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REVIEW

Trust in climate science and climate scientists: A narrative review

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Abstract

Trust in climate science provides the foundation for evidence-based policymaking on climate change mitigation and adaptation and public perceptions of the urgency of climate change. Here we consider the possibility that lack of public trust in climate science and climate scientists may undermine the effectiveness of climate science communication. To this end, we narratively review three topics of relevance to climate science and climate scientists: 1) The current state of trust; 2) Reasons for distrust; 3) How political engagement affects trust. We then draw on insights from communication and behavioral science to recommend how climate change communicators can become more trustworthy.

1. Introduction

According to the Intergovernmental Panel on Climate Change, the window of opportunity to secure a livable and sustainable future is rapidly closing [1]. Yet, global decarbonization is not one of humanity's top priorities, which is exemplified by the fact that most countries are not on track to meet the emissions reduction goal ratified under the Paris Agreement and strategies to meet this goal are lacking [2,3]. This is largely the result of powerful political and economic actors inhibiting action on climate change [4], some of which have sought to undermine public trust in climate science and discredit climate scientists [5–7]. Concomitantly, alarmist views of a crisis of trust in science, including environmental science (see [8]), have emerged [9]. While the evidence suggests that societal inaction on climate change is not primarily caused by attitudes towards climate science [4,10], such attitudes are likely to be *a* factor. Given the urgency to accelerate climate action, this invites the question as to what extent climate science and scientists are trusted and how they should best engage and communicate with the public to preserve, and potentially increase, public trust. While climate scientists are an important source of information about climate change (among many others), we believe that climate scientists benefit from better understanding the public's trust in them, trends, and predictors of trust, as well as how audiences respond to different forms of political engagement by climate scientists.

Social science research has established that appropriately placed trust has positive societal consequences. Information from trusted sources is more likely to be attended to, considered, accepted, and acted upon [11]. This is true across an array of domains, including climate science. Trust in climate science legitimizes evidence-based climate policy and helps decision-makers act in line with the best available evidence when facing and adapting to the climate crisis. Trust in scientists has been found to positively correlate with climate change beliefs [12], concern [13], the willingness to engage in individual mitigation and adaptation behavior [14], support for climate policies [15] and collective action, such as protest behavior [16].

There is growing interest in the science, journalism, and policymaker communities for robust evidence on public trust in science, generally, and particularly in the domain of climate change. Recent research has analyzed the narratives of trust in the literature on public trust in climate science [17], meta-analyzed the relationship between trust and climate change mitigation and adaptation behavior [14], reviewed communication strategies to enhance trust in climate change debates [18], and more broadly, reviewed concerns about a possible crisis of trust in environmental science [8]. Here, we extend these articles by providing an overview of the current state of trust in climate science and scientists.

Rather than providing an exhaustive review, we focus on three topics that we deem to be relevant to climate scientists and communication practitioners: 1) The current state of trust in climate science and climate scientists; 2) The correlates of climate science distrust and skepticism; 3) The effects of political engagement by climate scientists. After synthesizing the literature on the three focal topics, and identifying robust findings and research gaps, we provide recommendations on how to communicate effectively with different audiences in ways that foster public trust in climate scientists. The three topics and their foci were selected based on the most pertinent themes in public and scholarly debates on trust in climate science, previous review articles on the topic, and the expert assessment, experience, and domain expertise of the author team. This narrative review focuses on articles published over the last 10 years (2014–2023).

Trust can be a protean concept. In this article, we define trust as the willingness to accept vulnerability based on the positive expectations of the intentions and behaviors of another actor, organization, or system [19]. Trustworthiness is the perception that someone is worthy of trust. The perceived trustworthiness of scientists is influenced by several factors including perceptions of their: competence, integrity, benevolence, and openness [20,21]. While the literature on trust and trustworthiness is characterized by lack of clear explication of all the relevant constructs, a full explication of these concepts is beyond the scope of this article. Therefore, we have chosen to use the terminology as reported in each of the articles we cite.

2. The current state of trust in climate science and climate scientists

Between 2019 and 2021, the proportion of the global public who said they trust what scientists say about the environment (a lot or a great deal) rose from 57% to 68% [22]. In the 2021 study, 25% of the global public indicated they trust what scientists say about the environment a moderate amount–bringing the total level of moderate or great trust to 93%. However, there are significant regional differences. Trust is highest in South Asia (84% have a lot or a great deal of trust) and lowest in East Asia and the Pacific (57% have a lot or a great deal of trust) [22]. In European countries, trust in climate scientists was found to be similar to trust in scientists generally; in Italy and Poland, trust in climate scientists is slightly higher than trust in scientists generally [8]. In the US, 40% believe that environmental scientists do a good job conducting research all or most of the time and 45% believe that they do a good job some of the time [23].

