The use of qualitative research to better understand public opinions on climate change

Scott Kleinberg[1] · Anne H. Toomey[1,2]

Abstract

The science and practice of climate change communication have significantly evolved over the last two decades, leading to a subfield of environmental communication focused on perception, awareness, and risk associated with climate change. This body of literature has demonstrated the importance of recognizing the differences among individuals and social groups in terms of cultural, psychological, and political reasons for their perceptions regarding climate change and has provided guidance for communicating with target audiences. However, most of the research in this subfield has relied on quantitative data from nationally representative survey instruments. While such metrics are essential to understanding longitudinal trends in public perceptions, they are limited in providing deeper understanding of how an individual perceives climate change in relation to other environmental and social issues. Qualitative data, elicited through techniques such as focus groups and semi-structured interviews, can help to provide these insights. In addition, qualitative research can support a more relational approach to climate change communication, which emphasizes the importance of seeing science communication as an opportunity to connect, rather than to persuade. In this paper, we present findings from semi-structured interviews ("environmental conversations") with fifteen individuals based in the United States regarding their opinions, knowledge, and perceptions of climate change and other environmental issues. The findings demonstrate nuance and diversity in people's opinions on climate change and how they are connected to other priorities and values. We recommend the value of qualitative research as a tool not only to better understand different environmental perspectives, but additionally to support two-way science communication among the broader public.

Keywords Climate change perceptions · Science communication · Environmental messaging · Qualitative research · Climate change communication

Introduction

Broad policy goals are needed to address climate change and other environmental concerns at multiple scales of governance. However, action has been hindered by limited consensus among policymakers, lack of public understanding of the impacts of climate change, and political divides (Goldberg et al. 2020; McCright and Dunlap 2011a,b). For example, in

✉ Anne H. Toomey
  Toomey.ah@gmail.com

  Scott Kleinberg
  scott.l.kleinberg@gmail.com

[1] Department of Environmental Studies and Science, Pace University, One Pace Plaza, New York, NY 10038, USA

[2] Center for Biodiversity and Conservation, American Museum of Natural History, Central Park West & 79Th St, New York, NY 10024, USA

the United States (USA), the gap between the environmental views of left-leaning and right-leaning politicians and their supporters is fairly evident and well documented (Goldberg et al. 2020; McCright and Dunlap 2011a,b). Climate change denial is associated with right-leaning ideologies (van der Linden et al. 2020), and statements made by fossil fuel advocates, right-wing speakers, and social media all contribute to this trend (Bryanov et al. 2020; Gaudette et al. 2020; Lewandowsky et al. 2020).

Although the primary difference in climate change views can be attributed to ideology, additional demographic factors have also been correlated with certain beliefs and concerns regarding climate change. For example, individuals who self-identify as being very religious are more likely to deny the reality of climate change as compared to those who do not (McCright and Dunlap 2011a). Similarly, individuals who self-identified as conservative, white, and male reported denial of climate change significantly more than the general population (McCright and Dunlap 2011b; Nelson 2020).

Beyond demographic-focused studies, there have been efforts to create typologies to highlight common attitude types held by various publics (Wolf and Moser 2011). One of the most frequently cited of these approaches was a study by Roser-Renouf et al. (2014, 2021), which divided the American populace into six groups based on their beliefs and concerns about climate change. These include the following distinctions and respective beliefs associated with climate change: (1) "Alarmed" – the threats posed by climate change need immediate attention; (2) "Concerned" – climate change is human-caused but is mainly a problem for future generations; (3) "Cautious" – uncertainty as to whether the causes of climate change are natural or anthropogenic; (4) "Disengaged" – unawareness / unconcern about climate change than all other groups; (5) "Doubtful" – climate change does not pose a serious risk, and 6) "Dismissive" – climate change is a hoax.

Such demographic and ideological differences have led to calls to create targeted messages for specific populations. For example, within the "Six Americas" framework, the authors suggest encouraging engagement through voting and advocacy for the "Alarmed" and "Concerned" groups, whereas they suggest that explaining the causes and impacts of climate change may more effectively present the reality and dangers of climate change for "Cautious" and "Disengaged" Americans. Similarly, other research has suggested that science communicators should emphasize issues such as economic opportunities and national security in communicating about climate change to right-leaning ideologies, and using theological or moral appeals to resonate with religious individuals (Zia and Todd 2010).

