3-2015

Does Learning About Climate Change Adaptation Change Support for Mitigation?

Michael P. Vandenbergh

Heather Barnes Truelove

Amanda R. Carrico

David Dana

Journal of Environmental Psychology 41 (2015) 19–29

Contents lists available at ScienceDirect

Journal of Environmental Psychology

journal homepage: www.elsevier.com/locate/jep

Does learning about climate change adaptation change support for mitigation?

Amanda R. Carrico [a, *], Heather Barnes Truelove [b], Michael P. Vandenbergh [c], David Dana [d]

[a] Environmental Studies Program, University of Colorado at Boulder, USA
[b] Department of Psychology, University of North Florida, Jacksonville, FL, USA
[c] Climate Change Research Network, Vanderbilt University Law School, 131 21st Avenue South, Nashville, TN 37203, USA
[d] Northwestern University School of Law, USA

ARTICLE INFO

Article history:
Available online 7 November 2014

Keywords:
Climate change adaptation
Climate change communication
Climate change mitigation
Environmental attitudes
Climate change risk perceptions

ABSTRACT

Many have speculated that increased attention to climate change adaptation will reduce support for mitigation. The Risk Compensation Hypothesis suggests that remedies to reduce the impacts of risky behaviors can unintentionally increase those behaviors. The Risk Salience Hypothesis suggests that information about adaptation may increase the salience of impacts, and therefore increase mitigation support. Experiment 1 presented participants with a news article about an irrigation technology described as a way to improve efficiency (Pure Control), reduce emissions (Mitigation Control), or reduce drought vulnerability (Adaptation). Political moderates in the adaptation condition rated climate change as a higher political priority and were more supportive of a policy to subsidize the technology than those in both controls. Results were not replicated in Experiment 2. These results partially support the Risk Salience Hypothesis. There was no evidence to justify the concern that discussing adaptation will reduce support for mitigation or concern about climate change.

1. Introduction

The climate change discourse in North America and Europe has focused on mitigation over the last several decades. Mitigation typically involves measures to reduce the emission of greenhouse gasses by reducing reliance on fossil fuels. However, in recent years the scientific community has concluded that the effects of climate change are already occurring and that existing greenhouse gas (GHG) concentrations make further warming inevitable (IPCC, 2007). Consequently, the need for measures to adapt to climate change (which typically involves infrastructure or technological changes to cope with the impacts of climate change), in addition to efforts to reduce GHG emissions, has been widely acknowledged by scientists and policymakers (IPCC, 2007; Keskitalo, 2012; National Research Council, 2010). This realization is reflected in the media's handling of climate change as an issue of public significance. Between 1988 and 1990 the topic of adaptation represented less than 1% of all climate related coverage in major news outlets within the US and Great Britain. Since 2003, coverage of this topic has risen dramatically (Boykoff & Roberts, 2007). Thus, an important question is whether this shift in the climate change discourse has affected public perceptions of climate change in a manner that has policy implications.

The addition of adaptation to the public policy discourse is of central importance to both climate mitigation and adaptation policy. If adaptation is necessary, as is becoming increasingly clear, it will warrant discussions of how to design and implement optimal adaptation policies. At the same time, policymakers and scholars in the United States appear to have shied away from discussing adaptation until recently, out of concern that learning about adaptation could reduce policy support for mitigation (Pielke, Prins, Rayner, & Sarewitz, 2007; Ruhl, 2010). According to Victor and colleagues, "until just a few years ago, even discussing adaptation to climate change was taboo …." (Victor, Kennell, & Ramanathan, 2012, p. 119). In addition, for the substantial subset of climate policies that achieve both adaptation and mitigation, the consequences of framing them as one or the other could have important effects on public support for adoption and implementation.

With these concerns in mind, in this study we pose the question: does learning about initiatives to adapt to climate change affect attitudes towards climate change in general and mitigation in particular? After providing a brief review of the relevant literature we describe two studies that examine the effects of framing a policy as climate change mitigation vs. adaptation on attitudes and policy support.

* Corresponding author. University of Colorado at Boulder, UCB 215, Boulder, CO, 80309, USA. Tel.: +1 303 492 9163.
E-mail address: amanda.carrico@colorado.edu (A.R. Carrico).

http://dx.doi.org/10.1016/j.jenvp.2014.10.009
0272-4944/

1.1. Risk compensation

There is some, albeit limited, theoretical and empirical work to suggest that learning about adaptation may, in fact, "spill over" into attitudes towards mitigation. A related phenomenon in the domain of energy consumption and efficiency is the *rebound effect* (also "take-back effect"), which refers to the pattern in which a proportion of the technically achievable energy savings that result from an efficiency upgrade are "taken back" by an increase in usage of the product (Binswanger, 2001; Herring, 2006). Rebound effects occur, for example, when a household increases its thermostat settings during the winter after weatherizing the home (Hirst, White, & Goeltz, 1985). Rebound effects are often explained in economic terms, i.e., improvements in efficiency lead to lower energy costs which lead to an increase in consumption (e.g., Gillingham, Kotchen, Matthew, Rapson, & Wagner, 2013; Jevons, 1866). Although sometimes cited as a reason against promoting energy efficiency (Jenkins, Nordhaus, & Shellenberger, 2011; Tierney, 2011), rebound effects rarely, if ever, fully negate the benefits of energy efficiency improvements, and typically displace less than 30% of expected savings (e.g., Ehrhardt-Martinez & Laitner, 2010; Gillingham et al., 2013; Sorrell, 2007).

In a closely related line of work, others have debated the existence of *negative spillover effects* in pro-environmental actions (Bratt, 1999; Thøgersen, 1999; Tiefenbeck, Staake, & Roth, 2013; Truelove, Carrico, Weber, Raimi, & Vandenbergh, 2014), in which the adoption of one pro-environmental behavior reduces the likelihood of adopting a subsequent pro-environmental action because the individual feels morally "off the hook" (i.e., moral licensing, Zhong, Liljenquist, & Cain, 2009) or that the problem has been dealt with (i.e., single action bias, Weber, 1997). In particular, Weber's work on single action bias has found that farmers who adapt their cultivation practices (such as crop selection) to cope with climate change are unlikely to adopt off-farm adaptions (such as investing in futures) (Weber, 1997, 2006). Similarly, farmers who had engaged in either of these types of adaptations were less supportive of government intervention to mitigate climate change (Weber, 1997). Weber attributed these effects to a reduction in the perceived risk of climate change that resulted from engaging in an initial risk reducing behavior. However, neither study directly tested this explanation for the effect.

Both of these lines of work—rebound and spillover—suggest a negative relationship between engaging in one action and the performance of subsequent behaviors. In addition, work on spillover, moral licensing, and single action bias suggests an important relationship between behavior and attitudes. However, none of these lines of work addresses the potential impact of adopting a remedy in the future on risk perceptions and behavior. The most closely related body of work is in the area of risk compensation. This work suggests that remedies designed to reduce the impacts of high risk behavior can have the unintended consequence of reinforcing it by reducing the actual or perceived risk of engaging in the action. Early theorizing on this phenomenon (e.g., the "Peltzman Effect") originated alongside analyses suggesting that, even after controlling for a host of explanatory variables, the existence of a state seatbelt law is correlated with an increase in motor-vehicle fatalities (Calkins & Zlatoper, 2001; Peltzman, 1975). Authors interpreted this finding as evidence that drivers feel more secure when wearing seatbelts and compensate by driving more recklessly, leading to a greater number of overall traffic accidents and fatalities. As such, this phenomenon is often referred to as an "offsetting effect" or "compensatory behavior" (Calkins & Zlatoper, 2001; Cohen & Einav, 2003).

