

The Rise of Global Warming Skepticism: Exploring Affective Image Associations in the United States Over Time

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This article explores how affective image associations to global warming have changed over time. Four nationally representative surveys of the American public were conducted between 2002 and 2010 to assess public global warming risk perceptions, policy preferences, and behavior. Affective images (positive or negative feelings and cognitive representations) were collected and content analyzed. The results demonstrate a large increase in “naysayer” associations, indicating extreme skepticism about the issue of climate change. Multiple regression analyses found that holistic affect and “naysayer” associations were more significant predictors of global warming risk perceptions than cultural worldviews or sociodemographic variables, including political party and ideology. The results demonstrate the important role affective imagery plays in judgment and decision-making processes, how these variables change over time, and how global warming is currently perceived by the American public.

KEY WORDS: Affective image associations; global warming; skepticism

1. INTRODUCTION

Global warming is one of the most pressing problems facing the world. Although the average surface temperature of the Earth fluctuates naturally on geological timescales, temperature increases over the past century are widely regarded as human caused. The 2007 Intergovernmental Panel on Climate Change (IPCC) scientific assessment report established a 90% level of certainty that this warming is anthropogenic and primarily linked to industrial processes.⁽¹⁾ Substantial mitigation of greenhouse gas emissions is therefore required if “dangerous” anthropogenic impacts are to be minimized.^(2–4)

Through their energy use, consumer behavior, and support for or opposition to climate policies, the public will play an important role in each nation’s

effort to limit greenhouse gas emissions. The American public’s climate change risk perceptions, policy preferences, and behavior are particularly important as the United States alone produces approximately 20% of global carbon emissions.⁽⁵⁾ Although China is now considered to be the world’s largest overall emitter of carbon dioxide (the primary greenhouse gas), the United States contributes far more emissions per capita. With only 5% of the global population, the United States emits 19.10 tons of carbon dioxide per person per year, compared to 4.85 tons in China and 1.18 tons in India.⁽⁵⁾

Global warming has also emerged as an important policy issue for the Obama administration. Although previous administrations have been at odds with international policy on global warming, President Obama has made the issue a priority. The American Recovery and Reinvestment Act of 2009, for example, pledged more than \$80 billion for clean energy investments including \$6.3 billion for a range of local renewable energy initiatives. In June 2009, the House of Representatives also passed the

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American Clean Energy and Security Act (H.R. 2454) that aims to “create clean energy jobs, achieve energy independence, reduce global warming pollution, and transition to a clean energy economy.” More specifically, the legislation would establish a cap and trade system to limit the quantity of greenhouse gases that can be emitted nationally. This legislation has yet to pass the Senate, however.

Generally, a majority of Americans have been somewhat concerned about the issue for many years.^(6,7) As a policy priority, however, global warming has always been lower than other economic and social issues. For example, in 2009 the Pew Research Center found that only 30% of Americans said that global warming should be a top priority for the new president, compared to 85% who said strengthening the economy should be a top priority.⁽⁸⁾ Similarly, only 35% of Americans considered global warming to be a very serious problem compared to 44% in 2008.

Leiserowitz *et al.*⁽⁹⁾ also found declining levels of belief in climate change, worry, and perceived risk among the American public since the fall of 2008.² For example, between 2008 and 2010, they found that the number of Americans who believed that global warming is happening declined by 14 percentage points, accompanied by a 10-point drop in the belief that global warming is caused mostly by human activities, and a 13-point drop in the number of Americans who said they worry about global warming.³

Risk perception researchers have investigated the factors that drive differing levels of public concern. Cognitive risk perception studies, for example, have identified the various heuristics and biases individuals use to process and understand risk information. Driven by the psychometric paradigm,⁽¹⁶⁾ some research has explored the role of cognitive factors in risk perceptions of global warming. O'Connor *et al.*,⁽¹⁷⁾ for example, found that global warming knowledge modestly predicted risk perception and willingness to support governmental policies for mitigating the dangers, whereas Stedman⁽¹⁸⁾ found that global warming risk perceptions were best predicted by generic environmental concern and not specific knowledge about potential effects.

