Attributes of Weathercasters Who Engage in Climate Change Education Outreach

DAVID R. PERKINS IV

Missouri State University, Springfield, Missouri

TERESA MYERS, ZEPHI FRANCIS, RAPHAEL MAZZONE,[a] AND EDWARD MAIBACH

George Mason University, Fairfax, Virginia

(Manuscript received 1 March 2017, in final form 11 February 2018)

ABSTRACT

This research explores the role of weathercasters as local climate change educators and identifies attributes of those who present climate science to their viewers. In 2015, the authors attempted to survey all television weathercasters currently working in the United States ($n = 2128$); 478 participated, yielding a 22.5% participation rate. Using logistic regression to identify attributes of weathercasters who report on climate change on-air, it was found that the strongest predictors were participation in *Climate Matters* (a climate change reporting resource program) ($\beta = 1.01$, $p < 0.001$), personal interest in reporting on climate change ($\beta = 0.93$, $p < 0.001$), age (higher rates of reporting among older weathercasters) ($\beta = 0.301$, $p < 0.05$), and number of climate reporting interests ($\beta = 1.37$, $p < 0.05$). Linear regression was used to identify attributes of weathercasters who showed the most interest in climate change reporting. Weathercasters most interested in reporting about climate change on-air were more certain that climate change is happening ($\beta = 0.344$, $p < 0.001$), were convinced climate change is human caused ($\beta = 0.226$, $p < 0.001$), were older ($\beta = 0.157$, $p < 0.001$), and found the Third National Climate Assessment to be useful ($\beta = 0.134$, $p < 0.05$). Weathercasters who are personally motivated to seek and share broad scientific information, acting as ‘‘station scientists,’’ appear to be those who are also proactive in sharing climate change information. Assisting motivated weathercasters with programs that reduce barriers to climate change education outreach complements their abilities to educate the public regarding climate change science.

1. Introduction

a. Overview

Global climate change is a multifaceted and complex issue that will require significant levels of cooperation among members of society. The IPCC Fifth Assessment Report (IPCC 2014) emphasizes that climate change has characteristics of a collective action problem, and cooperative responses are required to effectively adapt to and mitigate future climate change. Because climate change is broad-reaching, a key component to garner social change is public education so people will understand how they are impacted and can respond with solutions (Abroms and Maibach 2008; Ding et al. 2011). In this research, we focus on television weathercasters as public climate change educators and use analytical modeling to establish methods to best identify those weathercasters most willing to educate the public on topics of climate change science.

b. Background

The Third National Climate Assessment (NCA) concluded that climate change is already causing serious negative impacts in every region of the United States and will likely increasingly affect the lives of Americans in the decades to come. Addressing some of the causes of climate change experienced today, the NCA observes that as a result of advances in climate science, there is ‘‘increased certainty that we are now seeing impacts associated with human-induced climate change’’ (Melillo et al. 2014). Though it is difficult to disentangle the exact attributable proportions of human-caused versus natural variation in the observed changes to our

[a] Current affiliation: University of Maryland, College Park, College Park, Maryland.

Corresponding author: Dr. David R. Perkins IV, davidperkins@missouristate.edu

DOI: 10.1175/WCAS-D-17-0025.1

climate today, we are witnessing change across the United States. According to chapter 2 of the NCA (''Our changing climate''), changes consistently observed in our climate include increasing average temperatures, lengthening frost-free seasons, an increasing number of heavy downpours, an increase in the frequency and intensity of winter storms, rising sea levels, reduced ice cover on land, lakes, and sea, and acidification of our oceans.

In turn, because these changes in our climate are happening so rapidly, they are largely creating negative impacts on human health, water supplies, agriculture, ecosystems, forests, transportation, and energy (Melillo et al. 2014).

American public understanding of our changing climate and its impacts is not aligned with accepted science. While most Americans (70%) believe that climate change is happening, fewer than half (43%) are highly certain of their belief, and only slightly more than half (53%) think climate change is mostly caused by human activities (Leiserowitz et al. 2016). Moreover, most Americans see climate change as a relatively distant problem: distant in space [i.e., more likely to harm people in developing countries (63%) or elsewhere in the United States (59%) rather than people in their community (46%) or themselves personally (41%)], distant in time [i.e., more likely to harm future generations of people (70%)], and distant in terms of species [i.e., more likely to harm other animal and plants species (71%)] (Leiserowitz et al. 2016). As a result of these differences between public perception and scientific reality, climate change has been described as being ''psychologically distant'' (Leiserowitz 2005; Spence et al. 2012).

Misalignments between public perception (that climate change is ''distant'') and scientific reality (that it is occurring today) can result in unintended consequences, as people do not adequately plan for future climate change impacts. This occurs because people tend to heavily discount future events when making decisions about current actions (Berns et al. 2007; van Vugt et al. 2014); this is the concept of ''out of sight, out of mind'' (van der Linden et al. 2015). Misalignments between public understanding of climate change and realities of climate change are problematic because society is facing—and will continue to face—important decisions about climate change adaption and mitigation actions. These considerations will take form in personal decisions and in public policy and political realms. Decisions that are made treating climate change as a ''distant problem'' are likely to be suboptimal, whereas decisions made in advance, treating climate change as a serious and eminent issue, are likely to lead to better adaptive outcomes. A study of California farmers provides a good example: farmers with a more accurate understanding of global climate change and its impacts on local water resources were more likely to embrace adaptation and mitigation responses than farmers who were not as aware (Haden et al. 2012).

Empirical evidence suggests it could be possible to reduce the psychological distance of climate change. The human mind privileges experience over analysis (Kahneman 2011); therefore, efforts to show people how they and their communities are experiencing and being affected by climate change should help reduce a component of ''psychological distance'' (van der Linden et al. 2015). People's personal experiences with extreme weather events can also influence their climate change risk perceptions (van der Linden 2015), beliefs (Myers et al. 2013; Akerlof et al. 2013, Borick and Rabe 2014), behaviors (Spence et al. 2012; Ranney and Clark 2016), and policy support (Rudman et al. 2013). Educational messages that decrease the perceived distance of climate change and focus on regionally relevant impacts of climate change (compared to messaging focused on global impacts) have been shown to enhance engagement in the issue (Scannell and Gifford 2013).

The effectiveness of educational outreach is complicated, however, by the possibility of ''motivated reasoning,'' where people can have tendencies to understand new constructs based on prior beliefs (Kunda 1990; Kahan 2013). Lending to this theory, climate change has become a politically polarized topic in America, with conservatives having become much less likely than moderates and liberals to accept the findings of climate science (McCright et al. 2016). Educational messaging about climate change must be carefully selected because in some cases, messages have been shown to increase polarized views about climate change along political lines (Hart and Nisbet 2011; Kahan 2013).