Although some have challenged this conclusion as it relates to seatbelt usage and driving behavior (e.g., Cohen & Einav, 2003), the underlying theory has been supported with data in other domains (e.g., Bolton, Cohen, & Bloom, 2006). For example, Viscusi argued that at least a portion of the increase in aspirin-related child poisonings after the introduction of child safety caps was due to a "lulling effect" in which consumers were lulled into less safety-conscious behavior by the new technology (Viscusi, 1984). Studies in the wake of major medical advances in the treatment of HIV found that a small but nontrivial proportion of gay or bisexual men (15–25%) reported that they were less concerned about becoming infected with HIV, and roughly 10% reported that they had engaged in higher risk sexual activity since new treatments had become available (Dilley, Woods, & McFarland, 1997; Kelly, Hoffman, Rompa, & Gray, 1998). Using an experimental design, Bolton and colleagues also found evidence that remedy messages (e.g., information about medicinal smoking cessation or debt consolidation opportunities) undermined risk perceptions and intentions to reduce risky behaviors—in this case smoking and credit card usage behaviors (Bolton et al., 2006).

Although more often discussed within the context of individual risk-taking behavior, multiple studies have found a relationship between knowledge of a remedy to reduce the impacts of high risk behavior and risk perceptions associated with the behavior in question (Bolton et al., 2006; Dilley et al., 1997; Kelly et al., 1998). Others have hypothesized that a reduced sense of concern over the impacts of one's behavior accounts for risk compensation behaviors (Peltzman, 1975; Viscusi, 1984). It is plausible that a similar *lulling effect* may also influence beliefs about the risks presented by climate change and the necessity of efforts to mitigate climate change. Like many health behaviors, climate change can be managed to some degree through prevention (akin to mitigation) or by coping with its impacts (akin to adaptation). If individuals learn about opportunities to adapt to future climate change impacts, they may see adaptation as a viable alternative to mitigation. In other words, individuals may become less concerned about climate change because they view adaptation as a remedy to the problem that can be paid for in the distant future and therefore believe that present costly preventative actions are no longer necessary. Adaptation may be costly as well; however, work on inter-temporal discounting suggests that individuals tend to apply steep discount rates to future costs relative to upfront costs (e.g., Ainslie & Haslam, 1992; Soman et al., 2005; Thaler, 1981). Individuals thus may perceive the future costs of adaptation to be lower than the current costs of mitigation, thereby reinforcing the perception that adaptation is an attractive alternative to mitigation.

1.2. Risk salience

An alternative and competing hypothesis is that learning about adaptation information may make climate change impacts more salient and thus increase concern about climate change and support for preventive measures. Although a majority of the public in North America and Europe believe that climate change is occurring, most see it as a problem that will occur in the distant future or in distant places (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007; Spence, Poortinga, & Pidgeon, 2011; Whitmarsh, 2008b) and few cite climate change as a top priority among national issues (Lorenzoni et al., 2007; Nisbet & Myers, 2007). Likewise, although global surface temperatures have already begun to rise, the impacts of climate change are subtle, slowly evolving, and typically overwhelmed by day-to-day variations in weather. As a result, climate change itself is not directly observable, particularly by the lay public. Some have hypothesized that this has led to low risk salience for individuals, which reduces motivation to take actions to prevent the problem (Whitmarsh, 2008a).

Learning about options for adaptation, in contrast, may provoke an individual to visualize the impacts of climate change by considering the adjustments that will be necessary to adapt to a warmer climate. This information could actually increase the negative images that are associated with climate change and may, as a result, increase support for preventive mitigation policy. It is known that negative image associations are related to increased risk perceptions of global warming (Smith & Leiserowitz, 2012) and support for climate policy (Leiserowitz, 2006). Work examining climate visualization platforms for educational and planning purposes have made similar arguments (e.g., Sheppard, 2005), hypothesizing that visual communication approaches that attempt to look into the future to assess the implications of climate change could be a powerful tool for motivating behavior change in the present. In a recent paper, Evans and colleagues (Evans, Milfont, & Lawrence, 2014) showed that respondents in New Zealand who were asked to respond to a set of questions regarding sea level rise and climate change adaptation measures in their local community reported a greater willingness to perform emissions-reducing behaviors compared to those who had not received these questions. This finding is consistent with the risk salience hypothesis and the expectation that learning about adaptation may actually heighten concerns about climate change and the need for mitigation.

1.3. Motivated reasoning

Motivated reasoning refers to the process whereby persuasive messages are interpreted through the audience's pre-existing worldview and cultural lens (Cohen, 2003; Kahan, Jenkins-Smith, & Braman, 2011). In this way, people with different ideologies can interpret the same message differently as they implicitly encode the message in line with their pre-existing views. Messages that are in line with one's worldview are easily assimilated as support for one's position, while messages that oppose one's pre-existing views are often disregarded or discounted based on superficial cues in the message (Kahan et al., 2011).

The most significant worldview, when considering climate change policy in the U.S., is political ideology. Climate change is highly polarized among liberals and conservatives in the U.S. (McCright & Dunlap, 2011) and political ideology has repeatedly been shown to influence climate change risk perceptions and policy preferences (Dietz, Dan, & Shwom, 2007; Leiserowitz, 2006; Tobler, Visschers, & Siegrist, 2012). Compared to political liberals and Democrats, political conservatives and Republicans are less concerned about climate change, believe there is less scientific consensus about climate change, and have lower levels of support for climate policy (McCright & Dunlap, 2011). Thus, information about climate change adaptation is expected to have differential effects on individuals' climate change concerns and support for climate policy based on their political ideology. The process of motivated reasoning should be most evident among liberals and conservatives, such that liberals will show support for climate change mitigation or adaptation policies and conservatives will show opposition regardless of the frame of the message to which they are exposed. However, political moderates may be less susceptible to motivated cognitions because the worldview of the politically moderate person in the US does not specify that he or she should be either in support of or in opposition to climate policy.

1.4. Study overview & hypotheses

In this study we test the two competing hypotheses of risk compensation vs. risk salience in response to learning about opportunities for adaptation to climate change. Participants were randomly assigned to read one of three mock news articles. In one version, the article described a policy to adapt to climate change (adaptation condition), in another version the article described the same policy but the purpose was to mitigate climate change (mitigation control), in a third condition the article described the same policy but the purpose was unrelated to climate change (pure control). Comparisons between those assigned to the adaptation condition and the two control conditions provide insight into the effect of learning about adaptation on risk perceptions and support for mitigation.

Although our hypotheses center around differences between participants assigned to the adaptation and mitigation control conditions, we included a "pure control" condition that makes no mention of climate change for two reasons. First, a pure control allows us to examine attitudes in the absence of any exposure to climate-related information, and whether exposure to information about climate change mitigation vs. climate change adaptation differentially affects these attitudes. For example, we may expect to see an impact of climate-related information on risk perceptions because the individual has been primed to consider the risks of climate change. In particular, the risk compensation hypothesis would suggest that recognizing opportunities for future remedies may reduce the perceived necessity of immediate preventive action. By comparing responses across the adaptation, mitigation control, and pure control conditions we can disentangle whether learning about adaptation influenced attitudes in a way that is unique from learning about climate change impacts.

Second, including the pure control condition allowed us to understand differences in public perceptions that may exist in response to a policy that is motivated to address climate change (whether adaptation or mitigation) vs. an identical policy that is motivated by other reasons. Although understanding these differences is not the primary focus of this study, it does provide insight into the extent to which information about any type of policy response to climate change, whether adaptation or mitigation, may affect climate change beliefs and policy support.

We predict that if learning about adaptation leads to risk compensation, those in the adaptation condition will exhibit less concern about the problem of climate change [H1a] and less support for mitigation policy [H1b] than those in either the mitigation control or pure control conditions. If learning about adaptation leads to risk salience, we would expect the opposite pattern. That is, we would expect that individuals in the adaptation condition would demonstrate greater concern about the problem [H2a] and greater support for mitigation [H2b] compared to those in either the mitigation control or pure control conditions.

