Northwestern | INSTITUTE FOR POLICY RESEARCH

Working Paper Series

WP-19-28

A Research Agenda for Climate Change Communication and Public Opinion: The Role of Consensus Messaging and Beyond

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Version: November 19, 2019

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ABSTRACT

Response to human-induced climate change is among the most pressing problems facing humanity. The fact that climate change has been accelerated by human activity enjoys a rare scientific consensus. This consensus, however, has not been fully endorsed by the general population, particularly in the United States. These skeptical beliefs create a major hurdle for climate mitigation and adaptation policy, particularly in societies where policy and law are created in response to public opinion. In this paper, the authors review many of the studies that have been done on the impact of communicating the scientific consensus to the general public. They discuss ongoing debates about these studies, but more importantly, they highlight complementary areas that they believe should define future research on climate change communications.

The authors thank Sander van der Linden for sharing details about his work, and Risa Palm for her excellent comments.

Climate change is the essence of a wicked problem – that is, one where there exists substantial complexities, profound interdependencies, no clear solutions, and ever evolving challenges (Incropera, 2016). It also is perhaps the most substantial threat facing humanity. Yet, particularly in the United States, a non-trivial portion of the population continues to express skepticism about climate change despite overwhelming agreement on the part of climate scientists that human activity has exacerbated climate change (Cook et al., 2016), and thus, a partial solution lies with changing human activity. While many technological challenges remain surrounding how to best respond to climate change, an equal or greater challenge will be building greater political and social consensus to promote behavioral and policy change.

The Consensus Messaging Approach

An obvious starting point is to consider how communicating a scientific consensus can affect people's beliefs about the fundamentals of climate change and policy outcomes. In democratic societies, passing new public policies requires public support, and hence, many have studied how providing scientific information can lead to a more informed electorate that will update their opinions in line with scientists' views (Bauer et al., 2007; Miller, 1998). The idea is that the public's views will come to cohere with the scientific perspective, and this will, in turn, eventually shift public policy in ways that at least partially reflect scientific advances.

Research on the science of science communication, however, largely rejects this "deficit model" where individuals simply accept the science (National Academy of Sciences, 2017, p. 30–31). Part of this rejection comes from work on emerging technologies where a scientific consensus may be lacking or difficult to relay given the complexities involved. This is not the case when it comes to climate change, a widely discussed issue where there is a clear scientific consensus that human activity is a primary contributor, and that the alteration of human activity

on a large scale can mitigate or slow at least some of the effects (Rare and California Environmental Associates, 2019).

The Gateway-Belief-Model (GBM) theorizes that communicating the level of consensus among climate scientists on human-caused climate change increases people's belief that an expert consensus exists. The model also posits that this belief in expert consensus, in turn, causes individuals to become more supportive of policy actions (Lewandowsky, Gignac, & Vaughan, 2013; van der Linden, Leiserowitz, Feinberg, & Maibach, 2015). Van der Linden, Leiserowitz, and Maibach (2019) argue that a "*change* in perceived consensus acts as a 'gateway' in the sense that it predicts smaller subsequent changes in personal (private) beliefs and attitudes about climate change. In turn, changes in these central beliefs predict support for policy action" (p. 50, italics in the original). The GBM points to a straightforward piece of the puzzle to addressing climate change: successful communication of consensus could help combat misinformation campaigns and vitiate the ideological divide present in the United States (Cook, 2016).

Many empirical studies have offered evidence consistent with the GBM, particularly the first step that emphasizing the scientific consensus increases people's perception of the level of scientific consensus on climate change (Bolsen & Druckman, 2018; Brewer & McKnight, 2017; Cook & Lewandowsky, 2016; Cook et al., 2017; Deryugina & Shurchkov, 2016; Ding, Maibach, Zhao, Roser-Renouf, & Leiserowitz, 2011; Goldberg et al., 2019; McCright et al., 2013; van der Linden, Leiserowitz, & Maibach, 2016). This belief in consensus matters, given efforts to discredit the scientific consensus via misinformation campaigns (Cook & Pearce, n.d.; van der Linden, Leiserowitz, Rosenthal, & Maibach, 2017). The evidence, however, for effects on other beliefs—for example, that climate change is human caused—and support for climate friendly policies is less clear. Several studies have failed to find direct effects of consensus messaging on

policy support, particularly when messages are directed at climate skeptics or Republicans (e.g., Bolsen & Druckman, 2018; Bolsen, Leeper, & Shapiro, 2014; Cook & Lewandowsky, 2016; Dixon, Hmielowski, & Ma, 2017; Kahan, 2016). Moreover, for reasons explained by McGrath (n.d.), the mediational evidence presented to-date is insufficient to definitively show an indirect causal path from consensus messages to consensus belief to policy support, as it requires experimental manipulation of the mediators to conclusively establish causality.

The GBM has generated substantial debate and disagreement in the published literature (Cook & Pearce, n.d.; Kahan, 2016; Kerr & Wilson, 2018; Ma, Dixon, & Hmielowski, 2019; Pearce et al., 2017; van der Linden, Leiserowitz, & Maibach, 2018; van der Linden, Maibach, & Leiserowitz, 2019). Here we turn to three particular critiques of the model to allow us to segue to larger questions that we believe should guide future research on climate change communication and public opinion.

Challenges to Consensus Messaging

Kahan provides a critique of the consensus messaging approach in pointing out that after two decades of concerted efforts to inform the public about the scientific consensus on climate change, a persistent gap exists along partisan lines (Kahan, 2015). Despite consensus messaging, Republicans continue to be skeptical of human-induced climate change, and less supportive of policy action. This raises questions about the efficacy of the overall strategy (Kahan, 2016). However, the counterfactual is unknown – it may be that even fewer would believe there exists a consensus and support climate friendly policies if not for the consensus messaging campaign.

Further, some findings on Republicans' response to consensus messaging directly contradicts the basic premise of the GBM by demonstrating that exposure to a consensus message *can backfire* and lead some individuals to become more doubtful about climate science

and less supportive of any actions to address the problem (Cook & Lewandowsky, 2016; Ma et al., 2019). Backfire effects may occur due to at least one of two motivation-driven processes. First, psychological reactance occurs when people believe they are being manipulated or forced to adopt a particular point of view (Brehm & Brehm, 2013; Petty & Cacioppo, 1979). Here, those who do not have prior beliefs consistent with the consensus message feel that their need for autonomy has been violated and reaffirm their autonomy by resisting the message. Second, backfire effects may occur as a result of motivated disconfirmation biases (Taber & Lodge, 2006). In this case, climate skeptics motivated to disconfirm the existence of climate change will generate counterarguments when presented with a consensus message and persuade themselves to become even more skeptical (Cook & Lewandowsky, 2016; Nisbet, Cooper, & Garrett, 2015). Kahan (2015) suggests that a conformity motivation underlies this disconfirmation bias: people care much more about holding beliefs and supporting policies consistent with their social groups than accepting scientific information (Kahan, Jenkins-Smith, & Braman, 2011), and when it comes to climate change, Republicans often may conform to follow what they believe other Republicans believe (Abeles, Howe, Krosnick, & MacInnis, 2019). This uncertainty about which motivations underlie observed backfire effects, then, raises the question: *what motivates people when it comes to processing consensus messages and forming opinions about climate change?* For example, what do they do when scientific information about human-induced climate change contradicts the beliefs of others in their social groups?