Research conducted over the past decade has shown that television weathercasters, despite their primary role of forecasting and reporting on local weather, have considerable potential to educate their viewers about global climate change and its local implications (Woods Placky et al. 2016; Anderson et al. 2013; Bloodhart et al. 2015; Espinoza et al. 2012). Additionally, their audiences are interested in learning more about climate change (Perkins et al. 2017). TV weathercasters are trusted sources of information about global warming who have excellent multichannel access to the public (via television, radio, social media, internet, and community events) and who are talented science communicators. Based on the 2015 National Survey of Weathercasters, nearly half (48%) of American weathercasters surveyed feel it is appropriate for them to present climate science on-air, and a majority feel it is appropriate to do so online (59%), in social media

(64%), and at community events (69%) (Maibach et al. 2015). Moreover, a field experiment conducted in the Columbia, South Carolina, media market demonstrated that when a TV weathercaster made a concerted effort to educate viewers about the local impacts of climate change—airing 13 one to two minute stories over the span of 1 year—the station's viewers' understanding of climate change improved (in comparison to viewers of other local stations in the media market not exposed to this information) (Zhao et al. 2014).

Although a natural extension of the ''station scientist''—a role for TV weathercasters advocated since the late 1990s by the American Meteorological Society (Henson 2010)—the proposed role of ''weathercaster as local climate change reporter'' is relatively new, having been proposed only in the past decade (Woods Placky et al. 2016). As a community of practice, weathercasters' views of climate change—and of the prospect about reporting on climate change—have evolved rapidly during this time (Maibach et al. 2017). Even weathercasters who are interested in reporting on climate change, however, cite barriers to their abilities to do so, including lack of time to produce and air stories, lack of access to broadcast-ready graphics, lack of access to climate scientists, lack of support by viewers and managers, and lack of viewer interest (Maibach et al. 2011).

In an initiative aimed at reducing some of these barriers, Climate Central (a nonprofit organization focused on reporting climate change information) and George Mason University began to develop resources in 2012 and 2013 specifically for TV weathercasters who were interested in reporting on climate change (Woods Placky et al. 2016). Building on the model previously developed and pilot-tested in Columbia, South Carolina, these resources—branded *Climate Matters*—include broadcast-ready story packages (graphics, key points, and background information) and climate science workshops that bring TV weathercasters together with leading climate scientists. By the end of 2013, these resources were available to any interested TV weathercaster, and over 100 weathercasters were participating in the program. As of May 2017, the number of participating weathercasters has grown to 409, spanning 136 news markets and 273 news stations across the United States (S. Sublette 2017, personal communication).

Summarizing, while established research has found that the public generally is not well versed in climate change science, it has also found great potential for weathercasters to help the general public understand climate science. Additionally, efforts to curb the ill effects of climate change—particularly those that are human caused—are more likely to occur when society better understands climate change. For varying reasons, however, not all weathercasters are motivated or willing to engage in climate change educational outreach. Until now, identifying those weathercasters most apt to participate in this educational outreach was haphazard and self-selecting. As a result, the process of public education in climate change has been slower and more inefficient than its potential. This research, however, seeks to improve on these past inefficiencies by providing an analytical approach to identify weathercasters who are most likely to be motivated and ready to educate the general public on climate change science. Understanding the best candidates allows for targeted efforts to both identify and assist weathercasters in becoming better and more active climate educators, thereby helping educate the general public regarding climate change science.

2. Methods

a. Overview

We used data from the 2015 National Survey of Weathercasters (Maibach et al. 2015) and performed statistical analysis to identify the factors that predict weathercasters' climate change reporting and educational outreach in various communication channels.

b. Sampling and data management

The survey team used a commercial database (Cision) to create a list of all professionals currently working as television weathercasters in the United States (Maibach et al. 2015). To verify and edit this list, Maibach et al. (2015) then conducted a manual search of the websites of all local television news stations, national television stations, and regional cable broadcast corporations in the United States. This yielded a total sampling frame of 2128 weathercasters. Weathercaster respondents were located throughout the United States, though more heavily based in large cities and on the eastern seaboard (Fig. 1).

An online survey was distributed to these 2128 verified weathercasters using Qualtrics software on 20 January 2015. This survey was left open for a ''field period'' between 20 January and 23 February. To encourage responses, the survey team sent five reminder emails (approximately one per week) to all nonrespondents until the close of the period. A total of 478 weathercasters responded to at least one question on the survey, yielding a response rate of 22.5%. The focus of this paper, however, is on those 417 weathercasters who responded that they believed climate change (as formally defined by the American Meteorological Society) was occurring—87.4% of the total sample.

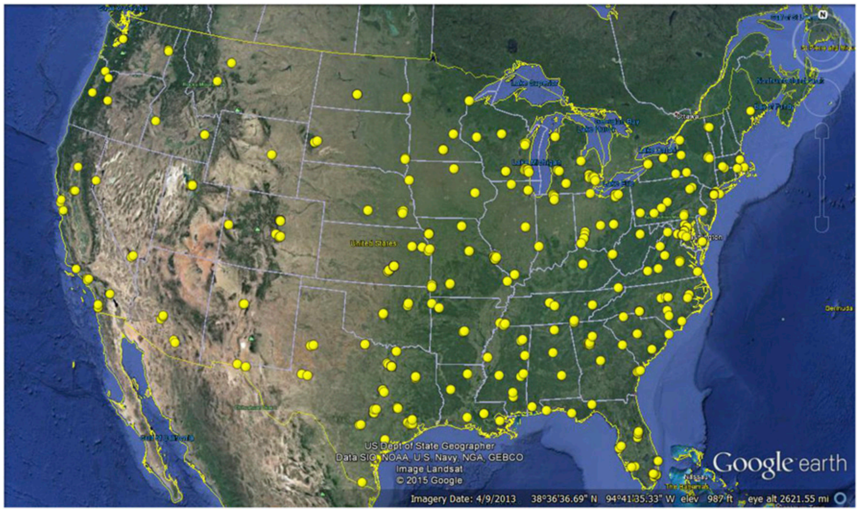

FIG. 1. Distribution of weathercaster respondents for 2015 National Survey of Weathercasters.