However, more recent research has put into question the effectiveness of targeted messaging for changing beliefs or inspiring action on climate change and other environmental issues (Kahan 2013; Chapman et al. 2017). Knowledge-based messaging has been repeatedly shown to be insufficient, and sometimes counterproductive, in inspiring attitude and behavioral change with regard to environmental issues (Kahan et al. 2012; Drummond and Fischhoff 2017; Cairney and Oliver 2017). Emotional appeals may in some cases be effective, but fear-based messages are not generally shown to promote engagement and can sometimes backfire, leading to increased skepticism. For example, one study found that the framing of climate change as a national security issue for a skeptical segment of the public was perceived as manipulative and misleading (Kusmanoff et al. 2021). Even direct prior experience with climate-caused disasters is not always correlated with increased concern about or action taken to address climate change (Wolf and Moser 2011; Palm et al. 2017). Further, emotional responses are not a guaranteed "switch" that will trigger a change of mind or actions, and different people may react differently to various emotional appeals (Chapman et al. 2017).

Thus, if message framing has not always been demonstrated to be effective, what other techniques exist? New research in science communication points to the "relational approach," which reframes communication as an opportunity to connect, rather than persuade (Kearns 2021). This reframing can be seen as building off of earlier communications work that viewed "identification," in which one party identifies with the interests of another, as a crucial aspect of rhetoric (the practice of effective or persuasive speaking or writing) (Burke 1969). Such an approach moves away from science communication that is based on a linear, dissemination-based model of providing information or seeking to convince, and towards two-way dialogue between scientists and various publics (Toomey 2016; Kearns 2021). For example, one area of increasing research focuses on the inherent potential of conversations about climate issues for increasing understanding, reducing apathy, and supporting engagement (Lertzman 2017).

Qualitative research methods, conducted through techniques such as focus groups and semi-structured interviews, can help to support a more relational approach to climate change research and communication, as qualitative approaches seek to elicit deeper understanding of individual perceptions, beliefs, and emotions. If done respectfully, qualitative methods can enable people to feel listened to and additionally offer opportunities for participants to ask questions about things they might be unclear about. For example, Jagannathan et al. (2023) found that interviews with farmers enabled a "joint construction of meaning" when discussing the value of long-term climate projections for on-farm adaptive decisions, and further supported the incorporation of these models into farmers' long-term information needs.

In this paper, we present findings from semi-structured interviews ("environmental conversations") with fifteen individuals regarding their opinions, knowledge, and perceptions of climate change and other environmental issues. Having a better understanding of the nuance among various environmental perspectives can provide insight into how individual priorities and values connect with topical policy issues. This information can give insight on people's views and perceptions of climate at a deeper level than quantitative data alone (Wolf and Moser 2011).

Methods

In November 2021, we conducted semi-structured interviews by phone with fifteen respondents. Participants were recruited via the snowball method using personal networks, wherein we sought to speak with individuals with whom we were not intimately connected (e.g., friends of friends), who would be willing to have a short conversation about their opinions on the environment. During recruitment it was made clear that individuals did not need to have any prior knowledge about climate change or the environment to participate, and participation was encouraged from anyone regardless of their opinions on these issues. By using personal networks and by clarifying that the

objective was to learn about diverse perspectives (as we framed the interview as a "conversation"), we hoped that participants would be comfortable enough to be open about their views and willing to talk, but not so close as to be influenced by their relationship with the researchers.

Each interview lasted 20–60 min depending on the length of the participant's responses and additional questions that arose. The interviewees were asked the same questions in similar order (Table 1). Of the fifteen participants, seven people were interviewed individually and four people were interviewed as pairs (in two-person focus groups; both pairs were married couples). The four remaining participants were a single family that were interviewed as a four-person focus group. Participants' time constraints, availability, and personal preferences determined whether an interview was done one-on-one or with family members.

This research was approved by Pace University's Institutional Review Board (#1763893-Pace). We recorded the age, gender, state of interviewees, but did not ask for additional demographic information (race, ethnicity, income level, political affiliation), as these interviews were framed as low-stakes "conversations." In some cases, the job (or past job, if the person was retired) was recorded. Thorough notes were taken during interviews with key quotes noted verbatim, which were coded for recurring themes using an emergent process. We identified twelve codes, which were then grouped into five categories (Table 2).

