

MOVING (THE FOCUS) FROM DENIAL TO DIALOGUE: THE RECOMMENDED DIRECTIONS FOR COMMUNICATING CLIMATE CHANGE TO NON-EXPERT AUDIENCES BASED ON THE ANALYSIS OF CLIMATE SCIENTISTS' COMMUNICATIVE EXPERIENCES

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ABSTRACT: The article's topic reflects climate scientists' presence and communication in the public sphere, while the main focus is on the two ways a society may respond to the climate scientists' communicative efforts: by denying the scientific messaging (climate change denial) and by engaging in relation-building communication (climate change dialogue). Those aspects were explored from the point of view of American and Polish climate scientists through the method of in-depth interviewing. According to the scientists, as the study results show, the most effective way to enhance science-society dialogue on climate change is to detangle from unproductive denial narratives and truly embrace the dialogic model of science communication by opening it to feedback, including honest societal scepticism.

KEY WORDS: Climate change communication, science communication, climate change denial, climate scientists, scientific consensus on climate change

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Introduction

The article's topic reflects climate scientists' presence and communication in the public sphere. At the same time, the main focus is on the two ways a society may respond to the climate scientists' communicative efforts: by denying the scientific messaging (climate change denial) and by engaging in relation-building communication (climate change dialogue). Those aspects were explored from the point of view of American and

Polish climate scientists through the method of in-depth interviewing as part of the broader qualitative study on climate change communication performed by scientists. The focus on scientists involved in public communication was inspired by an observation that when climate change in the context of science-society relations is discussed, we often miss one element in the equation: scientists themselves. While climate scientists are now more visible than ever before, and there is a great demand for their public engagement (Vernon,

Woolley 2019, Cologna et al. 2021, Racimo et al. 2022), the social roles of climate scientists are equally often taken for granted.

First, the author was interested in whether climate scientists believe that climate change deniers remain an essential voice in the climate debate and should be listened to and debated with. The second area of inquiry was how to improve the dialogue between science and society on climate change and to what extent the scientific consensus on climate change facilitates the communication of this knowledge.

According to the scientists, as the results of the study show, the most effective way to promote productive science-society dialogue on climate change is to first truly embrace the dialogic model of science communication (House of Lords 2000, Miller 2001, Bucchi, Trench 2014), and, then, enhance this conversation by investing in more diverse arrays of communicators to support the message as well as opening it to the societal feedback, especially the one that comes from individuals and groups that are 'honestly' sceptical. At the same time, most of the interviewed scientists admitted that although climate deniers are still much present and vocal in public discourse, persuading them to change their position or debunking their communication should not be a priority for climate science communicators the way it was in the past. In the same way, the scientific consensus on climate change may be a helpful tool to communicate climate science, but in terms of climate action, it is 'irrelevant until the broader societal consensus around climate change is built'.

Climate scientists as climate science communicators

Although many societal actors are involved in science communication on climate change, the public generally attributes it to scientists, who, despite recent declines, are trusted to act in the public's best interest. Seventy-seven percentage of Americans have at least a fair amount of trust in scientists (Kennedy et al. 2022). Similarly, as much as 83% of Poles trust scientists, and when it comes to communicating scientific findings and scientific news and reports, 80% reveal that scientists, engineers and documentarians are the most trusted sources of information (State of Science Index 2022).

Therefore, to set the scene for researching the science-society conversation on climate change from the point of view of climate scientists, it is necessary first to define this category of scientists. Innocent as it may seem, an attempt to assign scientists to a particular discipline and the question of who is considered as a climate scientist have already been sparking some polemics within the scientific community. In the 2015 study, Carlton and colleagues (Carlton et al. 2015) examined the climate change consensus beyond climate scientists and focused their research on biophysical science faculty from 12 American universities (all located in the U.S. Midwest). As the project's goal was to assess views about climate from 'non-climate scientists', by the sampling criteria, the team defined who, in their opinion, did not count as a climate scientist. However, among the participants in the survey were representatives of 'biological sciences, natural sciences, physical sciences, earth sciences, agriculture, environmental sciences, natural resources and other geosciences' (Carlton et al. 2015). Setting aside the otherwise encouraging results, the research sample selection has encountered substantive criticism. In his polemic, Steve Newton points to methodological problems with the very narrow definition of 'climate scientist' used in the study paper: almost half of the 'non-climate' participants described climate research as 'some' or 'most' of their work (Newton 2015). In practice, as Newton, a former Programs and Policy Director at the National Centre for Science Education (U.S.), states, 'Climate science is much more than just climatology or atmospheric physics; climate science is very multidisciplinary and integrates fields of knowledge involving not only current changes on Earth but the entire history of Earth's dynamic climate. That means you need researchers who do work as varied as measuring glacial retreat to studying changing migration patterns and struggling marine life to measuring isotopes in gases from delicate air bubbles in cores of ancient ice' (Newton 2015).