Finally, in H3 we expect that political ideology will moderate the effect of message frame on policy support. We predict that the effect of adaptation information on attitudes and mitigation policy support (consistent with either H1 or H2) will be most pronounced among political moderates because moderates are less committed to an ideological worldview and, therefore, less vulnerable to the processes of motivated reasoning than are liberals and conservatives.

2. Experiment 1

2.1. Method

2.1.1. Overview of experimental design

Experiment 1 involved an online study in which participants agreed to complete a 15–20 min survey. After answering a few basic demographic questions, participants were asked to read a short news article of the type they might find in an online version of a newspaper. The article described a new highly efficient irrigation technology and a Department of Agriculture program that would

Table 1
Experimental manipulations used in experiment 1.

Pure control	Mitigation control	Adaptation
Technological advances help American farmers manage water. DES MOINES – Recent developments in irrigation technology may have profound impacts on the way that water is managed by American farmers, helping to increase the efficiency of water use for farming practices. A new system developed by researchers and engineers at the Institute for Irrigation Science (IIS) in Des Moines includes electronic moisture sensors, high-efficiency irrigation pumps and virtual control technologies that allow farmers to deliver water more efficiently. The results from multiple years of evaluation research show crop yields that are as good as previous years, but with significantly less energy and water inputs. Considering that irrigation accounts for over 30% of water consumption in the U.S., these developments could play a major role in conserving water. Despite the potential payoffs, the cost of adopting this system may be prohibitive for many small and medium-sized farms. However, some farmers may be eligible to receive government assistance with the help of a new farm technology assistance program currently under review in the Department of Agriculture.	**Technological advances help American farmers manage water; reduce emissions that cause global warming.** DES MOINES – Recent developments in irrigation technology may have profound impacts on the way that water is managed by American farmers, while simultaneously reducing the release of heat trapping gases that cause global warming. A new system of irrigation developed by researchers and engineers at the Institute for Irrigation Science (IIS) in Des Moines includes electronic moisture sensors, high-efficiency irrigation pumps and virtual control technologies that allow farmers to deliver water more efficiently. The results from multiple years of evaluation research show crop yields that are as good as previous years, but with significantly less energy and water inputs. Considering that agriculture accounts for 8% of U.S. global warming emissions, these developments could play a major role in reaching U.S. targets for reducing greenhouse gas emissions to prevent global warming. Despite the potential payoffs, the cost of adopting this system may be prohibitive for many small and medium-sized farms. However, some farmers may be eligible to receive government assistance with the help of a new global warming mitigation program currently under review in the Department of Agriculture.	**Technological advances help American farmers manage water; adapt to global warming.** DES MOINES – Recent developments in irrigation technology may have profound impacts on the way that water is managed by American farmers, helping farmers to adapt to hotter temperatures and increased drought expected with global warming. A new system of irrigation developed by researchers and engineers at the Institute for Irrigation Science (IIS) in Des Moines includes electronic moisture sensors, high-efficiency irrigation pumps and virtual control technologies that allow farmers to deliver water more efficiently. The results from multiple years of evaluation research show crop yields that are as good as previous years, but with significantly less energy and water inputs. Considering that global warming is expected to bring hotter temperatures and drought to much of the U.S., these developments could play a major role in helping farmers to reduce crop damages expected from global warming. Despite the potential payoffs, the cost of adopting this system may be prohibitive for many small and medium-sized farms. However, some farmers may be eligible to receive government assistance with the help of a new global warming adaptation program currently under review in the Department of Agriculture.

Note. Underlined text indicates the components that varied across the three conditions.

provide financial assistance for farmers who wish to adopt the technology. Participants were randomly assigned to receive one of three versions of this article in which the rationale for the new technology varied. For all conditions, participants read that the new technology would deliver water more efficiently. This base information constituted the pure control condition. Additional information was added for the other conditions. Participants assigned to the mitigation control condition read that the technology would help reduce greenhouse gas emissions by improving efficiency in irrigation systems. Those assigned to the adaptation condition read that the technology would allow farmers to adapt to hotter temperatures expected with global warming by improving water delivery to crops. The full text included in each experimental manipulation is provided in Table 1.

After reading the experimental manipulation, participants completed a series of comprehension questions that served as a manipulation check. Following this, they completed the remainder of the questionnaire, which measured various constructs of interest, including support for mitigation policy and global warming risk perceptions.

2.1.2. Respondents

Adult research participants ($N = 1522$) were recruited through Mechanical Turk (MTurk) to participate in an online study about their opinions towards national current events in exchange for $0.50. Mturk is a cost-effective forum for conducting research and has been effectively used by behavioral researchers in a variety of settings with results that approximate traditional recruitment methods in terms of data quality (Buhrmester, Kwang, & Gosling, 2011; Mason & Suri, 2011).

The dataset was screened for duplicates and 58 were identified and removed. An additional 274 participants were omitted for failing a basic comprehension test. The final sample ($N = 1190$) was 50.5% male and 84% white. The mean age was 31.5, the median education was “College Graduate” and the median income was $35 k–49 k per year.

2.1.3. Measures

Four dependent variables (DVs) were considered in these analyses. We included one measure of support for policies to decrease greenhouse gas emissions (Mitigation Support). We included two measures of concern about global warming. One measure, designed to assess global warming risk perceptions (GW Risk), included two items that assess the likelihood and severity of global warming effects adapted from Leiserowitz (2006). The second measure (GW Political Priority) collected information about the importance assigned to global warming as a political issue relative to other major national issues (e.g., the economy, education, immigration). This measure has been shown to be an important predictor of political behavior (Iyengar, Hahn, Krosnick, & Walker, 2008). Finally, we included a measure of support for the plan that was proposed in the news article (Plan Support). The exact wording for each set of DVs and descriptive statistics are provided in Table 2.

We also included a measure of the respondent's political ideology. Participants were asked how they would best describe their political orientation for fiscal (financial and economic) issues as well as for social issues. Responses were made on a 7-point scale anchored by 1 = liberal, 4 = moderate, and 7 = conservative. The two items were highly correlated ($r = 0.60$, $p < 0.01$) and were averaged to create a single measure of political ideology. Respondents were then categorized into one of three groups. Those who averaged a 3 or lower on the ideology scale were classified as liberals ($n = 605$, 50.9%), those who scored between 3.5 and 4.5 were classified as moderates ($n = 395$, 33.2%), and those who scored 5.0 and above were classified as conservatives ($n = 189$, 15.9%).

2.2. Results

A series of 3 (article condition) × 3 (ideology) analyses of variance (ANOVAs) were performed on the four dependent variables (DVs). Sample sizes for each cell in this 3 × 3 factorial design are presented in Table 3. To control for family wise error, we used

Table 2
Dependent measures and descriptive statistics.

Variable name	Item(s)	*M*	SD	Range
Mitigation support [Used in Experiment 1 only)	In general, do you oppose or support the US taking action to decrease greenhouse gas emissions to reduce global warming? (Response options ranged from 1 = not at all, 4 = somewhat, 7 = very much)	5.52	1.59	1–7
GW risk	How likely do you think it is that the climate in the U.S. will change significantly over the next 50 years? (1 = extremely unlikely, 7 = extremely likely) If the climate in the U.S. changed significantly over the next 50 years, how positive or negative would the impacts be? (1 = extremely positive, 4 = neutral, 7 = extremely negative) (The two items were multiplied to calculate a score of risk perceptions as a function of likelihood × severity).	30.52	13.12	1–49
GW political priority	Here are some issues now being discussed in Washington D.C. Regardless of your position on these issues, please rate each issue according to whether you think it should be a low, medium, high, or very high priority for the President and Congress. (Response options were: 1 = low, 2 = medium, 3 = high, 4 = very high; Participants rated 10 issues, e.g., Economy, Education, Immigration, and Global Warming. Only the score for Global Warming is used here).	2.59	1.00	1–4
Plan support [Used in Experiment 1 only]	How much do you oppose or support the department of agriculture offering financial assistance to farmers who wish to purchase this new irrigation technology that you just read about? (Response options were: 1 = strongly oppose, 4 = neutral, 7 = strongly support)	5.41	1.40	1–7
Mitigation WTP (log) [Used in Experiment 2 only, replaced Mitigation Support]	It has been proposed that there are things that the US can do to lessen global warming by reducing the release of heat trapping greenhouse gases. How many extra dollars in taxes would you be willing to pay on your next tax filing if you knew the extra money would be spent to lessen global warming. (Respondents were asked to report their WTP in the form of dollars and cents; The distribution has been log transformed)	40.85	90.22	0–1000
Plan WTP (log) [Used in Experiment 2 only, replaced Plan Support]	How many extra dollars in taxes would you be willing to pay on your next tax filing if you knew the extra money would be spent to convert to white roofs in your region? (Respondents were asked to report their WTP in the form of dollars and cents; The distribution has been log transformed)	37.04	98.51	0–1000

Benjamini and Hochberg's (1995, 2000) adaptive false discovery rate (FDR) procedure. The results of the ANOVAs are summarized in Table 4, and the grand mean for each DV and estimated marginal means for the article condition and ideology factors are shown in Table 5.

