

Local TV News Viewer Reactions to Weathercasters Reporting the Local Impacts of Climate Change^①

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ABSTRACT

Most Americans misperceive climate change as distant risk; TV weathercasters can help correct this misperception by reporting on the current local impacts of climate change. Some weathercasters, however, are concerned that such reporting may alienate skeptical viewers. The goal of this study was to develop a better understanding of how viewers respond to climate change information delivered by weathercasters. Interviews were conducted with 30 local TV news viewers in Virginia with divergent views about climate change, categorized as *engaged*, *disengaged*, and *unconvinced*. During the interview, participants were shown two graphics and two videos about the local impacts of climate change. Most participants in all groups [21/30 (70%)] expressed interest in learning about climate change from weathercasters, particularly local and national impacts. Most participants in all three groups understood the key points and responded positively to both the graphics and the videos. Several *unconvinced* participants (6/10) were disinterested in seeing climate change information in the weather segment, but they were not opposed to it; they felt the weather segment was too short to adequately explain the information. These preliminary findings suggest that most of the local TV news viewers interviewed in this study—even those *unconvinced* that human-caused climate change is happening—respond positively to TV weathercasters as local climate educators. These findings are consistent with the reports of TV weathercasters who say that when they report on climate change, they receive far more positive than negative feedback from viewers.

1. Introduction

The Third National Climate Assessment made the case that serious impacts of climate change are now occurring in every region of the United States (Melillo et al. 2014). The Northeast, for example, has seen dramatic changes in heavy precipitation events, which threaten water quality, infrastructure, and ecosystems. Other parts of the United States have seen more extreme heat events, which negatively affect agriculture and the health of vulnerable populations. The assessment concludes that over the next several decades, temperatures are expected to increase by another 2°–4°F, and Americans face a range of options to adapt to risks and mitigate further harm to the nation's health, economy, ecosystems, and infrastructure.

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Despite these current impacts and prospective risks, most Americans see climate change as a relatively distant threat. Most Americans think climate change will cause harm to people in the future (71%), people in distant and developing countries (62%), and other (nonhuman) species (71%) and that it will have relatively little impact on them (42%) and people in their community (49%; Leiserowitz et al. 2018; Leiserowitz 2006). These misperceptions are associated with low issue engagement and support for climate policy (Gifford 2011; Weber and Stern 2011; Spence et al. 2012; Weber 2016). Helping people understand how climate change is affecting them and the people and places they care about, in the present or near future, is an important step toward building further public engagement (van der Linden et al. 2015; Jones et al. 2017).

For the past several years, as a strategy to address public misperceptions about climate risks, there have been systematic efforts to help TV weathercasters report about the local impacts of climate change. The most notable of these efforts is *Climate Matters*—a comprehensive climate

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reporting resource program developed by a partnership of universities (George Mason University, Yale University), nonprofit organizations (Climate Central, the American Meteorological Society), and government agencies (NASA, NOAA; Woods Placky et al. 2016). Because TV weathercasters are trusted sources of scientific information, are skilled science communicators, have access to diverse audiences, and address local (rather than global) conditions, they have considerable potential to help Americans understand that climate change is a not only a distant risk, but also a present reality (Maibach et al. 2016a). Field research has demonstrated that through their reporting and other outreach, weathercasters can successfully educate their viewers about climate change and help them develop more accurate perceptions of local and global climate change risks (Bloodhart et al. 2015; Zhao et al. 2014).

While many Americans want to learn more about climate change, particularly from their local TV weathercaster (Leiserowitz et al. 2015; Perkins et al. 2017), some weathercasters are hesitant to engage in climate change reporting (Maibach et al. 2010, 2011a; Meldrum et al. 2017; Wilson 2009, 2012). In America, as climate change has become a politically polarized topic (McCright and Dunlap 2011), some weathercasters are concerned that reporting on it will alienate some viewers (Meldrum et al. 2017; Schweizer et al. 2014). To address weathercasters' concerns, a better understanding of what local TV news viewers think about seeing climate change information during the television weather forecast is needed. This study begins to address this research need by qualitatively examining Virginia local news viewers' interest in learning about climate change from weathercasters, their understanding of climate change messages in on-air examples, and their reactions to on-air climate change content in a television weather forecast.

2. Literature review

a. The perception of climate change as a distant threat

When asked what comes to mind when they think of climate change (i.e., top-of-mind associations), Americans and Britons most frequently describe distant impacts to the natural environment, such as melting ice (e.g., melting polar ice caps, Antarctica melting; Lorenzoni et al. 2006; Leiserowitz 2006). There are several reasons why people tend to perceive climate change as a distant phenomenon or threat. First, the impacts of climate change are highly variable, and so the visible hazards and people impacted may seem spatially distant (Spence et al. 2012). Climate change is also a slowly advancing problem, such that the greatest impacts may occur at different points in time in the future, making it hard to envision compared to other

more acute and immediate risks, such as extreme weather events (Weber 2010; Whitmarsh 2008). Additionally, most people develop their understanding of new phenomena based on direct or vicarious experiences. However, climate change is an abstract statistical concept that, unlike weather events, describes average weather conditions for a region, making it difficult to learn about through direct experience (Weber 2006, 2010; Marx et al. 2007). Extreme weather events can be powerful teachers, but humans tend to discount the risk of these types of infrequent, difficult-to-anticipate threats (Weber 2010).

Despite the challenges to learning about climate change from personal experience, about 4 in 10 Americans say that they have personally experienced climate change (Leiserowitz et al. 2018). Changes in local weather and seasons, as well as extreme weather events, are the most common ways that people say they have experienced climate change (Demski et al. 2017; Akerlof et al. 2013; Leiserowitz et al. 2017). One study found that three out of the top four climate changes that people report having personally experienced were evident in their local climatic record (Akerlof et al. 2013). However, perceptions of having personally experienced climate change can also be subject to bias—the people who most strongly believe climate change is occurring, as well as those who most strongly believe it is not, are most likely to interpret their experiences in ways that support their preexisting beliefs (Myers et al. 2013).

