Localized Climate Reporting by TV Weathercasters Enhances Public Understanding of Climate Change as a Local Problem

Evidence from a Randomized Controlled Experiment

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ABSTRACT: A rapidly growing number of TV weathercasters are reporting on the local implications of climate change, although little is known about the effectiveness of such communication. To test the impact of localized climate reporting, we conducted an internet-based randomized controlled experiment in which local TV news viewers ($n = 1{,}200$) from two American cities (Chicago and Miami) watched either three localized climate reports or three standard weather reports featuring a prominent TV weathercaster from their city; each of the videos was between 1 and 2 min in duration. Participants' understanding of climate change as real, human-caused, and locally relevant was assessed with a battery of questions after watching the set of three videos. Compared to participants who watched weather reports, participants who watched climate reports became significantly more likely to 1) understand that climate change is happening, is human-caused, and is causing harm in their community; 2) feel that climate change is personally relevant and express greater concern about it; and 3) feel that they understand how climate change works and express greater interest in learning more about it. In short, our findings demonstrate that watching even a brief amount of localized climate reporting (less than 6 min) delivered by TV weathercasters helps viewers develop a more accurate understanding of global climate change as a locally and personally relevant problem, and offer strong support for this promising approach to promoting enhanced public understanding of climate change through public media.

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The Fourth National Climate Assessment, released in 2018, offers incontrovertible evidence that climate change is already affecting individuals, communities, and businesses across the United States, and threatens to further undermine well-being, safety, and access to basic resources as it progresses (USGCRP 2018). Yet, the public response to climate change has, thus far, been tepid. Most Americans perceive the threat as distant—in time, space, and species—and not personally relevant, and only a minority see climate change as a high-priority concern (Ballew et al. 2019). Enhancing public engagement in the issue is imperative for efforts to build resilience at the individual and societal levels and to limit the progression of climate change.

Public communication can be an effective tool for informing and enhancing public engagement in individual and collective responses to threats to health and well-being. The most successful public communication initiatives tend to feature simple clear messages, repeated often, by a variety of trusted sources (Maibach 2019). Arguably, the public education initiatives on climate change that have most faithfully applied this formula have been industry-funded disinformation campaigns (Oreskes and Conway 2010; Dunlap and McCright 2011). Conversely, there have been relatively few organized, sustained public communication efforts by government, industry, or civil society to help Americans better understand and connect with the reality and risks of climate change.

Climate Matters—initiated as a pilot test in 2010–11 by a university (George Mason), a civil society organization (Climate Central), and a local TV station (WLTX, Columbia, South Carolina), and scaled up thereafter in partnership with a professional society (the American Meteorological Society) and two government agencies (NOAA and NASA)—is one example of a sustained, science-based, public communication initiative on climate change (Placky et al. 2016; Zhao et al. 2014). *Climate Matters* was developed as a local climate reporting resource program with the aim of enlisting and enabling TV weathercasters as local, trusted, science-based, nonpolitical climate educators (Maibach et al. 2016). Weathercasters are trusted as a source of information about global warming (Maibach et al. 2016), and they have considerable access to the public that cuts across political, geographical, and socioeconomic divides (Demuth et al. 2011; Lazo et al. 2009). Moreover, they are interested in delivering stories that are not only compelling and relevant, but will contribute to the safety and well-being of their viewers (Schweizer et al. 2014). The American Meteorological Society encourages and enables weathercasters to engage in the role of "station scientist" (AMS 2019). Weathercasters have ample opportunity to provide locally relevant information about climate change that directly addresses the risks it poses to the health, economic security, and safety of individuals and their families, and communities. However, a 2010 nationwide survey of weathercasters found that while many were interested in reporting local climate stories, few were actually doing so, largely due to barriers such as lack of time to research local data and turn it into broadcast quality graphics (Maibach et al. 2016). The *Climate Matters* program was designed to address these barriers by providing weekly, TV-ready information about local impacts of climate change using high-quality, clear, and engaging graphics and locally relevant and timely information.

Climate Matters has been well received by TV weathercasters. There are currently more than 770 weathercasters across 184 media markets participating in *Climate Matters*, and on-air reporting about climate change has increased dramatically—approximately 3,200% between 2012 and 2018. Empirical studies of the program's impacts have been limited, however. A

quasi-experimental evaluation of the pilot test in Columbia, South Carolina—in which 13 approximately 2-min stories were aired over the course of one year—found that viewers of the test station developed a more science-based understanding of climate change (Zhao et al. 2014).