A distinct critique of consensus messaging argues that intense scrutiny to quantifying the level of scientific consensus on high-stakes, politically contested issues increases the public's uncertainty about the science and ultimately has little impact on public policy (Pearce et al. 2017; Pearce, 2014). Pearce et al. (2017) explain, "this happens as different parties are motivated to

undercut each other's claims, and the complexity of scientific judgment lends itself to generating endless disagreement on technical grounds" (p. 724, also see, Jasanoff, 2010; Sarewitz, 2004). These critics further argue that the consensus messaging approach results in a misplaced focus on technical knowledge and the need for scientific consensus as opposed to a convergence of interests that is essential for political cooperation and policy change. Pearce et al. (2017) acknowledge that "there are occasions where this consensus is worth stating. However, there will always be public voices of dissent, and drowning them out with consensus messaging is implausible" (2017, p.737; also see, Aklin & Urpelainen, 2014). Even so, some research contends there are inoculation methods to address dissenting voices (van der Linden et al., 2017). This critique, however, raises an important question: *what outcomes should researchers of climate change communication prioritize when studying public opinion?*

A final critique considers that most research on climate change messaging effects focuses only on variations across partisanship and ideology, but neglects other important possible moderators, such as personal experiences with local warming or natural disasters linked with the effects of climate change. While the potential for backfire and null effects by party and ideology are important to study, the fact that backfire effects have only been found in certain sub-populations should accentuate the point that different types of people react in different ways. This leads to a larger question: *whose opinions should we study when it comes to climate change? Has research paid sufficient attention to heterogeneity in how people might react to climate messaging and/or looked at sufficient variation within the populace?*

We argue these three highlighted questions cover crucial dimensions that should guide future work: (a) while consensus messaging can matter among certain populations with certain stimuli, more work is needed to match consensus messaging with prior attitudes and motivations;

(b) prior work has offered insufficient insight into which changes in attitudes or behavior would have an impact on slowing climate change, as well as how messages to address key changes should be framed when it comes to climate policy; and (c) there is insufficient attention to heterogeneity in opinion formation, which is a particularly acute concern given that the effects of climate change affect some vulnerable populations much more than others. As we discuss below, there are clear groups who are being affected by climate events (Schiermeier, 2011). Blindly looking for ways to shift domestic support for particular policies ignores the immediate effects happening to underserved populations.

Motivation and Effective Messaging

To understand opinion formation, one needs to understand the *motivational states* of those forming opinions. Many invoke the theory of motivated reasoning; the theory generally distinguishes two types of goals that people have when forming opinions: non-directional and directional. In the case of non-directional goals, individuals aim to form an accurate belief that is consistent with observed reality regardless of its implications; in the case of directional goals, individuals hope to reach a particular conclusion, such as upholding one's standing belief or group-identity (Kunda, 1990; Molden & Higgins, 2012). A widely discussed explanation for political divergence on climate change in the U.S. is that people engage in directional motivated reasoning (e.g., Dietz, 2013; Druckman, 2015; Hart & Nisbet, 2012; Kahan, 2015; Palm, Lewis, & Feng, 2017). For example, many Republicans have followed elite cues from their party (Brulle, Carmichael, & Jenkins, 2012; McCright & Dunlap, 2011; Tesler, 2018) and hold skeptical climate change views; thus, when they encounter information that human activity destroys the climate and demands policy innovation, they process that information in a directional fashion, with the goal of reaching a conclusion that confirms either their Republican

identity of being skeptical or their standing oppositional belief. They thus reject the information and may generate counterarguments and become even more skeptical. Democrats do the opposite, accepting the information as it fulfills their directional goals.

This type of motivational dynamic coheres with the observed partisan polarization on climate change. Yet, the same polarization could be the result of non-directional processing where all individuals hope to form the most objectively accurate opinions. It could simply be that Republicans do not trust climate scientists while Democrats do. Here it is the credibility of information, and not the satisfaction of a directional goal, that makes the difference. Unfortunately, few studies distinguish between these two possibilities in the domain of climate change (Druckman & McGrath, 2019). As Leeper and Slothuus (2014) explain, "While 'motivated reasoning' has become a convenient label to apply to any study of bias or partisan differences, use of the label requires evidence that motivations – indeed, the putative directional /defensive motivations – are at work… evidence of motivated reasoning from seminal observational studies… should be read with some skepticism" (p. 148–149).

To see why understanding and isolating motivations matters, consider the following observational equivalence problem in identifying determinants of successful climate change messaging: a consensus message based on scientific information may be seen as a credible piece of information – it works because people "rely on heuristics such as expert opinion" (Cook & Pearce, n.d., p. 6). For it to work in this manner, people must be motivated to form accurate opinions informed by expert evidence. On the other hand, the consensus message could work because people view the consensus as a descriptive social norm, as the authors of the GBM argue (van der Linden et al., 2018). Here, people learn that scientists hold particular beliefs about climate change and conform their own views with social norms established by expert scientists.

This perspective, at least implicitly, assumes directional motivations to hold beliefs that cohere with a relevant social group which, in this case, is scientists. Which motivation – non-directional or directional – underlies the documentation of consensus messaging effects remains unclear.

Perceiving the existence of a scientific consensus is *distinct* from perceiving a social consensus on an issue. A social consensus refers to "a consensus among nonscientists' group members, including one's social network members, such as family, friends, and acquaintances (social network consensus) and ordinary people in a society (public consensus)" (Kobayashi, 2018, p. 64). In many cases, individuals may be motivated directionally to behave in a manner that maximizes the likelihood of social approval (e.g., Dwyer et al., 2015; Fielding & Hornsey, 2016; Gerber & Rogers, 2009). Social consensus messages may also exert an informational influence independent of their normative influence. As Kobayashi (2018) explains, "even though people may have no great expectations for their group and social network members' expertise in scientific research, they may use perceived social consensus to heuristically judge whether a scientific claim is acceptable" (p. 66).

The success of any given climate change communication depends on whether its content aligns with an individual's motivational state (Bayes, Druckman, Goods, & Molden, 2019). First, when individuals are motivated by an accuracy goal, credible information appears to be quite influential (Bolsen, Druckman, & Cook, 2014; Bullock, 2011). This could be, for example, what occurs when people alter their opinions in light of new scientific information – including, possibly, that a consensus of scientists believe human-induced climate change is occurring. Second, when individuals are motivated to conform their views to established norms, it is crucial to know who is considered to be a part of one's relevant social group. If scientists are seen as part of one's group, then learning that a consensus of scientists hold a belief is likely to move

opinions in the direction of the scientists' beliefs. Yet, if scientists are not seen as a normatively relevant group, that messaging approach will not work in this way. It may be instead that one cares about his or her *social group*. Here, for example, Republicans will only change their opinions if they come to learn other Republicans also believe in human-induced climate change.

