PUBLIC WILL, ACTIVISM AND CLIMATE CHANGE

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PUBLIC WILL, ACTIVISM AND CLIMATE CHANGE

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EDITORIAL
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Editorial: Public Will, Activism and Climate Change

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Editorial on the Research Topic

Public Will, Activism and Climate Change

The temperature goals set in the Paris climate accord are likely to become unattainable if global emissions of greenhouse gases continue to rise after 2020, according to a June 2017 commentary published in Nature by some of the world's leading authorities. To avoid the most serious impacts of climate change, the global community must dramatically reduce its use of fossil fuels within the very near future.

While individual behavior changes can reduce emissions, their contributions are insufficient in the absence of large-scale, systemic change. For emissions to rapidly fall, the policies, regulations, and technologies that shape our energy use must change in ways that promote sustainable lifestyles and remove existing barriers to sustainable actions. These changes are more likely to be made if citizens and consumers demand them. Thus, collective action by citizens and consumers is sorely needed to prod legislators and corporations into enacting the policies and practices that can stabilize the climate.

A majority of Americans—and people in many other nations—tell pollsters they are concerned about climate change and support mitigation policies, but this support has yet to develop into a social movement with sufficient momentum to move mitigation to the top of the political agenda. Over half of Americans believed global warming should be a high priority for the Congress and president in May 2017, but only 12 percent had actually contacted a legislator in support of mitigation policies over the prior year.

There are signs that activism may be growing, however. In the 2 weeks following the Nov. 2016 election, 11,000 new monthly donors signed up with the Sierra Club—nine times their previous monthly record—and this surge was shared by other environmental groups, like the Environmental Defense Fund and National Resources Defense Council. Meeting attendance and volunteerism have reached new highs, and the April 2017 climate march drew 200,000 protesters in Washington, D.C., as well as tens of thousands in hundreds of sister marches across the country. More recently, school strikes across the globe led by Greta Thunberg and the growing influence of organizations such as the Sunrise Movement and Extinction Rebellion, indicate growing social and political momentum for climate action.

This growth may reflect political changes in Washington, D.C., but it may also reflect innovation within the climate movement itself. The movement is advancing the field of strategic communication, with communities like the Climate Advocacy Lab that foster collaboration between researchers and advocacy groups; tools like the Yale Climate Opinion Maps that permit national polling data to be downscaled to local and regional levels; and sophisticated targeting that permits advocacy groups to effectively identify potential new members.

In this Research Topic, we explore collective action on climate change and the development of public will. The study of mobilization and collective action is interdisciplinary and draws

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on psychology (Van Zomeren et al., 2008), sociology (Jasper, 1998; van Stekelenburg and Klandermans, 2013), and political science (Tilly, 2001; McAdam, 2017). Following Raile and colleagues' definition of public will as "a social system's shared recognition of a particular problem and resolve to address the situation in a particular way through sustained collective action," we feature papers that elucidate the individual, institutional, and social factors that lead people to become active politically on climate change, as well as the barriers that inhibit them from doing so.

What role do individual factors—anger, hope, efficacy and risk perceptions—play in motivating people to engage in collective climate action, and what inhibits them from doing so? Marlon et al. found that constructive hope and doubts are positively correlated with policy support and political engagement, while false hope and fatalistic doubt has the opposite relationship—indicating that focusing on constructive hope and doubts may help mobilize action on climate change. Geiger and Swim explored how gendered impressions of activists predict interest in engaging in activism. Their results point to a potential "dark side" of appearing masculine: perceptions of negative masculine traits were associated with counter-productive activism intent. Ballew et al. found that Latinos are more likely than Whites to report contacting government official about climate change, with stronger risk perceptions best predicting differences in climate change activism between Latinos and Whites.

What impact do different communication framings have on public attitudes and motivation to engage in climate activism? Velautham et al. showed that communicating the local impacts of sea level rise results is an effective way to motivate acceptance and engagement with the issue of climate change. Bloodhart et al. found that while people say they prefer messages framed without emotion, climate change messages framed with negative emotions are preferred over non-emotional messages.

How does the media cover the issue of climate change, and what role does this play in fostering or inhibiting activism? Stecula and Merkley content analyzed news coverage of climate change in influential media sources such as the New York Times and the Wall Street Journal. They found that frames that reduce support for climate action, such as frames emphasizing uncertainty or potential economic harms of climate mitigation policy, have been on the decline. In another study, Swim et al. conducted surveys before and after the 2017 March for Science and People's Climate March. They found that collective efficacy beliefs increased after the marches, with the greatest effect among consumers of conservative news sources (consistent with the fact that conservative media dedicated less coverage than liberal news sources to the marches prior to the marches).

Finally, how might research into collective action inform the strategies employed by environmental groups? Han and Barnett-Loro offer a framework for synthesizing research on movement-building that demonstrates ways to build political power, and identifies areas where additional research is needed. They emphasize the importance of more research into the strategic leadership choices and collective contexts that facilitate movement-building in addition to tactics designed to influence public opinion and individual behaviors.

We asked the contributing authors to specifically identify how they feel their research contributes to social science theory about public will and climate change activism, using Slater and Gleason's (2012) framework. The framework includes nine categories of contributions, most of which have sub-categories: advancing fundamental conceptual issues; extending a theory's range; elucidating causal mechanisms and contingencies; creating a new theory; describing phenomena and generating hypotheses; or comparing, synthesizing or reviewing theories. We encourage the journal to adopt this approach going forward, as we feel it's helpful to readers and to the field at large when authors are clear about how their scholarship has helped to advance the field.

In conclusion, this Research Topic offers valuable insights into the factors influencing people's willingness to engage in collective action, as well as potential barriers. These findings inform possible ways forward for communicators and organizations seeking to build public will and inspire people to become more politically active. It also provides frameworks for further research into this area.

AUTHOR CONTRIBUTIONS

JC wrote first draft of editorial. EM, JK, and NS edited draft to produce final draft.

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Gendered Impressions of Issue Publics as Predictors of Climate Activism

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The present work explores how gendered impressions of *issue publics* (i. e., those who are well-informed about, and have strong opinions about, a given topic) can predict individuals' interest in engaging in activism either consistent with the issue public's position or diametrically opposed to its position. In two studies (Ns = 286, 245) using MTurk samples, we explore the predictors of pro-climate and anti-climate activism based on the impressions of the *climate concerned* (i.e., an issue public supporting action on climate change; Study 1) and the *climate dismissive* (i.e., an issue public opposing action on climate change; Study 2). We relied on two complementary theoretical perspectives to make predictions: (a) *gender role congruity theory*, which suggests that the more perceivers ascribe gendered traits to issue publics that match the perceiver's own gender, the more they will engage in behavior associated with that issue public, and (b) *social value of attributes* which suggests that various components of femininity and masculinity may be universally valued (i.e., positive aspects of masculinity) or devalued (i.e., negative aspects of femininity) by society regardless of perceivers' own gender. Predictions made by *gender role congruity theory* were not supported: men, relative to women, did not prefer engaging in activism when they perceived the relevant issue public to be more masculine and women, relative to men, did not tend to prefer engaging in activism when they perceived the relevant issue public to be more feminine. In contrast, results were consistent with *social value of attributes* predictions suggesting the importance of positive components of masculine impressions of issue publics in promoting activism consistent with the issue public and discouraging activism diametrically opposed to the issue public Yet, results also point to the potential "dark side" of appearing masculine: ascription of negative masculine traits to an issue public was associated with increased willingness to engage in activism diametrically opposed to the issue public and ascribing negative masculine traits to the climate dismissive was associated with, reduced interest in engaging in anti-climate activism. In contrast, ascribing negative feminine traits to an issue public did not uniquely predict interest in engaging in activism either supporting or diametrically opposed to the issue public.

Keywords: stereotypes (social psychology), gender roles and identities, climate change engagement, environmental activism, masculinity—femininity

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GENDERED IMPRESSIONS OF ISSUE PUBLICS AS PREDICTORS OF CLIMATE ACTIVISM

Activism is one means by which the public can express dissatisfaction with those in positions of power. Periods of public activism can end the status quo and catalyze large-scale societal change, or alternatively, stop proposed large-scale change by demonstrating strong public opposition to these changes. Activism can convey public opinion to and put pressure upon decision-makers (Moyer, 1987; McAdam, 2017) and potentially provide new and useful discourses about a topic to the general public (Swim et al., 2014). Yet, the formation of social movements designed to promote (or discourage) action on issues can sometimes be guided by considerations inconsistent with public opinion on the topic itself. For example, despite opinion polls suggesting overwhelming US public support for action to address climate change in the late 2000s (Maibach et al., 2011) and at least a plurality of support for a cap-and-trade bill to reduce carbon emissions (Mufson and Agiesta, 2009), most publicly visible activism surrounding the cap-and-trade bill at that time opposed the bill—led by the conservative Tea Party movement, which strongly opposed action to address climate change (Dineen, 2011).

In the present work we focus on individuals' impressions of *issue publics* (i.e., those who are highly engaged with, and have strong opinions on, an issue) as predictors of interest in engaging in activism. In the context of climate change (the focus of the present work), the two relevant issue publics are the *climate concerned* (i.e., members of the public who are most concerned about climate change and support action to address the issue), and the *climate dismissive* (i.e., members of the public who are least concerned about climate change and oppose action to address the issue). Emerging avenues of research have signaled the relevance of impressions of issue publics in guiding individuals' engagement with issues (Bashir et al., 2013; Geiger, 2018). Here we build off this previous work by explicitly considering the gendered nature of these impressions based on other work suggesting that gender is a core component of impressions of climate change issue publics (Swim and Geiger, 2018), that these gendered impressions can influence decision-making (Swim et al., 2018), and more generally, that gender is a core component of how we evaluate others (e.g., Stangor et al., 1992). Thus, these studies suggested that gendered impressions could meaningfully contribute to collective action decisions. Yet, to date, no work that we are aware of has explicitly examined how gendered impressions of issue publics relate to activist behavior. In the present work, we attempt to synthesize and build upon these previous findings by conducting a systematic investigation into how gendered components of impressions about issue publics can promote or discourage activist behavior.

IMPRESSIONS OF ISSUE PUBLIC GROUPS AND ACTIVISM

Before exploring theoretical frameworks and predictions specifically related to gendered impressions, we first provide a brief general overview of the connection between impressions of issue public groups and interest in engaging in activism. Our reasoning rests in part on the emerging intergroup perspective increasingly used to explain social engagement around the topic of climate change (see Bliuc et al., 2015; Pearson et al., 2016). In this overview section we provide a brief overview of how impressions of specific issue publics could affect individuals' interest in engaging in (a) activism consistent with the issue public and (b) activism diametrically opposed to the issue public.

First, previous research suggests a link between impressions of an issue public and interest in engaging in group-supportive behavior. More specifically, previous research suggests that many hold negative or mixed impressions of activists and the *climate concerned* (i.e., members of the public who are most concerned about climate change and support action to address the issue), with negativity especially pronounced when considering those who engage in collective action behavior (Bashir et al., 2013; Klas et al., 2018; Swim and Geiger, 2018). Similarly, most hold negative impressions of the *climate dismissive* (i.e., members of the public who are least concerned about climate change and oppose action to address the issue; Swim and Geiger, 2018). In turn, ascribing negative traits and not positive traits to an issue public or activist group is associated with reduced interest in affiliating with that group and engaging in behavior associated with that group, including activist behaviors associated with the group (Bashir et al., 2013).

Second, we argue that impressions of issue public groups could also influence interest in engaging in activism diametrically opposed to the group. Based on the use of negative political advertising that paints unfavorable impressions of a candidate to promote behaviors that would oppose a candidate (i.e., voting for the competition), it would appear that negative impressions of issue publics might promote collective action diametrically opposed to an issue public's view on climate change. This possibility is further illustrated by calls for anti-climate activism centered around the supposed evils of Democratic politicians Al Gore or Nancy Pelosi (Barker, 2016; Polman, 2018) and calls for pro-climate activism which reference the power of anti-climate vested interests and billionaires in blocking action on climate change (McCarter, 2014). While research has provided mixed support for the efficacy of negative political advertising on certain outcomes (e.g., memory for ads, affect for the target or sponsor of the advertising, voting intention and behavior; Lau et al., 1999), research on collective identity suggest that it may be effective at promoting oppositional collective action. For example, impressions of an issue public group could promote activism opposed to that group as a means of demonstrating to others that one is not a member of the negatively viewed group (see Hogg et al., 1990). We explore and expand upon these concepts in more detail below.

GENDERED IMPRESSIONS OF ISSUE PUBLIC GROUPS

Research and theory on environmental topics suggest several gender-stereotypical beliefs along which environmental issue publics might be evaluated. On one hand, lay perceptions of

environmental concerns suggest that such concerns might be seen as feminine which contrast with masculine topics, such as business and technology (Swim et al., 2018). Anecdotes include the anthropomorphism of our planet as "Mother" Earth and actions women have historical taken to nurture and care for people by providing healthy physical environments which frame environmental action as consistent with traditional roles for women (Rome, 2006). Indeed, psychological research supports the notion that environmental issues tend to be perceived by the lay public as feminine (Brough et al., 2016; Swim et al., 2018). On the other hand, gendered impressions of environmental activists may also contain masculine components. In contrast to many other forms of pro-environmental behavior, in which women are more likely than men to engage (Zelezny et al., 2000), research suggests that men may be more likely than women to engage in environmental activism (Mohai, 1992). This may reflect stereotypes indicating that environmental activists, and activists more generally, possess stereotypically masculine traits, such as bravery and arrogance (Bashir et al., 2013; Swim and Geiger, 2018).

Below, we consider two complementary theoretical perspectives on the potential effects of gendered impressions on perceivers' interest in engaging. The first perspective, which draws from *gender role congruity theory* (Eagly, 1987; Eagly et al., 2000; Diekman and Eagly, 2008), suggests that individuals would be drawn to activism if their gendered impressions of activists matches their own gender. The second perspective, takes a broader societal perspective examining how masculine and feminine gender roles are valued in society. This perspective suggests that the social value of masculinity and femininity might influence both women's and men's activism preferences.

Gender Role Congruity Theory

Gendered impressions of issue publics may impact individuals' interest in engaging in activism based on whether their perception of the gendered nature of an issue public matches the individual's own gender. *Gender role congruity theory* (Eagly, 1987; Eagly et al., 2000; Diekman and Eagly, 2008) argues that gender stereotypes derive from societal division of labor and these stereotypes continue to perpetuate this division of labor. The stereotypes set up external expectations for women's and men's behavior with associated social rewards and punishments for conforming to or diverging from the expectations, respectively. These expectations can also be internalized and serve to self-regulate behaviors. For example, many women show reduced motivation in STEM (Science, Technology, Engineering, and Mathematics) disciplines due to the perception that those who are successful in these fields possess masculine rather than feminine traits (London et al., 2011). In contrast, the "reverse gender gap" in the classroom, where boys tend to underperform in grade school, can be explained in part by the perception of organization and dedication to school work as "feminine" (Elmore and Oyserman, 2012). Thus, gender stereotypes associated with roles, and presumably people who occupy the roles, can lead to gender matching where both women and men prefer engaging in behaviors perceived to be consistent with their gender and, correspondingly, men and women hesitate engaging in behavior when they view the behavior as inconsistent with their gender.

Gender role congruity theory suggests preferences for gender matching could influence women's and men's activism preferences. If climate change activism and activists are seen as feminine, women may be encouraged and men may be discouraged from engaging in activism. In contrast, if climate change activists are seen as masculine, men may be encouraged and women discouraged from engaging in activism. Based on the logic derived from gender role theory, we make the following hypotheses:

Hypothesis 1: *There will be an interaction between gender and perceived masculine traits, such that women (relative to men) will be less likely to engage in activism supporting a given position when they perceive the issue public supportive of that position to have greater masculine traits.*

Hypothesis 2: *There will be an interaction between gender and perceived feminine traits, such that men (relative to women) will be less likely to engage in activism supporting a given position when they perceive the issue public supportive of that position to have greater feminine traits.*

Social Value of Gendered Attributes

In contrast to gender role theory, other theory and research suggests that gendered impressions of groups along a given dimension could have fairly similar effects on interest in engaging in activism for both women and men. Gender stereotypes have been argued to represent both the roles and status that women and men have in society (Eagly and Steffen, 1984; Diekman and Eagly, 2000). Masculine stereotypes are argued to reflect the tendency for men to occupy high status and powerful groups, such as occupying leadership roles, and as a result these stereotypes are associated with a cluster of desirable attributes including agency, efficacy and respect (Deaux and Lafrance, 1998; Wojciszke et al., 2009). Thus, perceiving those who engage in a given behavior to possess greater levels of these socially valued masculine traits could motivate both women and men to engage in that behavior. Feminine traits are argued to reflect communal roles in service of others and are associated with warmth, caring for others, and being liked (Deaux and Lafrance, 1998; Abele and Wojciszke, 2007; Wojciszke et al., 2009). Thus, perceiving those who engage in a given behavior to possess greater levels of these socially valued feminine traits could also motivate both women and men to engage in that behavior.

An additional consideration is that the social value of masculine and feminine traits may be dependent upon differences among masculine and feminine traits that suggest that some masculine and feminine traits are more socially desirable than other masculine and feminine traits. Research on gender stereotypes indicates that a full set of gendered impressions can best be derived by considering (a) positive masculine, (b) negative masculine, (c) positive feminine, and (d) negative feminine traits (Spence and Helmreich, 1979; Diekman and Eagly, 2000). Recent work adds nuance and clarity

to these predictions by considering the predictive power gained by separating gendered impressions into positive and negative components (Swim and Geiger, 2018; Swim et al., 2018). This work reveals that negative masculine traits are more likely than positive masculine traits to be ascribed to the climate dismissive, while positive masculine and negative feminine traits are equally likely to be ascribed to the climate concerned. Additionally, the ascription of negative masculine traits to the climate dismissive decreases the extent to which women and men identify with the group whereas the ascription of negative feminine traits decreases the extent to which men, but not women, identify with the climate concerned (Swim, under review).

Here we adopt a framework which considers all four types of these gendered traits in an effort to examine which components of gendered impressions could best explain interest in engaging in activist behavior. Based on our review of the effects of impressions of issue publics on collective action noted above, we also consider whether issue public group impressions could influence interest in engaging in activism which is (a) consistent with the relevant issue public's opinion position and (b) diametrically opposed to the relevant issue public's opinion position.

Masculine Trait Impressions and Activism

The impact of masculine trait impressions of issue public groups on interest in engaging in activism may depend on the valence of the masculine traits. As we explain below, past research points to clearer predictions for associations between positive masculine trait impressions and interest in engaging in activism than negative masculine trait impressions and interest in engaging in activism.

Positive masculine traits associated with an issue public could encourage interest in engaging in climate change activism both because the positive nature of the traits makes them socially desirable and because the masculine nature of the traits associates them with agency, respect, and efficacy (Wojciszke et al., 2009). Positive masculine traits could promote a desire to engage with the group as a means of enhancing one's own status through building one's identity as a member of a respected group (Klandermans, 2008; Masson and Fritsche, 2014) because the agency and respect accrued to the group makes engagement with the group seem appealing, or because one might expect to also be perceived in that positive light if one were to engage in a similar behavior [see (Geiger and Swim, 2016)]. In addition, because engaging in activism diametrically opposed to an issue public group can socially signal that one is not part of that group, then perceiving that a group is high in positive masculine traits (and therefore socially desirable) may reduce interest in engaging in activism opposed to a group. Based on this logic, we make the following hypothesis:

Hypothesis 3a and 3b: Ascription of positive masculine traits to an issue public will be associated with (a) greater interest in engaging in activism consistent with that issue public's position and (b) lesser interest in engaging in activism diametrically opposed to that issue public's position.

In contrast, we propose competing predictions for the effects of negative masculine impressions of the issue public (e.g., arrogance and aggression) on interest in engaging in activist behaviors based upon one set of predictions derived from the lack of social desirability of the traits and a second set based upon the agency associated with masculinity. First, the negativity of these impressions suggests that they may be viewed as undesirable traits and people may be motivated to avoid affiliating with those who hold these traits (Bashir et al., 2013). The negativity of these traits could also motivate people to engage in activism diametrically opposed to the group goals, not only potentially to socially distance oneself from the group (Hogg et al., 1990) but also potentially due to a *reactance* effect (Cottrell and Neuberg, 2005; Miron and Brehm, 2006; Böhm et al., 2016), whereby the perceived aggressive characteristics of the group threatens the perceiver's freedom and opposing action is taken to reassert one's freedom. Second, and in contrast, people may be drawn to those perceived to hold these negative masculine traits because they are associated with agency, power, and status (Diekman and Eagly, 2000). This is consistent with the idea that negative masculine traits can be desirable because they convey an image of being "bad but bold" (Glick et al., 2004). Based on the presence of these competing possibilities, we do not make a directional prediction about relations between perceptions of negative masculine traits and either (a) group-consistent activism or (b) group-inconsistent activism.

Feminine Trait Impressions And Activism

As with masculine trait impressions, the impact of feminine trait impressions of issue public groups on interest in engaging in activism may depend on the valence of the feminine impression. As we explain below, we develop more clear predictions for associations between negative feminine trait impressions and interest in engaging in activism than we do for positive feminine trait impressions and interest in engaging activism.

Positive feminine traits impressions could promote engaging in activism consistent with the issue public group due to both the social desirability associated with positive traits and because the caring, warmth and liking associated with these traits may increase the desire to affiliate with the target group. These associations could also promote a desire to engage with the group and engage in group-consistent activism, perhaps due in part to people's increasing support for ideas when they believe that a person proposing the idea cares about the average person (Geiger, 2018). In contrast, however, femininity may not be seen as desirable because feminine traits are derived from care-taking societal roles which are low in power and status (Diekman and Eagly, 2000; Eagly et al., 2000). In turn, these expectations of low power and status could discourage people from engaging in activism related to groups perceived to have positive feminine traits or encourage them to engage in activism diametrically opposed to these groups. Based on the presence of these competing possibilities, we do not make directional predictions about relations between perceptions of positive feminine traits and either (a) group-consistent activism or (b) group-inconsistent activism.

In contrast, negative feminine traits, such as being whiny or complaining, may be viewed as unambiguously undesirable traits. As with positive feminine traits, negative feminine traits are argued to be derived from women occupying roles that low in power and status. In contrast to positive feminine traits, however, it has been suggested negative feminine traits (e.g., being a complainer) tend to be attributed to individuals in these roles who use low-power tactics to exert subversive societal influence (Diekman and Eagly, 2000). Thus, unlike positive feminine traits, these negative feminine traits are not associated with desirable attributes, such as warmth and likeability and are unambiguously undesirable. When individuals perceive groups to have negative feminine traits, they may attempt to socially distance themselves from the group, perhaps in part to prevent stigma by association (Pryor et al., 2012). Individuals may not only avoid engaging in group-consistent activist behaviors when they perceive the issue public group to have negative feminine traits, but may also further distance themselves from the group by engaging in group-inconsistent activist behaviors. Thus, we make the following hypotheses:

Hypothesis 4a and 4b: *Ascription of negative feminine traits to an issue public will be associated with (a) lesser interest in engaging in activism consistent with that issue public's position and (b) greater interest in engaging in activism diametrically opposed to that issue public's position.*

PRESENT RESEARCH

Across two studies we test the associations between perceptions of traits associated with climate change issue public groups (i.e., the climate concerned and climate dismissive) and interest in engaging in pro-climate and anti-climate activism. Study 1 assesses participants' stereotypes about the climate concerned. Study 2 assesses participants' stereotypes about the climate dismissive. Thus, in Study 1, pro-climate activism is consistent with the climate concerned's views and anti-climate activism is diametrically opposed to their views and therefore inconsistent with their views. In contrast, in Study 2, anti-climate activism is consistent with the climate dismissive's views and pro-climate activism is diametrically opposed and therefore with their views. Consistent with most other work assessing the relations between multiple interrelated predictors and an outcome, we employ multiple regression techniques (rather than examining zero-order correlations) to examine the unique predictive power of each predictor and account for potential confounds.

STUDY 1: PERCEPTIONS OF THE CLIMATE CONCERNED

The purpose of Study 1 was to examine whether impressions of the climate concerned in terms of positive and negative masculine and feminine stereotypes might help explain interest in engaging in pro-climate (i.e., group-consistent) and anti-climate (i.e., group inconsistent) activism.

METHODS

Participants

Three hundred thirteen participants were recruited in late January and early February of 2015 from MTURK (Mechanical Turk) and paid $.50 for their completion of the survey. Twenty-seven participants were excluded for not completing a question about gender (2), not providing trait ratings (1), failing an instructional check where they were asked to provide a specific response (none of the above) to a question where they were asked to indicate which of eight emotions reflected their current emotional state (4), completing in $<1/2$ the median completion time (18), and/or completing in $>3\times$ the median completion time (4). The final sample consisted of 286 participants: 131 (46%) women and 155 (54%) men. Ages ranged from 19 to 72 (*median* = *35*). Most participants were White/Caucasian (81%). The sample was somewhat more educated than the general public: 53% of participants had a 4-years college degree. About half of participants identified as politically liberal (11% very liberal and 39% liberal), followed by moderate (30%) and about one-fifth as politically conservative (18% conservative, 3% very conservative). Participants indicated their concern about climate change using a single-item measure validated in Swim and Geiger (2017). Similar to the general population (Maibach et al., 2011; Leiserowitz et al., 2015; Swim and Geiger, 2017), most participants were at least somewhat concerned about climate change: 23% self-identified as Alarmed, 40% as Concerned, 20% as Cautious, 5% as Disengaged, 8% as Doubtful, and 4% as Dismissive.

Procedure

Participants were told that the purpose of the study was related to using mnemonics to improve memory in conversations about controversial topics and were asked to use a mnemonic tool to memorize quotes paired with the names of people alleged to have said the quote. In reality, the quotes were used to create an image of those who are Alarmed about climate change and the memory task was to assure that they read the quotes.[1] The quotes reflect the belief that climate change was a problem and in need of immediate action (see **Appendix**). Following their use of the mnemonic tool and associated memory task, participants completed dependent measures, the instruction attention check question (see Participants section above), and demographic questions.

Measures

Concern About Climate Change

Because individuals' climate change concern is associated with the extent to which they view activists as possessing positive and negative traits (Swim and Geiger, 2018), we control for

[1] Participants were randomly assigned different names of the commenters to reflect either a) all female or b) all male names or c) a mixture of names for a different purpose. Results presented here did not change when we included this variable in the analyses, suggesting that ascription of gendered traits to the climate concerned is not primarily based upon the actual gender of the individuals but rather on the manner in which their actions align with societal expectations of gendered traits. This is consistent with previous theory on gendered traits and popular writing about gendered traits (e.g., Bump, 2013).

this variable in analyses. Participants completed the single-item self-categorization measure of climate change concern developed by Swim and Geiger (2017) by selecting the group that best described their opinions about climate change (Very Concerned, Concerned, Cautious, Disengaged, Doubtful, or Non-believer). Similar to previous work, responses were treated as a continuous measure on a 1 (Non-believer) to 6 (Very Concerned) scale ($M = 4.55$, s.d. $= 1.31$).[2]

Political Ideology

As noted above, participants completed a single-item measure indicating their political ideology on an −2 to +2 scale ranging from very liberal to very conservative and the midpoint indicating "moderate" ($M = -0.37$, s.d. $= 0.98$).

Stereotypes About Climate Concerned

Based on previous work (Swim and Geiger, 2018), participants used a five-point scale (0 = "not at all" to 4 = "very much") to rate how much they anticipated that a person who was "very concerned about climate change" would possess 12 different traits. The 12 traits represented negative and positive gendered traits (positive masculine traits: courageous, adventurous, stands-up under pressure, $\alpha = 0.80$; negative masculine traits: aggressive, dictatorial, arrogant. $\alpha = 0.78$; positive feminine traits, nurturing, gentle, sympathetic, $\alpha = 0.80$; negative feminine traits: nagging, whiny, complaining, Cronbach $\alpha = 0.88$). Consistent with previous work (Swim and Geiger, 2018) which developed these four categories, model comparisons using confirmatory factor analyses supported this four-factor structure over two-factor structures (negative vs. positive or masculine vs. feminine) and over a single-factor structure.

Interest in Climate Change Activism

Respondents were asked to indicate their interest in engaging in three forms of pro-climate activism: read blogs by those concerned about climate change, attend a public meeting or presentation about supporting a climate change policy, join a group marching for climate change activism in their state capital (seven-point scale, "very unlikely" (−3) to "very likely" (3); $M = -0.58$, s.d. $= 1.68$, $\alpha = 0.82$). Using a parallel set of three items, participants also indicated their interest in engaging in three forms of anti-climate activism (e.g., read blogs by those skeptical about climate change, etc.; $M = -1.83$, s.d. $= 1.10$, $\alpha = 0.64$).[3] Across both outcome variables, floor effects occurred due to a substantial minority of participants selecting strongly disagree (i.e., −3) on all scale items. Employing ordinary least squares (OLS) regression when there are floor effects in an outcome variable can result in overestimation of standard errors and misestimation of regression parameters (Zhu and Gonzalez, 2017), however, it is not possible to fully address this issue using data transformation among variables that have floor effects. Thus, following recommendations and analysis techniques that have been employed with similar patterns in previous datasets (Zhu and Gonzalez, 2017) we treated the two outcome measures as left-censored and employed Tobit regression (Tobin, 1958; Breen, 1996) for analyses, which is considered appropriate for censored data (Zhu and Gonzalez, 2017). The technique operates based on the assumption that there is an underlying normally distributed latent variable of interest in engaging in activism, and that many participants on the lower end of this scale, despite differing scores on the underlying latent construct, will score a −3 on the measured variable due to the fact that this is the lowest possible score.

RESULTS

A table of zero-order correlations between all measures is shown in **Table 1**.

We conducted regression analyses to examine the predictors of a) pro-climate activism and b) anti-climate activism. With each of these two outcome variables, we began by regressing the outcome measure upon political ideology, climate change concern, the opposite form of activism (to control for the general tendency of low interest in engaging in any sort of activism) and gender in Step 1. In Step 2, we added in main effects of the four types of trait impressions (positive masculine, negative masculine, positive feminine and negative feminine). In Step 3, interactions between each of the types of trait impressions and gender were added. Below, we describe results in the text related to a) testing specific hypotheses and b) statistically significant effects that were not hypothesized. In the text, we include standardized betas (in addition to unstandardized betas) in order to assess the effect size of each relation which is described. For the full results, see **Tables 2**, **3**.

Gender Role Congruity Predictions

We first examined the predictions made by gender role theory by examining whether participants would report greater interest in engaging in pro-climate activism when they associated the climate concerned with more traits of the participant's own gender (i.e., Hypothesis 1), and lesser interest in engaging in pro-climate activism when they associated the climate concerned with more traits of the other gender (i.e., Hypothesis 2). Hypotheses 1 and 2 predicted inverse patterns would occur when predicting anti-climate activism.

Hypotheses 1 and 2 were not supported: there were no interactions between any trait and participants' own gender on interest in engaging in either pro-climate or anti-climate activism, ps > 0.49, suggesting that the relationships between the trait impressions and interest in engaging in pro- and anti-climate activism were similar for female and male participants.

[2]We also assessed participants' identification with the climate concerned for exploratory purposes. This measure was correlated with participants climate change concern at $r = 0.73$, and models substituting this variable for participants climate change concern yielded similar results to those reported below. We tested possible interactions between participants' identification with the climate concerned and trait ascriptions to the climate concerned on pro- and anti-climate activism and found no significant interactions at the $p = 0.05$ level.

[3]Participants also rated the extent to which they would work with groups that either reduced or stop the reduction of their communities' contribution to climate change. However, the latter item was positively correlated with pro-climate activism despite the fact that it was intended as an anti-climate activism item; potentially because of the double negative. So, we did not include these items in our measure of willingness to engage in climate change activism.

TABLE 1 | Means, standard deviations, and correlations with confidence intervals for measures used in Study 1.

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. Concern about climate change	4.55	1.31									
2. Political conservatism	−0.37	0.98	−0.48** [−0.56, −0.38]								
3. Age	37.74	12.26	−0.11 [−0.22, 0.01]	0.18** [0.07, 0.29]							
4. Gender	1.46	0.50	0.12* [0.01, 0.24]	−0.14* [−0.25, −0.02]	0.06 [−0.05, 0.18]						
5. Positive Masculine Impressions	2.12	0.91	0.32** [0.21, 0.42]	−0.16** [−0.27, −0.05]	0.01 [−0.11, 0.12]	0.14* [0.02, 0.25]					
6. Negative Masculine Impressions	1.57	1.01	−0.52** [−0.60, −0.43]	0.39** [0.28, 0.48]	0.06 [−0.06, 0.18]	−0.13* [−0.25, −0.02]	0.02 [−0.09, 0.14]				
7. Positive Feminine Impressions	1.96	0.95	0.38** [0.28, 0.48]	−0.23** [−0.34, −0.12]	0.08 [−0.04, 0.19]	0.06 [−0.06, 0.17]	0.55** [0.47, 0.63]	−0.25** [−0.36, −0.14]			
8. Negative Feminine Impressions	1.65	1.13	−0.53** [−0.61, −0.44]	0.39** [0.29, 0.48]	0.02 [−0.10, 0.13]	−0.22** [−0.33, −0.11]	−0.20** [−0.31, −0.09]	0.74** [0.68, 0.79]	−0.25** [−0.36, −0.14]		
9. Pro-Climate Activism	−0.58	1.68	0.57** [0.48, 0.64]	−0.41** [−0.50, −0.30]	−0.19** [−0.30, −0.07]	0.03 [−0.09, 0.14]	0.32** [0.21, 0.42]	−0.33** [−0.43, −0.22]	0.33** [0.22, 0.43]	−0.39** [−0.48, −0.28]	
10. Anti-Climate Activism	−1.83	1.10	−0.34** [−0.44, −0.23]	0.21** [0.10, 0.32]	0.03 [−0.09, 0.14]	−0.13* [−0.24, −0.01]	−0.03 [−0.14, 0.09]	0.33** [0.23, 0.43]	−0.08 [−0.20, 0.03]	0.26** [0.15, 0.36]	0.02 [−0.10, 0.14]

*M and SD are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). *indicates $p < 0.05$. **indicates $p < 0.01$.*

General Effects of Gendered Trait Impressions

As anticipated (Hypothesis 3a), positive masculine traits of the climate concerned uniquely predicted interest in engaging in pro-climate activism, $b = 0.27$ ($\beta = 0.15$), $SE = 0.12$, $p = 0.03$. In contrast, Hypothesis 4a was not supported: negative feminine traits did not uniquely predict interest in engaging in pro-climate activism, $b = -0.16$ ($\beta = -0.11$), $SE = 0.12$, $p = 0.18$.

We next conducted a regression analysis to examine the predictors of anti-climate action. The regression was analogous to the regression conducted in the above paragraph. Examining the predictors of anti-climate activism, neither Hypothesis 3b or 4b were supported: interest in engaging in anti-climate activism was not uniquely predicted by either perceptions of positive masculine traits of the climate concerned, $b = 0.00$ ($\beta = 0.00$), $SE = 0.10$, $p = 0.98$ or perceptions of negative feminine traits of the climate concerned, $b = -0.01$ ($\beta = -0.01$), $SE = 0.10$, $p = 0.93$. In contrast, negative masculine traits of the climate concerned was uniquely positively related to interest in engaging in anti-climate activism, $b = 0.31$ ($\beta = 0.29$), $SE = 0.12$, $p = 0.007$.

DISCUSSION

Study 1 results were inconsistent with predictions made by gender role congruity theory. Specifically, contrary to the predictions of the theory, gendered trait impressions of the climate concerned did not exert gender-specific impacts on women or men's interest in engaging in pro-climate or anti-climate activist behavior.

In contrast, we found informative results that were partly consistent with predictions based on the social value of gendered attributes. Results indicated that consistent with predictions (Hypothesis 3a), ascription of positive masculine stereotypes to the climate concerned was uniquely associated with pro-climate activism, while in contrast, no other types of impressions about the climate concerned uniquely predicted interest in engaging in pro-climate activism. This suggests that ascription of agency and respect (i.e., positive masculine impressions) toward the climate concerned was associated with pro-climate activism more so than was nurturance and warmth (i.e., positive feminine impressions). Yet, ascription of masculine impressions to the climate concerned did not uniformly predict interest in engaging in pro-climate activism. Rather, ascribing negative masculine impressions of the climate concerned (i.e., bad but bold) did not uniquely predict interest in engaging in pro-climate activism and instead uniquely predicted interest in engaging in anti-climate activism. Although competing hypotheses in the introduction did not allow us to make this prediction in advance, this finding is consistent with proposition that a perceived threat from an agentic source may prompt anti-climate activism. These findings further suggest that although the climate concerned might be encouraged to present themselves as masculine in order to

TABLE 2 | Impressions of the climate concerned as predictors of pro-climate activism (Study 1).

	Pro-climate activism		
	Base model (95% CI)	**Main effects (95% CI)**	**Interactions (95% CI)**
Concern about climate change (mean centered)	0.90*** (0.74, 1.07)	0.73*** (0.55, 0.92)	0.73*** (0.55, 0.91)
Political conservatism	−0.34*** (−0.54, −0.14)	−0.30** (−0.50, −0.10)	−0.29** (−0.49, −0.09)
Anti-climate activism	0.45*** (0.28, 0.62)	0.44*** (0.27, 0.61)	0.43*** (0.26, 0.60)
Participant gender	−0.14 (−0.49, 0.21)	−0.26 (−0.60, 0.09)	−0.23 (−1.41, 0.94)
Negative masculine		−0.08 (−0.36, 0.20)	−0.04 (−0.40, 0.32)
Negative feminine		−0.16 (−0.40, 0.07)	−0.14 (−0.45, 0.17)
Positive masculine		0.27* (0.03, 0.52)	0.14 (−0.18, 0.46)
Positive feminine		0.08 (−0.14, 0.30)	0.19 (−0.12, 0.50)
Negative masculine traits × Gender			−0.10 (−0.65, 0.45)
Negative feminine traits × Gender			−0.08 (−0.56, 0.40)
Positive masculine traits × Gender			0.32 (−0.17, 0.80)
Positive feminine traits × Gender			−0.22 (−0.67, 0.22)
Constant	0.05 (−0.32, 0.43)	−0.24 (−0.97, 0.50)	−0.31 (−1.25, 0.63)
Observations	283	283	283
Log likelihood	−469.88	−462.34	−461.14
Wald test	190.63*** (df = 4)	213.21*** (df = 8)	217.03*** (df = 12)

*Values shown are unstandardized beta weights. 95% CI refers to the 95% confidence interval. This table was created using stargazer (Hlavac, 2018). *p < 0.05; **p < 0.01; ***p < 0.001.*

TABLE 3 | Impressions of the climate concerned as predictors of anti-climate activism (Study 1).

	Anti-climate activism		
	Base model (95% CI)	**Main effects (95% CI)**	**Interactions (95% CI)**
Concern about climate change (mean centered)	−0.47*** (−0.61, −0.32)	−0.38*** (−0.54, −0.23)	−0.38*** (−0.53, −0.23)
Political conservatism	0.20* (0.03, 0.37)	0.15 (−0.02, 0.32)	0.16 (−0.01, 0.33)
Pro-climate activism	0.30*** (0.19, 0.40)	0.30*** (0.19, 0.41)	0.29*** (0.18, 0.40)
Participant gender	−0.13 (−0.41, 0.16)	−0.09 (−0.37, 0.20)	0.45 (−0.53, 1.44)
Negative masculine		0.31** (0.09, 0.54)	0.40** (0.11, 0.69)
Negative feminine		−0.01 (−0.21, 0.19)	−0.003 (−0.26, 0.25)
Positive masculine		0.003 (−0.20, 0.21)	−0.003 (−0.27, 0.26)
Positive feminine		0.07 (−0.12, 0.26)	0.14 (−0.12, 0.40)
Negative masculine traits × Gender			−0.22 (−0.67, 0.22)
Negative feminine traits × Gender			−0.01 (−0.40, 0.38)
Positive masculine traits × Gender			0.04 (−0.36, 0.45)
Positive feminine traits × Gender			−0.14 (−0.51, 0.23)
Constant	−1.68*** (−1.89, −1.48)	−2.34*** (−2.87, −1.82)	−2.63*** (−3.34, −1.93)
Observations	283	283	283
Log likelihood	−407.85	−400.88	−399.68
Wald Test	66.16*** (df = 4)	81.77*** (df = 8)	84.88*** (df = 12)

*Values shown are unstandardized beta weights. 95% CI refers to the 95% confidence interval. This table was created using stargazer (Hlavac, 2018). *p < 0.05; **p < 0.01; ***p < 0.001.*

promote activism on climate change, they might be careful to avoid an appearance of the "dark side" of masculinity as this could exert an ironic anti-climate activist effect.

STUDY 2: PERCEPTIONS OF THE CLIMATE DISMISSIVE

The purpose of Study 2 was to examine whether individuals' impressions of the climate dismissive could explain interest in engaging in anti-climate (i.e., group consistent) and pro-climate (i.e., group inconsistent) activism.

METHOD

Participants

Two hundred seventy-two participants were recruited in February 2015 from MTURK (Mechanical Turk) and paid $0.50 for their completion of the survey. Twenty-seven participants were excluded for failing an instructional check (7), completing in <1/2 the median completion time (17), and/or completing in >3× the median completion time (7). The final sample consisted of 245 participants: 146 (60%) women and 99 (49%) men. Ages ranged from 19 to 78 (*median* = *33*). Most participants were White/Caucasian (81%). The sample was somewhat more educated than the general public: 39% of participants had a 4-years college degree. About half of participants identified as politically liberal (10% very liberal and 32% liberal), followed by moderate (35%) and about one-fifth as politically conservative (18% conservative, 5% very conservative). Like Study 1 and the general public (Maibach et al., 2011; Leiserowitz et al., 2015; Swim and Geiger, 2017), more participants were concerned than unconcerned about climate change: 26% self-identified as Alarmed, 39% as Concerned, 17% as Cautious, 4% as Disengaged, 7% as Doubtful, and 7% as Dismissive.

TABLE 4 | Means, standard deviations, and correlations with confidence intervals for measures used in Study 2.

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. Concern about climate change	4.51	1.48									
2. Political conservatism	−0.25	1.01	−0.51** [−0.60, −0.41]								
3. Age	37.02	13.19	−0.19** [−0.31, −0.07]	0.16* [0.03, 0.28]							
4. Gender	1.60	0.49	0.03 [−0.10, 0.15]	0.04 [−0.08, 0.17]	0.21** [0.09, 0.33]						
5. Positive masculine impressions	1.43	0.86	−0.43** [−0.53, −0.32]	0.39** [0.28, 0.50]	0.10 [−0.02, 0.23]	−0.03 [−0.16, 0.09]					
6. Negative masculine impressions	2.04	1.08	0.53** [0.44, 0.62]	−0.37** [−0.48, −0.26]	−0.17** [−0.29, −0.05]	−0.08 [−0.20, 0.05]	−0.15* [−0.27, −0.02]				
7. Positive feminine impressions	0.86	0.84	−0.37** [−0.47, −0.26]	0.26** [0.14, 0.37]	0.16* [0.03, 0.28]	−0.01 [−0.13, 0.12]	0.55** [0.45, 0.63]	−0.31** [−0.41, −0.19]			
8. Negative feminine impressions	1.72	1.15	0.47** [0.37, 0.56]	−0.36** [−0.47, −0.25]	−0.26** [−0.38, −0.14]	−0.10 [−0.23, 0.02]	−0.23** [−0.35, −0.11]	0.68** [0.61, 0.74]	−0.14* [−0.26, −0.01]		
9. Pro-climate activism	−0.52	1.68	0.61** [0.53, 0.69]	−0.42** [−0.52, −0.31]	−0.19** [−0.31, −0.07]	0.01 [−0.11, .14]	−0.37** [−0.48, −0.26]	0.40** [0.29, 0.50]	−0.20** [−0.32, −0.08]	0.43** [0.32, 0.53]	
10. Anti-climate activism	−1.82	1.14	−0.15* [−0.27, −0.02]	0.22** [0.09, 0.33]	−0.04 [−0.16, 0.09]	−0.06 [−0.19, 0.06]	0.27** [0.15, 0.39]	−0.11 [−0.23, 0.02]	0.27** [0.15, 0.38]	0.00 [−0.12, 0.13]	0.22** [0.10, 0.33]

*M and SD are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). *indicates $p < 0.05$. **indicates $p < 0.01$.*

Procedure, Materials, and Measures

The procedure was identical to that from Study 1 except that participants read quotes that were dismissive of climate change and the provided trait ratings of the Dismissive (see **Appendix**). The trait ratings were the same as those used in Study 1 (positive masculine traits, Cronbach $\alpha = 0.69$; negative masculine traits: Cronbach $\alpha = 0.83$; positive feminine traits, Cronbach $\alpha = 0.86$; negative feminine traits, Cronbach $\alpha = 0.86$) Again, model comparison supported a four-factor structure for trait ratings over two-factor and single-factor structures. Last, using the same items in Study 1, participants indicated their interest in engaging in pro-climate activism ($M = -0.52$, s.d. = 1,68, $\alpha = 0.81$) and anti-climate activism ($M = -1.82$, *s.d.*= 1.14, $\alpha = 0.68$). As before, we used Tobit regression due to floor effects on outcome measures.[4]

RESULTS

A table of zero-order correlations between all predictors and outcomes is shown in **Table 4**.

As in Study 1, we conducted regression analyses to examine the predictors of activism consistent with the issue public group being studied (i.e., anti-climate activism) and predictors of activism inconsistent with the issue public group being studied (i.e., pro-climate activism). As before, with each of these two outcome variables, we began by regressing the outcome measure upon political ideology, climate change concern, the opposite form of activism and gender in Step 1. In Step 2, we added in main effects of the four types of trait impressions. In Step 3, interactions between each of the types of trait impressions and gender were added. Below, we describe results in the text related to a) testing specific hypotheses and b) statistically significant effects that were not hypothesized. For the full results, see **Tables 5**, **6**.

Gender Role Congruity Predictions

Consistent with Hypothesis 2, there was an interaction between participants' own gender and perceptions of negative feminine traits of the climate dismissive on anti-climate activism, $b = 0.52$ ($\beta = 0.26$), $SE = 0.19$, $p = 0.006$. As shown in **Figure 1**, higher levels of perceived negative feminine traits toward the climate dismissive (i.e., one standard deviation above the mean) were associated with women being more interested than men in engaging in anti-climate activism ($p < 0.05$), whereas the reverse pattern was identified among those who perceived low levels of negative feminine traits (i.e., one standard deviation below the mean) toward the climate dismissive ($p > 0.05$). In addition, there was also an interaction between perceptions of positive feminine traits in the climate dismissive and participants' own gender on interest in engaging in anti-climate activism, $b = -0.53$ ($\beta =$

[4]Similar to Study 1, we assessed participants' identification with the climate dismissive for exploratory purposes. As in Study 1, there were no significant interactions between this measure and trait ascriptions on activism at the $p = 0.05$ level.

−0.19), $SE = 0.23$, $p = 0.02$, but in this case the interaction was in the opposite direction from predictions derived from gender role congruency theory (i.e., Hypothesis 2). As shown in **Figure 2**, among those who perceived the climate dismissive to possess high levels of positive feminine traits (i.e., one standard deviation above the sample mean), men were more interested in engaging in anti-climate activism than women ($p < 0.05$). In contrast, among those who perceived the climate dismissive to possess low levels of positive feminine traits (i.e., one standard deviation below the sample mean), women were equally interested as men at engaging in anti-climate activism ($p > 0.05$).

In contrast, Hypothesis 1 was not supported—there was no interaction between participants own gender and perceptions of either (a) positive or (b) negative masculine traits on interest in engaging in anti-climate activism, ps > 0.05.

General Effects of Gendered Trait Impressions

Similar to Study 1 findings, ascribing positive masculine traits to the climate dismissive predicted interest in engaging in anti-climate activism (Hypothesis 3a), $b = 0.49$ ($\beta = 0.37$), $SE = 0.12$, $p < 0.001$. In contrast, and also consistent with patterns in Study 1, Hypothesis 4a was not supported: ascription of negative feminine traits of the climate dismissive did not uniquely predict interest in engaging in anti-climate activism, $b = 0.13$ ($\beta = 0.14$), $SE = 0.10$, $p = 17$. However, we did find a unique negative relation between negative masculine impressions of the climate dismissive and interest in engaging in anti-climate action, $b = -0.24$ ($\beta = -0.23$), $SE = 0.11$, $p = 0.026$.

Results supported Hypothesis 3b: pro-climate activism was uniquely predicted by ascribing less positive masculine impressions of the climate dismissive, $b = -0.42$ ($\beta = -0.30$), $SE = 0.12$, $p < 0.001$. In contrast, Hypothesis 4b was not supported: pro-climate activism was not uniquely predicted by negative feminine impressions of the climate dismissive, $b = 0.06$ ($\beta = 0.04$), $SE = 0.10$, $p = 0.55$. However, we did find a positive unique relation between negative masculine impressions of the climate dismissive and interest in engaging in pro-climate action, $b = 0.24$ ($\beta = 0.15$), $SE = 0.12$, $p = 0.042$.

TABLE 5 | Impressions of the climate dismissive as predictors of anti-climate activism (Study 2).

	Anti-climate activism		
	Base model (95% CI)	**Main effects (95% CI)**	**Interactions (95% CI)**
Concern about climate change (mean centered)	−0.33*** (−0.48, −0.19)	−0.21** (−0.36, −0.06)	−0.18* (−0.33, −0.03)
Political Conservatism	0.37*** (0.18, 0.55)	0.25** (0.07, 0.43)	0.23* (0.05, 0.40)
Pro-Climate Activism	0.49*** (0.37, 0.62)	0.52*** (0.40, 0.65)	0.49*** (0.37, 0.62)
Participant Gender	−0.19 (−0.52, 0.13)	−0.17 (−0.47, 0.13)	−0.50 (−1.44, 0.44)
Negative Masculine		−0.24* (−0.46, −0.03)	−0.10 (−0.42, 0.21)
Negative Feminine		0.13 (−0.06, 0.33)	−0.16 (−0.45, 0.12)
Positive Masculine		0.49*** (0.25, 0.72)	0.32 (−0.004, 0.64)
Positive Feminine		0.09 (−0.14, 0.32)	0.40* (0.06, 0.74)
Negative masculine traits × Gender			−0.29 (−0.70, 0.11)
Negative feminine traits × Gender			0.52** (0.15, 0.90)
Positive masculine traits × Gender			0.33 (−0.10, 0.76)
Positive feminine traits × Gender			−0.53* (−0.98, −0.08)
Constant	−1.54*** (−1.80, −1.27)	−2.07*** (−2.59, −1.55)	−1.87*** (−2.63, −1.12)
Observations	240	240	240
Log Likelihood	−347.00	−332.66	−327.09
Wald Test	69.47*** (df = 4)	104.67*** (df = 8)	118.76*** (df = 12)

*Values shown are unstandardized beta weights. 95% CI refers to the 95% confidence interval. This table was created using stargazer (Hlavac, 2018). *p < 0.05; **p < 0.01; ***p < 0.001.*

DISCUSSION

Unlike in Study 1, in Study 2 we did identify some interactions between gendered trait impressions and participants' own gender on interest in engaging in activism. Yet, the pattern of interactions was not entirely consistent with the predictions made by gender role theory. Supporting gender role consistency theory (Hypothesis 2), participants' gender interacted with negative feminine impressions of the climate dismissive in the expected direction to predict anti-climate activism: men were less interested than women in engaging in anti-climate activism among participants who viewed the climate dismissive to have negative feminine traits. Yet, the interaction between positive feminine traits and participants' gender on anti-climate activism was in the opposite direction and directly opposed predictions (Hypothesis 2): men were more interested than women in engaging in anti-climate activism among participants who viewed the climate dismissive to have positive feminine traits. Because this pattern was not found in Study 1, and no other interactions between trait impressions and participants' own gender on either anti-climate or pro-climate activism were found here in Study 2, we are hesitant to conclude that theoretically driven predictions of gender matching preferences can be used to explain the results. Yet, these results suggest that at the very least, research which does not separate feminine impressions into positive and negative components should interpret findings consistent with gender role congruity theory cautiously because results could potentially differ based on how feminine impressions are operationalized.

Positive masculine stereotypes about the climate dismissive were the strongest predictor of pro-climate activism: the less

TABLE 6 | Impressions of the climate dismissive as predictors of pro-climate activism (Study 2).

	Pro-climate activism		
	Base model (95% CI)	**Main effects (95% CI)**	**Interactions (95% CI)**
Concern about climate change (mean centered)	0.75*** (0.62, 0.89)	0.60*** (0.45, 0.75)	0.60*** (0.45, 0.75)
Political conservatism	−0.44*** (−0.64, −0.24)	−0.30** (−0.49, −0.11)	−0.30** (−0.50, −0.11)
Anti-climate activism	0.61*** (0.46, 0.77)	0.66*** (0.50, 0.81)	0.64*** (0.48, 0.80)
Participant gender	0.14 (−0.21, 0.48)	0.15 (−0.18, 0.48)	−0.69 (−1.71, 0.33)
Negative masculine		0.24* (0.01, 0.47)	0.02 (−0.33, 0.36)
Negative feminine		0.06 (−0.14, 0.26)	0.08 (−0.22, 0.38)
Positive masculine		−0.58*** (−0.84, −0.32)	−0.61*** (−0.96, −0.26)
Positive feminine		0.23 (−0.02, 0.48)	0.17 (−0.20, 0.54)
Negative masculine traits × Gender			0.36 (−0.08, 0.81)
Negative feminine traits × Gender			−0.03 (−0.44, 0.38)
Positive masculine traits × Gender			0.01 (−0.47, 0.49)
Positive feminine traits × Gender			0.12 (−0.38, 0.63)
Constant	0.26 (−0.11, 0.63)	0.40 (−0.23, 1.04)	0.91* (0.05, 1.76)
Observations	240	240	240
Log likelihood	−372.17	−359.42	−357.31
Wald Test	230.09*** (df = 4)	270.84*** (df = 8)	275.47*** (df = 12)

*Values shown are unstandardized beta weights. 95% CI refers to the 95% confidence interval. This table was created using stargazer (Hlavac, 2018). *p < 0.05; **p < 0.01; ***p < 0.001.*

individuals ascribed positive masculine stereotypes to the climate dismissive, the more interest they reported in pro-climate activism. Aside from the interactions described in the paragraph above, primary conclusions from Study 2 are fairly similar to Study 1 and suggest that our predictions tend to replicate when the issue public group is varied from the climate concerned to the climate dismissive. Specifically, these results are consistent with the notion that perceiving the climate dismissive as possessing positive masculine traits (but not positive feminine traits) can not only encourage anti-climate activism but also dampen enthusiasm for pro-climate activism. However, in contrast, these results are also consistent with the notion that perceiving the climate dismissive as "bad but bold" can exert the exact opposite effects, promoting oppositional pro-climate activism and discouraging enthusiasm for anti-climate activism, perhaps based on the lack of likability or perceived misuse of power when these individuals are perceived as possessing negative masculine traits.

GENERAL DISCUSSION

The present study corroborates previous findings that stereotypes about activist groups is an important predictor of interest in engaging in actions consistent with a groups position (Bashir et al., 2013), while illustrating that assessing the gendered nature of stereotypes can add insights into toward understanding these relations. Specifically, the present research indicates that it is positive masculine stereotypes associated with a public issue group more than simply positive and not negative stereotypes that are the most strongly associated with interest in engaging in activism. Further, the association between activism supporting a certain position and positive masculine traits ascribed to issue publics who hold that position were found for both pro- and anti-climate activism. The study also points to the importance of masculine more than feminine impressions for both activism that is consistent with a public issues stance and that which is diametrically opposed to its position.

Masculine traits reflect agency and the present results are consistent with the notion that impressions derived from status and power associated with the group influence interest in engaging in behaviors consistent with a groups position. It is possible that masculine stereotypes indicate respect for the positions taken by the group (Wojciszke et al., 2009). The results suggest, however, that it is not just any type of masculine trait impressions of a group that predicts interest in engaging in group-consistent activism because negative masculine impressions, when they predicted interest in engaging in activism, predicted *lower* interest in engaging in group-consistent activism and greater interest in engaging in group-inconsistent activism. Negative masculine stereotypes suggest a potential misuse of power (Diekman and Eagly, 2000). Thus, the results suggest the possibility that oppositional activism could be spurred in part by viewing an issue public group as a threat. It is also consistent with the strategy of negative advertising in political campaigns suggesting that such strategies can be effective when it comes to promoting forms of activism and discouraging others.