Results

Interviewees ranged in age from 20 to 72, with approximately half of the respondents above the age of 60. Two-thirds of the interviewees were women (10 of 15), and all but one person resided in the northeastern region of the USA, in the states of New York, New Jersey, and Connecticut. For respondents whose jobs we recorded, three were former educators, two worked in STEM fields (and held

Table 1 Questions prepared for interviews

Question asked	Reasoning behind questions
What do you like most about nature or the outdoors?	The word "environment" has been associated with many different issues, movements, and changes. This question was put first, as it is the least controversial. We sought to see if participants value some aspects of the environment, regardless of their views, and even if they do not realize it.
What problems do you feel affect nature/outdoors/environment?	The purpose of this question was to tie in participants' views of nature to the environment. We were interested in hearing participants' views on what factors they believe influence the environment, before delving into specific issues.
How big of a risk do you think air/water pollution presents to your future?	We sought to see if clean air and water are resources valued by participants. We also wanted to determine if participants were aware of or concerned about pollution issues.
Do you think about renewable energy?	Unlike pollution prevention, switching to renewable energy is an issue that we believed could be more contentious due to its recent rise in popularity and presence in the news. We wanted to see how participants viewed renewable energy and if they understood the changes it would bring.
What do you know about the concept of climate change?	We were interested in the extent to which participants understood the causes and consequences of climate change. We also sought to see if participants have any strong opinions or preconceived notions on climate change.
How big of a risk do you feel climate change presents on your future? (to the future of America / the planet?)	We sought to gauge the extent to which participants understood the severity and consequences of climate change and if they believed it affects them personally.
Have you noticed any changes in the environment? (e.g., temperature, weather)	We were interested in whether participants had personal experiences with or observations of the effects of climate change.
Do you think environmentalism is a political movement? Why or why not? Should it be?	Mitigating climate change and other environmental issues has become a partisan issue in the USA. We were interested to understand the extent to which participants viewed environmentalism as being political.
What political issues are important to you?	We were interested in which political issues were important to the participants. We also sought to determine the prevalence of political issues in the minds of the participants and the extent to which particular political issues are tied to environmental opinions and views.

Table 2 Coding for recurring themes across interviews

Code:	Used when a participant talked about:	Categories/themes (results subheadings)
Appreciate Nature	The beauty or tranquility of nature, wildlife, or the outdoors	Value of Nature
Nature Recreation	The recreational value of nature and outdoor spaces	
Notice effects of CC	First-hand experience noticing climate change, typically seeing changes in temperature and weather over the course of their life-time	Impacts of Climate Change
CC Far-reaching Consequences	Climate change having broad consequences beyond a rise in global temperature. This was used for both environmental and non-environmental (economic, societal, etc.) consequences	
CC International	Climate change as a problem that affects nations across the globe or that governments outside of the USA also have a responsibility to address climate change	
Uninformed/Uninterested	Not knowing much about an environmental issue or that they have never put much thought into the issue	Perceived as a Distant Risk
Not in my lifetime	The effects of climate change will become severe decades in the future, not during their lifetime	
Immediate Concerns	People not caring about environmental issues if they are too focused on paying bills, etc. Also used when environmental issues are ignored due to a focus on other political issues	Reasons for Pushback and Hesitation
Trade Offs	Concern, criticism, or curiosity about the (economic) tradeoffs that may be necessary to attain environmental goals	
Media Issues	Not trusting the media or feelings that the media is partisan	Problems with Politics
Dislike Politics	Disliking politics and/or actively avoiding politics, political parties, or the behavior or actions of elected officials	
Polarization	Perceiving that society is very (politically) divided or is more divided than it was in the past	

advanced degrees in these areas), and other respondents were employed in various public and private sectors (e.g., telecommunications, hospitality, election monitoring).

The interviews revealed a wide spectrum of views regarding climate change and other environmental issues. Multiple interviewees indicated they appreciated the scenery, wildlife, and the sense of peace that comes with being outdoors; and spoke about the beauty of trees, water, and animal life. One respondent said when they are outdoors, they find themselves "looking, absorbing details… taking it all in." Others would talk about how being in nature was a serene and restorative experience. "Peaceful," "heavenly," "calming," and "for the soul" were phrases used by four respondents when talking about what they like about nature and the outdoors. Respondents also spoke about the outdoors as a place where they can be active and mentioned participating in activities such as cycling, walking, golfing, camping, and fishing.

