Personal Stories Can Change Climate Change Beliefs and Attitudes: The Mediating Role of Emotion

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Abstract

Sharing personal stories of how climate change is already harming people is a promising communication strategy to engage diverse and even skeptical audiences. Using two experiments, we test the effects of a radio story on the climate change beliefs and risk perceptions of political moderates and conservatives. The radio story, which aired on hundreds of stations across the U.S., is a North Carolina sportsman's personal account of how climate change has already affected the places he loves. Both experiments found positive effects on global warming beliefs and risk perceptions. Additionally, Study 2 found these effects were mediated by emotional reactions of worry and compassion. These studies suggest that personal stories can be a persuasive communication strategy.

Keywords: climate change, emotions, storytelling, experiment, anecdotes

Personal Stories Can Change Climate Change Beliefs and Risk Perceptions: The Mediating Role of Emotion

Engaging people in the issue of climate change can be difficult because many people view it as abstract, distant, and impersonal (e.g., Leiserowitz, 2006; Weber, 2006). In light of these challenges, scholars suggest that messages about aggregate long-term impacts (e.g., global sea-level rise by 2100) may often be less effective than messages about how climate change is harming people here and now (van der Linden, Maibach, & Leiserowitz, 2015). This is, in part, because personally relevant stories can increase emotional engagement by reducing psychological distance (e.g., Van Boven, Kane, McGraw, & Dale, 2010).

Further, research has found that affective responses may be a mechanism by which climate change messages affect beliefs and risk perceptions (e.g., Nabi, Gustafson, & Jensen, 2018; Spence & Pidgeon, 2010). However, these prior studies on the mediating role of emotions have tested the effects of messages about aggregate-level impacts of climate change, not stories about impacts on relatable individuals.

Here, we help connect these two areas of research by testing (a) the persuasive effects of a radio story about the negative impacts of climate change on an individual, and in a follow-up experiment we test (b) an explanatory mechanism: emotional reactions (specifically, worry and compassion) as mediators of the effects of this story.

Personal Stories of Impacts as a Climate Change Communication Strategy

Extant theory and research suggests that stories of the impacts of climate change on relatable individuals are an effective persuasion strategy. First, people tend to view climate change as distant and abstract (Leiserowitz, 2006). Therefore, stories that translate information about the effects of climate change into “relatable and concrete personal experiences” (van der

Linden, et al., 2015, p. 759) may be especially effective at reducing psychological distance and increasing emotional engagement, thereby increasing perceived importance and risk perceptions (Van Boven et al., 2010; Lu & Schuldt, 2016).

Further, research has found that storytelling can facilitate persuasion, particularly with oppositional audiences (e.g., Dahlstrom, 2014; Moyer-Gusé, 2008). This persuasive effectiveness is likely due to (a) heightened character identification which can lead to decreased social distance and stronger in-group associations (Hinyard & Kreuter, 2007; So & Nabi, 2013), and (b) transportation (immersion in the story) which can reduce counterarguing in oppositional audiences (Moyer-Gusé, 2008; Van Laer et al., 2013).

Applied to climate communication, this research suggests that stories of how climate change has impacted relatable individuals may lead an audience to identify with those individuals and vicariously experience those impacts (see review in Jones & Peterson, 2017). For audience members, these vicarious experiences may function similarly to personal experience with climate change impacts, which can have a powerful influence on how people view and act on the issue (e.g., Myers, Maibach, Roser-Renouf, Akerlof, & Leiserowitz, 2012; van der Linden, 2014).

In Study 1, we test whether a nationally aired radio story about climate impacts on a relatable individual can shift the climate change beliefs and risk perceptions of political conservatives in the U.S. Based on prior research and theory, we expected that:

H1: Listening to a personal story about the impacts of climate change will have positive effects on global warming beliefs, worry about global warming, risk perceptions, and issue priority.

Study 1

Methods

Participants. Participants were recruited through Amazon's Mechanical Turk (MTurk). Respondents were limited to political conservatives because this segment of the population is of high practical importance because they tend to be less concerned (than liberals) about global warming and its effects (Leiserowitz et al., 2019).