Even more problems may be introduced with an attempt to define climate scientists in Polish academic realities. This is because Polish climate science is in a particular position that is not comparable to how climate science is classified elsewhere (Malinowski 2015). Most Polish climate scientists come from two different backgrounds:

geography and physics. Usually, only the former are referred to as climatologists, but when it comes to climate scientists, the term is used more broadly to include representatives of other disciplines, especially atmospheric physicists. In this study, the author interviewed representatives of various disciplines: climatologists with a background in geography and specialising in climatology, atmospheric physicists, as well as representatives of other disciplines whose research or public communication is related to climate change.

Therefore, for this project, the author defines climate scientists broadly not only as scientists directly involved in climatology (the study of the changes in the Earth's climate over time and how they might affect the planet in the future) but also scholars with an interdisciplinary background who identify their research depend on or related to climate change. This interdisciplinary approach is motivated by how climate science developed over time, with interdisciplinarity as one of the postulates to enhance the field. Since the 1990s, scientific research on climate change has included multiple disciplines. Many authors stress that climate change cannot be addressed adequately from the perspective of any single discipline. Schipper et al. (2021) postulate that acceptance of embracing multiple disciplinary perspectives, shifting expectations of public messaging and, above all, looking to integrate the appropriate disciplines that can help understand human systems to mediate action in a better manner.

Material and methods

The qualitative data used for examining the concepts of climate change denial and science-society dialogue on climate change was obtained through in-depth interviews conducted with American and Polish climate scientists in two stages: (1) Conducting a study regarding American climate scientists in 2022 in the United States and (2) Interviewing of Polish climate scientists in 2023. Both studies have become part of the author's doctoral thesis, 'Characteristics of climate science communication. An optimisation model for communication processes related to the popularisation of scientific knowledge

based on American and Polish climate scientists' recommendations' (2024). In this paper, the author presents and discusses with a focus on the research results that are directly related to communication with climate change deniers and improving the dialogic aspects of climate science communication.

As a method, in-depth interviews help explain, better understand, and explore research subjects' opinions, behaviour, or experiences. An in-depth interviewing process is often described as a form of open conversation (Burgess 1982), yet this is a 'conversation with a purpose' (Webb, Webb 1932), which is gaining a deeper understanding of participants' experiences in a way that is specific to their context. The interviews were based on a semi-structured questionnaire that, among others, included questions about dealing with the rejection of climate science (climate change denial) and experiences related to communicating climate science publicly. The questions posed to the climate scientists that were directly related to the issue presented in the article were as follows:

1. Do you think that climate scientists are good science communicators?
2. What are the most significant difficulties you encounter while communicating climate science to the non-expert public?
3. What is the scientific consensus on climate change?
4. Is scientific consensus on climate change an effective climate communication tool?
5. How would you define climate change denial?
6. Have you encountered communication suggesting climate change denialism, and in what form?
7. Have you communicated publicly or privately with climate denialists on any occasion?
8. How did this communication go?
9. Have you experienced any form of verbal attacks related to your research and/or climate science popularisation activities?
10. How would you describe the science-society relationship in Poland/in the United States?
11. How can we improve public discussion on climate change and build societal consensus around the issue?

It is also important to mention that due to the semi-structured character of the questionnaire, the author, as a researcher conducting the

in-depth interview, was open to additional information that the participants were willing to share within the thematic framework.

The apparent limitation of the in-depth interview method is the relatively small samples that make it difficult to generalise findings to a larger population; however, considering both strengths and weaknesses of the method, the author decided to use an in-depth interview because there is only a limited number of qualitative studies involving climate scientists and the main goal is to gain a deep understanding of their communicative practices. The sample for this study is composed of 16 climate scientists [N = 16], 8 of whom are American climate scientists (CS_USA 1-8) and 8 representatives of Polish climate science (CS_PL 1-8). The recruitment process was based on snowball sampling, with additional consideration given to maximum variation. This ensured that the selected participants represented a wide range of perspectives related to the research topic, thereby strengthening the inclusiveness of the study and helping to avoid the 'echo chambers' effect.