c. Missing data

Of the 417 weathercasters selected for analysis, 378 finished the survey. Data were further cleaned by excluding respondents who failed to answer at least one-third of the survey questions; this yielded a final sample size of 328. For these responses, we used "Hotdeck" imputation (Myers 2011) to impute any missing data. This method replaces missing values by assigning the most likely response based on a randomly permuted data file based on U.S. geographic region. Geographic regions were stratified according to the National Climate Assessment designations of Great Plains, Midwest, Northeast, Northwest, Southeast, and Southwest. The purpose of this method is to improve inferences about the data population as a whole when using statistical techniques (Little and Rubin 2002). All analysis was performed using the IBM Statistical Package for Social Sciences (SPSS) software.

d. Dependent variables

To assess whether TV weathercasters reported on or conducted educational outreach regarding the local impacts of climate change, all survey participants were asked, "Over the past 12 months, did you use the following channels to inform your viewers, or other people in your community, about the local impacts of climate change?" Answers to this question were coded as 0 (no/do not know) or 1 (yes). This question separately assessed four communication channels weathercasters use most in their jobs: 1) on-air television reporting, 2) network-maintained website content, 3) social media outreach, and 4) community event appearances.

e. Independent variables

A range of independent variables was assessed in four topical categories: 1) demographics, 2) views about climate change, 3) views about reporting on climate change, and 4) use of climate change reporting resources (see Table A1).

1) DEMOGRAPHICS

This independent variable group comprises three metrics: age, gender, and professional certification. Table 1 describes the variable coding values based on the respective categories.

TABLE 1. Coding of demographic-independent variables.

Age		Gender		Professional certification[a]	
Code	Description	Code	Description	Code	Description
1	18 to 29	0	Male	0	No seal
2	30 to 39	1	Female	1	AMS seal
3	40 to 49			1	NWA seal
4	50 to 59			2	AMS CBM seal
5	60 to 69				
6	70+				

[a] In the event more than one seal was selected, the code assigned to the respondent was the code for highest seal of attainment obtained.

2) VIEWS ABOUT CLIMATE CHANGE

This independent variable group assessed the respondents' personal opinions about climate change regarding six topical areas (Table A1). All coded response categories can be seen in Table A2.

1) "Climate change belief certainty" was measured by asking respondents who believed that climate change had occurred over the past 50 years how certain they were in their beliefs.
2) "Human causation" sought to determine how much a respondent felt that climate change was attributable to human activities.
3) "Perceived local impact" was assessed to understand weathercasters' perceptions of the impact of climate change on their local area in both the past (past 50 years) and in the future (next 50 years). For each question, respondents were asked about impacts on weather, water resources, transportation, agriculture, and human health subjects. Separate factor analyses (maximum likelihood, varimax rotation, Eigen value > 1) were performed on the responses for perceived impacts over the past 50 years (past) and the next 50 years (future). The factor analysis of past local impacts data yielded two unique factors: "weather" ($\alpha = 0.733$), which included variables of average temperature, heat waves, droughts, and crops harmed by extreme weather; and "disruption" ($\alpha = 0.682$), which included variables of heavy precipitation, flooding, transportation disruptions due to extreme weather, and people injured, sickened, or killed by extreme weather. Future climate change impact variables all loaded on a single factor ($\alpha = 0.842$).
4) "Perceived mitigation potential" was assessed by asking respondents how much they felt mitigation measures could help in avoiding future climate change.
5) "Perceived adaptation potential" was assessed by asking respondents how much they felt adaptation could protect humans from climate change impacts. Adaptation assessment was conducted across several topical areas: transportation systems, freshwater supplies, homes and other buildings, agriculture, and people's health. A factor analysis for this variable (maximum likelihood, varimax rotation, Eigen value > 1) showed that all variables loaded on a single factor ($\alpha = 0.924$), and no further differentiation based on topical area was needed.
6) "Perceived scientific consensus" was determined by asking respondents, "To the best of your knowledge, what percentage of climate scientists think that human-caused climate change is happening?" Responses were collected through free-response numerical input.

3) VIEWS ABOUT REPORTING ON CLIMATE CHANGE

This independent variable grouping comprises three topical areas (Table A1). All coded responses can be seen in Table A2.

1) "Interest in climate change reporting" was assessed by asking respondents two questions to assess interest in climate change reporting. First, "Are you personally interested in presenting the local impacts of climate change?" Second, "As a TV weathercaster, is it appropriate for me to present the science of climate change...[on-air/online/in social media/at community events]?" Values from these two questions were combined, and the mean values were calculated to serve as the dependent variables.
2) "Range of climate change reporting interest" was assessed by asking respondents about their interest in a variety of environmental topics. An index score was created as a result of the number of "yes" responses to the following topics: impact on local wildlife, drought and water shortages, wildfires, extreme heat events, impact on air quality, extreme precipitation and/or flooding, sea level rise/storm surge, impact of crop and livestock production, hurricanes, and impact on human health.
3) "Obstacles to climate change reporting" assess perceived obstacles when reporting on climate change. We developed a list of nine potential obstacles to reporting on climate change. Factor analysis (maximum likelihood, varimax rotation, Eigen value > 1) yielded two factors: "resource" obstacles ($\alpha = 0.886$) (lack of time in the newscast, lack of time for field reporting, lack of training in climate science, lack of access to trusted scientific information, lack of access to appropriate visuals/graphics, and scientific uncertainty about climate change); and "social support" obstacles ($\alpha = 0.852$) (lack of news management support, lack of general management support, and lack of viewer support).

4) USE OF CLIMATE CHANGE REPORTING RESOURCES

This independent variable grouping assessed the frequency with which respondents used common climate change reporting resources. This was done by reviewing participation within the *Climate Matters* program and

TABLE 2. Use of climate change reporting resources.

Use of climate change reporting resources		
Q1: "Do you currently receive *Climate Matters* materials (via email) from Climate Central?"		
Q2: "How useful to you was the National Climate Assessment?"		
Code	Response Q1	Response Q2
0	No/not sure	Not at all useful/not sure
1	Yes	A little bit useful
2	—	Moderately useful
3	—	Very useful

assessing weathercasters' perceived usefulness of the National Climate Assessment (Table 2).

f. Analysis

To identify attributes that predict weathercasters' reporting on climate change, binary logistic regression models for each of four commonly used communication channels (Table 3) were conducted. We also calculated the probability of reporting on climate change on-air across independent variables to better contextualize differences across response ranges. Probabilities were determined based on the mean value for all predictors, compared with the coefficient mean relative to the minimum and maximum respondent outcomes for a given question response set.

g. Results

The rates of past-year reporting on local impacts of climate change in each of the four channels were 34% on-air, 35% online (station website), 45% in social media, and 45% at community events.

In total, the models predicted between 42% and 49% of the variance in the four dependent measures, although only five of the independent variables were significantly associated with the reporting behaviors.