Further, 38% believe that environmental scientists care about the best interest of the public all or most of the time, and 43% believe that they do some of the time [23]. This is in line with data from the World Economic Forum [22] showing that 85% of the public in North America has a great deal, a lot, or a moderate amount of trust in what scientists say about the environment. In Australia, a slim majority (54%–57%) has been found to trust two IPCC projections [24] and 58% trust scientists as a source of information on climate change (25% trusting a great deal and 33% trusting quite a lot) [25].

These studies indicate that, overall, claims of broad-based distrust in climate/environmental science and scientists are not well supported by evidence (see Gundersen et al., 2022). Data on trust in science in general show mixed results that vary by country; In the US, there is some recent evidence of a decrease of "confidence" in scientists in general from 2020–2023 [26]. Global data from the period 2018–2020 show an increase in trust in science in general in most sampled global regions [27], while in Switzerland (2016–2022) and Germany (2017–2022) levels of trust in science in general have remained relatively stable [28], [29]. On the contrary, across the globe, a strong majority of publics trust climate scientists and climate science. Moreover, one study suggests that climate skepticism (or the belief that human-caused climate change is not a reality) is declining in some countries [30]. Globally only 7% of people place little or no trust in what scientists say about the environment, although in North America the number is 16% [22]. Moreover, because longitudinal survey data on trust in climate scientists are lacking, and the limitations of longitudinal data on related attitudes like climate change beliefs [31], we cannot make inferences about whether there has been a decline of trust over time.

While claims of broad-based distrust do not appear to be well supported, it is important to note that distrust and skepticism, by even a small number of people, can be highly detrimental if they are people in positions of power (e.g., Presidents/PMs, senior government officials, CEOs, or a small but crucial voting block) that decrease support for climate policy [32], or if they actively stall mitigation efforts [6,33–35]. Moreover, researchers have found that traditional survey methods (i.e., direct survey questions) may underestimate the proportion of climate change skeptics, especially among the top 20% of the income distribution in the United States and conservatives in Germany [36].

3. Distrust and skepticism

Even though only a small minority of the global public lacks trust in climate scientists, an important question remains: Who are they, and why do they lack trust? Various studies make clear that low levels of trust and high levels of skepticism regarding climate science prevail among certain societal groups, such as American conservatives, and this may be politically consequential. Understanding the reasons for climate science distrust and skepticism can help climate scientists better understand how to communicate and behave in ways that are conducive to increasing public trust (see Section 5). In the following paragraphs, we narratively summarize some of the main findings that explain climate science distrust and skepticism (for a systematic review on climate change denial see [37]).

Conservative political views

In the U.S., ideological polarization on climate change over the last decades has led conservatives and supporters of free markets and less government interference in the economy [38–40] to hold beliefs about global warming that are inconsistent with the scientific consensus [41,42]. Similarly, the perceived trustworthiness of climate scientists is strongly divided along ideological lines, with Democrats being about twice as likely as Republicans to say they trust climate

scientists as a source of information about global warming [43,44] and state that environmental researchers do a good job and care about the public's interests [23]. Since 2008, the gap in levels of general "confidence" in science between U.S. liberals and conservatives has increased [45]. No data are available on the historical development of political polarization in climate science.

Distrust in climate science among groups of self-identified conservatives and right-leaning voters can be consequential, as they tend to be more likely to spread false and misleading information in their (online) social networks, may be more vocal on social media and get more attention in news media, which could undermine trust in reliable sources of knowledge about climate change [46–48]. However, two studies that looked at the relationship between climate skepticism and political conservatism in 24 countries found that the relationship was strongest in the United States (and other English-speaking) and weaker in most other analyzed countries [49,50].