A final possibility that we have not yet discussed is a directional motivation to confirm one's values. For example, individuals who hold moral values such as loyalty and sanctity will respond to a message that resonates with those values – such as one that frames actions on climate change as protecting the sanctity of the environment and being patriotic to the country (Wolsko, Ariceaga, & Seiden, 2016). As Kahan et al. (2015) state, "framing climate change science with identity-affirming meanings can mitigate [motivated] resistance" (p. 207) to sound scientific information (also see Feinberg & Willer, 2013). Our bottom line is that one cannot understand what type of message will alter people's opinions about climate change without having a sense of their motivations. To see how lack of knowledge about motivations limits what we know, we consider specific studies on consensus messaging.

Applying Motivational Lessons to Consensus Messaging Debates

In an earlier issue of this journal, Ma, Dixon, and Hmielowski (2019) test the effect of a consensus message on climate change opinions. Their primary research question involves the potential role of psychological reactance as mediating the relationship between consensus messaging and resulting change in climate change beliefs, risk perceptions, and policy support. Reactance theory posits that people cherish the freedom to make choices and resent being told how to think, what to believe, and how to act in their personal lives (Brehm & Brehm, 2013). When people feel manipulated by persuasive messaging, they will resist and counterargue the message, resulting in null or backfire effects on outcome measures. To test this, the authors

conduct a survey experiment on a sample of 661 respondents from an online panel, randomly assigning respondents to (1) a condition that received a consensus message about climate change ("Did you know? 97% of climate scientists have concluded that human-caused climate change is happening"), (2) a condition that received a basic message about climate change ("Did you know? Human-caused climate change is happening"), or (3) a no-message control condition. They measured reactance through items that asked respondents whether they felt manipulated, and indeed find some evidence of reactance in response to the consensus message, but only among Republicans and Independents with prior beliefs that questioned the existence of human caused climate change. Further, this reactance appeared to mediate a backfire effect in that sub-population, such that exposure to consensus messaging resulted in lower climate change beliefs, risk perceptions, and policy support.

van der Linden, Maibach, and Leiserowitz (2019) take issue with Ma et al.'s results. They respond with results from their own survey experiment on a larger national quota sample of 6,301 adults, which includes only two conditions (consensus messaging and control) but measures the same outcomes as Ma et al., with some wording variations. Contrary to Ma et al., they find no evidence that consensus messaging creates reactance. Furthermore, in a different article utilizing the same data, van der Linden et al. (2019) find that consensus messaging leads to significant increases in key climate change beliefs and policy support, further supporting the viability of the GBM.

We believe both sides make reasonable points. Van der Linden et al. offer evidence consistent with the GBM and conceptually do not replicate Ma et al.'s findings. Yet, Ma et al. are correct that van der Linden's experiment differed from theirs in some important ways and,

indeed, could not have been an exact replication, since the data were collected before the Ma et al. study took place.

We suspect differences in the results reflect the reality that consensus messaging effects do not generalize across times, contexts, and treatments. These are three crucial dimensions of external validity, despite being typically dwarfed by discussions of sample generalizability (Druckman & Kam, 2011; Shadish, Cook, & Campbell, 2002). First, the timing of a climate change messaging experiment matters. Consider that the general backfiring effect discovered by Ma et al. (2019) (i.e., reactance) seems to be quite fragile: some work finds it (e.g., Nyhan & Reifler, 2010; Peter & Koch, 2016) but the bulk of the recent evidence does not (e.g., Bayes et al., 2019; de Benedictis-Kessner, n.d.; Guess & Coppock, 2019; Nyhan et al., n.d.; Walter and Tukachinsky, 2019; Wood & Porter, 2019). Part of this inconsistency may be due to timing. Ma et al. collect their data shortly after one of the warmest February's on record that generated considerable conversation about climate change in 2017 (e.g., CBS News, 2017). This may have generated a feeling of threat among those opposed to climate mitigation policies. Weather trends, combined with the recent inauguration of President Trump, who boldly denied climate change, sent a clear signal that climate skeptics should actively push back against a consensus message. In contrast, the van der Linden et al. data come from 2016, prior to the election (personal communication 9/16/19), during a time of ostensibly less threat and aggressive counter-messaging. All data collections need to consider the context and timing (Druckman & Leeper, 2012).

Also of relevance are the precise message and outcomes examined. We will turn to the latter point in detail below, but in terms of messages, Ma et al.'s (2019, p.76) message states, "Did you know? 97% of climate scientists have concluded that human-caused climate change is

happening." This subtly differs from van der Linden et al. (2019, p. 51), who simply state the consensus. This could matter insofar as the former presents a FAQ from an ambiguous source while the latter is a declarative statement. The phrase "did you know?" could itself cause reactance among those who did not know and are not inclined to believe. More generally, the theoretical application of reactance theory seems unclear, as much of that work focuses on attitudinal and behavioral directives (i.e., "you should do or believe in something") that lead respondents to have negative cognitive and emotional reactions (e.g., Dillard & Shen, 2005). Here it is less clear that a consensus messages aligns with a directive; however, perhaps the "Did you know?" preface stimulates respondents to feel as if they "should have known." The larger point is that we continue to know little about variations in messages as well as context and timing.

Isolating such specifics about message and contexts, though, requires understanding motivations. Ma et al. (2019) argue that individuals are motivated by a need for "freedom," which they depict as a motivational state where the goal is to "maintain freedom and autonomy" (p. 73). Yet, the study neither offers direct evidence that this goal drives opinion formation nor points to other work suggesting it to be a crucial value in this domain. An alternative motivational process could entail Republicans holding a directional motivation to protect opinions that cohere with others in their social group. That is, they hold skeptical climate change beliefs, are motivated to uphold those beliefs, and thus counter-argue the consensus message and consequently become even more skeptical as a result of the aforementioned disconfirmation bias. Here, it is not protection of a freedom value at play, but rather what is called "identity-protective motivated cognition" (Kahan, 2015). This is akin to the prior discussion of having the goal to form opinions that align with key social group members – in this case, those who share one's

partisanship or ideology. Kahan (2017) states, "forming beliefs contrary to the ones that prevail in one's group risks estrangement from others on whom one depends for support, material and emotional… As a result of these influences, we should expect individuals to acquire habits of mind that guide them to form and persist in beliefs that, against the background of social norms, express their membership in and loyalty to a particular identity-defining affinity group..." (p. 2). Adhering to group-based social norms, rather than a need to maintain and protect individual freedoms, could be the key driving force.

As explained, these are distinct norms from those posited by the GBM model, where it is presumed "as a group, scientists are viewed as non-partisan… correcting people's perception of the scientific norm can help depolarize ideological worldviews and neutralize motivated cognition" (van der Linden, Leiserowitz, & Maibach, 2018, p. 2). Van der Linden, Maibach, and Leiserowitz (2019) state that the "basic premise of the GBM is that by communicating descriptive norms (i.e. consensus), people's perception of normative agreement can be 'debiased,' which in turn leads to changes in private attitudes and support for action…" (p.2). This suggests a type of directional cognition where the relevant norm is established by scientists rather than a social in-group. However, they also do not offer direct evidence of this mechanism.