Interest in climate change reporting was positively related to reporting behavior in all four communication channels: on-air ($\beta = 0.933$, $p < 0.001$), station website ($\beta = 1.368$, $p < 0.001$), social media ($\beta = 1.629$, $p < 0.001$), and community events ($\beta = 1.215$, $p < 0.001$).

Participating in *Climate Matters* was also positively associated with all four communication channels: on-air ($\beta = 1.006$, $p < 0.001$), station website ($\beta = 1.171$, $p < 0.001$), social media ($\beta = 1.167$, $p < 0.001$), and community events ($\beta = 1.043$, $p < 0.01$).

A weathercaster's age was positively associated with climate change reporting in three of the four communication channels: on-air ($\beta = 0.301$, $p < 0.05$), on their station's website ($\beta = 0.441$, $p < 0.001$), and at community events ($\beta = 0.385$, $p < 0.001$). This relationship was negative, but nonsignificant, for reporting in social media ($\beta = -0.144$, $p =$ NS).

Range of climate change reporting interest was positively associated with reporting on-air ($\beta = 0.180$, $p < 0.05$) and on the station website ($\beta = 1.37$, $p < 0.05$), but not in social media ($\beta = -0.009$, $p =$ NS) or community events ($\beta = 0.045$, $p =$NS).

The perceived past local impact of weather was positively associated with climate change reporting on the station website ($\beta = 0.701$, $p < 0.05$), but not in the other three channels: on-air ($\beta = 0.310$, $p =$ NS), social media ($\beta = 0.310$, $p =$ NS), and community events ($\beta = 0.215$, $p =$ NS).

No other independent variables were significantly associated with climate change reporting.

We found statistically significant reporting probabilities across several variables, including range of reporting interest, *Climate Matters* participation, National Climate Assessment usefulness, age, and interest in climate change reporting (Fig. 2).

Weathercasters who had a higher range of reporting interest, compared to those with low ranges of reporting interests, were shown to be as much as 32% more likely to report on climate change on-air. Interest in climate change reporting also had the potential to increase reporting likelihood by 62%. Participation in the *Climate Matters* program increased the probability of reporting climate change information on-air by 22%, and perceived usefulness of the National Climate Assessment raised the probability of reporting by as much as 15%. Age was another factor, as the oldest (and likely the most experienced) weathercasters were as much as 25% more likely to report on climate change on-air as those junior in the profession.

h. Post-hoc examination of interest in reporting on the local impacts of climate change

Because of the strong positive relationship between interest in reporting on climate change and reporting on climate change in all four communication channels ($p < 0.001$), we subsequently conducted a linear regression model (Table 4) where "interest in climate change reporting" served as the dependent variable. This was done to assess the predictors of interest in reporting local impacts of climate change.

TABLE 3. Results of logistic regression to identify predictors of reporting on the local impacts of climate change. Note: standard errors reported beneath coefficients

		Binary logistic regression predicting activity			
		On-air	Station website	Social media	Community events
Demographics	Age	0.301[c]	0.441[a]	−0.144	0.385[a]
		0.125	0.129	0.124	0.121
	Gender	0.426	0.204	0.325	−0.48
		0.383	0.411	0.379	0.367
	Professional certification	0.06	−0.226	0.336[d]	−0.136
		0.206	0.211	0.202	0.196
Views about climate change	Human causation	0.054	−0.189	−0.167	−0.187
		0.196	0.195	0.186	0.18
	Climate change belief certainty	0.203	0.212	0.315	−0.243
		0.232	0.243	0.223	0.214
	Historical perceived local impact: weather	0.31	0.701[c]	0.31	0.215
		0.315	0.326	0.313	0.306
	Historical perceived local impact: disruption	0.164	0.258	−0.048	−0.236
		0.383	0.395	0.369	0.376
	Future perceived local impact	−0.148	−0.377	−0.036	0.108
		0.48	0.498	0.479	0.476
	Perceived mitigation potential	−0.131	−0.087	−0.149	−0.252
		0.21	0.215	0.209	0.204
	Perceived adaptation potential	−0.038	0.035	−0.203	−0.317[d]
		0.175	0.181	0.182	0.169
	Perceived scientific consensus	−0.012	0.003	0	0.004
		0.009	0.009	0.008	0.008
Views about reporting on climate change	Range of climate change reporting interest	0.180[c]	0.144[c]	−0.009	0.045
		0.073	0.073	0.065	0.063
	Interest in climate change reporting	0.933[a]	1.368[a]	1.629[a]	1.215[a]
		0.186	0.24	0.235	0.204
	Obstacles to climate change reporting: resources	0.396	0.766	−0.729	0.101
		0.635	0.648	0.626	0.582
	Obstacles to climate change reporting: social support	−0.729	−0.523	−0.463	0.911[d]
		0.573	0.566	0.572	0.554
Use of climate change reporting resources	*Climate Matters* participation	1.006[a]	1.171[a]	1.167[a]	1.043[b]
		0.335	0.352	0.357	0.338
	National Climate Assessment usefulness	0.241[d]	0.095	0.169	0.227[d]
		0.142	0.144	0.141	0.137
	Nagelkerke R square	0.443	0.493	0.484	0.422

[a] $p < 0.001$
[b] $p < 0.01$
[c] $p < 0.05$
[d] $p < 0.10$

Independent variables in this model differ slightly from those used in the logistic model predicting use of climate change education materials. In this model, we excluded "obstacles to climate change reporting," "range of climate change reporting interest," and "*Climate Matters* participation." These variables were seen as either external to a weathercaster's personal interest in the topic of climate change or too coincidental in meaning to the dependent variable to yield substantive findings.

In total, the models predicted between 30% and 37% of the variance in the four dependent measures, although only six of the independent variables were significantly associated with interest in climate change reporting.

Climate change belief certainty was positively related to interest in reporting on climate change for each channel of communication: on-air ($\beta = 0.344$, $p < 0.001$), station website ($\beta = 0.325$, $p < 0.001$), social media ($\beta = 0.360$, $p < 0.001$), and community events ($\beta = 0.337$, $p < 0.001$).

