, 2016). Additionally, However, social media diminishes traditional gatekeeping, allowing anyone to publish information without vetting (Bimber & de Zúñiga, 2020). This shift disrupts the key role of academic and media institutions in developing a positive stance towards science (Anderson et al., 2012a) and moves science communication to a networked-algorithmic model driven by commercial interests, whereby social media policies hold a central role in who communicates what and how (van Dijck & Alinejad, 2020). This reduces quality control (Weingart & Guenther, 2016) and can manifest in the proliferation of scientific misinformation (Liang et al., 2014).

Social media often place the responsibility of evaluating scientific credibility on laypersons (Koidl & Kapanova, 2022), making judgments about source trustworthiness crucial (Bromme et al., 2015; Hendriks et al., 2016). Heavy social media users are better at identifying credible sources and fake news (Verma et al., 2018). However, on social media laypersons often make judgements by relying on prior attitudes (Gierth & Bromme, 2020) prejudices, or biases (Knobloch-Westerwick et al., 2015), which may create echo chambers that exacerbate scientific mistrust (Garrett, 2017; Diehl et al., 2021).

Study Contribution

Reported studies mainly examine how a general public trusts a directed target (individual or institution). However, to understand trust in science, there is also a need to attend to the connections between actors (O'Doherty, 2023). By focusing on select actors involved in stewarding trust in science, this study aims to gain a pluralistic understanding of the perceived relationships and actions that can bolster trust in science. Thus, our work adopts

a multistakeholder approach, drawing on the perspectives of a general, non-expert public, alongside those of media and scientific actors.

Methods

We report on the first phase of the three-year VERITY Project, whose overarching aim is to create a protocol for increasing societal trust in science for actors responsible for guiding such trust. To answer the research questions guiding this qualitative study a multistakeholder approach was adopted examining the perceptions of those who disseminate scientific information (journalists, researchers) and those who receive it (general public). The study received ethical clearance via the Cyprus National Bioethics Committee.

Participants were recruited across three different stakeholder groups (general public, journalists, researchers) in Cyprus, Greece, France, Ireland, and Austria. Different methods were used to recruit the sample: (a) the general public, was primarily a convenience sample, recruited through a call for participation disseminated via institutional communication channels; (b) for journalists and researchers, relevant persons and organizations were identified (e.g. newspapers, TV channels, researchers involved in science communication) and invited to participate. Participants were recruited across different European locations and to ensure uniformity recruitment criteria were identified for each stakeholder group at the outset of the study.

The *General Public* included participants from urban and rural locations. They reported a range of occupations: they engaged in services (e.g., lawyer, accountant), skilled work (e.g., joiner, tailor), managerial roles, public service (e.g. administrative officers, military officer, police officers). The group also included higher education students and retirees. The *Journalists'* sample was comprised of (a) non-specialized journalists who had covered science topics but did not specialize in science, (b) science journalists, who had science-related educational backgrounds, (c) science communicators in industry. Finally, the *Researchers'* group had a range of disciplinary expertise within the natural sciences, environmental sciences, humanities, and social sciences. Table 1 provides descriptive statistics for the participants across each stakeholder group.

Data collection Data were collected via focus groups and were supplemented by individual interviews, where needed. Data were audio recoded for physical focus groups or interviews, while those conducted online were recorded via digital conference software. Data were collected by consortium partners; all focus group facilitators and interviewers followed a protocol, and were given training prior to data collection.

