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Contents lists available at ScienceDirect

The Journal of Climate Change and Health

journal homepage: www.elsevier.com/ijoclim

Research article

Advocacy messages about climate and health are more effective when they include information about risks, solutions, and a normative appeal: Evidence from a conjoint experiment

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ARTICLE INFO

Article History:

Received 9 June 2021

Accepted 18 July 2021

Available online 21 July 2021

Keywords:

Climate change
Climate advocacy
Risk communication
Health communication
Conjoint analysis

ABSTRACT

Previous research has shown that providing information about the health consequences of climate change can increase climate change issue engagement and support for mitigation policies. Here, we extend that research by testing the motivational value of three categories of climate information (termed information categories): health consequences of climate change; health benefits of climate solutions; and calls-to-action intended to motivate people to engage in political advocacy for climate solutions. The use of choice-based conjoint analysis enabled us to determine the effectiveness of each information category, as well the effectiveness of specific types of information within each category. Research participants were adults quota-sampled to represent the U.S. population (n=7,596). We found that each of these categories—consequences, solutions, and a call-to-action—enhanced the overall motivational value of the message, with solution information being the most influential. Of the 360 message combinations tested, the most compelling first described the negative impacts of climate change on air quality, then explained how transitioning to clean energy will benefit people's health, and ended by explaining that most Americans support this solution, and many are taking action to advocate for it. These findings are consistent with a large body of risk communication theory, and provide practical insights to health professionals and others seeking to build public and political will for actions that reduce the health threats posed by climate change.

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1. Introduction

Climate change impacts on human health have been well-documented over the past two decades and are projected to drastically increase if mitigation responses remain inadequate [1,2]. Rising global temperatures directly heighten the frequency and intensity of extreme weather events, including heat waves, hurricanes, wildfires, floods, and droughts, directly damaging public health across broad geographical locations [2,3]. Furthermore, shifting climate patterns lead to an increase in the prevalence of vector-borne diseases, a reduction in crop yields and nutritional values, contamination of food and water, and rising socio-political conflicts [3,4].

Research on the nexus of climate change and health has correspondingly grown [5]. Extant public health recommendations stress the urgent importance of implementing policies to mitigate and

adapt to climate change—including integrating these plans into health policies—if we are to protect the public's health and our health systems [6,7]. Yet, when it comes to understanding climate change impacts on health, there is still a persistent disconnect between experts, such as researchers and health professionals, and non-experts, such as policy makers and the lay public, especially in the United States.

In general, climate change as an issue is considered psychologically distant and not personally relevant for many Americans. Most people perceive themselves, their families, and people in their community to be at less risk from climate change than people who are spatially (e.g., in developing countries) or temporally distant (e.g., future generations) [8]. In April 2020, fewer than half of American adults felt that people in the United States are being harmed by climate change right now, although this number did increase 13 percentage points between 2015 and 2020 [8]. A similar pattern follows for climate change impacts on health. In a 2014 survey, 61% of respondents reported having given little thought to this topic, and most respondents could not name specific affected health conditions

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[9]. Few people indicated that their own health (17%) or the health of Americans (31%) are currently being impacted by climate change, although greater proportions (27% and 39% respectively) expected such impacts in the future [9]. Similar to overall climate change risk perceptions, these numbers have grown recently. Between 2014 and 2020, significantly more people came to understand that climate change will cause a range of specific health conditions to become more common in their community over the next ten years. Depending on the health condition, this growth in awareness ranged from 13 percentage points (from 38% to 51% for pollen-related allergies) to 28 percentage points (from 26% to 54% for bodily harm from wildfires) [10].

In short, despite present, serious and growing impacts of climate change on health, most Americans do not accurately assess these risks, especially for themselves, their families, and people in their community. Although risk perceptions are increasing, more efforts are needed to bridge the gap between experts' risk assessments and the lay public's understanding. Promoting public understanding of the health risks of climate change is important because it can help people and families make better risk management decisions, and because prior research has shown it to be an effective way to increase support for climate change policies and actions that can reduce those risks and improve public health. Presenting information about the health implications of climate change and air pollution from fossil fuels has been shown to be novel, engaging, and personally relevant to people across the spectrum of views about climate change [11]. This approach promotes risk perceptions and policy support [12], affective assessment and assessment certainty [13], and hopeful emotions [14]. Focusing on the health impacts of climate change also has the potential to reduce political polarization around the issue, as people across the political spectrum, especially moderates and moderate conservatives, respond well to this information [12,13], making it a promising way to communicate information about this hyper-politicized topic.

