

In October 2018, the Intergovernmental Panel on Climate Change, composed of more than 60 scientists from 19 countries, issued a strong warning: Without immediate action to reduce worldwide carbon emissions to net zero, the earth could reach the tipping point of 1.5°C warmer than pre-industrial temperatures as soon as 2030. That could lead to increases in extreme temperatures, heavy precipitation, droughts, and sea level rise. If the temperature climbs to 2°C higher than pre-industrial levels, whole ecosystems could be lost, endangering industries, threatening human health, and increasing poverty worldwide (Allen *et al*, 2018). Since the late 1980's, scientists from many disciplines and nations have strongly agreed that human activity since the Industrial Revolution has caused Earth's global climate to change in a variety of ways (Oreskes, 2018): More hot days, shorter winters, more frequent heat waves, more extreme precipitation events and storms, and rising sea levels (Houghton, Jenkins, & Ephraums, 1990; Stocker *et al*, 2013; Cook *et al*, 2016). These changes already impact human health, agriculture, food security, economic welfare, social justice, and national security in measurable ways, and scientists forecast that will continue. (Walsh *et al*, 2014).

Science writers and communicators form a vital link between the scientific community and the public as most Americans use the Internet and other media as their primary source of science information (Allard *et al*, 2018). Still, in America only 49% of citizens are “very” or “extremely” sure climate change is occurring, while 42% of Americans believe they or their families will personally be affected by climate change (Leiserowitz, Maibach, Roser-Renouf, Rosenthal, Cutler, & Kotcher, 2018). The mismatch between scientists' agreement on climate change and American audiences' relatively low levels of climate change belief makes effective communication difficult at best (Brüggemann & Engesser, 2017).

The current political climate creates its own challenges. Academics and journalists describe a “post-truth” communication climate (McNair, 2017; Associated Press, 2018), “in which objective facts are less influential in shaping public opinion than appeals to emotion and personal belief” (Oxford Dictionaries, 2016). This “post-truth” climate poses a problem particularly for journalists trained to present opposing viewpoints in a balanced way (Tuchman, 1972; Entman, 1990). Those who cover science stories from both (or all) sides “fairly” may give equal space to true and false claims, potentially giving readers an incorrect impression of the scientific evidence (Boykoff & Boykoff, 2004; Fahy, 2018). This is especially true for politicized science such as climate change. Covering climate change deniers equally with the majority of scientists urging a response to anthropogenic climate change may lead audiences to believe the issue is still contested and uncertain (Antilla, 2005; Koehler, 2016; Brüggemann & Engesser, 2017).

Despite the changing physical and political climate, communicators can rely on established and emerging research to guide their work. The focus of this article is to summarize research on climate communication related to audience variables and to provide evidence-based messaging techniques for science and agricultural communication practitioners (eg. including those working in public relations in land grant universities or those writing for agricultural publications) as well as for traditional journalists.

### **Current Research in Climate Communication**

Science communication is more than simply communicating facts to increase audiences' knowledge about a topic or issue. Applying a critical perspective to scientists' findings in the name of serving audiences is part of a larger discussion regarding how best to connect scientists and the

public. Scientists themselves have been challenged as communicators. They have perennially struggled with the tendency to communicate using a “deficit model” approach, assuming that, if science and society disagree on an issue, the problem is simply that audiences need more science information. (Nisbet & Scheufele, 2009). However, audiences are not homogenous - they are composed of individuals, each of whom approaches the science message with a different set of beliefs, cultural norms, interests, motivations, and needs.

A variety of factors influence how audiences filter, process, and understand the information they hear, including complex science. Research indicates that people’s *knowledge* about climate change accounts for less than ten percent (9.3%) of the variance in their perceptions of climate risk. Far more influential are individual experiences and sociocultural factors such as community norms and values which account for more than half (56.48%) of their perceptions (van der Linden, 2015), making it particularly important that communicators address these factors in their stories.

Researchers have found that several variables affect audiences’ acceptance of climate science including their beliefs; demographic variables (such as political party, religious orientation, and where they live); as well as acceptance of misinformation and pseudoscience, and motivated reasoning. The following section will give a brief overview of factors that affect audience understanding of climate science.