Focus groups conducted with different stakeholder groups were homogenous in terms of professional background (journalists), scientific expertise (scientists), or lack thereof (general public) (Krueger, 2014). We conducted the following focus groups and interviews across each stakeholder group: for the *General Public* eight focus groups and one individual interview (conducted in Austria, Cyprus, Greece, Ireland, France), for *Journalists* four focus groups and four individual interviews (conducted in Cyprus, Austria and the U.K.), and for *Researchers* four focus groups and five individual interviews (conducted in Cyprus, Greece, Ireland). All participants were informed about the project and were then provided with an informed consent form prior to participation; all personal data provided by participants were pseudonymized at the outset of the analysis. Participants were provided with the option of

Table 1 Descriptive statistics for participants across each stakeholder group

	General public ($n=66$)	Journalists ($n=23$)	Scientists ($n=35$)
Missing demographic data	6	8	11
Male	26	8	23
Female	34	7	12
18–30	16	2	1
31–40	9	6	7
41–50	8	6	10
51–60	5	2	8
61–70	9	0	2
71–80	9	0	0
81+	4	0	0
Primary	15	0	0
Secondary	5	0	0
University degree	21	6	0
Master's degree	11	7	1
Doctoral degree	8	2	35

completing a demographics questionnaire, accounting for some of the missing demographic data.

Data analysis All data were transcribed verbatim and coded in Nvivo 14; they were analyzed inductively using thematic analysis, starting with data familiarization, generation of initial codes, code searching, reviewing and defining themes (Braun & Clarke, 2006). This analytical lens allowed us to iteratively search for themes within the data in relation to the research goals guiding this work, namely: the role stewards of trust hold in safeguarding trust in science and the actions needed to enhance trust in science. The identified actions were then tabulated and compared across stakeholder groups to establish commonalities across proposed actions.

Findings

The following subsections delve into the themes related to the two research questions, examining the commonalities between different stakeholder groups. Section 4.1 addresses the role of actors and their connection by focusing on two themes: (a) specific actors who hinder *and* facilitate trust in science; and (b) the value of multi-actor collaboration for enhancing trust in science. Section 4.2 presents proposed actions across groups; specifically to: (a) stimulate science education; (b) amplify science communication; (c) regulate social media.

How do Actors Facilitate Trust in Science?

Theme 1: Dual Role of Some Actors: Hinderers and Facilitators of Trust in Science

Participants across the three stakeholder groups drew attention to how political, scientific, media and technological actors affected trust in science bilaterally: as hinderers and facilitators. Participants reported that these four actors play an instrumental role in the public's diminishing trust in science.

Actors may at times act as 'merchants of doubt', intentionally undermining science through persuasive and sophisticated means (Oreskes & Conway, 2010). This was also reflected in our data for policymakers who may cast doubt on science intentionally, when the science is used to serve a different agenda; in other words, it is instrumentalized to serve a persuasive aim, rather than an informative or knowledge-related aim. This is illustrated in the following:

The problem, when politics instrumentalizes science like that, is this big downside of this evidence-based policy, right? It's this idea that you can produce scientific knowledge according to your political standing, and unfortunately, a lot of politicians are doing that where they have their scientists working in the background and then they take that data that has been produced and then they only show this one aspect of it. (FG #1 [IRE, GP, WEB])

Participants also indicated that a portion of the public may trust in political figures, so if such persons draw attention to the societal value of science it may bolster trust. Additionally, participants pointed to the regulatory role that policymakers occupy, which positions them as actors who have the power to enhance trust through evidence-based policymaking, which can also draw attention to the relevance of science in everyday life.

The media were also perceived to cast doubt on science, especially since media outlets tend to serve a partisan agenda which may influence how news stories are reported. While this might initially seem like an intentional practice, the examples discussed by participants indicate that at the source of this hindering role are constraints by which news media outlets operate; therefore, this concern about the media is at the infrastructural rather than the individual level. These constraints foresee limited press freedom and limited media pluralism since the news media landscape may be dominated by few voices:

There are those three main channels. They do not differentiate, one follows the other. There is no [media] pluralism. There is a single agenda to be followed, and this is dictated by certain people. So all channels [follow and] project that same agenda. (FG #3 [CYP, GP, LIV])

Despite these infrastructural constraints, participants acknowledged the role that the media hold in bringing the public closer to science, by acting as conveyors or disseminators of scientific discoveries. In this sense, the facilitating role of media actors lies in their ability to break down complex science into understandable stories that can create interest, as indicated by one participant in the researcher focus group, who said, "Journalists can make this magic of turning complex signs into something understandable for the public, which is something wonderful."