The required characteristic of the potential participants is that they must be climate scientists involved in climate science communication (public speaking, popularisation events, media, social media, advocacy or activism) and willing to share their experiences and strategies for communicating climate change to non-expert public, dealing with climate denial, as well as enhancing science-society dialogue on climate change, its risks, mitigation and adaptation. The sampled participants are representatives of different institutions. In the case of the United States, this means that scientists come from both public and private academic institutions. In the case of Polish universities and research centres, the author of the study also focuses on diversity and the broadest possible representation but points out that Polish climate scientists are relatively seldom involved in science communication, and some obvious choices were necessary and could not be substituted.

All the interviews were conducted in online venues (on Zoom and M.S. Teams platforms) in two languages, English and Polish. During the interviews, the automatic transcription was activated. For both groups of transcriptions, the author used the same analytical tool – 2022 MAXQDA Analytic Pro and thematic analysis as a method.

For a standardised presentation of the results, the author translated the statements of the Polish scientists into English.

Scientific consensus on climate change as a referring point for denial and dialogue

Before presenting the results, the author finds it necessary to explore further the notion of the scientific consensus on climate change as it constitutes a crucial aspect for both climate change denial responses and the science-society dialogue on climate change. Expanding on this thought, on the one hand, deniers, by definition, reject or try to undermine the concept of the scientific consensus on climate change. On the other, information about the extent of the scientific consensus on climate change can serve as a tool for communicating scientific findings about anthropogenic climate change and enhancing societal understanding of climate science. Some scholars believe the consensus itself to be the answer to the shortcomings of climate messaging as it has a 'tremendous communication appeal' (Lewandowsky et al. 2013, Hornsey, Fielding 2019, van der Linden et al. 2019).

Only a few instances in the history of science have seen almost all experts in a particular field agree on a particular topic; however, climate change is one of those instances (van der Linden et al. 2016). Nearly three decades of research have led to the conclusion that almost 99% of climate scientists have independently reached a consensus that human-caused global warming is happening. These findings form the foundation of the scientific consensus on climate change, which is defined as scientific agreement regarding the following points: Earth's climate has warmed significantly since the beginning of the Industrial Revolution, and greenhouse gas emissions are the leading cause of global warming; Further emissions will likely increase the global temperatures as well as likelihood and severity of environmental global change effects; People and nations can and should act individually and collectively to mitigate and adapt to unavoidable climate change and its consequences. The consensus is supported by various studies of scientists' opinions and by position statements of scientific organisations (American Association for the Advancement of Science, American Meteorological Society, Polish

Academy of Science and Intergovernmental Panel on Climate Change, to name a few examples). In addition, these main points are not disputed by any national or international scientific body. The American Association of Petroleum Geologists was the last scientific body to drop a dissent in 2007 when it updated its statement into a non-committal position (Oreskes 2007). Similarly, several organisations, primarily those affiliated with geology, also hold non-committal positions.

One of the methods of assessing the extent of consensus among climate scientists is by analysing the peer-reviewed papers published on the topic related to climate change (Oreskes 2004, Doran, Zimmerman 2009, Anderegg et al. 2010, Cook 2016, Cook et al. 2013, 2016). The most recent studies, including peer-reviewed climate papers, indicate a consensus of 98% or more (Lynas et al. 2021, Myers et al. 2021). However, despite overwhelming agreement among scientists, scientific consensus on climate change does not effectively reach the public perception and translate into meaningful change (Hornsey, Fielding 2019). Surveys consistently find that both the American and European public underestimate the extent of the scientists' consensus, likely due to the spread of misinformation, denial, and high politicisation of climate science (Druckman 2017, Bayes et al. 2023). At present, only about 1 out of 10 Americans understand the level of scientific consensus on human-caused climate change (van der Linden et al. 2016). These findings are consistent with previous results of an international survey across 16 nations, where only 51% of respondents believed that 'most scientists think that the problem is urgent and enough is known to take action' (World Public Opinion Poll 2009). Similarly, in Poland and other European countries, public opinion underestimates the extent of the scientific consensus on climate change. The survey conducted in six European countries found that, according to Poles, 'only 66% of scientists recognise that human action causes climate change' (PERITIA 2022). When it comes to recognising the actual level of scientific consensus on climate change, representatives of the other countries surveyed fare little better than Poles. The highest result (71%) was recorded in Ireland (PAN 2022, PERITIA 2022).