Prospective participants were first screened for political ideology by responding to the question "In general, I think of myself as…" on a five-point scale (1 = very conservative; 2 = somewhat conservative; 3 = moderate; 4 = somewhat liberal; 5 = very liberal). Only conservatives (those who selected "1" or "2") advanced to participate in Study 1 (N = 408). After data cleaning (i.e., removing participants who failed a comprehension check and those who did not listen to the whole radio story), 362 participants remained as valid cases for analysis (control n = 195; treatment n = 167). Most (73%) identified as "somewhat conservative," while the rest (27%) were "very conservative," which is similar to national proportions (e.g., Leiserowitz et al., 2019; 65% "somewhat" and 35% "very" conservative). The final sample was 52% female, with a mean age of 39.69 (SD = 12.49). The most common level of educational attainment was a bachelor's degree (40%), followed by "some college or associate's degree" (37%), "graduate or professional degree" (13%), high school diploma (10%), and less than high school diploma (11%). The sample was mostly White (82%), followed by Latino (6%), African-American (5%), and Asian-American (3%).

Procedure and stimuli. Participants were randomly assigned to either the control condition, in which they completed a word-sorting task, or to the treatment condition, in which they listened to a real 90-second radio story. The radio story features Richard Mode, an older North Carolina sportsman, who tells of his sadness from seeing the impacts of climate change on the ecosystems in which he hunts and fishes. This story is from a national radio program on

climate change that currently airs a new story each weekday on more than 500 stations across the U.S.[1] The full transcript is presented in the supplementary materials, and the audio is available online (see Peach, 2015).

Participants began the study by completing a set of survey measures about their climate change beliefs and risk perceptions (pre-test) before either listening to the radio story (treatment condition) or completing a word-sorting task (control condition). Then, participants responded to a "distractor" item that presented an image and descriptive text about the upcoming release of a Star Wars movie and asked participants how likely they were to watch the movie. Finally, all participants completed post-test measures identical to the pre-test measures, along with demographic questions.

Measures. The radio story describes the reality of global warming, its impacts on people and the natural environment, and the importance of addressing it, so we measured opinions about global warming regarding its reality, its importance, and its impacts. These measures were adapted from the *Climate Change in the American Mind* survey (e.g., Leiserowitz et al., 2019). Participants used seven-point Likert scales to indicate their belief in the existence of global warming (1 = "I strongly believe global warming is NOT happening," 7 = "I strongly believe global warming IS happening"), their belief that global warming is human-caused (1 = "I believe global warming is caused entirely by natural changes in the environment," 7 = "I believe global warming is caused entirely by human activities"), how worried they are about global warming (1 = "I am not at all worried," 7 = "I am very worried"), how personally important global warming is to them (1 = "Not at all important," 7 = "Very important"), and how high a priority global warming should be for the president and Congress (1 = "Low," 7 = "Very high"). To assess the

[1] It is unlikely that prior exposure could have affected the results, because the average audience of the radio program is about 134,000 (1 in 1,560 American adults), and exposure would be randomly distributed between conditions.

perceived risks of global warming, participants were asked "How much do you think global warming will harm… you personally," "… wildlife in your area," "… recreational fishing," "… commercial fishing," and "future generations of people?" For each of these five risk perceptions, participants reported their response on a seven-point scale from "Not at all" (1) to "A great deal" (7). Further details about the wording and response categories of these measures are presented in the supplementary materials.

An exploratory factor analysis (EFA) performed on a randomly selected half of the Study 1 sample provided strong evidence that the ten risk perception items represent one factor. A confirmatory factor analysis (CFA) on the other half of the sample corroborated this unidimensional structure.[2] Therefore, we created pre-test and post-test composite variables (pre-test Cronbach's α = .97; post-test α = .97), by taking the average of the standardized *z*-scores of each item and standardizing the resulting variable (M = 0, SD = 1). These pre- and post-test composite variables represent overall opinion about global warming and its impacts.

Because individuals' personal connection to fishing may influence responses, participants also reported their frequency of fishing during the past 12 months. This variable was used as a covariate in all analyses.

Analyses

H1 predicted that global warming beliefs and risk perceptions would be positively affected by listening to the story about the negative impacts that global warming is already having on a relatable individual. To test this hypothesis, an analysis of covariance (ANCOVA) was used for each individual variable and the composite variable to compare post-test means in

[2] The details of these factor analyses and the creation of the composite variables are reported in the supplementary materials.

the treatment and control conditions while controlling for the corresponding pre-test variable and frequency of fishing during the past 12 months.

Results

Results of the ANCOVAs support H1. Relative to the control, the treatment resulted in consistent positive small-to-medium sized effects (Schäfer & Schwarz, 2019) on many beliefs, risk perceptions, and on the composite variable (Table 1). Including gender, education, and race as covariates in the Study 1 analyses did not alter the results, so we report the results without these covariates.