Scientists might also occupy a hindering role by projecting a façade of infallibility, or perceived arrogance when talking to the public. For instance, attempting to simplify science might be perceived as dumbing down, which creates a strong power dynamic that can color the relationship between scientists and the public. This is further hindered by the fact that scientists might also be poor communicators. Participants viewed the use of jargon less as a sign of expertise, but rather as a strategy that might serve to maintain the power relations between expert and non-expert:

What I find really, really bad for a relationship like that, for gaining the trust of the public, is standing there pretending you're God, like you know everything, right? A lot of scientists have that, unfortunately. "I know it all. You don't know anything. And I'll dumb it down for you to understand." No. You just need to find the right language. (Participant #20 [IRE, R, LIV])

At the same time, participants acknowledged the indispensable role that scientists have in bolstering trust, through their expertise. However, expertise alone was not deemed enough to safeguard trust; communication skills, as well as epistemic virtues, such as humility and honesty also seemed to matter for participants, who pointed to the importance of disclosing who is funding the research, as a precaution against claims of monetary incentivization.

Lastly, social media companies were also identified as actors who serve a dual role as hinderers and facilitators of trust in science. On the one hand, they mediate access to information due to their increased popularity; however, their algorithmically-driven networked communication model influences what information is encountered online. Social media also encompass the risk of misinformation exposure, since there are no safeguarding mechanisms that can adequately respond to the speed at which misinformation travels on these platforms. While social media environments have facilitated interactions between experts and non-experts, and have provided a platform through which scientists can communicate science, the presence of online misinformation might serve to dwindle that effect, as indicated by a participant in a general public focus group, who explained that "in the last years there was this very big information tsunami, and the scientists have only one voice and the other fake news producers have several voices" (FG #1 [AUS, GP, LIV]).

Theme 2: The Value of Multi-Actor Collaboration

Participants also emphasized that there is value when multiple actors collaborate with a common goal. While the relationship between politicians and scientists was flagged as potentially problematic, participants across groups recognized that both actors play an instrumental role in placing science within the public sphere:

I think that both scientific and political institutions are responsible to provide adequate communication. Because scientists must inform the public about certain discoveries, certain limits as well, certain threats. And the political institutions must transmit and diffuse information in an adequate way, that is "edible", so people can digest this sort of information. (FG #1 [IRE, GP, LIV])

Another participant in the general public focus group described the relationship among different actors as complementary; actors worked together to facilitate trust in science in a tiered approach. Viewed in this way, multiple actors have a role to play: starting from scientists, who are experts in a particular domain but have limited communication skills, and followed by other, more effective science communicators, who step in to fill a skills-based gap that might result in hindering trust in science:

In other words, a scientist who knows everything, the terminology, doesn't have to talk to the public if they don't know how. There will then be someone, a bit further down, [the "ladder"] but it doesn't have to be a journalist specifically, who doesn't know anything. The person should just be an effective speaker, and they should know what's valid and what isn't, and where to draw the line. This also applies to teachers. Teachers are a very important part of this "ladder". If we lose the "ladder", we all fall off. We can't have that. (FG#1 [GRE, GP, LIV])

Participants in the journalists' and researchers' group mentioned the value of establishing partnerships across important societal institutions, such as religious institutions, which may have influence within a particular community, or between academic institutions and industry. These partnerships may serve to amplify voices in science, since they involve additional

actors within the ecosystem of trust, and, by extension they may facilitate trust in science. The value of multistakeholder involvement is indicated in the excerpt below:

A lot of people come into play here, the educators, the scientists, the science communicators, the medical communicators, the governments, the religions, everybody can do a little bit better. So, hopefully, the next generation will be better informed and then, you know, at the end of the day, it's people's personal opinion and people's personal choices, but, hopefully, they will have the ammunition to make better choices, I would say, and to trust the people. (Participant #2 [CYP, J, WEB]).