All interviewees acknowledged the reality of climate change to some degree, but a couple of respondents indicated that they believed it was exaggerated by the media and politicians. For example, one individual said that he thought it was "A lot of hoopla. It is a political topic that most politicians and people are using for political gain." Most respondents expressed that they had experienced the effects of accelerated climate change in one form or another over the course of their lives and gave specific examples of changes that they have noticed during their lifetime (e.g., frequent and severe storms and warmer winters). For example, one interviewee said, "I remember as a kid there was more snow. (There were) more consistent weather and storms. Recently we had 65 degree (weather) on Christmas, 70° in mid-November." A different respondent noted that we "don't have really hot, hot weather like we used to. Seems to me that winters are milder than in the past. When I was little, there was so much cold and snow in winter. Scary to think about, not having the same climate as I did when I was a child."

Furthermore, participants mentioned additional effects of climate change, including changing coastlines, displacement of people and wildlife, inability to grow crops, scarce food and water, and more natural disasters. "Catastrophic things like hurricanes can wipe out a season year of orange crops," one respondent noted. Another said that climate change will pose a "substantial risk. Changes in weather, growing patterns, efficiency, damage of storms, every aspect (of our lives) would be touched. Everything from clothes to food, how to heat and insulate the house(s) (that we live in)."

However, several interviewees spoke about climate change and other environmental threats as problems that will affect future generations, not themselves. One interviewee put it rather bluntly: "I'll be dead, so it won't matter." Another responded, "The younger you are, the bigger the risk. Not in a few years, but down the line (it) will get worse and worse."

A respondent with grandchildren said, "Not in my life, but my grandkids will have it worse." The sentiment was also expressed by a younger interviewee. "(Climate change will) probably not affect me personally. But it affects the planet. (The impacts of climate change) won't affect me before I die." The idea that younger generations should take action to address the climate change crisis came up more than once. An interviewee recommended that the government "should educate the youth to recycle and learn about climate change and the environment. (There will be a) bigger impact if they start at a young age so they can take responsibility."

Questions relating to how climate change and other environmental issues should be addressed were the most contentious and brought up the most uncertainty among interviewees. For example, many respondents were not familiar with renewable energy and asked the interviewer to explain the concept before providing their opinion on the issue. One respondent said, "I don't know what (renewable energy) is. Electric cars? Hadn't thought about it. Probably good. I can't think of an example that affects me." Other participants mentioned the potential drawbacks associated with environmental policies. Several discussed the short-term cost of switching from fossil fuels to renewable energy and brought up economic tradeoffs. A couple of respondents emphasized the importance of not "sweeping the negatives under the rug" when discussing solutions, and one individual said that "you look like a bad guy if you point out these problems and counterpoints. Environmentalists say you don't want to save the planet, (which will) lose the support of tremendous amounts of people. People see through that."

In addition to the tradeoffs mentioned above, several participants stated that environmental concerns just didn't weigh as heavily on their minds as other issues, including racial and gender equality, economic stability, gun control, religious oppression, and public health. Some mentioned that families struggling to make ends meet tend to be focused on immediate, financial issues, such as paying rent. Referring to the Endangered Species Act, one respondent talked about how the costs of protecting endangered species were too high: "One business project, millions of jobs for one lizard."

Three different individuals brought attention to how climate change is a global issue that impacts the lives of people outside of the USA and spoke about how other nations need to do their part to mitigate climate change. Two mentioned China as a nation responsible for worsening climate change and needing to make a major effort to address it. A third brought up the troubles associated with international climate action, citing dictators as unlikely to comply.