In contrast, despite the fact that negative feminine stereotypes are as likely to be associated with the climate concerned as are positive masculine stereotypes (Swim and Geiger, 2018), in general these stereotypes do not appear to uniquely predict interest in engaging in either pro-climate or anti-climate activism. This suggests that neither warmth or lack of status can fully explain relations between these trait ratings and interest in engaging inactivist behaviors.

In contrast to the patterns of associations that were consistent with hypotheses based upon the social meaning suggested by gendered traits, our work did not find consistent evidence to support predictions derived gender role congruity theory. Specifically, we only identified one interaction that supported gender matching predictions derived from this theory: In Study

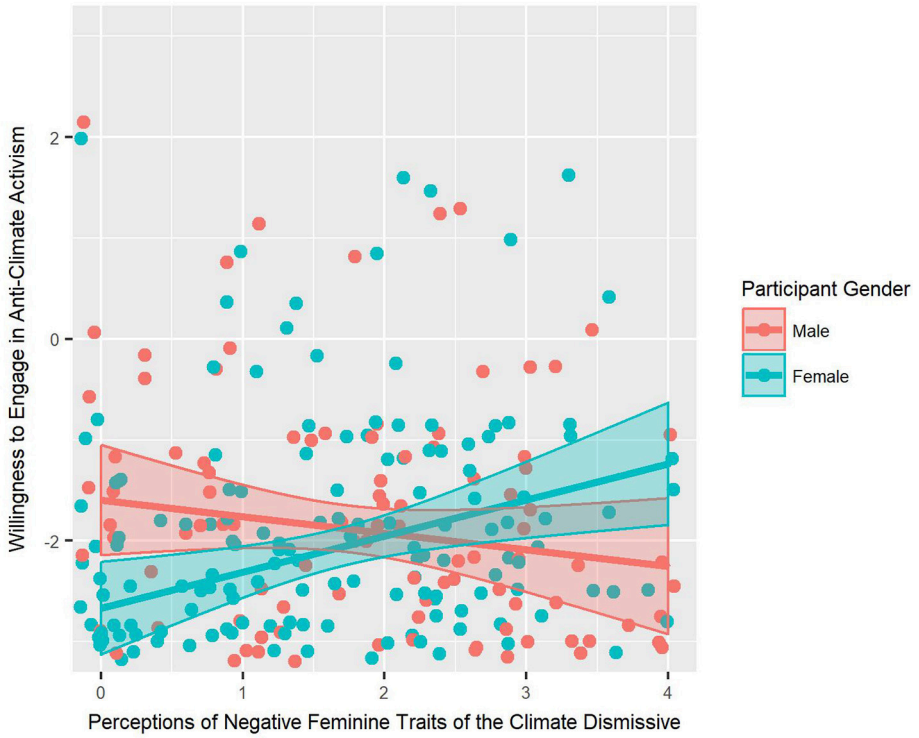

FIGURE 1 | Interactive effect of negative feminine trait perceptions of the climate dismissive and participants' own gender on interest in engaging in anti-climate activism (Study 2).

2, men were reported less interest in than women in engaging in anti-climate activism when they perceived that the climate dismissive had negative feminine traits. Yet, this interaction was counterbalanced by the exact opposite patterns found with the same outcome measure and positive feminine traits: in this case, men appeared to be more drawn to those perceived to have positive feminine traits than women. Because this pattern was not consistently identified across other analyses or in Study 1, we cannot draw firm conclusions from these findings, but we suggest that future work consider the possibility that men's aversion to femininity in certain circumstances may stem from negative aspects of femininity (being whiny and complaining) rather than positive aspects of femininity (being caring and kind).

We have several speculations as to why we did not find support for gender role congruity theory. First, the lack of gender role congruity effect for women is potentially explained by the tendency for masculine traits to be generally valued. Thus, as has been argued by researchers studying masculinity and different impacts of gender identity threats on women and men, gender role congruity effects may not be as potent for women as it is for men (Swim et al., 2018). For men, it is possible that taking a strong stance on climate change, either opposing or supporting it, is sufficiently agentic to overcome a potential threat of appearing feminine. Or they may believe that the feminine qualities would not be associated with them because these qualities might be reserved for women activists (Swim, under review). Second, gender role congruity theory may have not been supported in this specific context because decisions about whether or not to participate in climate change activism are more strongly driven by other identities, such as political orientation or party, that gender concerns are not as relevant. Yet, this latter explanation cannot explain why gender role congruity theory was not supported here but social value of traits theory was supported.

Limitations and Future Research

There are limitations to the conclusions that can be drawn based on the study design. For one, the cross-sectional designs we employed in both studies do not allow us to conclusively establish causality. Thus, there may be other possibilities for the observed findings which are not consistent with the theoretical background we proposed. For example, it is possible that those who are already interested in engaging in activism may alter their impressions of activists rather than the other way around (or the process could be bi-directional). To better test our proposed model as compared to these alternative possibilities, future research could devise an experimental study in which perceptions of the climate concerned or climate dismissive are experimentally manipulated, or alternatively, devise a longitudinal cross-lagged study design which examines changes in individuals' perceptions of activists and interest in engaging in activism are examined at multiple timepoints during a life period. Additionally, future work could consider measuring actual activism behavior rather than interest in activism to verify that interest in activism translates into actual behavior. It is possible that some people may indicate interest in engaging in activism opposing an issue

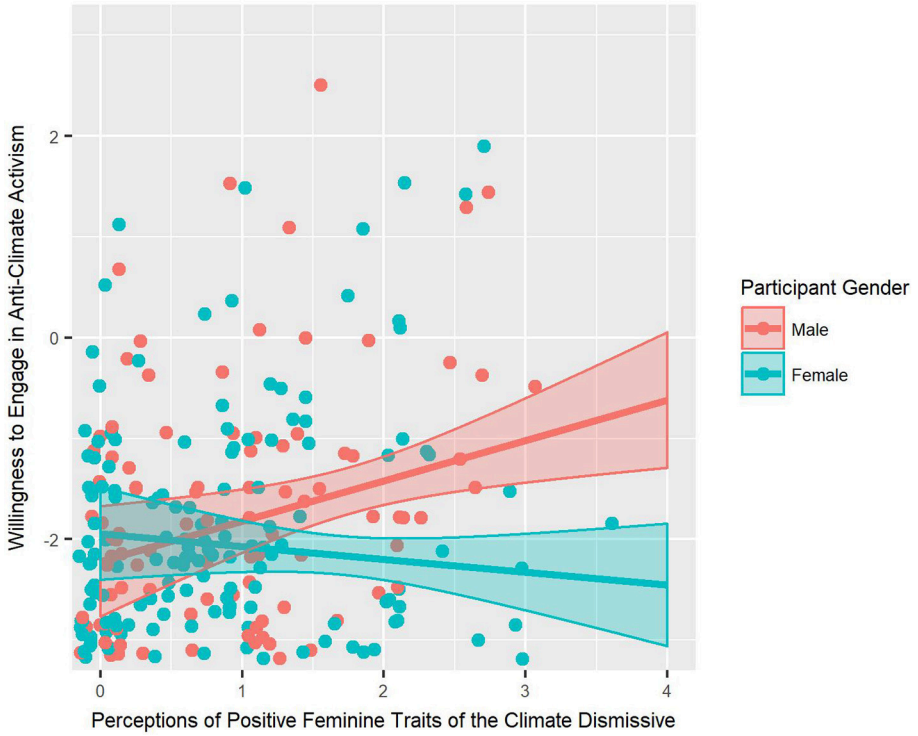

FIGURE 2 | Interactive effect of positive feminine trait perceptions of the climate dismissive and participants' own gender on interest in engaging in anti-climate activism (Study 2).

public's position but the public confrontational nature of the activism may dissuade them (Swim and Hyers, 1999).

Future work might also examine whether different framings of climate change could influence the extent to which gendered traits were ascribed to issue publics. For example, it is possible that use of "war" metaphors to describe climate change (Rao, 2015; McKibben, 2016) might lead people to ascribe masculine traits to climate change issue publics because war may be seen as a masculine venture.

Another direction for future research could be to test impressions of opinion groups on both sides of an issue as simultaneous predictors in the same study. Here, we tested them separately in Study 1 and Study 2. Yet, it is likely that perceptions of the climate alarmed are negatively correlated with perceptions of the climate dismissive. Including them both in the same model could improve our understanding of whether perceptions of the consistent issue public or the opposing issue public are better predictors of interest in engaging in activism.

Future work could also extend this work by considering a variety of political topics to examine whether the patterns identify in the present work replicate across different topics or whether they are specific to the topic of climate change. For example, it is possible that with regard to issues seen as "social issues" rather than "environmental issues" that the positive feminine traits may play a greater role since these traits are arguably related to caring about marginalized groups (a relevant consideration with regard to social issues), while people may not readily consider the justice implications associated with environmental issues such climate change (Swim and Bloodhart, 2018).

A final direction for future research could be to expand this research by considering the role that intergroup dynamics might play in the connections between perceptions of issue publics and interest in engaging in activist behavior. Although a discussion of intergroup relations and behavior is beyond the scope of the present work (but see footnotes 2 and 4 for exploratory analyses), recent work on the topic (Blatz and Mercier, 2018; Van Boven et al., 2018) suggests the potential for conceptual overlap between that work and the present theories. We suggest that future work might connect these two sets of literatures in the service of developing a model with more predictive power of who will ultimately engage in activist behaviors.

CONCLUSION

The present work builds upon an increasing trend among those using an intergroup perspective to understand social processes that influence climate change engagement (Bliuc et al., 2015; Pearson et al., 2016). Here, we illustrate the importance of considering the gendered nature of stereotypes that individuals have about social groups in predicting interest in engaging in activist behaviors. Our work suggests that masculine stereotypes about groups may be particularly relevant for understanding engagement in activism and that research can be best served by empirically separating positive and negative components of

masculinity when evaluating individuals' impressions of others. It is our hope this framework and these findings open up new considerations and possibilities for those interesting in understanding the complexities of how individuals come to engage in activism.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of name of guidelines, name of committee with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the Institutional Review Board at the Pennsylvania State University.

AUTHOR CONTRIBUTIONS

NG and JKS developed the study concept. Data collection was performed by JKS. NG performed the data analysis and interpretation under the supervision of JKS. NG drafted the manuscript, and JKS provided critical revisions. All authors approved the final version of the manuscript for submission.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

APPENDIX

Study 1 participants read the following four quotes, which were obtained from open-ended responses collected from participants in a different study: (1) *"Climate change is a topic that needs to be addressed. Nobody seems too concerned about it and by the time people really want to do something about it, it will be too late"*; (2) *"I find it unacceptable that those who did not even complete a science course in our tax-sponsored school system (some of who are now in government) claim to understand all about science, and presume to deny the findings of science while the rest of us continue to overheat"*; (3) "*While I agree that a lot of the proposals would negatively impact the economy, I believe that we need to do something about climate change, even if it's a small step, and that needs to be done now, not later. I favor an incremental approach, but that approach should start today"*; (4) *"Climate change is real, and it appears that policymakers are simply wringing their hands, refusing to find real solutions to problems. I think that at this point, any and all measures are helpful, both simple policies and far-reaching policies."*

Study 2 participants read the following four quotes (which were also obtained from participants in another study): (1) "There is new support for the theory that radiation from sunspots are ultimately behind global warming–not man-made causes of carbon emissions. We're in a season of particularly high solar activity"; (2) "I remember when I was young that they were warning about the coming ice age. Al Gore's 2007 prediction that all arctic ice would be gone by 2014 is now proven to be alarming fear mongering. It's all about money and power"; (3) "Numerous scientists are admitting they falsified data. The agenda originally was global warming, now climate change. Antarctica has more sea ice now than in past decades. It is truly sad people blindly follow this hoax being played on them by academia, the media, and government"; and (4) "The climate is changing as it has been for millions of years. We are not going to be able to change that regardless of how much money we spend".

In both studies, the quotes were paired with either a) four male names (Philip, Robert, Andrew, David), b) four female names (Julie, Diedra, Emily, Isabella) or c) two female and two male names (Julie, Philip, Diedra, Andrew).

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To Support a Stronger Climate Movement, Focus Research on Building Collective Power

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Building public will to address the climate crisis requires more than shifting climate change opinion or engaging more people in activism. Despite growing activism, the climate movement still needs to do more to translate public action into the power needed to effect meaningful change. This article identifies the kinds of research questions that need to be answered to bridge the gap not only between opinion and action, but also between action and political power. We draw on discussions from a conference that brought social scientists together with climate advocates in the United States. At this conference, movement leaders argued that to better support building a robust climate movement, research should move beyond traditional public opinion, communications, messaging, and activism studies toward a greater focus on the strategic leadership and collective contexts that translate opinion and action into political power. This paper thus offers a framework for synthesizing research on movement-building that demonstrates ways to focus research on power, and emphasizes the importance of organizing collective contexts in addition to mobilizing individuals to action.

Keywords: climate change, social movements, activism, power, organizing

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INTRODUCTION

Building public will to address the climate crisis requires more than shifting climate change opinion or engaging more people in activism (Raile et al., 2014). By many measures, the climate movement today is stronger than ever: more people taking actions, more financial resources, and deeper concern. Nonetheless, despite increasingly widespread popular demand for sensible climate solutions (Leiserowitz et al., 2017; Hestres and Nisbet, 2018) and broad organizational infrastructure to support climate activism across most Westernized democracies (Brulle, 2014), public will that translates into the political power needed to effect meaningful change has been elusive (McAdam, 2017). Even the 2014 and 2017 People's Climate Marches that drew hundreds of thousands to the streets, demonstrations in support of the Paris Climate Accords, and large-scale acts of civil disobedience in opposition to the Keystone XL and Dakota Access pipelines have resulted in only short-lived campaign victories. Nearly 10 years after the failure to pass comprehensive climate and clean energy legislation at the federal level, experts largely agree there is "little hope" existing policies are sufficient to address the scale of the crisis (Keohane and Victor, 2011).

How can research help bridge the gap not only between opinion and action, but also between action and power? Many articles in this special edition examine the question of the conditions that make it more likely individuals will take action around climate issues. Indeed, the gap between

opinion and action is well-known (Kahan and Carpenter, 2017), and burgeoning research in many fields of social science seeks to bridge it (Rickard et al., 2016; Doherty and Webler, 2016; Feldman and Hart, 2018). One of us works for the Climate Advocacy Lab, which supports field experimentation through direct funding and in-kind research assistance to build our collective understanding of the most effective strategies for moving people into action.

There is less attention, however, to the question of how those actions might translate into political influence. The challenge is this: in most cases, the null assumption is that activism becomes power at scale: that collective action is merely the sum of its parts, and the more people who take action, the more likely a movement is to achieve its goals. All things being equal, it is true that more is better (Madestam et al., 2013). Additional research, however, shows that for our stickiest social problems (like climate change), simply having more activists, money, or other resources is not sufficient to create and sustain the kind of large-scale change needed (Baumgartner et al., 2009; Canes-Wrone, 2015). Instead, we need a social movement that translates our actions into power. Social movements are a set of "actors and organizations seeking to alter power deficits and to effect transformations through the state by mobilizing regular citizens for sustained political action" (Amenta et al., 2010). Instead of focusing only on resources, movements focus on power. Instead of focusing only on individual action, they focus on collective action. To become a source of power, collective action must be transformative.

How, then, do we build the kind of movements that generate the collective action necessary to shift existing power dynamics? For scholars, what research can help advocates understand how to translate individual actions into the powerful, and transformative collective action necessary to create change? To examine this question, we co-hosted a conference that brought social scientists together with climate advocates in the United States. At this convening, movement leaders argued that to better support building a robust climate movement, research should move beyond traditional public opinion, communications, messaging, and activism studies toward a greater focus on the strategic leadership and collective contexts that translate opinion and action into political power. This paper thus offers a framework, described in **Table 1**, for synthesizing existing research on movement-building and highlighting the places where additional research is needed. We hope this framework can help focus more future research on the collective, relational contexts and strategic leadership choices necessary to generate collective action that translates into power. In describing the framework, we draw on Slater and Gleason's (2012) typology to show what we know and do not know about supporting movement actors seeking to make more impactful choices.

ASSESSING THE STATE OF RESEARCH ON CLIMATE MOVEMENT BUILDING

How do movement leaders translate supportive public opinion and grassroots activism into political influence? Answering this question rests on first understanding a few key points about social movements. First, movements operate in an environment of uncertainty. For the climate movement, everything from oil spills to hurricanes, domestic elections to international treaties, legal decisions, and market forces can affect the terrain they must navigate. Movement leaders cannot directly control many of these things. Second, policy change is not power. A given policy change will not automatically effect change in the world consistent with movement interests (Hacker, 2004). Moreover, policies can be easily overturned, as exemplified by the transition from Obama to Trump, and immediate rollback of key policies including the Clean Power Plan, restrictions on drilling and mining on public lands, and coal ash protections. To create lasting power, movements need broad constituencies that persist through the ups and downs and whims of different administrations. Third, there is no direct line from activism to power, because power is a dynamic relationship between movements and their targets. To wield power, movements use their resources to act on the interests of political decision-makers (Hansen, 1991). In fact, some research suggests the advocacy group resources most predictive of large-scale policy change are relationships with decision-makers—more so than lobbying money, campaign contributions, or the number of grassroots members (Baumgartner et al., 2009). Some argue that the climate movement's failure to build and sustain the kind of constituency that would pressure decision-makers contributed to the failure of cap-and-trade legislation in 2010 (Skocpol, 2013).

Given these three factors—persistent uncertainty, the need to focus on power not policy, and the complex interests of movement targets—what are the questions movement leaders need to answer to build a more effective climate movement? We argue that most research has focused either on documenting trends in the political environment in which movements work or on questions of how the movement can focus on building more of its resources (such as more supportive public opinion or more activists). Those questions are important. Particularly in today's uncertain, dynamic political environment, however, we also need research on strategy: how do movements create the leadership capacities and organizational (or "meso-level") conditions needed to navigate uncertain political situations and shifting relationships, and thus translate resources to power?

Organizations that have successfully wielded power in other issue areas can be instructive in showing why understanding strategic leadership and meso-level, collective contexts matters. Consider the gun debate in the United States. Polls show strong public support for stricter regulation of guns, advocates like Michael Bloomberg have poured hundreds of millions of dollars into the fight, and protests have brought millions of people into the streets for gun control. Nonetheless, the National Rifle Association (NRA) has been more effective in translating its activists and resources into political power. Why? First, leaders within the NRA undertook an intentional campaign to build an ardent constituency of gun owners that was willing to stand together, again and again, through ups and downs of any political fight, to support gun rights. As recently as the early 1970s, the NRA supported sensible gun regulations. Beginning in the 1970s, however, a group

TABLE 1 | A framework for research on movement-building.

Level of intervention		Types of leadership choices	
	Trends: Research on social, political, and demographic trends that help advocates understand the current socio-political environment and how it is changing.	**Tactics:** Research on tactics or best practices to help advocates perform more effectively, such as engaging people in activism, contacting elected officials, etc.	**Strategies:** Research helping to develop mental models or theories of change about how people, organizations, and social change processes work to shape strategy, allocation of resources, etc.
Micro: Research about the mass public (not elites), individual behavior and attitudes, including aggregate trends treated as the additive sum of individual behaviors, i.e., public opinion.	Understanding how individual attitudes, preferences, implicit biases, or behaviors have been changing: public opinion research, voting behavior, demography (race, class), etc.	Understanding best practices for shaping individual attitudes and behaviors: e.g., get-out-the-vote research, mobilization studies, counteracting implicit bias or misinformation; behavioral nudges, etc.	Research seeking to develop mental models about preference formation, human motivation, role of social pressure and social norms, identity development, etc.
Meso: Research about organizational, campaign, or network-oriented actions and behaviors in which the outcomes are collective.	Understanding how the organizations, networks, and other vehicles of movement building have evolved historically; changing trends in the information and communications approaches organizations use, etc.	Understanding the collective conditions organizations, campaigns, and the like can create to make certain behaviors and leadership capacities more likely: e.g., network studies, importance of relational conditions in sustaining activist engagement over time, research on distributed organizing and other structures, management studies, etc.	Research on leadership, organizational theories of change; studies of social movement outcomes, theories of collective action and the way collective action problems (and solutions) underlie many meso-level challenges, etc.
Macro: Research about the structures, institutions, and processes that shape the playing field on which movements operate.	Research on broad narratives and assumptions that shape climate movements, changing trends in the policy and media environment; structural ways policies and institutions disproportionately affect different groups; etc.	Research on what conditions support successful coalition (such as a shared organizing framework, like the Jemez Principles or time dedicated to trust and relationship-building); research on policy levers that can be used to enact environmental outcomes; research on other institutions or processes (such as the way media shapes the information environment, voter access laws, c3/c4 laws, money in politics) that shape movement outcomes; research on governmental responsiveness; etc. What types of campaigns lead to counter movements.	
Linking levels: Interactions between all levels.	Systems research, research on the feedback loops that connect institutional and policy outcomes to individual and organizational behavior (policy feedbacks, civic feedbacks), etc.		

Although the boundaries between the categories are fluid, we chose this approach to try to make clear the range of interventions practitioners can make to shape movement-building outcomes. Sample research topics are in each box. Boxes shaded in light green indicate the places where the most research is needed.

of hardline conservatives took control of leadership of the organization (Melzer, 2009).To build constituency, they used three key tactics: widespread benefits provided to gun owners from the national organization, strong appeals to identity, and a complex latticework of interpersonal relationships sustained at the local level (LaCombe, forthcoming). Second, leaders strategically leveraged this constituency to negotiate relationships with the Republican Party. The recurrent ability of leaders to deliver support from this constituency for policymakers became the basis through which the NRA built high-level relationships with elected officials and the Republican Party, thus cementing its hold over gun policy in the United States. By linking base-building with elite politics, the NRA transformed the political dynamics around gun rights.

The story of the power of the NRA in the last generation, thus, is a story about strategic leadership choices, and particular choices about how to leverage meso-level, collective contexts to shape a new kind of constituency around gun ownership. The NRA's base was built through work they did to create organizational settings around the country in which people developed collective identities as gun owners, and undergirded those identities with overlapping networks of relationships.

Research on climate activism, however, is not as robust on questions about strategic leadership or meso-level contexts as it is on questions of individual behavior and opinion change. How can the climate movement learn to build the same kind of strategic leadership and politically influential organizations from a durable, coherent constituency? The diffuse ecosystem of climate and clean energy advocacy organizations coupled with the complexity of the issue and requirement of significant cultural and economic shifts to address systemic drivers of the problem—necessitate deeper, evidence-informed recommendations from the academic community. Answering these key questions will require additional research on meso- and macro- level leadership choices, as depicted in **Table 1**.

Table 1 provides a framework for research on movement-building to show where questions about strategy and collective action can fit alongside existing work. The columns in **Table 1** distinguish between research that documents trends, or political conditions that shape the work movements do, and leadership choices, or the kinds of tactics and strategies movements can use. The rows depict the different levels at which trends can be studied or advocates can make interventions: individual (micro), organizational (meso), and institutional (macro). Examples of the kinds of research topics that fall into each category

are listed in the boxes. We are not claiming this is a comprehensive overview of climate movement research, or the only way to organize the research. Instead, it emerged from our conversations with advocates and is intended to sharpen our understanding of the places where research can support their work.

Looking first at the columns, we argue that we have more research on trends and tactics than we do on strategy. A robust body of research on social movements focuses on the external political conditions, or trends, that make movement outcomes more likely—for example, how partisan majorities in legislatures shape outcomes (see e.g., Amenta et al., 2010 for a summary). The power of structural trends in shaping political outcomes makes this a fertile area of research. Advocates argued, however, that although they need to understand those trends, they also need research on actionable choices where they can exercise agency, however, marginal the effects may be. Thus, the second and third columns examine choices movement leaders can make to increase the likelihood they will build the collective power need to win. In looking at these columns, however, we argue there is more work on tactics (such as questions around what kind of messaging is most effective) than strategy (such as broader questions asking which theories of change are most effective under what conditions), with most research focusing on the question of generating individual (micro-level) action.

Looking at the rows, we argue that there has been much more research at the micro-level, tracking the causes and consequences of individual behavior and opinion, than research at the meso or macro levels. Developing research at the meso-level can help movement leaders work smarter, not just harder, allowing them to more effectively mobilize resources in support of strategies and tactics that support collective action and build power. Focusing only on the attributes and behaviors of individuals at the expense of the meso-level can limit movements in two ways: first, it leaves many organizations struggling to scale outreach to ever larger groups of individuals; second, it focuses on selection instead of socialization, limiting our understanding of how to generate activism to the kinds of people who are easiest to activate, regardless of whether of those constituencies are the ones most essential to long-term power building efforts. This approach also can ignore the many ways in which people's citizenship is shaped by social and collective contexts, the relational processes that make movements work, and the way those contexts vary across diverse groups. Research shows the most durable, powerful constituencies emerge from collective contexts that transform people's interests, capabilities, relationships, and commitment to each other (Han, 2014). Just as gun clubs are crucibles for constituency-building in the NRA, so too were churches in the Civil Rights Movement, and locally created efforts to shut down bars in the temperance movement at the turn of the twentieth century. What is the equivalent for the climate movement? Environmental organizations have long been organized at the local level, around community-focused campaigns, fighting toxic waste facilities or coal-fired power plants, as well as shared interests in activities such as birds or hiking. More work can be done to parlay their large, dedicated member based into a politically powerful constituency.

There is also further work to do at the macro level, and linking across levels. How do climate and clean energy-focused organizations operating at sub-national, national, and international levels coordinate and collaborate more effectively to be mutually reinforcing? How do movement organizations create the conditions that make it likely their leaders will have the strategic capacity to figure out how to turn the resources they have into the political power needed to address the climate crisis (Ganz, 2000)?

In sum, we argue that existing research has taught us most about the micro-foundations of opinion and behavior on the climate (the top row), and the socio-political trends (the left column) that shape a movement's ability to achieve its goals (Amenta et al., 2010; McAdam, 2017). In Slater and Gleason's (2012) framework, much of the research on these topics would fall into what they refer to as Strategy 2, 3, or 4—in other words, this is an area in which a great deal of robust theory has been developed and scholars are doing studies to better understand how the theories apply in different contexts, what variables mediate and moderate the effects, and what some of the indirect pathways to change might be.

Relatively speaking, we have much less research on the strategic leadership choices that can be made at the meso and macro levels to build the climate movement we need (highlighted in green on the table). At the conference, advocates argued that more research is needed in these areas to offer leaders guidance on how to move beyond motivating individual actions toward building collective constituencies that have the flexibility and commitment needed to act on the interests of public officials over time, even as external conditions and internal movement priorities shift. Although important foundational research in this area exists, more work is needed, given the challenges of the current political context. In Slater and Gleason's (2012) framework, we would argue that research in this area is more at the stage of what they define as "theory development," which is strategies 6 and 7 in their typology.

CONCLUSION

The Social Science Citation Index lists over five thousand research papers published over the last 5 years that reference "climate change" or "global warming," offering insights for organizations at the micro and meso-level of intervention, helping inform the climate movement's approach to strategy, tactics, and communication. This body of research has contributed to the success of a number of important campaigns from stopping the construction of fossil fuel development and distribution infrastructure to shaping renewable energy portfolio standards to informing tactical decisions around decisionmaker contact and digital communications.

In our work with climate advocates, however, we hear that more research at the macro-level is needed to support decision-making around movement strategies. In particular, researchers

can make an invaluable contribution toward addressing the climate crisis by helping to identify choice points that make it more likely movement leaders will build sufficient, lasting political power. Movement leaders are obviously not the only audience researchers seek to reach in building a knowledge base about the climate movement; but for a body of work focused on such an urgent and critical topic, movement leaders are certainly a relevant audience. This paper is an effort to organize research in a way that helps speak to their needs. Through this kind of research, we can learn to build vehicles that will translate people's actions into political voice.

AUTHOR CONTRIBUTIONS

HH and CB-L contributed equally to the intellectual development of this paper. HH took the lead in writing.

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Climate Change Activism Among Latino and White Americans

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Research indicates that Latinos have particularly strong pro-environmental attitudes and support for policies to reduce climate change. This study explores differences in climate change activism (i.e., contacting government officials) between Latino and non-Latino White citizens in the United States, and the individual and social factors that predict engagement. Two parallel, nationally representative surveys find that Latinos (n = 1,433) are more likely than Whites (n = 861) to report having contacted a government official in the past and are more willing to contact officials in the future. Key predictors of Latinos' significantly higher levels of political engagement include greater risk perceptions, egalitarian worldviews, pro-environment injunctive norms, collective political efficacy, and greater social network effects. Competitive mediation analyses find that stronger risk perceptions best predict differences in climate change activism between Latinos and Whites. Climate change communicators might particularly seek to amplify Latinos' pro-climate tendencies (e.g., heightened risk perceptions) and social norms to encourage greater climate action by this vital and growing segment of the U.S. population.

Keywords: climate change activism, political action, public will, Latinos, risk perceptions

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INTRODUCTION

Climate change is one of the greatest threats—and opportunities—of the twenty-first century. While research consistently shows that unchecked climate change will have "severe, pervasive and irreversible impacts for people and ecosystems" (IPCC, 2014, p. 8), climate solutions, including clean energy, energy efficiency, and community resilience can greatly improve public health, security, and economic growth, among other benefits (e.g., APA, 2009; Edenhofer et al., 2011; Environmental Protection Agency, 2018).

Addressing climate change, however, represents a "massive collective action problem" [(Roser-Renouf et al., 2016, p. 4760; see also IPCC, 2014)]. While changes in individual behavior (e.g., recycling, energy conservation) can benefit the environment, increased political action—across diverse publics and scales—is necessary to pressure elected officials to enact policies to limit the carbon pollution causing global warming. Activism can be an important influence on the policy-making process, because without public pressure, it is unlikely that governments will prioritize climate change (Ockwell et al., 2009).

In other words, the expression of public will through activism is necessary, although not sufficient, to address climate change. Public will refers to a "social system's shared recognition of a particular problem and resolve to address the situation in a particular way through sustained

collective action" (Raile et al., 2014, p. 105). Indicators of public will and collective action on climate change include contacting government officials, public support for mitigation policy, and pro-climate consumer behavior like purchasing energy efficient vehicles. According to Raile et al. (2014), the term "public" does not simply refer to a majority group or a collective mass—many diverse "publics" exist and can be activated at any given time. In the United States, Latinos may represent a particularly important issue public (Krosnick, 1990).

Latinos comprise 17.4% of the U.S. population (55 million people), are the second-largest racial/ethnic group in the nation, and are projected to reach 24% of the population by 2065. Politically, 27.3 million Latinos are currently eligible to vote, and represent a critical group of voters in local, state, and national elections, especially in swing states such as Colorado, Florida, and Nevada (Pew Research Center, 2012). Latinos express stronger positive environmental attitudes and pro-environmental views than other Americans (Leiserowitz and Akerlof, 2010; Speiser and Krygsman, 2014; Pew Research Center, 2015; Krygsman et al., 2016; Macias, 2016a,b; Pearson et al., 2017, 2018). In a recent nationally representative survey of the U.S. population, Latinos were more likely than non-Latinos to be convinced that global warming is happening, think that it is human-caused, worry about it, and support climate policy (Leiserowitz et al., 2017). Latinos were also consistently higher than non-Latinos on other responses to climate change including issue involvement, personal importance, and collective political efficacy (i.e., believing that working together people can affect the government). Other studies have found that Latinos have heightened perceptions of vulnerability to climate change: for instance, they are more likely to perceive climate change as a health threat, relative to Whites (Akerlof et al., 2015).

Relatively less work, however, has examined whether Latinos are also more likely to *act* on climate change. In fact, some research suggests the opposite—that there may be a gap between heightened concern and taking action on climate issues among Latinos. In one study, Latinos were more likely to self-identify as "active supporters" of environmental movements than Whites (Greenberg, 2005); yet in another study, Latinos were less likely to join environmental groups (Johnson et al., 2004). Other research, though limited, has suggested that Latinos may be less politically engaged in climate change (Gibson-Wood and Wakefield, 2013) and other important issues than are other demographic groups (e.g., Arvizu and Garcia, 1996; Cassel, 2002; see also Jones-Correa et al., 2018). For example, in the 2016 Presidential Election, only 48% of eligible Latino voters voted compared to 60% of Blacks and 65% of Whites (U.S. Census Bureau, 2017).

Understanding the potential gap between Latinos' concern on the one hand, and their political behavior on the other, represents an opportunity to advance the national conversation and response to climate change, in addition to facilitating climate change activism among a fast-growing demographic.

The present study takes an exploratory approach to investigate differences in climate change activism between Latino U.S. citizens and non-Latino White U.S. citizens[1]. We focus specifically on the act of contacting government officials in the past 12 months and intentions to contact government officials in the future. We investigate the individual and social factors that predict Latinos' differential levels of political engagement, which can also inform climate change communicators (e.g., elected officials, advocacy organizations, national media) to more effectively engage this growing segment of the U.S. population. We follow two approaches as described in Slater and Gleason (2012). Specifically, we test known predictors of engagement in a specific population, Latino Americans (Strategy 2c), and the factors that *explain* differences in engagement between Latinos and Whites (Strategy 3.1 and 3.7 on mediation). Specific research questions include:

1. To what extent do Latinos and Whites differ in climate change activism (i.e., contacting government officials) to address global warming?
2. What are the key predictors of activism among Latinos and Whites?
3. To the extent that there are differences in activism between Latinos and Whites, what are the key factors that explain these differences?

The following review summarizes key individual, social, and cultural factors that have been shown to predict pro-climate behavior and activism in previous research. Although our research is generally exploratory, we make specific predictions, based on previous research, about the factors that are likely to predict climate change activism.

PREDICTORS OF CLIMATE CHANGE ACTIVISM

Ideology and Belief Systems

Party Affiliation and Political Ideology

In the United States, political views are consistently among the strongest predictors of public climate change opinions and engagement (e.g., McCright and Dunlap, 2011; Brulle et al., 2012; Hornsey et al., 2016). For instance, Republicans and conservatives are less likely to think climate change is happening and support climate policy than are Democrats and liberals, respectively (McCright et al., 2013). Given that partisanship and political ideology represent key correlates of environmental views, we expect that individuals affiliating more with the Republican party (compared to the Democratic party) and individuals with stronger conservative (as opposed to liberal) ideologies will be more likely to engage in climate change activism.

[1]Because, the present research focuses on the predictors of *political* engagement in the U.S., we conducted analyses using only respondents who are U.S. citizens. Latinos in the U.S. who are not citizens are less likely than Latino citizens to engage in the political behaviors we focus on. Future research might examine the factors that explain differences in engagement between Latino citizens and non-citizens as this was not the focus of our study.

Worldviews

Social, political, and cultural attitudes toward the world (i.e., worldviews) orient people's actions (Dake and Wildavsky, 1990, 1991; Dake, 1991, 1992). Individualism, egalitarianism, and fatalism are worldviews that each predict climate change risk perceptions and engagement. People with individualistic worldviews value freedom and fear constraints on their autonomy (e.g., regulations), and thus tend to oppose climate policies (Leiserowitz, 2006) and have low engagement in climate change activism (Roser-Renouf et al., 2014). Conversely, those with egalitarian worldviews (i.e., valuing fairness, equal opportunity, and social justice) tend to support climate policies (Leiserowitz, 2006) and engage in activism more (Roser-Renouf et al., 2014). Fatalists tend to believe that events are predetermined and lack motivation to act on climate issues; thus, they tend to be less supportive of climate policy (Leiserowitz, 2006) and less engaged in activism (Stern et al., 1999). We expect similar relationships in the present study: egalitarianism will be positively associated with climate change activism and individualism will be negatively associated. Similarly, we expect that political fatalism—the belief that political action is ineffective—will be negatively associated with activism.

Prior research also indicates that Latinos may have stronger egalitarian values than other racial/ethnic groups (Johnson et al., 2005; Carter et al., 2013). Egalitarianism may thus be a key predictor of activism among Latinos and may help explain differences in political engagement between Latinos and non-Latino Whites.

Collective Political Efficacy

People are more likely to act on climate change when they have a sense that they can help address the problem. Conversely, low efficacy poses barriers to climate action, including issue avoidance, and feelings of helplessness (e.g., Lorenzoni et al., 2007). There are several forms of efficacy including response efficacy (the belief that actions to reduce a threat will be effective), self-efficacy (the belief that one can make a difference), and collective efficacy (the belief that a group of people working together can make a difference) (e.g., Bandura, 2000; Witte and Allen, 2000). Efficacy beliefs are found to strongly motivate climate change activism (Roser-Renouf et al., 2014) and collective action more broadly (van Zomeren et al., 2008). Similarly, in this study, we expect that collective *political* efficacy (i.e., beliefs that people working together can affect what the government does) will be associated with climate change activism for both Whites and Latinos.

Barriers to Activism

Many individuals are unsure which actions to take to help address climate change, and barriers—including psychological, social, and structural—make it especially difficult to perform effortful actions like contacting a government official (e.g., Lorenzoni et al., 2007; Gifford, 2011; Roser-Renouf et al., 2014, 2016). A barrier refers to "an impediment to specified adaptations [or actions] for specified actors in their given context that arise from a condition or set of conditions" (Eisenack et al., 2014, p. 868). For contacting a government official—as the focal action of interest—we consider multiple barriers including factors related to identity (e.g., "I am not an 'activist'"), knowledge (e.g., not knowing who to contact), and social influence (e.g., being criticized by others). Together, we expect that the more barriers to contacting a government official Latinos and Whites perceive, the less likely they are to have done so in the past or to plan to do so in the future.

Risk Perceptions

Prior research has found that perceiving global warming as a personal and global threat motivates action to address it (e.g., O'Connor et al., 1999; Leiserowitz, 2006; Zahran et al., 2006; Roser-Renouf et al., 2014). Latinos have higher risk perceptions about global warming than other demographic groups (e.g., Leiserowitz et al., 2017). In a recent nationally representative survey, Latinos were more likely than non-Latinos to think global warming will cause "a great deal" of harm to nature and people (e.g., the world's poor, people in the U.S., their family), including themselves (Leiserowitz et al., 2017). Latinos were also more likely to say that they have personally experienced the impacts of global warming (53 vs. 39% of non-Latinos). We expect that perceiving global warming as a risk will be positively associated with climate change activism and may explain differences in engagement between Latinos and Whites.

Social Influence

Social Norms

Social norms about other people's behavior can be powerful sources of social influence (e.g., Cialdini et al., 1990; Schultz et al., 2007). Norms can be categorized as being descriptive or injunctive. Descriptive norms refer to what other people are doing, whereas injunctive norms refer to what people ought to be doing. Substantial research indicates that when these social norms are aligned—that many people are doing it and it is socially approved—they can strongly facilitate pro-environmental behavior (e.g., Goldstein et al., 2008; Nolan et al., 2008; Karlin et al., 2015). Previous research also finds that beliefs about injunctive norms (e.g., thinking that the government should be doing more to address global warming), in particular, predict climate change activism (Roser-Renouf et al., 2014). In this study, we focus on the norms of people close to the self: family and friends. We hypothesize that beliefs about descriptive norms (i.e., how much of an effort family and friends make to reduce global warming) and injunctive norms (i.e., how important it is to family and friends that you take action) are both predictors of activism.

Additionally, normative influence may also help explain differential levels of engagement between Latinos and Whites. From a cultural perspective, collectivism, or valuing the needs and goals of the group as a whole over the individuals within the group, tends to be stronger among Latinos in comparison to Whites (Oyserman et al., 2002). Families, in particular, play an important role in Latino culture (e.g., Keefe, 1979; Gaines Jr et al., 1997). Previous research indicates that Latinos tend to value familialism (a sense of solidarity, loyalty, and attachment to nuclear and extended family members) more than do Whites

and maintain more frequent contact with family members (Comeau, 2012). We expect that these cultural factors may affect the relationship between normative influence (from family and friends) and political activism for Latinos; that is, differences in social norms may explain why Latinos are more or less engaged than Whites.

Social Network Effects

The extent to which people hear others, including family and friends, talk about global warming, can signal how important the issue is and influence action. Interpersonal communication is theorized to be instrumental to public engagement and collective action on climate change (Swim et al., 2014; Clayton et al., 2015). When people become aware of others' concern about the threat of climate change, they become more willing to discuss the issues with others (Geiger and Swim, 2016) and perform individual and collective actions to address the problem (Swim et al., 2017). More generally, political discussion has been positively linked to several forms of political participation (e.g., voting likelihood, contacting political candidates; La Due Lake and Huckfeldt, 1998; Wyatt et al., 2000). Thus, we expect that hearing others (e.g., family, friends, coworkers) talk about climate change will be positively associated with activism.

Received Media Coverage

Generally speaking, the mass media determines whether and how issues are covered, thus influencing public perceptions, and opinions on the issue (e.g., Weingart et al., 2000; Slater, 2007; Feldman et al., 2014). The influence of the mass media on public perception can be both direct and indirect. For instance, information from elite media sources can get filtered through "opinion leaders" who then play a key role in disseminating information to the broad public (e.g., Katz and Lazarsfeld, 1995/2017). Thus, people's understanding and opinions on issues can be affected by how often they hear about them in the media. On the issue of climate change, people who pay attention to it in the media are also likely to be strongly involved and engaged in the issue (Nisbet and Kotcher, 2009). Further, because media coverage of political issues can facilitate political participation (e.g., Rojas, 2010; Ho et al., 2011), we expect that hearing about climate change in the media will predict taking political action on climate change.

Contact From Environmental Organizations

Contact from environmental organizations (e.g., emails, social media posts) is a common practice to promote actions including making donations, joining campaigns, and reaching out to government officials; however, more work is needed to understand the effectiveness of these outreach efforts (Roser-Renouf et al., 2014). In the present study, we test the extent to which being contacted by an environmental organization positively predicts climate change activism.

MATERIALS AND METHODS

Data come from two nationally representative surveys conducted simultaneously within the United States. A survey of Latinos was fielded from May 18 to June 8, 2017 and the other survey, which included non-Latino White respondents, was fielded from May 18 to June 6, 2017. The surveys were conducted using GfK's KnowledgePanel Latino® and KnowledgePanel®, respectively, which consist of online panels of members drawn from the U.S. population using probability sampling methods. Potential panel members were recruited using random digit dial and address-based sampling techniques to cover essentially all (non-institutional) residencies. Those who chose to join the panel but did not have Internet access were loaned computers and provided Internet access. Key demographics (age, gender, race, education, income) were weighted, post survey, to match U.S. Census Bureau norms for Latinos in the Latino survey and for the U.S. population as a whole in the survey that included non-Latino Whites. Forty-six percent of invited participants completed the survey of Latinos, and 51% of the invited participants completed the general U.S. population survey.

Participants

The initial sample of Latinos included 2,054 adults 18+ living in the U.S., 1,571 of whom were U.S. citizens and were, thus, considered for these analyses. The representative U.S. population sample included 1,266 adults 18+, 932 of whom were non-Latino Whites. Additional cases were excluded from both samples due to excessive missing data (see Missing Data).

The resulting Latino citizen sample ($N = 1{,}433$) was, on average, slightly younger ($M = 42.9$ years old, $SD = 16.4$) than the resulting White sample ($N = 861$, $M = 49.5$ years old, $SD = 17.6$). The the gender distributions of the samples were similar: 52.5% of Latinos were male in comparison to 49.6% of Whites. Annual household income was slightly greater in the White sample, but the distributions were similar: most respondents earned <$75,000 per year (59% of Latinos, 50.6% of Whites) and the modal group was those with household incomes of $100,000 or more (25.1% of Latinos, 36.5% of Whites). The majority of Latinos had a high school degree (32.5%), followed by some college (30.2%), and a Bachelor's degree or higher (19.2%), whereas the majority of Whites had a Bachelor's degree or higher (33.9%), followed by some college (29%), and a high school degree (28.7%).

There were also some geographic differences between the Latino and White samples. A greater proportion of White respondents lived in the Northeast (19.1% of Whites) and Midwest (27.2%) compared to Latinos (15.4% and 9% of Latinos, respectively). Conversely, a greater proportion of Latinos lived in the South (38.5% of Latinos) and West (37.1%) relative to Whites (33% and 20.7%, respectively). However, regional differences between samples had little or no effect in explaining differences in activism between Latinos and Whites (see **Supplementary Material**).

Measures

Party Affiliation and Political Ideology

Respondents completed several questions about partisanship and political views. To indicate party affiliation, respondents were asked "Generally speaking, do you think of yourself as…" with the following choices: "Republican," "Democrat," "Independent,"

"Other," and "No party/not interested in politics." As a follow-up, respondents who identified as a Democrat or Republican were asked if they consider themselves a strong Democrat or Republican (respectively), or not a very strong Democrat or Republican. Independents were asked if they consider themselves closer to the Democratic or Republican party, or neither. Together, responses to these questions formed an ordinal composite consisting of seven groups (e.g., strong Democrats, not strong Democrats, leaning Democrats, Independents, and so on).

Political ideology was measured with a single question, "In general, do you think of yourself as…" with five response options: "Very liberal," "Somewhat liberal," "Moderate, middle of the road," "Somewhat conservative," and "Very conservative."

Worldviews

Egalitarianism, individualism, and political fatalism were measured with items rated on 4-point scales ranging from 1 ("Strongly disagree") to 4 ("Strongly agree"). Respondents were asked to rate how much they agree or disagree with three egalitarian statements (e.g., "The world would be a more peaceful place if its wealth were divided more equally among nations," $\alpha_{Latino} = 0.75$, $\alpha_{White} = 0.77$), three individualism statements (e.g., "The government interferes too much in our everyday lives," $\alpha_{Latino} = 0.75$, $\alpha_{White} = 0.85$), and two political fatalism statements (e.g., "It's no use worrying about public affairs; I can't do anything about them anyway," $\alpha_{Latino} = 0.75$, $\alpha_{White} = 0.71$).

Collective Political Efficacy

Beliefs that people can collectively influence political outcomes were assessed with a 3-item index, where the question: "How much can people like you, working together…" was combined with statements such as: "affect what the government does about global warming" and "affect what corporations and industry do about global warming" on a 5-point scale ranging from 1 ("Not at all") to 5 ("A great deal") ($\alpha_{Latino} = 0.95$, $\alpha_{White} = 0.93$).

Risk Perceptions

Respondents completed an 8-item measure of the extent to which they think global warming will cause personal harm and harm to others such as "people in the United States," "future generations of people," "plant and animal species," and "the world's poor" on a 4-point scale ranging from 1 ("Not at all") to 4 ("A great deal"). Items were averaged to capture overall risk perceptions ($\alpha_{Latino} = 0.96$, $\alpha_{White} = 0.97$).

Barriers to Activism

To identify barriers to contacting elected officials about global warming, respondents reported how much they agree or disagree with 12 statements such as "I don't contact elected officials about global warming because I am not an activist," "I don't know which elected officials to contact about global warming," and "I'm too busy to contact elected officials about global warming" on a 4-point scale from 1 ("Strongly disagree") to 4 ("Strongly agree"). The 12 items were subjected to a principal components analysis to explore their structure. Although a different number of components emerged and loadings varied between groups, reliability analyses suggested that all 12 items were strongly internally consistent for both Latinos ($\alpha_{Latino} = 0.86$) and Whites ($\alpha_{White} = 0.82$); in fact, dropping items lowered reliability indices. Thus, mean composites were formed such that higher scores indicated greater perceptions of barriers to activism.

Social Norms

Respondents answered two questions to indicate perceptions of descriptive and injunctive norms on acting to reduce global warming. Descriptive norms were measured with the question "How much of an effort do your family and friends make to reduce global warming" on a 5-point scale from 1 ("No effort") to 5 ("A great deal of effort") and injunctive norms were measured with the question "How important is it to your family and friends that *you* take action to reduce global warming?" on a 5-point scale from 1 ("Not at all important") to 5 ("Extremely important").

Social Network Effects

Social network effects were measured with an item that asked respondents how often they hear other people they know ("family, friends, and coworkers") talk about global warming with response options ranging from "Never" to "At least once a week."

Received Media Coverage

To measure received media coverage of global warming, respondents answered the question "About how often do you hear about global warming in the media (TV, movies, radio, newspapers/news websites, magazines, etc.)?" with five response options ranging from "Never" to "At least once a week."

Contact From Environmental Organizations

Respondents were asked about how many times, if ever, they have been "contacted (by mail, phone, or in person) by an organization working to reduce global warming" with following response options: "Never," "Once," "Two or three times," or "Four or more times."

Climate Change Activism

As an indicator of past behavior, respondents were asked how many times over the past 12 months they had "written letters, emailed, or phoned government officials about global warming" with five response options ranging from "Never" to "Many times (6+)" as well as a "don't know" response category. Because responses to this item were strongly skewed (74% of Latinos and 83% of Whites reported "Never"), the item was dichotomized for analytic purposes (i.e., reported contacting an official vs. did not report contacting an official). As a follow-up to this question, respondents reported whether they urged the official to take action to reduce global warming (vs. not to take action or some other reason). Respondents who (a) contacted officials one or more times and (b) urged officials to take action to reduce global warming, were coded as having contacted an official.

To measure intentions to contact government officials, respondents answered two questions about how likely they would be to "write letters, email, or phone government officials about global warming" and "meet with an elected official or their staff about global warming" on a 4-point scale from 1 ("Definitely would not") to 4 ("Definitely would"). Responses to the two questions were averaged so that higher scores indicate stronger

intentions to engage in climate change activism ($\alpha_{Latino} = 0.85$, $\alpha_{White} = 0.87$).

Demographics and Religious Affiliation

Respondents also completed questions about basic demographics (e.g., age, gender, education, income) as well as any religious affiliation (e.g., Catholic, Protestant, "born again" or evangelical, etc.)[2]. Respondents who reported that they are agnostic or atheist or responded "none of the above" to the religion question were coded as having no religion.

Missing Data

Respondents who refused ten or more items from the Barriers to Activism index and/or refused or responded "don't know" to six or more items from the Risk Perceptions index and/or refused or responded "don't know" to five or more of the other predictors, were excluded from the analysis (a total of 138 Latino cases and 71 White cases, about 9 and 8% of cases, respectively). There were differences between the respondents who were excluded and those who were retained. Across Latinos and Whites, the excluded sample consisted of more females, evangelicals, and political moderates, and excluded respondents were less likely to identify as a Democrat. Specific to Latinos, excluded respondents were more likely to complete the survey in Spanish and be between the ages of 30 and 44 years. Further, across both Latino and White samples, retained cases reported greater egalitarian values, collective political efficacy, descriptive, and injunctive norms, frequency of contact from environmental organizations, frequency of hearing others talk about global warming and hearing about it in the media, and levels of climate change activism—both intentions and past behavior (see **Supplementary Material** for details). Although differences were minimal, these analyses indicate that the excluded respondents were less politically engaged than the retained respondents, indicating some selection bias. Accordingly, results should be considered with some caution.

For the remaining cases, missing data were imputed using hot deck imputation (Myers, 2011) to replace refusals or responses of "don't know." To impute values, we used demographic variables known from previous research to be related to beliefs and attitudes about global warming (e.g., education, income, political party). Missing data for a number of indices (egalitarianism, individualism, political fatalism, collective political efficacy, and intentions to contact government officials) were imputed at the index level (i.e., after the means for respondents who provided data were calculated), whereas missing data for other indices (risk perceptions and barriers to action) were imputed at the item level. For index level imputations, because within-index item means were similar, if a respondent answered any of the items, we used the mean of those responses as the index score. For respondents who did not provide a response to any item from the index, we imputed values at the index level. For risk perceptions and barriers, because within-index item means differed, we imputed at the item level before creating the index scores rather than averaging scores for the items responded to. We first determined that there should be at least a minimum subset of items in each index for which respondents provided actual data. Based on the distribution of the number of missing items by case, we determined that respondents who answered two or fewer items in either of the indices (risk perceptions and barriers to action) should be regarded as outliers in relation to the distribution of the number of items responded to by other (retained) respondents. Then, for the retained respondents, we proceeded with item-level imputations, and created indices from the averages of all of the answered and imputed items. In the Latino sample, the maximum percentage of imputed values for one variable was 13.5% (range 0.2–13.5%; $M = 3.48$, $SD = 3.89$, $Median = 1.55$). In the White sample, the maximum percentage of imputed values for one variable was 19% (range 0–19%; $M = 3.18$, $SD = 4.18$, $Median = 1.45$). No variable in the analyses had 20% or more values imputed.

[2]Respondents, were also asked the extent to which they attend religious services ranging from 1 ("Never") to 6 ("More than once a week"). Service attendance was initially considered as a predictor of past behavior and intentions; however, zero-order correlations suggested no consistent relationship across Latinos and Whites (*r*s ranged from −0.01 to −0.08) and was removed from predictor sets.

RESULTS

The following analyses apply sampling weights to adjust for key demographics (e.g., age, gender, education, income) to match norms of the U.S. Census Bureau. The exception to this procedure is the mediation analyses using Hayes' PROCESS where sampling weights cannot be used. Results were essentially the same when testing predictive models with or without sampling weights. For greater detail of the predictive models (e.g., 95% confidence intervals), see the **Supplementary Material.**

Differences in Climate Change Activism Between Latinos and Whites

The goal of the current set of analyses is to examine (1) Latino versus White differences in self-reported behavior of having contacted an elected official to urge them to take action on global warming, and (2) Latino versus White differences in intentions to contact an elected official to take action on global warming.

First, we tested if Latinos and Whites differ on the two dependent measures of interest. A chi-square test of independence finds that Latinos are significantly more likely than Whites to report having contacted an elected official to urge them to take action on global warming, $\chi^2_{(df=1)} = 10.60$, $p = 0.001$. For Latinos, 17.7% reported having contacted an elected official whereas 12.3% of Whites did. Likewise, an independent samples *t*-test shows that Latinos also had significantly higher intentions to contact government officials in the future than did Whites ($M = 2.57$, $SD = 0.91$ vs. $M = 2.12$, $SD = 0.91$, respectively), $t_{(2081)} = 10.83$, $p < 0.001$, 95% CI [0.37, 0.53], $d = 0.49$.

Predictors of Climate Change Activism

Contacting Government Officials in the Past

Binary logistic regression models assessed the relative strength of predictors of odds of having contacted an official in the past for Latinos and Whites. Predictors were entered into regression models through separate blocks: Demographics

(Model 1), Ideology and Belief System (Model 2), Barriers to Activism (Model 3), Risk Perceptions (Model 4), and Social Influence (Model 5). Because a small proportion of respondents reported having contacted government officials, the full model of predictors was not tested. According to Tabachnick and Fidell (2013) on binary logistic regression models, "a number of problems may occur when there are too few cases relative to the number of predictor variables" resulting in "too many cells with no cases," thus "the analysis may have little power if expected frequencies are too small" (p. 488). In short, testing all predictors in one model would lead to unstable estimates and unreliable results. However, given that political views are strong determinants of engagement with climate change (e.g., Hornsey et al., 2016), we performed additional analyses to test the robustness of effects by controlling for political ideology in Models 1, 3, 4, and 5 (see **Supplementary Material**). Relationships between the predictors and odds of contacting a government official were the same when adjusting for political ideology across models for both Latinos and Whites.

As shown in **Table 1**, key positive predictors of past activism among Latinos include risk perceptions, contact from environmental organizations, social network effects (i.e., hearing others talk about global warming), collective political efficacy, education, descriptive and injunctive norms of family and friends, and egalitarianism; conversely, negative predictors include perceived barriers, political fatalism, and conservative ideology.

Among Whites, positive predictors are largely similar, including risk perceptions, contact from environmental organizations, egalitarianism, collective political efficacy, descriptive, and injunctive norms, and education. Perceptions of barriers also strongly negatively predict past activism among Whites.

Intentions to Contact Government Officials in the Future

Multiple regression analyses on intentions to contact government officials in the future followed the same procedure as the binary logistic regressions. As a further exploratory analysis, all predictors were entered into the model simultaneously given that sample sizes were large enough to test the full model.

As shown in **Table 2**, among Latinos, the positive predictors of activism intentions include risk perceptions, egalitarianism, social network effects, descriptive norms, and contact from environmental organizations. Negative predictors of activism include Republican party affiliation, perceptions of barriers, income, and political fatalism.