Religious views

Several articles assess the role of religious and spiritual beliefs for climate skepticism; here, evidence is mixed. In a study of 24 countries, [50] found no effect of religiosity or spirituality on climate skepticism. Rutjens and van der Lee [51] similarly reported no effect of religiosity on climate skepticism in the Netherlands, and Evans and Feng [52] found no evidence that conservative protestantism in the U.S. leads people to have less belief in climate scientists' claims. An estimation of the relative importance of different predictors of negative perceptions of distrust in climate science further shows that religiosity is less important than political partisanship in the U.S. [43]. However, other studies in the US found negative effects of evangelical identity and fundamentalism on climate change beliefs [53,54]. Ecklund et al. [55] show that the relationship between climate skepticism and religious beliefs in the U.S. varies depending on the religious tradition in question: identifying as an evangelical protestant positively correlates with climate change skepticism ($r = .16$) (see also [56,57]), while the correlations with other religious traditions are negligible ($r < +/- .10$). A recent study further found that compared to Protestants, Jewish and non-religious respondents were more likely to believe in climate change being human-caused [58]. Leiserowitz et al. [59] show that 78% of American Catholics strongly or somewhat trust climate scientists as sources of information on global warming, compared to 63% of Evangelicals and 70% of Americans as a whole. It should be noted that several studies found younger conservatives as well as younger evangelicals to be less skeptical than their older counterparts pointing towards a generational divide over climate change [60,61].

Skepticism about scientists' motivations and practices

Across countries, various trustworthiness-related reasons have been identified to explain distrust and skepticism towards climate science and scientists: perceived alarmism and exaggeration by climate scientists [62]; concerns that incentive and funding structures bias climate scientists and their science [63–65]; the belief that scientists gain personally from overstating results [24]; the personal behavior of climate scientists, such as having a high carbon footprint [63,66]; perceptions that some practices of climate scientists are exclusionary and not transparent [24,62,65,67]; and doubt in the accuracy of data and models used by climate scientists [24,62,65].

Additional audience attributes

Other correlates of climate skepticism include an intuitive (vs. analytic) information-processing style [68], lower climate change-specific knowledge [68], stronger social dominance

orientation (i.e., the preference for social hierarchies and inequalities) and economic system justification [38,43], as well as higher intolerance overall, understood as people's absence or rejection of respect for diversity [69].

4. Effects of political engagement by climate scientists on trust

Many climate scientists are politically active. In 2019, for example, over 26,800 scientists in Europe signed a statement in support of the youth climate strikes [70]. Similar calls to action and support for civil disobedience were published in scientific journals and newspapers [71–74]. In a survey of 92 IPCC scientists led by *Nature* [75], two-thirds of respondents reported engaging in climate advocacy, with 40% saying they have contacted lawmakers to advocate for climate policies and 25% saying they joined demonstrations. The role of science in policy-making and advocacy has been debated for decades (e.g., [76]), albeit with only scant empirical evidence about its effect on public perceptions. Recent research has begun to investigate if advocacy by climate change researchers influences perceived trustworthiness. By advocacy, we mean publicly stated support for a particular cause or policy.

Research suggests that the credibility of scientists (what we refer to as trustworthiness) is not affected when scientists advocate in respectful ways for greater climate action in general, or when advocating for climate policies more generally [77,78]. However, advocating for specific climate policies may influence credibility, negatively or positively, depending on the policy [78,79]. For example, in the U.S., Kotcher et al. [78] found that when a climate scientist advocated for strict CO_2 limits on coal-fired power plants it had no effect on perceived credibility of the communicating scientist or trust in climate scientists more generally. However, when the scientist advocated for building more nuclear power plants as a solution to climate change, it reduced perceived credibility in the communicating scientist, but had no effect on trust in climate scientists generally. Beall et al. [79] found that advocating for a non-controversial policy, such as tax rebates for energy-efficient vehicles and solar panels, actually *increased* the perceived credibility of the communicating scientist. This was explained in part by audience perceptions that the scientist was motivated by a desire to serve the public and persuade them to take action. Similarly, when comparing people's views of an advocating vs non-advocating climate scientist, Cologna et al. [77] found that the scientist who openly advocated for stronger climate policy was more likely to be seen as acting in the interest of society than the non-advocating scientist, even though there were no differences in the overall credibility scores between the two scientists. Perceptions that a climate policy advocate cares about people like oneself has been found to increase policy support, while information about their expertise did not [80]. This corroborates the importance of distinguishing between different dimensions of trustworthiness (i.e., competence, integrity, benevolence, openness) when assessing trust in scientists [20].