The area of most similarity among responses —regardless of where interviewees fell according to their beliefs — was the perception that environmentalism and climate change had become political, and this was perceived to be negative. One person said, "the big problem is that (climate change) has become a political issue. This becomes a distraction from taking action on these issues." Similarly, another respondent said, "It is becoming more political. This may prevent people from understanding the truth or wanting to know the truth." In general, respondents did not differentiate between the policy process and their frustration with politicians and the media. One individual said "I don't like politicians, that's an issue. I don't trust them. But they run the show. (…)Politicians can be corrupt. They care about making money over caring about pollution." A few attributed the political problems the U.S. faces to "both sides," i.e., both major political parties in the USA as the problem. Issues with the political process itself were also scrutinized. As one interviewee put it, "a lot of people are fed up with politics." Another interviewee independently expanded on this: "Our ability to make progress is inhibited by politics. This is true with other issues too (not just climate change and environmental protections)." At least one respondent intentionally distanced themselves from political discourse altogether; stating, "I am uninterested in politics. I feel like an idiot talking about it. I just listen to those I trust." Many respondents felt that people today are more divided than ever, particularly when it comes to politics. "(You) can't talk about opinions with those who disagree with you," one respondent lamented. Another said, "People live in their own bubbles on both sides." The idea that more and more issues are becoming politicized was also common. "I probably wouldn't have said so (that environmentalism is political) a few years ago, but (now) everything is a political movement."

To gauge a sense of how each of the interviewees would be categorized via one of the typologies mentioned earlier, we attempted to place each of the respondents into one or more of the "Six Americas" categories. However, despite distinct criteria listed for each of the six Americas, the interviews revealed that people did not often fit into one category. For example, some interviewees expressed significant concern about the risks of climate change but lacked basic understanding about the related causes and potential implications. As stated by one respondent, "I think it's a big risk but don't know much about it." Alternately, some participants had a strong scientific understanding of climate change but did not support proposed solutions to address it (e.g., renewable energy, carbon taxes). For example, one interviewee with a science background gave a thorough explanation of the greenhouse effect, and then said, "if we stop carbon emissions, then (there is) no electricity! Environmentalists dance around this." Finally, some respondents experienced doubt as to the degree to which climate change was a threat but were in support of actions to address climate change and other environmental issues. One respondent, who was somewhat dismissive of the concerns about climate change, said, "(It is) not as much of a risk as portrayed, (but) it does need to be addressed."

Discussion

The conversations described above were designed to give insight into nuance and diversity in people's opinions on climate change and how they were connected to other priorities and values. All the interviewees acknowledged the existence of climate change, though some were doubtful about its causes and/or severity. Two participants stated that they felt climate change was not as severe as the media claims, and a third individual suggested that the current climate change we are experiencing is due to natural causes (as opposed to being anthropogenic). Interestingly, although most of the respondents were aware of and/or concerned about climate change, this did not seem to have major significance on interviewees' support for or engagement with environmental action and policy. Rather, it seemed that respondents cared about environmental issues but didn't give them as much thought or put as much priority on them as they did for other social and political issues. Similarly, many respondents argued that climate change is a problem that will only affect, and will need to be addressed by, future generations. However, this contrasted with statements made by the same individuals about the personal experiences they had with climate change over their lifetime (e.g., severe storms and warmer winters).

As noted in the results section, several interviewees appear to hold characteristics from more than one discrete Six Americas category. We believe that this framework is a comprehensive and effective means of better understanding public attitudes towards climate change, especially in comparison to simply dividing the public into a binary "support vs. oppose" view on environmental issues. However, even a framework like the Six Americas can be limiting if researchers are trying to gain an in-depth understanding of a person's environmental views and opinions, which may not perfectly align within classifications derived from more quantitative research approaches. Thus, we suggest that rather than the Six Americas framework being used to group members of the populace, the framework could highlight a spectrum of attitudes, some of which could be held by the same individuals. As has been suggested by other scholars, the goal of qualitative social science should not be to smooth over inconsistencies and tensions in a single narrative, but rather, to seek to bring them into the light, where they have the potential to offer new possibilities (Lertzman 2019).

In addition, as we framed these interviews as conversations, they allowed for the opportunity for respondents to ask questions of the interviewer about areas in which they had little understanding, such as the greenhouse effect or renewable energy. In this sense, the interviews in themselves provided a relational approach through which researchers and members of the public could exchange ideas about crucial environmental issues in a low stakes environment (Toomey 2016; Kearns 2021; see also Jagannathan et al. 2023). This approach has long been recognized by social change theorists and advocates in other fields. For example, the practice of "deep canvassing," in which issue advocates knock on doors and seek out conversations with constituents known to have voted against a particular issue, is being used by advocacy groups across the USA to garner support for particular policies and legislation (Kalla and Broockman 2022). One notable aspect of this practice is the focus on listening and seeking to connect through "nonjudgmental exchanging of narratives," rather than to persuade through facts or talking points. In this approach, empathy is an essential ingredient in supporting effective communication (Box 1, Lertzman 2017, 2019). Further research could more deeply explore this approach as a means of affecting attitudinal or behavioral change regarding climate change, environmental issues, and/or science in general. Such conversations could also help to inform environmental advocates about where misconceptions lie within the public understanding of environmental issues (Chapman et al. 2017).