Table 1

Effects of experimental condition on outcome variables in Study 1.

Dependent Variables	Marginal Means		SE		SD		Test Statistics		
	ctrl.	treat.	ctrl.	treat.	ctrl.	treat.	F	*p*	η_p^2
Happening	**4.37**	**4.62**	.056	.060	0.782	0.775	**8.80**	**.003**	**.024**
Human-Caused	3.86	3.97	.060	.054	0.838	0.698	2.45	.118	.007
Worry	**3.42**	**3.62**	.058	.062	0.810	0.801	**5.25**	**.022**	**.015**
Personal Importance*	3.51	3.69	.065	.065	0.908	0.840	3.76*	.053*	.010*
Issue Priority for Govt.	**3.46**	**3.66**	.051	.054	0.712	0.698	**6.82**	**.009**	**.019**
Personal Harm	**3.12**	**3.36**	.064	.069	0.894	0.892	**6.47**	**.011**	**.018**
Harm Local Wildlife	**3.92**	**4.15**	.065	.070	0.908	0.905	**5.96**	**.015**	**.016**
Harm Recreational Fishing	**3.78**	**4.22**	.063	.068	0.880	0.879	**20.33**	**.000**	**.054**
Harm Commercial Fishing	**4.01**	**4.42**	.066	.071	0.922	0.918	**17.43**	**.000**	**.047**
Harm Future Generations	4.38	4.42	.063	.068	0.880	0.879	0.22	.642	.001
Composite Variable	**-.053**	**.069**	.016	.017	0.223	0.220	**26.72**	**< .001**	**.070**

Note. Significant effects in bold. * = marginal significance. All results are from ANCOVAs with covariates of pre-test scores on the corresponding variable and frequency of fishing in the last 12 months. SE = standard error; ctrl. = control condition; treat. = treatment condition; *p* = p-value; η_p^2 = partial eta-squared effect size. The marginal means of the 10 individual items are on each item's original scale, but the composite variable is standardized (M = 0, SD = 1).

Study 1 Discussion

In sum, Study 1 provides evidence of consistent small-to-medium sized effects of an ecologically valid climate change message (i.e., a nationally-broadcast radio story) across these outcome variables in an audience of conservative Americans. These findings provide support for

extant theory and research suggesting that personal stories about climate change impacts is an effective means of persuasion.

One limitation of Study 1 is that the treatment condition (a radio story) and the control condition (a word-sorting task) are very different experiences. Thus, the two conditions may have different levels and types of selective participation (i.e., one requires audio capabilities), attrition, attention, and interest. Further, the word-sorting task took less time (mean = 28 seconds) than listening to the 90-second radio story, and it is unclear how this difference may have affected the results. Another limitation is that in the musical intro to the treatment audio clip the radio story's narrator introduced himself as "Dr. *firstname_lastname*," and stated the title of the series which included the word "climate" and the name of a well-known university (Peach, 2015). It is possible that these statements may have biased the responses of participants. Finally, while Study 1 demonstrates that this radio story is persuasive, it did not directly test mechanism(s) by which it was effective. Study 2's addresses each of these limitations.

An Explanatory Mechanism: Emotional Responses

A key mechanism that may account for the effects of this story about the personal impacts of climate change is emotional responses. For example, the emotions-as-frames model suggests that emotions can act as frames that guide responses to a message (Nabi, 2003; 2007; Nabi et al., 2018). In the context of climate change, a series of experiments have found that the effects of gain- and loss-framed messages about climate change on individuals' beliefs, attitudes, and risk perceptions are mediated by emotions such as fear and hope (Nabi et al., 2018; Nabi & Myrick, 2018; Spence & Pidgeon, 2010). Another study found that the effects of a message about drought in Africa that used a compassion prime were mediated by feelings of compassion and were strongest among political conservatives and moderates (Lu & Schuldt, 2016).

However, this extant research on the mediating role of emotion in climate change messaging has only tested the effects of messages about aggregate-level impacts—not personal impact stories about real, relatable individuals— even though the latter likely evoke more emotional engagement. We address this gap with Study 2.

In the radio story, the fisherman recounts the loss of beloved wildlife, stating at one point "there is a sense of loss that I cannot fully describe to you verbally." Not only is this story likely to evoke feelings of worry about the effects of climate change, but may also evoke feelings of empathy or compassion (Jones & Peterson, 2017).