Among Whites, risk perceptions, egalitarianism, and contact from environmental organizations are positive predictors of intentions; negative predictors include perceptions of barriers and Republican party affiliation.

Taken together, across Latinos and Whites for both dependent variables, perceiving that global warming is a serious risk consistently emerges as one of the strongest predictors of contacting a government official in the past and willingness to do so in the future. Additionally, egalitarianism and contact by an environmental organization consistently predicted past activism and behavioral intentions. Conversely, perceived barriers to activism represents one of the strongest negative predictors of engagement.

Explaining Differences in Climate Change Activism: A Competitive Mediation Analysis

One goal of the current research is to investigate which factors explain differences between Latinos and Whites on the dependent measures. We used the PROCESS macro (Hayes, 2013) in SPSS to test mediation models to determine the variables that best predict why Latinos exhibit stronger climate change activism and intentions than Whites. Our analytic approach was to first run mediation models in blocks that contained conceptually related variables. For example, the Social Influence block contained social network effects, how much respondents hear about global warming in the media, descriptive norms, injunctive norms, and whether the respondent has been contacted by an environmental organization. Running the mediation models in blocks enabled the identification of significant explanatory variables within blocks while controlling for demographics and other related variables.

According to Slater and Gleason (2012), one of the more interesting and meaningful approaches to explore mediation is to compare models. Thus, significant mediators were entered into a combined mediation model to (1) investigate whether they remained significant while controlling for significant mediators from other blocks and (2) to test whether some mediators were significantly stronger than others in explaining variation in the dependent variables. We used this same approach for both dependent measures of activism (see **Table 3** for differences in the predictors of climate change activism between Latinos and Whites, and **Tables 4**–**7** for mediation results).

As shown in **Table 4**, mediation analyses suggest that Latinos are more likely than Whites to have contacted government officials in the past, at least in part, because Latinos appear to be more egalitarian, and less individualistic, perceive greater collective political efficacy, perceive global warming as a greater risk, have stronger pro-climate descriptive, and injunctive norms, and more often hear people they know talking about global warming.

Why do Latinos also have stronger intentions than Whites to contact government officials? Mediation analyses indicate that Latinos have stronger intentions, at least in part, because they have a stronger identification with the Democratic party, are more egalitarian, perceive global warming as a greater risk, have stronger descriptive and injunctive norms, perceive greater collective political efficacy, and more often hear people they know talking about global warming (see **Table 5**)

Finally, we conducted a competitive mediation analysis using Hayes' PROCESS to determine which of the significant mediators were strongest in explaining differences between Latinos and Whites in the dependent measures of activism. Significance tests comparing each mediator to the other mediators in the model are listed in **Tables 6**, **7**. Standardized indirect effects are listed in order of magnitude. Consistent with the models reported above, we aimed to predict respondents' past behavior

TABLE 1 | Predictors of odds of having contacted a government official in the past 12 months.

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Latinos	**Whites**	**Latinos**	**Whites**	**Latinos**	**Whites**	**Latinos**	**Whites**	**Latinos**	**Whites**
DEMOGRAPHICS										
Gender	0.74	1.37								
Education	1.52***	1.48**								
Age	1.00	1.02**								
Income	1.02	0.91								
Catholic	0.78	0.87								
Born again	0.78	0.57								
Protestant	0.89	0.77								
No religion	1.60	1.83								
IDEOLOGY/BELIEF SYSTEM										
Party affiliation			0.97	0.87						
Political ideology			0.83*	1.09						
Egalitarianism			1.68***	2.68***						
Individualism			0.87	0.58*						
Political fatalism			0.53***	0.79						
Collective political efficacy			1.41***	1.47**						
Barriers to Activism					0.25***	0.14***				
Risk Perceptions							2.37***	5.71***		
SOCIAL INFLUENCE										
Social network									1.56***	1.49**
Contacted by organization									1.90***	2.51***
Descriptive norm									1.53***	1.88**
Injunctive norm									1.56***	1.49*
Hear in media									0.87	0.89

****p <0.001; **p <0.01; *p <0.05. Odds ratios are presented (0 = Did not contact, 1 = Contacted). Odds ratios above one mean greater likelihood to contact and those below one mean lesser likelihood. Gender coded as 1 = Male and 2 = Female. Catholic, Born Again, Protestant, and No Religion were dummy-coded as 0 = No and 1 = Yes. See section Measures for the coding of other measures. Results were the same when controlling political ideology across models (see* ***Supplemental Material*** *for analyses).*

of having contacted a government official as well as intentions to do so in the future. For the measure of past behavior, risk perceptions were significantly stronger than all other mediators in the model. Although not significantly different from each other, the strongest mediators after risk perceptions, in order of magnitude, were descriptive norms, egalitarianism, injunctive norms, social network effects, and collective political efficacy.

With few exceptions, the results were similar for predicting activism intentions. Risk perceptions were significantly stronger than all other mediators in the model. That is, perceived risk best predicts why Latinos have stronger intentions to contact a government official to act on global warming compared to Whites. Although not significantly different from each other, the strongest mediators after risk perceptions, in order of magnitude, were party identification, injunctive norms, egalitarianism, and social network effects. In other words, stronger identification with the Democratic party, higher injunctive norms, higher egalitarianism, and more frequently hearing others talk about global warming may equally explain why Latinos have greater activism intentions than Whites. Further, collective political efficacy and descriptive norms also explained differences between Latinos' and Whites' intentions at a similar magnitude to egalitarianism.

DISCUSSION

Overall, we find that, in the United States, Latino citizens are more politically active on climate issues than Whites. Latinos are more likely to have contacted a government official and have stronger intentions to urge them to act on climate change in the future. These results contrast with previous research on voting behavior and other forms of political action which indicate less engagement by Latinos than Whites (e.g., Johnson et al., 2004; Gibson-Wood and Wakefield, 2013), suggesting that climate change activism is a different form of political behavior for Latinos.

In addition, across both Whites and Latinos, we find that global warming risk perceptions most strongly predict climate change activism (past behavior and intentions) relative to the other predictors examined. Aligned with previous research findings (e.g., Roser-Renouf et al., 2014), other predictors of greater activism across both groups include egalitarianism (valuing fairness and social justice), collective political efficacy (beliefs that people working together can influence the government), and social influence factors such as social network effects (hearing other people talk about global warming), and perceptions of social norms (that friends and family are taking

TABLE 2 | Predictors of intentions to contact government officials.

	Model 1		Model 2		Model 3		Model 4		Model 5		Full model	
	Latinos	**Whites**	**Latinos**	**Whites**	**Latinos**	**Whites**	**Latinos**	**Whites**	**Latinos**	**Whites**	**Latinos**	**Whites**
DEMOGRAPHICS												
Gender	−0.03	0.03									−0.04	−0.03
Education	0.10**	0.04									0.05	−0.06
Age	0.05	0.05									0.04	0.01
Income	−0.18***	−0.05									−0.14***	−0.04
Catholic	−0.01	0.03									−0.05	0.004
Born again	−0.08*	−0.08									0.01	0.02
Protestant	−0.01	−0.01									−0.02	−0.01
No religion	0.01	0.11									−0.03	−0.05
IDEOLOGY/BELIEF SYSTEM												
Party affiliation			−0.22***	−0.19***							−0.17***	−0.11**
Political ideology			0.04	−0.09							0.05	−0.06
Egalitarianism			0.25***	0.20***							0.13***	0.13**
Individualism			0.01	−0.07							0.08**[a]	0.02
Political fatalism			−0.14***	−0.09*							−0.07*	−0.01
Collective political efficacy			0.13***	0.20***							0.04	0.10**
Barriers to activism					−0.22***	−0.37***					−0.14***	−0.19***
Risk perceptions							0.42***	0.53***			0.22***	0.21***
SOCIAL INFLUENCE												
Social network									0.16***	0.14**	0.11***	0.07
Contacted by organization									0.06*	0.14***	0.06*	0.06*
Descriptive norm									0.15***	0.16***	0.11***	0.07
Injunctive norm									0.21***	0.29***	0.05	0.08
Hear in media									−0.01	0.04	−0.05	0.02
F	5.56	2.73	55.07	55.19	68.93	119.10	286.86	295.48	60.09	62.82	30.51	27.46
Adjusted R^2	0.03	0.02	0.20	0.30	0.05	0.14	0.18	0.28	0.18	0.29	0.32	0.43

****p < 0.001; **p < 0.01; *p < 0.05. Values refer to standardized beta weights. Intentions to contact ranged from 1 ("Definitely would not") to 4 ("Definitely would"). Gender coded as 1 = Male and 2 = Female. Catholic, Born Again, Protestant, and No Religion were dummy-coded variables coded as 0 = No and 1 = Yes. See section Measures for the coding of other measures.*

[a] *Individualism strengthened from Model 2 indicating that this estimate is likely unreliable.*

action and that friends and family think action is important). We also found a consistent positive relationship between having been contacted by an environmental organization and activism, providing evidence that organizations' efforts are influential in promoting political action.

Conversely, perceiving barriers to contacting government officials (e.g., being too busy, not identifying as an activist, not knowing what to say or who to contact, feeling uncomfortable) is a relatively strong negative predictor of contacting government officials and willingness to contact them in the future. Future work should examine how barriers to activism can be effectively reduced, given that relatively little work has offered significant insight according to Eisenack et al. (2014). Making contacting government officials easier and more popular (capitalizing on social norms), in addition to providing information on who and how to contact and what to say, may help to address barriers and promote this type of climate change activism.

Although the strength of predictors of climate change activism were similar across Latinos and Whites, there were notable differences in some individual and social factors that we examined further through mediation tests to explain Latinos' greater political action on climate change. These analyses suggest that Latinos, on average, may be more likely than Whites to be engaged because they see global warming as a greater risk, have stronger egalitarian values, perceive greater political efficacy, more strongly identify with the Democratic party, perceive stronger injunctive norms, and are more likely to hear people they know talking about global warming.

Consistent with previous research (e.g., Leiserowitz, 2006), risk perceptions play a critical role in explaining engagement with climate change. In the current study, perceiving climate change to be a serious threat was the strongest predictor in explaining why Latinos have contacted government officials more than Whites and report greater intentions to do so in the future. Because personal and subjective experiences with environmental changes (e.g., personally experiencing natural disasters like hurricanes) play an important role in risk perceptions (Howe and Leiserowitz, 2013; Demuth et al., 2016; Marlon et al., 2018) and previous research finds that Latinos are more likely than non-Latinos to report having personally experienced the impacts of global warming (Leiserowitz et al., 2017), perceived or actual personal experience with climate change may be partly

TABLE 3 | Means and standard deviations of predictors by Latinos and Whites.

	Latinos	Whites	Cohen's *d*
Political ideology	2.87 (1.01)	3.18 (1.17)	0.28***
Party affiliation	3.09 (1.87)	4.20 (2.02)	0.57***
Egalitarianism	2.80 (0.79)	2.44 (0.81)	0.45***
Individualism	2.48 (0.75)	2.69 (0.83)	0.27***
Political fatalism	2.37 (0.83)	2.34 (0.75)	0.04
Collective political efficacy	2.87 (1.16)	2.64 (1.03)	0.21***
Perceived barriers	2.38 (0.58)	2.35 (0.52)	0.05
Risk perceptions	3.25 (0.81)	2.69 (0.94)	0.64***
Social network	2.58 (1.28)	2.43 (1.23)	0.12**
Hear in media	3.51 (1.22)	3.50 (1.26)	0.01
Descriptive norm	2.64 (1.04)	2.35 (0.98)	0.29***
Injunctive norm	3.02 (1.14)	2.42 (1.13)	0.53***
Contacted by organization	1.37 (0.80)	1.37 (0.85)	0.00

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$.

driving Latinos' heightened risk perceptions. While personal and subjective experiences can play a strong role, this raises questions about what other individual, social, and cultural factors predict risk perceptions among Latinos. Specifically, future research could investigate which factors most strongly (or weakly) explain differential risk perceptions between Latinos and Whites. For example, given that injunctive norms played a relatively strong role in explaining why Latinos are more politically engaged than Whites, the perceived norms of family and friends may likewise be a key predictor of risk perceptions among Latinos.

Interestingly, party identification, egalitarianism, injunctive norms, and social network effects play similar mediating roles in partially explaining group differences in intended climate change activism. It is plausible that these variables have similar antecedents. For example, egalitarian worldviews include a strong emphasis on fairness and social justice, values that are endorsed by the Democratic party (Democratic Platform Committee, 2016). Additionally, because people tend to adopt similar views to the people in their social networks (Huckfeldt and Sprague, 1991), it would be no surprise that people higher in egalitarianism and Democratic identification also affiliate with other people who find it important to act on global warming.

There are several limitations to this study. First, because we used correlational data, it is not possible to make causal claims. Additionally, we examined only one kind of climate change activism (i.e., contacting a government official). It is possible that the predictors of this form of activism do not broadly apply to other forms of activism such as signing petitions, joining a campaign, or consumer actions like rewarding or punishing businesses for their environmental impacts. Further research is needed to develop causal models, measure other forms of activism (also beyond self-report), and determine the generalizability of these findings. Further, our measure of contact by an environmental organization was limited to contact via mail, phone, or in-person. Environmental organizations offer other ways of becoming politically involved via email or social media. Thus, the predictive strength of contact by an environmental organization in the present work might be different if we were to include other methods of contact. Future research might investigate a broader range of methods by which environmental organizations contact the public.

In addition, although our data are nationally representative, there is some selection bias due to missing data. Roughly 8–9% of cases were excluded and there was indication that Latino and White respondents in the retained sample were more politically engaged than those who were excluded. Importantly, however, these differences were small and Latinos who were excluded still seemed to be more politically engaged on climate change than Whites who were excluded. Still, the present analyses might be overestimating relationships than would be found in the overall U.S. population. Future research should also examine how political action compares across other racial/ethnic minority groups in the United States. The present analysis was part of a larger research project focusing on Latinos and sample sizes of other racial/ethnic minority groups were not large enough to conduct in-depth analyses.

Further, although we found that regional differences between Latinos and Whites in the U.S. did not explain differences in political engagement between the two groups, Latinos in the Northeast tended to have higher levels of activism compared to those in the South and West (see **Supplementary Material**). Future research might integrate geographic-based data on structural and environmental factors (e.g., exposure to air pollution, sea-level rise) with survey data to investigate place-specific experiential and vulnerability factors that could influence Latinos' attitudes and behaviors related to climate change.

PROMOTING PUBLIC WILL AMONG LATINOS: IMPLICATIONS FOR CAMPAIGNS AND COMMUNICATIONS

The findings have implications for initiatives to promote climate change activism among Latinos. Consistent with research suggesting that Latinos have particularly strong pro-environmental attitudes and tendencies (e.g., Leiserowitz and Akerlof, 2010; Macias, 2016a,b; Pearson et al., 2017, 2018), our analyses find that Latino citizens tend to be more politically active on climate change than Whites. In other words, Latinos may represent a community with relatively strong public will (Raile et al., 2014) to address climate change.

Public will is conceptualized as a group of people (or a social system) with a shared recognition of a specific problem and a common drive to solve the problem in specific ways

TABLE 4 | Significant mediators of odds of having contacted a government official in the past 12 months.

Mediator	Conditional direct effects [95% CI]	Indirect effects [95% CI]
X → M		
Egalitarianism	−0.29 [−0.36, −0.21]	
Individualism	0.15 [.07,0.22]	
Collective political efficacy	−0.21 [−0.31, −0.10]	
Risk perceptions	−0.46 [−0.54, −0.38]	
Social network effects	−0.25 [−0.37, −0.14]	
Descriptive norm	−0.23 [−0.33, −0.14]	
Injunctive norm	−0.44 [−0.55, −0.33]	
M → Y		
Egalitarianism	0.31 [0.11,0.50]	
Individualism	−0.27 [−0.45, −0.09]	
Collective political efficacy	0.23 [0.11,0.35]	
Risk perceptions	0.57 [0.31,0.83]	
Social network effects	0.35 [0.24,0.47]	
Descriptive norm	0.40 [0.23,0.57]	
Injunctive norm	0.20 [0.05,0.36]	
X → M → Y		
Egalitarianism		−0.09 [−0.16, −0.03]
Individualism		−0.04 [−0.08, −0.01]
Collective political efficacy		−0.05 [−0.09, −0.02]
Risk perceptions		−0.26 [−0.41, −0.14]
Social network effects		−0.09 [−0.14, −0.05]
Descriptive norm		−0.09 [−0.16, −0.05]
Injunctive norm		−0.09 [−0.17, −0.02]

X = Group (0 = Latino, 1 = White); Y = Contacted an elected official (0 = No, 1 = Yes). Values refer to unstandardized direct and indirect effects. Covariates = Gender, Age, Education, Income, and four dummy-coded variables for each religious affiliation (Catholic, Born Again, No Religion, and Protestant). Significance was tested using bias-corrected bootstrap confidence intervals with 5,000 resamples. All indirect effects are significant (95% confidence intervals do not contain zero).

TABLE 5 | Significant mediators of intentions to contact government officials.

Mediator	Conditional direct effects [95% CI]	Indirect effects [95% CI]
X → M		
Party affiliation	0.78 [0.60,0.96]	
Egalitarianism	−0.29 [−0.36, −0.21]	
Collective political efficacy	−0.21 [−0.31, −0.10]	
Risk perceptions	−0.46 [−0.54, −0.38]	
Social network effects	−0.25 [−0.37, −0.14]	
Descriptive norm	−0.23 [−0.33, −0.14]	
Injunctive norm	−0.44 [−0.55, −0.33]	
M → Y		
Party affiliation	−0.06 [−0.08, −0.04]	
Egalitarianism	0.12 [0.07, 0.17]	
Collective political efficacy	0.10 [0.07, 0.13]	
Risk perceptions	0.23 [0.18, 0.28]	
Social network effects	0.09 [0.07, 0.12]	
Descriptive norm	0.06 [0.02, 0.10]	
Injunctive norm	0.09 [0.05, 0.13]	
X → M → Y		
Party affiliation		−0.05 [−0.07, −0.03]
Egalitarianism		−0.04 [−0.05, −0.02]
Collective political efficacy		−0.02 [−0.03, −0.01]
Risk perceptions		−0.11 [−0.14, −0.08]
Social network effects		−0.02 [−0.04, −0.01]
Descriptive norm		−0.01 [−0.03, −0.001]
Injunctive norm		−0.04 [−0.06, −0.02]

X = Group (0 = Latino, 1 = White); Y = Intentions to contact an elected official. Values refer to unstandardized direct and indirect effects. Covariates = Gender, Age, Education, Income, and four dummy-coded variables for each religious affiliation (Catholic, Born Again, No Religion, and Protestant). Significance was tested using bias-corrected bootstrap confidence intervals with 5,000 resamples. All indirect effects are significant (95% confidence intervals do not contain zero).

via sustained collective action (Raile et al., 2014). According to Raile et al. (2014), public will "emphasizes communicative processes that shape understanding, motivation, and intention" (p. 111). In other words, awareness and communication between members are critical steps in forming an engaged issue public. On the issue of climate change, Latinos in the United States are already personally aware of and concerned about global warming (Leiserowitz et al., 2017), and we find that Latinos have a propensity to take political action on the issue. Latinos—as well as the general U.S. public—also tend to underestimate the environmental concerns of the Latino community, despite the fact that Latinos top the list of groups most concerned about the environment (Pearson et al., 2018).

Thus, communication campaigns for the Latino community might focus on building accurate perceptions of *shared* awareness (i.e., promoting social norms and consensus) that other Latinos are concerned and acting on the issue to further facilitate collective action (see Raile et al., 2017 for methods and tools to build public will). For instance, correcting misperceptions via social consensus information that the majority of other people do in fact support pro-climate policy has been shown to increase personal support for policy (Mildenberger and Tingley, 2017). Among racial/ethnic minorities in the United States, even brief exposure to a racially diverse environmental organization can reduce misperceptions that Whites are more concerned about the environment and more representative of the term "environmentalist" than are non-Whites (Pearson et al., 2018).

Normative feedback interventions are also shown to be effective strategies to encourage pro-environmental behavior, such as saving energy at home (Karlin et al., 2015). For example, communicating to people how much energy they use relative to others in their neighborhood (i.e., a descriptive norm) and that high (low) energy use is socially disapproved (approved) of (i.e., an injunctive norm) can decrease high energy use and reinforce low energy use, which together can foster conservation norms in the community (e.g., Schultz et al., 2007). In other domains, social norm interventions can promote healthy dietary behavior (Robinson et al., 2014), support anti-bullying and pro-intervention attitudes (Perkins et al., 2011), and reduce alcohol consumption in college students (see Miller and Prentice, 2016 for a review). Because we find that social norms are among the strongest factors explaining climate change activism among Latinos, communication strategies that emphasize the social norms and consensus among Latinos (e.g., that a strong majority care about the environment) may be particularly effective in strengthening this potential issue public.

Moreover, our findings indicate that capitalizing on global warming risk perceptions may be an especially effective strategy in promoting a Latino issue public. According to a

TABLE 6 | Competitive mediation analysis of having contacted a government official in the past 12 months between Latinos and Whites.

Comparison variable	Variable	Contrast of indirect effects [95% CI]
Risk perceptions	Descriptive norm	−0.17 [−0.32, −0.03]*
	Egalitarianism	−0.17 [−0.34, −0.02]*
	Injunctive norm	−0.17 [−0.35, −0.01]*
	Social network effects	−0.17 [−0.32, −0.04]*
	Collective political efficacy	−0.22 [−0.36, −0.09]*
	Individualism	−0.22 [−0.38, −0.09]*
Descriptive norm	Egalitarianism	0.00 [−0.09, 0.08]
	Injunctive norm	0.00 [−0.11, 0.09]
	Social network effects	0.00 [−0.07,0.07]
	Collective political efficacy	−0.04 [−0.11, 0.02]
	Individualism	−0.05 [−0.12, 0.01]
Egalitarianism	Injunctive norm	0.00 [−0.10, 0.10]
	Social network effects	0.00 [−0.08, 0.08]
	Collective political efficacy	−0.04 [−0.12, 0.02]
	Individualism	−0.05 [−0.13, 0.02]
Injunctive norm	Social network effects	0.00 [−0.09, 0.09]
	Collective political efficacy	0.04 [−0.13, 0.04]
	Individualism	−0.05 [−0.13, 0.03]
Social network effects	Collective political efficacy	−0.04 [−0.10, 0.01]
	Individualism	−0.05 [−0.11, 0.01]
Collective political efficacy	Individualism	−0.01 [−0.06, 0.04]

Significant difference for (comparison variable–variable). Y = Contacted an elected official (0 = No, 1 = Yes). Variables listed in order of mediation strength. Covariates = Gender, Age, Education, Income, and four dummy-coded variables for each religious affiliation (Catholic, Born Again, No Religion, and Protestant). Significance was tested using bias-corrected bootstrap confidence intervals with 5,000 resamples. Individualism was reverse-scored to have the same sign as other variables in the model to enable significance tests for differences between specific indirect effects (Hayes, 2013).

TABLE 7 | Competitive mediation analysis of intentions to contact a government official between Latinos and Whites.

Comparison variable	Variable	Contrast of indirect effects [95% CI]
Risk perceptions	Party affiliation	−0.06 [−0.10, −0.02]*
	Injunctive norm	−0.07 [−0.11, −0.03]*
	Egalitarianism	−0.07 [−0.11, −0.04]*
	Social network effects	−0.08 [−0.12, −0.05]*
	Collective political efficacy	−0.09 [−0.12, −0.06]*
	Descriptive norm	−0.09 [−0.13, −0.06]*
Party affiliation	Injunctive norm	−0.01 [−0.04, 0.02]
	Egalitarianism	−0.01 [−0.04, 0.01]
	Social network effects	−0.02 [−0.05, 0.00]
	Collective political efficacy	−0.03 [−0.05, −0.01]*
	Descriptive norm	−0.03 [−0.06, −0.01]*
Injunctive norm	Egalitarianism	0.00 [−0.03, 0.02]
	Social network effects	−0.01 [−0.04, 0.01]
	Collective political efficacy	−0.02 [−0.04, 0.00]
	Descriptive norm	−0.02 [−0.05, −0.001]*
Egalitarianism	Social network effects	−0.01 [−0.03, 0.01]
	Collective political efficacy	−0.01 [−0.04, 0.01]
	Descriptive norm	−0.02 [−0.04, 0.00]
Social network effects	Collective political efficacy	0.00 [−0.02, 0.01]
	Descriptive norm	−0.01 [−0.03, 0.01]
Collective political efficacy	Descriptive norm	−0.01 [−0.02, 0.01]

Significant difference for (comparison variable–variable). Y = Intentions to contact an elected official. Variables listed in order of mediation strength. Covariates = Gender, Age, Education, Income, and four dummy-coded variables for each religious affiliation (Catholic, Born Again, No Religion, and Protestant). Significance was tested using bias-corrected bootstrap confidence intervals with 5,000 resamples. Party affiliation was reverse-scored to have the same sign as other variables in the model to enable significance tests for differences between specific indirect effects (Hayes, 2013).

recent study, Latinos are among the groups most exposed to air pollution (i.e., NO_2 concentration) (Clark et al., 2014). Providing information about these environmental injustices to Latino communities, for instance, may indirectly spur more collective political action. Importantly, however, there are clear ethical implications that such informational campaigns should carefully consider, such as ensuring that communities have the resources to support their members (e.g., involvement from local organizations). Emphasis on environmental inequities may also draw on egalitarian worldviews (e.g., valuing fairness and social justice), which play a central role in explaining climate change activism among Latinos. With the appropriate community resources to support action, communication campaigns such as these may also activate other groups, including other racial/ethnic minorities and the poor, who are disproportionately affected by climate problems (e.g., National Research Council, 2010).

Taken together, future work should focus on further engaging Latinos in climate action and understanding which strategies are most effective in promoting a climate change issue public among this growing segment of the U.S. population.

ETHICS STATEMENT

The Human Subjects Committee of Yale University deemed this study as exempt under 45 CFR 46.101(b) (2): Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior, unless the information is obtained and recorded in such a manner that the human subjects can be identified, directly or through identifiers linked to the subjects; and any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation. All subjects gave electronic informed consent to complete the online survey.

AUTHOR CONTRIBUTIONS

AL, SR, and MC developed the scope of work and design of the study. SR organized the database. SR, MG, and MB performed statistical analyses. MB and MG wrote the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcomm.2018.00058/full#supplementary-material

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"Be Worried, be VERY Worried:" Preferences for and Impacts of Negative Emotional Climate Change Communication

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While communication experts largely recommend avoiding climate change messages that create negative emotional states, little is known regarding how members of the public use emotions in their own communication about climate change. Given the important role individuals can play in addressing climate change via their interpersonal communication, it is important to understand preferences for using or avoiding communication framed with negative emotions, and their ultimate impact on taking action to address climate change. Further, social expectations about the use of emotions may influence whether individuals' gender and political identity impacts their preference for using specific types of emotions. Three studies tested preferences for and impacts of three negative emotions common to climate change responses: fear, sadness, and anger, in comparison to messages framed without emotion. Findings indicate that people generally prefer messages framed without emotion, although in line with predictions, women, and Democrats are more apt to prefer emotional messages than men and Republicans. Although participants say they prefer messages framed without emotion, climate change messages framed with negative emotions are more likely than messages framed without emotion to match participants' feelings on climate change, while messages framed with specific types of negative emotions are more likely than messages framed without emotion to convey impressions of the speaker as rational, strong, and caring, which in turn predict greater preference for emotional over non-emotional messages. Further, results from a petition-signing study indicate that communicating with negative emotions does not promote nor hinder behavioral engagement.

Keywords: emotion, climate change, communication, gender, political identity, public activism

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INTRODUCTION

Climate change can be an emotional topic due to the devastating effects it poses currently and in the future. The impacts on animals, natural spaces, and landscapes may evoke feelings of loss and sadness. The risks of continued and future impacts on people and essential resources may create fear, and frustration about humans not taking meaningful action may create anger at those who are perceived to block action or are indifferent. Decades of research indicate that emotions play a critical role in our attitudes, beliefs, decision-making, and behavior (e.g., see Schwarz, 2000),

and there has been increasing recognition that emotions impact willingness to engage in collective action (e.g., Van Zomeren, 2013). For example, the cover of TIME magazine urged readers in 2006 to "be worried. Be VERY worried" about global warming (Kluger, 2006), while the documentary series "Years of Living Dangerously" showed viewers the frightening and devastating consequences of climate change (Cameron et al., 2014). However, communicating too much emotion may result in the message appearing "emotional" and lacking logic, exhaust the emotional resources of those it is meant to impact, or leave individuals without efficacy or motivation to respond. This was largely the thesis of Nordhaus and Shellenberger (2014), who opined in the New York Times that "global warming scare tactics" do little more than create further skepticism about the topic. Recommendations by communication and psychology researchers have largely followed suit, suggesting that fear appeals in particular be avoided when communicating about climate change (O'Neill and Nicholson-Cole, 2009; Shome and Marx, 2009).

However, studies on communicating climate change information with emotions (and in particular, with negative emotions) are still evolving, and are needed to understand how climate change is communicated by individuals and what the potential effects may be on engaging in climate action. Most research on emotions and climate change has focused on the use or inducement of emotions in communications directed at the public (e.g., Cismaru et al., 2011), but has not examined how members of the public choose to use emotions in their own communication. The latter is important when considering the critical role the public can play in addressing climate change via their interpersonal communication, their public expression of attitudes and beliefs, and their subsequent collective actions (Swim et al., 2018a), such as writing to public officials about the topic (Moyer et al., 2001). Individuals may want to express negative emotions to authentically convey feelings such as sadness, fear, or anger or to communicate urgency. This preference may also involve considerations about the benefits and costs of expressing negative emotions, such as self-presentation concerns about whether one would appear strong or weak, and effectiveness considerations such as whether emotions would interfere with the message appearing logical or being impactful.

The purpose of the present research is to examine individual preferences for the use of negative emotions in communication about climate change, and to assess whether expression of negative emotions in these forms of communication impacts others' willingness to also communicate about and take action on climate change. In this research we examine individuals' preference for using emotion in their own communication about climate change directed at a governmental agency (the EPA) and potentially the public (because participants are given the option to publicly post their comments online). Although research on public activism has explored how and why individuals choose to engage in behaviors such as communicating to political or media organizations, there has not, to our knowledge, been an examination of individuals' preference for using emotions in these types of communication, particularly on the issue of climate change. Thus, we drawn on research from mass communications, interpersonal communication, and social psychological theory about individual-level attitudes, beliefs, and emotions related to climate change to inform our understanding of this issue and frame our investigation.

THE COSTS OF USING NEGATIVE EMOTION

Much discussion about using emotions in climate change messaging has recommended avoiding negative emotions because of the potential unintended consequences of decreasing engagement on the issue. Compassion fatigue is one central argument against using negative emotions to engage the public on climate change. It has been argued that members of the public have a "finite pool of worry" when it comes to considering climate change, especially when compared to other social/political issues of concern (Hansen et al., 2004; Weber, 2010). Continual bombardment with negative emotions can result in emotional exhaustion or eventual desensitization (such as research showing that repeated exposure to violent video games diminishes empathy in viewers; Anderson et al., 2010). Research suggests that decrements in concern are a way for people to regulate the intense emotions they may feel when exposed to mass suffering (Cameron and Payne, 2011). For example, compassion for polar bears harmed by climate change is lessened when individuals focus on the suffering of an entire population as opposed to a single identified polar bear (Markowitz et al., 2013). Desensitization may similarly occur for repeated exposure to negative emotional messages about climate change, and diminish the beneficial effects of emotions on acting to address climate change. Further, dire messages about climate change can increase skepticism about the existence of climate change for those who hold strong just-word beliefs, and skepticism is related to decreased willingness to engage in environmental action (Feinberg and Willer, 2011).

Additionally, the use of emotions may undermine the perceived strength of one's argument. Even though emotions influence our everyday decisions and behaviors, they are frequently perceived to be illogical (Shields, 2002). Therefore, expressing emotion in reference to climate change may create the perception that one's position is not based on facts or logic, particularly given that climate change facts have come under fire in political and social discourse (McCright and Dunlap, 2011). Further, the perceived contrast between emotion and logic can lead to the perception that emotionally-framed messages about climate change are propaganda and antithetical to deliberative, analytic processing of persuasive information (Pratkanis and Turner, 1996). Thus, audiences may feel less defensive toward messages that are framed without emotion compared to messages that are perceived as deliberatively persuasive.

Although recommendations against the use of negative emotions have been based on research of mass communications toward the public (such as marketing campaigns), individuals may be persuaded to take a similar approach in their interpersonal communication about climate change. Specifically,

those who wish to express negative emotions about climate change may hesitate because they have read warnings against doing so in popular media (e.g., see Engelhaupt, 2017), perceive that the use of emotions makes information appear illogical, or be concerned about undermining the effectiveness of the message. However, there may be important benefits to communicating about climate change with negative emotions, particularly in interpersonal communication, that we consider next.

THE BENEFITS OF EXPRESSING NEGATIVE EMOTION

Despite these potential costs, emotions are fundamental to decision making and behavior change, and the preferences for and benefits of their use in climate change communication warrants further study. First, emotions may help direct attention toward the issue of climate change. Negative emotional displays (e.g., anger) are more likely to receive attention than positive emotional displays (e.g., happiness; Rozin and Royzman, 2001), likely because emotional passion conveys concern and perceived importance (Parkinson, 1996), and information is more likely to be remembered when it is consistent with one's emotional state (Bower, 1981; e.g., climate change information framed with fear may resonate better with individuals who already feel fearful about climate change). Additionally, not expressing emotions may create the perception that even individuals who want to address climate change are not very concerned about the issue, which could decrease the perceived importance of the message (Czopp, 2013).

Second, a growing body of research framed with Protection Motivation Theory suggests that increased perceptions of threat can increase behavioral engagement on social and environmental issues, such as climate change (e.g., Floyd et al., 2000; Hornsey et al., 2015). For example, the more vulnerable individuals feel to the threats of climate change, the more likely they are to purchase electric cars (Bockarjova and Steg, 2014), take action to mitigate drought (Keshavarz and Karami, 2016), and be willing to engage in personal pro-environmental behaviors (Kim et al., 2013). While some research shows that negative framing of climate change information can produce a "boomerang" effect, particularly among those who are already predisposed to deny the impacts of climate change (i.e., conservatives; Hart and Nisbet, 2012), numerous studies indicate that when paired with information about how to address the threat, fear appeals can increase rather than decrease motivated behavior (Floyd et al., 2000; Moser and Dilling, 2011).

Third, emotions help to prompt and direct action (Ridderinkhof, 2017), such as toward sources of threat, and the expression of emotion has the potential to motivate action on climate change for oneself and others (e.g., taking an empathic perspective toward animals harmed by climate change increases financial support for environmental groups; Swim and Bloodhart, 2014). Individuals often assess their emotional orientation toward a specific topic when considering a behavioral response (Schwarz and Clore, 1996). Thus, messages that help individuals to pair their feelings on climate change with an emotional orientation (such as anger) may facilitate their likelihood of taking action to address it. Further, positive emotions may create complacency in regards to taking action to address climate change, as some negative emotions (shame and distress) have been more likely than positive emotions (hope) to prompt motivation to engage in climate change mitigation, (Hornsey and Fielding, 2016). Additionally, the use of emotions may help to spread communication about climate change to others. For example, messages framed with moral emotions are more likely to spread through social networks than those without emotional tones (Brady et al., 2017), with some types of emotions being more transmittable than others (e.g., angry messages are more likely to spread through social media than joyful or sad messages; Fan et al., 2014).

Fourth, regardless of their effects on others, people may feel a need to express their emotions about climate change, and suppression of these emotions may come at a personal cost. Emotional tone can be used to authentically communicate one's perceptions of reality (Higgins and Pittman, 2008) and individuals may desire to communicate this perception to others. For example, docents at local zoos and aquariums indicated that they felt uncomfortable with their inability to share the emotion they felt about climate change with visitors (Fraser et al., 2013). Suppressing emotions can interfere with cognitive tasks, increase stress, and ironically, increase intensity of the feelings (Richards and Gross, 1999; Dalgleish et al., 2009).

EMOTIONS AND IMPRESSION MANAGEMENT

Decisions about whether to use negative emotions in climate change communication go beyond beliefs about their effectiveness and personal benefits of expressing emotion to also include impression management (Schlenker, 1980). Emotional displays not only serve the function of communicating information about a situation (e.g., the importance of addressing climate change), but they also communicate information about the person displaying the emotion (e.g., the person is strong or caring; Hareli and Hess, 2010, 2012). When individuals are concerned with how they are perceived by others, they may alter their use or display of negative emotions (Flett et al., 1988). Negative stereotypes about environmentalists include characteristics such as "nagging" or "complaining" (Swim and Geiger, 2018) and being seen as "eccentric," "over-reactive" and "self-righteous" (Bashir et al., 2013), while "emotional" displays may be perceived as antithetical to logic (Shields, 2013). Thus, those who are concerned about climate change may want to manage the impression they make on others by restricting their use of emotions in climate change communication.

Gender

Social prescriptions about the display of emotion are highly gendered, and men in particular are expected to restrict their use of emotions (Rudman and Fairchild, 2004). Being "emotional" is a common stereotype about women (Fischer, 1993), and men experience a great degree of social pressure

to be masculine and not feminine (O'Neil, 1981; Diekman and Eagly, 2000; Diekman and Goodfriend, 2006; Bosson et al., 2009). Further, gender differences in behavior have been attributed to social pressures to conform to socially-enforced gender stereotypes and/or internalization of gender stereotypes (Diekman and Eagly, 2008). For example, men prefer climate change arguments that are framed with stereotypically-masculine terms (e.g., those that involve leadership and business) over stereotypically-feminine terms (e.g., those that involve caring for others) because the latter are seen as "whiny" (Swim et al., 2018b). Thus, men may be more likely than women to avoid using emotions in climate change communication.

However, impressions of both men and women using emotion in communication about climate change likely depend upon the specific emotion displayed, as some emotions are seen as masculine and others are seen as feminine. Anger is stereotypically associated with men, while sadness and fear are stereotypically associated with women (Simon and Nath, 2004). Correspondingly, anger conveys agency whereas sadness conveys nurturance and fear conveys vulnerability (Hareli and Hess, 2010; Nelson, 2015; Wrede et al., 2015). Thus, men may be more likely than women to avoid displays of fear and sadness when communicating about climate change, but not necessarily to avoid anger. Women may be more likely to express fear or sadness than anger because they are stereotypically-feminine emotions, but because women do not experience the same pressure to avoid masculine attributes, they might not show a preference for one negative emotion over another in their communication about climate change. Consistently, women report feeling greater fear and sadness about climate change than men, although there are not gender differences in reported levels of anger (Swim et al., unpublished data). This possibility is also reflected in the finding that women are equally likely to select masculine or feminine arguments for climate change messages (Swim et al., 2018b).

Political Identity

The choice to express negative emotions related to climate change could also reflect the desire to "fit" with one's political identity. Political identity is not only related to beliefs about climate change (Hornsey et al., 2016), but also the emotional intensity of those beliefs. In the United States, Democrats and Independents are more likely to endorse the existence and urgency of addressing climate change compared to Republicans (Roser-Renouf et al., 2014), and Democrats are the most worried about climate change, followed by Independents and then Republicans (Dunlap, 2014). Communicating an emotional response to climate change may be perceived as communicating one's political identity (Fielding and Hornsey, 2016). Therefore, those who identify as Republicans may be more likely to restrict emotions when discussing climate change, while those who identify as Democrats or Independents may be more likely to express negative emotional responses, either because it is a genuine reflection of their concern, or they see emotional expression as a way to display their political identity.

PRESENT RESEARCH

The purpose of the present research was to better understand preferences for using negative emotions in personal climate change communication and to explore whether emotional framings influence individual willingness to address climate change. We studied three negative emotions common to climate change responses: fear, sadness, and anger, in comparison to messages framed without emotion. Study 1 examined whether individuals prefer to send a climate change message framed with one of the three emotions or a message that did not express emotion, and whether this preference differed as a function of gender or political identity. We predicted that women would be more likely to prefer emotional messages than men, particularly when they are framed with fear or sadness, while men may be more likely than women to prefer messages framed with anger. Study 2 explored the perceptions individuals have about communicating about climate change with or without negative emotions, and whether these impressions influence preference for emotional messages over non-emotional messages. Finally, Study 3 tested whether the use of these emotions in a message about climate change influenced individuals to support an EPA proposal on climate change compared to each other or to a message without emotion. Across all studies, we also assessed whether political identity influences the preferences for and responses to messages framed with emotions and whether these effects vary by the type of emotion conveyed. In addition, selection criteria was used to exclude participants who did not believe in climate change or who indicated that they opposed the message about climate change because we were interested in examining the preferences of communication among those who desire to communicate about climate change, rather than the comparison between those who support vs. oppose climate change mitigation. Further, the motives for choosing to communicate about climate change with or without emotion may be different for those who oppose the message altogether, and may have obscured any true effects among those who wish to communicate about climate change.

STUDY 1

The purpose of Study 1 was to examine which type of message framing people prefer in regards to climate change communication. Specifically, we explored whether people prefer to communicate a message about climate change framed with negative emotion vs. without emotion, and whether the type of emotion changes their preference. Because of different possible reasons for preferring emotional or non-emotional communication, we did not make directional predictions for these contrasts. However, we predicted that individuals would prefer messages that are framed with emotions that reflect their gender or political identity.

Hypothesis 1: Participants will prefer climate change messages that reflect their gender and political identities.

H1a: Women will be more likely than men to prefer messages that express fear and sadness about climate

change, while men will be more likely than women to prefer messages that express anger or no emotion.

H1b: Democrats will be more likely than Independents, and Independents will be more likely than Republicans, to prefer to express negative emotions (fear, anger, sadness) about climate change.

Materials and Methods

Design

The study consisted of a 2 (participant gender: female, male) X 3 (political party: Democrat, Republican, Independent) between-subjects design. The dependent variable was preferred emotional framing of a message about climate change.

Participants

Two hundred and thirty seven U.S.-residing adults were recruited for the study through Amazon's Mechanical Turk and were paid $0.25 for their participation. Six were excluded because they did not choose one of three major political party groups. Because we were interested in preferences regarding the types of framing for climate change messages and not whether participants wanted to convey a message, we excluded 34 participants who indicated they would not send any message because they were not in favor of the policy. While there were no gender differences in opting out of selecting a message, Republicans ($n = 15$, 35%) and Independents ($n = 15$, 20%) were more likely than Democrats ($n = 3$, 3.0%) to opt-out of selecting a message, χ^2 (2, $N = 219$) = 26.17, $p < 0.001$. In addition, we attempted to remove participants who did not pay attention during the study by calculating the median completion time (4.35 min) among the remaining participants. This excluded an additional 36 participants who completed the survey in less than half the median completion time or more than two times the median completion time.

The final sample consisted of 161 participants living in the U.S (79 women and 82 men), with an average age of 34 (range 18 to 68, median = 32). The majority identified their race/ethnicity as White/Caucasian (80%), while a minority identified as Black/African American (6%), Asian (8%), Latinx (6%), or another racial/ethnic group (2%). Half the sample indicated that they identified with the Democratic political party (52%), while 35% identified as Independent, and 13% as Republican. Participants leaned toward being liberal (16% very liberal, 43%, liberal, 29% moderate, 9% conservative, 4% very conservative). Most participants indicated concern about climate change based upon self-categorization into one of the Six Americas climate change opinion groups (38% Alarmed, 42% Concerned, 16% Cautious, 4% Disengaged, 1% Doubtful; Maibach et al., 2009; Swim and Geiger, 2017). Most participants (78%) had completed between some college, a 2-year degree, or a 4-year college degree, and had a median annual income of between $30,000 and $39,999.

Procedure and Measures

Participants read a three sentence summary about the Environmental Protection Agency's (EPA's) proposal to reduce carbon pollution under the Obama administration, and were told that they would be allowed to comment on the proposal[1]. Next, they viewed a pre-written letter to the EPA, with a middle section where they could personally select specific sentences containing emotionally-framed statements, and told that their names and contact information would be posted publicly with their chosen comments. Participants were allowed to indicate that they would prefer to not choose any message options if they were not in favor of the EPA proposal. Participants then completed demographic questions and were debriefed about the true purpose of the study.

Preferred emotion framing of the message

Participants were asked to choose one of four responses about the Environmental Protection Agency's (EPA) proposal that contained either sadness, fear, anger, or no emotion framing. The four options all included the same statements, but described the writer as feeling either sadness, fear, anger, or no emotion (which used "I think" instead of "I feel"). The key emotion words were highlighted so that participants would be sure to notice the differences between the options. All four options were presented on the same page, and the order that they were presented in was randomized. The message text included the following, with the changes for the sad, fearful, angry, and no emotion messages appearing in that order (information not included in the brackets constitutes the no-emotion message:

> "[I feel **heartbroken/ frightened/** infuriated that] (I)in the last century, we're causing sea levels to rise after not having them change noticeably in the previous 2,000 years, putting many countries at risk of existing in the near future. While there are always changes in life on the planet, [it's **sad/ scary/ absurd** that] our worldwide reliance on fossil fuels (coal, oil, and gas) will accelerate the speed of environmental degradation that destroys animals' habitats beyond their ability to adapt and increase human illness such as asthma and Lyme disease. To be honest, I [feel **sad/afraid/angry** about the] [**think** there are] serious consequences for our future generations from the predicted rise in global temperatures."

Full statements can be found in the **Supplementary Materials**.

Gender and political identity

Participants self-selected their gender ("female," "male," or "other/do not wish to respond") and political identification ("Republican," "Democrat," "Independent," "no party/not interested in politics," or "other").

Results and Discussion

We first examined preferences for the non-emotional vs. an emotional message using binary logistic regression with message preference as the dependent variable and participant gender and political identity as predictor variables. Participants in general were equally likely to choose the non-emotional message (48%) as an emotional message (52%: sad = 12%; fear = 24%;

[1]Participants were also told that the advisory council who would review the comments would be primarily female, primarily male, or equally female and male. However, analyses indicated that the gender make-up of the audience did not have an effect on message preference.

anger = 16%), *Wald* ($df = 1$) = 0.24, $p = 0.63$, $OR = 0.92$. Women were twice as likely as men to select a message that conveyed emotions (60% vs. 44%, respectively) over the message that did not convey emotion, *Wald* ($df = 1$) = 4.83, $p = 0.03$, $OR = 2.11$ [95% CI: 1.08–4.10]. Although there was not a significant effect of political identity on preference for an emotional message over the non-emotional message, *Wald* ($df = 2$) = 2.83, $p = 0.24$, the trend was such that Democrats (54%), and Independents (54%) were more than twice as likely to select an emotional message over a non-emotional message than Republicans (38%), $OR = 2.30$ [95% CI: 0.84–6.33].

We then tested whether preference for the non-emotion message over each of the three emotion messages differed by participant gender. Results from a multinomial logistic regression, with participant gender as the predictor variable, indicated that, consistent with predictions, men were three times more likely than women to prefer the non-emotional message (56 vs. 40%, respectively) over the sad message (7.3% vs. 16.5%), *Wald* ($df = 1$) = 4.68, $p = 0.03$, $OR = 3.39$ [95% CI: 1.12–10.26], and men were two times more likely than women to prefer the non-emotional message over the fear message (20.7 vs. 26.6%), *Wald* ($df = 1$) = 3.28, $p = 0.073$, $OR = 2.15$ [95% CI: 0.94–4.93], although the latter effect was only marginally significant. Gender differences in preferences for the non-emotional message over the anger message were not significant, nor were the effects of political party on preferences for the non-emotional message over any one of the specific emotion messages. Omnibus X^2 (3) = 6.60, $p = 0.09$.

The results of Study 1 provide evidence for the hypothesis that women and men may be engaging in impression management when making choices about whether to communicate about climate change with or without emotion, and about which negative emotions they prefer. Women were more likely than men to prefer emotional messages, and consistent with prior research suggesting that men avoid feminine emotions that are associated with caring for others, men were more likely to select the non-emotional messages over sad and fear messages than women.

The lack of effect of political identity on preferences for non-emotional vs. emotional messages may have been a result of the relatively few participants who identified as Republican, as this was conflated with their willingness to send the message to the EPA. In addition, it may have been difficult to detect effects for preferences among specific emotions because the number of people who preferred emotional messages was spread across three types of emotion. Therefore, we retest preferences for emotional vs. non-emotional messages in Study 2 with a larger sample size, use a continuous measure of preference, and tests preference for one of the emotion messages over the non-emotional message using a between-subjects design.

STUDY 2

The primary purpose of Study 2 was to better understand the reasons for individuals' preference for communicating about climate change with negative emotions vs. without emotion. Given the potential costs and benefits for using negative emotions in climate change communication, we explored whether beliefs about persuasiveness, the need to express/match one's own feelings, and management of impressions of the speaker of the message influenced preference for a message about climate change framed with anger, fear, sadness, or no emotion. Specifically, we tested whether using negative emotions in climate change messages create impressions of the speaker of that message as caring, strong, or rational, and whether these impressions influence whether or not individuals prefer to use emotions. In addition, we aimed to clarify potential effects from Study 1 by testing a larger sample, directly comparing each of the emotions to a non-emotional message, and including a more powerful measure of preference.

We first examined whether perceived persuasiveness, matching of feelings, and impressions of the speaker would influence preference for one of the emotionally-framed messages over the non-emotional message. We made the following hypotheses:

H1: Perceived persuasiveness, matching of feelings, and impressions of the speaker of the emotional message will predict preference for the emotional message over the non-emotional message.

H1a: The more persuasive the emotionally-framed message is perceived to be, the more participants will prefer the emotional message over the non-emotional message.

H1b: The more the emotionally-framed message matches the participants' feelings about climate change, the more they will prefer the emotional message over the non-emotional message.

H1c: The more the speaker of the emotionally-framed message is perceived as strong, caring, and rational, the more participants will prefer the emotional message over the non-emotional message.

We then tested factors that could predict whether emotionally-framed messages were seen as persuasive, matched one's feelings, and conveyed positive impressions of the speaker. As in Study 1, we examined the role of type of emotion, participant gender, and political identity in predicting these preferences. One reason participants may prefer non-emotion messages more than emotionally-framed messages is that expressing emotion can be perceived as lacking rationality (Shields, 2002). Further, the specific emotions used may differ in the impressions they form, such that, consistent with expected gender differences (Simon and Nath, 2004) and traits associated with men and women (Diekman and Eagly, 2000), anger may make greater impressions of a speaker's strength, while sadness and fear may make greater impressions about the amount the speaker cares about climate change. Thus, we test whether emotion framing predicts impressions, and whether impressions mediate the relationship between emotion framing and preference:

H2: The type or presence of emotion used in messages will influence participants' impressions of the speaker of the message and subsequently their preference for the emotion message.

H2a: The emotionally-framed messages will be seen as more irrational than rational compared to the non-emotional message.

H2b: The message framed with anger will be seen as more strong but less caring than the messages framed with sadness or fear.

H2c: Impressions of the speaker of the message will mediate the relationship between emotion-framing of the message and preferences for the emotional message.

Because the expression of emotion is highly gendered and socially regulated, we anticipated that impressions of the speaker of the message (i.e., as strong or caring) might predict more or less preference for the message depending upon the participant's gender. That is, the gendered effects found in H1a from Study 1 might be explained by the fact that men are more likely to prefer messages that create the impression of strength, while women are more likely to prefer messages that create the impression of caring.

H3: The gender of the participant will influence the degree to which participants' impressions of the message predicts their preference for the message.

H3a: Men will be more likely than women to prefer the emotional message when they perceive the speaker of the message as strong.

H3b: Women will be more likely than men to prefer the emotional message when they perceive the speaker of the message as caring.

In order to retest the non-significant pattern found in H1b of Study 2, we retested the effects of political identity on preferences and explored why political identity might influence emotionally-framed messages. However, unlike gender, political identity is not necessarily associated with stereotypes about certain emotions over others, and thus we expected that participants' political identity would be related to whether messages framed with emotion match their feelings about climate change, rather than their impressions of the speaker of the message, and that matching of one's feelings would mediate the relationship between political identity and preference for emotionally-framed messages. Although we do not make specific predictions about whether specific types of emotions will be more likely to match participants' feelings based on their political identity, we also explore these potential differences.

H4: The political identity of the participant will influence the degree that the emotionally-framed message matches their feelings about climate change and therefore will indirectly predict their preference for the emotionally-framed message over the message framed without emotion

H4a: Democrats and Independents will be more likely than Republicans to indicate that the emotional messages match their feelings compared to the non-emotional message.

H4b: The extent to which the emotional message matches participants' feelings will mediate the relationship between political identity and preference for the emotion over the non-emotion message.

Measures and Methods

Design

The study employed a 2 (participant gender: female, male) X 3 (political party: Democrat, Republican, Independent) × 3 (modified type of emotional framing of message: sadness, fear, anger) between-subjects design. The dependent variables were impressions of the emotional message and its author, preference for the emotional over the non-emotional message, and choosing to submit the emotional message over the non-emotional message to the EPA.

Participants

Six hundred and ten participants living in the United States who indicated that they were Alarmed, Concerned, or Cautious about climate change were paid $1.00 to complete the study online through Amazon's Mechanical Turk. A pre-screening survey restricted participants who had participated in any other study related to this research, and allowed us to admit the same number of women and men to take the survey, although 20 participants were excluded for providing different gender identities on the pre-screening than on the survey itself. After reading the messages, participants indicated whether they would be likely to submit one of the messages to the EPA or to submit a comment in opposition to the clean power plan. Participants who indicated that they would not submit a message or submit an opposition message were also excluded ($n = 76$). After excluding these participants, the median completion time was 7.29 min. Like Study 1, those who completed the study in less than half the median time or more than twice the median time were also dropped from the analyses ($n = 98$)[2].

The final sample consisted of 416 participants living in the U.S (208 women and 208 men), with an average age of 38 (range 19 to 79, median = 34). The majority identified their race/ethnicity as White/Caucasian (78%), while a minority identified as Black/African American (8%), Asian (8%), Latinx (7%), or another racial/ethnic group (3%). Half the sample indicated that they identified as Democrat (50%), while 28% identified as Independent, and 17% as Republican. Most participants (75%) had completed between some college, a 2-year degree, or a 4-year college degree, and had a median annual income of between $30,000–$39,999.

Procedure

Participants read the same policy statement by the EPA as in Study 1 on their proposed "Clean Power Plan," and were told that the EPA provides an open period for public comments. They were then told that some groups provide pre-written statements for the public to modify and send to the EPA if they wish. Participants were provided with the "original" version of the

[2] Although participants were recruited based upon having indicated that they were Alarmed, Concerned, or Cautious about climate change, 17 participants indicated at the end of the survey that they were Disengaged, Doubtful, or Dismissive of climate change. These participants were not excluded from the study because they indicated in the survey that they would have submitted either the original or modified message to the EPA.

statement in support of the EPA's plan, which contained no emotion, and used "I think" to indicate opinions. Directly below, participants were provided with a "modified" version of the statement, which they were told was written by a member of the public, and used emotional wording, including "I feel" to indicate opinions. The modified version either contained sad, fearful, or angry emotions, and the statements were the same as those used in Study 1. As in Study 1, the differences between the two statements were underlined so that they were obvious to participants. The modified version of the statement served as the experimental manipulation of the study, and participants were randomly assigned to condition.

After viewing the "original" (no emotion) and "modified" (either sad, fear, or anger emotion) message, participants were asked to write a short description of the difference between the statements, and then compare the two. Specifically, they rated whether the original or modified statement was more persuasive, better matched their own feelings about climate change, and which of the two statements they preferred. They also answered questions about their impression of the person who made the modified statement. Finally, participants were asked whether they would be more likely to submit the original (no emotion) or modified (emotion) version of the statement to the EPA, completed demographic questions, and debriefed about the purpose of the study.

Measures

Persuasiveness of message

Participants used a sliding scale from 0 (not at all) to 100 (very much) to indicate whether the modified (emotion) statement was (1) "more persuasive," (2) "more convincing in conveying the need for the policy," and (3) "less effective" (reverse-coded) than the original (no emotion) statement, on a scale from 0 to 100, Cronbach's $\alpha = 0.92$.

Matching of feelings

Participants used a sliding scale from 0 (not at all) to 100 (very much) to indicate the amount they agreed with five items about whether the modified (emotion) statement accurately reflected their feelings. Items were "the modified comment conveys my feelings about climate change," "the modified comment does NOT convey my feelings about climate change" (reverse-coded), "the emotions expressed in the modified comment match my emotions," "the emotions expressed in the modified comment do NOT match the way I feel" (reverse-coded), and "the modified comment overstates the intensity of my feelings compared to the unmodified comment" (reverse-coded). Higher values indicate that the modified statement matches the intensity of the participants' feelings, Cronbach's $\alpha = 0.92$.