There was a significant main effect of ideology for all four dependent variables, with effect sizes in the medium to large range. As can be seen in the lower portion of Table 5, compared to moderates, conservatives were significantly less supportive of mitigation, perceived less risk of global warming, assigned a lower political priority to global warming, and were less supportive of the proposed plan. Liberals scored significantly higher than moderates on the same four dependent variables.

There was also a marginally significant main effect of article condition for mitigation support, though the effect size was very small. Planned comparisons revealed that support for mitigation policy was lower in the pure control condition than either the mitigation control ($p < 0.03$) or the adaptation ($p < 0.05$) conditions. However, there was no difference between the adaptation and mitigation control conditions. Although the adaptation condition differed from the pure control, the fact that it was not statistically different from the mitigation control suggests this effect is not unique to learning about adaptation. Instead, this suggests that those who received any information about climate change (regardless of whether it was about mitigation or adaptation) were more supportive of mitigation policy than those who did not receive information about climate change.

There was also a second marginally significant effect of article condition on plan support. Respondents were more supportive of the proposed plan to subsidize a new irrigation technology when it was described as an initiative to adapt to climate change rather an initiative to mitigate climate change ($p < 0.05$). However, there was no difference in plan support between those in the adaptation and pure control conditions ($p = 0.86$).

Both main effects were qualified by marginally significant interaction effects between article condition and political ideology. A third marginally significant interaction effect was also found for the dependent variable, political priority. The adjusted means associated with each of these three effects are plotted in Fig. 1. Planned comparisons for mitigation support revealed that liberals who received the adaptation condition did not differ from those who were assigned to either control condition. However, liberals who received

Table 3
Sample size by experimental condition, ideological group, and condition × ideology for Experiments 1 and 2.

	Experiment 1				Experiment 2			
	Liberal	Moderate	Cons.	Total	Liberal	Moderate	Cons.	Total
Control	251	164	63	478	168	118	66	352
Mitigation	173	118	63	354	158	115	63	336
Adaptation	181	113	63	357	132	102	44	278
Total	605	395	189	1189	458	335	173	966

Note. One participant in Experiment 1 and one participant in Experiment 2 refused to answer the political ideology questions. These individuals were removed from the analyses.

Table 4
Summary of experiment 1 ANOVA results.

Dependent variable	Effect	*F*	*df*	*p*	η^2
Mitigation support	Article	3.09	2	0.05[b]	<0.01
	Ideology	173.34	2	<0.00[a]	0.23
	Article × Ideology	2.15	4	0.07[b]	0.01
GW risk	Article	1.41	2	0.25	<0.02
	Ideology	74.20	2	<0.00[a]	0.11
	Article × Ideology	0.90	4	0.47	<0.01
Political priority	Article	2.44	2	0.09	<0.01
	Ideology	71.42	2	<0.00[a]	0.11
	Article × Ideology	2.62	4	0.03[b]	0.01
Plan support	Article	3.52	2	0.03[b]	0.01
	Ideology	62.85	2	<0.00[a]	0.10
	Article × Ideology	2.73	4	0.03[b]	0.01

[a] Significant effect.
[b] Marginally significant effect. All significance levels are based on FDR corrected alpha levels.

the mitigation control article were marginally more supportive of mitigation policy than those who received the pure control ($p < 0.10$). This may reflect a "bump" in support for mitigation after learning about a mitigation policy proposal. There was no effect of experimental condition among moderates or conservatives.

Planned comparisons for the political priority DV suggested that moderates who received the adaptation article rated climate change as a significantly higher political priority than those who received the pure control ($p < 0.05$) and mitigation control articles ($p < 0.01$). However, liberals and conservatives did not differ between the three conditions on this variable.

Finally, the interaction effect for plan support also indicated that moderates were significantly more supportive of the plan in the adaptation condition than in the mitigation control condition ($p < 0.01$). They were also marginally more supportive than those in the pure control condition ($p < 0.10$). Interestingly, moderates were also marginally less supportive of the plan in the mitigation condition than in the control condition ($p < 0.10$). On the other hand, conservatives were significantly more supportive of the plan in the pure control condition than in both the mitigation control ($p < 0.05$) and adaptation ($p < 0.05$) conditions. There was no difference in plan support between the latter two conditions, suggesting that this effect was driven by its connection to climate change rather than its connection to either mitigation or adaptation policy specifically.

2.3. Discussion

A number of conclusions can be drawn from the results of Experiment 1. First and foremost, these results clearly show that

Table 5
Experiment 1 adjusted means and standard errors for the full sample and for the levels of article condition and ideology.

	Mitigation support	GW risk	Political priority	Plan support
Grand mean	5.17 (0.05)	28.52 (0.41)	2.43 (0.03)	5.24 (0.04)
Article condition				
Pure control	5.01 (0.08)[1]	27.71 (0.67)[1]	2.93 (0.05)[1]	5.32 (0.07)[1]
Mitigation control	5.26 (0.08)[2]	28.49 (0.73)[1]	2.37 (0.06)[1]	5.08 (0.08)[2]
Adaptation	5.24 (0.08)[2]	29.37 (0.73)[1]	2.53 (0.06)[1]	5.34 (0.08)[1]
Ideology[a]				
Liberal	6.20 (0.06)	34.62 (0.52)	2.87 (0.04)	5.84 (0.06)
Moderate	5.18 (0.07)	28.16 (0.64)	2.48 (0.05)	5.21 (0.07)
Conservative	4.12 (0.10)	22.80 (0.91)	1.94 (0.07)	4.68 (0.10)

Note. Means (within a DV) bearing identical superscripts are not statistically different than one another at the $p < .05$ level.
[a] All mean differences (within a DV) between ideology groups are significantly different at the $p < .001$ level.