In sum, differences in the results of specific consensus messaging studies likely reflect variations in timing and stimuli but, even more so, differences in the motivations of individuals in different contexts: Do people want accurate climate change information? Do they want to hold beliefs that cohere with those in their social group? Do they want to form opinions consistent with those of scientists? Do they want to fulfill a need for autonomy in their thoughts and actions? Do they want to affirm a value, such as patriotism or sanctity? There clearly is heterogeneity across people and context in these motivations – and these variations likely map

onto attributes beyond partisanship, such as scientific thinking style (Oliver & Wood, 2018), and other socio-demographic variation such as religiosity (Pennycook, Ross, Koehler, & Fugelsang, 2016**)**. Cook (2019, p. 734), a co-author of the GBM, acknowledges that consensus messaging is not a "magic bullet." It may be a useful approach, but the reality is that other messaging approaches, such as drawing on social group norms explicitly, may be more effective. The motivations that drive reasoning in the domain of climate change should receive greater attention in future work.

Which Opinions To Study?

The main outcome studied in consensus messaging is perception of consensus. Yet, policy-makers likely only take action when their constituents demand specific climate relevant policies (for discussion, see Cook & Pearce, n.d.; Druckman, 2013). This leads to another question that has seemingly eluded those working on climate change communication – what exact outcome variables should be studied if the goal is to generate political and social consensus for large-scale efforts to address climate change? Are perceptions of consensus, beliefs about climate change, intended behaviors, and policy support meaningful? These are all outcomes social scientists have studied (e.g., Hornsey, Harris, Bain, & Fielding, 2016), but how do these outcome variables influence climate action?

This is a complicated question with multiple avenues to consider. First, a prominent avenue of change is, of course, implementation of government policy. Although climate policy support is a well-studied outcome in climate messaging work, a crucial follow-up question has been largely neglected: to whose opinions do policy-makers respond? It seems as if environmental and climate policy activity corresponds to the level of public opinion demanding it. Controlling for factors like average state resident ideology and characteristics of the

legislator/legislature, a host of correlational studies look on a state-by-state basis and report a relationship between public opinion and policy implementation in the U.S., both on general environmental issues like water pollution (Brace, Sims-Butler, Arceneaux, & Johnson, 2002; Johnson, Brace, & Arceneaux, 2005) and climate change in particular (Bromley-Trujillo & Poe, 2014; Egan & Mullin, 2017; Vandeweerdt, Kerremans, & Cohn, 2016).

Nonetheless, much more needs to be done to study the policy-opinion nexus, including investigating the possibility that other actors such as interest groups or think tanks are the main driving force (e.g., Domhoff, 2002), and/or that particular sub-groups of the public, such as those with high socio-economic status, are the only group to which policy-makers respond (Gilens & Page, 2014). These are substantial lacuna, given scholars have spent so much time studying climate change opinions but still have little sense of which, when, and whose opinions actually affect policy. Moving forward, it is important that scholars: a) figure out which substantive opinions affect policy, b) how messaging may affect those opinions, and c) whether consensus messaging might be involved, bringing us back to the importance of understanding motivations.

A second path to large-scale change involves the role of people in private politics. Private politics involves individuals and activists expressing themselves in the private realm via boycotting businesses and/or buycotting products. They often do this to bypass formal democratic (legislative) practices and induce companies to alter their behaviors or reward them for supporting a favored political position. As Baron and Diermeier (2007) state, "private interests such as activists…target private agents, often in the institution of public sentiment" (p. 600; also see Baron, 2003). This approach has become more feasible as non-governmental organizations (NGOs) exploit communication technologies to orchestrate boycotting and/or buycotting efforts (e.g., Abito, Besanko & Diermeier, 2019; Baron & Diermeier, 2007;

Druckman & Valdes, 2019; Reid & Toffel, 2009). Examples of successful protest efforts that have led companies to change their environmental practices include Nestle's efforts to end deforestation, Staples' increased usage of recycled paper, and Zara clothing stores eliminating fur products (Roser-Renouf, Maibach, & Leiserowitz, 2016; also see Reid & Toffel, 2009; Hiatt, Grandy, & Lee 2015). Roser-Renouf, Maibach, and Leiserowitz (2016) report that nearly a third of Americans rewarded companies that address climate change by buying their products more than once in the last year (2016) while about 20% said they had avoided products from companies with poor climate practices. Here it is not public opinion and policy support, per se, but market behaviors that matter (Endres & Panagopoulos, 2017). Given the urgency of addressing climate change, private politics becomes a more and more attractive route; yet, climate change communication research has paid little attention to the types of messages that induce private political behaviors. Such messaging likely involves targeting those who already view climate change as a substantial threat and emphasizing the potential efficacy as well as the normative importance of taking action via private politics (Roser-Renouf, Atkinson, Maibach & Leiserowitz 2016, p. 4777)

Finally, individual behaviors might matter too, and a sizeable literature has developed to study factors that lead to climate-friendly behaviors such as recycling, purchasing fuel efficient products, lowering thermostats, and using alternative transportation (e.g., Attari, DeKay, Davidson, & de Bruin, 2011). These studies suggest that these behaviors can make a difference when it comes to climate change, but messaging to induce these behaviors remains complicated. For example, in Levine and Kline (2019), two experiments demonstrate the effects of gain- and loss-frames in messaging on behaviors. In the field experiment, over 100,000 members of a social network site were randomly assigned to receive an email message with either (1) a loss

frame about the harms to public health that would be reduced with climate action, (2) a gains frame about the health benefits that would occur with climate action, or (3) a control message advocating for clean energy. In an analogous online survey experiment, 526 Amazon Mechanical Turk workers were randomly assigned to receive similar messages. The key outcome of interest for both experiments is a behavioral measure of political activism: joining an organization in the field experiment and joining an email listserv in the survey experiment. Findings across both experiments indicate that gain-frames were more successful at mobilizing behavior relative to the control. However, in the field experiment, loss-frames were overall *demobilizing,* and in the survey experiment, they were demobilizing specifically among those experiencing a health hardship, and thus facing a material constraint against spending resources on activism that a loss frame makes salient. In summary, framing and other contextual factors matter for whether and among whom messaging can effectively mobilize behavior change. Overall, our larger point in this section is that those who study message effects need to isolate which specific outcomes are of most interest, across three avenues of potential change: public channels, private politics, or behavioral change.

Whose Opinions To Study?

Distinct from the question of *which* attitudes and beliefs are most salient is the issue of *whose* opinions researchers should study. Most existing research generalizes in an effort to study message effects among the "mass public," with the main variation concerning ideology and partisanship. This is sensible insofar as climate change has become a clearly politicized issue on which partisan elites have staked out distinct positions (Bolsen, Druckman, & Cook, 2015; McCright & Dunlap, 2011). Yet, one under-explored aspect of this area of research is whether

studying the opinions and attitudes of certain sub-populations are of special interest. Here, two inter-connected questions emerge:

- Do some people's opinions matter more than others for policy change, and, if so, how do the most influential subsets of the population form climate change opinions?
- On the other hand, we already know that some people are more vulnerable to the harms posed by climate change than others (IPCC, 2014); how do these most vulnerable subsets of the population form climate change opinions?

On the first question, as mentioned, there is reason to believe that some sub-populations are more influential than others in determining climate policy. Although topic-specific research on the responsiveness of climate policy to public opinion is in its infancy, there is much work on representation that suggests that policy activity in general is more responsive to high-income and other elite segments of the public (e.g., Bartels, 2018; Gilens & Page, 2014). Investigating whether income, education, or other variables moderate the effect of public attitudes on climate policy implementation would form the basis of a research agenda that would be highly useful to an ultimate goal oriented toward policy outcomes, as identifying the most influential sub-populations opens up the opportunity for more targeted research about how these sub-populations form attitudes on climate change. That is, do the variations that might shape influence also alter what makes for effective messaging? Should advocacy groups tailor messages for the most influential audiences?