Perception that humans were a leading contributor to climate change ("human causation") was positively

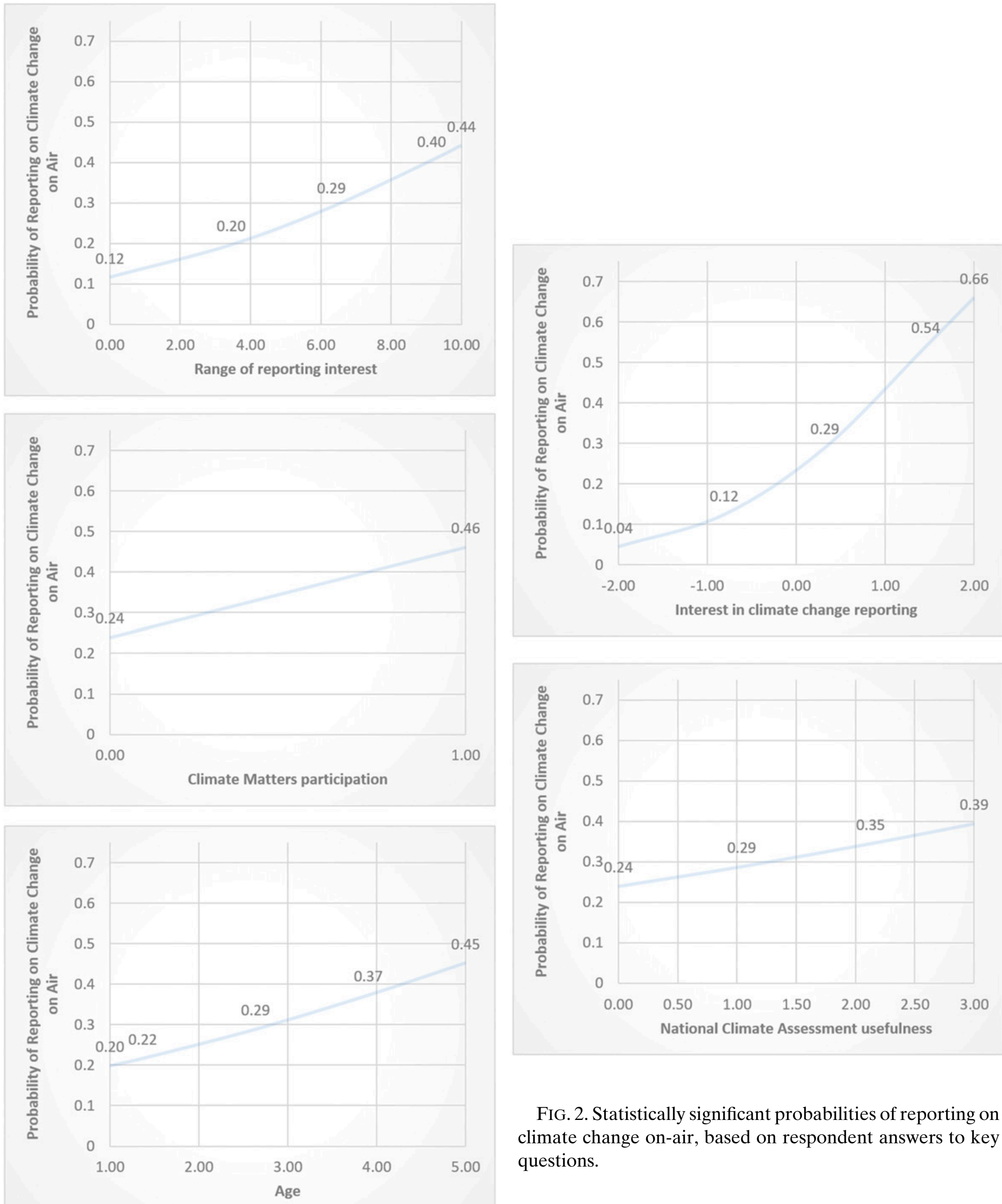

FIG. 2. Statistically significant probabilities of reporting on climate change on-air, based on respondent answers to key questions.

related to interest in climate change reporting for on-air ($\beta = 0.226$, $p < 0.001$), station website ($\beta = 0.244$, $p < 0.001$), and social media ($\beta = 0.153$, $p < 0.05$), but not for community events ($\beta = 0.073$, $p = 0.123$).

National Climate Assessment usefulness was positively related to interest in reporting on climate change for all four communication channels: on-air ($\beta = 0.134$, $p < 0.05$), station website ($\beta = 0.140$, $p < 0.05$), social media ($\beta = 0.181$, $p < 0.001$), and community events ($\beta = 0.154$, $p < 0.01$).

Future perceived local impact was positively related to interest in reporting on climate change for station website ($\beta = 0.303$, $p < 0.10$), social media ($\beta = 0.374$, $p < 0.05$), and community events

TABLE 4. Results of linear regression to identify predictors of weathercasters' interest in reporting climate change. Note: Standard errors reported beneath coefficients

Linear regression predicting "interest"					
		On-air	Station website	Social media	Community events
Demographics	Age	0.157[a]	0.061	0.060	0.059
		0.044	0.041	0.040	0.042
	Gender	−0.175	−0.398[b]	−0.289[c]	−0.429[a]
		0.128	0.119	0.116	0.122
	Professional certification	−0.065	−0.049	−0.085	−0.087
		0.071	0.067	0.065	0.068
Views about climate change	Human causation	0.226[a]	0.244[a]	0.153[c]	0.123[d]
		0.067	0.063	0.061	0.064
	Climate change belief certainty	0.344[a]	0.325[a]	0.360[a]	0.337[a]
		0.076	0.071	0.070	0.073
	Historical perceived local impact: weather	0.058	0.012	−0.055	0
		0.119	0.111	0.108	0.113
	Historical perceived local impact: disruption	−0.003	0.018	−0.049	−0.014
		0.139	0.130	0.127	0.133
	Future perceived local impact	0.344	0.303[d]	0.374[c]	0.386[c]
		0.179	0.168	0.163	0.171
	Perceived mitigation potential	0.016	−0.028	−0.026	−0.043
		0.071	0.067	0.065	0.068
	Perceived adaptation potential	0.070	0.045	0.086	0.042
		0.062	0.058	0.057	0.059
	Perceived scientific consensus	−0.003	−0.002	0	−0.002
		0.003	0.003	0.003	0.003
Use of climate change reporting resources	National Climate Assessment usefulness	0.134[c]	0.140[c]	0.181[a]	0.154[b]
		0.051	0.048	0.047	0.049
	R square	0.355	0.353	0.298	0.374

[a] $p < 0.001$
[b] $p < 0.01$
[c] $p < 0.05$
[d] $p < 0.10$

($\beta = 0.386$, $p < 0.05$), but was not significant for on-air ($\beta = 0.344$, $p =$ NS).

Gender was negatively associated and statistically significant for station website ($\beta = -0.398$, $p < 0.01$), social media ($\beta = -0.289$, $p = 0.05$), and community events ($\beta = -0.429$, $p < 0.001$), but was not significant for on-air ($\beta = -0.175$, $p =$ NS).