In turn, there is also evidence that feelings of worry and compassion can influence climate change beliefs and attitudes. Worry about global warming, in particular, is one of the strongest predictors of climate policy support (Goldberg et al., in press; Smith & Leiserowitz, 2014). Additionally, compassion elicited by climate change messages mediated the effects of those messages on support for political action, especially among political moderates and conservatives (Lu & Schuldt, 2016), likely because compassion motivates individuals to aid those who are suffering (Goetz, Keltner, & Simon-Thomas, 2010).

In sum, Study 2 extends the literature by testing whether worry and compassion mediate the effects that this story of personal-level climate impacts has on global warming beliefs and risk perceptions.

Study 2

The purposes of Study 2 were (a) to test the replicability of the observed main effects of Study 1 when sampling from a different population (conservatives and moderates, from TurkPrime Panels instead of MTurk) and using a revised methodology, (b) to address the

methodological limitations of the Study 1 control group, and (c) to test the mediating role of emotions.

Following from the findings of Study 1, we expect that:

H2.1: Listening to a personal story about the impacts of climate change will have positive effects on global warming beliefs, worry about global warming, risk perceptions, and issue priority.

The research summarized above indicates that emotional responses often mediate the effects of climate change messaging. The present story focuses on the threat of global warming and the personal loss that the fisherman experienced, so feelings of worry and compassion are likely and relevant emotional responses. Further, feelings of worry and compassion (in particular) predict beliefs and risk perceptions about climate change. Thus, we predict that:

H2.2: Feelings of compassion and worry will mediate the effects of the treatment on global warming beliefs and risk perceptions.

Design

The design of Study 2 mirrored that of Study 1, with a few changes that resolve the limitations of Study 1 mentioned above. The Study 2 treatment audio (available at https://osf.io/yrk7w/) did not have the narrator's intro and outro voiceover (leaving only the music). The control condition in Study 2 was not a word-sorting task, but instead was a similarly-constructed 90-second radio story (available at https://osf.io/y8hrc/) about a different scientific topic (the speed of cheetahs; Maynard, 2018), and used the same intro and outro music as the treatment condition. Mirroring Study 1, participants completed pre- and post-test measures of their beliefs and risk perceptions about global warming. As in Study 1, the Star Wars distractor item was included between the stimuli and the post-test. Measures of emotions felt during the radio story, and demographic measures, were administered in the post-test only.

Sample

Recruitment. The participants in Study 2 were obtained through Prime Panels, an opt-in survey sampling platform that recruits from a pool of more than 20 million diverse participants—a significantly larger and more diverse population than the MTurk worker pool (TurkPrime, 2018). Given the importance of character identification (perceived similarity), we recruited residents of six southeastern U.S. states (NC, SC, GA, AL, LA, MS). To test the effects when sampling from a broader population, we included both conservatives and moderates in Study 2. Overall, these sampling differences between Study 1 and Study 2 help increase the confirmatory power of the replication and the generalizability of the phenomenon and underlying theory (Crandall & Sherman, 2016; Schmidt, 2009).

Screening, cleaning, and demographics. After screening for political moderates and conservatives (N = 922), and after data cleaning (e.g., removing speeders and those who failed a comprehension check), 581 valid cases were left for analysis (control n=315; treatment n=266). The final sample (N = 581) used for analysis was 61% female, with a mean age of 39.96 (SD = 14.56). Many (49%) identified as "moderate" and many were "somewhat conservative" (33%), with fewer "very conservative" (19%). The mean age was 39.96 (SD = 14.57). The most common level of educational attainment was "some college or associate's degree" (43%), followed by high school (27%), bachelor's degree (18%), graduate or professional degree (9%), and "did not graduate high school" (3%). The sample was mostly White (78%), followed by African-American (13%), Latino (3%), and other ethnicities each comprising less than 1%.

Measures

Study 2's ten measures of global warming beliefs and risk perceptions were nearly identical to those used in Study 1, with minor formatting and phrasing adjustments detailed in the

supplementary materials. As in Study 1, factor analyses indicated that these items represent a single factor,[3] so a composite variable was created using the same methods as Study 1.

In addition, the level of emotions (i.e., compassion and worry) felt during the radio story was measured in Study 2 by asking "How strongly did you feel each of the following while you were listening to the audio clip?" with a list of four emotions and responses given on a five-point scale from "Not at all" to "Extremely." The first three items ("Compassionate," "Moved," and "Sympathetic") were derived from a prior experiment by Lu and Schuldt (2016). These items were averaged to create a compassion index (Cronbach's $\alpha = .93$).[4] The remaining item ("Worried") measured how much worry respondents felt when listening to the story.