A guiding principle offered by Fischhoff [15] and Maibach [16] for improving public understanding of climate change involves creating and testing simple, clear, accurate, relevant messages that, if shown to be helpful, can be delivered by a variety of trusted sources. In this study we developed brief messages—based on findings from peer-reviewed research on climate and health—and tested them to identify which message categories, and which specific messages, were the most compelling to American adults. Specifically, we evaluated messages in terms of their ability to promote political advocacy on climate change. While individual mitigation actions have a role to play in reducing emissions [17], such efforts need to be complemented by greater systemic emissions reductions that can only be brought about through policy change [18,19]. Increasing citizen advocacy is one means to cultivate the political will necessary for policy change [20,21]. Building on previous research in this area, we examined several key questions.

First, we evaluated the effects of information about various types of health harms caused or exacerbated by climate change to identify their relative effectiveness in encouraging advocacy actions. Prior studies have demonstrated the effectiveness of exposure to information about the health impacts of climate change on pro-mitigation cognitive and affective outcomes [11,14], and one study examined audience evaluations of specific types of climate change-related health harms and found that food-, water-, and vector-borne illnesses were especially worrisome to Americans [13]. However, research has not yet assessed the effects of exposure to specific types of health impact information on political advocacy. Our first research question thus asked:

RQ1. Which types of health impacts from climate change are considered most compelling in prompting advocacy actions?

Second, because there is an extensive literature demonstrating that many of the proposed climate change mitigation and adaptation measures also have direct or indirect benefits for human health (typically called “health co-benefits”) [22,23], we also examined the effect of presenting information on health benefits of climate change solutions. Extant research has primarily focused on conveying climate change impacts on health, but some studies suggest advantages to adding solution information, especially when such information is framed in terms of health solutions. Maibach et al. [11] found that information on the health benefits of mitigation policies was rated as clearer and more useful than information on impacts. Moreover, perceived benefits of mitigation have been shown to be positively related to intentions to engage in advocacy [24]. These findings are consistent with the Extended Parallel Process Model [25] which postulates: Risk information is more influential in changing behaviors when accompanied by efficacy information, or information indicating the presence and effectiveness of a solution. Therefore, we hypothesized:

H1. Messages with health solution information will be considered more compelling in prompting advocacy actions than messages without such information.

Similar to impact information, we are also interested in identifying the most compelling types of health solutions and thus asked the second research question:

RQ2. Which types of health solutions to climate change are considered most compelling in prompting advocacy actions?

Third, we tested multiple ways to enhance the call-to-action presented after the impact and solution information. A call-to-action is an explicit request for the audience to engage in a certain action or behavior (e.g., ‘donate now’, ‘click to learn more’, etc.), often containing assertive or directive language [26]. It can be accompanied by an incentive (e.g., ‘50% off’) [27] or appeal (e.g., ‘76% of people in your neighborhood save regularly’) [28] for the recommended action or behavior. Calls-to-action are frequently included as part of the design of environmental and climate change messages [29,30], but their effectiveness has not been specifically tested.

Among the appeals to accompany a call-to-action, we were particularly interested in descriptive norms [31] and external efficacy [32,33]. Positive descriptive norms – when a majority of the reference group engages in the behavior – have previously been found to increase climate change advocacy actions [34,35]. The evidence for negative descriptive norms – when only a minority of the reference group engages in the behavior – is more mixed. In their recommendations for climate change messaging, Fielding and Hornsey [36] advised against using negative descriptive norms. Hassell and Wyler [37], however, found that negative descriptive norms had a positive impact on willingness to take advocacy actions. Hence, there is a need to directly compare the effectiveness of these two descriptive norms appeals in the climate change context.