Climate change influences weather, but determining if changes in weather are linked to climate change is not intuitive (Weber 2010). These experiences often have to be interpreted, explained, or otherwise mentally associated to climate change (Weber 2010; van der Linden 2014, 2017). Van der Linden (2014, p. 438) posited, “the interactive engagement of both cognitive and emotional processing mechanisms is key to fostering more public involvement with climate change.” However, the processes of using communication to connect people's personal observations or experiences with more abstract climate information are poorly understood (Brügger et al. 2015, 2016; Jones et al. 2017). Making the impacts of climate change seem closer and more tangible might work by reducing psychological distance between the individual and the risk, by making the risk easier to visualize and less abstract, or by increasing perceptions of personal vulnerability and worry—or some combination of these processes (Brügger et al. 2015; Jones et al. 2017).

Developing a better understanding of the processes at play when localizing climate change is important, because when Americans know that they have personally experienced climate change, they are more likely to believe that climate change is happening (Myers et al. 2013), feel vulnerable to climate change risks (van der Linden 2014, 2017),

support pro-climate policies (Rudman et al. 2013), and engage in more sustainable behaviors (Spence et al. 2012). This collection of evidence suggests that communication efforts that help individuals connect their personal affective experiences with information that puts these experiences in the context of climate change is an important step toward creating more understanding and engagement with the issue of climate change (Fischhoff 2007; Pidgeon and Fischhoff 2011).

To develop communication that connects individuals' experiences with more abstract information about climate change, it helps to understand what different audiences believe about climate change, what they are interested in learning, and what communication strategies will most likely capture their attention (Maibach et al. 2011b; Roser-Renouf et al. 2014). Different audiences, however, have different perceptions about climate change, ranging in the United States from those who see the issue as highly relevant and are very engaged to those who are dismissive of the science. These audiences are termed Global Warming's Six Americas and include the *alarmed*, *concerned*, *cautious*, *disengaged*, *doubtful*, and *dismissive* groups (Maibach et al. 2011b; Roser-Renouf et al. 2014).

Each segment requires potentially different engagement and educational strategies. In terms of psychological distance, the *alarmed* see climate change as psychologically close; they believe their own family is at risk (96%) and that people in the United States are being harmed right now (81%; Roser-Renouf et al. 2014). Only 53% of the *concerned* believe people in the United States are being harmed right now, but both segments are interested in learning what they can do about climate change (Roser-Renouf et al. 2014). The *cautious* and *disengaged* segments pay little attention to information about climate change. For these audiences, showing them what is happening to places they can identify can be a means to capture their attention (Roser-Renouf et al. 2014). The *doubtful* do not see climate change as a risk; only 22% believe it will harm future generations. The *dismissive* segment is similar and believes no one in the United States is being harmed by climate change right now. The two latter segments tend to see climate change as a very distant threat, but communicating the concrete risks to people like themselves may be an effective strategy for generating attention and awareness (Hart and Nisbet 2012).

b. TV weathercasters as local climate change educators

Efforts to educate the public about climate change should come from trusted sources and be highly engaging, locally relevant, and delivered through a medium

that many audiences pay attention to (Roser-Renouf et al. 2014). Local television news, particularly the weather forecast, is one promising way to reach Americans with locally relevant information about climate change. Among local news enthusiasts and others, television news is a preferred source of weather information (Miller et al. 2012, p. 21). Furthermore, local weather audiences represent a diverse range of educational backgrounds, income levels, and racial groups (Miller et al. 2012; Demuth et al. 2011; Lazo et al. 2009), and conveying climate change information in the context of the local news and local weather forecast is likely to be effective for engaging many segments of the population (Wilson 2008).

With the advent of reporting resources such as *Climate Matters*, climate change reporting among TV weathercasters has been rapidly increasing in recent years (Maibach et al. 2017a; Woods Placky et al. 2016). However, many weathercasters continue to report barriers to reporting on climate change, including concerns about understanding the science and presenting it effectively during the short weather segment (Maibach et al. 2016a; Wilson 2009). For others, the practice of reporting about climate change—a subject perceived to have many negative connotations—clashes with their personal identity and professional persona of being the friendly weathercaster that people invite into their living room each night (Peters-Burton et al. 2014; Meldrum et al. 2016). As a subject that has become political (McCright and Dunlap 2011), some weathercasters are hesitant to talk about climate change for fear of alienating or losing viewers with different perspectives to competitors in their news market (Schweizer et al. 2014).

Engagement with viewers is of growing importance in broadcast journalism. Feedback comes in the form of viewer data from news consulting companies; calls or emails to the station; and, more directly, through websites, blogs, and social media (Henson 2010). Receiving negative viewer comments is undesirable to weathercasters and station management because the popularity of a weathercaster is essential for retaining viewers (Meldrum et al. 2017). Viewer ratings influence advertising rates and station revenue, and in the competitive news environment, station success is largely dependent on viewer retention (Schweizer et al. 2014). Because climate change is not often discussed in public (Maibach et al. 2016b; Geiger and Swim 2016), some station managers and weathercasters may perceive that audiences are not interested in the subject; however, there is growing evidence to suggest that viewers do want to hear about climate change, particularly from their local, trusted TV weathercaster (Leiserowitz et al. 2015; Perkins et al. 2017).

The goal of this study was to investigate how TV news viewers with a range of climate change beliefs understand and react to climate change information delivered in the context of the local TV weather forecast. To achieve this goal, we sought to answer several research questions. First, we wanted to know if local news viewers were interested in learning about climate change from local TV weathercasters, and if so, what types of information they were interested in learning. Second, we wanted to assess how local news viewers would react to videos of TV weathercasters using *Climate Matters* graphics to talk about the local or national impacts of climate change. Third, we wanted to determine if local news viewers were able to identify the intended messages of the *Climate Matters* graphics and videos they were shown.

Guided by insights generated by the Global Warming's Six Americas segmentation (Maibach et al. 2011b; Roser-Renouf et al. 2014), in the current research, we sought to examine audience-specific interests in and reactions to TV weathercasters reporting on climate change. To that end, we used a simplified approach—inspired by but not directly based on the Six Americas methodology—to segment local TV news viewers into one of three audience segments, characterized as *engaged*, *disengaged*, and *unconvinced*. The method and audience segments are described below.