The second question, though, addresses who will be most affected by the consequences. Climate change impacts will be most direct and salient for these sub-populations, reducing the psychological distance between climate change harms and climate action. Thus, it is important to study how messaging works for vulnerable sub-populations: how communications reach them,

how they process information, and whether or not their attitudes are represented in electoral decision-making about the environment.

Much research has already been done to identify these vulnerable sub-populations on both the global (e.g., IPCC, 2014; Chaplin-Kramer et al., 2019) and national levels (USGCRP, 2018). Recent work uses a broad conception of what constitutes a climate change consequence, encompassing not only environmental but also economic, infrastructural, health, and even crime and other social impacts (Watts et al., 2018; White, 2017). With so many potential impacts, the scope of vulnerability is correspondingly broad. As IPCC (2014) states,

> "People who are socially, economically, culturally, politically, institutionally, or otherwise marginalized are especially vulnerable to climate change…. This heightened vulnerability is rarely due to a single cause. Rather, it is the product of intersecting social processes that result in inequalities in socioeconomic status and income, as well as in exposure. Such social processes include, for example, discrimination on the basis of gender, class, ethnicity, age, and (dis)ability" (p. 54).

Implicit in this quote are the three dimensions typically used in international climate governance to identify vulnerability: (1) exposure of a given system or group to climatic stressors, (2) sensitivity, or degree to which the subject will respond to such stressors, and (3) adaptive capacity, or the subject's ability to adapt to the resulting changes (IPCC, 2014). Of those exposed to climatic stressors, more sensitive subjects are more vulnerable; holding sensitivity constant, those with the lowest adaptive capacity are most vulnerable.

In the same spirit, USGCRP (2018) identifies vulnerable sub-populations in the United States specifically. While almost everyone will be exposed to different kinds of climate change

impacts, certain sub-populations who are most sensitive to disturbances and least able to adapt to them will suffer most. These include "poor people in high-income regions, minority groups, women, pregnant women, those experiencing discrimination, children under five, persons with physical and mental illness, persons with physical and cognitive disabilities, the homeless, those living alone, Indigenous people, people displaced because of weather and climate, the socially isolated, poorly planned communities, the disenfranchised, those with less access to healthcare, the uninsured and underinsured, those living in inadequate housing, and those with limited financial resources to rebound from disasters" (USGCRP, 2018, p. 548).

USGCRP (2018) also recognizes that the most vulnerable segments of the public are also those who tend to have the least access to information and least voice in climate planning and governance. This circles back to how our two questions about sub-populations of interest are interconnected: that those who are most powerful and exert, perhaps, the most influence on climate policy outcomes are not the same groups that will be most impacted by the consequences. Recognition of this contrast is not new; it has been thoroughly studied, especially in qualitative and theoretical scholarship regarding climate equity on the global level (see, for example, Shue, 1999; Caney, 2005). However, to date, it has not been central in climate change research within the political behavior, communication, and psychology literatures. Key to this issue is that climate change is a problem with two foci: (1) mitigation of further climate change by reducing emissions, and (2) adaptation by increasing the resilience of those vulnerable to the climate change impacts already locked in by past emissions. Action on climate change must address both, and yet, the research on climate change in political science, communication, and psychology has overwhelmingly focused on beliefs, attitudes, and behaviors relevant for

mitigation alone (c.f. Haden et al., 2012). This work has also focused overwhelmingly on samples from Western populations, without special attention to vulnerable sub-populations.

As a comparison point, there is a large body of literature on climate change risk perceptions that focuses on factors influencing climate attitudes relevant for adaptation, particularly among non-Western populations. Furthermore, the explicit purpose of the research is often to promote adaptation in vulnerable sub-populations—for example, to ensure farmers adopt best practices to respond to climate change (Debela et al., 2015; Roco, Engler, Bravo-Ureta, & Jara-Rojas, 2012) or to assess gaps in rural infrastructure for responding to heat waves (Huang et al., 2018). This may reflect a general heightened concern about studying adaptation in developing nations, where exposure to certain climate impacts may be higher than the global average (Chaplin-Kramer et al., 2019), many sub-populations have natural resource-dependent livelihoods that are sensitive to climatic stressors (Chia et al., 2016; Meldrum et al., 2018), and lower levels of economic and infrastructural development may dampen adaptive capacity (Antwi-Agyei et al., 2017; Musinguzi et al., 2016). Yet, as discussed above, relatively vulnerable sub-populations also exist in developed nations, and climate scholarship on developed nations more generally should catch up to other climate work in studying climate attitudes to promote adaptation in those sub-populations.

Recognition of varying sub-populations of interest changes the nature of how climate change communication and public opinion has been studied to date. Future research should expand beyond primarily Western populations. Climate change poses an injustice in that groups who are most able to mitigate future harms are not the same groups who will most need to adapt to those harms. The dynamic between powerful versus vulnerable groups in the U.S. is nested within an analogous global-level dynamic involving developed countries versus developing

countries. While powerful and vulnerable sub-populations may be distinct, they are both important to study for different reasons, and special attention to these sub-populations of interest should guide future research on climate change messaging effects at both the U.S. and global levels.

Our central point in this section is that the very groups most affected by climate change have received little attention when it comes to how to best message to them. Moreover, the outcome variables most salient to addressing climate change in these populations – which are related to adaptation – have been overlooked and understudied in the extant messaging literature. Climate communication scholars would benefit from taking a step back and considering not only what messages matter and when, but also among whom and with regard to what outcomes, and whether those outcomes actually impact public policies.

Back to Consensus Messaging

Scientific consensus is rare and so when one exists, it makes sense to try to communicate it. While some studies have found that such messages can backfire in the case of climate change, evidence of this occurring is not widespread. Even so, that does not answer the question at the heart of climate change messaging research: will simply communicating scientific consensus result in actions that will help temper the effects of climate change? Answering this question requires an understanding of how people form opinions and which of various types of messages would be most effective, what outcomes are more relevant to study in terms of promoting mitigation and adaptation efforts, and how those processes vary across impacted populations. Documentation of motivations and contexts in each study should be accompanied by tracking the effects of messages on large-scale change, whether that be through individual behaviors, government policy implementation, or change in the private sector. Changing behavior and

policy is itself a wicked problem; there is no straightforward, one-size-fits-all solution, and even when effective approaches are found, encouraging adoption of them can be difficult. With this in mind, however, social scientists have a crucial role to play: we cannot move forward to encouraging adoption of effective communication strategies without first delineating the boundaries of those strategies, by looking at what motivates climate change opinion, within which populations, and with what outcomes.

References

Abeles, A. T., Howe, L. C., Krosnick, J. A., & MacInnis, B. (2019). Perception of public opinion on global warming and the role of opinion deviance. *Journal of Environmental Psychology, 63,* 118–129.

Abito, J. M., Besanko, D., & Diermeier, D. (2019). *Corporate reputation and social activism: Strategic Interaction, Firm Behavior, and Social Welfare*. Oxford University Press.