In the current study, we set out to more rigorously test the efficacy of climate communication by local TV weathercasters using *Climate Matters* materials—employing a randomized, controlled experimental design. Two local TV weathercasters who participate in the *Climate Matters* program created three videos each in which they discuss climate change in the context of their local weather. We then exposed audience members in their media market to these videos, or to their regular weather coverage, and assessed the impact of this exposure on their views about climate change. We used two distinct media markets—Chicago and Miami—to explore differences and increase generalizability.

A key goal of the *Climate Matters* program is to reach diverse audiences, demographically and ideologically. Given the wide disparity in the acceptance of and engagement with climate change across the political spectrum, it is particularly important to connect with conservatives around this issue. However, conservative audiences tend to be exposed to messages disparaging scientific evidence about climate change from political and social authorities and the media (Feldman et al. 2011), and it is unclear to what extent they may be receptive to communication of information consistent with climate science by weathercasters (Feygina et al. 2010). Moreover, there is a concern about psychological reactivity or backlash, whereby skeptical individuals may react to information about climate change by rejecting it as a means to affirm their political identities (Fielding and Hornsey 2016; Kahan et al. 2011). Research with weathercasters has shown relatively limited negative response to climate change coverage among audiences (Perkins et al. 2018; Maibach et al. 2017); however, the question of whether backlash occurs among conservative viewers has not been directly addressed.

Our study aims to address two key questions: 1) Does watching a local TV weathercaster report on the link between climate change and weather lead to greater acceptance of, concern about, and engagement with climate change in comparison with watching weather reports? and 2) Does such viewing affect people across the political spectrum in the same way?

Methods

To test these questions, we recruited 1,200 participants from the Chicago and Miami media markets (i.e., the designated market area, or DMA, whose population can receive the same television signals) via an online survey company (Qualtrics). Recruitment quotas were set such that the final sample would be balanced on demographics and political ideology. Participants were randomly assigned to watch videos of a prominent local weathercaster from their media market deliver either three weather reports (control condition) or three reports linking climate change to their local weather (experimental condition). After the videos, participants responded to questions that assessed their understanding, acceptance of, and concern about the impacts of climate change, as well as their interest in learning more and taking action to protect themselves and their communities. We also included a pre-test measure of climate change attitudes consisting of a subset of questions offered in the post-test. To guard against sensitization effects of the pre-test (where asking participants about their views of climate change prior to getting the experimental videos may prime them to react differently), we conducted a Solomon four-group experiment, where half of participants in each condition were randomly selected to receive both the pre-test and post-test and half only received the post-test.[1]

We assessed whether watching the climate videos resulted in more scientifically informed climate change understanding, acceptance, concern, and willingness to engage with climate solutions, in comparison to watching weather videos (the main effect of the video condition). We also assessed whether

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[1] Results showed no sensitization effects of completing versus not completing the pre-test measure of attitudes on outcomes.

participants' political ideology influenced their reactions to the videos (the interaction between video condition and political ideology). A detailed description of participants, methods, data analyses and additional results are presented in the online supplement (https://doi.org/10.1175/BAMS-D-19-0079.2).

Results

Does watching a TV weathercaster report on the link between climate change and weather lead to greater acceptance of, concern about, and engagement with climate change in comparison with watching weather reports?

We tested this question in two ways. The first analysis included all participants and modeled the post-test as the outcome, controlling for whether the participant had received the pre-test (covariance approach). The second analysis included only those participants who received the pre- and post-tests of climate attitudes, and modeled the change in scores between the pre- and post-tests as the outcome[2] (change score approach).

Covariance approach. Analyses showed that, overall, watching localized climate videos, compared to weather videos, resulted in more scientific climate change perceptions and acceptance.[3] Specifically, in the first analysis, participants who watched the climate (vs weather) videos reported greater acceptance that climate change is happening, anthropogenic, and harmful; a stronger sense of understanding how climate change works, that it is personally relevant, and concern about its impacts; and a stronger expectation that climate change will make weather worse sooner and harm people in one's community. Participants who watched the climate videos also expressed greater interest in engaging further with climate change—both learning about it as well as learning how to protect themselves from and limit its impacts. They were also more likely to believe they can contribute to limiting climate change. The only measure on which climate video viewers were not different from weather video viewers was perception of their ability to reduce the risk of being harmed by climate change (see Table 1 for means by video condition and Tables ES1a–c in the supplement for regression results).