### **Factors Affecting Audience Understanding and Acceptance of Climate Change**

Research has shown that individual responses to climate change information can be categorized on a continuum of six unique groupings ranging from “dismissive” to “alarmed”. In the middle are those “concerned,” “cautious,” “disengaged,” and “doubtful.” The groupings not only indicate the strength of the publics’ beliefs, but also possible issue involvement. Health information appeared a strong appeal for those who are on the “concerned” end of the continuum. Those who are less engaged with the issue (the “disengaged,” “doubtful,” and “dismissive”) thought much less about future human health impacts of climate change and may not even know climate change could impact them personally (Roser-Renouf, Maibach, Leiserowitz, Feinberg, Rosenthal, & Kreslake, 2014, p. 3). The authors conclude that incorporating personally relevant information (such as health impacts) appears to be a way to engage audiences in climate stories.

#### **Demographic factors**

Demographic variables including political party affiliation, religious beliefs, and geographic location all influence public perceptions of climate change. At an aggregate level, the most consistent predictor of climate change belief and engagement is political party affiliation: Democrats/ liberals tend to believe in climate change and support policies designed to mitigate it. While Republicans/ conservative tend not to believe in climate change, and tend to reject mitigation policies as being economically unfair and unsustainable (Bolsen & Shapiro, 2018; Dunlap & McCright, 2008; McCright & Dunlap, 2011; Bolsen & Druckman, 2018). This division was visible as early as 1997, with an 18-percent gap between Democrats and Republicans on whether they thought global warming was happening (Krosnick, Holbrook, & Visser, 2000). By 2018, when asked whether they thought climate change was a “very important” problem, 72 percent of Democratic voters said it was, compared to just 11 percent of Republican voters (Pew Research Center, 2018). While this is a generalization, the partisan divide is one of the most persistent issues facing communicators in climate message construction.

Additionally, people's religious beliefs interact with their politics and ethnicity in ways that impact their beliefs about the climate (Roser-Renouf, Maibach, Leiserowitz, & Rosenthal, 2016; Jones, Cox, & Navarro-Rivera, 2014), with evangelical religious groups being less likely to endorse global warming science.

Even where someone lives appears to impact his or her receptiveness to climate messaging. In parts of the United States in which smaller proportions of the population are *concerned* about climate change (rural districts and conservative states) these individuals appeared to demonstrate the most change in beliefs about scientists consensus on climate change after exposure to climate messages (Zhang, van der Linden, Mildenerger, Marlon, Howe, & Leiserowitz, 2018), providing support that effective communications (even with skeptical groups) can continue to heighten public awareness of climate issues.

### **Erroneous beliefs and pseudoscience**

Climate change perceptions for some relate to their individual susceptibility to misinformation and/ or pseudoscience. When systematic misinformation reaches the level of a parallel belief system, or pseudoscience, it may become embedded as *science denialism* in individuals (Hansson, 2017). They simply do not know or acknowledge the facts as currently understood by the scientific community. This includes people who intentionally deny the existence of climate change, the efficacy of policies intended to mitigate it, and/or the credibility of climate scientists. Techniques used by these groups to refute climate science include cherry-picking of facts (focusing on unique or unusual examples that seem to disprove the rest of the science); outright rejection of scientific discoveries that disprove their personal theories; emphasizing fake or overblown controversies; or setting impossibly high standards of acceptance for new evidence (Hansson, 2017). In a review of 42 commonly repeated denials of climate science, researchers found that all of the denials contain logical fallacies (Cook, Ellerton, and Kinkead, 2018). The prevalence of pseudoscience presents yet another barrier for public understanding of climate science. In these cases, directly addressing the misinformation may be necessary.

### **Motivated reasoning and identity protective cognition**

When scientific information clashes with beliefs or values held by individuals' identity groups, they may be motivated to conform to their group's beliefs rather than accept the message. Motivated reasoning causes audiences to evaluate information they encounter through their own belief lens (Hart & Nisbet, 2012; Lawrence & Estow, 2017). In worst-case scenarios, a "boomerang effect" may be triggered in which an individual's identity-motivated beliefs become even more entrenched after exposure to a message that contradicts their beliefs (Bolsen & Druckman, 2015). Similarly, contradictory information may be ignored in a process labeled "identity-protective cognition" (Sinatra, Kienhues, & Hofer, 2014). Given these barriers, evidence-based messaging becomes all the more critical for communicators.

After reviewing factors that influence audience acceptance of climate science, it is apparent that science communicators not only need to create scientifically accurate messages that convey the facts of climate change for an ideologically diverse population but they must also counter intentionally or unintentionally inaccurate information that misleads audiences. Awareness of the variables that influence audience understanding of climate change can inform decisions communicators make on how best to reach their audiences, while evidence-based messaging

practices can help science communicators cut through some of the audience skepticism and/or misinformation.