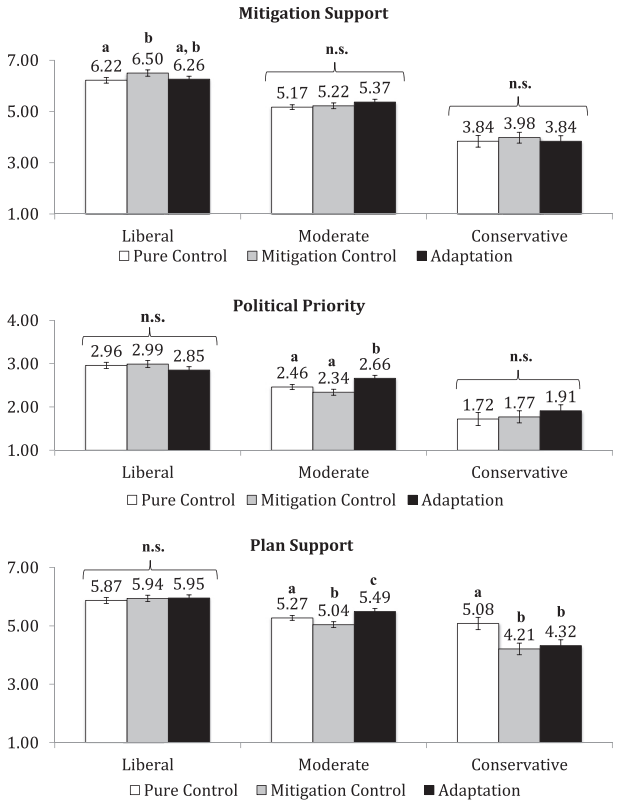

Fig. 1. Interaction effects from Exp. 1. Bars bearing identical subscripts are not significantly different ($p > 0.10$). N.S. = not significant.

the impact of the respondent's political ideology was vastly more important than any effect of message framing. Effect sizes suggest that political ideology had a medium to large effect on all DVs. On the other hand, the effect sizes associated with article condition, as well as the interaction between article condition and ideology, were consistently small. This pattern of results reinforces the conclusion that political ideology is one of the single most important factors in determining an individual's attitudes and beliefs concerning climate change (Leiserowitz, Maibach, Roser-Renouf, & Smith, 2011; McCright & Dunlap, 2011; Smith & Leiserowitz, 2012), and is substantially larger than the impact of how the message was framed.

Nevertheless, this pattern of results is partially consistent with Hypotheses H2a and H3. Political moderates who learned that the technology was designed to adapt to climate change assigned the issue a higher political priority (approximately 10% higher on average) than those who learned the technology was designed for the purpose of mitigation or water conservation. Moderates also expressed greater support for a government plan to subsidize the dissemination of the new technology when the stated objectives were to facilitate adaptation. Those assigned to the adaptation condition scored, on average, 4% higher than those in the pure control condition and 9% higher than those in the mitigation control condition. These patterns seem to be consistent with the risk salience hypothesis—suggesting that learning about adaptation may promote a somewhat greater concern about the problem rather than a diminished one. However, it is important to note that support for this hypothesis was found only for 2 out of the 4 DVs. Learning about adaptation had no impact on support for mitigation and no impact on global warming risk perceptions.

It is necessary to reiterate that support for the risk salience hypothesis was found only among political moderates; there is no

suggestion that this response to learning about adaptation would generalize to other political groups within the population. The fact that these effects occurred only among moderates does provide some support for H3. It is likely that any impact of message framing was overwhelmed by ideological commitments among those at the ends of the political spectrum. Liberals and conservatives have a more well-defined point of view on the highly polarized issue of climate change and, for this reason, we would expect these individuals to be less responsive to the type of subtle message changes that we used in this study. In other words, the attitudes of liberals and conservatives may be more stable in response to how information is framed, whereas the greater ambivalence of political moderates may have resulted in a shifting response according to changes in the message content (Conner & Armitage, 2008). This interpretation is consistent with other work, in the wake of the Fukushima nuclear accident, that found that individuals who were more ambivalent about nuclear energy prior to the accident were the most likely to display an attitude change towards nuclear energy after the accident (Visschers & Wallquist, 2013).

Liberals consistently scored the highest on all DVs, reflecting the position that climate change, among other environmental concerns, should be dealt with through government intervention (Leiserowitz, Maibach, Roser-Renouf, Feinberg, & Howe, 2012; McCright, Xiao, & Dunlap, 2014). Likewise, conservatives consistently ranked the lowest on all DVs. An exception to this latter finding is in the case of conservatives' support for the proposed plan. Those assigned to the pure control condition supported government subsidies to disseminate the irrigation technology at a level that was within range (though slightly lower) than liberals and moderates. However, those assigned to either the mitigation control or adaptation conditions scored approximately 16% lower on plan support. This suggests that any connection of the proposed plan to climate change—whether mitigation or adaptation—resulted in less support among conservatives. This is not surprising given the widespread skepticism about the science of climate change expressed among more conservative members of the public (McCright & Dunlap, 2011).

3. Experiment 2 (white roofs)

3.1. Methods

Experiment 2 was designed to determine whether the results from Experiment 1 could be replicated using an identical experimental design but a different issue focus. In this case, participants were shown an article describing a plan to convert to “white roofs” on buildings owned by the city of New York to reduce the need for air conditioning (Table 6). The rationale given for this initiative was randomized across experimental groups. In the control condition the rationale was to reduce strain on the power grid, in the mitigation condition the rationale was to reduce greenhouse gas emissions, and in the adaptation condition the rationale was to reduce strain on the electricity grid during heat waves expected with global warming.

In addition, the one-item measure of support for mitigation policy and support for the plan described in the article was replaced with a measure of the participant's self-reported willingness to pay (WTP) for these policies. Participants were asked how many extra dollars in taxes they would be willing to pay to (1) lessen global warming (WTP for Mitigation) and (2) convert white roofs in their region (Plan WTP). The specific item wordings and descriptive statistics are shown in the bottom portion of Table 2. This revision was made to reduce the possibility of ceiling effects—in Experiment 1 Liberals averaged a score of 6.2 out of 7.0 in their support for mitigation policy. In addition, by asking participants to consider how much they would be willing to pay out of pocket personally for mitigation policy or the described plan, we hoped to produce a finer distinction in levels of support. Similar items have been used successfully by Guagnano, Dietz, and Stern (1994).

Participants were categorized into ideological groups using the same procedure described in Experiment 1. Those who averaged a 3 or lower on 7-point measures of fiscal and social political ideology were categorized as liberal ($n = 458$, 47.4%), those who scored between 3.5 and 4.5 were classified as moderates ($n = 335$, 34.7%), and those who averaged a 5 or higher were classified as conservative ($n = 173$, 17.9%).

3.1.1. Respondents

Participants were $N = 1193$ adults recruited through MTurk. After screening participants, $n = 38$ duplicates were removed and $n = 188$ were removed for failing a comprehension test. The remaining sample ($N = 967$) was 79% white and 50.5% male. The mean age was 34.2 years, the median education was “College Graduate” and the median income was “$35,000–$49,999.”

3.2. Results

An examination of the distributions prior to analysis revealed a number of extreme outliers on the two WTP variables. The distribution for Mitigation WTP ranged from $0 to $10,000 and Plan WTP

Table 6
Experimental manipulations used in experiment 2.

Control	Mitigation	Adaptation
New York Moves to White Roofs to Reduce Strain on Electrical Grid NEW YORK CITY roofs may soon have a new look as part of a city-wide effort to the reduce strain on electricity supplies during hot summer months. Relying on the centuries-old principle that light-colored objects absorb less heat than dark ones, New York City is embarking on a year-long effort in which the roof space on city-owned buildings will be converted to a light-colored, reflective material. Studies show that these alterations will reflect more of the sun's heat back into space and can reduce the need for air-conditioning by 20% or more – meaning less strain on the electrical grid and reducing the likelihood of power failures. This effort is part of a city-wide initiative to improve power transmission throughout New York City.	**New York Moves to White Roofs to Reduce Global Warming** NEW YORK CITY roofs may soon have a new look as part of a city-wide effort to reduce greenhouse gas emissions that are causing global warming. Relying on the centuries-old principle that light-colored objects absorb less heat than dark ones, New York City is embarking on a year-long effort in which the roof space on city-owned buildings will be converted to a light-colored, reflective material. Studies show that these alterations will reflect more of the sun's heat back into space and can reduce the need for air-conditioning by 20% or more – meaning fewer greenhouse gas emissions that cause global warming. This effort is part of a city-wide initiative within New York City to prevent further global warming.	**New York Moves to White Roofs to Adapt to Global Warming** NEW YORK CITY roofs may soon have a new look as part of a city-wide effort to adapt to rising temperature associated with global warming. Relying on the centuries-old principle that light-colored objects absorb less heat than dark ones, New York City is embarking on a year-long effort in which the roof space on city-owned buildings will be converted to a light-colored, reflective material. Studies show that these alterations will reflect more of the sun's heat back into space and can reduce the need for air-conditioning by 20% or more – reducing the likelihood of power failures during heat waves that are expected with global warming. This effort is part of a city-wide initiative to prepare New York City for the effects of global warming.