Age was positively associated with interest in reporting on climate change for on-air ($\beta = 0.157$, $p < 0.001$) but it was not a statistically significant factor for station website ($\beta = 0.061$, $p =$ NS), social media ($\beta = 0.060$, $p =$ NS), and community events ($\beta = 0.059$, $p =$ NS).

3. Discussion

The aim of the current research was to identify the attributes that best predict weathercasters who are most likely to be motivated and ready to educate the general public on climate change science.

a. Overview of key results

Overall, we found four important findings as a result of the research. First, we found that television weathercasters who showed personal interest in reporting on climate change topics were more likely to discuss climate change with their viewership in all forms of outreach communication. Second, upon learning that this personal interest is a leading driver to subsequently reporting on climate change, we looked to answer the following question: What drives this interest? In doing so, we found two major factors that are associated with a weathercaster's interest in reporting on climate change: 1) their belief certainty that climate change is occurring and 2) the degree to which they felt the 2014 National Climate Assessment was useful to them. Third, negatively influencing factors, such as barriers (both real and perceived), need to be considered to capture a more complete picture of the reality of climate change reporting—weathercasters who are personally interested in reporting on climate change still cite barriers to their reporting. Fourth, we found that a weathercaster's

TABLE A1. Overview of independent variables with descriptive statistics.

Independent variables		
General categorization	Topic	Descriptive statistics (coded values)
Demographics	Demographic	Mean: 2.64 Standard deviation: 1.27 Male: 76.8% Female: 23.2%
	Professional certification	0: 31.7% 1: 35.4% 2: 32.9%
Views about climate change	Climate change belief certainty	Mean: 3.28 Standard deviation: 0.73
	Human causation	Mean: 3.34 Standard deviation: 1.15
	Perceived local impact	Mean: 0.570 Standard deviation: 0.546
	Perceived mitigation potential	Mean: 2.38 Standard deviation: 0.92
	Perceived adaptation potential	Mean: 2.60 Standard deviation: 1.01
	Perceived scientific consensus	Mean: 79.55 Standard deviation: 20.29
Views about reporting on climate change	Interest in climate change reporting	Mean: 2.68 Standard deviation: 1.29
	Range of climate change reporting interest	Mean: 6.30 Standard deviation: 2.85
	Obstacles to climate change reporting	Mean: 0.272 Standard deviation: 0.318
Use of climate change reporting resources	*Climate Matters* participation	Mean: 0.259 Standard deviation: 0.439
	National Climate Assessment usefulness	Mean: 1.04 Standard deviation: 1.09

age is a significant predictor of climate change reporting, where older weathercasters are more active in reporting on climate change.

b. *Results in context*

Our finding that weathercasters who had higher degrees of certainty that climate change was occurring were more interested in reporting on climate change is consistent with research by Peters-Burton et al. (2014). Their research found weathercasters who indicated they felt climate change was human caused subsequently perceived it to be a part of their professional job duties to use informal education to discuss the human contribution of climate change. Additionally, weathercasters who perceived the NCA to be useful showed more interest in reporting on climate change across all four modes of communication. It would appear that those who have broad scientific interests and actively seek extended learning opportunities through peer-reviewed scientific works, such as the NCA, may be more inclined to share that information with others. Indeed, those weathercasters who embrace the "station scientist" role popularized and promoted by the American Meteorological Society (Henson 2010) and/or the more recent "weathercaster as local climate change reporter" role (Woods Placky et al. 2016) may be acting proactively to engage their viewership in scientific outreach. The extent to which weathercasters felt the findings of the National Climate Assessment were useful to them also predicted weathercasters' interest in local climate change reporting.

Although there are positive influences on reporting and interest in climate change outreach, these must be balanced with a review of negative influencers—namely, barriers. Wilson (2009) found that obstacles, such as a lack of time for field reporting and a lack of station support, prevented weathercasters from discussing climate change. In addition, Maibach et al. (2011) identified barriers, such as lack of time to produce and air stories, lack of access to broadcast-ready graphics, lack of access to climate scientists, lack of support by viewers and managers, and lack of viewer interest. Woods Placky et al. (2016) reported that

TABLE A2. Views about climate change (coded responses).

Climate change belief certainty

"How sure are you that climate change is happening?"

Code	Response
1	Not at all sure
2	Somewhat sure
3	Very sure
4	Extremely sure

Human causation

"Do you think that the climate change that has occurred over the past 50 years has been caused __?"

Code	Response
−2	Largely or entirely by natural events
−1	Mostly by natural events
0	More or less equally by human activity and natural events/do not know
1	Mostly by human activity
2	Largely or entirely by human activity

Perceived local impact

"How much impact, if any, has [will] climate change had [have] on your local area over the past [next] 50 years?"

Code	Response
−2	Decrease[d] significantly
−1	Decrease[d] marginally
0	Stay[ed] about the same/do not know
1	Increase[d] marginally
2	Increase[d] significantly

Perceived mitigation potential

"Over the next 50 years, to what extent can additional climate change be avoided if mitigation measures are taken worldwide (such as substantially reducing emissions of carbon dioxide and other greenhouse gases)?"

Code	Response
0	I do not think there will be additional climate change.
1	Almost no additional climate change can be averted.
2	A small amount of additional climate change can be averted.
3	A moderate amount of additional climate change can be averted.
4	A large amount of additional climate change can be averted.
5	Almost all additional climate change can be averted.
No code	Do not know

Perceived adaptation potential

"Over the next 50 years, in the United States, to what extent can the following be protected from harmful impacts of climate change, if adaptation measures are taken (i.e., actions to reduce vulnerability)?"

Code	Response
0	I do not think there will be any harm.
1	A small amount of the potential harm can be prevented.
2	A moderate amount of the potential harm can be prevented.
3	A large amount of the potential harm can be prevented.
4	Almost all of the potential harm can be prevented.
No code	Do not know

weathercasters experience barriers, such as lack of access to high-quality content and limited access to climate scientists for consulting and news interviews.

In this research, we found that *Climate Matters* participation was a significant factor in predicting whether a weathercaster engaged in reporting climate change information across all channels of communication ($p < 0.001$ for on-air, station website, social media; $p < 0.01$ for community events). Simply, weathercasters who received materials from the *Climate Matters* program had higher likelihoods of reporting climate change information to their viewership. Further, controlling for all other variables in the model, weathercasters who participate in the *Climate Matters* program were approximately twice as likely to report about climate change on air as weathercasters who do not (46% vs 24%). Given the purpose of the *Climate Matters* program, our findings are important because they indicate that weathercasters who received *Climate Matters* materials report on climate change more often than those who do not receive the materials. In other words, *Climate Matters* appears to stimulate reporting on climate change by TV weathercasters. This may further indicate that those weathercasters experienced fewer and/or lessened barriers, which, consequently, gave them a greater ability to discuss climate change with their viewers.