However, we acknowledge challenges and limitations in scaling up this approach. One-on-one conversations may be powerful, but not always practical, approaches for engaging large segments of the public. Thus, we offer two avenues for thinking about how this method could be developed for greater scope and scale. First, the deep insights garnered by these qualitative interviews could help with the development of a script that could tap into the inconsistencies and tensions in various positions (see also Lertzman 2019). Rather than assuming that an individual "thinks like this or like that," and thus delivering a single narrative (e.g., climate action requires voting a certain way), scripts could embrace tensions and challenges, and offer the listener different options for engagement. For example, the script could emphasize that there are multiple types of people who care about climate issues — from farmers to urban designers — and allow listeners to tap into the stories that most interest them.

In addition, information flow theories, which study how differently structured social networks can support the spread and uptake of new ideas and behaviors, may provide additional avenues for research. This research has found that while broad dissemination techniques spread through weakly connected individuals can help to provide awareness of an issue (e.g., Twitter), for complex or controversial ideas such as climate change, it is more effective to channel information through tightly configured social networks (e.g., churches) (Centola 2018, 2021). This approach recommends identifying multiple individuals within a given social network who are connected and targeting messaging within their social group; if they are convinced, they are likely to pass on the word to others, who in turn will be more likely to be persuaded because of hearing of the new idea or innovation from multiple people within their personal network (de Lange et al. 2019). For example, one study found that communication outreach that targeted influential individuals could successfully propagate environmental interventions throughout the group

more effectively than more traditional outreach programs (de Lange et al. 2021). These ideas offer potential for scaling up targeted science communication tactics, though this scholarship is still exploratory, particularly in the environmental realm.

Box 1 Reflections on the interview process

The research described in this paper was conducted by a Masters student (SK, lead author), who was previously unexperienced with qualitative research and interviews of this nature. Over the course of the interviews, he gained a better sense for how to best conduct the questions and conversations in a way that allowed the interviewees to give thorough and frank opinions. This allowed for the iterative nature of questioning. For example, one question that was initially included in the interview script ("What do you think causes climate change?") was determined to be redundant, as other questions provided better insight into the extent to which interviewees understood climate science. The interviewer also took social cues from the participants, following up on areas that interviewees were passionate about during the conversations, and moving past topics on which they had no strong opinions

The interviewer experienced difficulties that can come with discussing complex topics like climate change and environmentalism. He realized that he had to be careful when divulging information and opinions, as doing so could influence the responses that participants gave. For example, during one interview, the interviewer brought up the increasing severity of storms. Later in the interview, the interviewee mentioned intense storms when talking about noticing the effects of climate change, which created uncertainty as to whether or not the interviewer had biased the response. Similarly, it was found that sharing one's own perspective could be problematic if they ran contrary to the respondent's opinion. Disagreement could derail a conversation or make the interviewee less likely to give their honest opinions. For example, during one interview, a participant mentioned that they had a high degree of science education, had some knowledge about climate science, and gave thoughtful responses on topics such as renewable energy. However, later during the interview, the participant expressed an opinion that, sometimes, economic prosperity and job creation can outweigh the environmental protections, arguing that "extinctions happen anyway." The interviewer was bothered by this conclusion, and tried to prompt further discussion by talking about the current anthropogenic mass extinction. The participant didn't engage with this response, which then created tension as the interview continued. The interviewer learned that while back-and-forth conversation can be a valuable means of gleaming more information about participants' views of environmental issues beyond the scope of the prepared questions, interviewers need to be cognizant of their words, both to minimize biases and ensure that conversations are candid. This is not to say that input from the interviewer is inherently negative, but to stress the importance of preparing in advance for emotions that may come up during the process.