Analyses

As in Study 1, ANCOVAs were used to assess differences in each variable between the treatment and control condition while controlling for the corresponding pre-test variable (where applicable) and frequency of fishing.

To assess the mediating role of emotions, we entered them into a parallel mediation model using the PROCESS macro in SPSS (Model 4; Hayes, 2013) with experimental condition (control=0, treatment=1) used as the independent (X) variable, the compassion index and worry as two mediators ($M_{1\text{-}2}$), and each dependent variable (Y_i; Table 2) in turn as the Y in its own model. Full mediation is evidenced when the direct effect of X on Y becomes nonsignificant when including the mediators ($M_{1\text{-}2}$). Because each Y was measured pre- and post-test, each model also included that Y's corresponding pre-test variable as a covariate. All models also included frequency of fishing as a covariate.

[3] The details of these factor analyses and the creation of the composite variables are reported in the supplementary materials.
[4] The supplementary materials report the factor analyses that indicated a unidimensional structure of the three-item compassion scale.

Results

Main effects. Supporting H2.1, and corroborating Study 1, the results indicate strong positive effects of the fisherman story on all beliefs, risk perceptions, and on the composite variable (Table 2). Including gender, education, and race as covariates in the Study 2 analyses did not alter the results, so we report the results without these covariates. The treatment effect on the composite variable was significantly larger in Study 2 than Study 1.[5] While the effects on several individual items are descriptively larger in Study 2 than Study 1, the difference was only statistically significant for one (perceived harm to local wildlife).

Table 2

Effects of experimental condition on outcome variables in Study 2.

Dependent Variables	Marginal Means		SE		SD		Test Statistics		
	ctrl.	treat.	ctrl.	treat.	ctrl.	treat.	F	*p*	η_p^2
Happening	**5.08**	**5.26**	.043	.046	0.763	0.749	**8.34**	**.004**	**.014**
Human-Caused	**4.37**	**4.64**	.040	.043	0.710	0.700	**20.68**	**< .001**	**.035**
Worry	**2.58**	**2.77**	.029	.031	0.515	0.505	**19.82**	**< .001**	**.033**
Personal Importance	**2.96**	**3.08**	.030	.033	0.532	0.537	**7.85**	**.005**	**.013**
Global Warming Issue Priority	**2.41**	**2.65**	.051	.054	0.905	0.879	**43.14**	**< .001**	**.070**
Clean Energy Issue Priority	**3.24**	**3.35**	.021	.023	0.373	0.374	**11.62**	**.001**	**.020**
Personal Harm	**2.22**	**2.41**	.027	.029	0.479	0.472	**22.56**	**< .001**	**.044**
Harm Local Wildlife	**4.53**	**4.99**	.055	.060	0.976	0.977	**31.66**	**< .001**	**.052**
Harm Recreational Fishing	**4.52**	**5.02**	.053	.058	0.941	0.944	**40.82**	**< .001**	**.066**
Harm Commercial Fishing	**4.76**	**5.14**	.049	.053	0.870	0.863	**29.94**	**< .001**	**.046**
Harm Future Generations	**3.07**	**3.17**	.023	.025	0.408	0.407	**8.57**	**.004**	**.017**
Composite Variable	**-.098**	**.116**	.015	.016	0.266	0.260	**94.29**	**< .001**	**.140**

Note. Significant effects in bold. All results are from ANCOVAs with covariates of the corresponding pre-test variable and frequency of fishing in the last 12 months. SE = standard error; SD = standard deviation; ctrl. = control condition; treat. = treatment condition; *p* = p-value; η_p^2 = partial eta-squared effect size. The marginal means of the 10 individual items are on each item's original scale, but the composite variable is standardized (M = 0, SD = 1).

Indirect effects. As a manipulation check, an ANCOVA controlling for fishing frequency found that feelings of compassion and worry were higher in the treatment group than the control group (compassion, $F(1, 578) = 182.27$, $p < .001$, $\eta^2_{partial} = .240$; worry, $F(1, 578) =$

[5] Comparisons of effect sizes were performed with *z*-tests (Paternoster, Brame, Mazerolle, & Piquero, 1998). These methods and results are detailed in the supplementary analyses.