### **Messaging Strategies**

Based on issues seen in audience understanding of climate science, we share seven messaging strategies to engage audiences with climate science. These strategies include: framing (local impacts, heightening personal relevance, use of thematic frames); reducing psychological distance; including emotional appeals; using efficacy cues, indicating weight-of-evidence and consensus messaging; using inoculation strategies for misinformation; and separating science from conspiracy theories.

#### **Framing**

To *frame* a topic is “to select some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation for the item described” (Entman, 1993, p. 52). Framing provides a context of meaning for public understanding of issues (Gamson & Modigliani, 1987, p. 143). Framing allows journalists to select and emphasize certain aspects of the climate change issue in order to best connect with the target audience (Entman, 1993), making framing a useful tool when addressing an audience likely to employ identity-protective cognition or motivated reasoning. Climate change is a multifaceted issue, and by emphasizing specific aspects communicators can demonstrate the relevance of climate change and solutions for a variety of audiences with differing motivations and interests.

There are a many ways that communicators can select salient aspects of climate change that relate to their audiences. For example, researchers have suggested for several years that framing climate change as something that will impact people’s local communities will increase their perception of vulnerability (Scannell & Gifford, 2013; Jones, Hine, & Marks, 2017). For example, a 2015 study (Wiest, Raymond, & Clawson, 2015) examined the interacting effects of a *local vs. global* frame, or frames showing climate change’s impacts on the American Midwest compared to locations around the world. The team found that, as expected, participants who viewed local frames perceived climate change to be a much more serious risk to their own community. Local framing also boosted Republicans’ and Independents’ likelihood to engage in individual behavior changes to mitigate climate change (p. 194).

Using personally relevant frames has also shown great promise. In fact, framing climate change as a public health issue is one of the most recommended strategies in messaging literature. The U. S. Global Change Research Program warns that climate change will affect food security, air quality, extreme weather events, and spread of disease vectors, as well as indirectly affecting mental health via stress and uncertainty (U.S. Global Change Research Program, 2016). As an example of local framing, communicators can include locally relevant impacts such as local food security, and local climate impacts such as flooding, or other relevant local impacts. Focusing on this narrow aspect of the larger issue breaks it down into something easier for audiences to connect to their daily lives, and makes it more compelling to them. For audiences such as farmers and those in the agricultural community, who are disproportionately affected by climate change and also less likely to believe in it (Prokopy, Morton, Ar buckle Jr., Mase, & Wilke, 2015), relevant framing may play an important role in connecting the issue to their experiences.

In addition to connecting with audiences within the body of an article, connecting the article itself back to the body of work on climate change may play a role in audiences' opinion formation. In 2011, Hart examined the difference in audiences' likelihood to support climate mitigation policy depending on whether they read stories using thematic or episodic framing. *Thematic* framing ties the presented information or story back to larger social trends and issues, while *episodic* framing simply presents a story or case study without making those ties (Iyengar, 1994). Hart (2011) presented two sets of readers with a story about a polar bear struggling to survive in a warming Arctic, but one of those was thematically framed, tying the story back to larger trends of climate change generally (p. 35). He found that the participants who read the thematically framed story were more likely to support government policies to reduce greenhouse gas emissions.

### **Psychological Distance and Relevance**

Because global climate change is such a large topic, audiences tend to view it as something distant and removed, rather than as something that can and will affect them and their communities (Leiserowitz *et al*, 2018; Scannell & Gifford, 2013). In light of this, one key communications goal is to reduce *psychological distance*, defined by Schuldt, Rickard, and Yang as “the distance at which objects and events are perceived to occur” (2018). Connecting climate change to personal health is an example of reducing *social* psychological distance - making it something that could happen to the reader or someone like him or her, rather than something that will happen to dissimilar people. Finding interviewees or story subjects who are similar to the target audience can reduce psychological distance, enhance message acceptance (Markowitz & Guckian, 2018), and encourage readers to see themselves as capable of making change (Bandura, 1977).

Other ways to reduce psychological distance are *spatial* — connecting climate change to the audiences' community or region; *temporal* — making it seem likely to happen soon rather than in the distant future (in the next decade as opposed to in 100 years); and minimizing *uncertainty* — characterizing climate change as something that is likely to happen, rather than something dubious (Lieberman *et al*, 2007; van der Linden, Maibach, & Leiserowitz, 2015).