Change score approach. This analysis examined only the variables included in both the pre- and post-tests as the outcome and tested whether their amount of pre–post change differed between the climate and weather video conditions. Results showed that, consistently, there was greater pre–post increase in the acceptance of, concern about, personal response to, and expectations of the impacts of climate change (except perceptions of the extent to which climate change will harm people in one's community) in response to watching the climate videos as compared to the weather videos (see Table 2 for average pre–post change by video condition, Tables ES2a and ES2b for regression results, and Fig. ES1 for a visualization of average change by condition).

In sum, there was strong and consistent evidence that being exposed to information about climate change linked to local weather as communicated by local weathercasters resulted in greater awareness of, acceptance of, concern about, and engagement with climate change.

[2] There is a debate—termed Lord's Paradox (Lord 1967)—about the best way to model pre–post data. There are two possible approaches: 1) model the postscore as the outcome, controlling for/covarying the pre-test score, and/or modeling the effect of an interaction between the experimental treatment and the pre-score (covariance approach); and 2) model the change between pre- and posttests as the outcome (change score approach). As shown by Lord (1967), these methods do not always result in the same conclusions. Numerous papers have since sought to elucidate the conditions under which each method should be utilized; however, there is no consensus about the preferred methodology. Therefore, we chose to apply both approaches, and to report in the main paper the change score methodology results for ease of interpretation, and report the regression methodology results in the supplemental section for interested readers. Substantive conclusions for the two methods are largely the same in this analysis. Using the second approach revealed that the effect of the videos varied by prior beliefs and the combination of prior beliefs and political ideology.

[3] Linear regressions for each outcome were used to determine the main effect of watching climate videos compared to weather videos on climate change acceptance. In addition, we included as predictors media market (Chicago or Miami), political ideology, frequency of watching local television, attention to local weather forecasts, whether the participants received a pre-test or not, and familiarity with the weathercasters featured in the videos.

Table 1. Means (adjusted for control variables) for each video condition and each outcome; *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$.

Question	Response options	Mean		Mean difference
		Weather	*Climate Matters*	
Do you think climate change is a bad thing or a good thing?	(1 = very bad; 11 = very good)	5.50	4.77	−0.73***
Do you think that climate change is happening or not?	(1 = I am certain climate change is not happening; 11 = I am certain climate change is happening)	8.91	9.24	0.33*
To what extent do you think climate change over the past 100 years is caused by natural events or by human activities?	(1 = Completely by natural events; 11 = Completely by human events)	8.05	8.28	0.23+
How well do you feel you understand how climate change works?	(1 = Not at all; 11 = Extremely well)	7.80	8.38	0.58***
To what extent is climate change personally relevant to you?	(1 = Not at all personally relevant; 11 = Extremely personally relevant)	8.00	8.36	0.36*
How concerned are you about climate change?	(1 = Not at all concerned; 11 = Extremely concerned)	8.12	8.57	0.45**
When, if ever, do you think climate change will start to make the weather worse in your community?	(0 = Now, it is already happening; 100 = 100 years from now)	39.17	34.43	−4.74*
How much do you think climate change will harm people in your community?	(1 = Will not harm at all; 11 = Will harm extremely)	7.33	7.78	0.45**
I want to learn more about climate change.	(1 = Strongly disagree; 11 = Strongly agree)	8.08	8.35	0.27+
I want to learn more about ways to protect myself from the impacts of climate change.	(1 = Strongly disagree; 11 = Strongly agree)	8.01	8.29	0.28+
I want to learn more about ways to limit climate change.	(1 = Strongly disagree; 11 = Strongly agree)	8.05	8.33	0.28+
I believe I can reduce my risk of being harmed by climate change.	(1 = Strongly disagree; 11 = Strongly agree)	7.10	7.28	0.18
I believe I can contribute to limiting climate change.	(1 = Strongly disagree; 11 = Strongly agree)	7.46	7.77	0.31*

Does the effect of watching a TV weathercaster report on climate change vary for viewers across the political spectrum?