Note. Underlined text indicates the components that varied across the three conditions.

Table 7
Summary of experiment 2 ANOVA results.

Dependent variable	Effect	*F*	*df*	*p*	η^2
Mitigation WTP[c]	Article	3.67	2	0.03[b]	0.01
	Ideology	61.40	2	<0.01[a]	0.12
	Article × Ideology	0.62	4	0.65	<0.00
GW risk	Article	2.95	2	0.05[b]	0.01
	Ideology	92.88	2	<0.00[a]	0.16
	Article × Ideology	0.60	4	0.67	0.00
Political priority	Article	0.80	2	0.45	0.00
	Ideology	95.52	2	<0.00[a]	0.17
	Article × Ideology	0.86	4	0.49	0.00
Plan WTP	Article	1.37	2	0.26	<0.01
	Ideology	22.77	2	<0.00[a]	0.05
	Article × Ideology	0.10	4	0.98	<0.01

[a] Significant effect.
[b] Marginally significant effect. All significance levels are based on FDR corrected alpha levels.
[c] Due to a violation of the normality assumption, this analysis was run using a nonparametric ANOVA on ranks procedure.

Table 8
Experiment 2 grand means and standard errors for the full sample and for the levels of article condition and ideology.

	Mitigation WTP	GW risk	Political priority	Plan WTP
Grand mean	444.31 (9.13)	27.56 (0.44)	2.45 (0.03)	456.76 (9.54)
Article condition				
Pure control	435.99 (15.00)[1]	26.52 (0.72)[1]	2.44 (0.05)[1]	470.50 (15.58)[1]
Mitigation control	474.17 (15.10)[2]	28.97 (0.74)[2]	2.51 (0.06)[1]	466.19 (15.84)[1]
Adaptation	413.77 (17.25)[1]	27.21 (0.84)[1,2]	2.40 (0.06)[1]	433.59 (18.06)[1]
Ideology[a]				
Liberal	566.45 (12.18)	35.01 (0.59)	3.00 (0.04)	531.18 (12.72)
Moderate	436.86 (14.16)	27.38 (0.69)	2.48 (0.05)	472.00 (14.82)
Conservative	320.61 (20.06)	20.30 (0.97)	1.87 (0.07)	367.10 (20.94)

Note. Means (within a DV) bearing identical superscripts are not statistically different than one another at the $p < .10$ level.
[a] All mean differences (within a DV) between ideology groups are significantly different at the $p < .01$ level.

ranged from $0 to $1,000,000. However, only a handful of participants reported figures above $1000 ($n = 1$ for Mitigation WTP and $n = 3$ for Plan WTP). Therefore, these cases were omitted. Even after removing the outliers, the distributions for both WTP measures were heavily skewed in the positive direction. In addition, a large number of $0 responses (21%–23%) caused bimodal distributions. Because the distributions violated the assumption of normality required for traditional general linear model procedures, both variables were analyzed using the nonparametric ANOVA on ranks procedure (Conover & Iman, 1981)[1] The remaining two DVs were analyzed using 3 × 3 ANOVAs. The results for all four omnibus tests are summarized in Table 7. Sample sizes for each cell of the factorial design are shown in the right-hand column of Table 3. Familywise error was controlled using the FDR procedure. Adjusted marginal means are presented in Table 8.

There was a significant main effect of political ideology for all four dependent variables. The effect sizes were medium for Mitigation WTP, GW Risk, and Political Priority, and small for Plan WTP. The pattern of means (Table 8) was nearly identical to what was found in the previous study such that political conservatives were less concerned about global warming and less supportive of mitigation policy or the proposed plan than moderates, whereas liberals were more concerned about global warming and more supportive of mitigation and the proposed plan.

The effect sizes associated with article condition and the article condition × ideology interaction effects were consistently small. There was a marginally significant main effect of article condition on Mitigation WTP. Controlling for political ideology, participants who received the adaptation message reported a significantly lower WTP for mitigation than those in the mitigation control condition ($p < 0.01$), but not the pure control condition ($p = 0.33$). Those in the mitigation control condition reported a marginally higher WTP than those in the pure control conditions ($p < 0.10$). Again, this suggests that participants were more supportive of mitigation after learning about a mitigation policy.

There was also a marginally significant main effect of article condition on GW Risk. Planned comparison suggested that the participants who received the adaptation article did not differ in GW Risk perceptions compared to those who received the mitigation control article ($p = 0.12$) or the pure control article ($p = 0.53$). However, those in the mitigation control condition reported a greater perceived risk of climate change compared to those in the pure control condition ($p < 0.05$).

Inconsistent with Experiment 1, there were no main effects of article condition on political priority and no interaction effects between article condition and political ideology on political priority or Plan WTP.

3.3. Discussion

The results from Experiment 2 provided no support for Hypotheses 1–3. As in Experiment 1, there was a significant main effect of political ideology for all DVs, and effect sizes suggested that ideology exerted a much stronger influence on attitudes towards climate change than the experimental manipulation of the message. Two marginally significant main effects of article condition were found for Mitigation WTP and GW risk perceptions; however, in neither case did the pattern of means conform to what was predicted under the risk compensation (H1) or risk salience (H2) hypotheses and, instead, suggest no effect of an adaptation message on mitigation attitudes concern about climate change.

In the case of Mitigation WTP, those assigned to the mitigation control condition were more supportive of mitigation than those in the adaptation condition, and marginally more supportive than those in the pure control condition. We interpret this as a "bump" in support for mitigation associated with learning about a proposal to mitigate climate change. Given that WTP for mitigation was lower in the adaptation condition than in the mitigation control condition, it is possible to interpret this result as a reduction in support for mitigation policy as a function of learning about adaptation. However, there was no statistically significant difference between WTP among those assigned to the adaptation conditions and those assigned to the pure control condition (the *p*-value in this case was 0.33). In other words, support for mitigation among those who read about an initiative to adapt to climate change was statistically equivalent to those who had not been exposed to information about climate change. For this reason, we see it as unlikely that learning about adaptation was associated with a reduction in support for mitigation, but rather that learning about mitigation was associated with an increase in support for mitigation. A similar pattern was found in Experiment 1; however only among political liberals.

There was also evidence that learning about mitigation provoked a greater perceived risk of climate change compared to those who received the pure control message. However, there was no

[1] These data were also analyzed using an ANOVA on the log transformed dependent measure and produced nearly identical results. Although the ANOVA procedure is typically considered to be robust to violations of normality, both the analysis on the log transformed DV and the ANOVA on ranks procedure produced different results than the traditional ANOVA procedure.

difference in risk perceptions between those in the mitigation control and adaptation conditions. It is possible that this was related to learning about climate change; it would not be surprising to the find that articles that explicitly mention climate change generate heightened climate related risk perceptions. However, the difference between the adaptation and pure control conditions was not statistically significant. Given this finding, it is possible there is something unique about the mitigation message that affected perceived risk. However, it is also possible that with improved power it would become apparent that this effect is due to the mention of climate change, rather than something specific about mitigation. Future studies should examine this question to provide further insight. It is also worth noting, that this effect was not replicated in Experiment 1.

4. Conclusions

In line with other work that has examined public understanding and attitudes towards climate change in the United States, this research suggests that one of the single most important factors in predicting an individual's level of concern about climate change and support for policy is his or her political ideology (Leiserowitz et al., 2011; McCright & Dunlap, 2011; Smith & Leiserowitz, 2012). Liberals within the sample were consistently the most concerned about the problem and the most supportive of initiatives to intervene, whereas political conservatives were consistently the least concerned and supportive.