Numerous studies and scholars discuss whether it is true that the recognition of the

almost unanimous agreement among experts by the public will lead towards bridging the knowledge-action gap and increasing support for science-based steps to mitigate and adapt to climate change (Maibach et al. 2014, van der Linden et al. 2015, Bayes et al. 2023). The author of this paper also asked scientists whether they think consensus is helping to strengthen public support for scientifically backed climate action. Overall, the majority, though not all scientists involved in the study, state that the scientific consensus is a helpful concept when communicating climate science but not the one that will immediately solve all communication problems they encounter in their practice. Although some of them underline that *it works very strongly on people's perception when there is a crowd behind some words*, a mechanism often used in clickbait titles (CS_PL7), they also express concern that not all non-experts understand the cause-and-effect relationships the consensus captures. In contrast, many people believe that being right about climate change can be achieved through discussion and negotiation and that the position of those with different opinions is also scientifically important (CS_PL2). Therefore, the scientific consensus on climate change should not only be expressed in the public sphere, but also the idea behind it must be thoroughly explained to the public.

Another aspect that is counterproductive in terms of communication is related to the fact that the definition of consensus as scientific does not fit in with the way climate change is thought about today. Even scientists themselves are no longer thinking about climate change solely in scientific terms and are advocating a broader view: *It is a societal problem, collective action problem. It is a political, or social problem, more than a scientific and technical one at this point* (CS_USA1). Moreover, the scientific consensus on climate change may not be a sufficient argument, especially when addressing denial or in-group thinking as well as a polarised audience. As one of the participants suggests, *Sometimes a grey area and some resistance is more persuasive than showing absolute agreement* (CS_USA2). While the scientific consensus on climate change represents an unprecedented level of scientific unanimity around a socially controversial issue, and scientists point out that values above 97% have 'advertising' value, scientists strongly emphasise that the problem of climate

change communication is not solely scientific, and, therefore, that no amount of expert agreement can compete with information and opinions transmitted through close personal relations and groups; *even consensus cannot always stand up to a heart-to-heart connection that has given someone their views* (CS_USA8).

On the whole, the scientific consensus on climate change is not a communication tool that opens all doors, including those behind which deniers are barricaded. However, it is worth noting, and according to climate scientists who act as science communicators, invoking it can be beneficial and is a step in the right direction. *The consensus in the scientific community is irrelevant because until we get and build enough of a societal consensus, we are not going to do what is necessary. But, as it turns out, communicating the extent of the scientific consensus helps to move us in the direction of building a societal consensus* (CS_USA4).

Strategies to communicate with climate change deniers

Responding to climate change, as Hornsey and Fielding state, is often described as 'the greatest economic and environmental challenge of our time, yet the window for providing solutions is closing' (Hornsey, Fielding 2019). As a starting point on the axis towards increasing public support for scientifically backed climate action, the author adopted climate change denial, that is, the complete or partial rejection of scientific consensus on climate change and the situation where a science-society conversation is impossible or significantly impeded. Climate change denial is defined as 'denial, dismissal, or unwarranted doubt that contradicts the scientific consensus on climate change, including the extent to which humans cause it, its effects on nature and human society, or the potential of adaptation to global warming by human actions' (ECPS, Dictionary of Populism). Although this definition performs its function by all means, quite paradoxically, there is no such thing as climate change deniers because, as Farmer and Cook argue, no one, even deniers, denies the fact that climate has been changing. On the contrary, most deniers use the data on the past climate cycles as proof that global warming is a natural phenomenon similar to the ones already happening in the Earth's history

(Farmer, Cook 2013a, b). That is why most definitions of climate change denial refer rather to negating the already defined scientific consensus on climate change.

As part of the study, the author asked the climate scientists participating in in-depth interviews about their experiences with climate change denial and strategies to communicate with deniers. It is important to note here that the perception of climate science denialism may significantly vary depending on the country where the scientist comes from. Deniers' attacks on American scientists have been gaining momentum ever since James Hansen spoke before Congress in 1988 and publicised the real risks of global warming (Hansen et al. 1988). With solid confidence, Hansen, then a NASA scientist, stated that the climate was warming and that this change, very likely of human-made cause, would lead to weather anomalies of disastrous consequences, including droughts, storms and floods. Even though there was a significant scientific consensus on these forecasts, climate deniers, supported by the fossil fuel industry, responded with a 'global warming conspiracy' (Weart 2011) campaign that hindered new environmental regulations. This campaign would continue for the next two decades with observable successes in influencing the public perception of climate science. Since that time, deniers, including contrarian scientists, orchestrated and funded by vested interest groups, have routinely organised attacks on scientists communicating climate change and advocating climate policy (Oreskes, Conway 2010).