We assessed this question by testing for differences in the effect of watching localized climate videos (vs weather videos) on acceptance and concern among more liberal versus more conservative audience members. Again, we first included all participants and then modeled pre–post change among those who received the pre-test only.

Covariance approach. As expected, conservative respondents were less likely than liberal respondents to accept, be concerned about, and be engaged with climate change (see coefficients for ideology in Tables ES1a–c). However, the effectiveness of the climate videos was similar for participants across the ideological spectrum. In other words, watching climate videos (vs weather videos) increased acceptance of and concern about climate change similarly for liberal and conservative respondents[4] (see Tables ES3a–c for all regression coefficients).

Change score approach. When modeling pre–post change as the outcome, we found no differences by ideology for most variables (see coefficients for ideology in Tables ES2a and ES2b; the exceptions were the outcomes of personal

[4] This was tested via an interaction between ideology and condition in linear regressions for each outcome. In addition, we included as predictors market (Chicago or Miami), frequency of watching local television, attention to local weather forecasts, whether the participants received a pre-test or not, and familiarity with the weathercasters featured in the videos.

Table 2. Average pre–post change (adjusted for control variables) for each video condition and each outcome. Note that we show only variables included in the pre-test, as for space reasons not all items asked on the post-test were also asked on the pre-test; *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, +$p < 0.10$.

Question	Response options	Average pre–post change		Difference in pre–post change
		Weather	*Climate Matters*	
Do you think climate change is a bad thing or a good thing?	(1 = very bad; 11 = very good)	0.11	−0.35	−0.46*
Do you think that climate change is happening or not?	(1 = I am certain climate change is not happening; 11 = I am certain climate change is happening)	0.03	0.31	0.28+
To what extent do you think climate change over the past 100 years is caused by natural events or by human activities?	(1 = Completely by natural events; 11 = Completely by human events)	−0.05	0.36	0.41**
How well do you feel you understand how climate change works?	(1 = Not at all; 11 = Extremely well)	0.13	0.83	0.70***
To what extent is climate change personally relevant to you?	(1 = Not at all personally relevant; 11 = Extremely personally relevant)	0.29	0.65	0.36*
How concerned are you about climate change?	(1 = Not at all concerned; 11 = Extremely concerned)	0.11	0.49	0.38**
When, if ever, do you think climate change will start to make the weather worse in your community?	(0 = Now, it is already happening; 100 = 100 years from now)	−0.03	−4.71	−4.68**
How much do you think climate change will harm people in your community?	(1 = Will not harm at all; 11 = Will harm extremely)	0.39	0.54	0.15

relevance—conservatives changed more than liberals—and the extent of community harm—conservatives changed less than liberals), nor did we find evidence that ideology influenced the effectiveness of the climate videos, as compared to weather videos, in producing pre–post change (see coefficients for ideology in Tables ES4a and ES4b).

Taken as a whole, these findings make clear that watching a TV weathercaster report on the local weather implications of global climate change resulted in more scientifically informed climate change understanding, concern, and willingness to engage further with the issue in comparison to watching weather forecasts. When modeling the post-test score among all participants, all but one of 13 outcomes were affected by exposure to the climate videos; a nearly identical pattern of responses was found using the change score method. Furthermore, across all outcomes, the effectiveness of the climate videos was consistent among participants across the ideological spectrum.

Discussion
Findings from this experiment provide consistent support that being exposed to local weathercasters reporting on the links between local weather and global climate change is an effective way to increase acceptance of, concern about, and engagement with climate change. Specifically, we found that—in comparison to watching TV weather forecasts—watching three TV segments in which a weathercaster discussed how climate change is contributing to local weather events or changes over time led viewers to be more convinced that climate change is happening and is caused by human activities, is a bad thing, is reason for concern, will make the weather worse sooner, and will bring harm to one's community. It also contributed to a greater interest in further learning about climate change, as well as how to protect oneself from it and reduce its progression. While climate videos did not increase a sense of efficacy around adaptation, they did increase efficacy around mitigation—a difference that warrants further investigation.