Prior research has demonstrated that educating people about environmental issues may not guarantee that they develop concern about a particular issue, let alone take action to solve it (Lewandowsky et al. 2015; Nerlich et al. 2010). Based on our findings, we propose that rather than developing messages designed to persuade, environmental communicators and researchers should find opportunities to connect with diverse publics on a regular basis. This could include participating in spaces such as community board or town hall meetings, tabling at community events (e.g., farmers' markets), and forming relationships with specific segments of the public (e.g., hunting or fishing groups) to create opportunities for regular dialogue.

An additional approach emphasizes the importance of telling "action-based" as compared to "concern-based" stories about climate change, which can promote feelings of connection, empathy, and agency (De Meyer et al. 2020). Rather than using stories to elicit concern or awareness, this approach emphasizes behaviors, allowing individuals to see their own diverse practices and concerns—from opting to eat less meat to volunteering at a local park — as a starting point for further engagement. In other words, rather than focusing on changing beliefs to change behavior, this method emphasizes that the relationship between beliefs and behavior often goes in the opposite direction. If we begin to see our own actions as pro-climate, we may be persuaded to engage in further actions, thus influencing our beliefs about our own role in the climate and wider environmental movement (Toomey and Domroese 2013; De Meyer et al. 2020).

The research process itself can also offer an important avenue for the development of such relational approaches. Instead of seeing public outreach and communication at the end stage of the research, scientists can bring people into the process of research — even that which is not designed to be "participatory." For example, fieldwork-based research offers many opportunities in which scientists may have to communicate with members of the public, such as speaking with community leaders and local government officials to get permits to do research, employing porters and guides for research in difficult terrain, and encountering curious onlookers while using odd-looking ecological techniques in urban or suburban settings (Toomey 2016). Qualitative research approaches, such as the one described in this paper, can also provide opportunities to support two-way science communication between researchers and diverse publics (Lertzman 2017; Jagannathan et al. 2023).

Conclusion

Much work remains when it comes to improving communication between environmental advocates and scientists with the public. Climate change policy and environmental policy do not have unilateral support across the broader population (Goldberg et al. 2020; McCright and Dunlap 2011a,b; van der Linden et al. 2020). However, our research supports previous findings that most individuals acknowledge the reality of climate change, and are, at the very least, cautious about its effects (Roser-Renouf et al. 2014). Research that explores the nuance and variety in people's opinions and beliefs about climate change can offer both hope and inroads for improving

environmental communication with the public. Developing relational research approaches that engage with a spectrum of perceptions may be an effective means of listening to, learning from, connecting with, and being accountable to diverse publics on the crucial environmental issues that affect us all.

Declarations

Competing interests The authors declare no competing interests.

References

Bloomfield EF, Tillery D (2019) The circulation of climate change denial online: rhetorical and networking strategies on Facebook. Environ Commun 13(1):23–34. https://doi.org/10.1080/17524032. 2018.1527378

Bryanov K, Watson BK, Pingree RJ, Santia M (2020) Effects of partisan personalization in a news portal experiment. Public Opin Q 84(S1):216–235. https://doi.org/10.1093/poq/nfaa011

Burke K (1969) A Rhetoric of Motives. University of California Press, Berkeley and Los Angeles, CA

Cairney P, Oliver K (2017) Evidence-based policymaking is not like evidence-based medicine, so how far should you go to bridge the divide between evidence and policy? Health Res Policy Syst 15:1–11

Centola D (2018) How behavior spreads: the science of complex contagions, vol 3. Princeton University Press, Princeton, NJ

Centola D (2021) Change: how to make big things happen. John Murray

Chapman DA, Lickel B, Markowitz EM (2017) Reassessing emotion in climate change communication. Nat Clim Chang 7:848–852

de Lange E, Milner-Gulland E, Keane A (2019) Improving environmental interventions by understanding information flows. Trends Ecol Evol 34(11):1034–1047

De Meyer K, Coren E, McCaffrey M, Slean C (2020) Transforming the stories we tell about climate change: from 'issue'to 'action.' Environ Res Lett 16(1):015002

Drummond C, Fischhoff B (2017) Individuals with greater science literacy and education have more polarized beliefs on controversial science topics. Proc Natl Acad Sci 114:9587–9592