### **Emotional Appeals**

Effective messages should also engage the emotions. Emotions are powerful motivators, and when communicators include emotional appeals as well as psychological appeals, it can enhance a message's potency. People engage in low-cost pro-environmental behaviors because they expect it to make them feel good (van der Linden, 2018), and when the people and places they love are threatened by climate change, they describe feeling worried, afraid, and sometimes powerless and frustrated (Wang, Leviston, Hurlstone, Lawrence, & Walker, 2018). Feelings of worry are correlated with higher support for mitigation and adaptation policies (Smith & Leiserowitz, 2014), and feelings of guilt are correlated with more willingness to act to care for the environment (Rees, Klug, & Bamberg, 2015).

For example, a 2018 *New York Times* article collected interviews from adults in several countries who are considering not having children because they are so concerned about the future impacts of climate change (Astor, 2018). The interviewees expressed fear, hopelessness, grief, and sadness. Communicators can use positive emotions and themes to motivate as well. In an April 2018 article from the *Star Tribune*, conservative meteorologist and climate communicator Paul

Douglas tapped into traditional conservative frames such as the economy and taking responsibility for one's actions (Chazin, 2018). He describes his approach as “weaving faith and science together into a narrative that tries to frame climate change and renewable energy into a story that appeals to people's hearts, as well as their heads”.

### **Including Efficacy Cues**

Messages that help audiences believe they are capable of bringing about a desired outcome are known as efficacy messages (Bandura, 1977, p. 193). People can develop efficacy by reading about people like them performing the desired action successfully, or by being encouraged by others that they themselves can do it (p. 195). Hart and Feldman (2016) describe three types of efficacy related to climate change: *Internal* efficacy, or the belief that the reader can act; *external* efficacy, the belief that politicians will actually listen to him/her; and *outcome* efficacy, the belief that the action will actually help address climate change (pp. 3-4). Efficacy is strongly linked to action – people with strong self-efficacy believe that they will succeed despite obstacles, and are more likely to persevere and act to achieve their goals. An example of self-efficacy and outcome efficacy are included in the example message below.

The road towards that transition [to mitigate climate change] includes daily decisions within your reach – like driving and flying less, switching to a ‘green’ energy provider and changing what you eat and buy. ... You don't have to go vegetarian or vegan to make a difference: cut down gradually and become a ‘flexitarian’. By reducing your consumption of animal protein by half, you can cut your diet's carbon footprint by more than 40%. (Ortiz, 2018).

Communication scholars have recommended that climate change messages not only include information on actions to take, but also statements on both individual and group efficacy (Maibach *et al.* 2008 p. 494-495).

### **Weight-of-Evidence Reporting and Consensus Messaging**

One of the most important messages that many climate communicators want to drive home is the strong consensus among climate scientists regarding its existence and severity. Environmental journalists found in the early 2000's that by adhering to a traditional practice of objectivity — presenting both sides of the climate change argument fairly and with equal space — that they were creating a “false balance” in which the skeptical voices seemed equal in prominence and number with the scientists warning of impending disaster (Boykoff & Boykoff, 2004; Fahy, 2018). In response, Sharon Dunwoody, a communication scholar from the University of Wisconsin, proposed the *weight-of-evidence* model (Dunwoody, 2005), in which the writer reports on both sides of the issue while making it clear where the majority of scientists stand. “An example of this line of research includes the now commonly used statement, ‘ninety-seven percent of global scientists support the research that the earth is warming due to climate change’. This...makes clear what the bulk of experts believe to be true” (Kohl, Kim, Peng, Akin, Koh, Howell, & Dunwoody, 2016, p. 979).

However, consensus messaging techniques alone may not be strong enough to overcome audience bias. In 2018, a team of researchers found that audiences in more conservative states responded more positively to the consensus message than those in more liberal states (Zhang, van der Linden, Mildenerger, Marlon, Howe, & Leiserowitz, 2018, p. 2). The researchers believe this

could be due to conservatives' likelihood to prefer consensus, hierarchy, and conscientiousness, as predicted by cultural cognition theory (Kahan, 2012). Conversely, another recent study investigated what happened when conservatives and liberals were presented political messages that conflicted with their personal values, and then were told that the majority of scientists agreed with the dissonant messages. Both liberal and conservative participants responded negatively to scientists who demonstrated high levels of consensus on issues with which they disagreed, with this effect being even more pronounced among liberals than conservatives (Dixon & Hubner, 2018). In short, a single technique like including consensus messaging is unlikely to overcome strongly held audience beliefs by itself.