What Actions Should be Taken to Increase Trust in Science?

Actions for Stimulating Science Education

Participants across the three stakeholder groups agreed that educational actors need to take care in stimulating an interest in science via science education. This proposed action can be considered at the individual (i.e., teachers) or societal level (i.e., policy). In our data, participants mostly focused on the individual level, by pointing to the role that teachers play in engaging students in science. However, scaling this action, and thus systematically amplifying its impact, would require action at the policy level in relation to science curricula and science education pedagogies.

Participants in the general public referred to the key role that teachers play in creating an interest in science and called for a shift in the pedagogical approaches used to teach science. This call was also echoed by participants in the journalists' group, who underlined the need for inquiry-based science education as a way of cultivating a scientific mindset, prompting one to be driven by questions rather than answers. An inquiry-based pedagogical approach closely models the scientific method (Pedaste et al., 2015), and can prepare students from a young age to conceptually understand the concept of scientific uncertainty (Metz, 2004). Participants in the scientists' group also emphasized the key role that teachers play, as conveyors of science for students at a young age. Stimulating science education within formal education, may increase trust in science by enhancing science literacy, and thus the public's understanding of science. Table 2 provides illustrative examples from participants, in relation to this action.

Actions for Amplifying Science Communication

There was also agreement on the actions that need to be taken by media actors. Participants across all three groups mentioned the value of spotlighting science in the media, and widening the news agenda to include news stories that explore scientific issues. Participants in the general public and journalists' groups, considered this to be a responsibility that falls on public service broadcasters.

Participants also agreed that science communication or science journalism should be funded. For instance, while open science practices are mandated in research projects, publishing in open-access journal articles is costly, and this cost may not be included in the budget of a research project. Scientists recognized that while science communication of funded projects is required, a different approach might need to be instituted (i.e., public engagement activities) in order to bring science closer to the public. Science journalists also pointed to

Table 2 Illustrative excerpts of overlapping proposed actions for educational actors across stakeholder groups

Action for Educational Actors: Stimulating Science Education	
General Public	"I think that the first step should be taken with children in school. Give them the incentive to work in groups, with the contribution and guidance of their teacher. Give them a topic, that interests them as well, and they will have an interest in searching for it." (FG#1 [CYP, GP, LIV])
Journalists	"It needs to start from education. […] I think they need to shake things around. They need to not tell us what's going on. Just give us a task and say go away and do this little experiment. Form a theory, find some results, and then come back and try and interpret those results and see if it agrees with what we already know. I think it should be done in reverse rather than telling people what to expect… Or, you know, grow three plants, one of them with water and sunlight, one of them with no water, one of them with no sunlight. Come back and tell me how the plants are doing and then we'll try and figure out why. Rather than teaching the whole cycle for photosynthesis and then be like, OK, now you do it in practice because it doesn't work like that. Science doesn't work like that." (Participant #2 [CYP, J, WEB])
Scientists	"The first contact with the definition of science is in school. So I think it will be very important. (…) For teachers to communicate the purpose of science and the importance of science and try to build trust, in children, from early age. And not to be afraid of being suspicious, of being skeptical, and to understand that persons of science are characterized by integrity, honesty, genuine interest, that is a what scientists are, and that maybe sometimes we make mistakes. Each one in their discipline, but the person that is worth trusting is the one that can admit their mistakes… tries to correct them." (FG #1 [GRE, R, WEB])

the limited funding they have available to produce science stories. Table 3 provides illustrative examples of actions participants mentioned for media actors and RFOs.

Communicating science was also regarded as being the purview of scientists. All three stakeholder groups proposed that scientists should proactively engage in science communication, but each group valued this for different purposes. For instance, participants in the general public considered this action essential because it would bring scientists closer to the community; participants in this group valued this connection with scientific experts, especially since it could also involve them learning about something they did not know. On the other hand, participants in the journalists' group proposed this action to facilitate their own role as conveyors of scientific findings. Relatedly, participants in the scientists' group proposed this action as a means of quality assurance for news science stories, and science integration in the news agenda.