Attari, S. Z., DeKay, M. L., Davidson, C. I., & de Bruin, W. B. (2011). Changing household behaviors to curb climate change: How hard can it be? *Sustainability: The Journal of Record*, *4*(1), 9–11.

Aklin, M., & Urpelainen, J. (2014). Perceptions of scientific dissent undermine public support for environmental policy. *Environmental Science & Policy*, *38*, 173–177.

Antwi-Agyei, P., Quinn, C. H., Adiku, S. G. K., Codjoe, S. N. A., Dougill, A. J., Lamboll, R., & Dovie, D. B. K. (2017). Perceived stressors of climate vulnerability across scales in the Savannah zone of Ghana: a participatory approach. *Regional Environmental Change*, *17*(1), 213–227.

Baron, D. P. (2003). Private politics. *Journal of Economics & Management Strategy*, *12*(1), 31–66.

Baron, D. P., & Diermeier, D. (2007). Strategic activism and nonmarket strategy. *Journal of Economics & Management Strategy, 16*(3), 599–634.

Bartels, L. M. (2018). *Unequal democracy: The political economy of the new gilded age*. Princeton University Press.

Bauer, M. W., Allum, N., & Miller, S. (2007). What can we learn from 25 years of PUS survey research? Liberating and expanding the agenda. *Public understanding of science, 16*(1), 79–95.

Bayes, R., Druckman, J.N., Goods, A., & Molden, D.C. (2019). Framing values, explaining information, and revealing norms: How motivated reasoning influences effective science communication. Unpublished manuscript. Northwestern University.

Brehm, S. S., & Brehm, J. W. (2013). *Psychological reactance: A theory of freedom and control*. Academic Press.

Brewer, P. R., & McKnight, J. (2017). "A statistically representative climate change debate": Satirical television news, scientific consensus, and public perceptions of global warming. *Atlantic Journal of Communication*, *25*(3), 166–180.

Brace, P., Sims-Butler, K., Arceneaux, K., & Johnson, M. (2002). Public opinion in the American states: New perspectives using national survey data. *American Journal of Political Science,* 173–189.

Bromley-Trujillo, R., & Poe, J. (2014). The importance of salience: public opinion and state policy action on climate change. *Journal of Public Policy*, 1–25.

Brulle, R. J., Carmichael, J., & Jenkins, J. C. (2012). Shifting public opinion on climate change: an empirical assessment of factors influencing concern over climate change in the US, 2002–2010. *Climatic change*, *114*(2), 169–188.

Bolsen, T., & Druckman, J. N. (2018). Do partisanship and politicization undermine the impact of a scientific consensus message about climate change?. *Group Processes & Intergroup Relations*, *21*(3), 389–402.

Bolsen, T., Druckman, J. N., & Cook, F. L. (2015). Citizens', scientists', and policy advisors' beliefs about global warming. *The ANNALS of the American Academy of Political and Social Science*, *658*(1), 271–295.

Bolsen, T., Druckman, J. N., & Cook, F. L. (2014). The influence of partisan motivated reasoning on public opinion. *Political Behavior*, *36*(2), 235–262.

Bolsen, T., Leeper, T. J., & Shapiro, M. A. (2014). Doing what others do: Norms, science, and collective action on global warming. *American Politics Research*, *42*(1), 65–89.

Bullock, J. G. (2011). Elite influence on public opinion in an informed electorate. *American Political Science Review*, *105*(3), 496–515.

Caney, S. (2005). Cosmopolitan justice, responsibility, and global climate change. *Leiden Journal of International Law*, *18*(4), 747–775.

CBS News. (2017). The numbers are in on this freakishly warm February. March 9. Available at: https://www.cbsnews.com/news/february-2017-warm-temperatures-climate-change/.

Chaplin-Kramer, R., Sharp, R. P., Weil, C., Bennett, E. M., Pascual, U., Arkema, K. K., ... & Hamann, M. (2019). Global modeling of nature's contributions to people. *Science*, *366*(6462), 255–258.

Chia, E. L., Tiani, A. M., Sonwa, D. J., Perez-Teran, A. S., & Tchatchou, B. (2016). Securing well-being with the advent of climate hazards: Case of forest-dependent communities in a landscape in the Congo Basin. *International Journal of Climate Change Strategies and Management*, *8*(2), 175–193.

Cook, J. (2016). Countering climate science denial and communicating scientific consensus. In *Oxford Research Encyclopedia of Climate Science*.

Cook, J., & Lewandowsky, S. (2016). Rational irrationality: Modeling climate change belief polarization using Bayesian networks. *Topics in cognitive science*, *8*(1), 160–179.

Cook, J., Lewandowsky, S., & Ecker, U. K. (2017). Neutralizing misinformation through inoculation: Exposing misleading argumentation techniques reduces their influence. *PloS one*, *12*(5), e0175799.

Cook, J. & Pearce, W. (Forthcoming). Is emphasizing consensus in climate science helpful for policymaking? In *Contemporary climate change debates: A student primer*. Abingdon: Routledge.

Cook, J., Oreskes, N., Doran, P. T., Anderegg, W. R., Verheggen, B., Maibach, E. W., ... & Nuccitelli, D. (2016). Consensus on consensus: a synthesis of consensus estimates on human-caused global warming. *Environmental Research Letters*, *11*(4), 048002.

de Benedictis-Kessner, J.,A. Baum, M.A., Berinsky, A.J., & Yamamoto, T. (N.d.) Persuading the enemy: Estimating the persuasive effects of partisan media with the preference-incorporating choice and assignment design." *American Political Science Review*. Forthcoming.

Debela, N., Mohammed, C., Bridle, K., Corkrey, R., & McNeil, D. (2015). Perception of climate change and its impact by smallholders in pastoral/agropastoral systems of Borana, South Ethiopia. *SpringerPlus*, *4*(236), 1-12.

Deryugina, T., & Shurchkov, O. (2016). The effect of information provision on public consensus about climate change. *PloS one*, *11*(4), e0151469.

Dietz, T. (2013). Bringing values and deliberation to science communication. *Proceedings of the National Academy of Sciences*, *110*(Supplement 3), 14081–14087.

Dillard, J. P., & Shen, L. (2005). On the nature of reactance and its role in persuasive health communication. *Communication Monographs*, *72*(2), 144–168.

Ding, D., Maibach, E.W., Zhao, X., Roser-Renouf, C., & Leiserowitz, A. (2011). Support for climate policy and societal action are linked to perceptions about scientific agreement. *Nature Climate Change*, *1*(9), 462–466.

Dixon, G., Hmielowski, J., & Ma, Y. (2017). Improving climate change acceptance among US conservatives through value-based message targeting. *Science Communication*, *39*(4), 520–534.

Domhoff, G. W. (2002). The power elite, public policy, and public opinion. *Navigating public opinion: Polls, policy, and the future of American democracy*, 124–137.

Druckman, J. N. (2013). Public opinion: Stunted policy support. *Nature Climate Change*, *3*(7), 617.

Druckman, J. N. (2015). Communicating policy-relevant science. *PS: Political Science & Politics, 48*(S1), 58–69.

Druckman, J. N., & Kam, C. D. (2011). Students as experimental participants. *Cambridge handbook of experimental political science, 1*, 41-57.