This research also provided partial support for the risk salience hypothesis: exposure to information about adapting to global warming increased the perceived urgency of climate change as a political issue and garnered more support for a policy to subsidize agricultural technology to improve irrigation. However, this effect was only found among political moderates who, presumably, are less fixed in their issue positions regarding climate change. In addition, the effect sizes associated with these results were small by accepted standards, and substantially smaller than the effect of ideology.

Although these findings provide support for the proposition that learning about adaptation increased risk perceptions and a form of policy support, learning about adaptation did not affect support for mitigation policy, therefore providing only partial support for risk salience (Hypothesis 2). These inconsistent findings across dependent variables do inject some uncertainty in these conclusions and, therefore, additional research in this area is warranted. However, these finding are consistent with the conclusions of Evans et al. (2014) who found that New Zealanders who were primed with questions about local sea level rise impacts and adaptation measures were more willing to engage in emissions-reducing behaviors than their counterparts who did not receive these primes.

The fact that these results were found only among political moderates is suggestive of the highly charged political climate around the issue of global warming in the United States and provides support for the hypothesis that political ideology moderates the influence of message frames on policy support (Hypothesis 3). Liberals consistently demonstrated very high levels of support for mitigation, global warming concern, and support for the proposed plan; while conservatives consistently ranked the lowest on these same measures. This is in line with previous research conducted in the United States (Leiserowitz et al., 2012; McCright & Dunlap, 2011). In addition, results for plan support indicated that conservatives were significantly less supportive of the proposed plan when the rationale for it involved climate change versus water use efficiency, irrespective of whether the climate change response was framed as adaptation or mitigation. On the other hand, although liberals and conservatives were unresponsive to subtle variations in policy descriptions, political moderates were responsive.

It is important to note that this particular finding is specific to the political climate within the United States. Evans et al. (2014) found no difference in responses to adaptation information as a function of climate change beliefs. However, their study took place in New Zealand where the political climate surrounding the climate change discourse is dramatically different than the United States. This finding suggests that investments in communication strategies designed to educate the American public about climate change may be better spent with political moderates as the targeted audience. However, even then, these results suggest that the impacts on attitudes are likely to be small. Furthermore, this study suggests that the concern that increasing media attention given to adaptation efforts may undermine support for mitigation, irrespective of political affiliation, is very likely unwarranted.

These conclusions should be interpreted with caution as the results observed in Experiment 1 were not replicated in Experiment 2 using a different policy scenario. In Experiment 2 there was no indication that learning about adaptation information influenced the perceived political priority of climate change or policy support. There was some suggestion that learning about mitigation actually increased the perceived risk of climate change relative to learning about a non-climate related initiative. It is possible that the article used in Experiment 1, involving irrigation technology, painted a more severe picture of the impacts of climate change than the second scenario, involving white roofs. First and foremost, drought impacts on food production may have been seen as a more critical consequence of climate change than power failures. Second, the policy response of a technological innovation to manage water may have been perceived as a more robust response than converting to white roofs, therefore communicating a greater magnitude of the problem. These two factors combined may have caused the manipulation in Experiment 1 to be stronger than that in Experiment 2. However, if this were the case we might expect to see greater risk perceptions of global warming among participants in Experiment 1 who received the irrigation manipulation compared to those in Experiment 2, and this was not the case.

Familiarity with the adaptation measure may also help explain differences observed between Experiment 1 and 2. The use of white roofs as a method of reducing energy consumption and indoor temperatures may be a new concept to many members of the public, especially compared to the concept of water conserving irrigation technology. Thus individuals may have been skeptical that white roofs are an effective means of conserving energy and reducing the need for air conditioning, therefore muting any differences between the experimental groups. On the other hand, it is possible that the irrigation technology was a more convincing method of coping with drought impacts, and therefore adapting to climate change. More research is needed to understand whether the findings generated from Experiment 1 replicate across different content domains, and to understand the conditions under which they do replicate.

It should also be noted that convenience samples were used in this research, and the participants are not representative of the broader population. In particular, the samples are substantially younger, more educated, and more liberal leaning than the average member of the general public. There were no significant demographic differences as a function of experimental condition and, therefore, this is unlikely to explain the pattern of results reported here. However, the demographic bias of the samples used in this research does limit our ability to generalize to the broader public. This limitation should be addressed in future research.

Regardless of the inconsistent findings across experiments 1 and 2, neither experiment nor the recent work of Evans et al. (2014) provided any suggestion of a risk compensation effect, as predicted in Hypothesis 1a and 1b. In other words, there was no

suggestion that learning about an adaptation initiative was related to a reduction in concern about climate change or a reduction in support for mitigation policy. This finding, if it holds through future replications, suggests the concern that learning about adaptation will reduce policy support for mitigation is unfounded. In the United States, liberals and conservatives seem not to be influenced by learning about adaptation, and to the extent moderates are influenced, they appear to become more concerned, rather than less, about climate change. They also appear to be more supportive of policies that are framed as adaptation rather than mitigation. As such, evidence suggests that a public discussion about climate change that includes a conversation about adaptation may actually go some distance towards engaging moderates in the climate change discourse.

Acknowledgments

This study was supported by funds from the Vanderbilt Climate Change Research Network.

References

Ainslie, G., & Haslam, N. (1992). Hyperbolic discounting. In G. F. Loewenstein, & J. Elster (Eds.), *Choice over time* (pp. 57–92). New York: Russell Sage Foundation.

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society. Series B (Statistical Methodology), 57*(1), 289–300.

Benjamini, Y., & Hochberg, Y. (2000). On the adaptive control of the false discovery rate in multiple testing with independent statistics. *Journal of Educational and Behavioral Statistics, 25*(1), 60–83.

Binswanger, M. (2001). Technological progress and sustainable development: What about the rebound effect? *Energy Policy, 36*, 119–132.

Bolton, L., Cohen, J., & Bloom, P. (2006). Does marketing products as remedies create "Get out of jail free cards"? *Journal of Consumer Research, 33*(2000 June).

Boykoff, M. T., & Roberts, J. T. (2007). *Media coverage of climate change: Current trends, strengths, weaknesses*. Retrieved from http://hdr.undp.org/en/reports/global/hdr2007-8/papers/Boykoff, Maxwell and Roberts, J. Timmons.pdf.

Bratt, C. (1999). Consumers' environmental behavior: Generalized, sector-based, or compensatory? *Environment and Behavior, 31*(1), 28–44.

Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's Mechanical Turk: A new source of inexpensive, yet high-quality, data? *Perspectives on Psychological Science, 6*(1), 3–5.

Calkins, L. N., & Zlatoper, T. J. (2001). The effects of mandatory seat Belt laws on motor vehicle fatalities in the United States. *Social Science Quarterly, 82*(4), 716–732.

Cohen, G. L. (2003). Party over policy: The dominating impact of group influence on political beliefs. *Journal of Personality and Social Psychology, 85*(5), 808–822.

Cohen, A., & Einav, L. (2003). The effects of mandatory seat belt laws on driving behavior and traffic fatalities. *Review of Economics and Statistics, 85*(4), 828–843.

Conner, M., & Armitage, C. (2008). Attitudinal ambivalence. In W. Crano, & R. Prislin (Eds.), *Attitudes and attitude change* (pp. 261–286). New York: Psychology Press, Taylor & Francis Group.

Conover, W., & Iman, R. (1981). Rank transformations as a bridge between parametric and nonparametric statistics. *The American Statistician, 35*(3), 124–129.

Dietz, T., Dan, A., & Shwom, R. (2007). Support for climate change policy: Social psychological and social structural influences. *Rural Sociology, 72*(2), 185–214.

Dilley, J. W., Woods, W. J., & McFarland, W. (1997). Are advances in treatment changing views about high-risk sex? *The New England Journal of Medicine, 337*(7), 501–502.