Contrary to conventional wisdom among critics of scientist advocacy, Beall et al. [79] found that perceptions that a scientist was trying to persuade people to take action was positively related to perceived credibility and that perceptions that the scientist's statement was motivated by their political views had no effect on perceived credibility. Similarly, Rakhimov and Thulin [81] found that advocacy for individual mitigation behavior does not undermine support for policy action, even though they did not specifically look at trust. On the other hand, Palm and colleagues [82] found that when climate scientists recommend individual mitigation behavior (versus recommending support for mitigation policy) Independent and Republican respondents expressed less trust in climate scientists, were less likely to support pro-mitigation candidates, and indicated reduced belief in human-induced climate change, although levels of trust among Democrats were unaffected. More research is needed to substantiate the available

evidence on the effects of advocacy of individual mitigation behavior on trust in climate scientists.

Perceptions of the carbon footprint of scientists who advocate for climate action have been shown to negatively influence their credibility and the behavioral intentions of their audience [66,83]. In two studies, Attari et al. [83] found that a large carbon footprint can greatly reduce the perceived credibility of a climate scientist who provides advice on how to reduce energy use, and negatively affect the audience's intentions to reduce personal energy consumption. Similarly, people have been found to be more likely to support decarbonization policies if the advocate of the policy has a low carbon footprint [66]. Sparkman and Attari [84] also found a negative effect of behavior-advocacy inconsistency on credibility and behavioral intentions. Notably, there is evidence for do-gooder derogation: highly sustainable advocates were found to be marginally less influential than moderately sustainable experts [84].

Support for the policy being advocated for is another important determinant of the perceived trustworthiness of advocating scientists [85,86]. Across two studies in Switzerland, Cologna et al., [85] found that trustworthiness perceptions of a climate change researcher recommending/advocating for policies depended on the respondents' pre-existing support for the policy recommended by the scientist. This finding was also confirmed in a recent study in Germany [86]. When giving policy advice on disputed climate policies (e.g., a ban on domestic flights), scientists can increase trust among participants with low policy support by clearly distinguishing between scientific and political claims [86]. This does not necessarily mean that climate scientists can or should only advocate for policies that are already popular. Climate scientists interested in advocating for policies with lower public support can draw upon research to craft persuasive arguments in favor of those policies, e.g., by emphasizing the co-benefits of action [87–90].

It is important to distinguish between the effects of political engagement on public views about individual scientists and their attitudes towards scientific research more generally. For example, Motta [91] found that perceptions of scientists' trustworthiness became more polarized after the March for Science, with liberals' perceptions becoming more positive and conservatives' perceptions more negative. However, the march had little effect on the public's attitudes about scientific research in general. Motta [91] provides an important contribution to the literature by analyzing a large-scale real-world advocacy action organized by a group of scientists. We encourage future research to distinguish between perceptions of trustworthiness of individual scientists and the larger scientific community and to further investigate real-word advocacy by larger groups of scientists. While existing research mostly focuses on policy and behavioral change advocacy, little is known about how other forms of political engagement, such as civil disobedience, influence scientists' perceived trustworthiness. However, the limited early work in this area suggests that civil disobedience may not undermine the credibility of environmental scientists' research findings [92].

5. Recommendations to increase trustworthiness

Communication and behavioral science provide insights that can help climate scientists and climate science organizations become more trustworthy [20]. These insights hold promise to shift communication from educating and defending to building public trust [93]. This is especially important as scientists are increasingly expected to play an active role in public and political engagement [77,94].

Fostering trust will require scientists to behave and communicate in ways that ensure that others have reasons to see them positively in various domains. One important insight from the research we reviewed is that such communicators should aim to increase trustworthiness

perceptions–i.e. the prerequisites of trusting behavior–by demonstrating competence, benevolence, integrity, and openness [95]. To behave with more integrity, climate scientists should increasingly walk the walk by reducing their personal carbon footprints, especially if they advocate for carbon footprint reductions. Climate scientists should appreciate the fact that public and political engagement can increase public perceptions of benevolence, especially when advocating for policies with high public support. Recent evidence also suggests that benevolence perceptions, and in turn willingness to trust scientists, can be increased by providing prosocial motivations in scientist biographies [96]. As climate skeptics in several countries have voiced concerns that funding structures bias climate scientists and that their practices are not transparent, we suggest that scientists can exhibit more openness by being transparent about their funding and data sources, and by declining funding from sources that entail obvious conflicts of interest [97].