External efficacy refers to individuals' beliefs about how responsive the government and political system are to public opinions and demands. This type of efficacy has been shown to positively influence people's willingness to take climate change advocacy actions [38,39]. However, media coverage of climate change rarely includes this type of information [40,41], potentially creating the impression that government actions are effective but not feasible, or that individual efforts cannot instigate such actions [42]. Thus, an external efficacy appeal may be effective in motivating people to engage in advocacy action. Here, two different operationalizations of external efficacy were created and tested, which we refer to as *surplus* efficacy – which emphasizes that policy makers are responsive and individual actions are already making a difference – and *deficit* efficacy – which emphasizes that policy makers will be responsive once they learn what the public demands. This latter operationalization was inspired by past research which found that policymakers and their staff often

do not have an accurate perception of their constituents' preferences [43,44]. Our final research question is concerned with the effectiveness of these different types of appeals.

RQ3. Which type of call-to-action appeal is considered most compelling in prompting advocacy actions?

2. Material and Methods

2.1. Sample

We surveyed a large, demographically diverse group of U.S. adults, quota-sampled to approximate a nationally representative sample ($n = 7,596$). Respondents were recruited by Climate Nexus Polling (June 26-30, 2020), which utilized several market research panels in the U.S. and recruited respondents using stratified sampling methods. Each panel vendor recruited individual respondents into their panel using various methods (cold calls, in person recruitment at shopping malls/events, email, online ads, etc.). Climate Nexus directly sampled from these panels and worked with all partners to de-duplicate and uniquely identify each respondent to eliminate overlap that may occur across panels. Climate Nexus utilizes fixed stratum proportions of the population, sets quotas, and identifies population parameters for sampling from their certified vendors. Respondents that met the specific quota requirements became part of the target population and a select random set of respondents were contacted (via email or application notification) to take the survey. Contact and recruitment into the survey was directly handled by their panel vendors. Quotas for this study were set to match census parameters for sex, race, age, education, income, and geographic region. Demographic characteristics of the sample can be found in Table A.1 in Appendix A.

2.2. Protocol

All of the following procedures were reviewed and approved by the George Mason University Office of Research Integrity and Assurance (IRBNet #1576828). After informed consent was obtained, participants engaged in a choice-based conjoint (CBC) exercise that revealed which message categories and specific message types were most likely to motivate them to contact their member of Congress. CBC is a method typically used to ascertain which attributes in a product or message are most influential on consumers' or respondents' decision-making.

The messages all had the same basic structure, beginning with a section titled "The Problem" that briefly described one type of health harm associated with climate change; followed by a second section titled "The Solution" that described a type of climate solution and its health benefits; and concluding with a section titled "How you can help" that included a call to action which specifically asked participants to contact their member of Congress and urge them to address this issue. Thus, each section represented a different information category and each category had multiple information types or variations of content that were randomly generated on each screen of the CBC exercise.¹ On each screen, participants were presented two messages and asked to select the message that would make them most likely to contact their member of Congress (see Figure 1 for an example of how the messages were presented to participants). Every participant evaluated four pairs of randomly selected messages presented across multiple screens.

The first information category varied in terms of the type of health impact described; we tested 8 different types of health impacts derived from past research [13,46], including extreme heat, poor air

quality, extreme weather, water-borne illness, food-borne illness, vector-borne illness, hunger and malnutrition, and mental health. The second information category varied in terms of the type of solution proposed; we tested 7 different types of solutions partially inspired by those outlined by *Project Drawdown* [47], including solutions focused on more sustainable energy, cities and communities, consumption, nature spaces, transportation, buildings, and food. The third information category varied in terms of the language used to strengthen the call-to-action, including positive descriptive norms, negative descriptive norms, surplus efficacy, and deficit efficacy. Each information category included a variation which omitted that category of information from the message in order to estimate the effect of excluding that information category (e.g., an appeal without impact information). The exact language used in the stimulus material is available in Tables 1-3.