3. Methods

a. Participants

Participants were recruited from respondents to a random-digit dialing telephone survey conducted in 2014 with 2000 randomly selected local news viewers in the state of Virginia (Bloodhart et al. 2015). At the end of the survey—which focused on news viewing habits and perceptions of local weather and climate change—participants were asked if they would be willing to participate in a subsequent interview. Of the 2000 respondents, 334 agreed to participate in an interview.

Using the telephone survey data, we subjected three variables to factor analysis: climate change belief certainty, belief about human causation, and degree of worry about climate change. These three variables formed a single factor. We then sorted the 334 willing participants into three more-or-less equally sized groups based on their factor score, forming high-, medium-, and low-engagement groups. For descriptive purposes, we named these groups *engaged*, *disengaged*, and *unconvinced* (see online supplemental material for questions and group means). The three groups are described below:

Engaged: Individuals in this group had relatively high belief certainty that climate change is happening,

tended to see it as primarily caused by humans, and were moderately to very worried about it.

Disengaged: Individuals in this group also believed that climate change is happening, although most were not certain of their belief, and they were unlikely to see it as being mostly human caused. They were markedly less worried about climate change than people in the *engaged* segment.

Unconvinced: Most individuals in this group believed that climate change is not happening or is largely attributable to natural causes and were not worried about it.

With the goal of interviewing 10 people from each of the three groups, we randomly selected 20 people from each group and contacted them by telephone to request and schedule an interview. Enrollment stopped after the recruitment goals were reached.

A total of 32 audio/video, semistructured interviews were conducted in October 2014 using GoToMeeting software (<https://www.gotomeeting.com/>). All interviews were recorded and transcribed for analysis. The interviews were brief and lasted approximately 30 min, and participants were compensated with a \$50 Visa or Amazon gift card for their time.

A total of 30 individuals were included in the analysis for this study. To have 10 participants per segment and facilitate easy comparisons among the groups, two of the 32 participants were randomly removed before conducting the analysis, one from each of two audience segments. Of the 30 study participants 15 were female, and 15 were male, and they ranged in age from 19 to 65 years old [mean $M = 49$ years, standard deviation (SD) = 14 years]. The research was conducted with approval from the George Mason University Institutional Review Board, OSP 114528.

b. Materials and procedure

The interview consisted of four main sections: introductory questions, interest in learning about climate change, viewing and comprehension of example graphics and videos of weathercasters reporting with similar graphics, and reactions to the information presented (for interview protocol, see supplemental material). The interview began with introductory questions, including how frequently participants watched the local weather on television. That was followed by questions to assess participants' interest in learning about climate change from TV weathercasters and what information would be of interest. Participants were then shown, in sequence and one at a time, two graphics and two videos of on-air climate change reporting by a TV weathercaster (described below). The graphics were produced

by Climate Central for the *Climate Matters* program; they are described in Table 1 and included in the supplemental material. The videos showed actual on-air segments by two Virginia-based TV weathercasters featuring *Climate Matters* graphics. After seeing each graphic or video, participants were asked questions to assess what they understood to be the main idea. Finally, the participants were asked how they felt about the information presented and whether they had any additional feedback or comments.

c. Analysis

To analyze the transcripts of the interviews, a codebook was developed for each question in the interview based on the goals of the study and the themes that emerged from participant responses. To assess the reliability of the coding scheme, 20% of the responses to each interview question were randomly selected and independently coded by two different researchers. The average Krippendorff’s alpha reliability coefficient for this study was 0.987 (alpha range = 0.718–1.0; Krippendorff 2004a,b), but intercoder reliability was high for each question coded (see supplemental material). The high alpha values in this study (maximum possible alpha is 1.0) demonstrate strong agreement between coders and reliability of the results.

4. Results

a. Are local news viewers interested in learning about climate change from local TV weathercasters? If so, what do they want to learn?

At the beginning of the interview, participants were asked if they would be interested in learning about climate change from a local TV weathercaster. Most participants [23/30 (77%)] expressed an interest in learning about climate change from TV weathercasters. A majority of the *engaged* (9/10) and *disengaged* (9/10) participants were interested, as well as half of the *unconvinced* (5/10) participants. The remaining seven participants were either unsure (1/10 *engaged*; 1/10 *unconvinced*) or not interested (1/10 *disengaged*; 4/10 *unconvinced*).

Participants were then asked to explain what kind of information about climate change, if any, they would like to learn from a TV weathercaster. A large majority (83%) of the participants identified at least one specific type of information they were interested in learning. Conversely, a small minority [5/30 (17%)], all of whom were from the *disengaged* and *unconvinced* belief groups, stated they were not interested in such information (1/10 *disengaged*; 3/10 *unconvinced*) or did not respond to the question (1/10 *unconvinced*).

TABLE 1. Climate change messages for each of the graphics and videos presented to participants of the study. Key parts of message used to assess message comprehension are in boldface. Participants who restated all of the key parts were coded as understanding all of the message. Participants who missed one or more key parts were coded as understanding some of the message, and participants who did not repeat any of the key parts were coded as understanding none of the message.

Media examples	Main message
Graphic 1	There will be more 95°F (or very hot) days in the future, in Richmond (or in Virginia) .
Graphic 2	Fall is getting warmer in the United States, except in the Southeast .
Video 1	Since the first Earth Day in 1970, the average temperature in Virginia has increased. There have been warm years and cold years , but it has increased about 2°F during that time.
Video 2	Summer nighttime temperatures are getting warmer in Richmond (or in Virginia) .

Nearly two-thirds (63%) of the participants wanted information about climate change impacts (19/30), especially people in the *engaged* (8/10) and *disengaged* (7/10) groups, but also almost half of the *unconvinced* (4/10) participants. Some of the participants specified the scale of the impacts they were interested in learning about, including national or global impacts [6/30 (20%)] and local impacts [7/30 (23%)]. Interestingly, more *engaged* (3/10) and *unconvinced* (3/10) participants said they were interested in learning about national or global impacts than local impacts (2/10 *engaged*; 1/10 *unconvinced*), while interested *disengaged* (4/10) participants were exclusively interested in learning about local impacts. In response to a follow-up question that explicitly asked whether they would be interested in learning about the local impacts of climate change, a large majority [23/30 (77%)] said yes. Almost all *engaged* (10/10) and *disengaged* (8/10) participants answered affirmatively to this question, as did half of the *unconvinced* (5/10) participants.