These findings are important for several reasons. They provide support for approaching climate outreach via local communicators, particularly weathercasters, to connect with audiences who would not otherwise have exposure to information about climate change or be in contact with scientists or educators who may engage them around climate issues. They also provide strong and consistent experimental evidence that the approach taken by the *Climate Matters* program is, indeed, a successful way to increase acceptance of and engagement with climate change among the general public. While the evaluation of the program's initial pilot test (Zhao et al. 2014), and various studies conducted since (Anderson et al. 2013; Perkins et al. 2018; Engblom et al. 2019), have provided evidence of the effectiveness of this approach, the current study offers the most direct causal proof of the extent to which exposure to climate coverage within weather reports is an effective communication tool. Thus, it provides the missing experimental piece by complementing the field research with audiences and annual survey research with the communicators to offer a complete picture.

While many education approaches require dedicated and effortful engagement from learners, the segments we tested were brief—between 1 and 2 min long—and were modeled after the way that *Climate Matters* materials are actually used by a rapidly increasing number of TV weathercasters. Moreover, this form of brief education is embedded in experiences that are central to people's lives. Not only do people pay attention to the weather, they use local temperature (Deryugina 2013) and weather and climatic events (Akerlof et al. 2012) to draw conclusions about whether climate change is happening. This is all the more so for people who are less knowledgeable about climate change, and who are more conservative. Therefore, making the link between climate and weather is particularly effective in engaging these audiences. Reports linking weather and climate also touch on our greatest concerns for safety and well-being, and thus draw our attention and underline the sense of relevance and importance.

Another important, and promising, finding is that the impact of watching the climate reports did not differ by ideology. Despite potential concerns about a backlash among conservative audiences, our findings provide evidence of similar acceptance of climate information offered by TV weathercasters among viewers across the political spectrum, and provide no indication of a negative reaction. While, on average, being more conservative is related to being less accepting and engaged with climate change (in line with extant findings), it is not related to learning less from the information shared in the videos. Indeed, participants of both ideological leanings shifted similarly toward acceptance, expectations of impacts, and engagement with climate change in response to watching the climate videos. Similarly, we saw that conservatives, as compared to liberals, found the videos less clear, informative, and believable, and felt less care and concern and more skepticism in response to watching the videos. However, they nonetheless were equally affected by the videos in terms of developing understanding and attitudes that are consistent with the scientific evidence on climate change.

Limitations and future directions for research. Interestingly, we found that our two media markets differed consistently from each other (see supplemental material for more details). Overall, participants in Miami seemed to be more aware of and engaged with climate change, and react more strongly to the videos. This may be due to the ways in which climate change is already affecting south Florida, especially sea level rise, tidal flooding, and increasing exposure to tropical storms, while Chicago experiences more winter and cold-related extreme weather events, which may not be as readily associated with climate change (Zaval et al. 2014). It may also, however, be related to reactions to the weathercaster who presented the information. An important future direction is to investigate the extent to which weathercaster attributes, such as gender, age, tenure in the market, reputation, likability, and personal connection, play a role in a communicators' ability to bring forward information that may be

challenging for audiences, and which of these attributes may be more important in certain markets, and among different audiences.

An important strength of this study were the video materials used: actual weather reports as seen by the public, and climate reports created and recorded by the same local weathercasters, which were consistent with the climate reporting that both weathercasters actually provide their audiences. This greatly increases the external validity of the study, and puts it closer to a field experiment, while providing the tight internal validity of a controlled experiment. Yet, it is not a true field experiment. We showed our participants three videos, in an attempt to simulate the kind of exposure a regular local TV viewer might have. However, we do not know how often participants actually see climate reporting by a weathercaster, or how much they are paying attention when they do. Therefore, our findings could be strengthened by future research conducted from an in situ perspective.

An additional question pertains to generalizability. Our study was strengthened by running the experiment in two distinct regions of the country—northern Midwest and the South—which differ in the impacts of climate change they are experiencing, as well as audiences. However, both of these are centered around a large metropolitan area, with sizable suburban populations that slowly transition into rural areas. The ability to generalize from these findings to rural populations, whose main economic activity is agriculture and whose population may be more consistently conservative, is somewhat limited. Future research would do well to include areas that are predominantly rural in their sample, as well as other regions of the United States, such as the plains, the Southwest, and West Coast.

Conclusions

In sum, this study provides strong and consistent evidence that offering climate information via trusted communicators in local media is an effective approach to increasing acceptance of, concern about, and engagement with climate change. Importantly, this strategy is effective across the political ideology spectrum.

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