Using a Hierarchical Bayesian estimation method developed by Sawtooth Software [45], we used responses from the choice exercise to calculate individual, respondent-level utility scores for each specific type of information within an information category and an importance score for each information category. In CBC analysis, utilities are numerical interval-level variables that represent the relative preference for each specific type of information within an information category, with higher values indicating greater preference. Utilities are scaled to sum to zero within each information category. Utilities cannot be compared between information categories. For example, we can compare the average utility for the poor air quality impact to the mental health impact, but we cannot compare the average utility for the poor air quality impact to the energy solution. Importance scores allow us to compare the relative importance of each information category in shaping overall message preference. Importance scores represent the range in utility scores within each information category, such that information categories with larger ranges have larger importance scores. In sum, this process allowed us to identify the most compelling specific types of information within each information category, as well as the most compelling combination of information out of a total of 360 different possible message combinations.

3. Results

Based on the average utility scores, we found that the most compelling type of health impact was poor air quality (RQ1), followed by food-borne illness, and extreme weather (Table 1). The least compelling impact was extreme heat.

The most compelling type of solution focused on the health benefits of transitioning to clean energy (RQ2), followed by more healthy cities/communities, and more healthy forms of consumption (Table 2). The least effective solution was focused on healthy food.

The most effective call-to-action leveraged positive descriptive norms to encourage people to contact their member of Congress (RQ3), followed by negative descriptive norms and surplus efficacy (Table 3). The least compelling call-to-action was the deficit efficacy statement.

Importantly, the presence of each category of information, including solution information (H1), substantially increased the effectiveness of the appeal. When we excluded certain information categories, the effectiveness of the appeals declined greatly (indicated by the lower utility scores for the no information control within each information category). For example, this means that an appeal with both impacts and solutions together was more far more compelling than focusing on just impacts or just solutions alone.

When we compared the relative influence of each information category, the solutions category had a greater impact on the overall effectiveness of an appeal than the impacts category (Table 4). The call-to-action category was the least influential of the three information categories we tested.

¹ In the language of CBC analysis, each information category represented an *attribute* and the information types represented different *levels* within an attribute (45).