Druckman, J. N., & Leeper, T. J. (2012). Learning more from political communication experiments: Pretreatment and its effects. *American Journal of Political Science, 56*(4), 875–896.

Druckman, J. N., & McGrath, M. C. (2019). The evidence for motivated reasoning in climate change preference formation. *Nature Climate Change*, 111–119.

Druckman, J. N., & Valdes, J. (2019). How private politics alters legislative responsiveness. *Quarterly Journal of Political Science*, *14*(1), 115–130.

Dwyer, P. C., Maki, A., & Rothman, A. J. (2015). Promoting energy conservation behavior in public settings: The influence of social norms and personal responsibility. *Journal of Environmental Psychology, 41*, 30-34.

Egan, P. J., & Mullin, M. (2017). Climate change: US public opinion. *Annual Review of Political Science, 20*, 209–227.

Endres, K., & Panagopoulos, C. (2017). Boycotts, buycotts, and political consumerism in America. *Research & Politics*, *4*(4), 1–9.

Fielding, K. S., & Hornsey, M. J. (2016). A social identity analysis of climate change and environmental attitudes and behaviors: Insights and opportunities. *Frontiers in psychology, 7*, 121. Available at: https://www.frontiersin.org/articles/10.3389/fpsyg.2016.00121/full

Feinberg, M., & Willer, R. (2013). The moral roots of environmental attitudes. *Psychological Science*, *24*(1), 56–62.

Gerber, A. S., & Rogers, T. (2009). Descriptive social norms and motivation to vote: Everybody's voting and so should you. *The Journal of Politics*, *71*(1), 178–191.

Gilens, M., & Page, B. I. (2014). Testing theories of American politics: Elites, interest groups, and average citizens. *Perspectives on Politics*, *12*(3), 564–581.

Goldberg, M. H., van der Linden, S., Ballew, M. T., Rosenthal, S. A., Gustafson, A., & Leiserowitz, A. (2019). The experience of consensus: video as an effective medium to communicate scientific agreement on climate change. *Science Communication*, *41*(5), 659–673.

Guess, A., & Coppock, A. (2018). Does counter-attitudinal information cause backlash? Results from three large survey experiments. *British Journal of Political Science*, 1-19.

Haden, V. R., Niles, M. T., Lubell, M., Perlman, J., & Jackson, L. E. (2012). Global and local concerns: what attitudes and beliefs motivate farmers to mitigate and adapt to climate change?. *PloS One, 7*(12), e52882.

Hart, P. S., & Nisbet, E. C. (2012). Boomerang effects in science communication: How motivated reasoning and identity cues amplify opinion polarization about climate mitigation policies. *Communication Research*, *39*(6), 701–723.

Hiatt, S. R., Grandy, J. B., & Lee, B. H. (2015). Organizational responses to public and private politics: An analysis of climate change activists and US oil and gas firms. *Organization Science*, *26*(6), 1769–1786.

Hornsey, M. J., Harris, E. A., Bain, P. G., & Fielding, K. S. (2016). Meta-analyses of the determinants and outcomes of belief in climate change. *Nature Climate Change*, *6*(6), 622–626.

Huang, L., Yang, Q., Li, J., Chen, J., He, R., Zhang, C., ... & Liu, Y. (2018). Risk perception of heat waves and its spatial variation in Nanjing, China. *International Journal of Biometeorology*, *62*(5), 783–794.

Incropera, F. P. (2016). *Climate change: a wicked problem: complexity and uncertainty at the intersection of science, economics, politics, and human behavior*. Cambridge University Press.

IPCC, 2014: *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

Jasanoff, S. (2010). A new climate for society. *Theory, Culture & Society*, *27*(2-3), 233–253.

Jost, J. T. (2018). Underestimating belief in climate change. *Nature Climate Change*, *8*(3), 189.

Johnson, M., Brace, P., & Arceneaux, K. (2005). Public opinion and dynamic representation in the American states: The case of environmental attitudes. *Social Science Quarterly*, *86*(1), 87–108.

Kahan, D. M. (2015). Climate-science communication and the measurement problem. *Political Psychology*, *36*(S1), 1–43.

Kahan, D. M. (2016). The 'Gateway Belief' Illusion: Reanalyzing the results of a scientific-consensus Messaging Study. *Journal of Science Communication*, *16*(5), 1–20.

Kahan, D. M. (2017). Misconceptions, misinformation, and the logic of identity-protective cognition. *Cultural Cognition Project Working Paper Series No. 164*. http://dx.doi.org/10.2139/ssrn.2973067.

Kahan, D. M., Jenkins-Smith, J., & Braman, D. (2011). Cultural cognition of scientific consensus. *Journal of Risk Research*, *14*(2), 147–174.

Kahan, D. M., Jenkins-Smith, H., Tarantola, T., Silva, C. L., & Braman, D. (2015). Geoengineering and climate change polarization: Testing a two-channel model of science communication. *The Annals of the American Academy of Political and Social Science, 658*(1), 192–222.

Kerr, J. R., & Wilson, M. S. (2018). Perceptions of scientific consensus do not predict later beliefs about the reality of climate change: A test of the gateway belief model using cross-lagged panel analysis. *Journal of Environmental Psychology*, *59*, 107–110.

Kobayashi, K. (2018). The impact of perceived scientific and social consensus on scientific beliefs. *Science Communication*, *40*(1), 63–88.

Kunda, Z. (1990). The case for motivated reasoning. *Psychological Bulletin, 108*(3), 480–498.

Leeper, T. J., & Slothuus, R. (2014). Political parties, motivated reasoning, and public opinion formation. *Political Psychology*, *35*, 129–156.

Levine, A. S., & Kline, R. (2019). Loss-framed arguments can stifle political activism. *Journal of Experimental Political Science*, *3*, 171–179.

Lewandowsky, S., Gignac, G.E., & Vaughan, S. (2013). The pivotal role of perceived scientific consensus in acceptance of science. *Nature Climate Change*, *2*(10), 399–404.

Ma, Y., Dixon, G., & Hmielowski, J. D. (2019). Psychological reactance from reading basic facts on climate change: The role of prior views and political identification. *Environmental Communication*, *13*(1), 71–86.

McCright, A. M., & Dunlap, R. E. (2011). The politicization of climate change and polarization in the American public's views of global warming, 2001–2010. *The Sociological Quarterly*, *52*(2), 155–194.

McGrath, M. C. (Forthcoming). Experiments on problems of climate change. In J. N. Druckman & D. P. Green (Eds.), *Advances in experimental political science*. Cambridge: Cambridge University Press.

Meldrum, G., Mijatović, D., Rojas, W., Flores, J., Pinto, M., Mamani, G., ... & Padulosi, S. (2018). Climate change and crop diversity: farmers' perceptions and adaptation on the Bolivian Altiplano. *Environment, Development and Sustainability*, *20*(2), 703–730.

Miller, J. D. (1998). The measurement of civic scientific literacy. *Public understanding of science*, *7*, 203–223.

Molden, D. C., & Higgins, E. T. (2012). Motivated thinking. In K. J. Holyoak & R. G. Morrison (Eds.), *The Oxford handbook of thinking and reasoning*. New York: Oxford University Press.