Impression of modification author

Participants were asked to provide their "impression of a person who would make this modification" along three primary dimensions: rationality, strength, and care. All comparisons were made on an 11-point scale (-5 to "strongly disagree" to 5 "strongly agree," using the following items at each end of the scales. *Rationality* of the author was measured with three items: eccentric vs. reasonable; irrational vs. rational; and overactive vs. calm, Cronbach's $\alpha = 0.91$. *Strength* of the author was measured with three items: weak vs. strong; frail vs. powerful; and timid vs. courageous, Cronbach's $\alpha = 0.92$. *Caring* of the author was measured with three items: insensitive vs. caring; indifferent vs. sympathetic; and uncompassionate vs. compassionate, Cronbach's $\alpha = 0.92$[3].

Preference for message

Preference for the emotional over the no-emotion statement was measured by asking participants the degree to which they (1) "like," (2) "are comfortable with," and (3) "are hesitant about the modified vs. the original comment" on an 11-point scale (−5 "original" to 5 "modified" with 0 indicating "neutral"), Cronbach's $\alpha = 0.92$. Thus, values below zero indicate preferences for the no-emotion message and values above zero indicate preferences for the message modified to include emotions.

Gender and political identity

Participants self-selected their gender and political identification with the same measures used in Study 1.

Results

We examined the descriptive statistics for all variables included in the analyses, comparing outcomes for each type of emotional message to the non-emotional message, and then the average of all emotional messages vs. the non-emotional message. Means and standard errors are presented in **Table 1**. We conducted *t*-tests comparing means to the mid-point of each measure in order to test evaluations of the emotional (modified) message to the non-emotional (original) message. In general, participants saw the message framed with emotion as significantly more persuasive, reflective of their feelings, and the author of the message as significantly more caring, strong, and rational than the non-emotional message. This was true for all of the specific types of emotions compared to the no-emotion message except in the case of anger vs. no-emotion on perceived rationality of the author, for which participants did not perceive the emotion or no-emotion message as being more rational. However, contradictorily, participants preferred the non-emotional message over any of the emotionally-framed messages. This finding is further fleshed out in the analyses below.

We also used a univariate ANOVA with a Bonferonni correction for the *post-hoc* tests to examine whether the type of emotion message predicted different impressions and preferences for the emotion message over the no-emotion message (also **Table 1**). The type of emotion message did not influence impressions of whether the message was persuasive, matched participants' feelings, or overall preference for the message. However, the anger message was seen as significantly less caring

[3]Participants also indicated whether they expected the author of the message to be man vs. woman, Democrat vs. Republican, liberal vs. conservative, and non-white vs. White. Although the speaker of the message framed with anger was perceived as more likely to be a man than a woman, this did not mediate the relationship between the emotion type and perceived rationality or strength of the message. There were no differences between whether the author was perceived to be a Democrat vs. Republican, liberal vs. conservative, or non-white vs. White.

TABLE 1 | Average perceptions of emotional messages compared to the non-emotional message.

Variable	All Emotion vs. No emotion	Sad vs. No emotion	Fear vs. No emotion	Anger vs. No emotion
	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)
Persuasive[1]	58.71 (1.43)*	59.40 (2.39)*[a]	60.48 (2.52)*[a]	56.11 (2.54)*[a]
Match feelings[1]	59.83 (1.28)*	63.44 (2.13)*[a]	58.58 (2.25)*[a]	57.02 (2.27)*[a]
Rational[2]	0.24 (0.12)*	0.74 (0.21)*[a]	0.74 (0.20)*[ab]	−0.31 (0.21)[b]
Caring[2]	2.52 (0.10)*	3.06 (0.16)*[a]	2.62 (0.17)*[a]	1.81 (0.17)*[b]
Strong[2]	1.01 (0.12)*	0.76 (0.20)*[a]	0.53 (0.21)*[a]	1.77 (0.21)*[b]
Preference[3]	−0.93 (0.15)*	−0.79 (0.26)*[a]	−0.86 (0.27)*[a]	−1.17 (0.27)*[a]

*Indicates that the mean is significantly different from the midpoint of the scale, using a t-test with a 95% confidence interval.

[a,b]Means with different letters within row are significantly different from each other, using an ANOVA to test emotion type on each outcome, with a Bonferroni correction for paired comparisons, $p < 0.05$.

[1]Scores indicate the extent to which the emotional message was more likely to have the characteristics than the non-emotional message: 0 (not at all) to 100 (completely), with a midpoint of 50.

[2]Scores indicate that extent to which the emotional message conveyed the impression more so than the non-emotional message:−5 (strongly disagree) to 5 (strongly agree), with a midpoint of 0.

[3]Scores indicate preferences for non-emotional message (-5) to preferences for the emotional message (5), with a midpoint of 0.

than the sad or fear message, $F_{(2,\ 411)} = 14.91$, $p < 0.001$, $\eta_p^2 = 0.07$, but more strong than the sad or fear message, $F_{(2,\ 411)} = 9.82$, $p < 0.001$, $\eta_p^2 = 0.05$, and was seen as less rational than the sad message, $F_{(2,\ 412)} = 6.74$, $p < 0.001$, $\eta_p^2 = 0.03$.

H1: Predicting Preferences for Emotional Over Non-emotional Messages

In order to test Hypothesis 1, a multiple linear regression was used to test the unique effects of perceived persuasiveness, matching of feelings, and the three impressions of the speaker (strong, caring, and rational) on preferences for the message framed with emotion over the original, no-emotion message. Participants' relative preference for the emotional message over the no-emotion message was positively related to perceptions of how persuasive the messages were, $B = 0.46$, $p < 0.001$, whether the messages matched their feelings, $B = 0.17$, $p < 0.001$, and their impressions of the author of the emotional message as rational, $B = 0.28$, $p < 0.001$, and as strong, $B = 0.10$, $p = 0.01$, $F_{(5,\ 405)} = 208.28$, $p < 0.001$, $R^2 = 0.72$. The extent to which the speaker was perceived as caring did not predict message preferences beyond the other predictor variables in the model. Thus, H1a, H1b, and most of H1c were supported.

H2: Effects of Emotion Type on Impressions

In order to test Hypothesis 2a and 2b, the type of emotion framing (sad, fear, anger) conveyed in the modified message was entered into a MANOVA predicting impressions of the speaker of the emotional message as rational, strong, and caring. *Post-hoc* tests were conducted using the Bonferroni correction. Impressions of the speaker of the emotional message differed depending upon the type of emotion used. Inconsistent with H2a, emotional messages were seen as more rational than irrational when compared to non-emotional messages, $t_{(414)} = 1.20$, $p = 0.05$. However, as noted above, the degree of perceived rationality of the emotional message depended on the specific emotion used, $F_{(2,\ 412)} = 6.78$, $p < 0.001$, $\eta_p^2 = 0.03$. The speaker was perceived as more rational when they conveyed sadness compared to when they conveyed anger ($M_{difference} = 1.05$, $p < 0.001$), although perceptions of the rationality of a speaker conveying fear did not differ significantly from either anger or sadness. Thus, H2a was partially supported, in that anger specifically was perceived as more irrational than rational, while other emotional messages (fear and sadness) were perceived as more rational than irrational.

Consistent with H2b, the speaker of the message was seen as stronger when they conveyed anger compared to sadness ($M_{difference} = 1.02$, $p = 0.001$) or fear ($M_{difference} = 1.245$, $p < 0.001$), with the latter two types of emotion not differing from each other, $F_{(2,\ 411)} = 10.02$, $p < 0.001$, $\eta_p^2 = 0.05$. Further, the speaker of the message was seen as less caring when they conveyed anger than when they conveyed sadness ($M_{difference} = -1.25$, $p < 0.001$) or fear ($M_{difference} = -0.80$, $p = 0.002$), with the latter two types of emotion not differing from each other, $F_{(2,\ 411)} = 14.91$, $p < 0.001$, $\eta_p^2 = 0.07$. Thus, H2b was supported.

In order to test H2c, we conducted a series of regressions to examine the parallel mediation effects of emotion type on preferences via rationality, strength, and caring, using PROCESS model 4 with 5,000 bootstrap samples and 95% bias-corrected confidence intervals (Hayes, 2017). The predictor variable was the orthogonal contrast of anger vs. sad and fear messages, controlling for the contrast of sad vs. fear messages[4] and whether emotions matched participants' feelings, in order to identify the unique mediating effects of impressions. Compared to the sad and fear messages, there was a significant, negative indirect effect of anger framing on preference for the emotion message via impressions of caring, $B = -0.08$, $SE = 0.02$, 95% CI [−0.14 to −0.04], and rationality, $B = -0.11$, $SE = 0.07$, 95% CI [−0.20 to −0.03], and a significant, positive indirect effect of anger framing on preference for the emotion message via impressions of strength, $B = 0.25$, $SE = 0.084$, 95% CI [0.17 to 0.33]. Specifically, framing the message with anger compared to sadness or fear decreased impressions of the message as caring ($B = -0.29$, $p < 0.001$) and caring increased preference for the message ($B = 0.28$, $p < 0.001$). Framing the message with anger compared to sadness or fear also decreased impressions of the message as rational ($B = -0.18$, $p < 0.01$) and rationality increased preference for the message ($B = 0.64$, $p < 0.001$). Contrarily, framing the message with anger compared to sadness or fear increased impressions of the message as strong ($B = 0.45$, $p < 0.001$) and strength increased preference for the message ($B = 0.56$, $p < 0.001$). Thus, H2c was supported.

H3: Effects of Participant Gender and Impressions on Preference

In order to test Hypothesis 3, two separate regressions tested preference for the emotional over the non-emotional message as

[4]The contrast between the fear vs. sad messages were not related to impressions, hence, there was no indirect effects from this contrast to preferences.

predicted by either (1) gender of the participant X impressions of strength, or (2) gender of the participant X impressions of caring. Neither interaction was significant suggesting that women and men do not differ in what drives their preferences for emotional message framing. Further, participant gender was not directly related to preferences for an emotional message over the non-emotional message. These findings indicate a lack of support for H3a and H3b.

H4: Effects of Political Identity on Matched Feelings

In order to test Hypothesis 4a, political identity (Republican, Independent, or Democrat) and type of emotion framing (anger, sadness, or fear) were entered into an ANOVA to test the extent to which messages matched participants' own feelings about climate change. *Post-hoc* tests were conducted using the Bonferroni correction. Political identity significantly predicted whether the emotion message matched participants' own emotions about climate change, $F_{(2, 389)} = 10.76$, $p < 0.001$, $\eta_p^2 = 0.05$, with Democrats ($M = 64.82$, $SE = 1.69$) reporting that the emotion message matched their feelings more than Independents ($M = 53.30$, $SE = 2.43$) or Republicans ($M = 53.03$, $SE = 3.12$; Independents and Republicans did not differ from each other). Thus, H4a was partially supported. There was not a significant interaction between political identity and type of emotion framing on whether the emotion message matched participants' feelings about climate change, suggesting that Democrats are more likely than Independents or Republicans to feel sadness, fear, and anger about climate change.

To test H4b, we conducted a regression to examine the parallel mediation effects of political identity on preferences via matching of feelings, using PROCESS model 4 with 5,000 bootstrap samples and 95% bias-corrected confidence intervals (Hayes, 2017). Because no differences were found between Independents and Republicans in H4a, the predictor variable was the orthogonal contrast of Democrats vs. Independents and Republicans, controlling for the contrast between Independents and Republicans and impressions of the message, in order to identify the unique mediation effects of matching of feelings. Results showed a significant, positive indirect effect, $B = 0.07$, $SE = 0.02$, 95% CI [0.03 to 0.13], such that Democrats were more likely than Independents or Republicans to say that the emotion message matched their feelings more than the non-emotion message, $B = 2.25$, $p < 0.001$, and matching of feelings predicted greater preference for the emotional message over the non-emotion message, $B = 0.03$, $p < 0.001$. Thus, H4b was supported.

Discussion

Consistent with general recommendations made in academic and popular literature, participants preferred the non-emotional message to the modified emotional message about climate change. However, the three reasons we tested (perceived persuasiveness, matching feelings, and impression considerations) significantly and independently predicted preference for the climate change message framed with emotion. While recommendations about using negative emotions in climate change communication are usually made under the assumption that they are less persuasive, we specifically found that participants perceived that the emotional messages were more persuasive and the speakers that used sadness and fear in their messages were perceived as more rational, caring, and strong than a message without emotion and speakers that used anger in their messages were perceived as more caring and strong than a message without emotion. Additionally, perceived persuasiveness, strength, and rationality of the speaker, as well as the degree to which emotions matched those felt by participants, contributed favorably to preference for using emotional messages. Thus, there may continue to be reasons to use negative emotions in climate change communication.

Further, the results suggest that preference for using specific emotions in climate change messages may be a result of concerns about impression management. The results demonstrated that beliefs about persuasiveness and matching of the participants' feelings did not differ based on the specific emotions, but that different emotions influenced impressions of the speaker, which in turn influenced preference for conveying the emotion. Specifically, the expression of anger was seen as more strong but less caring and rational compared to the expression of sadness and fear. More strength, in turn, predicted greater preference for the emotional message, while less caring and rationality predicted lesser preference for the emotional message. Thus, anger messages appear to have two opposing effects on preference due to impressions about those who use anger in climate change communication. Further, although it was not significantly different from fear and sadness, the results suggest that the anger condition was least preferred, suggesting that appearing caring and rational may be a more important consideration than appearing strong in individuals' preference for using anger in climate change communication.

Although participants' gender did not predict preferences for the emotional over the non-emotional message, impressions of the emotions were consistent with stereotypically feminine and masculine characteristics (i.e., fear and sadness conveyed caring while anger conveyed strength). Yet it is important to note that these results did not replicate the gender-matching preferences for emotionally-framed messages found in Study 1, which may have been the result of a forced choice rather than a continuous rating of preference used in Study 2. Further, results supported the prediction that Democrats would be most likely to prefer emotional messages over the non-emotion message because emotional messages were more likely to match their feelings, but contrary to expectations, Independents were not more likely than Republicans to say that the emotion messages matched their feelings about climate change. It is possible that Independents are motivated to avoid emotional responses toward climate change because of the strong political polarization of the issue (Dunlap et al., 2016).

STUDY 3

The general recommendation against using negative emotions in climate change communication posits that these emotions will hinder actions to address climate change that might otherwise occur. In addition, seeing a message as persuasive (i.e., likely to

change the attitudes or behaviors of others) was one key reason that individuals prefer non-emotional messages over messages framed with negative emotion. Therefore, the primary purpose of Study 3 was to test whether messages framed with sadness, fear, anger, or no emotion differentially influence the likelihood of individuals to take action to address climate change.

We test the effects of gender and political identity on the effectiveness of emotional and non-emotional message framings. Given gender differences in preferences for emotional messages found in Study 1, it is possible that emotional messages would be more effective at prompting action for women than for men. Consistent with this prediction, previous research suggests that women are more persuaded by messages that convey feelings about a topic while men are more persuaded by messages that convey thoughts (Mayer and Tormala, 2010). Study 1 results also suggest that sad messages may be particularly effective for women compared to men. However, given the lack of gender effects in Study 2, we do not make specific predictions about directionality of influence.

Results for the influence of political identity on preferences for emotional messages via matching of feelings in Study 2 were consistent with the under-powered pattern of effects in found in Study 1 suggesting that Democrats have greater preference for emotional messages relative to Republicans. Therefore, we expected that Democrats would be more likely than Republicans to take action to address climate change in general, and that emotional messages would be more likely to prompt action among Democrats than Republicans. However, we did not make predictions about Independents, as they were more similar to Democrats in Study 1 and more similar to Republicans in Study 2.

Materials and Methods

Design

The study consisted of a 2 (participant gender: female, male) X 3 (political party: Democrat, Republican, Independent) × 4 (emotional framing of message: sadness, fear, anger, no emotion) between-subjects design. The dependent variables were indication of willingness to support a petition for greater EPA mitigation of climate change via signing and sharing it with others, and actual signing of the petition.

Participants

Participants were 1,254 U.S.-residing adults recruited online from Amazon's Mechanical Turk and paid $0.50 for their participation. Like Studies 1 and 2, participants were excluded if they did not identify as belonging to one of the three major U.S. political party groups ($n = 115$, 9.2%) or if they completed the survey in less than half the median completion time or two times the median completion time (5.03 min; $n = 213$). Further, participants were not recruited for this study if they had participated in any of the prior studies.

The final sample consisted of 926 participants living in the U.S. (549 women and 377 men), with median age of 30 (range 19 to 77). The majority identified their race/ethnicity as White/Caucasian (81%), while a minority identified as Black/African American (7%), Asian (8%), Latinx (6%), or another racial/ethnic group (2%). Just under half the sample indicated that they identified as Democrat (43%), while 37% identified as Independent, and 20% as Republican. Participants leaned toward being liberal (13% very liberal, 38%, liberal, 28% moderate, 17% conservative, 4% very conservative). Most participants indicated they were concerned about climate change based upon self-categorization into one of the Six Americas climate change opinion groups (27% Alarmed, 43% Concerned, 16% Cautious, 6% Disengaged, 4% Doubtful). Most participants (75%) had completed between some college, a 2-year degree, or a 4-year college degree, and had a median annual income of between $30,000 and $39,999.

Procedure and Materials

As in Study 1 and 2, participants were told they would read a petition that would support the Environmental Protection Agency's (EPA) limit on industrial carbon pollution from coal power plants. Unlike in Study 1 and 2, participants were randomly assigned to one of four the emotion message conditions (sad, fear, anger, or no emotion). The message was nearly identical to that used in Study 2, and was designed to appear as if it was written by a lay person[5]. Participants indicated whether they were willing to sign and share the petition publicly, and asked to actually sign the petition by providing their name. Finally, participants completed dependent measures and demographic information, and were then thanked, debriefed, and compensated.

Measures

Willingness to support the petition

A composite scale of willingness to support the petition was created by averaging four items: "Would you be willing to sign the petition?," "Would you be willing to have your name appear on a public website?," "Would you be willing to post this on one of your social media sites?," and "Would you be willing to send this petition to someone you know?" Responses were measured on a four-point scale: 1 (*definitely not*), 2 (*probably not*), 3 (*probably yes*) and 4 (*definitely yes*), with larger numbers indicating a greater intention to sign the petition (Cronbach's $\alpha = 0.91$).

Actual signing behavior

Signing behavior was assessed with one item, and was presented to only those participants who indicated that they either would "probably" or "definitely" sign the petition. These participants were asked to provide their first and last name. If participants provided both their first and last name they were considered to have signed the petition. If no name or only their first or last name was indicated, they were not considered to have signed the petition.

[5]A manipulation check question asked participants to indicate which type of emotion was expressed in the message (sadness, fear, guilt, anger, or no emotion). Although participants were more likely to select the correct emotion by condition than any one of the other options, less than 50% selected the correct answer, except in the case of the anger condition, where a majority of participants selected the correct answer (62%). However, because the base (no-emotion) message may have invoked perceptions of emotions due to the expression of strong opinions and description of negative impacts, we did not remove participants based on the manipulation check question.

Gender and political identity
Participants completed the same measure of political party and gender identification as used in Studies 1 and 2.

Results and Discussion

We first tested a 2 (Participant gender: female, male) X 3 (Political Identity) × 4 (Emotional framing of message: sad, fear, anger, no emotion) between-subjects ANOVA on support for the petition. *Post-hoc* tests were conducted using the Bonferroni correction. Democrats ($M = 2.76$, $SE = 0.04$) were more likely than Independents ($M = 2.46$, $SE = 0.05$, $p < 0.001$), who were more likely than Republicans ($M = 2.01$, $SE = 0.06$, $p < 0.001$), to indicate willingness to support the petition, $F_{(2, 902)} = 50.31$, $p < 0.001$; $\eta_p^2 = 0.10$. There was also an interaction between participant gender and political party on willingness to support the petition, $F_{(2, 902)} = 2.91$, $p = 0.02$; $\eta_p^2 = 0.01$, such that Republican men ($M = 2.15$, 95% CI [1.98–2.31]) indicated greater willingness to support the petition than Republican women ($M = 1.87$, 95% CI [1.70–2.05]). There were no other significant gender differences. Importantly, the emotional or non-emotional framing of the message did not influence willingness to support the petition.

Next, we conducted a hierarchical logistic regression to test the effects of participant gender, political identity, and emotional framing of the message on actual signing behavior. Main effects were entered in block 1, two-way interactions were entered in block 2, and the three-way interaction was entered on block 3. Results indicated that only block 1 was significant, omnibus $X^2(6) = 83.49$, $p < 0.001$, *Nagelkerke* $R^2 = 0.12$, and no interactions were significant. Political party significantly predicted signing the petition, *Wald* ($df = 2$) $= 65.57$, $p < 0.001$, with Democrats over 4 times more likely to sign the petition than Independents or Republicans, *Wald* ($df = 1$) $= 59.82$, $p < 0.001$, $OR = 4.40$ [95% CI: 3.02–6.41], and Independents almost two times more likely to sign the petition as Republicans *Wald* ($df = 1$) $= 11.36$, $p < 0.001$, $OR = 1.92$ [95% CI: 1.31–2.81]. There was also a main effect of participant gender, *Wald* ($df = 1$) $= 13.90$, $p < 0.001$, such that men were almost twice as likely to sign the petition as women, $OR = 1.71$ [95% CI: 1.29–2.26]. Again, there were no effects of emotional framing on actual signing behavior.

Results from Study 3 indicate that framing a message about climate change with negative emotions does not reduce (or increase) behavioral willingness to support the issue or taking action via signing a petition. This key finding is important for recommendations regarding the use of negative emotions in climate change communication, and suggests that while experts and the general public may view climate change messages as more persuasive on behavior when framed without emotion, using negative emotions does not change individual behavior. We did, however, find that political identity was related to willingness and actual signing behavior, consistent with the literature on political orientation and climate change action (e.g., see Dunlap et al., 2016; Leiserowitz et al., 2018).

GENERAL DISCUSSION

Across three studies of climate change communications framed with or without negative emotions, it appears that the American public largely prefers messages that are framed without emotion, but that the use of negative emotions do not actually dissuade individuals from supporting action on climate change. Further, emotional communications are seen as more persuasive, more likely to reflect the feelings of individuals, and more likely to create impressions about a speaker's caring (except in the case of anger), strength and rationality, all of which also contribute to preferences for using negative emotions. Thus, the larger debate about avoiding negative emotions in climate change communications may be a product of concerns about the impressions negative emotions create about the speaker than about the actual effectiveness of the message on the audience. The results from Study 2 suggest that preferences for non-emotional framing of climate change messages are driven by social desirability concerns perhaps even more so than perceived effectiveness. Although perceived persuasiveness was associated with message preferences, and participants perceived the emotional messages as more persuasive than the non-emotional messages, they still preferred the non-emotional message over the emotional messages. We therefore conclude that conveying negative emotions about climate change when communicating information to others can be beneficial for creating impressions about the speaker and when individuals want to express their emotions, particularly since using these emotions does not reduce others' likeliness of taking action to address climate change.

We found mixed support for the influence of gender on preferences for using negative emotions. In Study 1, men were less likely than women to select messages framed with "feminine" emotions compared to messages without emotion, yet we did not find these same effects in Study 2. Plus, contrary to research on the influence of prescriptive gender stereotypes (Diekman and Eagly, 2008), we did not find that messages framed with stereotypically-feminine or masculine emotions resulted in differences between women and men for willingness to sign the petition. Although some research has indicated that women are more or as likely as men to sign public petitions (Dietz et al., 1998; Norris et al., 2004), other research suggests that women are less likely to feel confident about using the internet (Hargittai and Shafer, 2006), and are less likely to engage in prosocial behavior when the behavior is seen as assertive or risky (e.g., see Eagly, 2009). This is further supported by the finding that men were not more likely than women to indicate willingness to support the petition (except among Republican men and women). Thus, gender differences could have resulted from the fact that the petition signing behavior was online, and women may have been more concerned than men that their names or contact information would be posted publicly. Therefore, the gendered preference for using negative emotions in climate change communication may require further exploration into the situational constraints and types of behaviors measured.

Finally, the results across three studies support prior research on the influence of political identity on emotions and engagement

related to climate change. Democrats were more likely than Independents or Republicans to indicate that negative emotional messages matched their feelings about climate change, to prefer messages framed with negative emotions, and to support and sign the petition to address climate change. This is consistent with other findings that Democrats are more concerned about climate change and are the political group most likely to take action to address climate change (Leiserowitz et al., 2018). While our results also reflected prior findings that Independents generally fall in between Democrats and Republicans in their willingness to address climate change, we unexpectedly found that Independents were just as unlikely as Republicans to prefer messages about climate change framed with emotion. One possible explanation for this finding is that Independents are more hesitant to weigh in on conversations about climate change than Democrats, particularly if it is seen as a partisan issue, and Independents are motivated to appear non-partisan (Dunlap et al., 2016). However, because the majority of investigations into the political partisanship of climate change primarily analyze the difference between Democrats and Republicans, this finding and explanation warrants further investigation.

Limitations and Future Directions

The primary limitation of the current research is that we tested communications framed with negative emotions (i.e., language that expressed negative emotional feelings by the author) as opposed to messages that are intended to invoke negative emotions in the reader. We did not attempt to manipulate, nor did we measure, whether the framing of the message changed the emotional state of the participants. The academic and popular consensus around avoiding negative emotions in climate change communication primarily bases this recommendation off of assumptions that creating a negative emotional state among members of the general public will inhibit behavioral responses (e.g., see Moser, 2007). Therefore, individuals may avoid expressing negative emotions, even though it is unclear to what extent using negative emotional tones in one's own communication about climate change impacts the emotions of others. Thus, we were interested in exploring the former phenomenon rather than the latter, to understand both the benefits and drawbacks to personally using emotions in one's own communications about climate change. While our findings suggest that expressing negative emotions about climate does not create behavioral inhibition, we are limited in our ability to make recommendations about messages which invoke a strong negative emotional state in readers/listeners, as it is still possible that this might diminish their inclination to address climate change behaviorally. Further, we provided an immediate and direct avenue for taking action to address climate change (sending a petition), which may also have helped to alleviate behavioral inhibitions due to the feeling that participants lacked personal or collective efficacy.

Another limitation is that we only tested signing a petition as a measure of behavioral response to addressing climate change. We choose this behavior because it is argued to be one of the more unlikely but also more impactful forms of personal pro-environmental behavior (e.g., see Stern, 2000) and it presented fewer barriers to engagement such as lack of skills or resources. However, the nature of signing an online petition is public, direct, and allows others to see one as a climate change activist. Therefore, people who care about the issue of climate change but who do not want to experience public scrutiny or confrontation may have been resistant to engaging in this behavior. In particular, this may have been important for the gender and political identity effects found in Study 3: that is, women and Independents/Republicans may be more likely to engage in a less-conspicuous behavior to address climate change, such as anonymously donating money. Thus, these results should be replicated and include tests of other types of behavioral engagement.

All three studies were conducted between 2014 and 2016 during the Obama presidency and the EPA plan to cut carbon emissions that was summarized for participants described the actual plan put forth by the Obama administration. Participants in Study 3 were directed to the actual EPA site at which they could submit their comments. All data was collected before Trump was elected to office and the priorities of the EPA were shifted. Thus, the type and strength of emotions felt by the public regarding climate change may be different under the current presidential administration, and future research may illuminate the degree to which current political discourse shapes whether and how negative emotions are used to communicate about climate change and influence individuals to take action.

Conclusions

Many scholars and commentary in public media recommend avoiding negative emotional framing of climate change information due to the potential lack of effectiveness of negative emotional frames. Consistent with this logic, respondents were less likely to prefer emotional over non-emotional framing of climate change messages. However, this preference may lead members of the public to suppress their emotions when communicating about climate change. Despite gendered associations with emotions we did not find consistent evidence that preferences varied by gender nor that the gendered impressions conveyed by the emotions differentially affected women and men. In contrast, political identity was related to the preference for expressing negative emotions related to climate change with Democrats preferring emotional messages more than Republicans and Independents because negative emotions were more likely to match their feelings about climate change, which may be a result of Democrats being more concerned about climate change (Leiserowitz et al., 2018). However, the results suggest that there are impression management benefits to using negative emotions in climate change messaging, and that expressing negative emotions does not hinder others' likelihood of signing a public petition to address climate change.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the Pennsylvania State University

Institutional Review Board for research with human subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the Pennsylvania State University Institutional Review Board.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this manuscript will be made available by the authors, without undue reservation, to any qualified researcher.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcomm.2018.00063/full#supplementary-material

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Framing Climate Change: Economics, Ideology, and Uncertainty in American News Media Content From 1988 to 2014

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The news media play an influential role in shaping public attitudes on a wide range of issues—climate change included. As climate change has risen in salience, the average American is much more likely to be exposed to news coverage now than in the past. Yet, we don't have a clear understanding of how the content of this news coverage has changed over time, despite likely playing an important part in fostering or inhibiting public support and engagement in climate action. In this paper we use a combination of automated and manual content analysis of the most influential media sources in the U.S. -the *New York Times*, *Wall Street Journal*, the *Washington Post*, and the *Associated Press*- to illustrate the prevalence of different frames in the news coverage of climate change and their dynamics over time from the start of the climate change debate in 1988. Specifically, we focus on three types of frames, based on previous research: economic costs and benefits associated with climate mitigation, appeals to conservative and free market values and principles, and uncertainties and risk surrounding climate change. We find that many of the frames found to reduce people's propensity to support and engage in climate action have been on the decline in the mainstream media, such as frames emphasizing potential economic harms of climate mitigation policy or uncertainty. At the same time, frames conducive to such engagement by the general public have been on the rise, such as those highlighting economic benefits of climate action. News content is also more likely now than in the past to use language emphasizing risk and danger, and to use the present tense. To the extent that media framing plays an important role in fostering climate action in the public, these are welcome developments.

Keywords: climate change, framing, global warming, science communication, news media

INTRODUCTION

News media shape public attitudes on a variety of topics, and climate change is no different. Commentators attribute much of the blame for Republican climate denial to conservative news outlets like *Fox News*,[1] which have been found to disseminate misinformation on climate science.[2] However, *Fox News* represents only a small part of the news media environment, more important is the content of climate change news content in widely consumed mainstream news outlets. Although it has been the subject of a large amount of research, we do not have a good sense of how this content has changed over time.

Science communicators understand the importance of the news media. Of particular interest has been how climate change is framed in public discourse. Communicators have a choice of which considerations to emphasize and which to downplay on any given political issue and they make such decisions strategically. The choices they make are the issue frames that proliferate in political discourse. This is even truer with a complex topic like climate change. It is an issue that involves multiple complex domains, like science, economics, and value considerations, trade-offs, unequal impacts within society and across nations, and future projections about somewhat uncertain consequences. This complexity provides journalists, parties, and interest groups tremendous latitude in framing the issue to serve their interests and beliefs. The news media play a seminal role in this process because they are often the primary source of information on complex political issues for the average citizen. They are therefore the primary mode of delivery of issue frames to the public.

Frames related to climate change can emphasize economic costs or benefits, heighten partisan or ideological conflict, emphasize or downplay scientific uncertainty, among other things. There are likely implications for the public's support for climate action and willingness to act on these attitudes in a variety of ways—from voting for environmentally-friendly candidates to engaging in personal action to reduce one's own carbon footprint or even engaging in political activism. If the frames citizens encounter lead citizens to think of climate science as uncertain or mitigation as being costly, or see climate change as an ideological battleground, we might expect their propensity to support and engage in climate action to vary accordingly (Bain et al., 2016; Hornsey and Fielding, 2016; Walker et al., 2018).

A growing body of experimental research has explored how different frames in climate communication can affect attitudes and behavior. Alongside this important work has been research that examines the prevalence of frames in political discourse (Boykoff and Boykoff, 2004, 2007; Antilla, 2005; Boykoff, 2007; Hoffman, 2011; Painter and Ashe, 2012; McGaurr et al., 2013; Painter, 2013; Painter and Gavin, 2016; Feldman et al., 2017). These works have shed light on the nature of climate change coverage in the United States and in other countries. However, their use of manual coding limits the degree to which they can reliably observe changes in the prevalence of important frames over a long time period and across different news outlets. This is where our main contribution lies.[3] This paper aims to systematically analyze the content of the climate change news stories in the most popular news media outlets in the United States as climate change emerged as a national issue. Specifically, we examine three key features of coverage identified in the literature to influence public attitudes on climate change: uncertainty and risk surrounding climate change (Morton et al., 2011), economic costs and benefits of mitigation policies (Brulle et al., 2012), and appeals to conservative ideology (Dixon et al., 2017).

FRAMING CLIMATE CHANGE

Framing is an essential concept in communication studies and has been a subject of interdisciplinary research for several decades. It refers to "the process by which people develop a particular conceptualization of an issue or reorient their thinking about an issue" (Chong and Druckman, 2007, p. 102). The process of framing involves two key ingredients: selection and salience. Framing is then about selecting some key aspects of the perceived reality and making them more salient in the process of communication (Entman, 1993). Those receiving that message have their own unique conceptualizations of issues—often called "frames in thought"—which are influenced by "frames in communication" or considerations that are advanced by speech acts or written work (Chong and Druckman, 2007). The influence of the latter on the former can be seen as a *framing effect*.

Scholars have exhibited framing effects with surveys, experiments, and qualitative case studies across a wide range of issues including support for government spending, campaign finance, affirmative action, evaluations of foreign nations, and many others (see Chong and Druckman, 2007 for an extensive survey of the literature). However, issues that are most influenced by mediated communication tend to be complex ones that are mostly "invisible" to the public and, thus, difficult to comprehend for many (Schäfer and O'Neill, 2017).

Framing is unavoidable. All human knowledge makes use of frames, and every word is defined in relation to the frames it neurally activates (Lakoff, 2010). Moreover, since frames always come in systems, a single word can have the potential to activate

[1] https://www.theguardian.com/environment/climate-consensus-97-per-cent/2013/aug/08/global-warming-denial-fox-news

[2] https://www.theguardian.com/environment/climate-consensus-97-per-cent/2014/apr/08/fox-news-28-percent-accurate-climate-change

[3] For example, Boykoff (2007) examined five U.S. and two U.K. newspapers in the years 2003–2005. Boykoff and Boykoff (2004) examined five American newspapers over a much longer period of 1988–2002, however, the issue of climate change didn't gain salience until post-2006 (see Merkley and Stecula, 2018). Boykoff and Boykoff (2007) expanded the scope of their work by focusing on a longer time period (1988–2004) and by adding broadcast television transcripts. Hoffman (2011), on the other hand, examined more recent coverage in major U.S. papers, but only over a very limited timespan: September 2007 to September 2009, and only in opinion editorials. Painter and Gavin (2016) examined climate coverage in the *New York Times* and the *Wall Street Journal*, among newspapers from other countries, but their temporal focus was limited to a period from November 19, 2009 to February 18, 2010.

not only its defining frame, but also much of the system its defining frame is in (Lakoff, 2010). Every issue, including climate change, can be viewed from a variety of different perspectives and understood as having consequences for multiple values or considerations. For those doing the communicating, the skillful use of framing can help them effectively convey their argument, frequently by emphasizing specific a specific set of considerations related to the issue at hand. The varying weights placed on these considerations often play a decisive role in determining overall attitudes and preferences (Druckman, 2001). The information environment, such as the news media, play an important role in this process as they frequently carry the specific messages from the elites to the mass public (for an example of how this works in the context of energy policy, see Clarke et al., 2015).

Economic Costs and Benefits

We focus on three classes of frames that we believe have particular relevance for societal debate on climate change, based on an analysis of relevant literature. First, frames in climate change news coverage can focus on the economic costs and benefits of climate action for individuals or the society writ large. Researchers have found that fluctuations in the state of the economy affect levels of environmental concern (Kahn and Kotchen, 2010). People are less likely to support climate change mitigation policies when the economy is underperforming (Elliott et al., 1997), and concern with climate change is correlated with higher levels of employment and income (Scruggs and Benegal, 2012; Carmichael et al., 2017).

The state of the economy is an objective fact, but the future projection of the possible consequences of climate mitigation policy for the economy is far more complex. As such, it is open to framing by political actors seeking to mobilize public support for their position. Economic concerns surrounding climate change can be framed in terms of their costs and benefits. Some work has shown that cost-framed messages are effective in influencing climate change attitudes and behaviors (Davis, 1995; Vries et al., 2016), while framing climate mitigation in terms of possible benefits increases support for climate action, even more so than pointing out the costs of inaction (Spence and Pidgeon, 2010).

Party elite behavior has adjusted accordingly (Nisbet, 2009). Republicans have typically adopted frames to highlight the potentially detrimental economic costs of climate action, like increased energy costs or the impact on the US's global competitiveness, to mobilize public opposition to mitigation. Democrats, for their part, have tended to emphasize the benefits of investing in renewable energy sources and their potential to revitalize the economy (Nisbet, 2009). This has been particularly true since President Obama's push for green jobs with the economic stimulus advanced in the aftermath of the Great Recession.

The relative balance of these frames in news content may have implications for the willingness of the public to support and engage in climate action (Bain et al., 2016; Hornsey and Fielding, 2016; Walker et al., 2018). As corporate America has gradually transitioned between intransigence on greenhouse gas emission reductions to cooperation, it is possible this balance has changed over time. No work has systematically examined this possibility in news content.[4] We do so here.

Conservative and Free-Market Ideology

Second, frames may be present in the news media that present climate change mitigation through the lens of left-right ideological conflict. Ideology and values matter in shaping citizen attitudes toward climate action. Anchored in a rich literature on motivated reasoning in social psychology (Kunda, 1990; Ditto and Lopez, 1992), *cultural cognition theory* posits that individual risk perceptions—and the acknowledgment of expert consensus—are shaped by their values in ways to maintain their group identities (Kahan, 2013). Those with individualistic value predispositions are expected to be more skeptical of environmental risks because they justify regulation and government intervention (Kahan et al., 2011). Kahan and his colleagues highlight several mechanisms of cultural cognition: the selective recall of supportive expert opinion, the selective imputation of knowledge and trust to sympathetic experts, and the biased search of information and assimilation of expert messages. Along a similar line, Campbell and Kay (2014) argue that *solution aversion* is key to understanding conservative reticence to accept climate science. Policy solutions to combating climate change are threatening to the ideological identities of conservatives, which biases the perception and interpretation of information from experts. Consequently, they find, along with other scholars, that emphasizing market-friendly solutions to mitigation can lower conservative resistance to climate science (Campbell and Kay, 2014; Dixon et al., 2017).

One important limitation of ideological and values-based explanations for conservative resistance to climate change is that it takes this resistance as a fait accompli. However, it is not clear that this was the case. As late as 1997 Republicans were as likely as Democrats to see climate change as a serious problem (Krosnick et al., 2000). Citizens had to learn to connect their individualistic or conservative ideological beliefs to opposition to climate action. They could have done so with exposure to ideological frames and arguments in the news made by conservative and Republican elites. After all, the conservative movement has mobilized, more or less unanimously, to oppose climate change mitigation (Oreskes and Conway, 2011). To be sure, these groups have often used arguments related to economic costs of mitigation to undermine public support for climate action. They could have also used frames emphasizing the ideological threat of climate action, in the form of larger government, reduced American sovereignty, and sizable restrictions on free market competition. These themes tap into the individualism end of Kahan's individualism-communitarianism values dimension and conservative ideology more broadly.

A large literature on partisan cues in public opinion formation highlights the fact that political elites are often powerful drivers of public opinion (Downs, 1957; Zaller, 1992; Berinsky, 2009).

[4] Feldman et al. (2017) have analyzed climate change news coverage by examining different types of frames, including the economy, but their approach did not distinguish between economic cost and benefit, nor was it the central focus of their analysis.

Previous research has found that the news coverage of climate change has politicized over the past few decades (Merkley and Stecula, 2018) and that partisan cues can polarize the public on this issue (Tesler, 2018; Van Boven et al., 2018). What remains unknown, however, is the degree to which ideological frames and arguments are conveyed in the news media on climate change. These frames could have provoked the polarization of Americans above and beyond the effects of partisanship.

Uncertainty and Risk in Climate Change

A final set of important frames in climate news coverage involves the communication of uncertainty and risk in climate change. Scientific uncertainty exists when there is a lack of scientific knowledge or disagreement over the knowledge that exists at a given point in time (Friedman et al., 1999). Researchers understand that all forms of scientific endeavors involve such uncertainty. In the context of climate change, discussion of uncertainty can focus on conflicting claims or a lack of knowledge about the existence or cause of climate change, its present-day effects, and the difficulty with assessing probabilities of specific outcomes and their consequences in the future (Patt and Schrag, 2003; Renn et al., 2011). Journalists covering scientific issues, such as climate change, are also routinely confronted with uncertainty, since controversy and debate are important criteria for the "newsworthiness" of a story (Friedman et al., 1999). As a result, how journalists present and describe scientific uncertainty affects how the public interpret such uncertainty.

Communicating this uncertainty, however, is notoriously difficult (Fischhoff and Davis, 2014). Scientific discourse often involves an amount of details that can overwhelm even seasoned experts. It can also leave out crucial uncertainties that are commonly understood by the experts within the field, but need to be communicated to the broader public (Fischhoff and Davis, 2014). Finding the right balance is difficult, yet essential, considering the important role that uncertainty plays in human decision making (Curley et al., 1986; Sword-Daniels et al., 2018). Psychological research shows that uncertainty generally has a negative effect on prosocial behaviors, since it tends to enable people to adopt self-serving narratives about their actions and limit their capacity to cooperate in social dilemma situations (Hine and Gifford, 1991; Dannenberg et al., 2015; for a review of the literature, see Kappes et al., 2018).

Experimental work highlights that uncertainty framing also matters for climate change related behaviors, such as decreasing one's energy consumption (Morton et al., 2011). A focus on uncertainty in news coverage can potentially reduce the public's support and engagement in climate action because of the unclear outcomes of such actions.

Uncertainty can take several forms in climate change coverage. On a wide range of climate impacts and long-range forecasts of future warming there is uncertainty that is appropriately acknowledged by experts in the media's coverage of climate science. More problematic is if uncertainty is used in a way that casts doubt on the well-established tenants of the climate consensus of the *Intergovernmental Panel on Climate Change* (IPCC)—that climate change is happening, is predominantly man-made through the production of greenhouse gas emissions, and will result in severe environmental and human harm. The persuasive power of uncertainty in this context is its implicit justification and reification of the status quo, especially as it pertains to fossil-fuel usage and carbon emissions (Feygina et al., 2010).

One way in which this type uncertainty enters the media coverage of climate change has been through the journalistic engagement of so-called "false balance." Reporters frequently treat topics as debates in which they present "both sides" in order to adhere to a journalistic norm of objectivity. This norm exists, in part, because both journalists and the general public prize it (Schudson, 1978; Giannoulis et al., 2010), but also because it acts as a mechanism to protect journalists from attacks on their credibility and to preserve access to sources on both sides of a given political debate (Hallin, 1989; Shoemaker and Reese, 2013). The desire for balance also serves the media's tendency toward drama and conflict in news coverage (Bennett, 2007).

In many contexts it is important for journalists to be fair and evenly balanced in their presentation of different sides of a story, but it quickly becomes awkward when discussing the existence or causes of climate change where the credibility of each side does not have equal weight. And, the consequences of this coverage are troubling. Presenting a scientific consensus as a debate confuses the public on the state of the science and, in the case of climate change, possibly reduces support for climate action (Friedman et al., 1999; Corbett and Durfee, 2004; Koehler, 2016; McCright et al., 2016).

Newsroom norms of objectivity will only contribute to a balanced presentation of a political debate if another side presents itself. Journalists ultimately rely on easily accessible sources when reporting on the news. And, because of the activism of the fossil fuel industry and conservative movement, there have been no shortage of sources ready and willing to use a platform provided by journalists to cast doubt on climate science—the so-called "Merchants of Doubt" (Oreskes and Conway, 2011). Scholars have noted that these groups have made a concerted effort to mobilize opposition to climate mitigation policy by undermining trust in foundations of climate science for both the public and policy makers (Jacques et al., 2008; Dunlap and McCright, 2011; Dunlap and Jacques, 2013; Farrell, 2016a,b). While these groups are likely not as active in the media as conventional wisdom might suggest (Merkley and Stecula, 2018), it is still possible that the press, and in particular conservative media, pick up on their message of uncertainty in their coverage of climate science even if they don't explicitly cite these actors.

As the broader research on misinformation has shown, various myths surrounding climate science, including those pertaining to certainty of different outcomes, tend to be "sticky," and hence very difficult to correct (Lewandowsky et al., 2012). Efforts to correct such information tend to be ineffective, and, in some circumstances might even result in what is called a backfire effect, when people get more entrenched in their original position (Nyhan and Reifler, 2010; Lewandowsky et al., 2012). Some promising work suggests that exposing people to correct information prior to misinformation might be an effective way to "inoculate" them from the perils of misinformation, at least in some contexts, but the broader point remains that, if the

press disseminates uncertainty frames about climate change, such information might play a negative role in people's attitudes about climate change and climate change mitigation policies (Cook et al., 2017; Jolley and Douglas, 2017).

The themes of uncertainty have been analyzed in the context of climate change news coverage. Some research has shown that coverage of climate change in the 1990s and early 2000s was characterized by scientific inaccuracy and uncertainty, which was driven by an adherence to balanced reporting and resistance to a growing body of scientific evidence. More recently, however, balance nearly disappeared from the press (Zehr, 2000; Boykoff and Boykoff, 2004, 2007; Boykoff, 2007). The scope of this work, however, has been fairly limited in terms of the time dimension as well as the amount of news coverage examined, as was highlighted in the previous section. However, scholars who have been examining this feature of news coverage of climate change in the comparative context, have highlighted that the U.S. coverage features substantially more climate skeptic voices pushing doubt about climate science, compared to countries like India or France (Painter and Ashe, 2012). Furthermore, contrary to the findings in the U.S.-centric literature, the authors found that skeptics voicing climate increased their media presence between 2007 and 2010 (Painter and Ashe, 2012). In a separate analysis, Painter (2013) also found that uncertainty was the second most common frame used in climate change coverage, appearing in 76 percent of American articles, however it was the salient frame in only 13 percent of the coverage. It is important to note that this analysis, however, was based only on a total of 55 articles. This disparity in findings highlights the need to systematically examine uncertainty in the context of American news coverage and examine degrees of uncertainty, not just whether the frame is present or not.

Related to the communication of scientific uncertainty is risk. Discussion of possible climate change impacts involve frames and language that convey the severity of possible climate impacts. As the science of climate change has evolved, it has become increasingly clear that risks of inaction are high (Oreskes, 2004; McMichael et al., 2006; IPCC, 2014). Importantly, the prospect of severe loss has been found to motivate people to engage in collective action in social dilemma situations (Milinski et al., 2008; Dannenberg et al., 2015; Farjam et al., 2018), but people tend to underestimate risks associated with climate change because they are abstract and mostly detached from their daily life (Weber, 2006; Rabinovich and Morton, 2012). Consequently, frames that focus on the dangers of climate change may motivate climate action in the general public.

Climate impacts, however, occur both in the distant future and at present. Accordingly, these risks can be framed either way. Scholars have noted that the public's propensity to support and engage in climate action may be conditioned by the degree to which they psychologically proximate to the effects of climate change (see McDonald et al., 2015 for a review). The most studied aspect of this has been spatial proximity. For example, Spence and Pidgeon (2010) find that framing climate impacts as locally relevant increases one's propensity to support climate mitigation. There is a temporal dimension as well. Nicolaij and Hendrickx (2003) demonstrate through experimental manipulation that increasing the temporal onset of climate change produces a reduced willingness to engage in climate action for about half of their participants. The reason why proximity, either temporal or spatial, might matter has to do with the fact that things that are psychologically close seem more tangible and important than those that are "farther" apart, as construal theory would suggest (Trope and Liberman, 2010). What we do not know, however, is how temporally proximate the presentation of climate change is in the major sources of information consumed by Americans.

These three, broad sets of frames: economic costs and benefits, appeals to conservative values, and uncertainty and risk in climate science all could play a role in shaping the public's support and engagement in climate action. However, little is known about how often these frames are featured in news content and how this may have changed over time. As a result, in the rest of this paper, we seek to answer the following research questions:

1. What is the balance of economic cost vs. economic benefits frames in climate change coverage, and did it change over time?
2. How prevalent were ideologically conservative appeals in the climate change coverage, and did they change over time?
3. How often do the news media cover climate change using uncertainty and risk frames, and did the prevalence of these frames change over time?

DATA AND METHODS

We conducted a content analysis of prominent American news media outlets to learn more about how the news media frames climate change. We selected three top circulation daily newspapers with a large, and growing, online presence to get a representative view of the mainstream media coverage: the *New York Times*, the *Wall Street Journal*, and the *Washington Post*, as well as the newswire agency the *Associated Press*. We choose these newspapers since they are the highest circulation papers in the United States and this circulation has been increasing in recent years.[5] Furthermore, they each enjoy a large online presence as the *New York Times*, the *Washington Post*, and the *Wall Street Journal* are ranked as the 3rd, 7th, and 19th most popular news websites on the internet by Alexa, at the time of this writing.[6] They have also been the focus of a vast amount of scholarly attention in communication literature, as they are widely considered to be agenda-setters for both the public and other news media sources (Golan, 2006; Zhang, 2018). The *Associated Press*, according to its annual report, is used by 900 newsrooms globally, and nearly half of the world's population sees their content on any given day.[7] In short, these sources represent a significant portion of the mainstream news media landscape.

This selection of sources clearly does not include social media data, which, according to the data by the Pew Research Center, makes up an increasingly larger portion of Americans'

[5]http://www.journalism.org/fact-sheet/newspapers/
[6]https://www.alexa.com/topsites/category/Top/News
[7]https://www.ap.org/about/annual-report/2017/ap-by-the-numbers.html

TABLE 1 | News sources.

Source	No. of articles	% of corpus	Start date
Associated Press	5,457	39	1988
New York Times	4,015	28	1988
Washington Post	3,469	25	1988
Wall Street Journal	1,200	8	1991
Total	14,141	100	

media diets.[8] Our main focus, however, is longitudinal, so we concentrate on the most influential print news sources that have covered the issue of climate change from the beginning. Furthermore, it is worth highlighting that most Americans continue to get their news from mainstream sources, even in the age of a highly fragmented media landscape. For example, recent analyses of actual behavior data, such as people's web browsing patterns, reveal that most people obtain their news from mainstream, centrist sources (Flaxman et al., 2016; Guess, 2016). That is not to say that the partisan sources and social media are irrelevant or that they might not be growing in prominence, but our focus in this project was on the influential mainstream sources that covered the issue of climate change from the emergence of the issue.

News articles were collected from *Lexis Nexis* and *Factiva* for the time period between 1988 and 2014. We start our analysis in 1988, the year of James Hansen's Congressional testimony, which the *New York Times* proclaimed to be the "Beginning of Global Warming."[9] Articles that mentioned climate change only in passing were excluded from the sample, to ensure that we examined only relevant news reports.[10] In total, the corpus includes 14,141 stories. A detailed breakdown of news reports, by source, is featured in **Table 1**. The *Associated Press* makes up the bulk of the content, but the *New York Times* and the *Washington Post* also covered the issue extensively. The *Wall Street Journal* is an outlier, representing only 8 percent of the sample.

We rely primarily on automated approaches to content analysis in this paper, which allow for the full classification and measurement of entire populations of news articles across criteria we are interested in. These techniques are increasingly used by scholars in the social sciences to study news content and political discourse more broadly (Young and Soroka, 2012; Grimmer and Stewart, 2013; Lacy et al., 2015). They stand in contrast with human coding approaches, thus far dominant in climate change communication literature, that depend on the coding of much smaller random samples of articles. Human coding has its advantages. It can allow for a nuanced coding of content that takes fully into account the context in which words and language are used. However, the costs of this richness are efficiency and a lack of estimate precision across diverse sub-populations. Our aim in this paper is to provide estimates of the prevalence of frames in news content across sources and over a long period of time—tasks which are much more feasibly done with automated approaches to content analysis.

We use supervised machine learning to identify economic, conservative ideological, and uncertainty frames in coverage. The process first involves us (the researchers) hand coding a random samples of 2177 articles to train and test an algorithm.[11] In this case we use Support Vector Machines (SVM), which is a supervised machine learning technique that plots data points on an n-dimensional space to find a hyperplane that best differentiates our classes of objects. We ensured our sample was stratified across three periods (1988–1996, 1997–2005, and 2006–2014) to ensure that our algorithm's performance would not fluctuate as climate change increased in salience over time.

We randomly divided our hand coded sets into a training set (80%) and a testing set (20%). The former is used to train the algorithm, while the latter allows us to compare the machine's coding to our own. After training and testing the algorithms, they were used to classify the full corpus of articles for each of our frames.

We assess the reliability of our trained algorithms with three metrics. First, we compute a simple accuracy measure, which is the percent of our testing set with agreement between our human and machine coding. However, accuracy alone is not sufficient to judge the quality of a classifier. Algorithms may have poor predictive capacity but still yield high accuracy scores when classes are imbalanced by following a simple rule of assigning cases the value of the dominant class. Thus, we also present precision ($\frac{true\ positives}{true\ positives+false\ positives}$) and recall ($\frac{true\ positives}{true\ positives+false\ negatives}$) scores for each algorithm. The former tells us how many of our selected items are relevant. This metric is used by those concerned with minimizing false positives. The latter tells us how many of our relevant items are actually selected—related to the minimization of false negatives. We present both because we want precision and recall to be approximately equal to present unbiased estimates of proportions. We don't want false negatives to outweigh false positives or vice versa. Note that these two metrics are typically used in the context of information retrieval where researchers are primarily interested in accurate predictions of instances of a class of objects—in this case our frames. Because we are interested in estimating proportions of articles of a given class we need to be interested in accurate predictions of both the presence and absence of our frames, so we take the average of precision and recall scores for both.

The above process was applied to train and test the algorithms related to each of our frames. The only difference between them

[8]http://www.journalism.org/2018/09/10/news-use-across-social-media-platforms-2018/

[9]https://www.nytimes.com/1988/06/24/us/global-warming-has-begun-expert-tells-senate.html

[10]This was accomplished through a combination of human coding and supervised machine learning, where a sample of stories was hand coded as relevant or not and then the machine learning algorithm was used to apply that to our corpus.

[11]The training and testing sets were pulled from a larger number of mainstream newspapers, which we have analyzed as part of our larger project studying climate change news content. However, only 30% of the training set came from other mainstream newspapers. For this paper, one researcher completed the hand coding, while the second randomly selected 10% of these hand coded items (200 articles) to assess the reliability of the coding. Our Krippendorff's Alpha score is 0.87 for economic cost frames (95% agreement), 0.92 for economic benefit frames (98% agreement), 0.88 for uncertainty frames (96% agreement), and 0.83 for conservative frames (99% agreement). The human coding input for the algorithm is thus highly reliable.

was in the size of the hand coded training and testing set. Each of our frames is imbalanced in the hand coded set. There are more cases of each frame being absent than there are of instances of a frame being used. SVM, like other supervised machine learning approaches, is vulnerable when classes are imbalanced. In the process of training and testing our algorithms we found we could improve performance by training on a corpus where articles with a given frame command a larger share of the hand coded set. So, for each of our frames we randomly removed articles without a given frame such that those with the frame represented a third of the overall set. This reduced the number of overall articles in the combined hand coding set used for training and testing purposes as described below.

We now discuss each of our coding tasks in turn. First, we coded whether (1) or not (0) a news article had mention of possible costs of climate change mitigation to the economy. This could involve discussion of higher taxes, higher energy prices, reduced employment or economic growth, or reduced competitiveness vis-à-vis developing countries. We code these dimensions of economic cost together because they are often discussed together in news content, and, when not, typically involve the use of similar language and rhetoric. The reliable use of supervised machine learning requires the selection of topics that are clearly distinct in their language. In some cases substantial discussion was present in a given article about economic impacts, but in other cases such frames were present in short rhetorical passages from political elites, particularly Republicans. An example of the use of such a frame can be found in a *New York Times* article on December 13, 1997 where Republicans attacked the Kyoto Protocol:

> "Republicans are already testing arguments…Jim Nicholson, the chairman of the Republican National Committee, said the pact will 'radically change the American life style.' And Audrey Mullen, the executive director of the conservative group Americans for Tax Reform, said, 'Al Gore would prefer to stick working-class America with a big tax increase and stick America with lost jobs."'