Participants also pointed to actions for academic institutions, since in order to engage in science communication, the necessary resources and incentives need to be in place to encourage engagement in the public sphere. This was mainly mentioned by the participants in the journalists and scientists' group, illustrating the two-fold challenge that this action is meant to address: on the one hand, institutional resources could enhance scientists' skills in public communication with a non-expert public (i.e., journalists, the general public), and on the other hand, it could incentivize participation in the media sphere. Table 4 indicates some examples from the data concerning actions that scientists and academic institutions can take to widen science communication efforts and reach.

Table 3 Illustrative excerpts of overlapping proposed actions for media actors and RFOs across stakeholder groups

Action for Media Actors: Increase Science Stories in the Media	
General Public	"If the state TV channel would present [science topics] consecutively, most people watch the state channel. Because the other [private] channels have their interests, whereas the state channel, [represents] the state." (FG #2 [CYP, GP, LIV])
Journalists	"When part of a television programme or radio show or a newspaper or website will be dedicated to science issues, which will channel or be made in collaboration with scientific actors, for example. It would be a good way, I think, of starting a relationship of trust and establishing it so that the world can also know that when you go to the website of [the public service media channel] or newspaper, or whoever else, and go to the Science section, and there won't only be stories about the moon, i.e., there is a full moon tonight or I don't know what. There will be other [scientific] stories. Or even in health, for example, it will have a 'Scientific News' section. The same goes for technology." (Participant #3 [CYP, J, WEB])
Scientists	"The interesting thing we see is media organisations that are more inclined to have programmes employing scientists, or someone with scientific training. That is, they actually bring in scientists to the discussion, and it isn't non-scientists presenting the work of scientists." (Participant #17 [IRE, R, LIV])
Action for RFOs: Fund Science Communication / Science Journalism	
General public	"There are political and economic reasons why scientists may find it difficult to pass on scientific data, and unfortunately the cost is a problem. And what's more, it costs a lot to get published, and that's what a friend of mine who used to be a researcher told me, which means that a lot of scientists can't publish, so in the end we don't have access to all the science." (FG #1 [FRA, GP, LIV])
Journalists	"So right now the major obstacle from what I can do and the group of journalists I work with, is really funding. So we are getting funded by private foundations and if we had a big grant of some, let's say a million euros a year that will make a big difference for us. We are doing well now with much less, but I really think that if we were funded, you can say on a comparable level as main media, I think we could make a difference and we will not be representing the university. We will be representing journalism." (FG #2 [CYP, J, WEB])
Scientists	"Funding organizations could sort of earmark funds that they give in a context of a research proposal or of a research grant. They could earmark funds for activities that specifically address public needs and public information. So that's the one of the things that I could think of where funding agencies could play a role." (FG #1 [GRE, R, LIV])

Actions for Policymakers: Regulate Social Media Platforms

Journalists and the general public both indicated that policymakers need to take an active role in regulating social media platforms, who bear responsibility for the dissemination of science, but also hold potential for creating an interest in science. Table 5 provides illustrative examples across participants, in relation to this action.

Conclusions

Societal trust in science is built and relatively influenced by various actors performing in the public sphere. Policymakers play a pivotal role through their influence on trust in science debates and agendas, which can vary based on their policies' effectiveness and ability to

Table 4 Illustrative examples of overlapping proposed actions for scientists across stakeholder groups