349.70, $p < .001$, $\eta^2_{partial} = .377$). Supporting H2.2, the results of the mediation models in PROCESS found that worry and compassion (M_{1-2}) fully mediated the treatment's (X) effect on most individual variables (Y_i). However, the treatment effect on the composite variable was only partially mediated by emotions (that is, the direct effect of X on Y remained significant with the mediators in the model). Significant indirect effects through worry were more common than through compassion (Table 3).

Table 3

Worry and compassion as mediators of treatment effects on outcome variables in Study 2.

		Model Results						
Dependent Variables	Mediator	Indirect Effect (β)	95%CI LL	95%CI UL	Contrast Sig. (y/n)	Residual Direct (β)	95%CI LL	95%CI UL
Happening	Compassion	.034	-.018	.090	n	-.049	-.137	.038
	Worry	**.115**	**.026**	**.208**				
Human-Caused	Compassion	.039	-.022	.099	n	.011	-.080	.101
	Worry	**.114**	**.023**	**.215**				
Worry about GW	Compassion	.063	-.025	.153	**y**	**-.142**	**-.255**	**-.029**
	Worry	**.285**	**.162**	**.411**				
Personal Importance	**Compassion**	**.088**	**.031**	**.155**	n	-.055	-0.151	.040
	Worry	.070	-.018	.157				
G.W. Issue Priority	Compassion	.029	-.019	.078	n	.059	-.024	.142
	Worry	**.122**	**.039**	**.211**				
Personal Harm	**Compassion**	**.126**	**.067**	**.199**	n	-.024	-.124	.076
	Worry	**.088**	**.000**	**.177**				
Harm Local Wildlife	**Compassion**	**.057**	**.005**	**.111**	n	.021	-.077	.119
	Worry	**.135**	**.038**	**.237**				
Harm Rec. Fishing	**Compassion**	**.077**	**.022**	**.135**	n	.094	-.004	.192
	Worry	.069	-.021	.157				
Harm Comm. Fishing	**Compassion**	**.063**	**.014**	**.116**	n	.036	-.054	.125
	Worry	**.085**	**.008**	**.164**				
Harm Future Gens.	Compassion	.024	-.031	.081	n	.032	-.058	.123
	Worry	.041	-.035	.121				
Composite Variable	**Compassion**	**.044**	**.009**	**.080**	n	**.092**	**.034**	**.149**
	Worry	**.079**	**.025**	**.140**				

Note. Values represent standardized effects. Significant effects are in bold. Significant effects are defined as those where the confidence intervals do not overlap 0. 95CI LL and UL represent 95% confidence intervals with 5000 bootstrapped samples. Contrast Sig. indicates whether or not the contrast of indirect effects reveals a significant difference (y=significant) between compassion and worry in the degree to which they, respectively, mediate the effect of X on Y. Residual Direct indicates the remaining direct effect of X (treatment) on that Y when accounting for the indirect effect of the emotion mediators. All models include covariates of pre-test scores on the corresponding variable and frequency of fishing in the last 12 months.

Discussion

Study 2 replicated the observed effects of the radio story on global warming beliefs and risk perceptions found in Study 1 while sampling from a different population and comparing the treatment to a more comparable control stimulus. Importantly, Study 2 also provided evidence of the key role of emotions in explaining these effects on global warming beliefs and risk perceptions. In almost all cases, the treatment effects on individual variables were fully mediated by the level of felt worry and/or compassion.

An exploratory follow-up analysis using only conservatives in Study 2 showed that the larger effects of Study 2 on the composite variable (relative to Study 1) cannot be attributed to Study 2's inclusion of political moderates (see supplementary materials for methods and results). Another potential explanation for these larger effects is that Study 2 only sampled from six Southeastern U.S. states, including North Carolina. Thus, Study 2 participants may have considered the North Carolina fisherman to be more similar, more credible, and/or more aligned in values.

General Discussion and Future Directions

Public-facing communicators should seek to reduce psychological distance and evoke constructive emotional responses (e.g., Van Boven et al., 2010; van der Linden et al., 2015, Nabi et al., 2018). The present study suggests that a valuable way for public-facing communicators to enact those strategies is to use personal stories about the impacts of global warming on relatable people and places. These findings also have practical importance because they indicate that communicators and advocates could use personal stories to shift the beliefs and risk perceptions of political conservatives and moderates.