Nearly one quarter of the participants [7/30 (23%)] wanted information about the scientific evidence behind climate change—including *engaged* (2/10), *disengaged* (3/10), and *unconvinced* (2/10) participants. A small minority of participants [3/30 (10%)] wanted information about actions individuals can take to prevent the harmful effects of climate change—all of these were from the *engaged* group.

Participants were not explicitly asked to explain why they wanted the information they identified, but many provided a rationale for their choice. Participants who wanted to learn about the national or global impacts explained that they wanted to understand how climate

change is currently impacting people and the planet. For example, one participant wanted to know what is happening, "...around the world weather-wise. Like instances of weather that's different from what it normally is, unbiased. Like if it's a lot colder, in places, and a lot hotter in places, or a lot more storms in places, even earthquakes." Participants who wanted to learn about local impacts mostly wondered how climate change was affecting their state or community. For example, one participant said, "I want to see them [TV weathercasters] address climate change on a local level...because we're talking about stuff happening in Alaska, or in the North Pole or whatever, about the ice caps melting away and all that stuff, well it's really not affecting us here, so we can't really see it. But what about the stuff that we can see, that we're actually seeing. Like you know the drought, you know are we going to have a cold winter or a mild winter?"

Many participants described how providing information about the impacts of climate change in the context of the local TV weather forecast would help raise awareness about the problem of climate change and change people's behavior. For example, one participant felt that local climate change information could "make [other viewers] change their personal habits or support government efforts to lessen the effect of climate change." A few participants went even further to say that they felt weathercasters had a duty to share information about local climate change impacts. One participant explained, "I think if they're aware of things like that and they can prove it then I think it's a responsibility to make the public aware of what's going on."

Participants who wanted a deeper understanding of why climate change is occurring wanted to know what is causing climate change and how it will affect the planet over time. For example, one participant explained that they wanted evidence and an explanation for "...how the earth is actually like warming, how the climates changing, like day to day, and then maybe over long term." The participants who were interested in information about actions they could take to prevent the harmful effects of climate change wanted information that went beyond stating the problems—they wanted solutions. These participants were primarily concerned with knowing what they could do to minimize the impacts of climate change or, according to one participant, "...what are reasonable steps or things we can do to counteract it."

b. Did participants understand the main idea in the graphics and videos?

After assessing participants' initial interest in learning about climate change from a TV weathercaster, they were shown two graphics typical of those produced

for the *Climate Matters* program (<http://medialibrary.climatecentral.org/about-us>). Following that, participants were shown two short videos of Virginia weathercasters using *Climate Matters* graphics to report about a climate change impact during their weather forecast. After viewing each graphic and video (available in supplemental material), participants were asked to explain what information the example was trying to convey. To assess comprehension of the main idea, participant responses were coded based on their ability to identify—in their own words—the key parts of the message (see Table 1). The responses were coded to indicate whether the participant recalled all, some, or none of the message of each graphic and video.

Graphic 1, which presented a local climate change impact, showed the projected increase in 95°F "very hot days" in the future, in Richmond, Virginia (Table 1). Graphic 2, which presented national climate change impacts, showed that fall is getting warmer in all parts of the United States, except the Southeast (Table 1). A majority of participants from each group were able to identify all or some of the message for each graphic [graphic 1: 27/30 (90%); graphic 2: 26/30 (87%); see Fig. 1]. Message comprehension did not differ by audience for either graphic (graphic 1: 9/10 *engaged*, *disengaged*, and *unconvinced*; graphic 2: 9/10 *engaged* and *disengaged*, 8/10 *unconvinced*).

Message comprehension was relatively high for both videos as well. Video 1 was a 1-min segment, and the main message was that Virginia's average temperature has increased by 2°F since 1970. Video 2 was an approximately 2-min segment, and the key message was that summer nighttime temperatures in Virginia were increasing. A large majority of participants were able to identify all or some of the main message for video 1 [24/30 (80%)] and video 2 [21/30 (70%); see Fig. 1]. Comprehension rates differed only slightly among the three groups of participants (video 1: 8/10 *engaged*, 9/10 *disengaged*, and 7/9 *unconvinced*; video 2: 8/10 *engaged*, 7/10 *disengaged*, and 6/10 *unconvinced*).

c. How did participants react to the graphics?

Participants were asked if they had any suggestions to improve the graphics they were shown. Reactions were coded as positive when participants made a complimentary statement or said the graphic was interesting. Reactions were coded as neutral when the participants restated the graphic's message and did not include any personal evaluations or opinions about it. Reactions were coded as negative when the participants criticized one or more aspect of the graphic or its message. Reactions were coded as mixed when both positive and negative statements were present in the same response.