Action for Scientists: **Proactively Engage in Science Communication**	
General Public	"It's Science that should reach out to the people, the scientists. There are municipalities, organized groups, associations, groups, it's so easy." (FG#2 [CYP, GP, LIV])
Journalists	"From what I understand, sometimes [science communication] is also an obligation, issuing a press release in something related to scientific research. It shouldn't be so procedural. It is indeed in the interest of the researcher, of the scientist, after all, to inform the public about the subject they are engaged with. That's the most important thing. Then with the help of journalists, the researcher will have to chase it up, pick up the phone and say… Show readiness anyway, communicate the issue." (Participant #1 [CYP, J, WEB])
Scientists	"We're very dependent on the person in the middle and that person is, to me, generally speaking, the national media or something, some other organisation, and we need to think about how actually they're presenting signs, because I think there's a massive difference between what they're saying and what their agenda is and what it is that they want and maybe what if we, like, the scientific community is saying and what the scientific community wants. So, I don't know if the scientific community should take full ownership of the communication process, but certainly they definitely need to be more involved within it." (FG #1 [IRE, R, LIV])
Action for Academic Institutions: **Provide Institutional Mechanisms that Facilitate Science Communication**	
Journalists	"So the training for scientists to speak with a lay public is also important. So to have a science communication office in [academic] institutions that train scientists to speak to the public, and to speak to the media, I think it is also important and I think it's still in process." (FG# 2 [CYP, J, WEB])
Scientists	"Scientific institutions should take these steps, because at the end of the day we are also professionals. We're not doing this out of our good hearts, we're professionals. We love what we're doing, but we're professionals and we're getting rated and with KPIs. In terms of all that, we have to follow also the professionals of our jobs. In order for science communication to be active and take these steps, our institutions have to make it part of our job to do that." (FG #1 [CYP, R, LIV])

Table 5 Overlapping proposed actions for policymakers across stakeholder groups

Action for Policymakers: Regulate Social Media Platforms	
General Public	"It's not only an ethical question. In my opinion it can also be regulated that like 5% of the total time in YouTube should be true, scientific and understandable videos to distribute, or I don't know." (FG #1 [AUS, GP, LIV])
Journalists	"I think the educational mission that actually the broadcasters and the editors and the people responsible for social media have, is really low. I mean, social media exists, but they don't have an educational mission. Yeah, they don't have it." (FG #1 [AUS, J, LIV])

communicate scientific uncertainty (Pechar et al., 2018; Landström et al., 2015). Similarly, public funding by governmental agencies seems to significantly enhance the legitimacy and transparency of scientific research. However, private funding introduces potential conflicts of interest, necessitating transparency and adherence to research integrity to maintain public confidence (Caulfield et al., 2014). Academic institutions contribute to trust mostly through their perceived competence and public engagement strategies. Academic integrity (i.e., procedural good science requirements) and research ethics (i.e., ethical relations among stakeholders) are perceived as major pillars of societal trust in science (Magalhães, 2024; Dahal, 2024). However, researchers may face barriers like a lack of communication skills and out-

reach funding. CSOs can foster trust by making scientific information accessible, promoting scientific literacy, and ensuring ethical standards (Millar et al., 2023). Intermediaries like advocacy groups and specialized journalists bridge gaps between scientists and policymakers, fostering understanding and trust in scientific processes. Social media mediate access to scientific information, and can bolster and hinder trust, accounting for why participants called for greater platform regulation. Our research highlights that understanding actors requires considering their contexts and the conditions affecting their role in trust in science.

Regarding who holds responsibility for safeguarding or enhancing trust in science, participants reported that political figures can both hinder and enhance trust in science. Policymakers may undermine credibility by casting doubt on scientific findings for political or economic reasons but can enhance trust by endorsing evidence-based policymaking. The media, were also perceived as a double-edged sword; they may foster doubt due to limited press freedom, and often serve partisan agendas. However, the media can bridge the gap between science and the public by simplifying complex information engagingly, overriding scientific jargon which could make scientists alienating to the public. Scientists' expertise is vital when communicated transparently and humbly. Social media platforms act as mediators, widening access to science; still, due to certain effects of their algorithmically-driven models and lack of source checking, they often pose risks by rapidly spreading misinformation (Bimber & de Zúñiga, 2020).