The positive relationship we found between a weathercaster's age and their reporting on climate change is supported with a Poliakoff and Webb (2007) study that found that scientists are less likely to participate in public engagement if they lack personal experience in public engagement and media skills. Among TV weathercasters who are often designated as a network's scientist, it is plausible that less experienced/younger television weathercasters may feel a lack of experience or training that subsequently discourages them from participating in climate change reporting. More junior weathercasters might also lack both the time for presentation and the authority to guide the types of information that are released to the public. Worth further research consideration are the perceptions of the "allowable limits" less-senior weathercasters may have within their organization.

We assessed varying communication channels—on-air, online, social media, and community events—to determine any nuances in our findings. Despite statistical significance across all channels of communication, on-air reporting showed weaker associations between personal interest and reporting outcomes. This finding is consistent with previous surveys (Maibach et al. 2011). It is possible that concern about negative viewer reactions, barriers such as the lack of available time, and tighter news management control of on-air information could be driving these results.

TABLE A3. Views about reporting on climate change (coded responses).

Interest in climate change reporting

Q1: "Are you personally interested in presenting the local impacts of climate change?"
Q2: "As a TV weathercaster, it is appropriate for me to present the science of climate change. . .[on-air/online/in social media/at community events]?"

Code	Response Q1	Response Q2
−2	Definitely not	Strongly disagree
−1	Probably not	Disagree
0	Not sure	Neither agree or disagree
1	Probably yes	Agree
2	Definitely yes	Strongly agree

Range of climate change reporting interest

"Which, if any, of the following local climate change stories would you be interested in reporting on?"

Code	Response
0	No/not applicable
1	Yes

Obstacles to climate change reporting

"How important are the following obstacles for you currently in reporting on climate change?"

Code	Response
0	Not an obstacle
0.5	A somewhat important obstacle
1	A very important obstacle

Findings of this study provide interesting questions for future research that investigate the links between weathercaster attributes and climate change reporting behaviors. Awareness of local impacts due to climate change over the past 50 years was not a significant predictor of weathercasters' reporting on climate change. Future research should first question the weathercaster's interpretation of local impacts due to climate change and then assess, based on those beliefs, their reporting tendencies. Variables concerning mitigation or adaptation as they relate to climate change were not found to be statistically significant predictors of reporting tendency. A possible research question to explore this finding is asking if weathercasters feel that mitigation or adaptation concerns are within their job purview. Both variables that aimed to capture potential obstacles were not statistically significant. This finding warrants future in-depth research, as obstacles seem to be important factors that may present disincentives for presenting climate change materials. Beyond modeling, the use of a mixed-methods approach utilizing in-depth interviews may provide additional context to barriers experienced by weathercasters.

4. Conclusions

This paper explored attributes of weathercasters who are more actively embracing the role of local climate change educator. Television weathercasters work at a key junction between climate science and the public. With public trust, strong science communication skills, and more access to the public than most climate scientists, weathercasters can serve as leaders in efforts to educate the public about the local impacts of global climate change.

Continued engagement between members of the climate science and broadcast meteorology community, and continued efforts to support weathercasters as local climate educators—through *Climate Matters*, the National Climate Assessment process, and other means—appear to be promising ways of assisting the broadcast meteorology community in fulfilling its fullest potential as an important source of climate change information for the public. Facilitating better public understanding of climate change and its harmful impacts on society today can promote proactive behaviors that will help society mitigate and adapt to climate change harms in the future.

Acknowledgments. This research was supported by a grant from the National Science Foundation (Award DRL-1713450).

APPENDIX

Independent Variables and Coding Methodology

Appendix includes Tables A1, A2, and A3.

REFERENCES

Abroms, L. C., and E. W. Maibach, 2008: The effectiveness of mass communication to change public behavior. *Annu. Rev. Public Health*, **29**, 219–234, https://doi.org/10.1146/annurev.publhealth.29.020907.090824.

Akerlof, K., E. W. Maibach, D. Fitzgerald, A. Y. Cedeno, and A. Neuman, 2013: Do people "personally experience" global warming, and if so how, and does it matter? *Global Environ. Change*, **23**, 81–91, https://doi.org/10.1016/j.gloenvcha.2012.07.006.

Anderson, A. A., T. A. Myers, E. W. Maibach, H. Cullen, J. Gandy, J. Witte, N. Stenhouse, and A. Leiserowitz, 2013: If they like you, they learn from you: How a brief weathercaster-delivered climate education segment is moderated by viewer evaluations of the weathercaster. *Wea. Climate Soc.*, **5**, 367–377, https://doi.org/10.1175/WCAS-D-12-00051.1.

Berns, G. S., D. Laibson, and G. Loewenstein, 2007: Intertemporal choice—Toward an integrative framework. *Trends Cognit. Sci.*, **11**, 482–488, https://doi.org/10.1016/j.tics.2007.08.011.

Bloodhart, B., E. Maibach, T. Myers, and X. Zhao, 2015: Local climate experts: The influence of local TV weather information on climate change perceptions. *PLOS ONE*, **10**, e0141526, https://doi.org/10.1371/journal.pone.0141526.

Borick, C. P., and B. G. Rabe, 2014: Weather or not? Examining the impact of meteorological conditions on public opinion regarding global warming. *Wea. Climate Soc.*, **6**, 413–424, https://doi.org/10.1175/WCAS-D-13-00042.1.

Ding, D., E. W. Maibach, X. Zhao, C. Roser-Renouf, and A. Leiserowitz, 2011: Support for climate policy and societal action are linked to perceptions about scientific agreement. *Nat. Climate Change*, **1**, 462–466, https://doi.org/10.1038/nclimate1295.

Espinoza, S., A. Posegate, K. Rowan, K. Wilson, X. Zhao, and E. Maibach, 2012: Television weathercasters as environmental science communicators. *Environmental Leadership: A Reference Handbook*, D. R. Gallagher, Ed., SAGE Publications, 411–419, https://doi.org/10.4135/9781452218601.n44.

Haden, V., M. Niles, M. Lubell, J. Perlman, and L. Jackson, 2012: Global and local concerns: What attitudes and beliefs motivate farmers to mitigate and adapt to climate change? *PLOS ONE*, **7**, e52882, https://doi.org/10.1371/journal.pone.0052882.

Hart, P. S., and E. C. Nisbet, 2011: Boomerang effects in science communication: How motivated reasoning and identity cues amplify opinion polarization about climate mitigation policies. *Commun. Res.*, **39**, 701–723, https://doi.org/10.1177/0093650211416646.