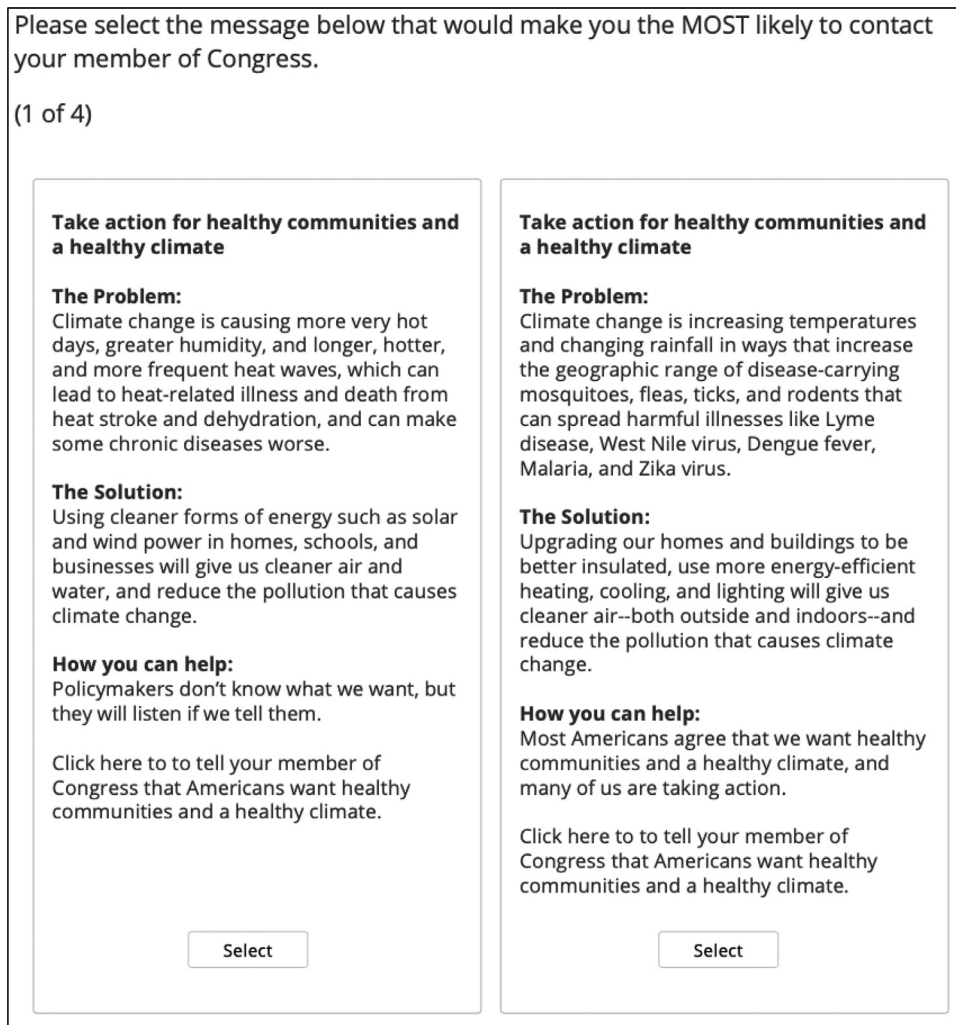


Fig. 1. Example of how messages were presented to participants

In a supplementary analysis, we found little variation in terms of how participants ranked the different types of information across race and party identification (Tables B.1-B.8 in Appendix B). The air quality impact/energy solution/positive descriptive norm call-to-action combination was the most effective overall message for every racial and partisan subgroup with one exception: Republicans viewed the solution focused on cities and communities as slightly more compelling than the energy solution, but otherwise ranked the other information categories similarly to Democrats and Independents.

4. Discussion

Our findings extend prior research by helping to identify the specific categories and types of information about climate change and health that are likely to generate greater public demand for policymakers to address this issue. Importantly, we found that the inclusion of each information category (i.e., impact information, solution information, and call-to-action appeal) enhanced the effectiveness of the overall message. Of these categories, the solution information was the most important in determining overall message effectiveness, consistent with prior research showing that statements regarding solutions were perceived more positively than those regarding impacts [11], and that including information about solutions in climate change communication is beneficial [39,48]. Specifically, we found that the most compelling message is comprised of information about the negative impacts of climate change on *air quality*, how *clean energy* can address this problem, and how this solution is

supported by and advocated for by most Americans. Moreover, we found that this message had consistently broad appeal across racial and partisan groups (see Appendix B).

Although a previous study found that people viewed food- and water-borne illness as especially novel and worrisome health impacts of climate change [13], we found that poor air quality was more compelling in a message designed to increase advocacy. This may partly be due to the intuitive links between the burning of fossil fuels, air pollution, and respiratory illness. Surprisingly, we found that extreme heat was the least compelling impact, which may be due to the fact that many Americans fail to perceive the health risks associated with extreme heat, even those with increased vulnerability [46].

To our knowledge, our study is the first to evaluate public responses to different categories of solutions to address the health effects of climate change. We found that in the context of promoting advocacy on climate change, emphasizing the benefits of clean energy was the most effective. This may be partly attributable to the heavy emphasis on energy-related actions in government efforts to educate people about individual mitigation behaviors [49]. Prior research has also found that people tend to underestimate the mitigation potential of transportation and food-related actions, which could explain why these solutions were less compelling as a justification for advocacy [50].

Among the appeals accompanying the call-to-action, we found that descriptive norms were more effective than efficacy appeals, and that positive descriptive norms were more compelling than negative descriptive norms. These findings accord with past research which

Table 1
Rankings, means, and 95% confidence intervals for impact information utilities.