Gaudette T, Scrivens R, Davies G, Frank R (2020) Upvoting extremism: Collective identity formation and the extreme right on Reddit. New Media Soc 23. https://doi.org/10.1177/1461444820958123

Goldberg MH, Gustafson A, Ballew MT, Rosenthal SA, Leiserowitz A (2020). Identifying the most important predictors of support for climate policy in the United States.Behav Public Policy 1–23. https://doi.org/10.1017/bpp.2020.39

Jagannathan K, Pathak TB, Doll D (2023). Are long-term climate projections useful for on-farm adaptation decisions? Frontiers in Climate 4

Kahan DM, Peters E, Wittlin M, Slovic P, Ouellette LL, Braman D, Mandel G (2012) The polarizing impact of science literacy and numeracy on perceived climate change risks. Nat Clim Chang 2:732–735

Kahan D (2013) Making climate-science communication evidence-based. Cult Pol Clim Change: How Info Shapes Our Common Future 203–220

Kalla JL, Broockman DE (2022) Voter outreach campaigns can reduce affective polarization among implementing political activists: evidence from inside three campaigns. Am Political Sci Rev 116:1516–1522

Kearns F (2021) Getting to the heart of science communication: a guide to effective engagement. Island Press

Lertzman R (2017) Tackling Apathy and Denial. Climate 2020:62–65

Lertzman R (2019) New methods for investigating new dangers: on the radical practice of listening. Clim Psychol: On Indifference disaster 25–39

Lewandowsky S, Oreskes N, Risbey J, Newelle B, Smithson M (2015) Seepage: Climate change denial and its effect on the scientific community. Glob Environ Chang. https://doi.org/10.1016/j.gloen vcha.2015.02.013

Lewandowsky S, Smillie L, Garcia D, Hertwig R (2020) Technology and Democracy: Understanding the influence of online technologies on political behaviour and decision-making. Publications Office of the European Union. https://ec.europa.eu/jrc/en/publi cation/eur-scientific-and-technical-research-reports/technology-and-democracy

Li N, Su LY-F (2018) Message framing and climate change communication: a meta-analytical review. J Appl Commun 102:1c–1c

McCright AM, Dunlap RE (2011b) The politicization of climate change and polarization in the American public's views of global warming, 2001–2010. The Sociological Quarterly

McCright AM, Dunlap RE (2011a) Cool dudes: The denial of climate change among conservative white males in the United States. Glob Environ Chang 21(4):1163–1172. https://doi.org/10.1016/j.gloen vcha.2011.06.003

Nelson J (2020) Petro-masculinity and climate change denial among white, politically conservative American males. Int J Appl Psychoanal Stud 17(4):282–295

Nerlich B, Koteyko N, Brown B (2010) Theory and language of climate change communication. Wiley Interdisc Rev: Clim Change 1:97–110

Nielsen JO, D'haen SAL (2014) Asking about climate change: Reflections on methodology in qualitative climate change research published in Global Environmental Change since 2000. Global Environ Change 24:402–409. https://doi.org/10.1016/j.gloenvcha. 2013.10.006

Palm R, Lewis GB, Feng B (2017) What causes people to change their opinion about climate change? Ann Am Assoc Geogr 107:883–896

Roser-Renouf C, Stenhouse N, Rolfe-Redding J, Maibach E, Leiserowitz A (2014) Engaging diverse audiences with climate change: message strategies for global warming's Six Americas. In SSRN Electronic Journal. https://doi.org/10.2139/ssrn.2410650

Toomey AH (2016) What happens at the gap between knowledge and practice? Spaces of encounter and misencounter between environmental scientists and local people. Ecol Soc 21

Toomey AH, Domroese MC (2013) Can citizen science lead to positive conservation attitudes and behaviors? Hum Ecolol Rev 50–62

van der Linden S, Panagopoulos C, Azevedo F, Jost JT (2020) The paranoid style in American politics revisited: an ideological asymmetry in conspiratorial thinking. Polit Psychol. https://doi.org/10. 1111/pops.12681

Wolf J, Moser SC (2011) Individual understandings, perceptions, and engagement with climate change: insights from in-depth studies across the world. Wiley Interdisc Rev: Clim Change 2:547–569

Zia A, Todd AM (2010) Evaluating the effects of ideology on public understanding of climate change science: how to improve communication across ideological divides? Public Underst Sci 19:743–761