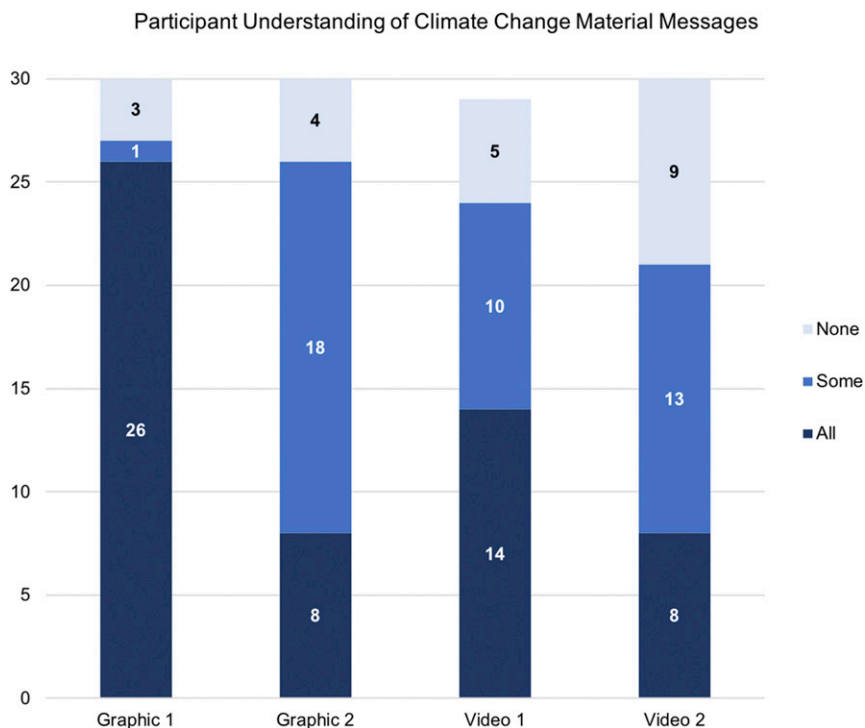


FIG. 1. Participant understanding (all, some, or none) of the main messages of the two graphics and two videos shown during the interview ($N = 30$). Note that video 1 would not play for one of the study participants ($N = 29$).

Feedback on the graphics was primarily mixed or positive (Fig. 2). Most participants who had positive reactions to the graphics (graphic 1: 10/30; graphic 2: 6/30) commented on their simplicity and conciseness and had no suggestions for improvement. The rest of the participants (graphic 1: 20/30; graphic 2: 24/30) provided feedback that was mixed. These participants explained aspects of the graphic they did not like and made suggestions on how to more effectively convey the message. Many of these statements were coded as mixed because participants had generally positive comments about the graphics' messages but often critiqued the graphic layout.

Participants broadly suggested three ways to improve the graphic layout, including changing the design, more thoroughly explaining the content, and including the source of the data. These three types of feedback were mentioned equally by participants across all three groups. Graphic design suggestions (i.e., color changes, resizing graphic components, etc.) were among the most common types of feedback for both graphic 1 [14/30 (47%)] and graphic 2 [10/30 (33%)]. Many participants explained how the graphics needed more thorough explanations [graphic 1: 12/30 (40%); graphic 2: 13/30 (43%)].

Participants believed the explanation quality could be improved if the time range of the data was more

personally relevant (i.e., projections for next 20 years rather than 100; graphic 1: 6/12; graphic 2: 6/13), if the graphics told a story (i.e., comparing the past to the present; graphic 1: 5/12; graphic 2: 4/13), and if it explicitly stated why the impact was personally important (graphic 1: 5/12; graphic 2: 6/13). For example, one participant said, "I think when you take it out to the year 2060, and the year 2100, I think for some people it would be hard for them to...they can't like process that, because they think, I'm not going to be here in 2060, so what does that make a difference to me for?" Another participant explained that they wanted to see "...numbers that they can see will affect them in their lifetime, you know, like something that's going on within the next 5 or 10 years. And then maybe talk about the progression of how it will affect their children or grandchildren. For some people it has to hit closer to home."

Last, some *engaged* (3/10) and *unconvinced* (2/10) participants wanted to know where the data were coming from for graphic 1. For example, one participant said, "I want to know where it comes from and why they're stringing that." While this concern was brought up only a few times, it is important to note that participants want to make sure they are getting information from a reputable source.

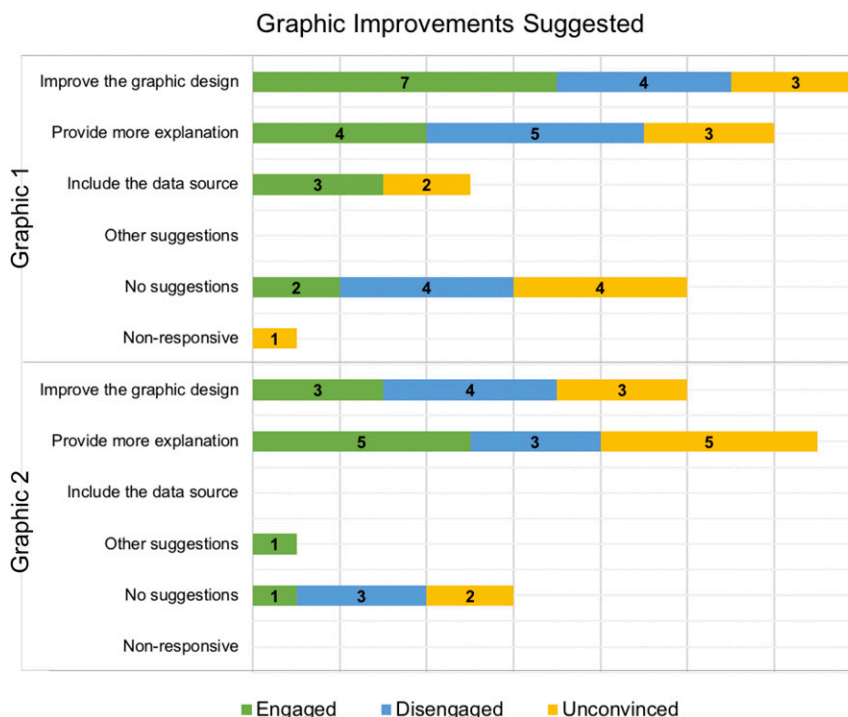


FIG. 2. Suggested improvements for the graphics by participant group.

d. Evaluations of the videos were largely positive or neutral

After viewing each video, participants were asked for their reaction and whether they had any feedback. Similar to the graphics, the participants' reactions were coded as positive, neutral, negative, or mixed. The majority of participants had positive [video 1: 12/29 (41%); video 2: 14/30 (47%)] or neutral reactions [video 1: 10/29¹ (34%); video 2: 7/30 (23%)], but some reacted negatively [video 1: 7/29 (24%); video 2: 9/30 (30%)]. Unsurprisingly, *engaged* participants were most likely to react positively (7/10 for both videos), *disengaged* participants were most likely to have neutral reactions (video 1: 5/10; video 2: 3/10), and *unconvinced* participants were most likely to have negative reactions (video 1: 3/9; video 2: 4/10).