Future research could test other types of personal stories—and other mediators, including different emotions—to determine which messages and mediators best generate strong and

consistent effects among different audience groups. One alternative explanation for the strong positive effects of this radio story is that it frames the issue as the loss of an idyllic past, which may resonate with conservatives (Baldwin & Lammers, 2016). The story also features a down-to-earth, relatable character who may evoke identification and credibility perceptions among many listeners. Future research should investigate the role of these other potential mechanisms.

The results of Study 1 and Study 2 should be interpreted, however, in light of relevant limitations. First, alternative research designs (e.g., field experiments) might provide better estimates of the real-world effects than artificial settings such as this online experiment. It is also possible that pre-test measures might affect participants' response to the treatment (e.g., demand effects, testing effects). However, recent research provides strong evidence that the risk of demand effects in survey experiments is quite small (Mummolo & Peterson, 2019). Scholars argue that these risks are smaller than some of the known limitations of between-subjects designs such as poorer measurement and substantive sample differences between experimental conditions that go undetected (Gelman, 2017; Goldberg, 2019).

Despite these caveats, these studies provide strong evidence that personal stories about climate change can shift public climate change beliefs and risk perceptions. They also show that emotional responses play an important role in determining the effects of messages about global warming.

References

Appel, M., & Mara, M. (2013). The persuasive influence of a fictional character's trustworthiness. *Journal of Communication, 63*(5), 912-932.

Baldwin, M., & Lammers, J. (2016). Past-focused environmental comparisons promote proenvironmental outcomes for conservatives. *Proceedings of the National Academy of Sciences*, *113*(52), 14953-14957.

Cooper, K. E., & Nisbet, E. C. (2016). Green narratives: How affective responses to media messages influence risk perceptions and policy preferences about environmental hazards. *Science Communication*, *38*(5), 626-654.

Crandall, C. S., & Sherman, J. W. (2016). On the scientific superiority of conceptual replications for scientific progress. *Journal of Experimental Social Psychology, 66,* 93-99.

Gelman, A. (2017). Poisoning the well with a within-person design? What's the risk? *Statistical Modeling, Causal Inference, and Social Science.* Accessed April 23, 2020 at https://statmodeling.stat.columbia.edu/2017/11/25/poisoning-well-within-person-design-whats-risk/

Goetz, J. L., Keltner, D., & Simon-Thomas, E. (2010). Compassion: an evolutionary analysis and empirical review. *Psychological Bulletin, 136,* 351-374.

Goldberg, M. H. (2019). How often does random assignment fail? Estimates and recommendations. *Journal of Environmental Psychology, 66,* 101351.

Goldberg, M. H., Gustafson, A., Ballew, M. T., Rosenthal, S. A., & Leiserowitz, A. (in press). Identifying the most important predictors of support for climate policy in the United States. *Behavioural Public Policy.*

Hinyard, L. J., & Kreuter, M. W. (2007). Using narrative communication as a tool for health behavior change: a conceptual, theoretical, and empirical overview. *Health Education & Behavior*, *34*(5), 777-792.

Jones, M. D. (2014). Communicating climate change: Are stories better than "just the facts"?. *Policy Studies Journal*, *42*(4), 644-673.

Jones, M. D., & Song, G. (2014). Making sense of climate change: How story frames shape cognition. *Political Psychology*, *35*(4), 447-476.

Jones, M. D. & Peterson, H. L. (2017). Narrative Persuasion and Storytelling as Climate Communication Strategies. In *The Oxford Research Encyclopedia Climate Science*, ed. Matthew C. Nisbet. New York: Oxford University Press, 1–21.

Leiserowitz, A. A. (2005). American risk perceptions: Is climate change dangerous?. *Risk Analysis: An International Journal, 25*(6), 1433-1442.

Leiserowitz, A. (2006) Climate change risk perception and policy preferences: The role of affect, imagery, and values. *Climatic Change*, 77, 45-72.

Leiserowitz, A., Maibach, E., Rosenthal, S., Kotcher, J., Goldberg, M., Ballew, M., Gustafson, A., & Bergquist, P. (2019). *Politics & Global Warming, December 2018*. Yale University and George Mason University. New Haven, CT: Yale Program on Climate Change Communication.

Lu, H., & Schuldt, J. P. (2016). Compassion for climate change victims and support for mitigation policy. *Journal of Environmental Psychology*, *45*, 192-200.

Marlon, J. R., van der Linden, S., Howe, P. D., Leiserowitz, A., Woo, S. L., & Broad, K. (2018). Detecting local environmental change: The role of experience in shaping risk judgments about global warming. *Journal of Risk Research*, 1-15.