Beyond this targeted assessment of actors' role in the contemporary ecosystem of trust in science, our study confirms this phenomenon's relational and systemic nature. Viewing trust in science from this perspective allows us to capture the mediation dynamics and emerging trust drivers in societies characterized by the so-called "distributed trust" (Botsman, 2017; Thunert, 2021). Moving away from essentialism, the above references to each actor's contribution to trust in science necessarily embed trust's social and contextual character. This is because trustors always rely on trustees to assume concrete risks, which involve situational, interactionist and agential components (Hendriks et al., 2015; Cummings, 2014; Peters et al., 1997). Consequently, *trust in action* encompasses specific political strategies and values translated into specific forms of distancing, conflict and collaboration between actors. One example of this is how the value of transparency is often associated with and enabled through participatory activities between researchers and CSOs, although it can also potentially bring legitimacy problems (Millar et al., 2023). CSOs can amplify scientific voices and advocate for science by translating complex information into accessible formats, supporting ethical research practices and influencing ethics public debates around science (Ferretti & Pavone, 2009). Our findings indicate that multi-actor involvement in science communication and public engagement is transversal to cooperative actions that can bolster trust in science.

Along these lines, each group of stakeholders shared particular views regarding the main actions to be implemented to enhance public trust in science and the roles of different stewards of trust in improving this trust; communication and education are at the core of the above stakeholders, highlighting partnerships and collaboration among stewards of trust. The circulation of scientific knowledge efficiently and precisely through various public means is translated into required cooperation aimed at funding, human resources, and governance schemes enabling partnerships. The proposed actions concerning stimulating science interest through education, fostering the public communication of science, and applying a regulatory framework that accounts for the mediating role social media hold in societal

trust in science stress the importance of collaboration, starting with partnerships between politicians, institutions (i.e., academic, funding organizations) and scientists. Despite potential conflicts and contextual dynamics revealed by the literature (Brondi et al., 2021), this relationship is seen as complementary and needed, with scientists providing expertise and politicians leveraging their platforms to highlight scientific relevance.

The educational component is highly valued and recognized as supplementary to the above efforts by cultivating scientific literacy and interest from an early age. Teachers play a critical role in this process, and policy-level interventions are necessary to develop and implement pedagogies that mirror scientific inquiry and foster a deeper understanding of scientific uncertainty. Still, while scientific literacy is often cited in our results, it is seemingly suggested in the spirit of "solutionism", a means of protecting against misinformation and science skepticism; the same applies for the proposal to regulate social media. However, the issue is more complex than that. Research has shown that preexisting beliefs and value judgments significantly influence how individuals interpret scientific information and claims (Nisbet et al., 2015). Therefore, while science education could bolster science literacy, epistemic education, which entails reaching judgments on the basis of epistemic competence (Kuhn et al., 2008), should also be integrated in the curriculum. Epistemic education accounts, acknowledges and addresses individual beliefs, understandings, and values regarding knowledge and knowing, and views epistemic disagreements among experts as a productive space for learning (Chinn et al., 2020).

This study is not without limitations, however. Our samples across the three stakeholder groups varied in terms of age and educational background, and we acknowledge that this could have played a role in our findings. Additionally, it is worth noting that we did not purposely seek out to recruit teachers, or policymakers in this study, even though actions for educators and policymakers were identified in our findings. Future work could include these two stakeholder groups to provide a more nuanced—and informed—understanding of how educators and policymakers can steward trust in science.

The multistakeholder approach adopted to address the research goals of this study enabled us to explore the perceived connections among actors identified and to highlight recommendations for actions that could be taken to enhance trust in science, as indicated by overlapping proposed actions across stakeholders. The findings also suggest that trust in science can be enhanced via multistakeholder collaboration, also indicated in the proposed actions. We acknowledge that the socio-cultural context could play a role in the types of actions mentioned. Still, we encourage more empirical studies exploring trust in science to adopt a multistakeholder lens which can enable exploration crosscutting comparisons and connections that can further a systemic understanding of an ecosystem of trust.

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Declarations

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