It is important to note, however, that negative evaluations were not rejections of the evidence, but rather critiques of the weathercaster's delivery and a desire for more explanation (Fig. 3). Critiques of the weathercaster's delivery included how fast the weathercaster moved through the message, especially in video 2 [9/30 (30%)]. One *unconvinced* participant stated, "they throw you information so quickly and she's walking back

and forth. You really can't get a good look at what the information is... it's just a lot of information to grasp."

Several participants wanted more explanation about how the information is personally relevant (video 1: 11/29; video 2: 4/30). For video 1, participants wanted to know what a "2°F increase" meant. One participant stated, "I think it might have been nice if he had told what that 2° means. You know, does it mean more bugs, or does it mean crops are changing or do we have to plant some things." This suggestion was less common for video 2 because the weathercaster talked about the personal relevance. One participant stated, "I will expect a higher cooling bill... from that information [more warmer nights] I would be able to weigh whether I would be more comfortable to open my windows or use the air-conditioner, whether it would be cost-effective..." Only one *unconvinced* participant blatantly doubted video 2 because they "wanted to see the evidence" on climate change. Overall, the negative reactions were generally the same across all three belief groups and focused on the presentation of the information and not the content of the message itself.

e. After watching the examples, were participants interested in receiving more climate change information?

At the end of the interview, participants were asked whether they had any additional reactions to the idea of

¹ One of the 30 participants was unable to stream video 1 due to technical difficulties.

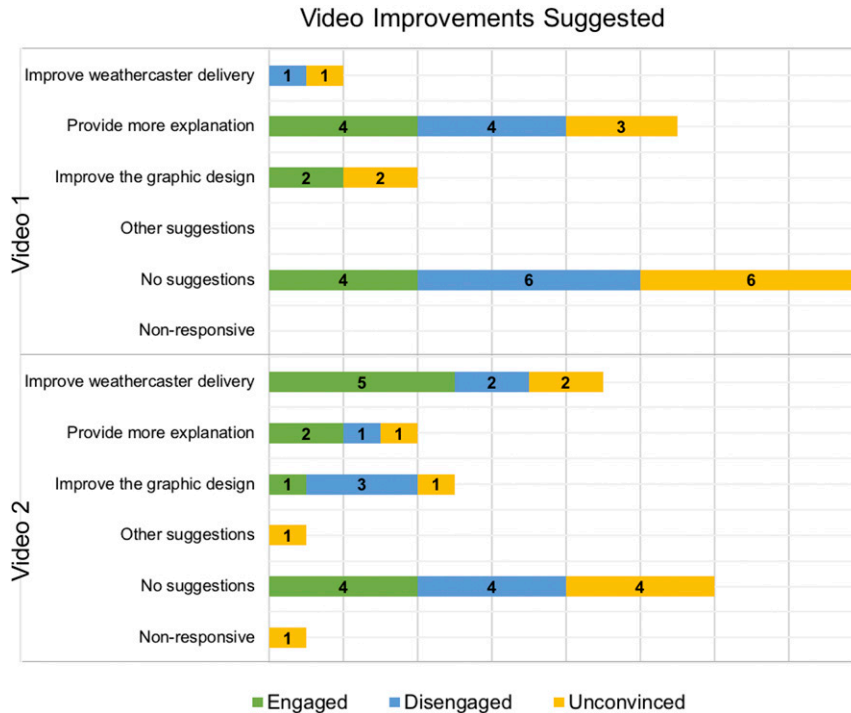


FIG. 3. Suggested improvements for the videos by participant group.

TV weathercasters reporting about climate change. Responses to this question were used to gauge how participants, after seeing four examples (two graphics, two videos), felt about the content. The participants' responses were assigned one of three codes: interested, not interested, and no comment. Participants were also asked to explain their reasons for interest or disinterest.

At the end of the interview, most of the participants were interested in getting climate change information from their local TV weathercaster, including all of the *engaged* (10/10) and most of the *disengaged* (8/10) participants, while the remaining *disengaged* (2/10) participants did not have anything further to say about TV weathercasters' reporting on climate change. Some of the *unconvinced* participants (3/10) also expressed an interest in seeing information about climate change from their TV weathercaster.

Many of the interested participants explained that they wanted to become more informed about climate change [14/30 (47%)]. For example, one participant said, "I would like that. I would like to know more." After seeing the examples, some participants remained convinced that showing more on-air content about climate change could change other people's opinions about climate change and encourage the adoption of behaviors to mitigate the effects of climate change [4/30 (13%)]. These four individuals (2/10 *engaged*; 2/10 *disengaged*) wanted information about what people can

personally do to reduce the effects of climate change. One *disengaged* participant said, "I think it would be nice to actually know the benefits...of what we can be doing to actually prevent global warming."

Three participants—one from each of the three groups—changed their view during the interview. At the start of the interview, these participants were not interested in learning about climate change from a local TV weathercaster, whereas by the end of the interview, they were interested. These participants described that the presentation of climate change facts in the context of the weather forecast was the reason for their change in interest. The *disengaged* and the *unconvinced* participants who changed each became interested because they found the information to be factual, not opinion oriented. The *disengaged* participant explained that if the information "was past weather...charts, projections" and it did not "...get into the commentary" or "...show political bias," they would support seeing that type of information on air. The *unconvinced* participant stated that "if they can use information from the National Weather Service, or NOAA, or if it's really documented concrete evidence that I can take to the bank, I love hearing about it. Because it's an issue that everybody is talking about. That's everybody's platform now politically, and if people can understand more about it, or become more interested in it, then we'll be in better shape!"

Unconvinced (6/10) participants were the only participants who remained largely disinterested in seeing climate change information in the on-air weather segment. While one participant became more interested after seeing the exemplar videos, two others became less interested. However, it is important to note that four of the six participants who were not interested were also not opposed to seeing on-air climate change information. For example, one stated, “if it really makes people understand what’s going on, then I don’t have an issue with it.” These four *unconvinced* participants wanted more information about climate change, but they felt that the weather forecast was not the right place for it because weathercasters lack the time to go in depth. Specifically, they wanted in-depth information and felt that the internet or elsewhere in the news were better places to provide that information. For example, one participant explained that “throwing it [climate information] in there, it really isn’t enough information. . . I don’t think the local TV forecaster has enough time unless they’re doing a special on it.” Another *unconvinced* participant suggested that it would be good as part of “The Weather Channel app or something like that.”