Henson, R., 2010: *Weather on the Air: A History of Broadcast Meteorology*. Amer. Meteor. Soc., 241 pp.

IPCC, 2014: *Climate Change 2014: Synthesis Report.* R.K. Pachauri and L.A. Meyer, Eds., IPCC, 151 pp., https://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full.pdf.

Kahan, D., 2013: Ideology, motivated reasoning, and cognitive reflection: An experimental study. *Judgment Decis. Making*, **8**, 407–424.

Kahneman, D., 2011: *Thinking, Fast and Slow*. Macmillan, 499 pp.

Kunda, Z., 1990: The case for motivated reasoning. *Psychol. Bull.*, **108**, 480–498, https://doi.org/10.1037/0033-2909.108.3.480.

Leiserowitz, A., 2005: American risk perceptions: Is climate change dangerous? *Risk Anal.*, **25**, 1433–1442, https://doi.org/10.1111/j.1540-6261.2005.00690.x.

——, E. Maibach, C. Roser-Renouf, G. Feinberg, and S. Rosenthal, 2016: Climate change in the American mind: March 2016. Yale University and George Mason University Climate Change Communication Rep., 51 pp., http://climatecommunication.yale.edu/wp-content/uploads/2016/06/Climate-Change-American-Mind-March-2016-FINAL.pdf.

Little, R. J. A., and D. B. Rubin, 2002: *Statistical Analysis with Missing Data*. 2nd ed. Wiley, 408 pp.

Maibach, E., and Coauthors, 2011: A national survey of television meteorologists about climate change education. George Mason University Center for Climate Change Communication Rep., 53 pp., https://www.climatechangecommunication.org/wp-content/uploads/2016/03/June-2011-A-National-Survey-of-Television-Meterologists-about-Climate-Change-Education.pdf.

——, and Coauthors, 2015: A national survey of broadcast meteorologists about climate change: Initial findings. George Mason University Center for Climate Change Communication Rep., 68 pp.

——, and Coauthors, 2017: TV weathercasters' views of climate change appear to be rapidly evolving. *Bull. Amer. Meteor. Soc.*, **98**, 2061–2064, https://doi.org/10.1175/BAMS-D-15-00206.1.

McCright, A., S. Marquart-Pyatt, R. Shwom, S. Brechin, and S. Allen, 2016: Ideology, capitalism, and climate: Explaining public views about climate change in the United States. *Energy Res. Soc. Sci.*, **21**, 180–189, https://doi.org/10.1016/j.erss.2016.08.003.

Melillo, J. M., T. C. Richmond, and G. W. Yohe, Eds., 2014: *Climate Change Impacts in the United States: The Third National Climate Assessment*. U.S. Global Change Research Program, 841 pp., https://doi.org/10.7930/J0Z31WJ2.

Myers, T. A., 2011: Goodbye, listwise deletion: Presenting hot deck imputation as an easy and effective tool for handling missing data. *Commun. Methods Meas.*, **5**, 297–310, https://doi.org/10.1080/19312458.2011.624490.

——, E. W. Maibach, C. Roser-Renouf, K. Akerlof, and A. A. Leiserowitz, 2013: The relationship between personal experience and belief in the reality of global warming. *Nat. Climate Change*, **3**, 343–347, https://doi.org/10.1038/nclimate1754.

Perkins, D., E. Maibach, N. Gardiner, J. Witte, B. Ward, B. Woods Placky, K. Seitter, and H. Cullen, 2017: Most Americans want to learn more about climate change. *Bull. Amer. Meteor. Soc.*, **98**, 1103–1107, https://doi.org/10.1175/BAMS-D-16-0097.1.

Peters-Burton, E., V. Schweizer, S. Cobb, and E. Maibach, 2014: Weathercaster views on informal climate education: Similarities and differences according to climate change attitudes. *J. Geosci. Educ.*, **62**, 431–444, https://doi.org/10.5408/13-046.1.

Poliakoff, E., and T. Webb, 2007: What factors predict scientists' intentions to participate in public engagement of science activities? *Sci. Commun.*, **29**, 242–263, https://doi.org/10.1177/1075547007308009.

Ranney, M. A., and D. Clark, 2016: Climate change conceptual change: Scientific information can transform attitudes. *Top. Cognit. Sci.*, **8**, 49–75, https://doi.org/10.1111/tops.12187.

Rudman, L., M. McLean, and M. Bunzl, 2013: When truth is personally inconvenient, attitudes change: The impact of extreme weather on implicit support for green politicians and explicit climate-change beliefs. *Psychol. Sci.*, **24**, 2290–2296, https://doi.org/10.1177/0956797613492775.

Scannell, L., and R. Gifford, 2013: Personally relevant climate change: The role of place attachment and local versus global message framing in engagement. *Environ. Behav.*, **45**, 60–85, https://doi.org/10.1177/0013916511421196.

Spence, A., W. Poortinga, and N. Pidgeon, 2012: The psychological distance of climate change. *Risk Anal.*, **32**, 957–972, https://doi.org/10.1111/j.1539-6924.2011.01695.x.

van der Linden, S., 2015: The social-psychological determinants of climate change risk perceptions: Towards a comprehensive model. *J. Environ. Psychol.*, **41**, 112–124, https://doi.org/10.1016/j.jenvp.2014.11.012.

——, E. Maibach, and A. Leiserowitz, 2015: Improving public engagement with climate change: Five ''best practice'' insights from psychological science. *Perspect. Psychol. Sci.*, **10**, 758–763, https://doi.org/10.1177/1745691615598516.

van Vugt, M., V. Griskevicius, and P. W. Schultz, 2014: Naturally green: Harnessing Stone Age psychological biases to foster environmental behavior. *Soc. Issues Policy Rev.*, **8**, 1–32, https://doi.org/10.1111/sipr.12000.

Wilson, K., 2009: Opportunities and obstacles for television weathercasters to report on climate change. *Bull. Amer. Meteor. Soc.*, **90**, 1457–1465, https://doi.org/10.1175/2009BAMS2947.1.

Woods Placky, B., E. Maibach, J. Witte, B. Ward, K. Seitter, N. Gardiner, D. Herring, and H. Cullen, 2016: *Climate Matters*: A comprehensive educational resource program for broadcast meteorologists. *Bull. Amer. Meteor. Soc.*, **97**, 709–712, https://doi.org/10.1175/BAMS-D-14-00235.1.

Zhao, X., and Coauthors, 2014: Climate change education through TV weathercasts: Results of a field experiment. *Bull. Amer. Meteor. Soc.*, **95**, 117–130, https://doi.org/10.1175/BAMS-D-12-00144.1.