Type	Text	Rank	Mean	LLCI	ULCI
Poor air quality	Climate change reduces air quality by increasing smog, smoke from more wildfires, pollen, and mold from higher humidity and flooding. This can lead to more lung infections, asthma and allergy attacks, bronchitis, chest pains, and even death.	1	18.37	17.69	19.04
Food-borne disease	Climate change is causing higher water temperatures, heavier downpours, and more flooding that can spread bacteria, viruses, and parasites from animal and human feces into fields where food is growing. People who eat contaminated food can suffer from diarrhea, vomiting, and in severe cases, paralysis, organ failure, and death.	2	14.91	14.29	15.53
Extreme weather	Climate change is causing increases in the frequency and severity of some extreme weather events such as major storms, floods, and droughts, which can lead to injury, displacement, reduced availability of safe food and water, and can make it harder to get medical care by damaging roads, bridges, and power lines.	3	13.06	12.57	13.55
Water-borne disease	Climate change is causing higher water temperatures, heavier downpours, and more flooding that can spread bacteria, viruses, and parasites from animal and human feces into waterways. People who drink or swim in the contaminated water can suffer from diarrhea, vomiting, and in severe cases, paralysis, organ failure, and death.	4	10.96	10.38	11.54
Vector-borne disease	Climate change is increasing temperatures and changing rainfall in ways that increase the geographic range of disease-carrying mosquitoes, fleas, ticks, and rodents that can spread harmful illnesses like Lyme disease, West Nile virus, Dengue fever, Malaria, and Zika virus.	5	1.12	0.47	1.76
Hunger and malnutrition	The level of carbon dioxide in our air is increasing, and the resulting climate change is increasing temperatures, heavy rainfall, and flooding. More carbon dioxide in the air decreases the nutritional value of food by causing plants to produce less protein, more starch and sugar, and take in fewer essential minerals.	6	-0.67	-1.35	0.01
Mental health	Climate change is causing increases in extreme weather events such as floods, droughts, and major storms. Many people exposed to the worst of these events experience severe stress and mental health effects including depression, anxiety, post-traumatic stress disorder (PTSD), and increases in suicidal thoughts.	7	-4.69	-5.25	-4.13
Extreme heat	Climate change is causing more very hot days, greater humidity, and longer, hotter, and more frequent heat waves, which can lead to heat-related illness and death from heat stroke and dehydration, and can make some chronic diseases worse.	8	-8.72	-9.28	-8.16
Control (no impact info)	N/A	9	-44.34	-45.11	-43.57

Note: LLCI and ULCI represent the lower and upper levels of the 95% confidence interval around the mean; Control means that information category was absent

Table 2
Rankings, means, and 95% confidence intervals for solution information utilities.

Type	Text	Rank	Mean	LLCI	ULCI
Energy	Using cleaner forms of energy such as solar and wind power in homes, schools and businesses will give us cleaner air and water, and reduce the pollution that causes climate change.	1	27.25	26.43	28.06
Cities and communities	Improving the design of our communities by adding trees and parks, and making it easier and safer to get around on foot, bike and mass transit will help people become more physically active and lose weight, and reduce the pollution that causes climate change.	2	25.19	24.58	25.80
Consumption	Encouraging recycling and reusing materials at home, work, and in factories will give us cleaner air and water, save energy, reduce waste, and reduce the pollution that causes climate change.	3	23.27	22.70	23.84
Nature spaces	Restoring and protecting forests will give us cleaner air and water, and capture and store carbon dioxide, the main form of pollution that causes climate change.	4	14.53	13.91	15.15
Transportation	Using cleaner forms of transportation, such as electric vehicles and more fuel-efficient airplanes will give us cleaner air and water, and reduce the pollution that causes climate change.	5	-7.10	-7.74	-6.47
Buildings	Upgrading our homes and buildings to be better insulated, use more energy-efficient heating, cooling, and lighting will give us cleaner air—both outside and indoors—and reduce the pollution that causes climate change.	6	-7.32	-7.93	-6.71
Food	Encouraging local and organic farming, reducing food waste at stores and in restaurants, and encouraging consumption of more fruits and vegetables and less beef will help people eat more healthfully and reduce the pollution that causes climate change.	7	-14.04	-14.99	-13.09
Control (no solution info)	N/A	8	-61.77	-62.52	-61.03

Note: LLCI and ULCI represent the lower and upper levels of the 95% confidence interval around the mean; Control means that information category was absent

Table 3
Rankings, means, and 95% confidence intervals for call-to-action information utilities.