5. Discussion

Participants from all three groups—*engaged*, *disengaged*, and *unconvinced*—expressed an interest in learning about climate change from TV weathercasters. Most participants understood the messages about climate change that the graphics and videos intended to convey. The participants’ reactions to the graphics and the videos were primarily positive or neutral, with relatively few negative responses from any group, including the *unconvinced* participants. The majority of participants were interested in receiving climate change information from the outset of the interview, and this interest both remained and increased among some participants after being exposed to the example graphics and videos. In short, most of the interview participants across all three groups showed considerable receptivity to the information provided. These findings contribute to climate change communication literature and illuminate several avenues for future research.

To our knowledge, this is the first study to date that qualitatively investigates local news viewers’ reactions to weathercasters on air reporting on climate change and weathercasters’ ability to help their viewers see climate change as a more personally relevant, local issue. We found that participants from all three groups were interested in learning more about the impacts of climate change, especially information that is local, relevant, and relatable to their daily lives. Our results are similar

to previous findings—mostly from experimental studies—that local climate change information tends to resonate with a much broader audience, compared to information at larger spatial scales (Altinay 2017; Jones et al. 2017; Scannell and Gifford 2013; Spence and Pidgeon 2010).

This finding may be explained by construal-level theory, which describes that people think more concretely about issues that are proximal or close to them socially, temporally, geographically, or hypothetically (Trope and Liberman 2010; Jones et al. 2017). In other words, people tend to be more engaged with the subject of climate change when it is locally framed, involves people like them, and is relevant to the decisions they have to make, particularly among individuals with strong feelings of place attachment (Hart and Nisbet 2012; Scannell and Gifford 2013; Jones et al. 2017; Altinay 2017). However, efforts to make climate change more proximal through communication have had mixed results (Spence and Pidgeon 2010; Brügger et al. 2015; Altinay 2017). The process or processes by which localizing works—and for whom and at what times—remains an important need within psychological distance research (Brügger et al. 2015; Jones et al. 2017).

While our audience segments are too small to make comparisons that can be generalized to the population, we found some differences across the groups in their desire for local climate change information, which offers new insights for understanding the process of localizing climate change. When initially asked, *disengaged* participants expressed interest in local climate change information, while *engaged* and *unconvinced* study participants both asked for national- or global-level information. This pattern is interesting because a growing number of Americans say they have experienced the impacts of climate change in their region, but segments of the population like the *disengaged* continue to think that climate change impacts other places, other nonhuman species, or people far off in the future (Leiserowitz et al. 2018; Spence et al. 2012; Lorenzoni et al. 2006). Local climate change messages may resonate particularly well with *disengaged* audiences, but it remains unclear why this may be. *Disengaged* participants are least certain of their climate change beliefs, but because they are not set in their views about climate change, they may be more actively looking for confirmatory evidence for what they are experiencing. Future research should further investigate how preexisting climate change belief certainty, perceived experience, or perceived vulnerability influences the effects of local and global climate change messages (Jones et al. 2017). A similar, emerging line of research has started to explore the variation in the effects of climate change

messages by geographic region and has found stark differences in the effects of a scientific consensus message by state (Zhang et al. 2018).

Because of the global nature of climate change, there has also been some debate about whether presenting local information is effective for all audiences (Brügger et al. 2015). During the interviews, the participants of our study were shown both local and national climate change information (see supplemental material), and message retention was high for each example among all the segments, so it is unclear whether the effects of local messages were distinctly influential. Future research should further explore the role of geographic scale in climate information, particularly the combination of information at different scales and its effect on awareness, risk perceptions, or motivation to act. For example, national or global climate change information may help people understand one aspect of an issue, such as the size and gravity of the problem, while local- or regional-scale climate change information may affect another, such as understanding the personal risks and specific actions to take to make solving a big problem seem more feasible (Spence et al. 2012).

Interest in getting climate change information from TV weathercasters decreased among 2 of the 10 *unconvinced* participants after seeing the example graphics and videos. Several *unconvinced* participants were not opposed to the information, but rather felt that the on-air weather segment was not the right venue for this information. These participants desired more in-depth explanations of climate change and felt that there was insufficient time to accurately present information about climate change within the weather segment. These findings suggest that some members of this small segment of the American population (about 22% of the American public would fall into the *unconvinced* group) may be more interested in getting climate change information from other communication platforms that afford greater amounts of explanation—such as websites, longer-format news stories, or short documentaries.

Weathercasters may play an important role in providing climate change information through alternate channels; a recent survey of weathercasters found they use a range of communication channels in their day-to-day work (Maibach et al. 2017b). About 27% of weathercasters currently produce longer-format science stories to air in other parts of the news broadcast, and more than half (57%) are at least somewhat interested in doing so. Comparing the effects of similar messages and kinds of information across multiple communication channels is becoming more common in political communication, but applications to science communication have been more limited (Bode and Vraga 2018; Kruikemeier et al. 2018).

Given that the format of the weathercast was the primary concern among several *unconvinced* participants—and not the messenger themselves—weathercasters may continue to be seen as trusted sources for climate change information (Leiserowitz et al. 2015). While the audience may not agree with weathercasters' messages, the results suggest that they can maintain trust by being transparent about climate change data and information sources. The participants of our study, especially the *unconvinced*, valued the presentation of facts and data sources in the sample graphics and videos. Including source information when presenting about climate change should help maintain trust, which is very important to weathercasters and station management for retaining popularity in their market (Meldrum et al. 2017).