Second, we coded articles for whether (1) or not (0) they had references to economic benefits for climate change mitigation. These frames feature discussion of win-win features of some climate mitigation policies, like green jobs, lower energy and gas bills through increased energy efficiency, and increased profits for green-friendly corporations. Importantly, we coded these frames not to include reference to the costs of climate inaction. Discussion of energy efficiency, on its own, was also not enough to meet our criteria. There had to be mention of how such efficiency benefits consumers or companies in the long run. For example, this frame was used in a *Wall Street Journal* article on March 14, 2008 describing Wal-Mart's efforts to reduce its carbon footprint:

> "The company is also looking into ways to reduce the amount of plastic used in making bottled-water containers, he said. The impetus for the company in doing all this isn't just to please environmentalists, he said, but to save money. 'It really is about how you take cost out, which is waste,' he said. 'The savings by taking out wasted material helps keep prices low for Wal-Mart's customers.' Indeed, Mr. Scott told reporters after his talk that the current economic slump is prodding Wal-Mart even more to undertake its waste-reduction program. 'When is a better time?"'

We classified our full sample based on a training and testing set of 1,878 articles for economic cost frames, and 864 for economic benefit frames. Our economic cost classifier was 80% accurate, with an average recall and precision of 0.76 and 0.80 respectively, indicating good performance. Similarly, our economic benefit classifier was 80% accurate with average recall and precision scores of 0.74 and 0.78, respectively.

Third, we coded articles if there was any discussion related to conservative ideological themes (1) or not (0). Specifically, we were interested in arguments that stressed the need to oppose climate action because such policies empower bureaucrats, undermine American sovereignty, serve a "big government" agenda, redistribute wealth, increase regulation, restrict freedom, or violate the principles of the free market. Importantly, we wanted these arguments to be distinct from arguments about economic cost, and we excluded conservative frames that were used in support for climate action as their occurrence was too rare to reliably train an algorithm to engage in topic classification. This frame was used in the same *New York Times* story as above:

> "Republicans are already testing arguments. Steve Forbes, a Republican Presidential contender, immediately called the accord 'an unprecedented government seizure of American freedom and sovereignty.' He added that 'the Clinton health care plan pales in comparison."'

More commonly, though, these themes were present in newspaper op-eds, such as the following from a *Wall Street Journal* op-ed on December 13, 2004:

> "There's nothing capitalist about lobbying government to erect a program that serves no other purpose than the redistribution of wealth, whether it be from one company to another, or from consumers to corporations."

We trained our algorithm on a combined training and testing set of 405 articles. Our classifier was 85% accurate, with average recall and precision scores of 0.70 and 0.80, respectively.

Finally, we coded each article for how balanced it was toward arguments of supporters and opponents of the IPCC consensus—that climate change is happening, manmade, and a serious problem. Articles were coded −1 if there was no presence of discussion in the article that cast uncertainty on the veracity of any part of the IPCC climate consensus. They were coded 0 if there was effectively an even balance of perspectives between those that support for IPCC consensus and those that reject it, and 1 if the article featured a complete rejection of the IPCC consensus and embrace of the uncertainty frame. This latter category primarily took the form of op-eds by climate skeptics. Articles were also coded as −0.5 and 0.5 if they featured both perspectives on climate science but were notably slanted in one direction or the other.

There were too few instances of articles scored 0 and below to train an algorithm to reliably return a fine grained measure of article balance, so we collapsed all categories above −1 when training our algorithm. Thus, articles could be scored as 1 if they had any discussion that cast doubt on the IPCC consensus and thus used an uncertainty frame, and 0 if they had no such discussion.

An example of the use of an uncertainty frame is found in a *Washington Post* article on October 30, 2000 citing a quote by, at the time, presidential candidate Texas governor George W. Bush:

> "By contrast Gov. George Bush remains largely stuck in a posture of wait and see. He says he takes global warming seriously, and he has proposed mandatory controls on power plant emissions that would include caps on the greenhouse gas carbon dioxide. But in the debate he said, 'I don't think we know the solution to global warming yet. . . . Before we react I think it's best to have the full accounting, full understanding of what's taking place.'"

We trained our algorithm on combined training and testing set of 1,179 articles. Our classifier was 77% accurate, with average recall and precision scores of 0.70 and 0.68, respectively.

To examine the prevalence of language related to risk and time horizon, we turned to a different set of automated content analytic methods. Instead of supervised machine learning, we used dictionary methods. There were two primary reasons for this choice. First, the aspects of coverage discussed above were difficult to capture using a dictionary approach, and we weren't able to produce reliable results with the dictionaries that we inductively put together. Supervised machine learning approaches, however, did reliably work. Secondly, capturing simpler components of language, such as risk and tense, is much more straightforward with dictionary methods, especially with a pre-assembled and verified dictionaries included in *Linguistic Inquiry and Word Count* (LIWC) software (Tausczik and Pennebaker, 2010). The software has been used in countless studies in the fields of communication, political science, and computational linguistics, among others.

The LWIC dictionary is composed of 1,393 words measuring different linguistic dimensions. For our purposes here, we use two specific dictionaries embedded into LWIC: risk and present tense. The risk dictionary is a collection of words and phrases such as alarm, avoid, hazard, and threat, while present tense includes words like lives, now, or present. In general, research has shown that dictionary methods tend to do a good job capturing different linguistic dimensions of text, comparable to the performance of manual coding (Young and Soroka, 2012).

RESULTS

We begin by presenting the results for economic frames. The results of our manual coding are displayed in **Table 2**. It reveals that, across all three periods, close to 30% of all stories had reference to possible economic costs of climate mitigation. This was largely consistent across all three time periods of our study. In contrast, frames focusing on economic benefits of climate policy are relatively limited, comprising just under 13% of coverage. However, there has been a notable spike in such coverage more recently in period 3 (18.9%). SVM classification yields largely similar results. Close to 30% of articles contain frames related to economic costs, and there has been a modest decrease in the most recent time period (24.4%), while 20% have economic benefit frames, which have risen substantial in the most recent period (23.9%) compared to the earliest period (10.8%).

Figure 1 below presents the SVM results annually since 1988. Economic cost frames unsurprisingly appear to coincide with important policy debates such as the Rio conference, the Kyoto protocol, and Kyoto's implementation. In all three of these periods Republicans and their allies in heavy industry were active in framing the climate debate in terms of the cost of mitigation to the American economy due to the exclusion of developing countries from mandatory emissions reduction targets. Since 2001, however, it does appear that the presence of these frames in coverage have decline somewhat. In contrast, economic gain frames marched steadily upwards in the 2000s, coinciding with the changing posture by much of corporate America toward climate change mitigation. There now appears to be an even contest between economic cost and economic benefit frames in news coverage, which was far from the case in the 1990s.

The media's treatment of economic frames is relatively consistent across each of the outlets used here as shown in **Table 2**, with one notable exception. The conservative *Wall Street Journal* is substantially more likely to present economic cost frames (43.4%) compared to the others (24.7%, average), though it is also modestly more likely to also focus on gains (27.4 vs. 20.1%, average). In the temporal dynamics, however, each of our outlets are fundamentally similar. All four outlets have seen a gradual convergence in the promotion of economic cost and benefit frames in their coverage, as shown in **Figure 1**. In the contest to frame climate change mitigation as either a cost or a benefit, there is now a fair fight.

In sharp contrast, conservative ideological framing—independent of concerns for economic costs—is very limited. Our manual coding reveal that such frames are only present in under 4% of news coverage. This figure has remained relatively constant across the three periods of our study. Our SVM algorithm returned results broadly similar to our coding, though estimating the percentage slightly higher (5.6%). There were only a few times in the past few decades when the conservative framing was featured in more than 10% of the news articles. As shown in **Figure 2**, in the years of peak salience of the issue, 2007–2009, conservative framing was featured in 3, 5, and 7% of all news coverage, respectively. Interestingly, there is little evidence of a rise in conservative ideological framing, despite increasing partisan polarization on climate change.

There are, however, important differences between the *Wall Street Journal* and the other papers. This is unsurprising, given that the *Wall Street Journal* is considered the flagship newspaper of the conservative movement. There are several years when the conservative framing was featured prominently in the climate coverage in the Journal. That was especially the case in 1996 and 2001, where the conservative frame was present in 67 and 29% of the climate stories in the *Wall Street Journal*. In the years

TABLE 2 | Hand coding and SVM results.

	Total	Period 1 (1988–1996)	Period 2 (1997–2005)	Period 3 (2006–2014)	AP	NYT	WP	WSJ
Economic Cost (Manual)	28.8%	29.7%	29.1%	27.4%				
Economic Cost (SVM)	27.0%	32.7%	32.3%	24.5%	28.7%	21.9%	24.6%	43.8%
Economic Gain (Manual)	12.8%	9.7%	9.9%	18.9%				
Economic Gain (SVM)	20.8%	11.4%	14.6%	24.4%	18.3%	22.3%	20.6%	28.3%
Conservative Ideology (Manual)	3.8%	2.7%	4.5%	4.3%				
Conservative Ideology (SVM)	5.7%	5.8%	6.4%	5.4%	3.8%	6.5%	6.3%	9.3%
Uncertainty (Manual)	18.1%	24.9%	14.6%	14.4%				
−1	81.9%	75.1%	85.4%	85.6%				
−0.5	10.7%	15.5%	9.6%	7.0%				
0	3.9%	5.2%	2.9%	3.5%				
0.5	1.1%	1.6%	0.4%	1.3%				
1	2.3%	2.6%	1.7%	2.7%				
Uncertainty (SVM)	19.6%	32.3%	21.2%	16.6%	16.1%	18.5%	23.8%	26.2%

when the issue was covered most prominently, however, even the Journal used the framing at the rates comparable to other news outlets, usually below 10% of all coverage. Conservative and Republican elites have not typically framed opposition to climate change in grand ideological terms, relying instead on arguments about economic cost, and, to a lesser degree, scientific uncertainty, as we shall see below.

Our manual coding also reveals that uncertainty frames are not present in climate change coverage at levels we might expect. This is in line with past work that shows organized climate skeptics are rarely featured in the news (Merkley and Stecula, 2018). Only 18% of coverage features any discussion that contradicts the IPCC climate consensus. And, of this share of coverage, well over half (10.7%) is still slanted in a way that privileges voices aligned with the IPCC consensus. Much dreaded "false balance" in climate coverage is rare. It also appears that the news media has improved in their coverage on this score. The share of coverage with *any* uncertainty framing has decreased from 25% in period 1 to ∼14% in period 3.

The SVM results are consistent with our manual coding. It found 19% of articles to have some presence of uncertainty framing, which has dropped from 32% in period 1 to 16% in period 3. This is reflected in the annual plot of our SVM results in **Figure 3**. Uncertainty framing spiked to over 40% in periods of intense policy debate in the 1990s, but has marched steadily downward since, such that the best estimate of uncertainty framing in coverage at present is around 10%.

Again, results are reasonably consistent across our sources, though the conservative *Wall Street Journal* focuses on uncertainty frames modestly more than our other outlets on average (25.4 vs. 19.4% average). The dynamics shown in **Figure 3** below, however, illustrate that the decline in uncertainty framing is consistent across all of our sources, such that the *Wall Street Journal* has largely converged with the rest. Again, it is worth noting that instances of "false balance" are likely even lower than these rather liberal estimates of uncertainty. The news media have simply not treated climate science in a balanced way, and they have increasingly purged any reference to uncertainty surrounding the IPCC consensus from their coverage.

Risk framing is measured differently than economic cost and benefit frames and other results discussed above due to a different method employed in capturing it. The results are presented in **Figure 4**. The y-axis indicates the percentage of words in an average article each year that indicate risk. The numbers themselves are low, and somewhat difficult to substantively interpret, but what is clear is that language conveying danger and risk is increasingly present in climate change coverage as the issue has risen in salience. Between 1995 and 2014, risk language usage in the press increased by over 35%. There are no substantive differences between the outlets. All display similar patterns of increased usage of risk framing, as the issue has increased in salience in the mid-2000s. What might be surprising, however, is a relatively high usage of risk language in the early 1990s. The reason for that peak, however, is rooted in a relatively low number of articles in that time-frame, especially before the Kyoto Protocol. The bulk of the stories in that period primarily focused on the science of climate change, and therefore language relating to risk was comparatively common.

We also measured framing relating to temporal distance using the dictionary approach—specifically words used in climate coverage that were in the present tense. As **Figure 5** demonstrates, there has been an increase in present-tense language around the time when the issue exploded in salience, in mid-2000s, around the release of Al Gore's award winning documentary *An Inconvenient Truth.* This pattern appears to be modestly stronger with coverage by the *Associated Press* and the *Washington Post*, though it is, on average, higher now than in the past for all four outlets.

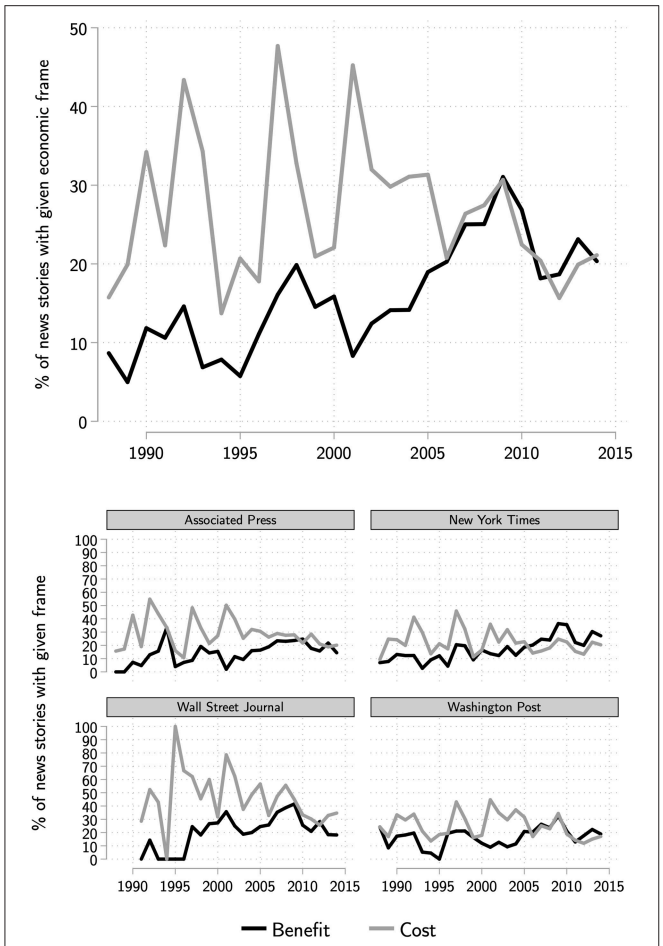

FIGURE 1 | Proportion of climate change news coverage with economic framing from 1988 to 2014 in our combined corpus (top panel) and by source (bottom panels).

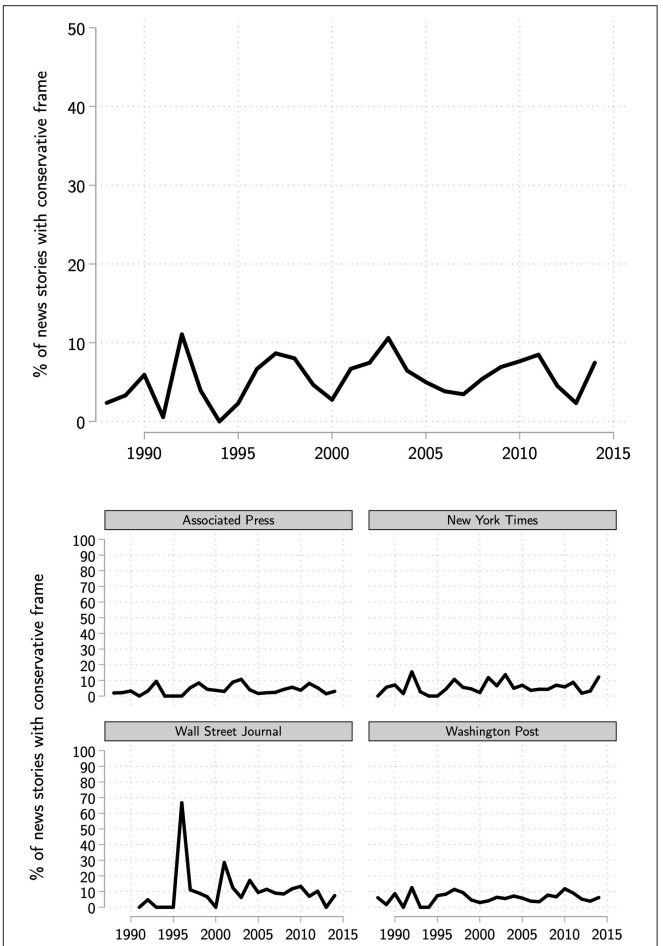

FIGURE 2 | Proportion of climate change news coverage with conservative framing from 1988 to 2014 in our combined corpus (top panel) and by source (bottom panels).

DISCUSSION

Frames play an essential role in distilling complex topics into more manageable components so that people can identify its relevance and form opinions (Spence and Pidgeon, 2010). It is inevitable in the context of climate change because of the sheer number of dimensions associated with the issue—questions pertaining to the science and future climate forecasts, impacts, public policy, and related tradeoffs, among others. Frames, however, are not neutral. Journalists, interest groups, environmentalists, and party elites all compete to elevate frames conducive to their interests and ideologies (Nisbet, 2009).

A rich literature has emerged using experimental methods to examine the influence of these frames on public attitudes toward climate science and mitigation policy. Together, these works have provided important insights into the public's complex relationship with climate change. We know that frames emphasizing economic cost reduce support for climate mitigation (Davis, 1995; Vries et al., 2016), but those emphasizing gains are important at marshaling support (Spence and Pidgeon, 2010). Scholars have speculated that uncertainty frames confuse the public about the state of the science, and reduce their propensity to engage in mitigation behavior (Boykoff and Boykoff, 2007), and there is some experimental evidence in support of that notion (Dixon and Clarke, 2013; Clarke et al., 2015; Dixon et al., 2015; Koehler, 2016). We also know that less polarizing climate change discourse may reduce Republican antipathy toward climate action (Tesler, 2018). However, we believe that more work needs to address the information environment in which citizens learn about climate change. How often are these frames present? Has the dominance of certain frames changed over time? Are there differences across outlets? Scholars need to increase their focus on the study of *content*, particularly in the news sources that most citizens learn about political issues.

We find here reason for optimism. Many of the frames which scholars have identified as reducing citizen propensity to support and engage in climate action have been on the decline in the mainstream media—even in the flagship publication of the conservative movement: the *Wall Street*

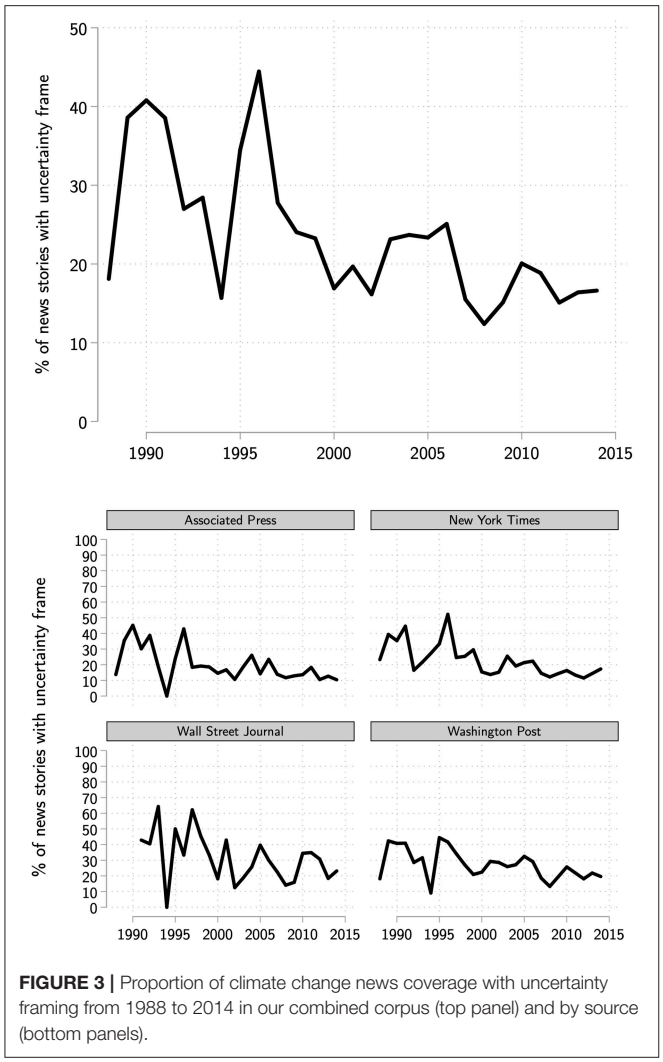

FIGURE 3 | Proportion of climate change news coverage with uncertainty framing from 1988 to 2014 in our combined corpus (top panel) and by source (bottom panels).

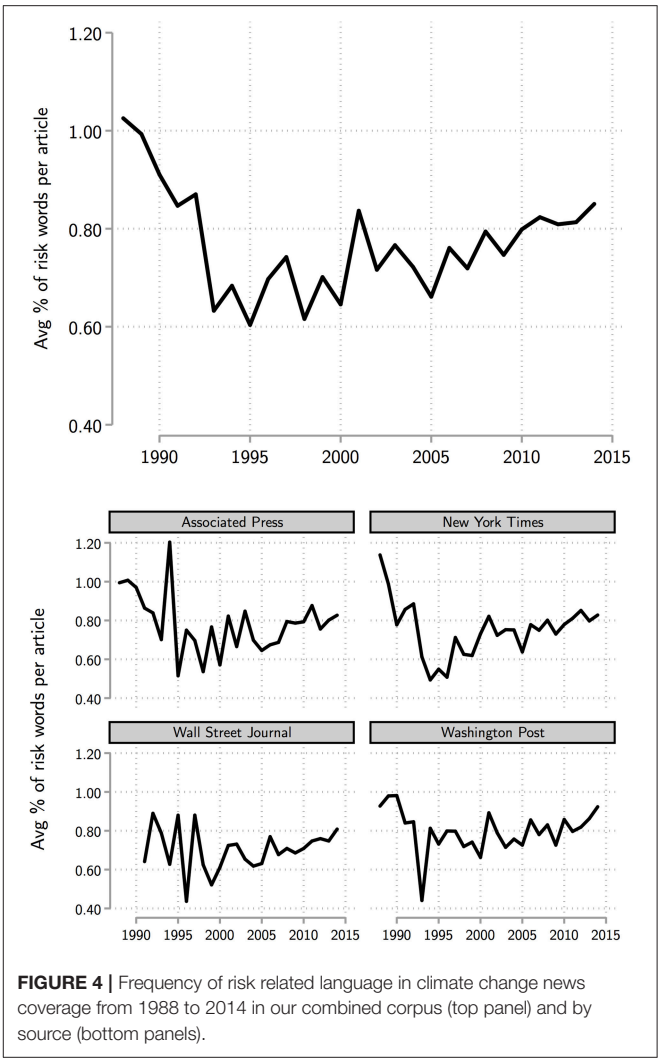

FIGURE 4 | Frequency of risk related language in climate change news coverage from 1988 to 2014 in our combined corpus (top panel) and by source (bottom panels).

Journal. Frames pertaining to the possible economic harms of climate mitigation policy have been prominent in the past, but appear to be on the decline. Similarly, frames related to uncertainty in the IPCC consensus have been in sharp decline, and true instances of "false balance" have never been particularly common. Conservative ideological frames, for their part, have never gotten traction in mainstream news coverage and this is even true in the *Wall Street Journal*. The reason for this appears to be that economic cost is the argument of choice for conservative and Republican elites when communicating opposition to climate change mitigation policy. The three pillars of argument typically used by countermovement organizations and the Republican Party to undermine climate action have been muffled in dominant news outlets.

At the same time, frames conducive to the support and engagement in climate action by the general public have been on the rise. Frames that emphasize the economic benefits of climate action have been on the sharp ascent since 2008 and now match those of economic cost. There is now a fair fight between rival interpretations of the economic implications of greenhouse gas emission reductions. The use of the present tense is also more common in climate coverage, as is the presentation of language related to risk. Climate discourse is increasingly focused on the risk posed by inaction and the here and now. To the extent that citizens may not be informed of the gravity of the risk posed by uncontrolled greenhouse gas emissions, or discount threats that appear to be far in the future, these are welcome developments.

We cannot definitely say why these changes are occurring with a study of news content. However, it seems likely that the sharp changes we have observed in the prevalence of economic frames is a result of the changing posture of the business community. A key characteristic of the Kyoto debate was the monolithic opposition of American business to climate mitigation. Notwithstanding the continued reticence of the fossil fuel industry—this is no longer true. Many sectors of American industry see opportunities for profit with climate mitigation strategies—or, at least publicly recognize the need to minimize future risks posed by climate change (Sullivan, 2008; Lee, 2012; Weinhofer and Busch, 2013; Doda et al., 2015). Other companies

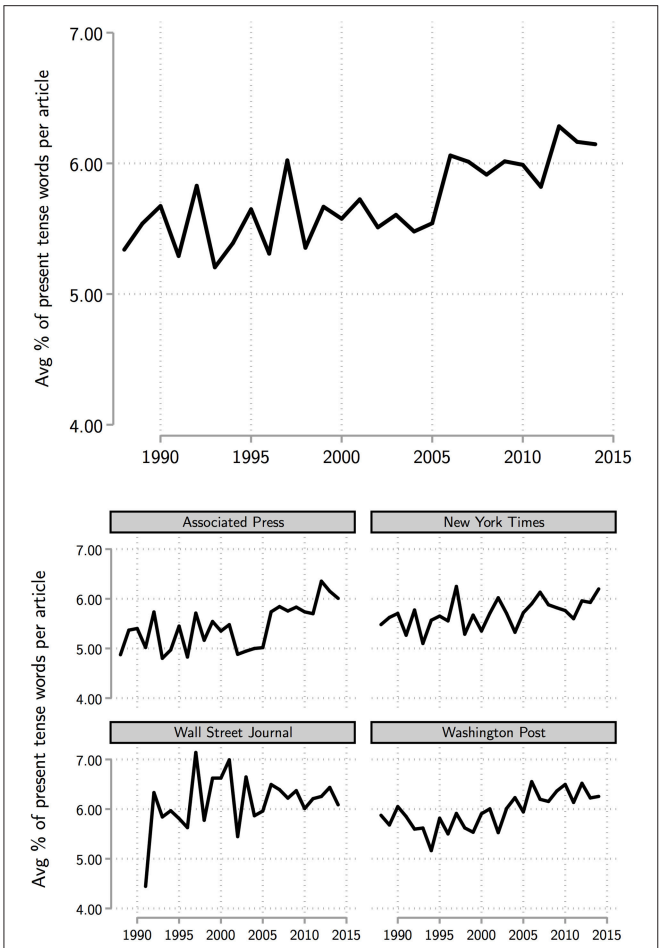

FIGURE 5 | Frequency of present-tense related language in climate change news coverage from 1988 to 2014 in our combined corpus (top panel) and by source (bottom panels).

have emerged explicitly to capitalize on the emerging green economy. News content is reflecting these changes.

One limitation of our automated content analysis approach was the need to code distinct dimensions of economic frames together within the respective umbrellas of economic costs and benefits. In so doing, we may have lost important nuance. We cannot, for instance, say whether frames related to disemployment effects of mitigation policy are more common than those focusing on energy costs. We believe this tradeoff was necessary to maximize the precision of our over time estimates—a task which is much more suited for automated content analysis compared to the hand coding of a smaller batch of articles. Future work should make more thorough use of human coding to tease out the prevalence of different dimensions of economic costs and benefits and, if possible, how each of them may have changed over time.

Similarly, it is likely that news content is reflecting changes in climate science. The IPCC consensus is robust, but there is no doubt that confidence in its main tenants has solidified over time as data and research has accumulated. Journalists have likely reflected this change in their content. Our hand coding reveals that most of the decline in the use of uncertainty frame has been found in stories that reference uncertainty, but largely support the IPCC consensus (scored −0.5) and those that provide a balance of perspectives on the consensus (scored 0). These are primarily news stories. In contrast, there has been no notable decrease in articles that primarily reject the IPCC consensus, which are largely op-eds. In short, whatever problem that remains is primarily due to news outlets lending their op-ed pages to climate skeptics rather than the operation of a journalistic norm of balance—a point reinforced with the even lower share of coverage using uncertainty frames by the AP newswire. The implication is that continued scholarly focus on false balance and organized skeptics is perhaps misplaced—at least as far as understanding public opinion is concerned. Further research should explore the roots of these changes in journalist practice to allow us to avoid similar problems of false balance on other issues of scientific and expert consensus.

Not all is well, though. It is heartening that conservative ideological frames are rarely used to oppose climate action, but at the same time these themes are not used in *support* of it either. Research has found that conservative frames in support of climate action can be highly persuasive to conservative and Republican identifiers (Campbell and Kay, 2014; Dixon et al., 2017). We were not able to find enough instances of this frame's use to reliably train an algorithm to measure its (lack of) prevalence. Science communicators and journalists need to do more to elevate conservative arguments for climate action and those making these arguments.

Perhaps even more importantly, previous work has shown that there has been a steady rise in the presence of cues or messages from party elites on climate change (Merkley and Stecula, 2018). This may help explain why, for all the gains that have been made in raising the awareness among Americans to the threat of climate change, the public has also polarized on the topic. A wide array of research on public opinion formation has shown such cues to be informative for citizens and persuasive on a wide range of issues (Zaller, 1992; Cohen, 2003; Berinsky, 2009), because both partisanship and negative partisanship form critical parts of their social identity (Green et al., 2002; Iyengar et al., 2012). Mobilizing a societal consensus on climate action requires an awareness of this dynamic in the information environment and solutions that can overcome polarizing elite discourse.

We hope that our findings will not only contribute to the academic body of work on this topic, but will also prove useful for journalists, science communicators, and policy makers. For journalists to change and improve their practice, they first need to know what their current practice is and how its changed over time. One specific issue with climate coverage, for example, is the lack of conservative frames supporting climate action. Since science communicators believe these frames are the key to persuading Republicans, as was highlighted above, journalists should do a better job amplifying those voices in their coverage. Furthermore, as the issue of climate change has been extensively studied, journalists and media professionals can use some of the lessons of this coverage and apply

them to other issues with broad scientific consensus, but were coverage is routinely worse, such as the safety of genetically modified foods.

Future scholarship needs to bridge experimental research examining the effects of frames and cue sources on climate attitudes with descriptive analyses of the real world information environment where Americans are exposed to these messages. Both are needed to allow science communicators to effectively craft strategies to mobilize Americans for climate action. We hope that our paper provides useful information to scholars seeking to design stronger, more externally-valid experimental studies and journalists concerned with writing news content conducive to raising public concern about the threat of climate change.

Furthermore, future work on this topic needs to more thoroughly link the body of work that has developed on this topic in a comparative context. As the news media environment is becoming more global, particularly with the rise of the importance of social media in the information environment of an average person, a systematic understanding of how climate change is covered and how that coverage changed in different countries with different media systems, might illuminate best practices for science communicators, policymakers, journalists, and members of the interested public in different institutional contexts.

DATA AVAILABILITY

Replication data is available at https://osf.io/gfyhe/.

AUTHOR CONTRIBUTIONS

DS and EM collected the data and produced the tables and figures, wrote, and edited the article, as well as handled the revisions during the review process. EM performed the hand coding and ran machine learning analysis and wrote the bulk of the data and methods, results, and discussion. DS performed the dictionary content analysis and validated hand coding and wrote the bulk of the initial literature review and the introduction.

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frontiers in Communication

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Climate Change Marches as Motivators for Bystander Collective Action

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Political marches are one of the most public and vocal means of engaging in collective action and can potentially build social movements by increasing the likelihood that bystanders become engaged with the social movement. Here, we conduct a trend study to test the impacts of two back-to-back highly visible large-scale climate change related marches on bystanders, targeting psychological drivers of collective action: efficacy beliefs, perceptions of others' climate change activism and concerns, impressions of marchers, and behavioral intentions. Participants either completed a survey the day before the March for Science (n = 302) or several days after the People's Climate March, which occurred a week after the first march (n = 285). Results suggest that the marches were at least partially effective: bystanders' (a) collective efficacy beliefs and (b) impressions of marchers improved after the march. In contrast, marches were ineffective in increasing perceptions of others' engagement with concern about climate change. We anticipated that political leaning of bystanders' news sources would moderate effects of marches. Unexpectedly, collective efficacy beliefs improved among consumers of conservative, but not liberal, news. This unanticipated result is consistent with the notion that conservative news sources dedicated less coverage than liberal news sources to the marches prior to the marches (potentially leading to lower collective efficacy among those who consumed these sources), but that coverage afterwards was more equal across ideological bias of news sources. We also found that the more conservative the news sources consumed by an individual, the more negative impressions they had of marchers, and this relation was strongest among those that indicated, after the marches, that they had heard about the marches. These results on impressions are consistent with the notion that, when marches were covered, conservative news sources *portrayed* marchers relatively more negatively than liberal news sources. Overall, results suggest that marches can increase the likelihood that bystanders will participate in social movements via changes in psychological drivers of participation and the effects will likely depend upon political leanings of news sources via both whether sources mention the marches and how the sources cover the marches.

Keywords: collective action, protest, bystander, efficacy, group norm, meta-perceptions, stereotypes

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INTRODUCTION

Political marches are one of the most public and vocal means of engaging in collective action and a visible contributor to social movements. In the last few years the public has witnessed marches around the globe for many topics including protests about climate change inaction and lack of respect for science, with the latter including concerns about disrespecting scientific warnings about climate change (Fleur, 2017). Political marches are a method that a group can use to visibly and dramatically communicate their concerns about a topic, influence others, and contribute to a larger movement aimed at social change (Thomas and Louis, 2013). Marches emphasize the power of people to influence the power of *elites*—those in social, economic, and political positions that allow them to exert control on powerful institutions, laws, myths, traditions, and social norms and thereby have disproportionate control over societal outcomes (Moyer, 1987; Moyer et al., 2001). However, protests can also expand social movements by engage other members of the public to join their movement and create a stronger force for change (Moyer, 1987). Considering the goal of increasing participation in a social movement, some predictors of joining a social movement are linked to the consequences of marches on bystanders. For example, marches could inspire others to join a movement to address climate change by increasing the perceived efficacy of the public's ability to take action to address climate change (Wallace et al., 2014).

The present research studies the psychological impacts of two highly visible large-scale climate change related marches on *bystanders*—people in the general public who did not participate in the marches but had the opportunity to learn about the marches. The two events had their primary marches in Washington DC and sister marches across the nation and world. They were within 2 weeks of each other and both included a theme of a need to address climate change (Fleur, 2017; Levenson, 2017). Here, we examine psychological impacts that other research points to as predictors of engagement in collective action, specifically (a) efficacy beliefs, (b) beliefs about other people's engagement in the topic, (c) impressions of protestors, and (d) intentions to engage in collective action. The psychological impacts of marches on bystanders is likely linked to the information people receive about the marches. The news media, however, is a gatekeeper of information and, therefore, may be a key contributor to the success of marches (Koopmans, 2004). Thus, we examine whether bystanders' preferred news sources moderate the impact of marches on bystanders.

Much research on political marches and other forms of collective action has focused on predictors of participation in collective action rather than the consequences of collective action (Louis, 2009; Thomas and Louis, 2013). For instance, much research has studied the role of self-efficacy, group identity, ingroup norms, emotions, and perceived violation of moral standards on participation in collective action (van Zomeren et al., 2008; van Zomeren, 2013). In contrast, there is more limited research on the consequences of collective action on bystanders (e.g., their opposition to power elites and support for protesters; Thomas and Louis, 2014). Impacts of marches on bystanders (the focus of the present work) are important because, as noted above, they can contribute to the success of marches.

Here, we examine potential outcomes of the marches on bystanders that have been shown by other research to be psychological predictors of participation in collective action. In doing so, we extend previous work examining sympathetic responses to protestors' causes (e.g., Branton et al., 2015; Andrews et al., 2016) in order to study outcomes which have been suggested to distally predict engagement in social movement activity and collective action. Specifically, this research tests whether the March for Science and the People's Climate March held in the spring of 2017 influenced (a) collective and personal efficacy to address climate change, (b) perceptions of others' engagement in the topic (i.e., perceived group norms and meta-perceptions), (c) impressions of marchers, and (d) intention to engage in subsequent collective action to address climate change.

We also test the moderating role of bystanders' preferred news sources on these outcomes. While some political marches are direct, observable, and explicit confrontations with powerful elites, in most cases confrontations and public awareness are mediated through news coverage (Koopmans, 2004). Goals of movements are often simply to become visible and large-scale marches may be deemed newsworthy and, thus, can garner such attention. Yet, the type of visibility they achieve depends upon how the marches are portrayed. For example, when providing visibility, media coverage of social movements may positively or negatively resonate with its audience and descriptions may or may not convey the movements' legitimacy (Koopmans, 2004). This suggests that the tenor of news coverage can influence the effectiveness of marches (Amenta et al., 2015; Jasper and Duyvendak, 2015; Karpf, 2018). Thus, psychological impacts of marches on bystanders may be filtered through the public's encounters with the movements via news sources providing different effects based upon one's preferred news sources.

PSYCHOLOGICAL IMPACTS

Efficacy

Efficacy, perceptions of one's ability to effect change, is a robust predictor of climate change action (van Zomeren et al., 2008; Lee, 2010; Doherty and Webler, 2016; Geiger et al., 2017). *Collective efficacy*, the degree to which an individual perceives they can work together with others to meet a goal, is a subfacet of efficacy that influences willingness to engage in collective action (Roser-Renouf et al., 2014) This is further subdivided into (a) the perceived ability of a group to engage in specific actions (*collective efficacy*) and (b) the perceived ability of those actions to produce the desired outcomes (*collective response efficacy*). Learning about others' collective action increases the belief that one's community can improve their situation (i.e., collective response efficacy; Bilali et al., 2017). Marches may increase collective efficacy by being salient examples of cooperation in service of a common goal; observing large numbers of people willing to engage in coordinated action to address climate change is evidence that groups of people can work together to address climate change and large-scale marches may convey confidence that social change is

possible. Thus, learning about marches in support of science and the need to address climate change may increase the expectation that the public can engage in collective efforts and collective efforts can effectively address climate change.

Collective efficacy contrasts with *personal efficacy,* which is made up of a) *self-efficacy,* individuals' perceived ability to personally engage in an action and b) *response efficacy*, whether that action would produce a desired outcome. Both forms of personal efficacy can promote many types of climate change action (Swim et al., 2014; Doherty and Webler, 2016; Geiger et al., 2017). In addition, marches can influence personal efficacy (Wallace et al., 2014), possibly by serving as role models for how to engage in collective action (e.g., Bandura, 1997). Although the above research suggests that marches could influence personal efficacy and the impact on personal efficacy is potentially important for future engagement in climate change action, marches may not influence personal efficacy. Marchers may be sufficiently different from an individual to not be ideal role models to address personal efficacy and may not address personal barriers to action.

Based upon these considerations, we make the following hypotheses.

H1a: Large-scale climate change and science marches will increase perceived efficacy to address climate change.

H1b: These effects of marches will be present for collective efficacy and not personal efficacy.

Perceptions of Others' Engagement: Group Norms

Descriptive norms (perceptions of others' behavioral tendencies) are powerful predictors of behaviors (Cialdini, 2003), including climate change collective action (Doherty and Webler, 2016). Large-scale marches supporting action on climate change could alter perceived group norms about engagement in efforts to address climate change for at least two reasons. First, the People's Climate March and March for Science in 2017 drew thousands of people together across the nation and the globe, drawing particularly large numbers in large cities (Fleur, 2017; Levenson, 2017; Mooney et al., 2017). Thus, the marches provided strong visual images of many people taking action to address climate change. Second, exemplars of people concerned about climate change may be made salient and, via the availability heuristic, increase the perceived prevalence of participants in collective action pertinent to climate change (Manis et al., 1993).

However, the effects of marches on perceived group norms may be limited by the scale of the assessment: whether they are perceptions of national or community norms. Even with "sister marches" that provide additional attention to the marches in local communities (Fleur, 2017; Levenson, 2017; Science News Staff, 2018), many communities did not have marches. Thus, the marches may be more likely to affect perceived national norms than norms within one's own community. Based on these considerations, we make the following hypothesis.

H2a: Large-scale climate change and science marches will increase perceptions that it is normative to participate in collective action to address climate change.

H2b. This effect of marches will be present for perceptions about national norms and not perceptions of community norms.

Perceptions of Others' Engagement: Meta-Perceptions

Meta-perceptions (perceptions of other people's perceptions) can influence individuals' thoughts and actions (Noelle-Neumann, 1993; Geiger and Swim, 2016). Meta-perceptions are distinct from injunctive norms because injunctive norms are beliefs about what people's approval or disapproval of behaviors such as whether someone should engage in collective action (Cialdini, 2003) whereas meta-perceptions are perceptions of other people's positions on topic areas, such as perceptions about how concerned other people are about climate change (Geiger and Swim, 2016). Perceptions that a majority of society hold a given opinion can sway individuals toward that opinion (Moore, 1921; Prentice and Miller, 1993; Sechrist and Stangor, 2001). Further, people are more willing to talk about certain topics, such as climate change, when they perceive that a majority of other people's opinions and level of concern about the topic align with their own opinions and concerns (Noelle-Neumann, 1974; Geiger and Swim, 2016). Many people discuss climate change less frequently than they otherwise would due to systematic underestimation of the extent to which other people are concerned about climate change (i.e., pluralistic ignorance; Leviston et al., 2013; Geiger and Swim, 2016) and correcting this misinformation can promote discussion of the topic (Geiger and Swim, 2016).

Large marches supporting action on climate change could alter climate change meta-perceptions for the same reasons they may influence perceived group norms. The size of large scale marches provide strong visual images of many people who are concerned about climate change and more accessible exemplars of people concerned about climate change may be made salient and increase the perceived prevalence of those concerned about climate change via the availability heuristic (Manis et al., 1993). Thus, marches have the potential to encourage bystanders to also participate in collective action by increasing estimates of the extent to which others are concerned about human-caused climate change.

Similar to perceptions of group norms we examine different scales of meta-perceptions specifically, national, community, and interpersonal level. On one hand, meta-perceptions at an interpersonal level may be stronger predictors of climate change engagement than meta-perceptions at the scale of the U.S. and one's community (Geiger and Swim, 2016). However, similar to our predictions about perceived norms, the effects of marches on meta-perceptions may be limited to perceptions at a national scale. Further, most people may not know others who participated in the marches because four out of five Americans have not participated in any marches at all between 2016 and 2018 (Jordan and Clement, 2018) and even fewer are unlikely to have participated in these two marches in particular. Even if specific friends and family members did participate, the perceiver may have already been aware of that person's beliefs about climate change in advance because participation in rallies tends

to be predicted by strong beliefs (Bliuc et al., 2007; McGarty et al., 2009). Thus, the marches may be more likely to influence perceptions of the strength of climate change concerns in the US than among community members and personal contacts. Based on these considerations, we make the following hypothesis.

H3a: Large-scale climate change and science marches will increase perceptions that others are concerned about climate change.

H3b: This effect of marches will be present for meta-perceptions of people in the United States and not for perceptions of one's community and personal contacts.

Impressions of the Concerned

Impressions of marchers can be an important contributor to willingness to engage in behaviors that support opinions expressed by participants in the march. Previous research has found that many ascribe negative traits to environmental activists, for example, perceiving them as eccentric, self-righteous, and over-reactive (Bashir et al., 2013). Environmental activists may be perceived particularly negatively when they engage in collective action behaviors such as marches (Bashir et al., 2013; Klas et al., 2018). In turn, these negative impressions are negatively associated with perceivers' willingness to engage in environmental activism. Marches have the potential to either make marchers seem prototypical or counter these expectations. This could be dependent in part on how the media covers the marches (e.g., whether they dedicate a high percentage of coverage to marchers who engage in negatively viewed extreme or militant behaviors).

It may also be informative to consider a range of types of impressions that may be associated with marchers. Impressions of those who are very concerned about climate change are not likely to simply vary in the extent to which they are seen positively or negatively (Swim and Geiger, 2018). They also vary in the extent to which they are perceived to have feminine and masculine traits. It may be important to include gendered traits and not just general activist traits to be able to capture different ways that marches may impact impressions of marchers.

Given the importance of negative impressions of activists on participating in collective action, it may be important to consider both positive and negative gendered traits. Feminine traits can be subdivided into (a) positive communal attributes such as being nurturing and (b) negative low status attributes such as being complainers. If activists are portrayed as being concerned about ethical consequences of climate change, they may be seen as feminine because these concerns reflect caring for others (Swim et al., 2018b). Raising concerns about the impact of climate change on others could be portrayed with positive feminine attributes such as caring about the planet or with negative feminine attributes such as being a complainer. Masculine traits can be subdivided into (a) positive agentic traits such as being a leader and (b) negative agentic traits such as being arrogant (Diekman and Eagly, 2008). Activists may be portrayed as being agentic because of the effort it takes to engage in such behaviors, but the agency could be portrayed with positive masculine attributes such as assertively tackling a problem or with negative masculine traits such as being arrogant. Examining positive and negative gendered traits may provide a nuanced understanding of the effects of marchers on impressions of marches because these impressions of activists along these dimensions can have differentially predictive effects on willingness for the perceivers to engage in activist behaviors. For example, research suggests that agentic-masculine portrayals may have a more potent impact on bystanders' likelihood of engaging in subsequent political action than communal-feminine portrayals, but negative masculine portrayals might discourage pro-climate action while positive masculine portrayals promote pro-climate action (Geiger and Swim, 2018).

Not knowing the full range of behavior that would be on display and how activists would be portrayed by the news media *a priori*, we did not make directional predictions about the effects of the marches on impressions on activist traits or gendered traits. Rather we were interested in documenting which traits were influenced because positivity and negativity and the gendered nature of impressions could have implications for whether the public is willing to join a climate change social movement (e.g., Bashir et al., 2013; Geiger and Swim, 2018; Swim et al., 2018b). Yet, as described below, we predicted that the portrayal of the protestors may differ dependent upon the news sources and the influence of news source would influence impressions.

Subsequent Collective Action

A successful political march will be one that activates bystanders to take action (Moyer, 1987; Moyer et al., 2001). There is evidence that marches can have this effect with larger marches influencing the general public such as by increasing subsequent monetary contributions and voting (Madestam et al., 2013). Thus, large scale climate change and science marches may increase the likelihood that others will report intending to engage in collective action to address climate change after the marches. Based on these considerations, we make the following hypothesis.

H4: Large-scale climate change and science marches will increase intent to engage in collective action to address climate change.

NEWS SOURCE

News sources have a reputation of dedicating little coverage to climate science and often fail to acknowledge the validity of the science (Akerlof et al., 2012). These omissions and failures are particularly prominent among conservative commentary outlets (Akerlof et al., 2012) to the point where some researchers state that these outlets are promoting climate denial (Dunlap and McCright, 2011). Some have argued that misleading coverage of climate science reflects vested and ideological interests by the owners of these news sources and conservative think tanks which motivate them to discourage large-scale action to address climate change (Dunlap and Jacques, 2013). Based on this perspective, we anticipated that conservative news sources might limit coverage of the two marches and, when covering the marches, present predominantly negative portrayals. The negative coverage could extend to unfavorable portrayals of marchers. For example, to journalists contributing to conservative news sources, marchers who express support for

climate science and climate action may be considered out-groups and, therefore, subject to out-group derogation that align with negative stereotypes about activists and those alarmed by climate change (e.g., Swim and Geiger, 2018).

In contrast, more liberal news sources might be more likely to cover the marches and portray the marches and marchers relatively more positively. The New York Times and Washington Post, two news sources that have been classified as relatively liberal (Budak et al., 2016; Otero, 2018), are more likely than relatively more conservative news sources to present scientific information about climate change (Akerlof et al., 2012). While including negative opinions, liberal news sources are more likely than conservative news sources to include text or opinions conveying the accuracy of climate science (Akerlof et al., 2012). Because of more attention to and positive portrayals of climate science, liberal news sources, relative to conservative ones, likely dedicate a greater percentage of coverage to climate-related marches and portray the marches more positively. The positive coverage could extend to favorable portrayals of marchers. For example, to journalists contributing to liberal news sources, marchers who express support for climate science and climate action may be considered ingroups and, therefore, subject to ingroup favoritism that align with positive stereotypes about those alarmed by climate change (e.g., Swim and Geiger, 2018).

As a consequence of differences in coverage of the marches, if people get their news from conservative news sources, they may be less likely to learn about the two climate related marches we examine in the present research. If they do encounter news about the marches from these conservative news sources, they may learn about negative aspects about the ability of marches to create a successful protest and information that dismisses the legitimacy of their causes (collective efficacy). The may also encounter news that downplays the number of people involved in the marches (descriptive group norms) and concern about their causes (meta-perceptions) and presents negative portrayals of protestors (impressions). As a result, the news may discourage subsequent efforts to address climate change (collective action). In contrast, people who get their news from liberal news sources may be relatively more likely to learn about the two climate related marches we examine here and, if they learn about the marches they may encounter information about the effectiveness of the marches to gather people and address climate change (collective efficacy). They may encounter information that indicates that engagement is common with many people participating in the two marches (descriptive group norms) and expressing concern about climate change (meta-perceptions). They may also encounter news that presents positive portrayals of protestors (impressions). As a result, the news may encourage subsequent efforts to address climate change (collective action). Based on these considerations, we make the following hypothesis.

H5: Hypothesis 1 through 4 and impressions of marchers will be moderated by the source of news such that the hypotheses will be more likely to be supported and changes in impressions will be more positive and less negative among those who get their news from liberal sources and the opposite among those who get their news from conservative news sources.

Exploratory Analyses

We also explore the possibility that psychological impacts of information obtained from news sources on bystanders might be most potent on those who are most attuned to the marches. Those who heard about the event may be those most attuned to news, particularly news about climate change. As a result, news sources may have a stronger impact on those who heard about the marches than those who had not heard about the marches. The joint effect of being attuned to climate change information and the effect of news sources may illustrate a polarizing effect of news sources. For example, among those that obtain their news from conservative sources, those who report having heard about the marches may have more negative views of the marchers than those who did not hear about it. In contrast, among those that get their news from liberal sources, those who report having heard about the marches may have more positive views of the marchers then those who did not hear about it.

PRESENT RESEARCH

The present research used a trend study to test the impacts of large-scale climate change related marches on bystanders' efficacy beliefs (H1), perceived group norms (H2), meta-perceptions about climate change concerns (H3), impressions of protestors, and subsequent behaviors (H4). One group completed measures immediately before the March for Science and the People's Climate March held in the spring of 2017 and a different group completed measures immediately after the marches. These marches drew thousands of participants to the primary marches in Washington DC and sister marches across the nation and globe (Fleur, 2017; Levenson, 2017). For example, the March for Science organization reported that over 600 sister marches were held across the globe in April 2017 (Science News Staff, 2018). These marches are on par with other large scale liberal leaning marches that occurred between 2016 and 2017 held in response to President Trump and his administration (Jordan and Clement, 2018). The March for Science was held first and protested the US "government's misuse and rejection of scientific expertise" including climate science (Science News Staff, 2018). The People's Climate March, held a week later, protested the Trump administration's environmental policies (Levenson, 2017).

We test whether changes in the psychological impacts of marches on bystanders differ dependent upon the political leanings of the bystanders preferred news sources (H5). We also explore whether news sources influence these psychological impacts most strongly for those who heard about the event after the event. We acknowledge that selective attention to news sources that match one's political leanings (Mitchell and Weisel, 2014) may create confounds with our measures of preferred news sources and whether participants heard about the marches. Similarly, those most concerned being more likely to attend to climate change information than those least concerned about climate change (Swim and Geiger, 2017) potentially resulting in those concerned about climate change being more likely to have heard about the marches. Thus, we included political

ideology and degree of concern about climate change, as well as demographic information, as covariates in our analyses. Although including covariates cannot definitively rule out confounds, effects for news sources with the inclusion of these covariates are suggestive of the unique effects of political leanings of news sources.

METHODS

Participants and Procedure

We recruited 340 participants to complete a survey the day before the March for Science, which was held on April 22, 2017 (*pre-survey*) and 348 to complete the survey several days after the People's Climate March, which was held on April 29, 2017 (*post-survey*). Both surveys contained identical measures except the marches were described in future tense in the pre-survey and past tense on the post survey. All participants were recruited from Amazon's Mechanical Turk via Turkprime and paid $1.00 for the completion of their surveys. After eliminating participants for duplicate IP addresses ($n = 8$), failure to pass an instructional check included at the end of the survey before the demographic measures ($n = 36$ and 48, pre and post survey, respectively) and participants that reported participating in the marches ($n = 9$ post survey)[1], there were a total of 587 participants (302 pre-survey participants and 285 post-survey participants. The data set analyzed for this survey can be found at Swim et al., 2018). Power analyses indicate that 485 participants are necessary to detect a small effect size ($F^2 = 0.02$), for an increase in R^2, with alpha = 0.05, and power = 0.80, and with two predictors and six covariates to test effects pre and post march effects and 395 participants are necessary with the same specification with one predictor and eight covariates to test interaction effects for pre and post march by news source (see results). Thus, our sample size had >0.80 power to detect small effects because we had more than this number of participants.

Demographics are reported in **Table 1**. Although the sample is a convenience sample, it is roughly representative of the population, albeit with the sample being slightly more liberal than the population as suggested by political party affiliation. Overall, participants' ages ranged from 18 to 77 with the median age being 35 years old which is close to the median age in the US in 2017 being 35.3 (U. S. Census Bureau, 2017a). On a socio-economic status (SES) ladder, that ranged from 1 (lowest SES) to 10 (highest SES), 10% of participants chose 1 and 2, 36% chose 3 and 4, and 41% chose 5 and 6, which is similar to self-reported social class in the US where 8% identify as lower class, 30% as working class, and 43% identify as middle class (Bird and Newport, 2017). About three-quarters of the participants identified as White (74%) and 5% as Latino/a (participants were asked to choose a single category). In comparison, in the United States, 61% identify as White Non-hispanic and 18% as Hispanic of any race (U. S. Census Bureau, 2017b). This suggests a possible overrepresentation of Whites and underrepresentation of Hispanics in our sample, although it is difficult to tell conclusively because it is unclear whether some participants who identified as White or another race may have also identified as Hispanic. Most tended to express at least some concern about climate change as reflected by their self-classification into the Six Americas categories which is similar to what is reported in National surveys using the Six Americas screening tool (e.g., Roser-Renouf et al., 2016). The percent of Republicans in our sample (23% pre and 18% post) is less than that found in the United States (26%) and the percent in of Democrats our sample (40% pre and 36% post) is more than that found in the United States (28%) during the time the survey was taken (Gallop Poll, 2018).

TABLE 1 | Demographics.

	Pre ($N = 302$) percent or mean (*SD*)	Post ($N = 285$) percent or mean (*SD*)	*p*-value[a]
Gender (Men)	47%	59%	<0.01
Age	37.93 (12.45)	37.51 (11.87)	0.67
SES Ladder (1 to 10)	4.83 (1.72)	4.54 (1.66)	0.04
ETHNICITY			
White	74%	77%	0.39
African American	10%	9%	
Latino/a	5%	5%	
Asian	7%	7%	
Other	5%	2%	
Liberal (-3) to conservative (+3)	−0.31 (1.12)	−0.33 (1.15)	0.87
POLITICAL PARTY			
Republican	23%	18%	0.13
Democrat	40%	36%	
Independent	32%	40%	
Not interested in politics	2%	4%	
Other	2%	3%	
Six Americas (Self-classification 1, very concerned; 6 dismissive)	2.21	2.39	0.12
Very concerned	35%	36%	0.82
Concerned	33%	30%	
Cautious	17%	15%	
Disengaged	8%	6%	
Doubtful	3%	6%	
Dismissive	3%	7%	

[a]*p-values are for t-tests when comparing means and chi-squares when comparing percentages.*

Measures

Participants completed measures in the order presented here. See **Supplemental Material** for items in multi-item measures.