Type	Text	Rank	Mean	LLCI	ULCI
Positive descriptive norms	Most Americans agree that we want healthy communities and a healthy climate, and many of us are taking action.	1	8.84	8.39	9.30
Negative descriptive norms	Most Americans agree that we want healthy communities and a healthy climate, but not enough of us are taking action.	2	6.85	6.46	7.24
Surplus efficacy	The actions of people like you are already making a difference. Policymakers are listening.	3	4.66	4.16	5.17
Control (no call-to-action info)	N/A	4	-9.60	-10.11	-9.08
Deficit efficacy	Policymakers don't know what we want, but they will listen if we tell them.	5	-10.76	-11.29	-10.23

Note: LLCI and ULCI represent the lower and upper levels of the 95% confidence interval around the mean; Control means that information category was absent

Table 4
Rankings, means and 95% confidence intervals for importance scores

Information category	Rank	Mean	LLCI	ULCI
Solutions	1	44.29	44.12	44.45
Impacts	2	35.63	35.47	35.78
Call-to-action	3	20.09	19.94	20.24

Note: LLCI and ULCI represent the lower and upper levels of the 95% confidence interval around the mean

found that positive descriptive norms are strongly associated with climate advocacy [34,35]. Interestingly, we found that the deficit efficacy information was the least effective call-to-action, and less compelling than the control version that omitted this information category. It is possible that some people found the suggestion that policymakers are simply unaware of constituent preferences to be implausible and reacted more negatively to this appeal as a result, though more research is needed to develop a more definitive explanation for this finding.

Finally, the high degree of consistency in how participants ranked the various types of information across racial and partisan groups is notable given that climate change is a politically polarized issue. That said, it is important to be mindful that choice-based conjoint analysis only provides an estimate of the relative effectiveness of certain messages compared to others. For example, although Republicans and Democrats ranked the messages similarly, it is still reasonable to expect that Democrats would be more responsive to the same message relative to Republicans given their higher willingness to engage in climate advocacy.

Our study is not without limitations. Our findings rely upon participants' perceptions of which messages are most likely to motivate them to contact their member of Congress, and no observations of actual advocacy behavior in response to the messages tested were obtained. Although some validation studies suggest that preferences revealed through conjoint experiments correspond to actual behavior in the real world [51], the larger question of whether measures of perceived message effectiveness are valid predictors of actual message effectiveness remains a subject of debate [52]. Future research could address this limitation by testing a range of message combinations included in this study in a field experiment to assess the ecological validity of our findings. Participants in our study were limited to adults in the United States. Given the importance of increasing public support for climate action globally [53], future research should endeavor to understand how well these findings generalize to other national contexts.

The compelling climate-health information identified in our study is especially useful for the large numbers of health professionals who are interested in and willing to promote sustainability [54] and climate actions [55–58]. Although some may worry that advocating for specific climate solutions could harm their credibility, research suggests that as long as experts advocate for popular solutions, such advocacy can actually enhance their perceived credibility relative to discussing impacts alone [51,52]. Furthermore, health professionals are especially well-positioned to communicate about climate change to a variety of audiences. For example, they can explain the health relevance of climate change and climate solutions to patients, clients, colleagues, and the general public; advocate to hospital systems and policy makers; and educate future practitioners [4]. Notably, a 2014 survey found that primary care physicians were rated the most trusted source of information about the health effects of climate change, with the CDC as the second most trusted [9]. Thus, there exists a strong and established relationship between health professionals and the lay public, as well as a commitment to viewing climate and health as connected issues – both of which can facilitate the dissemination of climate change and health information.

Increasing public demand for more ambitious government action to address climate change is essential to improving global health [2]. Our study provides useful insights for health professionals and other advocates seeking to advance public engagement and political will around this issue, and we hope it catalyzes further research on how best to communicate the health implications of climate change.

Author statement

John Kotcher - Conceptualization, formal analysis, funding acquisition, investigation, methodology, project administration, supervision, writing - original draft, writing - review & editing

Lauren Feldman - Conceptualization, writing - review & editing

Kate T. Luong - Writing - original draft, writing - review & editing

James Wyatt - Funding acquisition, investigation, methodology, writing - review & editing

Edward Maibach - Conceptualization, funding acquisition, writing - review & editing

Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

We thank The Energy Foundation for providing grant funding to support this research. The funder had no role in the study design, data collection, analysis and interpretation of the data, the writing of the report, or in the decision to submit the article for publication.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.joclim.2021.100030.

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