On the one hand, American climate scientists play the active role of whistle-blowers and pioneers; they are the voices that international academia follows. On the other hand, when it comes to communicating about climate change, probably no other democratic country produces as much pseudoscience and science denial as the United States. This is partly confirmed by the words of one of the participants in the study, who notes: *Climate change denial is our export commodity* (CS_USA4). Nevertheless, climate change denial as a societal reaction to climate science is not characteristic only of U.S. citizens; contrary, it has a universal character. From a global perspective, there is a relatively high level of scepticism about climate change in Saudi Arabia, Indonesia, and the United States, and it is relatively low

in China and Europe (Milman, Harvey 2019). However, denial narratives can easily be found in European and, to a large extent, Polish climate debates. What distinguishes the United States from other nations is the degree of institutionalisation of climate denial. In the United States, climate denialism has an organised and well-funded structure (Dunlap, McCright 2015), resulting in >90% of academic papers being sceptical of climate change coming from right-wing think tanks (Xifra 2016).

Moreover, a few dominant discourses have emerged within climate change denial over the last three decades (Dunlap, McCright 2010). First, the denial took the form of denying global warming itself, followed by the denial of its anthropogenic cause, or lack of evidence that supports human-caused climate change, and finally, the denial of the seriousness of its consequences whatsoever became dominant (Dunlap, McCright 2011, Farmer, Cook 2013a, b). According to Mann (2021), a renowned climatologist who has faced decades of attacks initiated by denial camps, delay (in mitigating climate change) has become the new form of denial. 'One can no longer credibly deny that climate change is real, human-caused, and a threat to our civilisation', Mann notes in his Op-Ed published in Los Angeles Times and explains that because of this shift, 'the forces of inaction - the fossil fuel interests and the front groups, organisations and mouthpieces-for-hire they fund - have been forced to turn to other tactics in their effort to keep us dependent on fossil fuels' (Mann 2021). These denial tactics, according to Mann (2021), include deflection (emphasising individual behavioural changes and diverting attention from necessary systemic changes), division (inciting activists to fight among themselves and weakening their united front), and doomism (convincing public opinion that 'it is too late to do anything anyway'). What binds all of these discourses together is the rejection of the scientific method on the one hand and, on the other, applying what nowadays would be called the deniers' attempt to 'cancel' scientists who communicate climate change publicly. By misrepresenting science, deniers traditionally weakened the scientists' claims, and they were particularly successful in doing so when it came to climate science and scientific facts concerning anthropogenic climate change.

Many authors try to propose an effective response strategy to climate change denial. This is also the subject of the author's qualitative study. As shown in the literature on climate denial, the first thing scholars need to acknowledge is that a meaningful discourse may not be possible when one party avoids following the rules agreed upon by the academic community. Therefore, responding to climate change denial may pose a certain difficulty for scientists accustomed to certain standards of debate. According to Diethelm and McKee, the standard academic response to a counterargument is to engage with it, testing the strengths and weaknesses of the various views in the expectation that the truth will be revealed through a process of debate. However, this requires both parties to follow specific rules, such as a willingness to consider the evidence as a whole, rejection of deliberate distortions and acceptance of principles of logic (Diethelm, McKee 2009). Nevertheless, these scholars point out that refusing deniers' right to have a stance could be even more harmful than the inconvenience of dealing with a difficult partner to have a conversation about climate change. The author aimed to examine whether climate scientists who are practically involved in climate change communication share this view and to what extent they are willing to communicate and argue with deniers in the public sphere.

When dealing with climate deniers, study participants suggest that communicators must answer two questions: whether to engage in the discussion at all and, if the answer is positive, how to communicate scientific facts to people who are highly likely to be in denial. Some scientists recommend ignoring the deniers altogether (CS_USA3, CS_USA5), while others admit that they would avoid such confrontations if possible (CS_PL4, CS_PL6). Interacting under limited circumstances and necessarily in public was also among the recommended strategies for communicating with climate change deniers. Scientists (CS_USA1, CS_USA7) advise against trying to communicate so that only one unconvinced person will be reached. However, suppose there is a chance for the exchange of arguments to reach a wider audience, for example, by commenting on publicly available social media, encourage such an attempt to communicate. In that case, there is a chance to reach people who are both concerned

about climate change and hold moderate positions on the spectrum of denial ('a means to reach the middle' strategy).