[1]We excluded attendees because our research is on effects on bystanders. Although removing attendees could alter the comparability between the pre- and post-march samples, we found little differences with and without them. The differences were that excluding attendees made an interaction predicting pessimism about marches nonsignificant and an interaction predicting negative masculine impressions marginally significant at $p = 0.052$. We did not exclude people from the pre-march survey who planned (3 and 2%) or thought they might attend (17 and 19%) the marches because we could not tell if they acted on those plans.

News Sources

In an open-ended question, participants indicated where they got their news about everyday events and were asked to be as specific as possible. Then they provided self-ratings on a five-point scale as to the political leanings of the news sources ("Very Liberal," −2 to "Neither liberal or Conservative," 0 to "Very Conservative," 2). Next they indicated how closely they followed news about global climate change ("Not at all," 0 to "Very," 3). Then they answered an open-ended question about news sources about global climate change and a closed ended question about political leaning of these news sources using the same response options as for their ratings of general news sources. Detailed descriptions of the news sources and coding procedures can be found in the **Supplemental Materials**.

Coding of News Sources

Because subjective evaluations of the political leaning of news sources may be influenced by a belief that one's news sources do not have political biases, we created independent ratings of participants' news sources. Seventy-six sources listed by participants could be found on the "Media Bias Chart" version 4 (Otero, 2018). Derived from this chart, each of the 76 out 282 sources listed by participants was coded from liberal (−9) to conservative (+9). At the time we were coding the values, the chart values for "political bias" ranged from −42 to 42 and the ratings per source were not available. We determined values assigned to news sources based upon a visual inspection of the Media Bias Chart. We overlaid −9 (very liberal) to + 9 (very conservative) grid on the chart with markers for every tenth of a digit on the chart and selected the value that fell at the midpoint of each graphic used to designate each of the media sources displayed on the chart. We assigned this value to each news source listed by participants for general news sources and climate change news sources. The media bias had ratings for what they labeled as local news sources with liberal and conservative cities. When our participants noted local news sources, we looked up the zip code for the city associated with the local news source they listed and looked up how the city voted in the previous national election. Based upon these characterizations we indicated that the local news sources as either being one with liberal or conservative leanings and used the ratings for these two categories from Media Bias. The correlation between the values we assigned to the sources and that now available from Media bias is $r_{(73)} = 0.93$.

Limitations associated with the Media Bias ratings include the following: the ratings were done by one person and that person also developed the coding protocol; the selection of articles per source may not be a good representation of the source; the precise algorithm used to combine ratings is not provided, although a general description is given. For critiques of content analysis related to coding media sources see Lacy and Riff (1996) and Lacy et al. (2015). Despite these limitations, we used this rating system for the following reasons: the ratings were done by someone other than ourselves; the ratings were systematically done with countable criteria (e.g., counting of positions taken in each sentence of each article); our participants provided many sources and Media Bias provided the largest number of codable sources that we could find; convergent validity of the ratings was indicated by correlations between the coded ratings of news sources and participants' subjective ratings of the political leanings of their general news and climate change news sources, $r_{(439)} = 0.53$, $p < 0.001$.

Some participants ($n = 146$) provided news sources that were not listed on the Media Bias chart (e.g., "Reddit" or "Google News") either because the sources were user-tailored, they aggregated news from a variety of sources or they were not specific news sources (e.g. "TV," "friends," and "family"). We devised an imputation method by regressing the ratings derived from Media Bias (among participants for whom we were able to calculate such ratings from the Media Bias chart) onto individuals' subjective ratings and self-reported political ideology. We used this regression model, with each individuals' subjective ratings and self-reported political ideology, to estimate ratings that would have been obtained from Media Bias. The resulting predicted values replaced missing values for participants without ratings provided by Media Bias.

Most participants had multiple news sources, particularly because they provided both their general news sources and their climate change news sources. Therefore, we averaged ratings across these news sources (see **Supplemental Materials**). Results are similar whether we use subjective ratings or the codes derived from Media Bias. We report analyses using the latter codes because of the reasons noted above as to why we used Media Bias ratings and they represent a more independent representation of the political leaning of participants' news sources than participants' subjective ratings.

Climate Change Concern

We used the single-item measure of climate change concern developed by Swim and Geiger (2017) where participants were given one-sentence descriptors of each of the Six Americas climate change opinion groups (Maibach et al., 2011) that were labeled Very Concerned (to represent the Alarmed with a less pejorative label), Concerned, Cautious, Disengaged, Doubtful, and Non-believer (to represent the Dismissive with a less pejorative label).

Meta-Perceptions

Using a seven point scale ("None," 0 to "Almost everyone," 6), Participants rated their perceptions of the proportion of people from each of 10 groups who were "Very Concerned" about climate change using a seven point ranging from "none" to "almost everyone." Of interest for the present research were ratings of "the U.S. public," "people in my community," and "people I know personally (friends, family, coworkers, acquaintances, neighbors)[2]."

Heard About Marches

On two separate scales, participants indicated how much they heard about the march for science and the people's climate march

[2]Participants also rated perceptions of others' beliefs about climate change. Results are similar for perceived concern. We report meta-perceptions for climate change concern based on the notion that those marching would be perceived not only to believe in climate change but to be highly concerned about the issue if they are motivated to participate in such an action.

TABLE 2 | Observations about marches.

	Pre ($N = 302$) percent or mean (SD)	Post ($N = 285$) percent or mean (SD)	p-value[a]
Independent news source rating (−9 = liberal, 9 = conservative)	0.22 (2.48)	0.22 (2.56)	0.99
Self-reported new sources (−2 = liberal; 2 = conservative)	−0.41 (0.81)	−0.48 (0.84)	0.28
Closely follow news about global climate change (0 = not at all; 4 = very)	1.65 (0.77)	1.61 (0.83)	0.51
Self-reported sources of news about climate change (−2 = liberal; 2 = conservative)	−0.47 (0.91)	−0.59 (0.93)	0.10
Heard about march for science (% nothing vs. % very little vs. % a small amount, quite a bit, plus very much)	61%/10%/29%	34%/13%/53%	<0.001
Heard about people's climate change march (% nothing, vs. % very little, vs. % a small amount, quite a bit, plus very much)	71%/10%/19%	48%/17%/36%	<0.001
March for science near where *p*'s live (Percent no, not sure, yes)	24%/66%/11%	33%/47%/19%	<0.001
People's climate March where *p*'s live (Percent no, not sure, yes)	23%/71%/6%	33%/58%/08%	0.004
Know someone who [plans on attending/ attended] March for Science (Percent no, maybe, yes)	78%/9%/13%	75%/10%/15%	0.57
Know someone who [plans on attending/ attended] People's Climate march (Percent no, maybe, yes)	84%/10%/7%	82%/12%/6%	0.67

[a]*p-values are for t-tests when comparing means and chi-squares when comparing percentages.*

before they read about it in the survey on a five-point scale ranging from "Nothing at all" (0) to "Very much" (5). Because of the skewed data (see **Table 2**) and to avoid potential excessive influence of a minority who reported hearing a lot about the marches, we dichotomized this measure to represent those who had not heard about the marches (i.e., reporting that they had heard "Nothing" or "Very little") vs. those who heard at least a small amount about the two marches (i.e., reported that they had heard "A small amount," "A moderate amount," "Quite a bit," and "Very much"). Participants were also asked to provide descriptive information about what they heard which is not analyzed here.

Location of Marches

Separately rating each march, participants indicated whether or not there were marches near them or whether they were unsure.

Participation in Marches

Separately rating each march, participants indicated whether they knew someone and whether they themselves were attending or had attended the marches ("Yes," "Maybe," or "No"). See Footnote 1 for information about their own attendance.

Impressions

Participants rated the extent to which people who participated in the rallies had 15 attributes on a five-point scale (0 = "Not at all" to 4 = "Very much"). Three of the attributes were obtained from previous research on stereotypes about activists (eccentric, self-righteous, overactive, Bashir et al., 2013, Cronbach $\alpha = 0.81$). Twelve of these traits were derived from research assessing negative and positive gendered traits about climate change opinion groups (Swim and Geiger, 2018): negative masculine traits: aggressive, dictatorial, arrogant (Cronbach $\alpha = 0.86$); negative feminine traits: nagging, whiny, complaining, (Cronbach $\alpha = 0.92$); positive masculine traits: courageous, adventurous, stands-up under pressure, (Cronbach $\alpha = 0.79$); positive feminine traits; nurturing, gentle, sympathetic, (Cronbach $\alpha = 0.82$).

Efficacy

All efficacy measures used seven-point scales ranging from −3 (Strongly disagree) to 3 (Strongly agree). Participants completed four items about *collective response efficacy* to address climate change (e.g., "Humans have the ability to reduce climate change"; Cronbach $\alpha = 0.82$). They also completed two items to assessing being pessimistic about *collective efficacy* to take action to address climate change ("It is impossible to get large groups of people to work together on anything"; Cronbach $\alpha = 0.71$) and the two items measuring being optimistic about collective efficacy ("People are capable of working together to solve big social problems"; Cronbach $\alpha = 0.51$) (see **Supplemental Materials** for the reason for the distinction between pessimism and optimism in constructs of collective efficacy). It should be noted that we might have difficulty detecting effects with the optimism subscale because of its low reliability. The two measures were correlated at $r_{(578)} = -0.49$.

Using the same scale, participants also completed three items to assess self-efficacy to take action to address climate change (e.g., "I am capable of contacting government officials to share my views about climate change with them," Cronbach $\alpha = 0.74$) and three items to assess personal response efficacy (e.g., "When average people share their views on climate change with government officials, it can influence officials' actions on climate change," Cronbach $\alpha = 0.88$).

Group Norms

Using a seven point scale ("None," 0 to "Almost all," 6), participants indicated the number among the general public in the United states who had engaged in four different types of collective action over the previous 6 months (political behaviors, such as voting, contacting officials, signing petitions,

environmental activism related to climate change, talking to friends and family members about the importance of addressing climate change, using social media to educate friends, and family about climate change; Cronbach $\alpha = 0.87$). They repeated this for estimates about people in their community (Cronbach $\alpha = 0.92$).

Collective Action Intentions

On a five point scale ("Definitely not," −2 to "Definitely will," 2), participants indicated the likelihood that they would engage in the same behaviors noted for group norms plus two additional behaviors ("Learn more about climate change," and "Start or increase my commitment to particular groups working to address climate change" Cronbach $\alpha = 0.91$). They were asked to not include attendance at the rallies in their assessments.

RESULTS

Confirming our assumption that those who completed the survey prior to the marches were likely to be similar to those who completed the survey after the marches, there were no differences on all key demographics variables (except gender and SES), political ideology, and concerns about climate change (see **Table 1**). Political leaning in news sources and how closely they followed news about climate change did not differ between the pre- and post-march groups (see **Table 2**). However, consistent with our use of pre-post survey as a measure of learning about the march, more people indicated hearing at least some information about the march after the march than before the march. Consistent with our expectations about low participation within particular communities and participants' personal contacts, most participants reported that there was not a march near where they lived and few knew people who had participated. Pre- vs. post-march reports of locations of marches suggests that more people thought there would be a march near them than actually occurred.

Overview of Analyses

We regressed each of our possible outcome variables (collective efficacy, group norms, meta-perceptions, impressions of marchers, collective action intentions) on time of survey (Pre = −1 vs. Post = 1) and political leaning of news source (liberal to conservative) at step 1, and the interaction between time of survey and news source at step 2. We also included covariates in step 1: SES, gender, age, ethnicity (i.e., whether or not White), climate change concern, and political ideology (see above for measure details). Including gender and SES allowed us to adjust for gender and SES difference in our pre- vs. post-march samples. Including participants' climate change concern and political ideology as covariates allowed us to focus on the effects of political ideology of the news sources unique from the effects of participants' views on climate change and political ideology. All continuous variables were centered and all categorical variables were coded at −1 vs. 1. For continuous measures and interactions with continuous measures, we present the proportional reduction of error (PRE) which is a measure of effect size identical to η_p^2 (Judd et al., 2009). Follow-up analyses of differences between timing of the survey for significant interactions were conducted using simple slopes at ± 1 *SD* from the mean of news source (Aiken et al., 1991). When comparing pre-march and post-march ratings both as main effects and within interactions, we report the corresponding *t*-tests and Cohen's *d* in order to convey the strength of the effects in standard deviation units which could help with the interpretation of the effect size. In order to understand the interactions, follow-up tests of the effects of political leaning of news sources were done with the pre and post survey responses. For all analyses, significant interactions and their corresponding simple slope analyses for effects of news sources are presented in Figures. All non-significant effects noted below are at $p > 0.050$.

About a third of those completing the survey after marches reported not hearing about the marches, potentially diminishing our ability to detect pre vs. post effects of the marches because of a dilution of the treatment. A comparison between hearing and not hearing about the marches after the marches could potentially detect effects not found comparing pre- vs. post-data. Additionally, comparing those who heard vs. not heard about the marches after the marches allowed us to test for potential polarizing impacts of news source on those most vs. least attuned to information about the marches. Thus, following the analyses comparing responses before and after the marches, we tested differences between those who heard vs. had not heard about the marches and the interaction between hearing about marches and news sources only among those that completed the survey after the marches. We regressed each of our outcome variables on time of survey having heard about the march (−1 = not heard, 1 = heard) and political leaning news source (liberal to conservative) at step 1, and the interaction between time of survey and news source at step 2. As before, we also included covariates in step 1: We included gender, age, SES, ethnicity, climate change concern, and political ideology. All continuous variables were centered all categorical variables were codded at −1 and 1. Follow-up analyses of differences between those who heard and did not hear about the march were conducted using simple slopes at ± 1 *SD* from the mean of news source (Aiken et al., 1991). As with the first set of analyses, for continuous predictors and interactions with continuous measures we present PRE and for binary predictor variables, we report the corresponding *t*-tests and Cohen's d values. Also, in order to understand the interactions, follow-up tests of the effects of political leaning of news sources were done within those who heard and those who had not heard about the marches.

Efficacy

Consistent with predictions (H1), people were less pessimistic about people's ability to work together to address climate change after the march ($M = -0.38$) than before the march ($M = 0.02$), $t_{(557)} = -3.23$, $p = 0.001$, 95% CI[−0.32, −0.08], $d = -0.27$, and more optimistic about their ability to work together to address climate change after the march ($M = 1.03$) than before the march ($M = 0.80$), $t_{(557)} = 2.59$, $p = 0.01$, 95% CI[0.03, 0.21], $d = 0.22$. In contrast, there were no effects for time of survey for collective response efficacy $t_{(563)} = -0.96$, $p = 0.336$, 95% CI[−0.12, 0.04], $d = -0.08$, and, per predictions (H1b) no effects of timing of

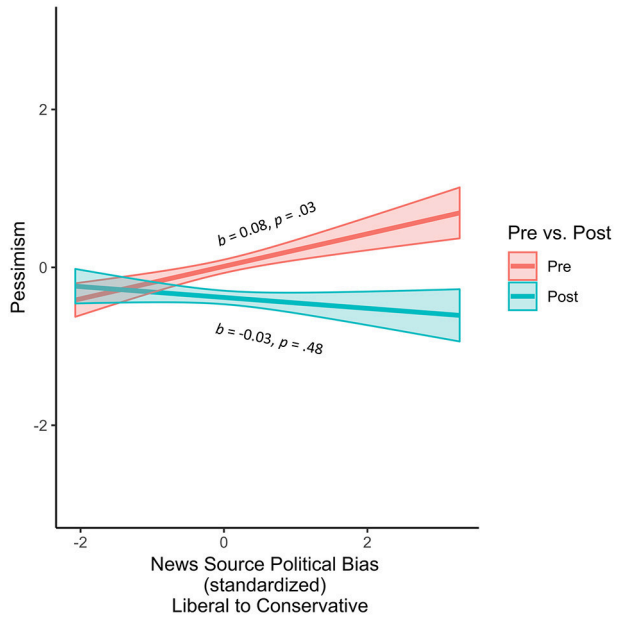

FIGURE 1 | Pessimism as a function of time x news source $F_{(1, 556)} = 5.20$, $p = 0.02$, 95% CI[−0.10, −0.01], PRE = 0.01; Scale bands represent 95% confidence intervals.

survey on personal self-efficacy, $t_{(563)} = 0.37$, $p = 0.710$, 95% CI[−0.08, 0.12], $d = 0.03$, and personal response self-efficacy, $t_{(563)} = 1.12$, $p = 0.264$, 95% CI[−0.04, 0.16], $d = 0.09$.

However, opposite to predictions that effects of the marches would be particularly strong among participants who got their news from liberal news sources (H5), follow-up tests for an interaction between time of the survey and news sources indicated that the increase in efficacy from before to after the marches was strongest for those who received their news from more conservative news sources (see **Figure 1**). Those who obtained their news from conservative sources were less pessimistic after the march ($M = -0.45$) than before the march ($M = 0.22$), $t_{(556)} = -3.90$, $p < 0.001$, 95% CI[−0.50, −0.17], $d = -0.33$. There was no effect of time of survey (i.e., pre-marches vs. post-marches) on pessimism for those who received their news from liberal sources. Follow-up tests within timing of the survey revealed a relation between news sources and pessimism before the marches and not after the marches.

Hearing About Marches

In contrast to the interactive effect between ideology of news source and timing on collective efficacy beliefs, exploratory analyses on post-march responses suggest a polarizing effect of news sources on personal and collective response efficacy beliefs (see **Figure 2**). Among those that obtained their news from liberal sources, those that had heard about the marches perceived greater collective response efficacy ($M_{heard} = 1.12$ vs. $M_{notheard} = 0.76$), $t_{(272)} = 2.06$, $p = 0.04$, 95% CI[0.02, 0.69], $d = 0.25$, and personal response efficacy ($M_{heard} = 0.90$ vs. $M_{notheard} = 0.48$), $t_{(272)} = 2.03$, $p = 0.04$, 95% CI[0.01, 0.81], $d = 0.25$, than those that did not hear about the marches. The reverse was true for those that obtained their news from conservative sources, but the means were not significantly different from each other on collective efficacy, ($M_{heard} = 0.88$ vs. $M_{notheard} = 1.06$), $t_{(272)} = -1.03$, $p = 0.30$, 95% CI[−0.25, 0.08], $d = -0.12$), and personal response efficacy ($M_{heard} = 0.67$ vs. $M_{notheard} = 1.03$), $t_{(272)} = -1.74$, $p = 0.08$, 95% CI[−0.74, 0.05], $d = -0.21$). Other follow-up tests indicated that the relation between political leaning of news sources and response efficacy beliefs were not significant within those that heard about the marches and significant within those that had not heard about the marches. The interactions between hearing about the marches and news sources after the marches were not significant for optimism or pessimism about people's ability to work together or personal self-efficacy.

Perceptions of Others' Engagement: Group Norms

Contrary to predictions that perceived group norms would be greater among participants who completed a survey post-marches (relative to pre-marches, H2), there were no main effects of time of survey, on perceptions of group norms in the US as well as participants' own community. Opposite to predictions that effects of the marches on bystanders would be particularly strong among participants who reported consuming liberal news sources (H5), individuals who received their news from liberal news perceived it was less normative to take action on climate change at the national level after the march ($M = 2.20$) than before the march ($M = 2.54$), $t_{(562)} = -2.56$, $p = 0.01$, 95% CI[−0.30, −0.04], $d = -0.22$ (see **Figure 3**). In contrast, for those who reported consuming conservative sources, there was no difference in perceived norms before ($M = 2.32$) vs. after the march ($M = 2.19$), $t_{(562)} = 0.94$, $p = 0.35$, 95% CI[−0.07, 0.20], $d = 0.08$. Like the interaction effects between news source and timing of the survey on collective efficacy, follow-up tests within timing of the survey indicated a relation between political leaning of news sources and personal response efficacy before the marches but not after the marches.

Hearing About the Marches

Examining perceived norms after the march indicated no effects of whether or not participants had heard about the marches after the march, news source, and interactions between these two variables.

Perceptions of Others' Engagement: Meta-Perceptions

Contrary to predictions that meta-perceptions would be greater among participants who completed a survey post-marches (relative to pre-marches, H3), there were no effects of timing of survey on any of our three meta-perception measures: meta perceptions of "the U.S. public," "people in my community," and "people I know personally." Contrary to predictions that this effect would be moderated by political leaning of news sources (H5), there was also no interaction between timing

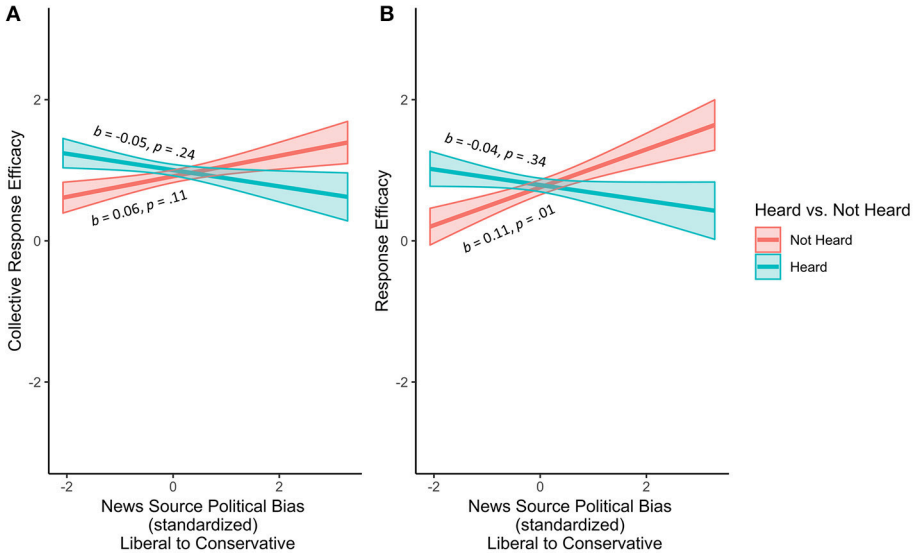

FIGURE 2 | Efficacy as a function of whether heard x news source. **(A)** $F_{(1,\ 272)} = 5.02$, $p = 0.03$, 95% CI[−0.10, −0.01], PRE = 0.02; Scale bands represent 95% confidence intervals. **(B)** $F_{(1,\ 272)} = 7.40$, $p = 0.01$, 95% CI[−0.13, −0.02], PRE = 0.03; Scale bands represent 95% confidence intervals.

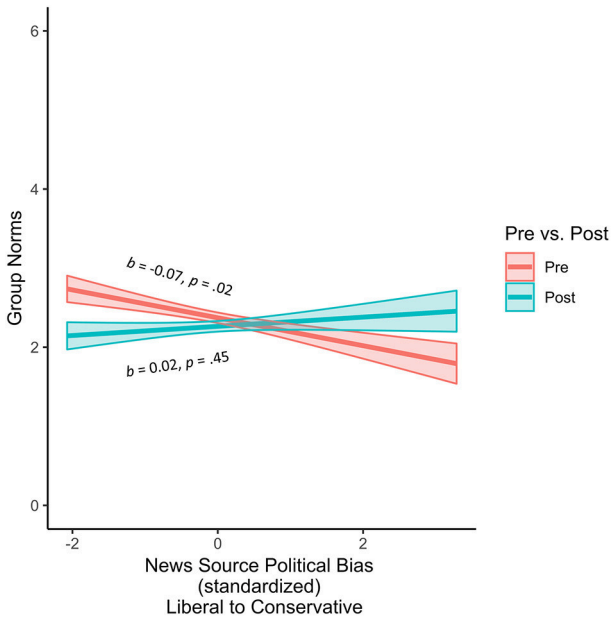

FIGURE 3 | Group norms as a function of time x news source. $F_{(1,\ 562)} = 6.15$, $p = 0.014$, 95% CI[0.01, 0.08], PRE = 0.01; Scale bands represent 95% confidence intervals.

of the survey and our or media effects on any of these three meta-perceptions.

Hearing About the Marches

Examining meta-perceptions after the march indicated no effects of whether or not participants had heard about the marches after the march, political leaning of news source, and the interaction between these two variables.

Impressions

While a goal of the marches would be to improve perceptions of those very concerned about climate change, we did not make predictions about the effects of the marches on perceptions of those very concerned about climate change because we did not know whether there would be controversies about the marches. However, we predicted in Hypothesis 5, that, if there was an effect of the marches on perceptions of those very concerned about climate change, perceptions of the marchers would be more positive and less negative following the march if people got their news from liberal sources and the reverse for those who got their news from conservative sources.

Consistent with a desired effect of the marches, participants ascribed fewer negative masculine traits to marchers after the march ($M = 1.12$) relative to before the march ($M = 1.35$), $t_{(563)} = -3.01$, $p = 0.003$, 95% CI[−0.19, −0.04], $d = -0.25$. Consistent with news sources conveying different portrayals of the marchers, the results also revealed that, relative to receiving news from liberal sources, receiving news from more conservative news sources was associated with ascribing more negative impressions of marchers, specifically, negative masculine traits, $b = 0.05$, $t_{(563)} = 2.86$, $p = 0.004$, 95% CI[0.02, 0.09], PRE = 0.01, negative feminine traits, $b = 0.07$, $t_{(563)} = 3.37$, $p = 0.001$, 95% CI[0.03, 0.11], PRE = 0.02, and negative activist traits, $b = 0.05$, $t_{(563)} = 2.60$, $p = 0.009$, 95% CI[0.01, 0.08], PRE = 0.01. However, there were no significant interactions between time of the survey and news source on impressions.

Hearing About the Marches

Exploratory analyses with those who completed the survey after the march suggested that there was a polarizing effect of news sources on negative impressions of marchers. Simple slopes analyses for the significant interactions revealed that

associations between political leaning of news sources and negative impressions of marchers noted above was present among those who obtained their news from conservative sources but not among those that had not heard about the marches (see **Figure 4**; albeit the interaction for negative masculine traits was marginally significant at $p = 0.052$). The result was that, among those who viewed more liberal news sources, participants who reported hearing about the march perceived the marchers as having fewer negative masculine traits ($M_{heard} = 0.94$ vs. $M_{notheard} = 1.19$), $t_{(272)} = -1.66$, $p = 0.098$, 95% CI[−0.27, 0.02], $d = -0.20$, negative feminine traits ($M_{heard} = 1.06$ vs. $M_{notheard} = 1.51$), $t_{(272)} = -2.64$, $p = 0.009$, 95% CI[−0.77, −0.11], $d = 0.31$, and negative activist traits ($M_{heard} = 1.06$ vs. $M_{notheard} = 1.51$), $t_{(272)} = -2.44$, $p = 0.02$, 95% CI[−0.67, −0.07], $d = 0.28$. Among those who got their news from conservative sources (+1 *SD*), the effects were trending in the opposite direction with a marginally significant effect of having heard about the march for negative activist traits, ($M_{heard} = 1.60$ vs. $M_{notheard} = 1.47$), $t_{(272)} = 1.70$, $p = 0.090$, 95% CI[−0.04, 0.55], $d = 0.22$.

Collective Action Intentions

We predicted, but did not find, that marches would increase collective action intentions (H4), $t_{(563)} = -0.01$, $p = 0.99$, 95% CI[−0.07, 0.07], $d < 0.01$. Further, in contrast to predictions that indicated that this effect would be strongest for those who obtain their news from liberal sources (H5), a significant interaction between timing of survey and news sources suggested that marches increased collective action intention among those who obtained their news from conservative news sources (see **Figure 5**). Simple slope analyses for the significant interactions indicated that, among those who got their news from conservative sources, intentions to engage in collective action increased following the march ($M = -0.18$) relative to before the march ($M = -0.34$), $t_{(562)} = 1.58$, $p = 0.11$, 95% CI[−0.02, 0.18], $d = -0.13$, granted this effect was only marginally significant at +1 *SD*. Yet, for those who received news from liberal sources, follow-up tests were not significant at −1 *SD*, $t_{(562)} = -1.58$, $p = 0.12$, 95% CI[−0.18, 0.02], $d = -0.13$. Consistent with these weak effects, neither of the slopes for political leaning of news sources within those that heard and not heard about the marches were significant.

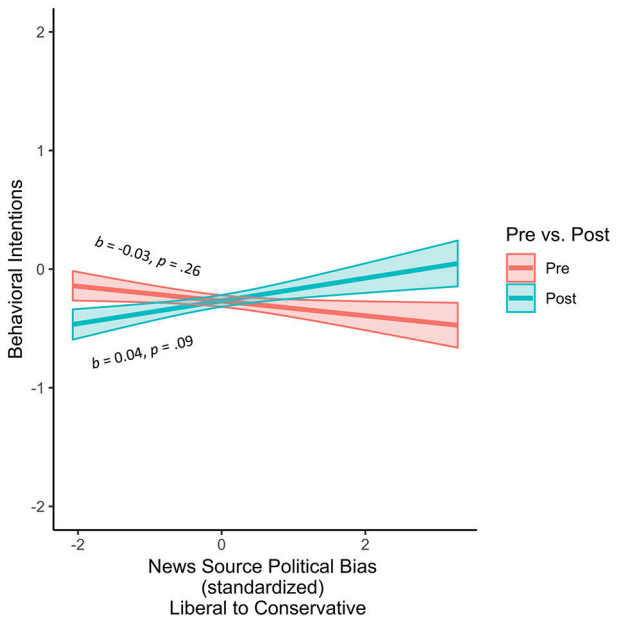

FIGURE 5 | Behavioral intentions as a function of time x news source. $F_{(1, 562)} = 2.24$, $p = 0.02$, 95% CI[< 0.01, 0.06], PRE = 0.01; Scale bands represent 95% confidence intervals.

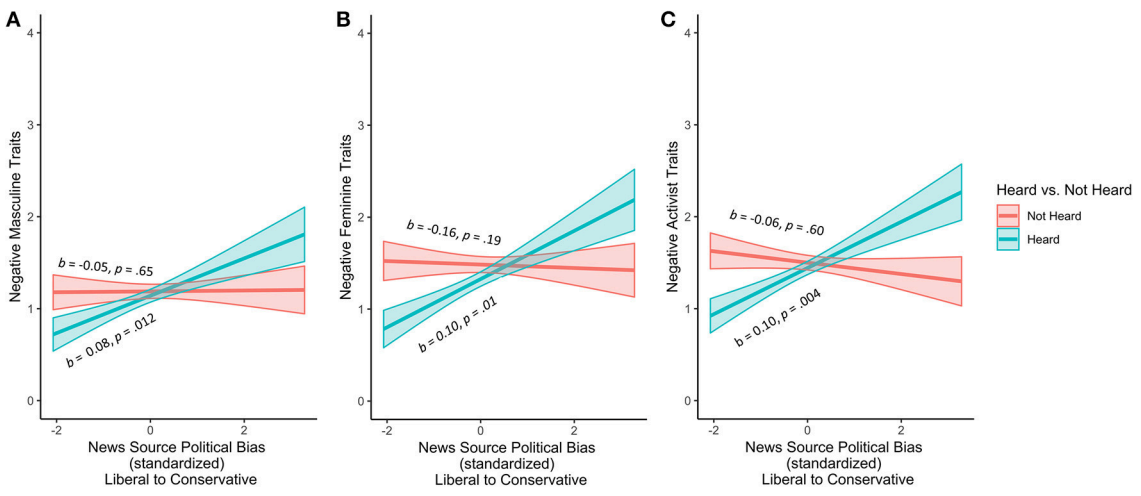

FIGURE 4 | Impressions of marchers as a function of whether heard x news source. **(A)** $F_{(1, 272)} = 3.80$, $p = 0.052$, 95% CI[0.01, 0.10], PRE = 0.02; Scale bands represent 95% confidence intervals. **(B)** $F_{(1, 272)} = 6.05$, $p = 0.014$, 95% CI[0.01, 0.10], PRE = 0.02; Scale bands represent 95% confidence intervals. **(C)** $F_{(1, 272)} = 8.94$, $p = 0.003$, 95% CI[0.02, 0.10], PRE = 0.03; Scale bands represent 95% confidence intervals.

Hearing About the Marches

Examining impressions after the march indicated no effects of whether or not participants had heard about the marches after the march, news source, and interactions between these two variables on collective action intentions.

DISCUSSION

The purpose of the present research was to consider the potential impact of large-scale marches as a catalyst for engaging the public in a larger social movement to contribute to a public demand for policymakers to take into account climate science and the public's views on climate change. A measure of success of the marches would be to influence bystanders to marches beyond affecting bystanders' concerns or beliefs about the topic by inspiring people to become members of a movement demanding action to ensure a habitable planet for present and future generations. In the present research we tested the effects of large-scale climate change related marches on bystanders to the marches, specifically in terms of psychological outcomes that previous research indicates could be useful stepping stones to overcome psychological barriers to engagement and encourage collective action consistent with the goals of this social movement. The ability to create the success desired by those participating in the marches was considered within the context of bystanders' preferred news sources that could influence their views about the marches and marchers.

The results suggest some successful outcomes of the marches on bystanders in terms of increased collective efficacy and decreased negative impressions of marchers. However, effects for the role of politicized media sources in moderating these effects were not completely as predicted. First, opposite to predictions, the marches appeared to have favorable effects on collective efficacy beliefs and collective action intentions among those who reported consuming *conservative* news and diminished perceptions that it was normative to engage in collective action among those who reported consuming *liberal* news. Second, political leaning of news sources did not predict *changes* in impressions of marchers from before to after the marches. However, more favorable impressions of marchers were found among those who obtained news from liberal sources relative to those who obtained news from conservative sources before and after the marches suggesting that media may have contributed to polarization at both time periods. As detailed below, we suggest that results for news sources on efficacy beliefs that were opposite to predictions may be a result of whether or not information is presented about the marches while results suggestive of polarization in impressions may be a result of how the marchers were portrayed.

We note that many of the effects that we identify occurred despite many having reported hearing "very little" or "nothing" about the marches. Although most of our reported effect sizes fall in the range of what is typically considered small for psychological research (Cohen, 1988), observing these effects across a sample that is roughly representative of the entire US population suggests that these marches may have had sizable impacts when considering the sheer number of people who were exposed to these marches. Indeed, the marches may have had even larger effects on key outcomes upon those who more closely follow climate change news or happened to spend time being exposed to such news in this particular situation.

Efficacy

Consistent with overarching goals of marches (Moyer, 1987; Moyer et al., 2001), participants were more positive about people's ability to work together to address climate change after (vs. before) the marches, both being less pessimistic and more optimistic about people's ability to cooperate with each other to solve large problems. One explanation for these effects is the possible role of the marches as concrete demonstrations of collective efficacy. In contrast, the marches did not affect collective response efficacy, possibly due to our assessment timing of several days after the marches. It may require more time and the accumulation of impacts of multiple marches and other forms of collective action to demonstrate changes indicative of collective response efficacy (see Wallace et al., 2014). We predicted weaker or no effects pre- vs. post-marches on personal measures of efficacy and this was borne out in our results. As noted in the introduction, our participants may not have seen themselves as similar to the marchers and the marches may not have addressed personal barriers for engaging in collective action that would be necessary to alter personal efficacy.

News source effects on collective efficacy were opposite to predictions. We speculate that conservative news sources may have been more likely to mention the marches after, than before, the marches. Prior to the marches, the more conservative one's news source, the more pessimistic people were about people's ability to work together to address climate change. These relation with news sources may be because conservative news sources may have given less attention to the marches than more liberal sources. After the march, there was no relation between political leaning of news sources and collective efficacy beliefs. This suggests that after marches news sources across the ideological spectrum may have all provided basic visibility to the marches and illustrated the large numbers attending them, which may have provided sufficient information to demonstrate collective efficacy. Thus, increased visibility in conservative news may have increased collective efficacy beliefs among readers of conservative news sources, whereas visibility may have been present for readers of liberal news sources prior to and after the marches.

In contrast to the interactive pattern of effects of ideology of news source and timing of survey on collective efficacy, analyses of post-march data suggest that those who heard about the marches and read liberal news sources increased personal and collective response efficacy relative to those that did not hear about them, an effect not found among those who read conservative news sources. More positive analysis of the efficacy of marches by liberal than conservative news sources may have created this effect. However, the relation between news sources and response efficacy beliefs was not significant for those who heard about the marches. The null effect here also provides evidence that liberal and conservative news sources may have similarly recognized the marches after the march. The present

study cannot determine why political leaning of news sources was related to perceived response efficacy among those who had not heard about the marches. However, the presence of an effect for news sources among those presumably less attentive to the marches (i.e., they had not heard of the marches) and not present among those who were attentive (i.e., they had heard of the marches), suggest that the assessments of response efficacy among those who had not actually heard about the marches were, perhaps, a result of those individuals' default assumptions about the ability of marches to influence others or from sources other than their preferred news sources.

Impressions

The marches improved impressions of those who participated in the marches. Although there were no effects of the marches on positive traits, post-marches impressions of marches on negative masculine traits (i.e., aggressive, dictatorial, and arrogant) were less negative than pre-march impressions. The effect of marches on negative masculine traits can be important in understanding why people might choose to engage in climate activism. For example, the less people perceive that those most concerned about climate change have negative traits, and particularly masculine traits, the less likely they are to engage in activism that opposes such action (Geiger and Swim, 2018). Thus, because the present marches diminished impressions on negative masculine traits, the marches may diminish reactance against climate change action. However, because traits ascribed to those most concerned about climate change, especially positive masculine traits, are associated with willingness to engage in pro-climate action (Geiger and Swim, 2018), the lack of effects on positive traits suggests that the marches would not necessarily increase willingness to participate in action that is consistent with the themes of the marches examined here.

These analyses also revealed that those who got their news from more liberal news sources, independent of their own political views and concerns about climate change, reported fewer negative views of the marchers on negative masculine, feminine, and activist traits than those who got their news from more conservative sources. The lack of interaction between timing of completing the survey and political slant of news source on impressions suggests that news source's portrayal of the marchers may have contributed to these impressions both before and after the marches. Consistent with the argument that news sources contribute to impressions, the relation between political leaning and news sources on negative impressions was significant among those who reported hearing about the marches and not among those who reported not having heard about the marches. Thus, attention to different news sources may accentuate different impressions of marchers. The resulting effect of these associations was that, among those who got their news source from more liberal sources, those that reported hearing about the marches ascribed fewer negative traits to marchers than those that reported not hearing about the marches. In contrast, while comparisons between having heard vs. not heard about the marches was not significant at one standard deviation above the mean on political leaning of media sources, the results suggest that among those who got their news source from very conservative sources (i.e., two or more standard deviations from the mean), those that reported hearing about the marches ascribed more negative traits to marchers than those that reported not hearing about the marches.

Perceptions of Others' Engagement: Group Norms and Meta-Perceptions

We did not find evidence of favorable effects of marches on perceptions of other people's engagement in the topic (i.e., group norms and meta-perceptions). The marches may have, however, contributed to doubt about other people's engagement among participants that obtained their news from liberal sources; contradicting our hypotheses, after the marches (vs. before the marches) survey participants who got their news from liberal sources were less likely to perceive that it was normative for the general U.S. public to engage in activist behaviors. Yet, like our assessment of effects of news sources on efficacy beliefs, an examination of these patterns suggests that biases in news sources may have had more influence prior to the marches than after the marches. Prior to the marches, the more conservative one's news sources, the weaker participants' perceived the national collective action norms. In contrast, after the marches, there was no relation between political slant of news sources and perceived national and community group norms. Again, we speculate that effects of news sources prior to the marches may be because liberal news sources dedicated a greater percentage of pre-march coverage to the marches than conservative news sources, making group participation more salient to those who got their news from liberal sources. After the marches, in contrast, news sources across the political spectrum may have dedicated an equal proportion of coverage to the marches, making exemplars similarly salient.

Our results also suggest that the marches did little to influence survey participants' perceptions of other people's engagement in the topic (i.e., meta-perceptions). We had predicted effects would be stronger for perceptions about concern in the US than concern in one's community or among one's personal contacts. Yet we found no effects for any of these meta-perceptions. The lack of effect may be because those who engage in the marches are not only seen as unrepresentative of one's community and personal contacts but also seen as unrepresentative of the general public. This suggests that marches may want to consider how some actions may get attention but potentially have a disadvantage of making them seem less representative of the general public. It also suggests that it would be informative to attend to how the media chooses to present information about marchers, for example, whether they are presented in a way that makes them seem like prototypic activists who are not seen favorably (e.g., Bashir et al., 2013). These impressions may then influence the likelihood that assumptions about bystanders will generalize to assumptions about different groups of people (e.g., local community or nation as a whole).

Subsequent Collective Action

Directly opposing predictions, after the march, those who got their news from conservative sources were more likely to report being more likely to engage in collective action than they reported prior to the marches and this effect was not present for those

who got their news from liberal news sources. The effect is consistent with our findings that conservatives report greater collective efficacy (i.e., less pessimism about people's ability to work together) after (vs. before) the marches and other research indicating that collective efficacy is associated with participating in collective action (Roser-Renouf et al., 2014). Importantly for engaging the public, however, the means were at or below the midpoint of the scale indicating that all participants had no intention of engaging in collective action. Thus, although some of the effects we found might nudge people toward joining a climate change social movement immediately after the march, more is likely needed for these nudges to transpire into actual behaviors.

LIMITATIONS AND FUTURE DIRECTIONS

There are limitations to conclusions that can be drawn from our measure of political leaning in news sources. First, our analyses do not differentiate between getting news from mixed sources of information (e.g., viewing some liberal and some conservative sources) vs. getting news from sources that present moderate information (e.g., neither strongly liberal or strongly conservative). Future research may wish to differentiate between these two different reasons for having relatively more moderate news sources than very liberal and very conservative news sources. Second, we cannot determine whether the news sources were the most influential source of their information about the marches. A few people may have gotten their information from direct observation. Others may have learned about the marches via conversations in their social networks and via social media, sources which can be more effective at changing opinion than formal media (Swim et al., 2018a). Third, although we included covariates in our analyses that would help rule out effects confounded with preferring liberal vs. conservative news sources, we cannot rule out the possibility the effects of news sources rest in characteristics of audiences that we were unable to control for with our covariates and not due to effects of the political leanings of news sources. Last, we do not have a measure of the amount of participant engagement (e.g., time) with their news sources. Differences between those who heard vs. not heard about the marches are suggestive of difference in engagement, but they are not a direct measure of these differences.

Our results suggest that it would be informative to do content analyses of news coverage of climate change marches in order to determine, for example, differences in amount of attention given to the marches as well as differences in portrayals of the marches across various news sources. Consistent with Koopmans (2004) analysis of news coverage of social movements, assessing differences in quantity and quality of coverage about the marches could be relevant to understanding whether the marchers positively or negatively resonate with audiences and the perceived legitimacy of the marches. As we suggest above, the visibility of the marches may be responsible for increasing collective efficacy whereas the favorability of portrayals of the marches could diminish negative impressions of marchers. Thus, it may be valuable for future research to examine the content of the coverage's of marches and test the impact of different types of coverage on different types of outcomes.

Here, we used a trend analysis comparing one set of participants' ratings prior to the marches and a second set of participants' responses after the marches. This design creates some limitations in our ability to detect effects of the march on the public because we cannot fully rule out other potential explanations for pre-post differences that were not related to the marches themselves. We attempted to rule out potentially confounding variables by controlling for demographic characteristics and other relevant covariates (political ideology and sources of information) as covariates in our analyses. Further, although it is possible that an unrelated event could have occurred between the pre- and post-surveys that could have influenced the outcome measures, the short timeframe between the two (<2 weeks) suggests that this is unlikely to have occurred.

A more relevant weakness of our study design might be because we conducted assessments at only two time points: immediately before and immediately after the marches. Future work could consider collecting a larger set of measurements over a broader period before and after the marches. This could capture a variety of additional effects, including the potential that different news sources may provide different information about the marches prior to the marches, creating differences in their audiences even before the marches occur. Further, it may take more time to be able to detect effects of marches and it may take an accumulation of effects from different marches and other types of collective action to influence collective response efficacy as well as meta-perceptions and perceived group norms. Yet, capturing the unique effects of marches over a longer period of time within a broader context of unfolding current events is difficult due to the potential for other intervening effects to occur. The challenge of assessing long term effects of marches and cumulative effects of marches, however, is worth pursuing because these effects may be important for understanding social movements as a whole (Moyer et al., 2001).

We also note limitations in our ability to reliably detect effects due to the extreme variability in information that various individuals were exposed to regarding the march. For example, even after the marches about a third of our sample reported that they had heard "nothing" or "very little" about either march. We examined whether reporting hearing more than "a little" about marches predicted various outcome measures but these analyses had additional limitations. Specifically, comparing those who heard about the marches vs. those who did not hear about them does not take into account a variety of reasons for why they heard or did not hear about the marches. We assumed that it reflected greater attunement to information about climate change and public response to it. This is confirmed by a correlation between having heard about the marches and generally paying attention to news about climate change[3]. Analyses also revealed that effects of reporting hearing about the marches could not be explained by differences in participants' SES, gender, age, concern about

[3] $r_{(591)} = 0.32, p < 0.001$

climate change, or political ideology. Yet, engagement could involve other factors such as whether one lives in a city where the marches occurred and whether bystanders know people who participated in the marches.

Last, the generalizability of our data is limited because they were from a convenience sample rather than a randomly selected sample. Several of our demographic findings roughly match those in the US population. However, the sample may over represent those who identify as White and underrepresent those who identify as Hispanic so the research may be more applicable to the former than the latter. The sample also has more Democrats and fewer Republicans than found in the general population, suggesting that the sample may be more liberal than the general population. This suggests that, although political ideology was used as covariate in the analyses, we may not adequately represent results in a sample with more individuals who are politically conservative. More particularly, given selective attention to news sources that match one's political leanings (Mitchell and Weisel, 2014), we may have underrepresented the impact of conservative news sources. However, if one assumes that the Media Bias chart we used to assess political leanings of news sources is accurate, it is interesting to note that participants' self-ratings of their news sources suggests that their news sources may be more conservative than they perceive them to be. Thus, our findings may more accurately represent the impacts of conservative news sources than one might assume given the underrepresentation of conservatives in the sample.

CONCLUSION

Marches are an important component of social movements. Our results suggest that large, highly visible marches have the potential to enhance public participation in social movements by increasing perceived collective efficacy and diminishing negative impressions of marchers among the general public and possibly inspiring collective action. Yet, our results also suggest that by some metrics the marches had limited effects on promoting public engagement with climate change: the marches did not affect perceptions of whether it is normative to participate in collective action and others' concern about climate change and we found that few people willing to engage in collective action either before or after the marches. Our results indicate that media biases may influence effects of marchers on bystanders. First, our results are consistent with the possibility that liberal and conservative news sources provided similar visibility of the marchers after the march (but not before the march). This possible greater coverage of marchers by conservative news sources could explain increased perceptions of collective efficacy among conservatives. Second, our results are consistent with the notion that liberal and conservative news sources may provide different images of marchers and, by doing so, they may polarize the impression of marchers. Specifically, our results are consistent with the notion that conservative news sources may provide more negative portrayals of marchers than liberal news sources. The importance of news sources on moderating the psychological impacts of marches points to the need for more research on coverage of marches, how marches are portrayed, how people respond to the information, and the effects they can have prior to marches.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of The Pennsylvania State University Office for Research Protections. The protocol was approved by the Pennsylvania State University Office for Research Protections Internal Review Board. All participants were provided a consent form in accordance with the Declaration of Helsinki. We received a waiver for written consent because the study was conducted online and it allowed participation to remain anonymous. This was allowed because the research presented minimal risk to participants and involved no procedures that would require written consent outside of the research context. Participants were informed that completion of the survey was an indication of consent.

AUTHOR CONTRIBUTIONS

JS and NG contributed jointly to the generation of the idea for the study. NG constructed the survey and monitored the data collection. ML did the analyses. JS supervised the analyses and wrote the document. NG and ML helped edit the paper.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcomm.2019.00004/full#supplementary-material

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Communicating Climate Change Oceanically: Sea Level Rise Information Increases Mitigation, Inundation, and Global Warming Acceptance

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Cognitive impediments and global warming's gradual pace, among other factors, have inhibited some people from detecting climate change's everyday effects. This results in global warming often being perceived as a non-urgent, non-personal, threat that inhibits larger-scale collective action combatting climate change and public will regarding such action. Extreme weather events that global warming causes or exacerbates (e.g., hurricanes, flooding, heat, and droughts), however, are memorable due to their high emotional, social, and economic costs. Sea level rise is an especially salient American issue, given recent heightened storm surges, and the large population-segment who live in or near coastal areas with dangerous flooding risks. In this experiment, we show that providing American participants with U.S.-specific information about the economic and/or geographic/cartological effects and risks of sea level rise results in (a) an increased acceptance of oceanic rise as a phenomenon that is concerning and caused by global warming, and (b) an increased acceptance, in general, of global warming's anthropogenic nature. Communicating sea level rise information also led to (c) a general decrease in nationalism and (d) changes in the perceived effectiveness of mitigation strategies for sea level rise–specifically (d1) a decrease in the perceived effectiveness of constructing sea walls /dikes and (d2) an increase in the perceived effectiveness of phasing out fossil fuel usage. Overall, we find that communicating striking information about this oceanic by-product of global warming is an effective way to motivate acceptance and engagement with the issue of climate change in a reasonably broad manner. The experimental findings replicate, extend, and dovetail with prior experiments by our laboratory, bringing up to six the number of brief interventions (i.e., of roughly 5 or fewer minutes) that have been proven to increase people's science-normative beliefs about global warming. Our laboratory's website, HowGlobalWarmingWorks.org, offers samples of these materials, which additionally include surprising statistics, textual and video explanations of global warming's mechanism, and a contrast of Earth's temperature rise since the 1880's vs. the U.S. stock market rise since then.

Keywords: cognition, sea-level-rise, global warming, nationalism, climate change, education, psychology

INTRODUCTION

Current sea level acceleration is unprecedented in human history (Woodworth et al., 2009; Rahmstorf, 2010). Sea levels, rising since the 1800's (Christensen et al., 2007; Church and White, 2011), are expected to rise at least until 2100 (Holgate and Woodworth, 2004; Church and White, 2006)—a phenomenon widely agreed to be due to global warming. Global sea levels are predicted to increase 0.2–0.6 m beyond 1990 levels by 2095 (Solomon et al., 2007) and alternative predictions vary from 0.5 to several meters before 2100 (Hansen et al., 2006; Schubert et al., 2006; Carlson et al., 2008). More recent projections (Fischer et al., 2018) indicate that even these alternative predictions may prove conservative.

Sea level rise is an especially salient U.S. concern, following striking hurricane-triggered flooding in New Orleans (Katrina), New York (Sandy), Houston (Harvey), North Carolina (Florence and Michael), and Puerto Rico (Maria and Irma), etc. (e.g., Kishore et al., 2018). Beyond storm surges, U.S. flooding frequency from non-storm high tides has doubled in just 30 years, causing human deaths and many billions of dollars in damage, with risks to infrastructure and coastal properties high and soaring (Nicholson-Cole and O'Riordan, 2009; Milman, 2018). Sea level rise's threat clearly impacts America's housing market, with homes more exposed to oceanic rise selling for approximately 7% less than equivalent homes at higher elevations yet equidistant from the beach (Bernstein et al., 2018). Besides property damage, frequent flooding and sea level rise cause many social, legal, and economic challenges, including issues from sanitation to gentrification (Kolbert, 2015). Growing concerns about extreme weather events have already caused reassessment of families' attachments to residential environments (Bates et al., 2008), altered citizens' perceived security (McDonald, 2008), elicited adaption and mitigation behaviors among low-lying coastal-area residents (Brody et al., 2008), and reduced energy consumption (Spence et al., 2011).

Despite strong global warming evidence, including rising oceans, many Americans are skeptical about the fact of Earth's average surface temperature increase; about 32% deny that the increase is mostly anthropogenic (Leiserowitz et al., 2018). Partisan divides exist regarding global warming's anthropogenicity and its actual and projected side effects (Krosnick et al., 2000; Leiserowitz, 2006; Dunlap and McCright, 2008; Hulme, 2009; Klick and Smith, 2010; McCright and Dunlap, 2011; Villar and Krosnick, 2011; Zhao et al., 2011; Park and Vedlitz, 2013). Some explain this acceptance asymmetry as reflecting biased assimilation (building on Lord et al., 1979), in which people holding a strong belief may (a) occasionally be more likely to reject information running counter to it or (b) subject such information to higher critical standards than they would information that supported their pre-existing beliefs (McCright and Dunlap, 2011; also see motivated reasoning, confirmation bias, or motivated skepticism: Kunda, 1990; Nickerson, 1998; Redlawsk, 2002; Taber and Lodge, 2006).

Kahan et al.'s (e.g., Kahan et al., 2012) cultural cognition perspective posited that one adopts a worldview reflecting one's identifying group. Related to Festinger's cognitive dissonance theory (e.g., 1957, regarding other topics), Kahan et al. suggest that communicating climate change information, such as scientific evidence/facts, yields selective attention to this information–particularly aspects that reinforce prior beliefs–while virtually dismissing contravening aspects. Such a biased assimilation would suggest that communicating climate change information could drive people with opposing prior worldviews apart. Our research group, however, has consistently shown that providing people with coherent scientific information about global warming, such as its scientific mechanism and salient statistics, leads to global warming acceptance *increases* across both the full left/right liberal-to-conservative spectra for both economic and social conservatism (Ranney and Clark, 2016; Ranney et al., 2016, in press; also see van der Linden et al., 2017).

Along with increasing global warming acceptance, it seems desirable for America to use its collective identity to help mitigate global warming's effects, such as rising oceans–a view informed by Gould's 1993 model associating nationalism with the formation of social ties and networks among citizens. However, our laboratory has consistently shown negative correlative and causal relationships between nationalism and global warming acceptance over the course of many surveys and experiments, which we have explained using the induced Reinforced Theistic Manifest Destiny theory (RTMD, Ranney and Thanukos, 2011; Ranney, 2012; Ranney et al., 2012; etc.)—a generative theory that predicts and explores relationships among six constructs, including global warming acceptance, nationalism, and the acceptances of: evolution, creationism, a higher power(s), and an afterlife. The negative relationship between nationalism and global warming acceptance may be exacerbated by political rhetoric that often tries to pit U.S. nationalism ("America First") against environmental concerns–such as the fossil-fuel-friendly "Drill, Baby, Drill" slogan at one party's political convention (McCright and Dunlap, 2003)—and the widespread framing of climate change as threatening (e.g., "job-killing") to economic stability and growth (Hardin, 1968; Hennes et al., 2016; see also Lewandowsky et al., 2013, on free-market adherence's association with global warming denial). The relationship between strong national identification and inhibited support for environmental change was posed, by Feygina et al. (2010), as a manifestation of System Justification Theory, in which threats to the legitimacy and stability of social (and national) institutions/systems lead to motivated recall of environmental facts (Hennes et al., 2016). Better understanding the bi-directional relationship between nationalism and the perception/acceptance of global warming (and its effects) seems increasingly important because many environmental resources (e.g., the atmosphere) are international, and nationalistic concerns must be transcended to produce the international agreements necessary to dramatically reduce greenhouse gas emissions.

This paper presents a new experiment showing that clearly communicating the economic and/or inundation effects/risks associated with sea level rise–some global warming by-products–increases the acceptance that oceanic rise is a current, worsening phenomenon that is both concerning and caused by global warming. Communicating such information led, in some cases, to a direct increase in acceptance that climate change is

anthropogenic, even though climate change is barely–and sometimes never–mentioned in the interventions' modules. After reading such sea rise information, participants exhibited general acceptance increases regarding (a) sea level rise *and* (b) global warming. We also observed (c) a decrease in nationalism, (d) a decrease in the perceived effectiveness of constructing mitigating sea barriers, and (e) an increase in the perceived effectiveness of phasing out fossil fuel usage. Overall, we (1) once again replicated that information-based communications of environmental risk/effects can clearly modify global warming attitudes, and (2) illustrated that such communications alter beliefs about other forms of climate change engagement, such as altering participants' preferences for mitigating actions.

Some Climate Communication Background

Cognitive barriers prevent most people from identifying climate change's full threat. Global warming's gradual pace and its corresponding environmental changes inhibit some from detecting its effects amid weather variability (Marx et al., 2007; Weber, 2010; Weber and Stern, 2011). Most environmental degradation is incremental and modestly tangible in casual observers' typical epochs. We cannot visually perceive air's greenhouse gas accumulation, and we generally perceive ecological changes only following severe environmental damage. A view of climate change as a non-urgent, non-personal, threat has–heretofore–been thought to hinder proactive behavioral responses to the issue (Lorenzoni and Langford, 2001). Leiserowitz et al. (2018) note that 30% of Americans do not believe that global warming will affect the U.S. and 48% believe it will not harm them individually. A dozen years ago, Krosnick et al. (2006) accordingly noted that climate change ranked as less important in people's lives than competing issues such as terrorism, health care, and the economy. Climate change's non-urgent, non-personal, perceptions have been proffered to explain the value-action gap, whereby people's actions do not match the green attitude levels they express in surveys (Pedersen and Neergaard, 2006; Röös and Tjärnemo, 2011).