Musinguzi, L., Efitre, J., Odongkara, K., Ogutu-Ohwayo, R., Muyodi, F., Natugonza, V., ... & Naigaga, S. (2016). Fishers' perceptions of climate change, impacts on their livelihoods and adaptation strategies in environmental change hotspots: A case of Lake Wamala, Uganda. *Environment, Development and Sustainability*, *18*(4), 1255–1273.

National Academies of Sciences, Engineering, and Medicine. (2017). *Communicating science effectively: A research agenda*. Washington, DC: The National Academies Press. doi: 10.17226/23674.

Nisbet, E. C., Cooper, K. E., & Garrett, R. K. (2015). The partisan brain: How dissonant science messages lead conservatives and liberals to (dis) trust science. *The ANNALS of the American Academy of Political and Social Science*, *658*(1), 36–66.

Nyhan, B., & Reifler, J. (2010). When corrections fail: The persistence of political misperceptions. *Political Behavior*, *32*(2), 303–330.

Nyhan, B. Porter, E., Reifler, J. & Wood, T.J. (N.d.) Taking fact‐checks literally but not seriously?: The effects of journalistic fact‐checking on factual beliefs and candidate favorability. *Political Behavior.* Forthcoming.

Oliver, J. E., & Wood, T. J. (2018). *Enchanted America: How intuition and reason divide our politics*. University of Chicago Press.

Palm, R., Lewis, G. B., & Feng, B. (2017). What causes people to change their opinion about climate change?. *Annals of the American Association of Geographers*, *107*(4), 883–896.

Pearce, W. (2014). Scientific data and its limits: rethinking the use of evidence in local climate change policy. *Evidence & Policy: A Journal of Research, Debate and Practice*, *10*(2), 187–203.

Pearce, W., Grundmann, R., Hulme, M., Raman, S., Hadley Kershaw, E., & Tsouvalis, J. (2017). Beyond counting climate consensus. *Environmental Communication*, *11*(6), 723–730.

Pennycook, G., Ross, R. M., Koehler, D. J., & Fugelsang, J. A. (2016). Atheists and agnostics are more reflective than religious believers: Four empirical studies and a meta-analysis. *PloS one*, *11*(4), e0153039.

Peter, C., & Koch, T. (2016). When debunking scientific myths fails (and when it does not) The backfire effect in the context of journalistic coverage and immediate judgments as

prevention strategy. *Science Communication*, *38*(1), 3–25.

Petty, R. E., & Cacioppo, J. T. (1979). Issue involvement can increase or decrease persuasion by enhancing message-relevant cognitive responses. *Journal of Personality and Social Psychology*, *37*(10), 1915.

Rare and California Environmental Associates. (2019). *Changing Behaviors to Reduce U.S. Emissions: Seven Pathways to Achieve Climate Impact*. Arlington, VA: Rare.

Reid, E. M., & Toffel, M. W. (2009). Responding to public and private politics: Corporate disclosure of climate change strategies. *Strategic Management Journal*, *30*(11), 1157–1178.

Roco, L., Engler, A., Bravo-Ureta, B. E., & Jara-Rojas, R. (2015). Farmers' perception of climate change in Mediterranean Chile. *Regional Environmental Change*, *15*(5), 867–879.

Roser-Renouf, C., Maibach, E., & Leiserowitz, A. (2016). Consumer activism on global warming. Yale University Program on Climate Change Communication. https://climatecommunication.yale.edu/publications/consumer-activism-global-warming/

Roser-Renouf, C., Atkinson, L., Maibach, E., & Leiserowitz, A. (2016). Climate and sustainability: The consumer as climate activist. *International Journal of Communication*, *10*, 4759–4783.

Sarewitz, D. (2004). How science makes environmental controversies worse. *Environmental Science & Policy*, *7*(5), 385–403.

Schiermeier, Q. (2011). Climate and weather: Extreme measures. *Nature News*, *477*(7363), 148–149.

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). Experimental and quasi-experimental designs for generalized causal inference. Publisher

Shue, H. (1999). Global environment and international inequality. *International Affairs*, *75*(3), 531–545.

Taber, C. S., & Lodge, M. (2006). Motivated skepticism in the evaluation of political beliefs. *American Journal of Political Science*, *50*(3), 755–769.

Tesler, M. (2018). Elite domination of public doubts about climate change (not evolution). *Political Communication*, *35*(2), 306–326.

USGCRP. (2018). Reidmiller, D., Avery, C. W., Easterling, D. R., Kunkel, K. E., Lewis, K., Maycock, T. K., & Stewart, B. C. (Eds.). *Impacts, risks, and adaptation in the United States: Fourth national climate assessment, volume II*. Washington DC: U.S. Global Change Research Program. doi: 10.7930/NCA4.2018.

van der Linden, S., Leiserowitz, A., & Maibach, E. W. (2016). Communicating the scientific consensus on human-caused climate change is an effective and depolarizing public engagement strategy: Experimental evidence from a large national replication study. *Social Science Research Network*.

van der Linden, S., Leiserowitz, A., & Maibach, E. W. (2017). Gateway illusion or cultural cognition confusion?. *Journal of Science Communication*, *16*(05).

van der Linden, S., Leiserowitz, A., & Maibach, E. (2018). Scientific agreement can neutralize politicization of facts. *Nature Human Behaviour*, *2*(1), 2.

van der Linden, S., Leiserowitz, A., & Maibach, E. (2019). The gateway belief model: A large-scale replication. *Journal of Environmental Psychology*, *62*, 49–58.

van der Linden, S. L., Leiserowitz, A. A., Feinberg, G. D., & Maibach, E. W. (2015). The scientific consensus on climate change as a gateway belief: Experimental evidence. *PloS One*, *10*(2): e0118489.

van der Linden, S., Leiserowitz, A., Rosenthal, S., & Maibach, E. (2017). Inoculating the public against misinformation about climate change. *Global Challenges*, *1*(2), 1600008.

van der Linden, S., Maibach, E., & Leiserowitz, A. (2019). Exposure to Scientific Consensus Does Not Cause Psychological Reactance. *Environmental Communication*, 1–8.

Vandeweerdt, C., Kerremans, B., & Cohn, A. (2016). Climate voting in the US Congress: the power of public concern. *Environmental Politics*, *25*(2), 268–288.

Walter, N., & Tukachinsky, R. (2019). A Meta-Analytic Examination of the Continued Influence of Misinformation in the Face of Correction: How Powerful Is It, Why Does It Happen, and How to Stop It?. *Communication Research*, 0093650219854600.

Watts, N., Amann, M., Ayeb-Karlsson, S., Belesova, K., Bouley, T., Boykoff, M., ... & Cox, P. M. (2018). The Lancet Countdown on health and climate change: from 25 years of inaction *The Lancet*, *391*(10120), 581–630.

White, R. (2017). *Transnational environmental crime*. Routledge.

Wolsko, C., Ariceaga, H., & Seiden, J. (2016). Red, white, and blue enough to be green: Effects of moral framing on climate change attitudes and conservation behaviors. *Journal of Experimental Social Psychology, 65*, 7–19. http://dx.doi.org/10.1016/j.jesp.2016.02.005.

Wood, T., & Porter, E. (2019). The elusive backfire effect: Mass attitudes' steadfast factual adherence. *Political Behavior, 41*(1), 135–163.