Scientists take different approaches when communicating with climate sceptics or deniers during public events. One of them described an elaborate and effective strategy they use every time: *If I have a meeting in some group that I do not know much about at all, where there may be different people, the first thing I have to do is to build a relationship. It is a relationship based on the assumption that I know more about the topic. I ask questions that are very simple on the one hand, but on the other hand, the answers are very non-obvious, which means, for example, I ask how much air is there. How thick is the atmosphere?* (CS_PL3). This participant describes that as a result of such a conversation with the audience, a relationship is built that confirms the scientist's competence and knowledge and weakens the possible claims from deniers who are among the public. Moreover, some scientists believe that at this point, climate change deniers constitute only a margin of opinions and that the *let them be* approach will be more beneficial than wasting the energy to get them to believe (CS_USA2).

I wish we had wasted less time worrying about denial because I just don't think it was ever as big of an issue as people think it was. And so, we've wasted all this time trying to get 15% of the population to be believers instead of focusing on what is happening to that coalition of the willing. Over the last couple of decades, there have already been way more people on board. They're [deniers] very vocal, but I don't think there are many of them, and I think that certain climate scientists have really tended to focus on those few denialists versus just going, who cares, they're already on the margins, and they're way more people in the non-denial camp (CS_USA2).

One participant urges scientists not only to allow but also to encourage people to be sceptical about climate change and science and actively seek answers in the hope that they will be more convinced when they get to the information themselves (CS_USA5). At the same time, another advises that *just not getting the segment of people that deny climate change angry by the message is already a successful climate change communication* (CS_USA4).

Based on the conducted interviews, the author can conclude that currently, the most significant part of communication between scientists and

deniers is conducted online (emails, comments, social media). In relation to that, one participant in the study points out an overrepresentation of climate deniers among those commenting on climate science articles and news. Nearly 65% of climate scientists admit that they avoid online confrontations with deniers, who may be much more active and vocal online than the rest of the population but are not representative of the general public and are a distraction rather than a real threat to communication of the scientific facts.

Recommendation for enhancing science-society dialogue on climate change

As one can observe, climate science communication does not take place in isolation from society but within the framework of society, even and especially when society expresses opposition to the information being communicated. Therefore, the author intended to collect climate scientists' recommendations on how to improve the dialogue between science and society regarding the climate issue that would transform the scientific consensus on climate change into a broader and more far-reaching impact and societal consensus on science-backed climate actions.

In line with what can be found in the literature on communicating climate science to broad, non-expert audiences to influence their behaviours (Cook, Overpeck 2019), both U.S. and Polish climate scientists have pointed to the relationship-building process as fundamental for effective climate science communication. Regarding science communication theory, it indicates that scientists are aware of the need to move from information transfer, also known as the deficit model, to more dialogic interaction with the general public. Furthermore, in order to improve the science-society dialogue on climate change, one scientist (CS_USA2) suggests that communication should be considered part of the relationship challenge. The recommendation was to re-envision the relationship between scientists and members of the public as well as, on a more general scale, between humans and the planet. In reorganising the communication order, this scientist suggests tearing down the notion of the 'ivory tower' (understood as academic disconnection from the practical concerns of everyday life) and making scientists more open to the fact

that the public may question their authority. The scientist also suggested that the academic community should focus less on producing and performing authority and more on playing its social role and experiencing climate change together with other citizens.

I suggest focusing much more on a sort of human relationship where scientists are much humbler and not so 'we have all the answers about things'. That is where I see us as a community getting in the most trouble all the time. It's by kind of putting forward solutions that are not grounded in reality (...). More openness to questioning societal authority for science. The structural change on the expert community side. Scientists walk into a room where they don't know anything and act like they do know. This idea of the ivory tower is actually antithetical to what we need to be doing. I would really like to see us focus way less on just the production and the performance of scientific authority and just be, like I said, in the mess with everybody else. This is a giant mess. We're all in it, and we all have a role to play (CS_USA2).

Another recommendation that can be categorised as related to the relationship between the communicators and the audiences is to develop a more attentive approach and two-sidedness when it comes to talking about listening (CS_USA2, CS_USA5). It is traditionally assumed that the public does not listen to scientists, jokingly, that the fact that the public does not listen to scientists begins every catastrophic movie; however, the audience's questions should be just as important part of the discourse as the answers given by scientists. According to the participants referred to earlier, climate scientists should listen and address societal inquiries carefully and not just come with a ready-made, predetermined message indicating that they 'know everything best'. This recommendation challenges what is commonly found in science communication curriculum by shifting part of the emphasis away from speaking and, instead, valuing scientists-communicators for active and attentive listening.