It is important for scientists and practitioners to remember that there is not one monolithic public with one coherent level of trust or perceptions of trustworthiness–there are different groups with different motivations, behaviors, media and information use [98]. Communicators should therefore recognize that certain tactics that work to build trust with some audiences may reduce one's trustworthiness in the eyes of other audiences or have no effect. For example, emphasizing shared values might increase trustworthiness perceptions with some groups, but alienate other groups who do not share these values. However, appeals to broadly shared values, such as the continuance of life on Earth, can be effective at resonating with the wider public (e.g., in the case of ozone depletion; [99,100]).

Perceived trustworthiness is also influenced by audience member's emotional states, including their emotional responses to climate change and to the communicating scientists [101]. Gregersen and Bye [102] found that participants trusted climate change information less when it was provided by a researcher described as angry as compared to a researcher described as sad, or when no emotion was noted (although the effects were small and not replicated in a follow-up study). Climate change information provided by non-emotional researchers (versus sad or angry) was found to be more trusted by participants reporting no sadness or low to moderate anger [102]. Similarly, researchers found that science communicators with aggressive language styles are perceived as less trustworthy than communicators with a neutral style [103]. More research is needed to evaluate how emotions in climate change communications affect scientists' perceived trustworthiness (for a review on emotional climate change communications and narratives see [104]).

When addressing skeptical audiences, we recommend emphasizing the co-benefits of addressing climate change, such as economic development, which has been found to motivate climate change action across ideological divides [87]. Some successful interventions are reported in the literature that may be useful for communicators wishing to engage with skeptical audiences. For example, Goldberg et al. [105] found that a stewardship frame message increased Christian Americans' belief in climate change by increasing perceptions that environmental protection is a moral and religious issue, and that other Christians care about environmental protection [105]. Targeted advertisements designed to appeal to Republicans have also been found to increase Republicans' understanding of the existence, causes and harms of climate change [106]. Other research has shown that raising awareness about the health impacts of climate change can be an effective strategy to increase peoples' cognitive and affective engagement with the issue, including somewhat conservative people [107].

For some audiences, climate scientists are not the most trusted source on global warming [44]. For example, conservative Republicans in the U.S. have higher trust in primary care doctors and television weather forecasters than in climate scientists as sources of information on global warming. When seeking to foster trust, scientists should also consider that they are just one component

in a larger communication ecosystem–and potentially benefit from this. Communicating climate science takes place in "social settings" [108] that involve a range of actors beyond science and the general public, such as science journalists, university press offices, and other "intermediaries" at the science-society interface [109]. These actors can help to convey trustworthiness by serving as access points for the public to engage with climate research. Accordingly, a recent meta-analysis found that media use is positively related to trust in scientists and public belief in climate change [110]. We recommend scientists to engage not only with the public, but also with such intermediaries and other trusted sources of information on global warming.

It is crucial to conceptualize science-society communication not (only) as a top-down endeavor but (also) as a bottom-up process: Communication should not just aim to increase people's understanding of climate science in order to increase its public acceptance–this has been shown to be ineffective or even backfire, as it may trigger resentments of climate skeptics who feel patronized by an allegedly elitist scientific community (see [111]). Rather, climate communication must seek to stimulate genuine engagement through dialogue with the public, which can increase perceptions of openness, which in turn increases the prospects for building bonds of trust. Such engagement opportunities (e.g., citizen science projects, co-creation workshops, or science fairs) are useful because they provide excellent opportunities to demonstrate and communicate key dimensions of trustworthiness. It should be noted that most of the available literature on trust in climate science focuses on the U.S., which might limit the effectiveness of our recommendations in other countries. Nevertheless, we hope that these recommendations can help climate change communicators to engage with different audiences in ways that foster trustworthiness. For readers interested in science-based practitioner guides on climate change communication, we recommend the following guides [112–115].

6. Conclusion

Our narrative review shows that a large share of national publics perceive climate scientists and climate science as trustworthy. However, trust in climate science is politically polarized, particularly in the U.S., where conservatives have lower levels of trust than liberals. Distrust in climate science can be politically consequential and should be taken seriously, even if exhibited by only a minority of the public. We identify several reasons that lead some audiences to be distrustful or skeptical about the competence, integrity, benevolence, and openness of climate scientists–four key dimensions of trustworthiness. Given the narrative style of this review and the continuously developing research on trust in climate science, we invite more systematic reviews on the topic which could help to identify potentially overlooked correlates of (dis)trust in climate science. We find no clear evidence that respectful advocacy by climate scientists negatively affects trustworthiness perceptions. However, the effect of advocacy on perceived trustworthiness seems to be dependent on the policy in question. We provide several recommendations that can help climate change communicators become more trustworthy.

Author Contributions

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