Ehrhardt-Martinez, K., & Laitner, J. A. (2010). Rebound, technology and people: Mitigating the rebound effect with energy-resource management and people-centered initiatives. In *American Council for an Energy-Efficient Economy, Summer Study Proceedings* (pp. 76–91).

Evans, L., Milfont, T. L., & Lawrence, J. (2014). Considering local adaptation increases willingness to mitigate. *Global Environmental Change, 25*, 69–75.

Gillingham, K., Kotchen, M. J., Rapson, D. S., & Wagner, G. (2013). The rebound effect is overplayed. *Nature, 493*, 475–476.

Guagnano, G. G. A., Dietz, T., & Stern, P. C. P. (1994). Willingness to pay for public goods: A test of the contribution model. *Psychological Science, 5*(6), 411–415.

Herring, H. (2006). Energy efficiency – A critical view. *Energy, 31*(1), 10–20.

Hirst, E., White, D., & Goeltz, R. (1985). Indoor temperature changes in retrofit homes. *Energy, 10*(7), 861–870.

IPCC. (2007). Climate change 2007: Synthesis report. In Core Writing Team, R. K. Pachauri, & A. Reisinger (Eds.), *Contribution of Working Groups I, II, and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate change*. Geneva, Switzerland.

Iyengar, S., Hahn, K. S., Krosnick, J. A., & Walker, J. (2008). Selective exposure to campaign communication: The role of anticipated agreement and issue public membership. *The Journal of Politics, 70*(01), 186–200.

Jenkins, J., Nordhaus, T., & Shellenberger, M. (February 2011). *Energy emergence: Rebound & backfire as emergent phenomena. A review of the literature*. Oakland, CA: Breakthrough Institute.

Jevons, W. S. (1866). *The coal question* (2nd ed.). London: Macmilliam and Co.

Kahan, D. M., Jenkins-Smith, H., & Braman, D. (2011). Cultural cognition of scientific consensus. *Journal of Risk Research, 14*(2), 147–174.

Kelly, J. A, Hoffman, R. G., Rompa, D., & Gray, M. (1998). Protease inhibitor combination therapies and perceptions of gay men regarding AIDS severity and the need to maintain safer sex. *AIDS (London, England), 12*(10), F91–F95.

Keskitalo, E. (2012 October). Agenda-setting on the environment: The development of climate change adaptation as an issue in European states. *Environmental Policy and Governance, 394*, 381–394.

Leiserowitz, A. (2006). Climate change risk perception and policy preferences: The role of affect, imagery, and values. *Climatic Change, 77*(1–2), 45–72.

Leiserowitz, A., Maibach, E., Roser-Renouf, C., Feinberg, G., & Howe, P. (2012). *Public support for climate and energy policies in September 2012*. New Haven, CT: Yale Project on Climate Change Communication. Retrieved from http://environment.yale.edu/climate-communication/files/Policy-Support-September-2012.pdf.

Leiserowitz, A., Maibach, E., Roser-Renouf, C., & Smith, N. (2011). *Gobal Warming's Six Americas in May 2011*. New Haven, CT.

Lorenzoni, I., Nicholson-Cole, S., & Whitmarsh, L. (2007). Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global Environmental Change, 17*(3–4), 445–459.

Mason, W., & Suri, S. (2011). Conducting behavioral research on Amazon's Mechanical Turk. *Behavior Research Methods*, 1–23. June 30.

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. *Sociological Quarterly, 52*(2), 155–194.

McCright, A. M., Xiao, C., & Dunlap, R. E. (2014). Political polarization on support for government spending on environmental protection in the USA, 1974–2012. *Social Science Research, 48*, 251–260.

National Research Council. (2010). Adapting to the impacts of climate change. In *International Journal of Health Geographics* (Vol. 7). Washington D.C.

Nisbet, M. C., & Myers, T. (2007). The polls trends: Twenty years of public opinion about global warming. *Public Opinion Quarterly, 71*(3), 444–470.

Peltzman, S. (1975). The effects of automobile safety regulation. *The Journal of Political Economy, 83*(4), 677–726.

Pielke, R., Prins, G., Rayner, S., & Sarewitz, D. (2007). Climate change 2007: Lifting the taboo on adaptation. *Nature, 445*, 597–598.

Ruhl, J. (2010). Climate change adaptation and the structural transformation of environmental law. *Environmental Law, 363*, 365–375.

Sheppard, S. R. J. (2005). Landscape visualisation and climate change: The potential for influencing perceptions and behaviour. *Environmental Science & Policy, 8*(6), 637–654.

Smith, N., & Leiserowitz, A. (2012). The rise of global warming skepticism: Exploring affective image associations in the United States over time. *Risk Analysis, 32*(6), 1021–1032.

Soman, D., Ainslie, G., Frederick, S., Li, X., Lynch, J., Moreau, P., et al. (2005). The psychology of intertemporal discounting: Why are distant events valued differently from proximal ones? *Marketing Letters, 16*(3–4), 347–360.

Sorrell, S. (2007). A report produced by the Sussex Energy Group for the Technology and Policy Assessment function of the UK Energy Research Centre. *The rebound effect: An assessment of the evidence for economy-wide energy savings from improved energy efficiency* (Vol. 42, p. 169). Australian Family Physician.

Spence, A., Poortinga, W., & Pidgeon, N. (2011). The psychological distance of climate change. *Risk Analysis, 32*, 957–972.

Thaler, R. (1981). Some empirical evidence on dynamic inconsistency. *Economics Letters, 8*, 201–207.

Thøgersen, J. (1999). Spillover processes in the development of a sustainable consumption pattern. *Journal of Economic Psychology, 20*(1), 53–81.

Tiefenbeck, V., Staake, T., & Roth, S. (2013). For better or for worse? Empirical evidence of morla licensing in a behavioral energy conservation campaign. *Energy Policy, 57*, 160–171.

Tierney, J. (2011, March). *When energy efficiency sullies the environment*. New York, NY: New York Times.

Tobler, C., Visschers, V. H. M., & Siegrist, M. (2012). Addressing climate change: Determinants of consumers' willingness to act and to support policy measures. *Journal of Environmental Psychology, 32*(3), 197–207.

Truelove, H., Carrico, A., Weber, E., Raimi, K., & Vandenbergh, M. (2014). Positive and negative spillover of pro-environmental behavior: An integrative review and theoretical framework. *Global Environmental Change, 29*, 127–138.

Victor, D., Kennell, C. F., & Ramanathan, V. (2012). The climate threat we can beat. *Foreign Affairs, 119*, 112–121.

Viscusi, W. W. (1984). The lulling effect: The impact of child-resistant packaging on aspirin and analgesic ingestions. *The American Economic Review, 74*(2), 324–327.

Visschers, V. H. M., & Wallquist, L. (2013). Nuclear power before and after Fukushima: The relations between acceptance, ambivalence and knowledge. *Journal of Environmental Psychology, 36*, 77–86.

Weber, E. (1997). Perception and expectation of climate change: Precondition for economic and technological adaptation. In M. H. Bazerman, D. M. Messick, A. Tensbrunsel, & K. Wade-Benzoni (Eds.), *Psychological perspectives to*

environmental and ethical issues in management (pp. 314–341). San Francisco: Jossey-Bass.
Weber, E. (2006). Experience-based and description-based perceptions of long-term risk: Why global warming does not scare us (yet). *Climatic Change, 77*(1–2), 103–120.
Whitmarsh, L. (2008a). Are flood victims more concerned about climate change than other people? The role of direct experience in risk perception and behavioural response. *Journal of Risk Research, 11*(3), 351–374.
Whitmarsh, L. (2008b). What's in a name? Commonalities and differences in public understanding of "climate change" and "global warming". *Public Understanding of Science, 18*(4), 401–420.
Zhong, C.-B., Liljenquist, K., & Cain, D. (2009). Moral self-regulation: Licensing & compensation. In D. de Cremer (Ed.), *Psychological perspectives on ethical behavior and decision making* (pp. 75–89). Charlotte, NC: Information Age.