There can be this sense that just because you're a scientist, you understand all science, or you're an expert in everything. And that's so far from the truth. That's why I have such a big focus in my own practice and my own writing on stuff about listening because I think there's been such an enormous focus on scientists talking better. That's been the entire science communication focus since I've been a scientist,

and there's just been zero focus on listening. And again, I think that's caused us major, major problems (CS_USA2).

I think we have a listening problem. I think that just creates distrust, and I think it's a full-heartedly earned source of distrust. This idea of elitism doesn't come from nowhere, that stereotype. There's a lot of I know something you don't know about your community, and I'm going to tell you how to fix it, and that is just not the right way to do this work (CS_USA5).

Some participants made an equally interesting and thought-provoking suggestion (CS_PL6, CS_PL8) that providing information about climate change online by scientists simply is no substitute for their in-person contact with the audience. While disseminating information is crucial, in-person interactions with scientists also improve understanding of climate science and can inspire pro-climate actions as well as re-establish the role of the university as a place of meeting and open exchange of ideas, not just knowledge transfer oriented towards a closed group of students.

I am convinced that a scientist should show a civic attitude. Well, but it must involve something more than knowledge. It should be a display of emotions, feelings, concerns, and responsibility for this nature. To reach out to the public with this message as much as possible at all costs (CS_PL6).

There is not enough focus on live meetings. So that's what I say sometimes; I'm already a little tired of all this writing. Well, no one reads it after all. There is too little live contact, as it should. In-person meetings between scientists and the general public should be part of what universities do (CS_PL8).

In this view, interaction must be as meaningful as information when it comes to improving the dialogue between science and society on climate change and further emphasises the social role of climate scientists. There is no doubt that the 'scientific understanding of climate change', as Knutti points out, 'has accelerated in recent decades, but climate action has not kept pace' (Knutti 2019). At the same time, most scholars indicate that much can be done to improve scientific communication with the general public (Moser, Dilling 2011, Moser, Dilling 2007). Thus, when not a lack of information stands in the way of needed change, it may be a lack of meaningful interaction or the 'communication gap between scientists and the public' (Hunter 2016).

Discussion

The key findings of this study concern the continued need to develop climate change communication based on dialogic models. These are not only the recommendations advocated by scholars involved in science communication studies as a sub-discipline of social communication but also by climate scientists actively engaged in communication processes related to the dissemination of knowledge about climate change on a daily basis and as part of their academic and beyond-academic (outreach) activities.

Scientists are aware of the special considerations in communicating climate science, which are unique even within the framework of scientific communication and require considerable diligence and care. Traditionally, scientific disciplines developed their deliberations in isolation from social systems; today, scientific reflection on complex problems like climate change – also presented as a ‘wicked problem’ (Rittel, Webber 1973, Hulme 2009) – must include a profound synthesis of multiple systems: from our bodies to the ecosystem to the entire planet. This is both a scientific and a communicative challenge. However, as one of the participants interviewed for this study points out, climate science communication is less about progressing climate science and more about achieving better results with the information that scientists already have (CS_USA5). In order to use this information effectively, scientists need to exist in public and should be open to feedback coming from other social actors involved in communication. Hence, ‘global climate change’, as Dietram Scheufele, a life sciences communication expert, notes, ‘is not just a political problem or a communication problem or an oceanic and atmospheric problem. It’s all of the above – it’s science meeting society’ (Chapman 2013). The process for such a meeting is an open one, which means that scientists who want to communicate climate science to the general public have to accept that their interaction may also take the form of confrontation when a dismissive audience is involved.

However, the empirical data makes it possible to conclude that scientists no longer engage extensively in fighting with deniers. While they acknowledge the presence of climate change denial and face it regularly, in their opinion, the

group of contrarians does not pose a real risk of distorting the communication and is ‘overhyped’ through online exposure.

Another important statement is that, according to climate scientists, the role of climate change deniers as social actors who could have a tangible impact on public thinking about climate change is diminishing. Therefore, engaging in public dialogue with deniers can be counterproductive. In this case, both American and Polish scientists concur.