Another communication challenge is that climate changes are hardly just localized, being manifest over wide, diverse, geographical scales (Hamilton and Keim, 2009; Ruddell et al., 2012). The potential lack of climate change's salience in one's local daily environment (Helgeson et al., 2012), coupled with its global scope (Breakwell, 2010), yields little concrete or personally affective imagery to motivate engagement with global warming (Leiserowitz, 2006, 2007)—producing disconnects between perceptions of climate change's seriousness and one's feelings about obligatory actions (Hulme, 2009).

This experiment's manipulations communicate information about aspects of global warming's effects that seem highly relevant to Americans. In keeping with (a) dual processing theories emphasizing the most vivid elements of direct and vicarious experiences as superior methods for risk and climate communication (Sloman, 1996; Chaiken and Trope, 1999; Slovic et al., 2004), and (b) our own work that has emphasized the pivotal role of surprise in learning (Ranney et al., 2016; Munnich and Ranney, 2019) and rationality-monitoring (e.g., Ranney, 1996), we designed interventions that intended to elicit affective responses–hypothesizing that these would lead to rapid categorizations and useful evaluations of such information (Slovic et al., 2004). The chosen communication topic–sea level rise–seemed likely to (1) have been personally or indirectly experienced by U.S. participants and (2) carry affective associations for participants.

Methodological Contextualization of Sea Level Rise

Oceanic rise was this experiment's selected topic due to its impacts on many people and institutions across the socio-economic continuum, including military bases (e.g., Norfolk, Virginia's), small businesses, and home owners across vast U.S. coastline swathes. Because inundation is relevant and/or personally threatening to many Americans, it seems among the likeliest issues useful for influencing behavior/actions (Weber, 2006). Other advantages of sea level rise communication over less salient climate change effects, are clear linkages between oceanic rise and global warming, with scientists proving that warming temperatures have increased hurricanes' strengths and that oceanic expansion increases chronic nuisance flooding frequencies (Milman, 2018)—science demonstrable in simple classroom experiments. The media occasionally, persuasively, state the relationships between climate change and its effects, such as flooding (Olausson, 2009)—and personal experiences with extreme weather events (e.g., flooding) have highlighted climate change for non-victims (Konisky et al., 2016). Sisco et al. (2017), for example, found that associations between global warming and extreme weather, including coastal flooding, frequently became simultaneous Twitter posts.

Although sea level rise is relatively underexplored, topically, within climate change communication, Wong-Parodi et al. (2018) recently studied communicating both flood risk projections and flood-mitigating actions to respondents affected by Hurricane Sandy. Communicating about protective actions was most successful at encouraging action, but it reduced the perceived probability of future flooding and did not change perceptions of climate change as driving future flooding–due, the authors argued, to unfamiliarity with quantitative estimates of risk and changes in resilience upon reading about protective actions. In complement to their study, we herein assess communicating salient and compelling sea level rise risk information to a broader U.S. audience who hadn't necessarily experienced flooding. We developed three instructional modules that communicated cartological and/or statistical information about sea level rises. The first encapsulated some current and future *economic* ramifications of oceanic rise on coastal *housing* markets. The second showed land inundated in s*outhern Florida* following zero-, one- and four-degree (Celsius) global temperature increases. The third was extreme, showing how the *southeast U.S.* coastline would change if Earth's frozen water *completely* melted.

Economic Information

Rising seas' economic consequences are inescapable, and the media often describes storm severities in financial-damage terms (e.g., Hurricanes Harvey and Irma alone yielded estimated losses of $290 billion dollars; Wile, 2017), with such costs heavily associated with housing-market impacts. Hughes (2015) found that coastline-protecting urban adaptation plans largely seek to protect valuable assets, echoing Berrang-Ford et al.'s findings (2011). Our experiment's economic module therefore communicated information about current and projected U.S. financial losses, hypothesizing that our American participants would find it salient and compelling.

We additionally chose to communicate actual and projected economic losses/damages to invoke people's loss aversion tendencies (Tversky and Kahneman, 1991) and to counter prevalent misconceptions that reducing emissions is expensive compared to maintaining the status quo (Shwom et al., 2010; Jacobson et al., 2017). Such misperceptions may exist because publicity around climate policy impacts usually frames reducing emissions as a cost/loss (Hatfield-Dodds and Morrison, 2010), increasing perceptions of mitigation strategies as unfair (Kahneman et al., 1986) and leading to status-quo-protecting oppositions to policies/goals curtailing fossil fuel use (Dietz et al., 2007)—despite Delucchi and Jacobson (2011), etc., indicating the relative frugality of moving to sustainable fuels from fossil fuels. Framing actions that inhibit climate change as economic opportunities has, encouragingly, been experimentally shown to increase such policies' public support (Lockwood, 2011). For instance, framing emission-reducing cost as a foregone gain (i.e., a long-run money saving) produces higher willingness to reduce CO_2 emissions among Australians (Hurlstone et al., 2014). We additionally hypothesized that communicating climate change's considerable financial damage would prompt surprise–therefore increasing participants' perceived risks regarding global warming (Ranney et al., 2016) and oceanic rise, leading to further predictions of increased desires for individual and collective level actions to solve the problem.

Geographic/Map Information

In presenting the economic statistics, we drew on (a) our laboratory's prior research on how quantitative information, including statistics, can prompt visceral surprise–leading to updated understandings and changes in preferences and policies (Garcia de Osuna et al., 2004; Munnich et al., 2007; Ranney and Clark, 2016; Ranney et al., 2016; Munnich and Ranney, 2019), and (b) theories of visualization in science and science education, which indicate that graphical data representations often increase engagement and understanding (e.g., Gilbert, 2010; Ranney et al., 2016). Visual representations have also been effective regarding climatological information, with a pie chart usefully communicating climate change's scientific consensus to the general public (van der Linden et al., 2014). Our own laboratory has shown that graphical, visually striking, depictions of Earth's increasing mean surface temperature since the 1880's have successfully prompted surprise and corresponding increases in the acceptance of global warming's anthropogenic nature (Chang, 2015; Ranney et al., 2016). Sea level rise is similarly inherently associated with striking imagery. We therefore hypothesized that inundation data regarding parts of the land in southern Florida and/or the southeastern U.S. *that will be lost* under different sea-rise scenarios would represent compelling, visually-striking, affective, images that would prompt increases in sea level rise acceptance *and* global warming acceptance.

Main Hypotheses

Among other hypotheses, our central hypotheses are: (a) communicating economic information about sea level rise's effect will yield increased sea level rise acceptance, increased global warming acceptance, and deceased nationalism, (b) communicating one or two map-based geographic impacts of sea level rise will yield increased sea level rise acceptance, increased global warming acceptance, and decreased nationalism, and (c) more information about sea level rise will yield greater increases in sea level rise acceptance, global warming acceptance, and decreased nationalism.

METHOD

Participants

Amazon Mechanical Turk (MTurk) participants were paid upon survey completion—and 384 completed responses were collected, in total, across eight conditions after exclusion criteria (detailed in Procedure) were applied. Of these, 64% were female, with ages ranging from 18 to 75 years old ($M = 38.2$), and with widely varying household incomes (median = $55,000) and education levels (with 51% having a bachelor's degree or more). The plurality, 47%, identified as Democrats, with the rest being largely Republican or Independent (with smatterings of Libertarian, Green, and "Other")—and 32 participants identified (separately) as Tea Party members. (The median participant was a "4" and "5" on our 9-point *social* and *economic* conservatism scales, respectively.) Regarding religion, 45% of participants identified as Catholic, Protestant, or (other) Christian, while 38% identified as Atheist or Agnostic.

Experimental Design

We presented each module to participants (a) individually, (b) as paired combinations, and (c) all three together, based on a $2 \times 2 \times 2$ (economic-or-not x Florida-or-not $\times$ southeastern-U.S.-or-not) factorial design. Our control condition's participants received a short text about how the moon causes tides (which few people know); this seemed superior to a no-intervention ("not-not-not") control as it (1) allowed for better assessment of experimenter demand (for which we did not find significant evidence) and (2) was on the topic of sea-height modulation yet divorced from the temperature-causality of global warming's sea level increases. **Table 1** summarizes the modules presented in each condition.

Materials

The Economic module some participants received was divided into two parts. Part 1 employed four selected statistics from an 11/24/16 New York Times article that included several actual (and one projected) negative impacts on home sales in coastal,

TABLE 1 | Summary of the modules presented in each condition.

Condition number	Modules included	Abbreviations of the modules included
1	Economic impacts ($)	$
2	Economic impacts ($) + Shorter-term geographic impacts: Southern Florida (FL)	$ + FL
3	Economic impacts ($) + Shorter-term geographic impacts: Southern Florida (FL) + Longer-term geographic impacts: South eastern US (SE)	$ + FL + SE
4	Economic impacts ($) + Longer-term geographic impacts: South eastern US (SE)	$ + SE
5	Shorter-term geographic impacts: Southern Florida (FL)	FL
6	Longer-term geographic impacts: South eastern US (SE)	SE
7	Shorter-term geographic impacts: Southern Florida (FL) Longer-term geographic impacts: South eastern US (SE)	FL + SE
8	Control Group: Tides [described above]	[Control: Tides]

high flood-risk, areas. Part 1's statistics were: (1a) Attom Data Solutions' by-county data show that 2011–2016 flood-prone area home sales increased roughly 25% slower than those in usually flood-free counties–and that people living on the coast are reconsidering their purchases, (1b) climatologists predict that Southeast Florida's tidal floods will increase from roughly the current 10 to about 240 in 2045, (1c) prior-year U.S. home sales were higher by 2.6%, but in Miami-Dade County's high-risk flood zones, they *decreased* roughly 7.6%, and (1d) for high-risk U.S. flood areas, median home values were 4.4% *lower* than a decade ago, yet those in low-risk places were 29.7% higher. Participants then received the economic module's part 2, including a data table (developed by the online real estate company Zillow.com) that drew on a projected six-foot sea level rise by the year 2100 to calculate/display property losses in terms of number of projected lost properties, the percentage of each state's total housing stock lost (e.g., 12.6% for Florida), and total value of projected lost properties for the five states projected to lose the most in property value (Rao, 2017). The table's five states (and respective billions in projected lost property value) were: Florida ($413B), New Jersey ($93B), New York ($71B), Massachusetts ($51B), and California ($49B). Text above the table informed participants that a six-foot rise was projected in a 3/31/16 Nature peer-reviewed journal article that, according to NOAA and Zillow.com, would lead to total U.S. property losses of $882 billion dollars–with roughly 1 in 50 U.S. houses ("1.9 million homes") getting swamped.

Some participants received the Southern Florida module, which was based on projections made by an article in the *Proceedings of the National Academy of the Sciences* and climatecentral.com that calculated the sea-rise corresponding to specific increases in global mean temperature. According to such (conservative) projections, sea levels following equilibrium would rise seven feet with a 1°C global average temperature increases, and 29 feet following a 4°C increase. While climatecentral.com made projections for every terrestrial Earth location, participants receiving this module were asked to review maps only of how southern Florida would/will be affected by the two respective sea level increase scenarios (corresponding to the two global mean temperatures increases, see **Figure 1**). These maps were simplified versions of climatecentral.com's projections (i.e., not indicating inundation *heights*) and were black and white, using cross-hatching to differentiate inundated from non-inundated areas.

Participants receiving the southeastern U.S. module viewed a simplification of a projection that *National Geographic* produced displaying how coastlines would appear if *all* of Earth's ice melted (see **Figure 2**). This representation was not linked to any particular greenhouse gas emissions scenario, although Earth has been occasionally ice-free (prehistorically, as explained to participants). **Figure 2**'s map and text were intended to illustrate America's physical vulnerability in a surprising, striking manner.

Procedure

Beyond receiving an intervention, each participant also completed a pre-test and a post-test consisting of a 36-item survey that included items about global warming acceptance, sea level rise acceptance, and two possible solutions to sea level rise: phasing out fossil fuels and building sea level walls/dikes. Most of these 36 items (other than the 10 specific to sea-level rise) were used in prior studies (e.g., Ranney and Clark, 2016; Ranney et al., in press, etc.). The two policy-solution items represented (a) the most well-known engineering sea level rise risk mitigation policy (i.e., hard infrastructure defense; Tol et al., 2008; Abel et al., 2011), and (b) a highly general, well known, global warming mitigation strategy to reduce greenhouse gas emissions. As in prior studies, some of the previously-used items probed participants' views on religion, evolution/creation, and nationalism–as additional constructs in Ranney's (2012) RTMD theory–for instance, to assess the modules' and interventions' effects on participants' acceptance of nationalism, as well as of global warming and sea level rise. Cronbach's alpha for this study's ten sea level rise items, eight global warming items, and four (reduced in number from prior studies) nationalism items were, respectively, 0.91, 0.81, and 0.73.

Participants were recruited from *all* U.S. states/territories to assess intervention-modulated beliefs related to sea level rise as a phenomenon of interest to Americans in general. Participants completed the experiment in successive batches during 6/16/17−6/25/17. We recruited participants in batches in order to roughly ensure that participants were being sorted evenly into each condition. Participants were paid $0.60–$1.00 on completing the survey, as compensation increased following participant feedback (and regarding completion-duration data) from initial (condition-balanced) participant batches. On average, participants spent 22 total minutes on the experiment.

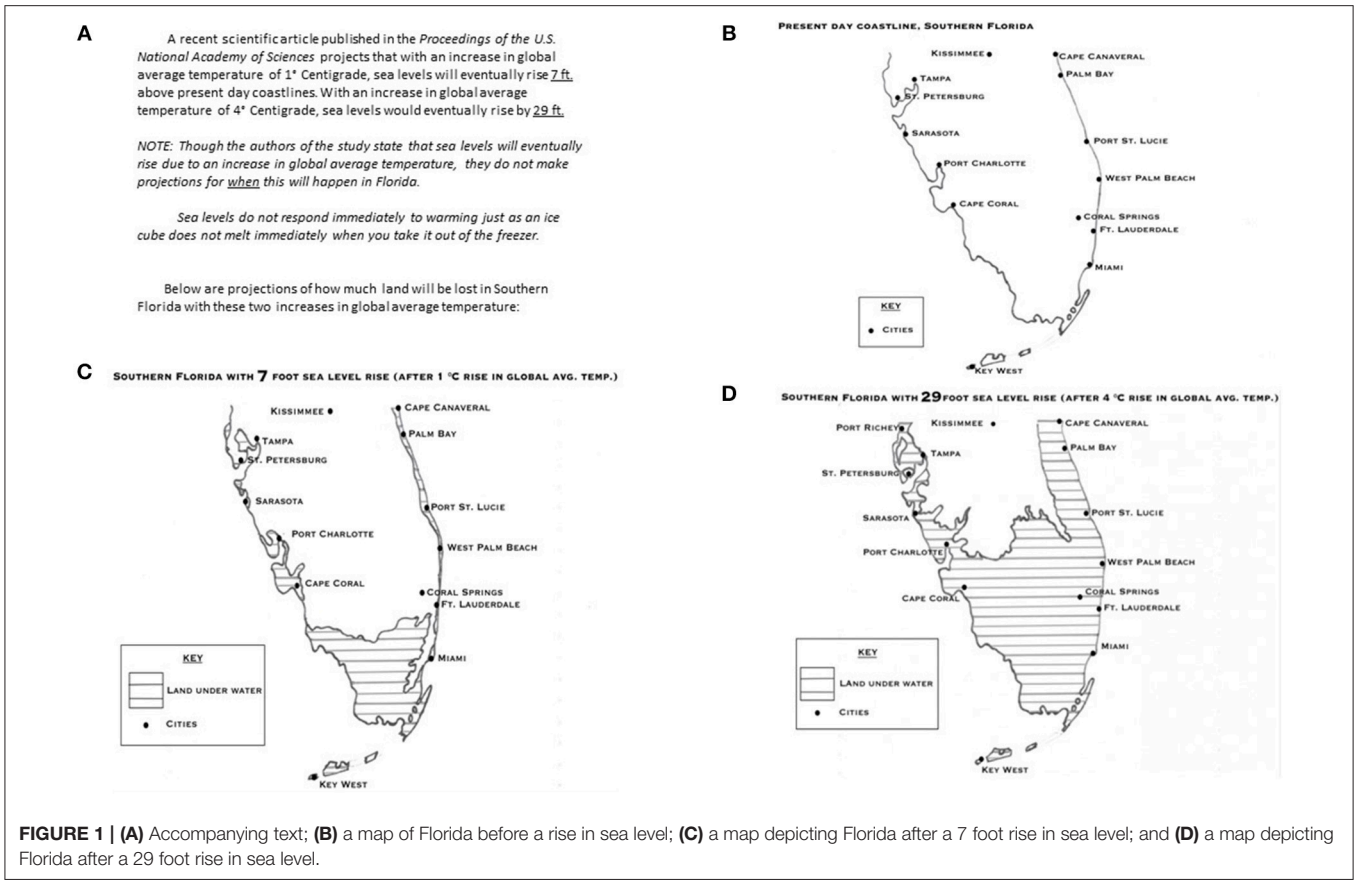

FIGURE 1 | (A) Accompanying text; **(B)** a map of Florida before a rise in sea level; **(C)** a map depicting Florida after a 7 foot rise in sea level; and **(D)** a map depicting Florida after a 29 foot rise in sea level.

Beyond typical attentional "catch" questions in the pre- and post-tests–designed to assess participant attention and response coherence (including an item asking participants to self-report what percentage of attention they paid to the intervention)—information checks for each module ensured that participants engaged properly with the material. Participants experiencing the economic module received a comprehension query about which U.S. state would lose the greatest number of properties and participants experiencing the inundation modules received items about which cities would be under seawater from (as module-appropriate) 7-foot, 29-foot, or 214-foot inundations. Timers were also employed. Each participant was scored based on catch-item success, responses to the interventions' comprehension questions, and duration to complete the pre- and post-tests. Excluded participants scored <75% on this index, compared to the maximum possible for their condition. Participants were also excluded whenever (a) an IP address (by longitude and latitude) was outside the U.S., (b) multiple people used the same IP address, and/or (c) if one's response exhibited an extremely long or short survey completion time (in accordance with the mean and standard deviation of the times participants spent on each condition). If participants' answers to free response questions were problematic–for instance, markedly incomplete/incoherent or plagiarized (e.g., from Wikipedia), their responses were also excluded. After filtering through these detailed exclusion criteria, 384 of 498 initial participants remained. Seven of the one hundred fourteen eliminated respondents were disqualified based on IP address, 12 because they were above or below duration thresholds for the total time taken on the condition, and 95 based on their scores for the indexed cumulative exclusion criteria.

Because participants were assigned to groups in a randomized control trial experimental design, the conditions' effects were assessed using both *between*-participant *t*-tests (to compare pre-to-post-test changes among the major dependent variables for the experimental participants to pre-post-changes for the control participants), and *within*-participant *t*-tests. These allow assessment of pre-to-post-test changes in sea level rise acceptance, global warming acceptance, and nationalism—as well as changes in preferred mitigation strategy (support for barriers and/or fossil fuel phaseouts). ANOVAs assessed interaction effects among the three modules, and correlations and regression analysis explored relationships among the main variables and certain demographic variables.

RESULTS

Increases in Sea Level Rise Acceptance

Communicating information about sea level rise generally led, as hypothesized, to a robust gain in sea level rise acceptance: the aggregation of all seven experimental conditions yielded an average increase of sea level rise acceptance from $M = 6.49$

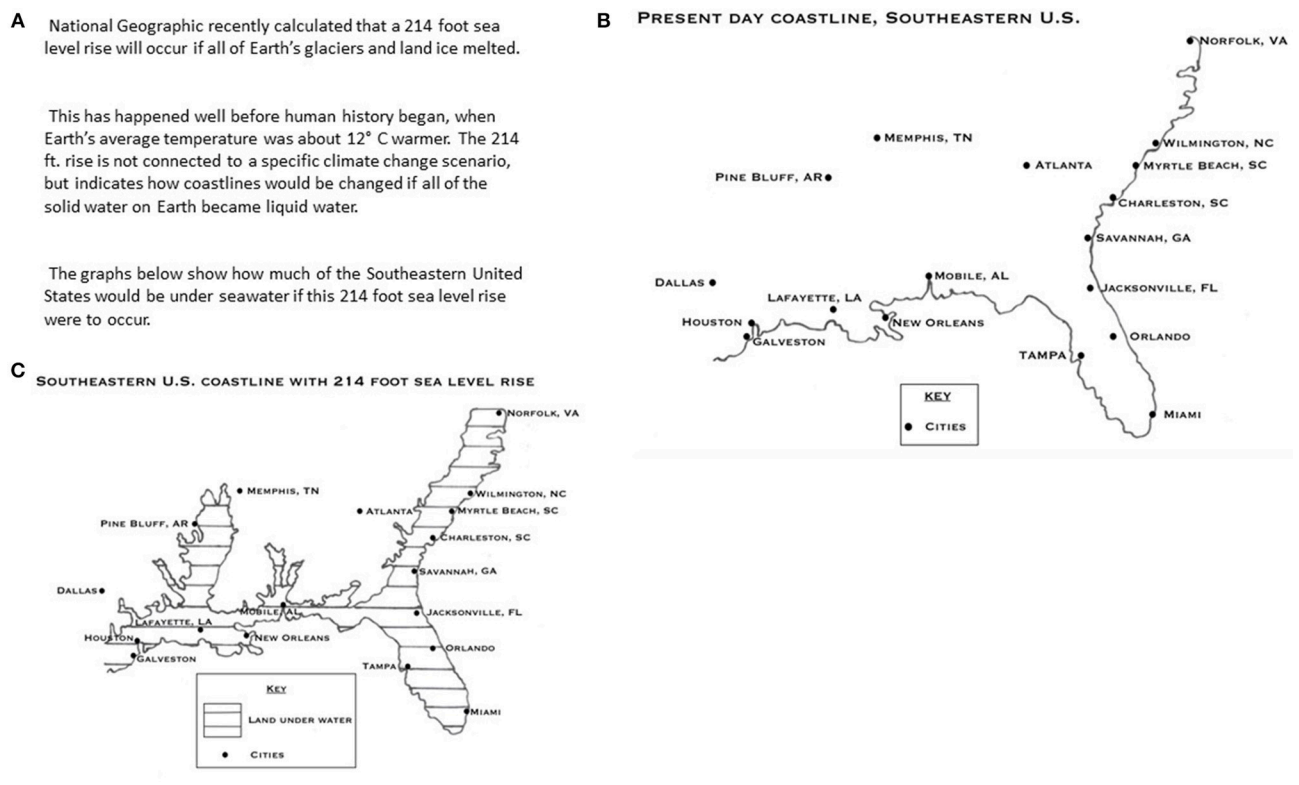

FIGURE 2 | (A) Accompanying text; **(B)** map depicting the southeastern U.S. coastline; **(C)** map depicting how the southeastern U.S. coastline would appear if all of Earth's ice melted.

(SD = 1.50) to M = 6.68 (SD = 1.53) on a 9-point scale [$t_{(332)} = 7.22$, $p < 0.001$, $d = 0.401$]. Through sub-aggregations, the effects of the *amounts* of information included in the various conditions on changing participants' sea level rise acceptance were also assessed. Excluding the statistically significant condition 3 from the analysis (given that it was the only three-module condition), we found potent increases in sea level rise acceptance with roughly double the amount of information included in relevant conditions (i.e., for the three two-module interventions, numbers 2, 4, and 7; $t_{(157)} = 5.307$, $p < 0.001$, $d = 0.442$; **Table 2**).

Presenting participants with sea-level risk information also yielded numeric increases in acceptance of sea level rise (as a phenomenon that is concerning and caused by global warming) across each of the seven individual experimental conditions—with each of the seven also yielding a higher t-value, numerically, than the (non-significant) control condition (**Table 2**; binomial $p < 0.01$ for both findings). *Statistically significant* increases in participants' sea level rise acceptance were observed in five of the seven experimental conditions, with four of these seven yielding p-values of lower than 0.005 (**Table 2**). Four of the five conditions that led to significantly increased acceptance involved the economic module, either by itself (condition 1) or in combination. Subsequent analysis supported the notion that the economic module may have been superior to the cartographic-based ones at increasing sea level rise acceptance because the economic module's contribution to that increase was significant [$F_{(1,376)} = 4.41$; $p = 0.036$, $d = 0.216$] using a ($2 \times 2 \times 2$ ANOVA). These results suggest that information about economic consequences or damages can be a powerful communication arena for changing minds regarding sea level rise. The combination of information about southern Florida's and the southeastern U.S.'s projected oceanic rises were also shown to be potent (as per condition 7's and condition 3's robust gains).

Increases in Climate Change Acceptance

Additionally, despite making little explicit use of the phrase "climate change" or "global warming" in the modules and none at all in the southern Florida module, aggregating over all seven experimental conditions showed that participants' acceptance of global warming increased significantly after being exposed to sea level rise information ($p < 0.01$, $d = 0.143$; **Table 3**). As was done for sea level rise, we assessed the effects of *amounts* of oceanic rise information on participants' global warming acceptance (**Table 3**). Given condition 6's ambiguous utility in isolation (see the next paragraph, etc.), it is not surprising that aggregating the one-module conditions did not yield a significant difference. However, significant increases in global warming acceptance were observed with roughly double the amount of information included in conditions [i.e., two-module conditions; $t_{(157)} = -3.506$, $p < 0.001$, $d = 0.304$; **Table 3**]. More instruction,

TABLE 2 | Change in sea level rise acceptance by condition and number of modules.

Condition(s)	*n*	Pre-SLR acceptance/ out of 9.0		Post-SLR acceptance/ out of 9.0		Change from pre- to post	*t*-value	*df*	*p*-value	*d*
		M	*SD*	*M*	*SD*					
1 ($)	52	6.48	1.50	6.74	1.53	+0.26	+4.19	51	0.00011***	0.613
2 ($ + FL)	56	6.24	1.50	6.40	1.56	+0.16	+2.29	55	0.026*	0.308
3 ($ + FL + SE)	49	6.61	1.45	6.86	1.40	+0.25	+3.09	48	0.0033**	0.431
4 ($ + SE)	57	6.34	1.75	6.55	1.82	+0.21	+3.25	56	0.0019**	0.424
5 (FL)	38	6.87	1.32	6.93	1.29	+0.05	+0.67	37	0.50	0.121
6 (SE)	36	6.16	1.37	6.28	1.51	+0.12	+1.64	35	0.109	0.105
7 (FL + SE)	45	6.76	1.37	7.00	1.36	+0.24	+4.26	44	0.0001***	0.619
8 (control:tide)	51	6.18	1.69	6.21	1.84	+0.03	+0.41	50	0.68	0.063
1-module (conditions 1, 5, and 6)	126	6.51	1.43	6.66	1.47	+0.15	+3.831	125	0.000201***	0.332
2-modules (condition 2, 4, and 7)	158	6.43	1.57	6.63	1.61	+0.20	+5.307	157	3.74E-7***	0.450
All 7 experimental conditions	333	6.49	1.50	6.68	1.53	+0.19	+7.221	332	3.13E-10***	0.401

*$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$.

naturally, seems requisite for cognitive change regarding a less direct construct (and global warming is indirectly changed by ocean-level information).

Disaggregating further, significant changes in participants' global warming acceptance were also observed in two of the seven experimental conditions (conditions 2 and 7: p =0.0391, $d = 0.294$; and $p = 0.010$, $d = 0.415$ respectively; **Table 3**). Numerical increases in global warming acceptance were observed in six of the seven experimental conditions. Condition 6, which offered the southeastern U.S. inundation projection module in isolation, yielded the only decrease (which was non-significant and not even marginal) among the conditions regarding global warming acceptance—and yielded a numeric outlier described in the next sub-section, too. We suspect that, *in isolation*, the 214-foot sea level rise may seem fantastical, shocking, or even surreal to some participants—perhaps, occasionally enhancing skepticism in some. (The control condition's 0.00 change from pre- to post-test, showed, as predicted, no evidence of experimenter demand bias, which suggests no such bias for the experimental conditions, either.)

Nationalism Reductions

Extending findings by Ranney et al. (in press), decreases in nationalism were generally observed after exposure to the interventions' scientifically representative climate-change-relevant information. Pooling all seven experimental conditions, it was found that presenting people with information about sea-level rise risks (conceptually associated with global warming) led to significant decreases in nationalism [$t_{(333)} = -3.80$, $p < 0.001$, $d = -0.201$; **Table 4**]—again, while increasing global warming's and oceanic rise's acceptances. Assessing the effect of the amount of information included in the various conditions on changing participants' nationalism, we found that the informational increases in acceptance of sea level rise and global warming with roughly double the amount of information (two-module conditions: **Tables 2**, **3**, respectively) were mirrored by a *decrease* in nationalism [$t_{(157)} = -3.48$, $p < 0.01$, $d = -0.290$ for the two-module conditions; **Table 4**]. Indeed, in spite of condition 6's outlier character, aggregating its data with the other two one-module conditions (which were significant and marginal) also yielded a significant nationalism decrease [$t_{(126)} = -1.99$, $p < 0.05$, $d = 0.162$].

Four of the seven experimental conditions yielded statistically significant or marginally significant decreases in participants' nationalism from pre-to-post-test, and nationalism numerically dropped in six of the seven experimental conditions (**Table 4**). As for global warming acceptance, the southeastern U.S. module in isolation was the only condition with a numerical result suggesting a contra-predicted directional change. The 214-foot rise again seemed to stretch participants' credulity when not being paired with an additional module(s). Overall, however, these results support previous findings about the inverse and even bi-causal relationship between nationalism and global warming acceptance (Ranney, 2012; Ranney et al., 2012, in press; Ranney and Clark, 2016). (The control condition again showed no significant change.)

The Major Dependent Variables' Results More Broadly

These results (**Tables 2–4**) largely support the reasonable idea that more information, when germane/crucial, contributes to greater belief changes. This follows a trend also observed in Ranney and Clark (2016), in which participants' increased acceptance of global warming reflected the amount of received information about the mechanism of global warming. The trend was even more formally assessed and observed in Ranney et al.'s (in press) Experiment 4, regarding the lengths of mechanism-explaining videos (from 1 to 5 min) as well as texts (from 35 to 596 words). However, there is a hint that the present experiment's two-module effects gain little with a third module's (quasi-redundant) addition, and may cause participants to lose attention, given that condition 3's effects were as directionally predicted, but only statistically significant for the sea level rise dependent variable (**Table 2**; $p = 0.003$, $d = 0.431$).

TABLE 3 | Change in global warming acceptance by condition and number of modules.

Condition(s)	*N*	Pre-test GW acceptance/out of 9.0		Post-test GW acceptance/out of 9.0		Change from pre- to post	*t*-value	*df*	*p*-value	*d*
		M	*SD*	*M*	*SD*					
1 ($)	52	6.90	1.89	6.98	1.90	+0.08	+1.451	51	0.153	0.212
2 ($ + FL)	56	6.49	2.08	6.64	2.07	+0.15	+2.120	55	0.0386*	0.294
3 ($ + FL + SE)	49	7.17	1.95	7.24	1.98	+0.07	+1.327	48	0.191	0.179
4 ($ + SE)	57	6.57	2.34	6.67	2.31	+0.10	+1.585	56	0.143	0.214
5 (FL)	38	7.38	1.68	7.39	1.62	+0.01	+0.167	37	0.868	0.021
6 (SE)	36	6.78	1.87	6.68	1.90	−0.10	−1.144	35	0.261	−0.189
7 (FL + SE)	45	7.14	1.93	7.30	1.89	+0.16	+2.583	44	0.0102*	0.415
8 (control:tide)	51	6.75	2.12	6.75	2.19	+0.00	+0.110	50	0.913	0.00
1-module (conditions 1, 5, and 6)	126	7.01	1.82	7.02	1.83	+0.01	+0.140	125	0.888	0.022
2-modules (condition 2, 4, and 7)	158	6.72	2.14	6.85	2.12	+0.13	+3.506	157	0.000592***	0.304
All 7 experimental conditions	333	6.90	2.00	6.97	1.99	+0.07	+2.955	332	0.00812**	0.143

*$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$.

TABLE 4 | Change in nationalism by condition and number of modules.

Condition(s)	*n*	Pre-test nat out of 9.0		Post-test nat/out of 9.0		Change from pre- to post	*t*-value	*df*	*p*-value	*d*
		M	*SD*	*M*	*SD*					
1 ($)	52	5.74	1.39	5.53	1.40	−0.21	−1.940	51	0.0508†	−0.276
2 ($ + FL)	56	5.54	1.78	5.42	1.79	−0.12	−1.643	55	0.106	−0.238
3 ($ + FL + SE)	49	5.27	1.61	5.21	1.66	−0.06	−0.593	48	0.556	−0.093
4 ($ + SE)	57	5.71	1.64	5.45	1.65	−0.26	−2.581	56	0.0125*	−0.338
5 (FL)	38	5.80	1.49	5.61	1.47	−0.19	−2.271	37	0.0291*	−0.368
6 (SE)	36	5.70	1.76	5.79	1.72	+0.09	+0.940	35	0.354	0.162
7 (FL + SE)	45	5.74	1.68	5.63	1.64	−0.11	−1.768	44	0.0841†	−0.267
8 (control:tide)	51	5.47	1.58	5.58	1.81	+0.11	+1.178	50	0.244	0.174
1-module (1, 5, and 6)	126	5.75	1.52	5.63	1.51	−0.12	−1.99	125	0.0483*	−0.186
2-modules (condition 2, 4, and 7)	158	5.66	1.69	5.49	1.69	−0.17	−3.48	157	0.000643***	−0.290
All 7 experimental conditions	333	5.63	1.62	5.50	1.62	−0.13	−3.80	332	0.000123***	−0.201

†$p < 0.1$, *$p < 0.05$, and ***$p < 0.001$.

Descriptive statistics and intercorrelations for the three major "change" dependent variables (sea level rise acceptance change, global warming acceptance change and nationalism change) across all seven conditions are summarized in **Table 5**, along with participants' economic and social conservatisms, which were self-reported on separate 9-point scales at the experiment's end. A significant positive correlation was found between *change* in global warming acceptance and *change* in sea level rise acceptance ($r = 0.29$, $p < 0.001$), consistent with an association between perceptions of sea level rise and global warming. A multiple regression analysis (**Table 6**) evidenced that, consistent with expectations, sea level rise acceptance changes were positively associated with global warming acceptance changes, *even after* adjusting for participants' economic and social conservatism ratings. Global warming acceptance and inundation acceptance were moderated by neither economic nor social ideology.

Belief Changes Regarding Sea Level Rise Mitigation Strategies

Decreases regarding the effectiveness of sea walls or dikes as a solution to sea level rise were observed, aggregating across all seven experimental conditions [$t_{(332)} = -2.19$; $p = 0.029$, $d = -0.127$]. Two-module interventions, when aggregated, also displayed significant decreases regarding sea walls or dikes as an effective ocean-rise solution (**Table 7**; $p < 0.01$, $d = -0.213$). Numerical decreases in such effectiveness beliefs were observed in five of the seven of the experimental conditions. A significant decrease manifested in condition 2, which was comprised of the economic and southern-Florida map modules [$t_{(55)} = -2.3117$, $p = 0.024$, $d = -0.302$; **Table 7**]—and which produced statistically significant increases in both global warming and sea level rise acceptance (**Tables 2**, **3**), and a near-marginal nationalism decrease ($p = 0.106$, $d = -0.338$;

TABLE 5 | Intercorrelations of Main Study Variables across all conditions (including control), along with measures of conservatism.

	Variable mean	*SD*	1	2	3	4	5
1. GW acceptance change	+0.07	0.46	–				
2. SLR acceptance change	+0.19	0.48	0.29***	–			
3. Nationalism change	−0.13	0.63	−0.082	−0.075	–		
4. Social conservatism	3.91	2.32	0.025	0.011	0.091†	–	
5. Economic conservatism	4.46	2.38	−0.025	−0.075	0.10†	0.77***	–

†$p < 0.1$ and ***$p < 0.001$.

TABLE 6 | Multiple regression of change in sea level rise on changes in acceptance of global warming and related constructs (experimental conditions; i.e., 1–7).

Predictor	Step 1		Step 2	
	b (SE)	β	b (SE)	β
Intercept	0.17 (0.026)		0.19 (0.056)	
GW acceptance change	0.31 (0.055)	0.29***	0.30 (0.055)	0.28***
Nationalism change			−0.037 (0.041)	−0.049
Social conservatism			0.019 (0.017)	0.091
Economic conservatism			−0.022 (0.017)	−0.11
Social conservatism*GW acceptance change			0.038 (0.036)	0.037
Economic conservatism*GW acceptance change			0.0053 (0.037)	0.0069

***$p < 0.001$.

Table 4). As expected, the control condition about tides showed no significant change.

In contrast to the decreased support for the barrier solution (**Table 7**), an *increase* in support for phasing out fossil fuels obtained across the seven aggregated experimental conditions [$t_{(332)} = 2.29$; $p = 0.02$, $d = 0.120$]. Furthermore, the aggregated *two-module* conditions yielded a significant increase in support of phasing out fossil fuels [$t_{(157)} = 2.543$, $p = 0.01$, $d = 0.197$; **Table 8**]. Numerical increases in post-test beliefs about the effectiveness of combatting sea level rise through fossil fuels phase-outs were observed for five of the seven conditions, with the increases in two conditions being marginally significant. Please note that the average pre-test and post-test ratings ($M = 6.26$, $SD = 2.28$ and $M = 6.42$, $SD = 2.23$, respectively) for fossil fuel phase-out effectiveness are much higher than the respective effectiveness ratings for sea barriers ($M = 4.41$, $SD = 2.03$ and $M = 4.27$, $SD = 2.16$). These figures indicate higher support—and perhaps familiarity regarding—a fossil fuel phaseout, compared to the sea wall/dike solution.

Results Summary

Providing participants with scientifically representative information about sea level rise and its risks, including current and projected economic aspects of oceanic rise, generally yielded acceptance increases in sea level rise *and* global warming (**Tables 2**, **3**). Likewise, receiving combinations of modules—that is, a greater "dose" of information about oceanic inundation—caused sea-level-rise acceptance *and* global-warming acceptance to increase (**Tables 2**, **3**), even though an explicit link between global warming and sea level rise was rarely, if ever, raised for participants. These acceptance increases occurred while the sea-level-rise information also caused a *decrease* in nationalism (**Table 4**)—extending findings by Ranney et al. (in press; also see Ranney et al., 2016) that demonstrated causal, inhibitory, relationships between global warming and nationalism in both directions.

Information about the consequences of sea-level-rise, when aggregated, led to decreases in the perceived utility of sea walls or dikes, especially for the two-module interventions, and even for condition 2 on its own (with its economic module and southern Florida module; **Table 7**). In contrast, the perceived effectiveness of phasing out fossil fuels generally *increased* from pre-testing to post-testing (**Table 8**).

GENERAL DISCUSSION

Increased Global Warming and Sea Level Rise Acceptance

This experiment's interventions were largely successful, by collectively demonstrating yet another way that representative empirical evidence and scientific information about climate change and/or its associated (here, sea level) effects can lead to greater acceptance of those effects/risks—as well as greater acceptance that global warming is occurring, concerning, and anthropogenic. Sea level rise information now joins five other ways our laboratory has shown that brief instruction (usually under 5 min) can increase global warming acceptance. The other five ways include poignant statistics, temperature (compared to stock market) time series graphs, supra-nationalist statistics, and both texts and videos explaining global warming's mechanism. The present experiment also provides yet another empirical disconfirmation regarding (Kahan et al., 2012) stasis view (see Ranney and Clark, 2016; van der Linden et al., 2017; Ranney et al., in press) while showing the powerful importance of communicating empirical, scientific, and/or quantitative information for improving the justifiable adoption of more science-normative climate beliefs and policy preferences. Particularly noteworthy is that the present modules and interventions each regarded just a single *effect* of global warming—sea level rise—and not global warming more directly.

TABLE 7 | Changes in the perceived effectiveness of building sea walls or dikes by condition and number of modules.

Condition(s)	*n*	Pre-test barrier acceptance/out of 9.0		Post-test barrier acceptance/out of 9.0		Change from pre- to post	*t*-value	*df*	*p*-value	*d*
		M	*SD*	*M*	*SD*					
1 ($)	52	4.69	1.73	4.73	2.00	+0.04	+0.2602	51	0.796	0.042
2 ($ + FL)	56	4.46	2.02	3.98	2.27	−0.48	−2.312	55	0.0246*	−0.302
3 ($ + FL + SE)	49	4.20	2.13	4.33	2.47	+0.13	+0.785	48	0.437	0.136
4 ($ + SE)	57	4.75	2.29	4.61	2.32	−0.14	−0.797	56	0.429	−0.105
5 (FL)	38	4.08	2.11	3.87	2.29	−0.21	−1.091	37	0.282	−0.188
6 (SE)	36	4.31	2.12	4.17	1.93	−0.14	−0.531	35	0.599	−0.085
7 (FL + SE)	45	4.13	1.91	3.87	2.03	−0.26	−1.522	44	0.135	−0.227
8 (control:tide)	51	4.43	1.89	4.47	2.17	+0.04	+0.198	50	0.844	0.031
1-module (1, 5, and 6)	126	4.40	1.97	4.31	2.09	−0.09	−0.779	125	0.438	−0.074
2-modules (condition 2, 4, and 7)	158	4.47	2.10	4.18	2.13	−0.29	−2.719	157	0.00730**	−0.213
All 7 experimental conditions	333	4.41	2.05	4.25	2.16	−0.16	−2.194	332	0.0289*	−0.127

*$p < 0.05$ and **$p < 0.01$.

TABLE 8 | Changes in the perceived effectiveness of phasing out fossil fuel use, by condition and number of modules.

Condition(s)	n	Pre-test phaseout acceptance/out of 9.0		Post-test phaseout acceptance/out of 9.0		Change from pre- to post	*t*-value	*df*	*p*-value	*d*
		M	*SD*	*M*	*SD*					
1 ($)	52	6.38	2.11	6.69	2.11	+0.31	+1.907	51	0.0622†	0.268
2 ($ + FL)	56	5.88	2.27	6.05	2.28	+0.17	+1.256	55	0.214	0.160
3 ($ + FL + SE)	49	6.80	2.13	6.78	2.18	−0.02	−0.136	48	0.892	−0.019
4 ($ + SE)	57	6.11	2.71	6.33	2.36	+0.22	+1.251	56	0.216	0.153
5 (FL)	38	6.89	1.96	6.55	2.19	−0.34	−1.379	37	0.176	−0.236
6 (SE)	36	5.97	2.35	6.28	2.02	+0.31	+1.281	35	0.209	0.209
7 (FL + SE)	45	6.40	2.19	6.80	1.96	+0.40	+1.889	44	0.0655†	0.269
8 (control:tide)	51	5.88	2.24	6.00	2.53	+0.12	+0.830	50	0.411	0.134
1-module (conditions 1, 5, and 6)	126	6.42	2.15	6.53	2.10	+0.11	+0.903	125	0.368	0.079
2-module (condition 2, 4, and 7)	158	6.11	2.41	6.37	2.23	+0.26	+2.543	157	0.0120*	0.197
All 7 experimental conditions	333	6.33	2.28	6.49	2.17	+0.16	+2.292	332	0.0225*	0.120

†$p < 0.1$ and *$p < 0.05$.

The effects we observed from communicating information about current and projected economic risks seem particularly promising regarding ways to increase sea level rise acceptance (see **Table 2** and associated analysis). This subfinding coheres with McCright and Dunlap's (2011) theory of anti-reflexivity. They posed that conservatives respond more positively to information focused on the "production sciences"—economic impacts of climate change—and react less positively to "impact science" (here, the non-economic of our modules solely about the inundations' cartological/topological impacts). Their theory, however, doesn't assert that liberals will reject production science. Therefore, we propose that communications about climate change's projected economic impacts can be honed to become even more effective ways to increase climate change acceptance across the entire socio-political spectrum. System Justification Theory may also explain the impacts from communicating economic information, in particular, regarding sea level rise acceptance. In this theory, communicating sea level rise's potential effects on socio-economic systems may lead participants to acknowledge our current system's shortcomings and practices, and to thus perceive environmentalism as a way of upholding (rather than threatening) the American way of life—producing pro-environmental intentions (Feygina et al., 2010).

Increased Support for a Fossil Fuel Phaseout, but Reduced Support for Barriers

Our seven experimental conditions offer copious data. A relatively normative exemplar is condition 2, combining the economic and southern Florida modules, that led to increases in global warming and sea level rise acceptances, along with a near-marginal drop in nationalism. It also yielded a decrease in

perceived utility for sea barriers (**Table 7**) and, directionally, an increase in desiring a fossil fuel phaseout. Condition 7 produced a similar result-pattern.

The decreased acceptance of sea barrier effectiveness was a general effect when aggregating the seven experimental conditions (**Table 7**). In contrast, receiving sea level rise information *increased* participants' desires to phase out fossil fuels (**Table 8**), possibly due to greater knowledge or familiarity with phaseout solutions. Phaseout mitigation strategies have been widely publicized, and many examples exist of social norm messaging campaigns seeking to reduce individual fossil fuel usage, regarding: energy consumption (Allcott, 2011), recycling (Schultz, 1999), and hotel towel use (Goldstein et al., 2008; Schultz et al., 2008). Judging by the rather high ratings of fossil fuel reduction solutions even at the pre-test (**Table 8**), participants seemed, *a priori*, familiar with—and obviously somewhat persuaded by—fossil fuel phaseout mitigation strategies. Unfamiliarity about sea-inundation solutions other than fossil fuel reductions possibly caused participants to favor more familiar solutions (a behavioral momentum manifestation; Nevin et al., 1983) and to adopt more intransigently ensconced behavior (perhaps a sunk-cost example; Cunha and Caldieraro, 2009): if time, money, or behavior has already been invested in fossil fuel reductions, such actions might seem preferable to less familiar solutions. Constructing barriers may also be associated with lower personal efficacy, compared with reducing fossil fuels, given absent clear infrastructures/pathways to support building sea walls/dikes.

An attractive, alternative, (co-)explanation for preferring fossil fuel phaseouts over barrier building may be economic. Diekmann and Preisendörfer (2003) proposed explaining why people with even high environmental concern engaged primarily in the lowest impact pro-environmental behaviors—using a relative cost model. People with pro-environmental beliefs were modeled as engaging in pro-environmental behaviors; for instance, being more likely to start recycling (an inexpensive change) than to reduce driving or flying (a costly change). Likewise, O'Connor et al.'s (2002) Pennsylvania survey found respondents willing to engage in money-saving pro-environmental behaviors like buying energy efficient devices, but less willing to try harder actions, such as installing solar panels (see also Byrka et al., 2017). Policies implying more direct costs, such as barrier building, generally have lower public support, according to Bostrom et al.'s (2012) finding that "inexpensive" environmental policies are largely favored over costlier ones. In the short term at least, sea walls are a more costly protection strategy (Nicholson-Cole and O'Riordan, 2009), especially given the enormous coastline loss associated with even a 7- or 29-foot sea level rise (see **Figures 1**, **2**)—compared to fossil fuel emission reductions, which are associated with *savings*. The potential scale of lost land, depicted in our inundation maps of southern Florida and the southeastern U.S., plausibly led participants to consider sea walls/dikes as especially expensive, impracticable, solutions compared to fossil fuel reduction. For instance, southern Florida has about 4,000 coastline miles and the southeastern U.S. has about 32,000 coastline miles; dikes for these are virtually unimaginable compared to Holland's roughly 350 miles. Consistent with this hypothesis, when participants saw only the cartographic modules (FL, SE, or FL + SE: conditions 5-7), each condition produced numeric drops in barrier effectiveness ratings.

Reduced Nationalism

This experiment's observed *inverse* relationship between nationalism and global warming acceptance replicates Ranney et al.'s (in press) Experiments 3 and 4, which demonstrated bidirectional causality between these two constructs (also see Ranney et al., 2016). It also reflects many of our laboratory's earlier correlational findings of an inverse relationship between nationalism and global warming acceptance—before being shown causally that increasing global warming acceptance suppresses nationalism and that reducing nationalism (with a supranationalist-statistics-quiz-plus-feedback technique) increases global warming acceptance (e.g., Ranney and Clark, 2016; Ranney et al., 2016, in press). This inverse relationship was formally hypothesized in Ranney's RTMD theory (e.g., Ranney and Thanukos, 2011; Ranney, 2012; Ranney et al., 2012), which also noted positive associations between global warming acceptance and biological-evolution acceptance (and negative associations between each of those two and creationism, nationalism, afterlife acceptance, and deity/deities acceptance)[1]. The observed decrease in nationalism upon learning about sea level rise's effects is also explained by RTMD theory, since oceanic rise is a climate change phenomenon that global warming spawns (Ranney, 2012; Ranney et al., 2016, in press). In advancing a set of causal relationships among such constructs, we draw on Category 3, and specifically sub-category 3.9, of the Slater and Gleason framework (2012) by (a) our demonstration of the underlying relationship between nationalism and sea level rise, and (b) by showing how manipulating one construct produces changes in others.

Future Work

We seek to further characterize people's attitudes and understandings regarding climate change and its solutions, and so we are piloting interventions addressing (a) the inexpensiveness of sustainable solutions, (b) why one should trust climate scientists, and (c) false claims that climate change is a hoax. Likewise, we seek the most effective combinations and/or "dosages" of our various interventions for varying kinds of participants. We note that, compared to most of the intervention-types our laboratory has (successfully) assessed so far regarding enhancing global warming acceptance, our sea level rise manipulations have been among the least direct (i.e., other than by reducing global warming acceptance by using supra-nationalistic statistics, Ranney et al., 2016, in press); this may be why the magnitude of observed changes following our nationalism and sea-level-rise interventions seem a bit more modest than the more direct interventions of germane statistics, time-series graphs, and mechanistic explanations. In general, our findings also help illuminate a panoply of pro-social and/or more emotional aspects that feed into support for climate change

[1] RTMD's central gist is that Americans generally see their country as having been most rewarded by God (or providence, etc.; Ranney, 2012; Ranney et al., 2012).

mitigation strategies. Going forward, we seek to uncover the influences of various emotions, particularly hope, in shaping efficacy perceptions about individual or collective actions to mitigate climate change.

As noted earlier, this experiment's sea level rise intervention represents our laboratory's sixth kind of brief, information-based intervention that has been shown to increase global warming understanding *and* global warming acceptance among Americans. That such intervention-types can take mere minutes to change minds (e.g., a 400-word text of the mechanism of global warming; Ranney and Clark, 2016; Ranney et al., in press) has also further encouraged us to explore their possible utilizations *beyond* our empirically-vetted efforts through the aforementioned HowGlobalWarmingWorks.org (including its various translations to non-English languages)—for instance, to directly inform the public using telephone-based communication.

Limitations

Our study's experiment includes the strengths of having developed informational aids about sea level rise that were informative and compelling enough to improve engagement with this important issue—along with our use of mixed between-participant (conditions) and within-participant (pre-post) analyses (as opposed to studying solely correlational trends). One limitation is that MTurk participants are hardly fully demographically representative of America's population. However, MTurk provides more U.S.-representative data than typical *student* samples. MTurk has increased access for harder-to-reach populations (Smith et al., 2015) and, despite its slightly liberal population bias, it seems a valid recruitment tool for psychological research relating to political ideology and in general, compared to national benchmark data (Berinsky et al., 2012; Clifford et al., 2015). A notable issue regarding MTurk as a sampling pool, however, is the reduced "naiveté" of participants (Chandler et al., 2014). This, coupled with the relatively small sample and effect sizes, indicate that this study should be extended/replicated with a larger sample size, refined interventions, and/or even more nationally representative participants.

Following a planned analysis, we did not find differential responding to the interventions by those who are (or will be) more directly impacted by sea level rise (e.g., participants living in Florida or the southeast-coast states depicted in the graphical interventions). However, the economic intervention included data from a range of states, and coupled with the relatively low number of participants recruited from Florida and the southeast, it's not surprising that differences were not found between those who are "directly" impacted by sea level rise compared to those who are not. A more thorough exploration of this question will require more precise, systematic, participant selection processes.

Another limitation stems from the experiment using a single-session pre- and post-testing design. While this reduced some ecological utility, having a post-test immediately after the informational treatments allowed assessing the effects of these treatments alone—and enabled us to collect enough data to carry out within-participant, as well as between-participant, analyses (given the likely response drop-off, were a multi-wave study design adopted). The fact that the pre-/post-changes from the control condition were non-significant also indicates that experimenter demand and sensitization were not significant factors in the changes observed. A multi-wave study design, however, might have offered affordances—for instance, further reducing experimenter sensitization, or demand effects caused by answering the same items in a relatively short amount of time, and providing data on the longer-term effectiveness of our interventions. Given that our past experiments have demonstrated such long-term changes in global warming acceptance up to 34 days after exposure to interventions (Ranney and Clark, 2016; also see Ranney et al., in press), we are optimistic about the importance and efficacy of providing information in the context of meaningfully improving how people engage with rising oceans in particular and climate change in general.

Concluding Thoughts

This experiment demonstrates that communicating information about the physical and economic consequences of global warming's effects due to rising seas generally led to, despite sea level rise barely being explicitly related to global warming in the interventions, (a) increases in the acceptance of, and concerns about, oceanic rise and (b) increased global warming acceptance, especially in aggregate and higher "information doses." Elucidating the current and projected financial damage due to oceanic rise (as in our economic module) may be especially effective in increasing the public's willingness to act on sea level rise, relative to the more cartographic (Florida and southeast-U.S.) instructional modules we employed.

While our interventions' materials were derived directly from news media and the internet (i.e., effectively available to the public), the information was entirely empirical and fact-based, in contrast to the ways in which climate change information is *usually* presented to the public by the media—with media's common adherence to journalistic norms such as personalization, "balance," and dramatization. Adherence to such norms led Boykoff and Boykoff (2007) to label the U.S.'s mass media climate change coverage as "informationally deficient," which partially explains why recent increases in media coverage have not yielded marked increases in the acceptance of anthropogenic climate change, compared to the success of our laboratory's short interventions (e.g., Ranney and Clark, 2016; Ranney et al., in press).

As predicted, our sea level information also caused a decrease in nationalism, presenting yet more empirical evidence for RTMD theory (Ranney, 2012, etc.; Ranney and Clark, 2016), which proposed (at least) correlational relationships among six constructs—relationships that are appearing increasingly causal, such as the bidirectional inverse causality between nationalism and global warming acceptance (Ranney et al., in press). Further, we found an increased preference for the mitigating solution of phasing out fossil fuel use, whereas a solution involving sea walls/dikes decreased in desirability.

The results are heartening in several ways. For instance, we once again showed that communicating empirical information about climate change's effects can increase people's acceptance of (e.g., the anthropogenicity of) global warming, disconfirming Kahan's stasis view even more saliently (Ranney and Clark, 2016; Ranney et al., 2016, in press; van der Linden et al., 2017, etc.). (Nb. Kahan et al., 2015, disconfirm stasis themselves, showing increased climate change concern following geoengineering information). As shown historically regarding tobacco's health effects and heliocentrism, knowledge usually leads to science-normative attitude changes, rather than leaving people divided (i.e., few people still believe Earth to be flat). Our results also indicate neither fatalism nor solution-aversion after participants learn the adverse actual-and-projected effects of sea level rise (cf. Lorenzoni et al., 2007). Further encouraging is that our oceanic rise information yielded increased desires to phase out fossil fuels. Additional study into what might inhibit people from engaging with even more obviously *collective* climate change solutions (e.g., demanding government action) is desired.

The six numerical, mechanistic, and graphical types of interventions our group has developed—now including a set of sea level rise statistics and maps—have been shown to successfully increase *individuals*' understandings and acceptances regarding global warming. However, our website HowGlobalWarmingWorks.org (Ranney and Lamprey, 2013), which contains the majority of these interventions, has even had considerable "viral" success at more wholesale levels—with over one million page views attributable to it to date. With the continuing translation of many of its videos, pages, and texts into multiple languages, such as Mandarin, German, and Spanish, we hope to extend the website's reach to the largest audience possible. We thus hope to provide people around the globe with crucial climate knowledge tools, in the hope that individuals and groups might become more/highly active regarding global warming with the receipt of scientific information—another step in fostering worldwide activism to inhibit climate change's destructive course.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the University of California, Berkeley's Committee for the Protection of Human Subjects (and its guidelines) with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the University of California, Berkeley's Committee for the Protection of Human Subjects.