Notably, the *unconvinced* participants did not have negative reactions to the climate change information they were presented. Previous research has described how some weathercasters are uncomfortable discussing climate change on air for fear of alienating viewers with differing views and receiving negative feedback (Schweizer et al. 2014; Maibach et al. 2016a; Meldrum et al. 2017). We did not directly ask participants whether the content presented would motivate them to contact the weathercaster or the station with complaints; however, none of the *unconvinced* participants in this study were irritated or angered by the climate change information presented. These findings are consistent with the results of a recent survey of TV weathercasters that found that weathercasters who report on climate change receive more positive than negative feedback from viewers (Maibach et al. 2017b). However, study participants may have been reluctant to display anger or incivility in the intimate interview setting; future research could investigate when and how viewers communicate with stations when they are not pleased with their content.

In addition to wanting information about local climate change impacts, many participants, and particularly *unconvinced* participants, were interested in learning why climate change is happening and how scientists know it is caused by humans. These results are consistent with previous research that suggest that members of the *unconvinced* segment want information that explains how scientists know that climate change is real (Roser-Renouf et al. 2014) and posits that acceptance of climate change information may be greater among the *unconvinced* if it is presented in more subtle ways (Roser-Renouf et al. 2014). Because our interviews explicitly focused on climate change, and participants were clearly aware of this, we were unable to test this assumption. However, this would be an interesting area

for future research because the presentation of climate change information in an actual TV weather forecast is probably subtler than what was recreated for the interviews. If the *unconvinced* participants were receptive to the materials they were shown during the interviews, they may be even more receptive to them in a more natural setting.

Engaged participants were most likely to want information about solutions or steps that can be taken to mitigate and respond to the local impacts of climate change, which is consistent with prior research showing that once individuals know that climate change is a threat, they become interested in what they can do about it (Roser-Renouf et al. 2014). Some weathercasters have expressed discomfort with presenting information about climate change responses or policies on air (Meldrum et al. 2017). This concern should not, however, pose a limitation because most weathercasters already offer safety and adaptation recommendations—for example, warnings against driving through flooding water—even if the climate change context is not offered (Henson 2010). Moreover, other members of the local TV news team (e.g., reporters, anchors) can present local information about solutions and responses to climate change. Providing information about both the risks and the solutions to climate change rarely happens within the same newspaper article or broadcast segment but should be a useful technique to prevent people from feeling like a problem is too large to overcome or that they, or their community, do not know what to do about it (Hart and Feldman 2014; Feldman et al. 2017).

There are several limitations to this study that should be noted. First, the small sample size and the fact that all of the study participants lived in one U.S. state necessitates caution in generalizing these findings beyond the participants of the study. Further research will be needed to understand how these results may be similar or different in other states or TV markets. Despite this study's small size, these results contribute to prior research by providing a deeper, more nuanced look at how different audiences may be interpreting climate change information presented in the context of the local TV weather forecast. Future research should quantitatively measure local news viewers' responses to similar stimuli in order to develop a more generalizable understanding of the processes of localizing climate change.

Another limitation is that the interviews were conducted in 2014, only 1 year after Climate Central began producing graphics for weathercasters in the *Climate Matters* program. Since then, the resources available to weathercasters have expanded (i.e., production support, webinars, workshops, Spanish translation of content), and the materials have been improved to better meet

weathercaster needs (Woods Placky et al. 2016). For example, *Climate Matters* now offers animated graphics and base-level images that can be modified to fit television stations' own graphic packages. To date, there have been 28 webinars and 11 workshops to help weathercasters learn how to use *Climate Matters* materials (B. Woods Placky 2017, personal communication). Because the graphics have been improved and more weathercasters have been trained to use the resources, conducting this study with the newer graphics and videos could also generate different levels of viewer interest, message retention, and feedback. Because Americans' views about climate change have evolved, *Climate Matters* materials have improved, and on-air delivery of climate change information has expanded, it would be valuable to replicate this study using a quantitative approach and extend it to a larger, more representative sample of Americans.

Finally, the generalizability of these results to the present day may also vary, considering the interviews were conducted during a U.S. presidential administration that was more open to climate science and mitigation policies. However, the results of this study should remain useful, despite the change in the political context since 2014 when the interviews were conducted, because most Americans' global warming beliefs may be changing independent of the views of the presidential administration. More Americans are certain climate change is happening and about its human causes—and they are more worried about it—than they were in October 2014 (Leiserowitz et al. 2018). Since October 2014, the number of Americans who are extremely/very sure that climate change is not happening has declined from 9% to 7%, and the number of Americans who are extremely/very sure that climate change is happening has increased from 38% to 49% in 2018. In addition, 58% of Americans now understand that global warming is mostly human caused, up 7% from October 2014. In addition, greater numbers of Americans are somewhat or very worried about global warming now (62%) than in 2014 (56%).

Given these trends, we would expect TV audiences to be more welcoming toward information about climate change presented in the context of the local weather forecast, despite what political elites are saying about the issue. Construal-level theory suggests that threats perceived to be psychologically distant will be construed more abstractly, and more abstract construals are subject to greater influence from deeply held beliefs, such as political ideology (Brügger et al. 2016; Trope and Liberman 2010). This research would suggest that weathercasters' reports about the local impacts of climate change, especially how local people are affected, may be less vulnerable to politically motivated reasoning and boomerang effects (Hart and Nisbet 2012; Jones et al. 2017), but more

research is needed. Recent research shows that the presence or absence of partisan policy solutions more strongly influences climate change attitudes than climate impact information when it is presented together (Feldman and Hart 2018).

6. Conclusions

This study provides an understanding of how viewers with different opinions about climate change react to the on-air discussion of climate change by TV weathercasters. The results of this research demonstrate that most of the study participants—local TV viewers from Virginia—are largely interested in learning more about the local impacts of climate change from their local TV weathercaster, despite their different views about climate change. While negative comments may occasionally be directed to the weathercasters or their station, this research should help alleviate some of the concerns about receiving negative feedback or losing viewers due to climate change information. While these concerns are legitimate and likely vary from region to region, it is important to reiterate that many Americans want to learn more about climate change (Perkins et al. 2017) and find climate change information presented in the context of the local TV weather forecast to be interesting. Reporting in this way may help viewers connect what they are experiencing firsthand to more abstract, long-term trend information through simple, locally relevant messages.

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