### **Inoculation / Correcting Misinformation**

Strategies that climate communicators can use to deal with issues of misinformation in the public include preventing errors before they spread and/or “treating” or correcting errors after they spread. *Inoculation theory* involves anticipating common errors or false beliefs that may be held by members of the audience, and preemptively addressing those errors in the body of the message. Typically, successful inoculation includes both a warning that falsehoods and logic errors exist and that the reader may encounter them, followed by a preventative rebuttal of the argument (Cook, Lewandowsky, & Ecker, 2017).

In their 2017 study on inoculation, van der Linden *et al* gave six examples of common false beliefs about climate change (supplementary information, pp. 1-2): 1) There is no consensus among scientists about climate change, 2) Most climate scientists say human-caused global warming is happening because that's how they get government grant money, 3) Global warming is not real; therefore the “consensus” is a hoax, 4) The so-called “consensus” studies showing that climate scientists agree human-caused global warming is happening are flawed. 5) The IPCC (Intergovernmental Panel on Climate Change) is an alarmist organization, filled with alarmist scientists who are creating a “false consensus” about the reality of human-caused climate change and, 6) Climate scientists are doing everything possible to silence the global warming skeptics.

In messages where it is appropriate to inoculate against possible false beliefs or reasoning errors such as these, communicators can directly address and debunk these ideas in their stories so readers will remember the correct information when they encounter it later. For example:

Think about climate change and you may picture melting ice caps and stranded polar bears. But you should also picture ... disease-spreading Asian tiger mosquito [which spreads Zika Virus and West Nile Disease]. As seasonal cycles shift and ecosystems are thrown off balance, those invasive species — and many others — could infiltrate a broader range of territories with devastating consequences to our health, vital habitats and industries” (Morrison, 2018).

### **Addressing Conspiracy Beliefs**

Some audience members may believe that climate change is a hoax perpetrated by the scientific community. According to Bolsen and Druckman (2018), one way to present accurate information to an audience that holds conspiracy beliefs is to validate their belief in conspiracies in general, while making a clear separation between believing in climate change and believing in

conspiracies. If the audiences' beliefs are acknowledged rather than threatened, audience members are less likely to feel personally attacked and more willing to listen to the information (Cohen & Sherman, 2014). For example:

[A] group is now claiming that the California wildfires were caused by lasers or directed energy weapons manipulated by the US government. Some conspiracists argue that the fires were a government-led attempt to destroy entire regions, while others have suggested that the US was trying to clear a path for a high-speed rail system ... To set the record straight, we talked to Marko Bourne, a former Federal Emergency Management Agency (FEMA) official who now leads Booz Allen Hamilton's emergency management, disaster assistance, and risk practice” (Bendix, 2018)...

This approach appears to be effective. In one study on conspiracy theories, participants were presented a standard message about climate consensus, accompanied by the statement: “A majority of people acknowledge that on many topics, powerful people work to mislead citizens for bad purposes. Yet human induced climate change is not one of those topics” (p. 455). Research found that participants who indicated they believed in conspiracies and believed that climate change was a hoax demonstrated slight increases in their belief in climate change— and more interest in receiving information about climate change—when they received the message with this qualifier.

In summary, climate communication would benefit from use of the range of techniques discussed above. From a framing perspective use of both episodic framing and thematic framing is helpful. Episodic framing (and the emotion it evokes) engages attention, relevance, and is helpful in motivating public action. Thematic framing is critical in providing cues for which strategies are effective, particularly with the goal of policy changes. Local framing along with proximity cues are essential for heightening personal relevance. Proximity cues should include not only spacial but temporal cues as seen in recent climate reports stating that actions must be taken within the next decade. Including both internal and external efficacy cues is essential to offset hopelessness and to provide a roadmap for action. Regarding the journalistic norm of balance, weight-of-evidence (or consensus) reporting is a much more accurate approach for science news. Finally, when misinformation is promoted, it is essential to counter quickly with accurate science from reputable and credible sources. When used together, these strategies enhance the message design for science and agricultural communicators writing about climate change.

## **Conclusion**

The emerging field of science communication continues to inform communication practices to both better understand audiences, and to use that understanding to craft meaningful evidence-based messaging that motivates public engagement with climate change. As the urgency for action on climate change increases, communicators can play a key role by using the best science for developing messaging strategies that leverage audience characteristics to aid in motivating the public to engage on this complex science problem. Emerging research is examining models that link personal experiences of extreme weather events specifically with cognitive attributions to climate change in order to motivate behaviors that protect communities. As the public interfaces with science primarily through the media, communicators are instrumental in staying current with these evidence-based practices for crafting messages that bridge the multiple gaps in public understanding of climate science.

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