AUTHOR CONTRIBUTIONS

QB and MR conceived, designed, and implemented the experiment. LV performed the statistical analyses and wrote the first draft of the present manuscript. All authors contributed to manuscript revision, read, and approved the submitted version, and all authors agree to be accountable for the content of the work.

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How Hope and Doubt Affect Climate Change Mobilization

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The severe threats posed by anthropogenic climate change make hope and a sense of efficacy key ingredients in effective climate communication. Yet little is known about what makes individuals hopeful–or in contrast, doubtful–that humanity can reduce the problem, or how hope relates to activism. This study uses mixed-methods with two national surveys to (1) identify what makes people hopeful or doubtful that humanity will address the problem (Study 1, $N = 674$), and (2) whether hopeful and doubtful appraisals are related to activism or policy support (Study 2, $N = 1{,}310$). In Study 1, responses to open-ended questions reveal a lack of hope among the public. For those with hope, the most common reason relates to social phenomena–seeing others act or believing that collective awareness is rising ("constructive hope"). Hope for some, however, stems from the belief that God or nature will solve the problem without the need for human intervention (which we call "false hope"). The most prevalent doubts are low prioritization, greed, and intergroup conflict (i.e., the need for cooperation at various scales to successfully address the issue). We identified both "constructive" and "fatalistic" doubts. Constructive doubts are concerns that humanity won't address the problem effectively, while fatalistic doubts are beliefs that we can't address the problem even if we wanted to because it is in the hands of God or Mother Nature. In study 2, we used these emergent hope and doubt appraisals to develop survey measures. Regression analyses suggest that constructive hope and doubt predict increased policy support and political engagement, whereas false hope and fatalistic doubt predict the opposite. An interaction exists between constructive hope and doubt in predicting political behavioral intentions, which suggests that having hope that humans will reduce climate change, along with recognition that humans are not doing enough may also be constructive and motivate political action. Climate change communicators might consider focusing on constructive hope (e.g., human progress, the rise of clean energy), coupled with elements of constructive doubt (e.g., the reality of the threat, the need for more action), to mobilize action on climate change.

Keywords: climate change, hope, fear, doubt, activism, politics

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KEY FINDINGS

- Many Americans who accept that global warming is happening cannot express specific reasons to be hopeful that we can address the problem and find it easier to identify doubts.
- The most commonly stated reasons for feeling hopeful are personal actions and perceived changes in social awareness and norms; less common reasons include human nature, government, scientists, and God.
- Among those who accept that global warming is happening, the primary reasons for doubt that we can limit global warming are the belief that it's a low priority for most people, and greed. Other common doubts relate to politics, the need for international cooperation, the belief that it's already too late, and concern that the public is ignorant and/or being misled.
- Hope and doubt are both significant predictors of political behaviors (e.g., donating to an organization) and support for greenhouse gas mitigation policies (e.g., regulate carbon dioxide as a pollutant). Specifically, "constructive" forms of hope and doubt positively predict engagement, yet, "false" hope (e.g., wishful thinking) and "fatalistic" doubt (e.g., beliefs that there is nothing humans can do) appear to have negative effects on engagement.

KEY LESSONS

- A lack of hope may undermine an individual's response and collective efficacy, which are essential for motivating actions to solve the problem.
- Communicating that awareness is increasing, and highlighting efforts being made to address the problem (rather than progress already made, which can weaken motivation for some) may reinforce existing sources of hope among the public and support motivation to engage in climate issues. Hope, however, is not enough—action is essential.
- Hope is not always good and doubt is not always bad; the combination of constructive hope and doubt may actually be motivating, whereas false hope and fatalistic doubt may lead to avoidance, distancing, and inaction.

INTRODUCTION

Anthropogenic climate change poses serious risks to societies through its impacts on species, natural resources, economies, socio-political institutions, and structures, cultural traditions, and human health (Intergovernmental Panel on Climate Change (IPCC), 2018; USGCRP, 2018). To motivate action that would allow us to avoid the worst climate change damages, many communicators highlight impacts such as sea level rise and extreme weather that pose direct threats to the economy, human health and communities, national security, and more. The intention is to elicit public concern and promote protective actions by helping individuals understand that although climate change involves global-scale processes, it increases many risks to our own well-being and safety. Specifically, people need sufficient awareness of the seriousness of the risks to motivate action, but also sufficient efficacy in solving the problem (Witte, 1992). We assert that this sense of efficacy is dependent upon both hope that solutions exist and can be implemented, as well as doubt that the problem will resolve itself without action.

The academic literature addresses the advantages and disadvantages of eliciting emotional responses in the American public through climate change communications. In particular, many warn against fear appeals because they can trigger counter-productive responses like avoidance, denial, and reactance, when solutions are unknown, undesirable, or inaccessible (Folkman and Lazarus, 1990; Lazarus, 1999; Hastings et al., 2004). However, little research has examined the role of hope and doubt in the beliefs Americans hold about climate change, and how these appraisals might impact collective action to address the issue. We examine different types of hopeful and doubtful appraisals, and discuss how literature on the use of other emotion framing in climate change communications may inform the potential for hope and doubt to engage the public.

Hope

Past research in health and psychology shows that hope serves to motivate effort, goal achievement, and adaptive responses in the face of adversity (Stotland, 1969; Farran et al., 1995; Lazarus, 1999; Snyder, 2000; Fritze et al., 2008). Our understanding of the role that hope plays in climate change communication and pro-environmental action (e.g., activism), however, is much more limited. An explicit examination of the emotion of hope regarding climate change revealed that individuals who feel more hope express stronger support for mitigation policies (Smith and Leiserowitz, 2014). Other studies have examined efficacy in relation to hope, for example by testing the effects of optimistic messages on political participation (Chadwick, 2010; Feldman and Hart, 2016; Hornsey and Fielding, 2016), but found mixed results. Several studies have examined the effects of hope about climate change on behavioral intentions (Ojala, 2007, 2008, 2012b; O'Neill and Nicholson-Cole, 2009; van Zomeren et al., 2010; Myers et al., 2012; Hart and Feldman, 2014). Most—but not all—of these studies find positive relationships.

One reason for the disparate findings may be the type of appraisal individuals are making about climate change that lead them to feel hopeful. "Realistic hope" (Hickey, 1986) or "constructive hope" (Ojala, 2012a) include appraisals that one has the ability to overcome obstacles and can lead to constructive problem solving. Constructive hope may be associated with beliefs that humans are capable of changing their behavior or that elected leaders will enact climate change policies. Alternatively, "false hope" or "magic hope" (Schachtel, 1959) is considered a coping mechanism that refers to the hope that things will improve on their own accord. False hope can be likened to wishful thinking that climate change is not serious, or that someone or something else will fix the problem; such hope is likely unproductive or counter-productive to public activism on climate issues. Previous research suggests that constructive hope appraisals (i.e., remaining hopeful about the human capacity to address climate change) are positively related to pro-environmental behavior, whereas having a sense of "false hope"

(i.e., remaining hopeful that climate change will work itself out) is negatively related to behavior (Ojala, 2012a).

Doubt

Doubt plays a significant role in the public discourse about climate change, but it is often considered primarily in relation to the vocal few who dismiss the existence of the problem itself. Yet, many who believe global warming is happening and who want to address it may also have doubts about whether effective change is possible. Although doubt could diminish feelings of hope, it may also work alongside hope to encourage climate change activism. Capstick and Pidgeon (2014) identify this difference and distinguish two categories of doubts about climate change, including doubts about its existence as a human-driven problem (i.e., skepticism), and doubts about the effectiveness of potential responses (i.e., response efficacy).

However, doubts about efficacy may also be divided further by their impact on engagement. Like hope, "constructive doubt" may include the appraisal that something can be done, combined with concern that all the necessary steps may not come together. In the context of climate change, constructive doubt may manifest as the worry that people may not act quickly or at a scale large enough to avoid the major impacts of climate change. Specifically, some constructive doubtful appraisals that reflect recognition of human inaction and skepticism about whether people are willing to change might be associated with personal responsibility and motivation to take individual action. For example, in a nationally representative survey of Americans, 89% were found to express some degree of doubt or pessimism about people's willingness to reduce global warming in spite of many reporting personal willingness to change their household conservation behavior (Leiserowitz et al., 2009). On the other hand, "fatalistic doubt" includes the belief that nothing can be done, and that there is no point in trying to address the issue. Such fatalistic doubt might demotivate engagement on climate change because it indicates a complete lack of efficacy. As such, previous research finds that those with fatalistic attitudes are less supportive of climate change policy (Leiserowitz, 2006).

The Impact of Hope and Doubt Appraisals on Collective Action

The extended parallel process model (EPPM; Witte, 1992) provides a framework for effective risk messages that can support the development of public and political will. The EPPM emphasizes the importance of keeping the severity and personal vulnerability of a threat central to the message, while coupling it with information about solutions in a way that engenders both response efficacy (i.e., a belief that there is a remedy or solution to the problem) and self-efficacy (i.e., feeling capable of taking the needed action); this allows people to focus on controlling the danger instead of controlling only their fearful emotions (Bandura, 1982, 1997).

In the context of climate change, high self-efficacy is positively correlated with intentions to reduce one's carbon footprint (Milfont, 2012; Hornsey et al., 2015). Efficacy constructs are also central to Protection Motivation Theory (PMT, Rogers, 1983), which proposes that the motivation to protect oneself depends on a threat appraisal or risk assessment (i.e., the perceived severity and likelihood of a threat), and a coping appraisal, which includes both response efficacy and self-efficacy (Floyd et al., 2000; Hornsey et al., 2015). Given the broad scope and diffuse nature of the climate change threat, proxy efficacy–the perception that others who are acting on our behalf (i.e., government representatives) will do so successfully–is vital (Bostrom et al., 2018).

The EPPM expands on the PMT by emphasizing that the levels of both fear and efficacy must be high in order to promote the intended effects (i.e., "danger control"). If fear is high but efficacy low, "fear control" may result. However, if fear is too low, there may be no effect at all. Thus, when a serious threat is communicated and coupled with information that increases response efficacy, behavioral engagement to mitigate climate change can also increase (Bockarjova and Steg, 2014; Keshavarz and Karami, 2016).

While the EPPM and PMT models emphasize the importance of fear and efficacy in risk communication, they do not directly address the roles of hope and doubt. Efficacy and hope are related, as they are both future- and goal-oriented, but hope is considered a discrete emotion (Lazarus, 1991), and is distinct from the cognitive beliefs associated with efficacy (Magaletta and Oliver, 1999). In addition, hope is evoked by appraisals of a future outcome that are consistent with one's goals, possible but not certain, personally important, and imagined as leading to a better future (Chadwick, 2015). Doubt is similarly linked with appraisals of future outcomes and their probabilities of occurrence, but with the effect of decreasing efficacy.

However, given previous research on the need for both positive and negative responses to evoke efficacy and engage collective action on climate change, it is possible that both hope and doubt are necessary components of Americans' appraisals about climate change. Specifically, constructive doubt about whether we are taking the necessary actions may motivate those who realize that failure becomes the most likely option if everyone just stands by without acting. In addition, constructive hope and doubt that climate change can be mitigated may be helpful in countering apathy, denial, or free-riding. Previous qualitative research on individuals participating in a climate march suggest that both hope and doubt may promote engagement (Grecni et al., 2014). Through dozens of participant interviews during the march, three types of hopeful attitudes were identified in response to the question "What gives you hope that global warming can be reduced?" One common response was from individuals who were not hopeful (i.e., they were doubtful) but who were acting nonetheless out of a sense of duty and responsibility. A second common response was from those who said they were not hopeful until they arrived at the march and saw so many other people feeling the same way they did (i.e., doubt was transformed into hope). A final group indicated a clear sense of being hopeful, often referring to specific actions and policies being enacted at local, state, and/or national and international levels. The interplay of constructive hope and doubt is evident in these

responses, and points to the need for further exploration of both constructs.

The purpose of the present research was to understand what evokes hopes and doubts about the public's ability to take meaningful action on climate change. Here we systematically investigate the beliefs that make Americans hopeful and doubtful about climate change using data from two nationally-representative surveys conducted during the Spring and Fall of 2013. Study 1 explores the qualitative contents of Americans' hopes and doubts about reducing anthropogenic climate change. Study 2 examines how holding particular hopeful and doubtful beliefs about why we can or cannot address global warming is related to political behaviors and policy preferences. We also analyze these relationships in the context of efficacy to test the unique relationships between hope/doubt and political engagement. Our research approach follows several strategies from Slater and Gleason's (2012). First, we address fundamental conceptual issues about hope and doubt, including redefining and re-operationalizing a key concept (Strategy 1a). We also use content analysis of responses to questions about hope and doubt to identify potential messages that may resonate with the public and warrant subsequent research (Strategy 8a). Taken together, we employ content analysis, construct elucidation, measurement development, and predictive tests to improve our understanding of how hope and doubt relate to political engagement.

STUDY 1

Study 1 addresses the question "What makes Americans hopeful or doubtful that we can reduce anthropogenic climate change?" We collected open-ended responses from our survey respondents about what made them feel hopeful or doubtful that climate change can be reduced. In particular, we were interested in the types of appraisals about climate change that constituted (1) constructive hope, (2) false hope, (3) constructive doubt, and (4) fatalistic doubt. Although skepticism about the existence of climate change is a form of doubt, this form of skepticism automatically negates the need for action, while we were interested in the appraisals that may influence or hinder collective action on climate change. Thus, only respondents who acknowledged that global warming exists were asked the questions.

Study 1 Method

Participants and Recruitment

Data were gathered from 1,045 American adults who completed an online survey[1] weighted to be nationally representative (part of the *Climate Change in the American Mind* project[2] in April, 2013. All participants were aged 18 and older, and the demographics were generally representative of the adult US population (**Table 1**). Of the 1,045 initial survey participants, 63% (674) believed that global warming was happening and were asked the questions about hope and doubt (the order of the questions was randomized). Of those 674 participants, 34% (n = 223) did not respond to the hope item, and 29% (n = 189) did not respond to the doubt item. This left an overall response rate of 42% (n = 435) to the hope item, and 45% (n = 469) overall response rate to the doubt item.

Design and Measures

Two single, open-ended items were used to measure hope and doubt in Study 1 ("*What, if anything, makes you [hopeful/doubtful] that global warming can be reduced?*"). The items were part of a larger survey that included questions on the reality and causes of climate change, risk perceptions, and

TABLE 1 | Study 1 and 2 demographics.

	Study 1 (N = 674)	Study 2 (N = 1,310)	2013 U.S. census data
Average age (SD)	47.4 (15.8)	47.0 (17.1)	
Sex			
Male	333 (48.7%)	642 (47.1%)	48.6%
Female	341 (51.3%)	668 (52.9%)	51.4%
Race/ethnicity			
Non-hispanic white	511 (66.5%)	1010 (66.8%)	63.3%
Hispanic/Latino	55 (13%)	114 (13.7%)	16.6%
Non-hispanic black/African American	62 (11.8%)	104 (11.7%)	12.2%
Non-hispanic biracial/multiracial	27 (1.1%)	48 (1.3%)	2.1%
Non-hispanic other	19 (7.6%)	34 (6.5%)	5.9%
Income			
Less than $25,000	107 (17.8%)	235 (19.3%)	23.4%
$25,000–$34,999	66 (10.8%)	127 (10.6%)	10.3%
$35,000–$49,999	93 (14.8%)	160 (11.1%)	13.6%
$50,000–$74,999	140 (19.7%)	268 (18.4%)	17.9%
$75,000–$99,999	94 (12.2%)	180 (15.4%)	12.2%
$100,000 or more	174 (24.7%)	340 (25.1%)	22.6%
Highest level of education			
Less than high school	37 (9%)	88 (10.9%)	13.9%
High school	193 (29.3%)	426 (30.1%)	28.1%
Some college	187 (29.1%)	374 (28%)	29%
Bachelor's or higher	257 (32.6%)	422 (31%)	28.8%

Study 1 and 2 frequencies are unweighted and percentages are weighted. U.S. Census data were derived from the 2013 American Community Survey. Education percentages reflect only those 25 years and older.

[1]Participants were randomly sampled from a large, online panel recruited by GfK using random digit dialing and address-based sampling. Panel members who did not have Internet access were provided access in order to participate in the panel. The panel is nationally representative, and following data collection, the final sample was weighted to adjust for any deviations from national benchmarks on all major demographics.

[2]Climate Change in the American Mind (CCAM) is an ongoing collaboration between the Yale Program on Climate Change Communication and the GMU Center for Climate Change Communication. The collaboration entails bi-annual nationally representative surveys on Americans' climate-relevant beliefs, attitudes and behaviors, which are used for both polling reports and social research. See http://climatecommunication.yale.edu/ and https://www.climatechangecommunication.org/).

policy preferences. The responses were coded using a bottom-up, grounded theory approach to identify emergent themes or categories of appraisals that arose naturally from the participants. Responses to the open-ended hope/doubt questions that were very similar to one another were first grouped independently by two of the co-authors into narrow categories (e.g., "I am not hopeful" was grouped with "Nothing"), and then a broader set of about one dozen categories each for hopeful and doubtful responses. Through discussion, a single scheme was developed where responses were assigned to up to two categories. Two authors then assigned all responses to categories using this scheme but an inter-coder reliability test of 40 random responses by a third co-author was unacceptably low ($\alpha < 0.7$). The categories were subsequently revised through discussion to clarify the broadest categories, such as "human nature" and "effort/action," which occasionally captured similar ideas. Categories were also considered mutually exclusive, so when a response could fit into multiple categories the first idea mentioned was used to capture appraisals that were most salient and cognitively accessible to respondents. An inter-coder reliability test showed that this final scheme, which contained 14 categories, was robust for both the hope items ($\alpha = 0.93$) and the doubt items ($\alpha = 0.99$).

Study 1 Results

Hope

Initial analysis of the responses to the question "*What, if anything, makes you hopeful that global warming can be reduced?*" resulted in 10 categories of hopeful responses as follows (from largest to smallest): (1) Not hopeful (17%); (2) Effort/Action (16%); (3) Awareness/Information (15%); (4) Other (11%); (5) Science/Technology (10%); (6) Human nature (9%); (7) Nature/God (9%); (8) Don't know (6%); (9) Government/Corporations (6%); and (10) Feeling the effects (6%). These 10 categories include three combined groups ("Children/Future generations" went into "Other," "Science," and "Technology," and "Government," and "Corporations" were combined) which ensured that each had at least 5% of the valid responses (**Table 2**). Some gender differences are apparent in hopes and doubts that we can reduce global warming (**Supplementary Table 1**). For example, female respondents were more likely than males to say that "Awareness/Information" or "Effort/Action" inspired hope, whereas males were more likely to have hope rooted in "Human nature" or "Science/Technology." Liberals were more likely than conservatives to say that "Awareness/Information" gave them hope or that people would need to "Feel the effects," whereas conservatives were more likely to say "Nature/God" inspired hope, or that they don't know or have no hope that we can reduce global warming.

Doubt

Initial analysis of the valid open-ended responses resulted in 10 types of doubtful responses: (1) Low priority (25%); (2) Greed/Money (18%); (3) Nature/God (10%); (4) Politics/Government (10%); (5) Other (7%); (6) No doubt (7%); (7) Don't know (7%); (8) Lack of international cooperation (6%); (9) Too late (6%); and (10) Lack of knowledge/Misinformation (5%). Several categories were combined due to similarities in the responses and to ensure that each group had at least 5% of the valid responses: "Little care or concern" and "Change is difficult" were combined into "Low priority," "Corporate greed/Money" was combined with "High costs/Greed," and "Government/Politics" was combined with "Corruption (Money in politics)" (**Table 3**). Male respondents were more likely than females to cite "International cooperation" as a cause of doubts that we can reduce global warming, while females were more likely to cite "Misinformation" (**Supplementary Table 2**). Liberals were more likely than conservatives to offer doubts related to "Greed," "Politics/Gov't," and "Misinformation" while conservatives were more likely to reference "Nature/God" or say "Don't know," it's "Too late," or it is a "Low priority."

Study 1 Discussion

The survey responses indicate that, for many people, reasons to be hopeful that we can address climate change are not obvious (**Table 1**). The most common response among those who answered the question about hope was "Not hopeful" (17%), especially among conservatives. Furthermore, 6% of people said they don't know what makes them hopeful. This lack of hopeful beliefs is striking, especially considering that respondents who do not accept that the problem exists (and thus can be expected to say they are not hopeful about solving it) were not included in the sample. When participants did offer a specific hope, the results were diverse, but most commonly emphasized beliefs about people. Liberals were more likely to cite "Awareness/Information" rather than "Effort/Action" as a source of hope, whereas conservatives and moderates were more likely to cite "Effort/Action" rather than "Awareness/Information," which suggests that emphasizing concrete actions that can be taken and building efficacy may be particularly important for promoting hope among moderates and conservatives. References to external forces such as God, the resilience of nature, or technology were much lower than those with social associations. The top two categories that referenced specific hopes (33% combined) were Effort/Action, and Awareness/Information–both of which included concrete, experiential ideas about the social dimensions of problem solving, such as behavioral changes surrounding energy use, education, and communication efforts, or social and political organizing.

Another common category that focused specifically on people was "Human nature" (9%) (e.g., faith in people, in human ingenuity and innovation). Although the "Other" category included some references to people as well (e.g., future generations), this group also included incoherent responses. Thus, the "Effort/Action," "Awareness/Information," and "Human nature" categories (42%) all represent hopes focused on individuals and groups working together (excluding corporations and governments). In contrast, hopes about government and institutions, science and technology, or reactionary motivation (e.g., responding only after the damage is more evident) were less common–about 6% each. Fewer (11%) expressed hope that the problem will be solved due to factors other than individual or collective action (e.g., Nature or God).

TABLE 2 | Open-ended responses about what is making Americans hopeful about climate change.

Response category (%) & operational definition	Examples of verbatim open-ended responses
Not hopeful (17%)–succinct, clearly expressed lack of hope.	"Nothing," "Not hopeful"
Effort/Action (16%)–references to individuals or groups making efforts and doing more (often visibly) to solve the problem, including observations of changing behaviors.	"Grassroots and group efforts"; "People are trying more"; "Everyone doing a small part"
Awareness/Information (15%)–a broad category focusing primarily on cognition, e.g., rising awareness, information, consciousness, education, realization. Excluded mentions of specific efforts/actions.	"People seem to be getting more informed"; "The number of people who think it's happening increases each year"
Other (11%)–all responses that did not clearly fit an existing category.	"The alternative is unthinkable"; "My kids and grandkids"; "Children of our future"; "By reducing the depletion of the ozone layer and not chemical spraying by the government…"
Science/Technology (10%)–references to science, scientists, scientific knowledge or opinions, consensus, overwhelming evidence, disentangling cause-and-effect, and technological developments, renewable energy, consumer products, innovations that increase efficiency and reduce waste.	"Electric cars"; "Technology will most likely be the answer. Heavy investments in RD"; "Increased viability of alternative energy sources"; "Scientists… maybe they can come up with ideas"
Human nature (9%)–abstract category for references to all humans, to people joining together, or to characteristics and qualities of people as good, caring, cooperative, feeling responsible, or wanting to succeed, persist, and survive.	"People"; "Conscientious, compassionate and motivated human spirit"; "Faith in mankind"
Nature/God (6%)–hope because the problem is beyond human control and that nature or God will take care of it, or that natural cycles, Mother Nature, or the supernatural will rectify the problem.	"Jehovah's kingdom"; "Prayer"; "The planet is only doing what it has been doing for thousands of years. We might have some impact but not a lot"
Don't know (6%)–explicit expressions of lack of knowledge or opinions.	"Don't know"
Gov't/Corporations (6%)–responses about government, laws, regulations, politicians, political parties, or how governmental entities are acting or should act, and references to companies, corporate responsibility, sustainable development and growth, industry, the private sector, costs of doing business, manufacturing, and factories.	"President Obama"; "New government policies and regulations"; "US should be the leader in battling the global warming"; "Private companies leading the effort"
Feeling the effects (6%)–responses about impacts motivating people, the need to feel fear and pain, to be personally affected or to incur costs before being willing to change, references to extreme weather or to declining or threatened natural resources such as water and food.	"Natural disasters"; "Extreme weather," "Sudden die-offs"; "Superstorms"; "Fear and pain brought on by actuality"

Overall, the more common emphasis on hope about people emphasizes our fundamentally social nature (van der Linden et al., 2015), and suggests that information describing individuals working to address the problem may resonate with many people and amplify hope. This is not to say that personal responsibility is not important—other research indicates that attributions of personal responsibility in relation to climate change (i.e., that the individual is responsible for climate change mitigation) may motivate systematic processing of information (Rickard et al., 2014), which has implications for behavior change. There is also risk, however, insofar as hope that others are learning and acting can diffuse responsibility and lower engagement, such as having a sense of "false hope" or unrealistic optimism that others (including technology or a higher power) will solve climate change Ojala, 2012a; see Snyder et al., 2002 for a review of false hope).

Doubts included perceptions about the low personal relevance and importance of the issue to others, barriers to action such as politics and money, religion, and experiences relating to weather and climate (**Table 2**). The most common doubtful responses related to a lack of concern, care, or prioritizing of climate change among others (25%). The lack of concern and prioritization identified by many respondents is consistent with the perceived distance of climate change (Weber, 2006) and with the low priority assigned to the issue more generally when people are asked to rank it against other current issues like healthcare, jobs, or terrorism (Leiserowitz et al., 2014). The greater importance that respondents placed on such social rather than physical limitations (e.g., believing that it is too late to slow the warming given the lags in the system) is worth emphasizing as it points to the central importance of social norms and collective efficacy in generating motivation for addressing global warming.

Another important set of doubts (18%) related to competing priorities, primarily surrounding money, and including references to greed. Perceived intergroup conflict, whether in the US (10%) or internationally (6%), and the fact that some impacts are already "locked in" because of the inertia of the climate system (6%) were also common sources of doubt. Misinformation or a lack of awareness among the public about the problem are also recognized as significant barriers to progress on climate change that limit hope for some (5%). About 5% of responses cited outcomes beyond human control. Relatively few individuals who replied (7%) said they don't know what makes them doubtful about reducing global warming.

Overall, Study 1 provides insights into the types and frequency of hopeful and doubtful associations that Americans have with global warming, which may have implications for political engagement on the issue. Results also help to pinpoint

TABLE 3 | Open-ended responses about what is making Americans doubtful about climate change.

Response category (%)	Examples of verbatim open-ended responses
Lack of concern/Low priority (25%)–references to human traits such as carelessness, laziness, apathy, complacency, stubbornness; recognition that change is difficult, good intentions may exist but other more pressing concerns have higher priority.	"People just don't want to change"; "That nobody really cares"; "Unwilling to change"; "Too many other issues we are facing have greater priority"
Greed/Money (18%)–references to individual greed and selfishness or corporate drive for profits over environment and public good, problems with capitalism, lack of care, and concern about others, environment, or resources due to prioritization of personal or private gain.	"Big money doesn't care"; "Consumers greed for convenience"; "People can't afford the increased cost of making changes"; "financial backing for new technology"
Nature/God (10%)–references to natural weather patterns, Mother Nature, cycles, God being in control, biblical prophesies, or destiny.	"Man can't control Mother Nature"; "It truly is not in our hands"; "It's a natural process. It's happened for billions of years"; "I believe in the bible and it says things are going to get worse"
Politics/Government (10%)–responses about elected officials, politicians, Democracy, Congress, government denial, or unwillingness to act.	"Political gridlock"; "Because I don't believe the government will do enough to make a difference"; "Congress of fools"; "Politicians not believing the impact of Global Warming"
Other (7%)–all responses that did not clearly fit an existing category.	"We live a world thats messed up"; "over population"; "only if we don't take an active role"; "There is a large dependence on fossil fuel powered transportation. It will be hard to find away around that"
No doubt (7%)–expressions that no doubt exists.	"Nothing. We have to change our attitudes"; "Never too late"; "I'm not doughtful"
Don't Know (7%)–clear expressions of lack of knowledge or opinions.	"Don't know"; "not sure"; "have no idea"
Lack of international cooperation (6%)–responses that identify concerns surrounding other countries, particularly China and India, also developing countries, global governments, or the need for international cooperation among multiple countries.	"Getting other countries to agree on a plan"; "China, India and other largely population countries have to participate in cutting emissions"; "Apathy in developing countries"; "The rapid growth of warming industries in China and Africa"
Too late (6%)–expressions of doubt that there is still time for remedies or that the problem can be solved at all, references to catastrophic impacts that have already taken place, or that forces underway are unstoppable.	"Events that caused it have already happened"; "We have ignored the issue for too long–it's too late"
Lack of knowledge/Misinformation (5%)–responses about people's ignorance, lack of knowledge about the problem or its consequences, about denial, lack of awareness or lack of acceptance of the problem.	"The amount of people ignorant or in denial of the problem"; "The general public is stupid"; "We are not sure of the prime causes, nor whether we can take proper steps to reduce the harm"

some common motivating or demotivating beliefs regarding climate change among Americans, and hint at potential avenues for hopeful messaging. A limitation of Study 1, however, is that it reflects hopes and doubts in a dynamic political environment, which has changed substantially since the survey was administered. Nonetheless, the content analysis of responses provides insights, such as the social nature of hope and doubt, and the commonness of false hope. Study 2 grew directly out of analyses from Study 1, so again focuses only on individuals who believe global warming is happening. In Study 2, the open-ended questions were used to construct closed-ended questions to allow modeling. Thus, Study 2 is a more quantitative analysis that examines hopeful and doubtful appraisals based on the open-ended (unprompted) questions in Study 1. Study 2 also assesses the strength of these appraisals in predicting political engagement with climate change.

STUDY 2

The purpose of Study 2 was to further examine Americans' hopes and doubts about climate change identified in Study 1 through analyses of their effects on political engagement. Study 1 revealed Americans' open-ended perceptions, which may be held more strongly than simple responses of agreement or disagreement to close-ended prompts. Operationalizing the results of Study 1 in close-ended questions, however, allows us to assess the hopeful and doubtful appraisals of climate change and the relationship of these appraisals to political engagement. We expected to find positive (negative) relationships between hopeful (doubtful) appraisals and both policy support and political behavioral intentions; however, it is also plausible that there are different types of hopeful and doubtful appraisals (as we found in Study 1) that differentially predict engagement. To examine these questions, we developed measures of hope and doubt based on the open-ended results from Study 1, and assessed the relative strength of appraisal indices created from the hope and doubt measures in predicting political behavioral intentions and policy preferences. Further, to elucidate the moderation or boundary conditions of relationships (following Slater and Gleason's, 2012, Strategy 4.1), we also explored interactions between hope and doubt on engagement.

Study 2 Method

Participants and Recruitment

Data were gathered from 1,657 American adults who completed a nationally-representative survey (part of the *Climate Change in the American Mind* project) in December, 2013[3]. Sampling

[3]For a different project unrelated to the study reported here, an experiment was embedded in the December, 2013 survey to test the effects of the term "global

and weighting replicated procedures described in Study 1. Participant demographics were closely representative of the adult US population (**Table 1**).

As in Study 1, our sample was limited to Americans who believe global warming is happening, at least to some extent. Of the 1,657 initial survey respondents, 198 did not receive the hope and doubt items (about 12%) because they said they were "extremely" or "very sure" global warming is not happening. Of the remaining respondents, 149 were excluded due to excessive missing data (about 10%; see **Supplementary Material** for procedures) resulting in a final sample size of 1,310 respondents.

Because some cases were still missing data on some of the questions, we used the hot deck imputation method (Myers, 2011) to impute values (see **Supplementary Material** for details). The percentage of cases that had at least one item imputed in any one of the scales (hope, doubt, political engagement, and policy preferences) ranged from 4.2 to 9.8%.

There were some small differences between the retained sample and the cases that were excluded due to missing data (see **Supplementary Material**). Although respondents who were retained had relatively similar levels of efficacy, policy support, and political behavioral intentions compared to excluded cases, dropped respondents scored lower on constructive hope and doubt, and scored higher on false hope and fatalistic doubt. These results indicate there may be some bias in our final sample. In addition to excluding respondents who are certain global warming is not happening, our final set of respondents may not be representative of the general public and, accordingly, results should be interpreted with some degree of caution.

Design and Measures

All questionnaires were self-administered by respondents in a web-based environment. The survey took an average of 29 min to complete. Closed-ended items (based on the themes that emerged from Study 1) included 11 statements that reflect reasons why people are hopeful about climate change, and 10 statements that reflect reasons why people are discouraged or doubtful about climate change. The question stem for the hopeful and doubtful reasons was identical and read "Please indicate how strongly you agree or disagree with each of the following statements" with response options as follows: "Strongly disagree"; "Somewhat disagree"; "Somewhat agree"; "Strongly agree"; and a "Don't Know" option (coded as the midpoint of the 5-point scale).

Question indices were constructed using Principal Components Analysis (PCA) on hopeful beliefs, doubtful beliefs, political behavioral intentions, and policy preferences (see **Supplementary Material** for analyses and items). Based on results of the PCAs and reliability analyses, two subscales emerged within each of the hope and doubt measures, and behavioral intentions and policy preferences each loaded onto single components as expected. Thus, the following scales were used (see **Table 4** for a correlation matrix as well as scale means and reliabilities).

Hopeful because people–individually and collectively–can reduce climate change (constructive hope)

The extent of agree or disagreement with eight statements indicated a form of constructive hope or remaining optimistic that people will solve the problem (e.g., "Humanity will rise to the occasion and reduce global warming/climate change" and "The nations of the world will cooperate to reduce global warming/climate change").

Hopeful because something external–other than people–will fix the problem (false hope)

Three items indicated false hope reflecting either a kind of wishful thinking, or faith that a higher power will solve the problem, such as "We don't need to worry about global warming/climate change because nature will take care of it" and "We don't need to worry about global warming/climate change because science and technology will solve it."

Doubtful because of skepticism of human action (constructive doubt)

Four statements measured a form of doubt that we consider constructive to motivating engagement, that is, skepticism about whether people will act on climate change (e.g., "Most people don't know enough about what they can do to reduce global warming/climate change," and "Most people are unwilling to take individual action to reduce global warming/climate change").

Doubtful because nothing can be done (fatalistic doubt)

Four items measured a form of doubt based on fatalism or believing that there is nothing people can do to solve the problem including "Humans can't affect global warming/climate change because you can't fight Mother Nature" and "It's already too late to do anything about global warming/climate change."

Political behavioral intentions

Respondents answered the question "How likely would you be to do each of the following things if a person you like and respect asked you to?" by rating 14 statements (e.g., "Write letters, email, or phone government officials about global warming" and "Sign a petition about global warming, either online or in person") from "Definitely would not" to "Definitely would" ("Don't know" responses were coded as the midpoint of the 5-point scale similar to hope and doubt items). Those who answered "Don't know" were excluded from the scale. Responses were averaged to indicate intentions to take political action climate change.

Policy support

Respondents were also asked "How much do you support or oppose the following policies?" to indicate their support or opposition to six climate change policies (e.g., "Regulate carbon dioxide (the primary greenhouse gas) as a pollutant" and

warming" vs. "climate change." Half of the sample (n = 830) was randomly assigned to a questionnaire using the term "global warming" and the other half (n = 827) was randomly assigned to a questionnaire with identical questions, except using the term "climate change." There were statistically significant differences between conditions on only three of the 21 hope and doubt items. Further, the mean composites of scales used in the present analyses were not significantly different between the conditions suggesting that, overall, responses were relatively similar between conditions. Given these results, and that both terms are widely used in public discourse, we combined the two datasets and treated the questions as equivalent.

TABLE 4 | Study 2 correlation matrix (N = 1,310).

	Mean	SD	1	2	3	4	5	6	7
1. Constructive hope	3.14	0.62	(0.73)						
2. False hope	2.17	1.00	−0.01	(0.76)					
3. Constructive doubt	3.59	0.76	0.14***	−0.20***	(0.65)				
4. Fatalistic doubt	2.69	0.84	−0.02	−0.64***	0.08**	(0.67)			
5. Response efficacy	2.59	0.90	0.16***	−0.30***	0.04	−0.37***	–		
6. Policy support	2.85	0.66	0.22***	−0.44***	0.20***	−0.40***	0.26***	(0.86)	
7. Behavioral intentions	2.75	0.79	0.19***	−0.43***	0.14***	−0.43***	0.31***	0.69***	(0.96)

$^{***}p < 0.001$; $^{**}p < 0.01$. Cronbach's alpha coefficients are in the diagonal.

"Provide tax rebates for people who purchase energy-efficient vehicles or solar panels") on a 4-point scale from 1 ("Strongly oppose") to 4 ("Strongly support").

Response efficacy

Respondents indicated how much they agree or disagree with the statement "The actions of a single individual won't make any difference in global warming/climate change" on a 4-point scale from 1 ("Strongly disagree") to 4 ("Strongly agree"). Responses to this item were reverse-scored so that higher scores suggest greater response efficacy than lower scores.

Study 2 Results

Correlation Analyses

Correlations between measures of hope and doubt suggested surprisingly small relationships between constructive hope, false hope, and constructive doubt (see **Table 4**), except there was a strong positive relationship between having false hope and fatalistic doubt ($r = 0.64$, $p < 0.001$). This suggests that people who exhibit wishful thinking that something other than people will solve climate problems (e.g., technology, a higher power) also tend to doubt that there is anything that can be done because it is out of people's hands.

As expected, constructive hope is positively related to response efficacy, climate change policy support, and intentions to engage politically on the issue (rs range from 0.16 to 0.22, $p < 0.001$). Conversely, false hope and fatalistic doubt are both negatively related to efficacy, policy support, and behavioral intentions (rs range from −0.30 to −0.44, $p < 0.001$). Constructive doubt is positively associated with policy support ($r = 0.20$, $p < 0.001$) and political behavioral intentions ($r = 0.14$, $p < 0.001$) suggesting that having some doubt may be related to pro-climate attitudes and intentions to take political action.

Hierarchical Multiple Regression Analyses

As shown in **Table 5**, hierarchical multiple regression analyses tested the relative strength of hope and doubt in predicting engagement on climate change (Model 1). Analyses also tested the predictive strength of hope and doubt compared to response efficacy—a correlate to remaining (constructively) hopeful about global warming, policy support, and behavioral intentions. Response efficacy was entered in on the second step of regression models (Model 2). Further, as an exploratory test, we also examined the extent to which hope and doubt interact with one another in predicting policy support and behavioral intentions (Model 3).

Regression analyses suggest that constructive hope, false hope, and fatalistic doubt are the strongest predictors across models: people who remain hopeful about human action tend to support climate change policy and say they are willing to take political action, whereas those who have false hope that others (e.g., higher powers) will solve climate change tend to have less policy support and weaker behavioral intentions. People who have fatalistic doubt or believe that there is nothing that can be done to solve problems also tend to have less policy support and weaker intentions to take political action. Constructive doubt also predicts greater policy support and stronger behavioral intentions, but is lower in predictive strength than the other hope and doubt predictors. The predictive strength of hope and doubt remain similar even when controlling for response efficacy (Model 2). Compared with the hope and doubt predictors, response efficacy explained little additional variance in policy support ($\Delta R^2 = 0.004$) and behavioral intentions ($\Delta R^2 = 0.014$) when entered into the model. Conversely, when reversing the order of entry, the hope and doubt predictors explained a sizeable amount of additional variance in policy support ($\Delta R^2 = 0.216$) and intentions ($\Delta R^2 = 0.180$) compared to when it was just response efficacy in the model (respectively, $R^2 = 0.07$ and $R^2 = 0.099$).

Interaction tests of constructive hope and doubt (Model 3 in **Table 5**) indicate a significant effect on behavioral intentions, but not policy support. As shown in **Figure 1**, there is a stronger positive relationship between constructive hope and intentions to take political action on climate change for those who have higher (constructive) doubt than those who have less doubt. In other words, having hope that humans will reduce climate change with some degree of skepticism and recognition that humans are not doing enough may be constructive and motivate political action. The results from the regression models shown in **Table 5** were similar when controlling for gender, age, education, and political ideology (see **Supplementary Material**).

DISCUSSION

Research on hope related to engagement with societal issues is nascent. Studies from health perspectives (e.g., "palliative"

TABLE 5 | Hope and doubt predicting policy support and political behavioral intentions ($N = 1,310$).

Predictor	Policy support			Political behavioral intentions		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Constructive hope	0.20***	0.19***	0.19***	0.17***	0.15***	0.15***
False hope	−0.25***	−0.24***	−0.24***	−0.23***	−0.21***	−0.22***
Constructive doubt	0.14***	0.14***	0.15***	0.09***	0.09***	0.11***
Fatalistic doubt	−0.25***	−0.23***	−0.23***	−0.29***	−0.25***	−0.25***
Response efficacy		0.07**	0.07**		0.13***	0.14***
Const. Hope*Const. Doubt			0.04			0.12***
F	127.39***	103.99***	87.30***	116.41***	100.06***	89.46***
R^2	0.282	0.286	0.288	0.264	0.278	0.293
ΔR^2		0.004	0.002		0.014	0.014

*$p < 0.001$; **$p < 0.01$. Standardized Beta coefficients are presented. Predictors used to create interaction terms in Model 3 were mean centered.*

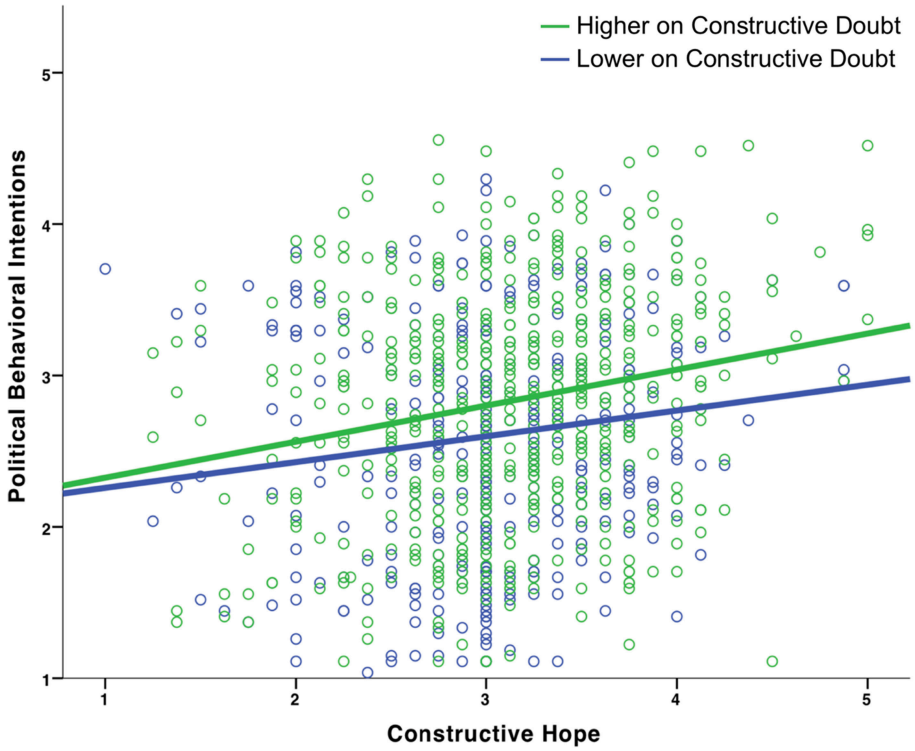

FIGURE 1 | Interaction effects of constructive hope and doubt on political behavioral intentions. Higher constructive doubt (green) refers to respondents scoring a four or more on the doubt measure ($n = 535$) and lower constructive doubt (blue) refers to those scoring a three or below ($n = 409$).

hope in cancer patients) or psychological perspectives have often examined hope in relation to character traits like optimism or to goal-setting (Stotland, 1969; Scheier and Carver, 1985; Snyder, 2000). Scholars have only recently begun to focus on how hope may motivate engagement with broad issues like climate change (Myers et al., 2012; Smith and Leiserowitz, 2014), and how to best construct messages that effectively promote hope in climate change (Chadwick, 2015). Even less work, if any, examines doubt. As a step toward understanding the role of hope and doubt in building public will, we sought to elucidate the constructs and explore how they relate to climate change engagement.

We found many different types of hopeful and doubtful appraisals about climate change. Yet, nearly one quarter (23%) of participants were either not hopeful or could not recall any reasons to be hopeful. Among those who *were* hopeful, the most common reasons included seeing others act or learning about other's efforts to reduce the problem. Hope was primarily derived from individual and collective actions, and from positive observations of behaviors rather than from negative pressures to respond (such as extreme weather events) or from developments in science and technology, although these do provide hope for some. While many individuals were inspired by seeing

others engage in pro-environmental behaviors, such feelings alone are insufficient to reduce the impacts of climate change; taking personal responsibility for changing behaviors–through cooperation, participation, and organization of social, political, and cultural efforts–is ultimately required.

Content analysis of the hopeful appraisals also revealed a coherent component we label "false hope" after Snyder et al. (2002). False hope indicated a belief that there is no need to worry about global warming because some external force is going to address it. Although the belief that God or nature will solve global warming could also be considered faith, we prefer the label false hope because the negative relationship between these appraisals and policy support or political engagement suggests that these ideas are being used to rationalize inaction rather than to promote constructive faith-based support. False hope is not always recognized in studies of hope, and sometimes it is considered in the broader context of (unrealistic) optimism. People consistently exhibit an optimism bias, expecting positive events to happen more often to oneself than to others (e.g., Weinstein, 1980). Extreme forms of optimism can be harmful because they can lead to decreased risk perceptions and poor decision-making (Lovallo and Kahneman, 2003). Extreme forms of optimism may also negatively impact pro-environmental behavior, as suggested by our study. It is important for communication researchers to understand the distinction between constructive and unrealistic forms of optimism and hope. In communication research, optimistic messages have been hypothesized to either motivate climate change mitigation behaviors by stimulating hope and efficacy (Chadwick, 2015) or to promote complacency by reducing risk perceptions and distress (Hornsey and Fielding, 2016).

The sources of doubt among participants related in large part to perceptions that human nature is flawed–that people are greedy, ignorant, inherently apathetic, or have difficulty enacting change. Concerns about corporations and politicians were also major sources of doubt. As with hope, there are two distinct components of doubt, which reflect different types of efficacy. Constructive doubt referenced ideas linked primarily to collective-efficacy (e.g., people are unwilling to take action), whereas fatalistic doubts related primarily to response-efficacy (e.g., can't fight Mother Nature).

The different hopeful and doubtful appraisals are uniquely related to political engagement. The constructive forms of hope were consistently associated with increased policy support and political engagement on climate change, which is consistent with previous research on climate change and hope as a discrete emotion (Smith and Leiserowitz, 2014). Previous research examining hope in the context of climate change, however, did not distinguish constructive from false hope. We also found that constructive hope exerts an influence on engagement that is distinct from response efficacy, which suggests that hope (and doubt) may have an independent effect on action that is not accounted for in the EPPM or PMT. In contrast to constructive hope and doubt, false hope and fatalistic doubt had negative relationships with both policy preferences and political behaviors. We hope this study will motivate new research exploring the intersection of hope and optimism especially at the intersection of climate and health given the enormous health co-benefits that could be achieved by reducing carbon emissions (Petrovic et al., 2014).

Communication guidelines for practitioners in the climate change domain have emphasized the importance of conveying hope to counter the emotional reactions that can accompany the recognition of the seriousness and scope of the threat. Our study supports these efforts and suggest that communications might focus on inspiring constructive hope specifically, and not just efficacy. There is also a need to focus efforts on dampening false hope and fatalistic doubt. The positive relationship between constructive doubt and political engagement, however, is an interesting finding that may point to the value of recognizing the difficulties inherent in addressing the problem. The interaction between constructive hope and doubt was predictive of willingness to engage in political behavior. This finding implies that recognizing that we could reduce climate change, but that people are not doing enough and thus we may fail, is highly motivating.

There are several limitations of this study. First, the data were collected during the Obama presidency at a time when climate change was being taken seriously by the administration. The administration was developing a range of policy solutions to reduce greenhouse gas emissions and was cooperating with other countries to pursue strategies for limiting the threat of global warming. In contrast, the Trump administration has refuted or minimized the threat of climate change, arguing variously that it is a hoax, or not serious, or easily fixed, or is already too advanced to be addressed. The dramatic reversal in the administration's attitudes toward the problem and the corresponding effects on policy progress and efforts to address the issue very likely influenced public attitudes toward the problem. Thus, the relative distribution of hopeful and doubtful appraisals has potentially changed over time, but the broad categories of appraisals and their relationships to engagement are probably more stable.

Second, we did not aim to validate measures of hope and doubt. Study 1 conducted a content analysis to elucidate the constructs in an exploratory fashion and Study 2 developed measures from these appraisals to assess their relationships with engagement. This is likely why we found low reliabilities for the doubt construct in particular. In addition, the construction of the typology of hope in Study 1 grouped some categories that include potentially interesting distinctions, such as those between individual and collective, systemic, or structural approaches, as well as between public and private efforts. While these distinctions were recognized in Study 1, their expression did not register as a unique factor in the analysis of the closed-ended questions that comprised Study 2. Using results from the present work, future research could seek to develop and validate measures of hope and doubt.

Third, we consider response-efficacy but not self or collective efficacy (the latter of which is more difficult to measure) although these are also key components of engagement with climate change. We also do not examine other forms of efficacy (i.e., self- and collective-efficacy) that also warrant investigation in relation to hope and doubt about global warming. Relatedly, our study reflects only results from those who believed that global

warming is happening. While hope is, by definition, only relevant to those who perceive a threat in the first place, doubt could be examined in future work among those skeptical that global warming is happening. Doubts about the distribution of benefits of proposed solutions to climate change (in light of the costs and their distributions), are clearly a major motivating force for some. "Solution aversion," for example, exists in the US for some conservatives who perceive that most policies designed to address the issue are incompatible with their ideological values, and thus deny the existence of the problem in the first place (Campbell and Kay, 2014). Last year in France, a new carbon tax prompted violent opposition because the costs were perceived as too high and poorly distributed relative to the perceived benefits. In this case, the problem is accepted and the solution may have been effective at reducing emissions if implemented, but doubts about its fairness and the value of benefits resulted in a rollback of the tax.

Future research could address some of these limitations as this study is only broadly scratching the surface of what underlies Americans hopes and doubts about this complex issue, and how they relate to different forms of efficacy and engagement. Future work could look, for example, at which sources most strongly influence hope (e.g., "people are starting to come together to challenge the fossil fuel industry") and doubt (e.g., negative appraisals of corporations vs. politicians). In our model, the predictive strength of response efficacy decreases with hope and doubt in the model, so it may be that feelings of efficacy precede hope and doubt, which promote action, but it could also be that the reverse is true–that hope and doubt appraisals lead to feelings of efficacy. Alternatively, and perhaps most likely, these relationships are bidirectional.

Implications and Conclusions

Public will refers to a "social system's shared recognition of a particular problem and resolve to address the situation in a particular way through sustained collective action" (Raile et al., 2014, p. 105). Our research has implications for the roles that hope and doubt play in building public will and fostering engagement with climate change. First, despite increasing emphasis on hope in the climate communications subfield, our results indicate that there seems to be a "hope gap" among the public. Not only is there a lack of hope, there is also a lack of information and ideas about what may promote hope, especially among political moderates. This hope gap is especially relevant in the face of increasing climate impacts and insufficient national and international actions thus far to address the root causes of the problem.

Second, it is important to distinguish between hope that is associated with political engagement and support for policies that address climate change (constructive hope) vs. hope that distances the issue and is linked with disengagement (false hope). Doubt can either reinforce hope in a constructive manner (i.e., via recognition of a problem), or in a negative manner (fatalistic doubt), which seems to hinder or be used to rationalize disengagement. In their constructive forms, doubt relates to recognizing that there is a problem—people are not acting—while hope helps to raise people up to address the situation; these findings are evidenced by the interaction between hope and doubt when predicting political intentions.

Messages about the realistic solutions that exist for reducing climate change impacts can directly address the need for hope, while information about the known causes of climate change (Ranney and Clark, 2016) can address misconceptions that produce false hope. Likewise, messages that address common doubts about climate change may reinforce constructive hope, while information that addresses response-efficacy may help limit fatalistic doubt (e.g., the feeling that it is already too late).

Perceptions of changing social norms and mobilization are common among those individuals who are hopeful and are strongly related to pro-environmental behavior. Hopeful messages can be informed by these ideas that emerged unprompted in the themes of Study 1 as they are likely to continue to resonate with the public. Such stories would focus on seeing others taking action, information about changing social norms and growing awareness among the public (Pew Research Center, 2018), information about the co-benefits of reducing global warming (e.g., clean air, economic growth, technological advancement), and stories about local to global initiatives that are succeeding. These ideas are already associated with hope in the public mind. Coupling these kinds of stories with news about the threat are likely to be more effective than if solutions are presented separately (Witte, 1992). Moreover, solutions are often presented with a conflict frame, rather than with an innovation or mobilization frame (Hart and Feldman, 2014). Our research is consistent with the positive impact of an innovation or mobilization frame insofar as these ideas are already common among hopeful appraisals made by the public.

Hope and efficacy can also be promoted jointly by demonstrating the value and power of interpersonal communication about climate change, particularly when it is face-to-face (Clark and Brennan, 1991). Encouraging communication about both the physical and social dimensions of climate can help empower participants and promote action. While the "information deficit" model is now widely recognized as flawed, obtaining accurate information about cause and effect for many problems remains a key element of learning. Experimental evidence shows that acquiring new information about the physical mechanisms behind the greenhouse effect can transform attitudes about global warming (Ranney and Clark, 2016). Understanding the strength of the scientific consensus on climate (i.e., 97% of climate scientists are convinced by the abundant evidence that global warming is happening and human-caused) is linked to greater support for climate policies, and yet is largely underestimated (van der Linden et al., 2015). Social influence approaches are also shown to be effective at promoting behavior change, such as leveraging community leaders to promote action in communities and perceiving social norms supportive of actions (e.g., Abrahamse and Steg, 2013). Conveying the widespread support for action on climate in the US, even among conservatives and Republicans (Leiserowitz et al., 2018), can also help to reduce pluralistic ignorance (Geiger and Swim, 2016). Structural, institutional,

and policy factors are also central in supporting individual and collective action.

The appraisals absent from or limited in our content analysis of hope also yield insights that might inform efforts to build public will. Limited appraisals invoking scientific and technological advances, for example, suggest that these may be less engaging than messages relating to movement building or other social efforts. Technology and scientific advances explicitly being used by family and friends, or in the context of social organizing, however, may be more salient. Such "peer effects" have been documented through the diffusion of solar photovoltaic panels in communities, for example, where the adoption of the new technology by homeowners in the area increases the probability of additional installations (Bollinger and Gillingham, 2012). Other research has demonstrated the importance of addressing perceived social norms in the diffusion of environmentally friendly behaviors more broadly and highlights the effectiveness of these frames in increasing pro-environmental behaviors (Cialdini, 2007). Highlighting pro-environmental actions also directly counters common doubts about climate change, such as that humans are innately apathetic and greedy, or that change is too difficult or costly.

In general, the findings across two studies suggest a hope gap among the American public, despite the myriad efforts underway to address climate change at individual to international scales. Our data suggest that Americans by-and-large are not hearing about these efforts. Yet, those who do feel hopeful are supported by hopeful beliefs, are more likely to engage in pro-environmental behaviors and to support policy. In addition, we find some evidence that there is such thing as a "healthy dose of doubt"–that understanding the scope and seriousness of the threat can also serve to support public will and reinforce engagement with climate change.

ETHICS STATEMENT

This research utilizes data from the Climate Change in the American Mind surveys, conducted by the Yale Program on Climate Change Communication and the George Mason University Center for Climate Change Communication. The Human Subjects Committee of Yale University deemed this study as exempt under 45 CFR 46.101(b) (2): Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior, unless the information is obtained and recorded in such a manner that the human subjects can be identified, directly, or through identifiers linked to the subjects; and any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation. All subjects gave electronic informed consent to complete the online survey.

AUTHOR CONTRIBUTIONS

JM, AL, EM, and CR-R designed the instruments and collected the data. JM, MB, BB, and JR-R performed data analysis. All authors contributed to writing and editing of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcomm.2019.00020/full#supplementary-material

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