When it comes to communicating scientific facts to sceptical audiences, the scientists recommend moving away from confronting deniers and, instead, focusing communicative efforts on an audience that has no formed opinion yet or is looking for information. Furthermore, this also translates into moving from fact-checking to fact-telling. As one of the scientists points out (CS_PL2), this strategy implies that although debunking and straightening out misconceptions in the audience’s understanding of climate science is essential, the knowledge communication cannot be entirely based on that. *There are fewer and fewer misconceptions in the public sphere that need debunking, so there is less and less opportunity to respond to them and use them in your communication. It is time to start encouraging interest in new topics, introducing new concepts and presenting a more general perspective on climate issues or science* (CS_PL2).

In their search for the ideal model and strategy for communicating climate science, scientists seem to have disentangled themselves from years of public wars with deniers, as well as made their message independent of climate denial communication. Such a step may have also been made possible by a change in the attitude of many media outlets (for instance, BBC), which have stopped supporting the ‘false balance’ (Imundo, Rapp 2022) understood as inviting scientists and deniers to their programs as experts on equal footing. However, scientists emphasise the need for constructive dialogue with sceptical publics that are open to climate science communication. They are referring primarily to genuine information-seekers whose scepticism does not preclude a change of heart when presented with reliable and non-repudiable facts.

However, in their statements, participants in the study did not refer to new forms of climate

change denial such as those indicated by Mann (2021; 'delay is a new denial'); this may have to do with the fact that such denialism affects predominantly those active in the science advice and policy-making sphere rather than pure science. In the recently published report, 'New Climate Negationism. How populism in Poland influences our thinking about climate change', Sadura et al. (2023) emphasise the 'new climate change denial' by which they understand the presentation of climate denial as related to the new waves of right-populism. The aim of the policy paper they present based on the public poll conducted by CBOS (Centre for Public Opinion Research, a Polish opinion polling institute) is to demonstrate how the right-wing populists in Poland have changed their strategy and are not trying to deny the phenomenon of global warming. Instead, they are focusing on promoting narratives that delay the adoption of solutions to reduce emissions. One of their main goals is to undermine the European community's decision to achieve climate neutrality and instruments for this task (Sadura et al. 2023). Therefore, the author would recommend conducting more studies to consider new forms of climate change denial and their impact on scientific communities and climate science communication. This would allow us to see whether denialism as a social response to climate communication has actually diminished or whether it is merely effectively bypassing the scientific debates where it would be doomed to lose and instead move to the front lines of regulation and policy-making.

The study also clearly shows that scientists recognise that science communication shares the same flaws as scientific culture in general, namely, that they resist engaging with the public on more dialogic or even participatory terms. As for recommendations on the dialogue between societal actors involved in public conversation on climate change, the scientists suggest relationship-building as a foundation for effective climate science communication and reciprocity in attentiveness and listening. In order to conduct *emotionally intelligent science communication* (CS_USA2), interdisciplinary experts should be included in climate science communication processes, and the findings of the social sciences, especially communication science, should be taken into account. In addition, the scientists

recommended maximum diversity among communicators and called for including more local experts with whom the audience will share the same problems arising from climate change in their region.

Online communication (Schäfer 2012) undoubtedly contributes to democratising the process of learning about climate change; however, among the recommendations provided by climate scientists, the importance of the personal presence of communicators at events that popularise and promote science is also mentioned. At a time when many events are moving to online venues, scientists recognise the general public's need for face-to-face contact, where inspiration comes from both information and interaction. Scientists repeatedly emphasise that the problems of climate change are problems that affect all of us, and only with a joint effort can they be solved. A good start will be a broad social dialogue, even if specific groups of dismissive audiences reject it – 'let them' without expending energy on idle communication. Overall, the scientists are also aware of the need to expand their communicative efforts beyond educating on the scientific consensus on climate change to building partnerships with diverse audiences that would mark the beginning of the societal consensus on science-backed climate actions.

Given the limited sampling, the author would recommend further quantitative and qualitative studies on climate scientists as climate change communicators. Based on her experience from this study, the author recognises that while there is a widespread perception in the literature that communicating science, including climate science, 'is important and is not done well' (Ziman 1992, Nelkin 1995, Hartz, Chappell 1997, Treise, Weigold 2002), this does not mean that climate scientists have not mastered the art of communicating science, but rather from the fact that there are still relatively few of them. This shortage of climate science communicators, especially in Poland, may stem from the fact that the academic context is not conducive to engaging in communicative efforts. However, those who do engage in communication are a valuable source of knowledge about the public responses to climate change communication messages, possible barriers and potential directions for improving climate knowledge dissemination.

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