Maynard, T. (2014) *Cheetah Speed.* The 90-Second Naturalist. Accessed February 5, 2019, http://soundserver.cinradio.org/90_Second_Naturalist/052114.mp3

McCright, A. M., & Dunlap, R. E. (2011). The politicization of climate change and polarization in the American public's views of global warming, 2001–2010. *The Sociological Quarterly*, *52*(2), 155-194.

Moyer-Gusé, E., & Nabi, R. L. (2010). Explaining the effects of narrative in an entertainment television program: Overcoming resistance to persuasion. *Human Communication Research*, *36*(1), 26-52.

Myers, T. A., Maibach, E. W., Roser-Renouf, C., Akerlof, K., & Leiserowitz, A. A. (2013). The relationship between personal experience and belief in the reality of global warming. *Nature Climate Change*, *3*(4), 343-347.

Nabi, R. L. (2003). The framing effects of emotion: Can discrete emotions influence information recall and policy preference? Communication Research, 30, 224- 247. doi:10.1177/0093650202250881

Nabi, R. L. (2007). Emotion and persuasion: A social cognitive perspective. In D. R. Roskos-Ewoldsen & J. Monahan (Eds.), *Social cognition and communication: Theories and methods* (pp. 377-398). Mahwah, NJ: Erlbaum.

Nabi, R. L. (2015). Emotional flow in persuasive health messages. Health Communication, 30, 114-124. doi:10.1080/10410236.2014.974129

Nabi, R. L., Gustafson, A., & Jensen, R. (2018). Framing climate change: Exploring the role of emotion in generating advocacy behavior. *Science Communication*, *40*(4), 442-468.

Nabi, R. L., & Myrick, J. G. (2018). Uplifting fear appeals: Considering the role of hope in fear-based persuasive messages. Health Communication, 9, 1-12. doi:10 .1080/10410236.2017.1422847

Paternoster, R., Brame, R., Mazerolle, P., & Piquero, A. (1998). Using the correct statistical test for the equality of regression coefficients. *Criminology*, *36*(4), 859-866.

Peach, S. (2015) *A hunter/fisherman sees impacts of warming world.* Yale Climate Connections. New Haven, CT: Yale Center for Environmental Communication. Accessed February 5, 2019, https://www.yaleclimateconnections.org/2015/10/a-hunter-fisherman-sees-impacts-of-changing-climate/

Schäfer, T., & Schwarz, M. (2019). The meaningfulness of effect sizes in psychological research: Differences between sub-disciplines and the impact of potential biases. *Frontiers in Psychology*, *10*, 813.

Schmidt, S. (2009). Shall we really do it again? The powerful concept of replication is neglected in the social sciences. *Review of General Psychology*, *13*(2), 90-100.

Smith, N., & Leiserowitz, A. (2014). The role of emotion in global warming policy support and opposition. *Risk Analysis*, *34*(5), 937-948.

So, J., & Nabi, R. (2013). Reduction of perceived social distance as an explanation for media's influence on personal risk perceptions: A test of the risk convergence model. *Human Communication Research*, *39*(3), 317-338.

Spence, A., & Pidgeon, N. (2010). Framing and communicating climate change: The effects of distance and outcome frame manipulations. *Global Environmental Change,* 20, 656-667.

Spence, A., Poortinga, W., & Pidgeon, N. (2012). The psychological distance of climate change. *Risk Analysis: An International Journal*, *32*(6), 957-972.

TurkPrime. (2018, December). Retrieved from turkprime.com.

Van Boven, L., Kane, J., McGraw, A. P., & Dale, J. (2010). Feeling close: emotional intensity reduces perceived psychological distance. Journal of Personality and Social Psychology, 98, 872-885.

van der Linden, S. L. (2014). On the relationship between personal experience, affect and risk perception: The case of climate change. *European Journal of Social Psychology*, *44*, 430–440.

van der Linden, S., Maibach, E., & Leiserowitz, A. (2015). Improving public engagement with climate change: Five "best practice" insights from psychological science. *Perspectives on Psychological Science*, *10*(6), 758-763.

Van Laer, T., De Ruyter, K., Visconti, L. M., & Wetzels, M. (2014). The extended transportation-imagery model: A meta-analysis of the antecedents and consequences of consumers' narrative transportation. *Journal of Consumer Research*, *40*(5), 797-817.

Weber, E. U. (2006). Experience-based and description-based perceptions of long-term risk: Why global warming does not scare us (yet). Climatic Change, 77, 103–120.