² Similar declines in public beliefs and concerns were found by Gallup,^(10,11) Pew,⁽¹²⁾ Washington Post-ABC,⁽¹³⁾ and AP-Stanford.⁽¹⁴⁾

³ A subsequent national survey in 2011 found that belief that global warming is happening increased by 7 percentage points, while other measures held steady or declined slightly.⁽¹⁵⁾

More recently, researchers have focused on the role of “affect,” or the emotional quality of “good” or “bad” associated with different risks.⁽¹⁹⁾ This research has found that people draw upon both affect and other emotional cues to process information and make decisions about risk. Whereas the “risk as analysis” paradigm emphasizes the use of cognitive deliberation to assess risk, the “risk as feelings” approach argues that people are often more reliant upon affect and emotion when making risk judgments and decisions.^(20,21) Affect is processed quickly, automatically, and efficiently and enables people to make daily decisions with relatively little cognitive effort. As such, affect helps to guide perceptions of risk and benefit. Individuals are often motivated to engage in activities that produce positive and pleasant feelings, but also to avoid activities that produce negative and unpleasant feelings. Empirical support for this “affect heuristic” is growing and has been used to explore public risk perceptions for a range of issues.⁽²²⁾

Researchers have also investigated the affective dimensions of public risk perceptions of global warming, using affective imagery analysis. “Imagery” here refers to mental representations or cognitive content within the individual mind and can include both perceptual and symbolic representations.⁽²³⁾ “Affective imagery” is therefore defined as “sights, sounds, smells, ideas, and words, to which positive and negative affect or feeling states have become attached through learning and experience.”⁽²⁴⁾ Affective imagery analysis uses a structured form of word association in order to identify the mental representations and feelings people spontaneously associate with particular risks, hazards, or target terms.⁽²⁵⁾ This methodology also has the ability to gather qualitative data in a systematic and quantitative way, using representative samples. While understanding public response to risk is often difficult to unpack when using standardized scales and survey items,⁽²⁶⁾ in-depth qualitative studies are difficult to replicate. The collection and content analysis of free associations using survey samples, however, can provide some of the depth and richness of qualitative approaches, with the rigor of standardized and representative data collection methods.

In 2002, Leiserowitz^(3,27) used affective imagery analysis as part of a nationally representative survey study on American climate change risk perceptions, policy preferences, and behaviors. Respondents were asked: “When you hear the words ‘global warming,’ what is the first thought or image that comes

to mind?” Respondents were then asked to provide a positive-to-negative affective rating of the associations they had provided. The images were then content analyzed to identify common themes. Americans were most likely to associate global warming with impacts on places or natural ecosystems distant from everyday experience. Associations to melting ice were most frequent, followed by generic references to rising temperatures, and impacts on nonhuman nature. These and other survey results demonstrated that most Americans considered global warming a threat distant in both time and space, with little direct relevance to the lives of most respondents. Furthermore, the study found that affect, imagery, and cultural worldviews were better predictors of public climate change risk perceptions and policy preferences than sociodemographic or political variables.⁽²⁷⁾

This approach was also replicated in a nationally representative survey in the United Kingdom and comparative analysis but using the stimulus term “climate change” instead of “global warming.”⁽²⁸⁾ The study found that Americans and Britons had different associations to these stimulus terms. For example, Britons were most likely to provide associations to “weather” compared to “melting ice” in the United States. Americans were more likely to provide associations with rising temperatures and impacts on nonhuman nature whereas Britons were more likely to provide associations to the ozone hole. Despite these differences, however, mean affect ratings were negative for all images in both the American and U.K. samples, indicating that global warming and climate change had negative connotations for both populations.

Both of these studies contributed to the theoretical understanding of how public risk perceptions are guided and influenced by cognitive representations and associated feelings of good or bad, and how these affective images of risk can vary across cultural contexts. Unknown, however, was how well these measures can detect and explain shifts in the connotative meaning of a hazard and subsequent risk perceptions and policy preferences over time. Here, we report results from a time series of nationally representative surveys in the United States, each using affective imagery methodology, to track changes in these variables over time. This time series thus enables us to examine the year-to-year influence of these factors on public perceptions, but also helps to explain why, in recent years, American public opinion has cooled on global warming. Similarly, this article contributes to the emerging literature on the causes and

consequences of climate change skepticism in the United States and internationally.^(29–31)

2. METHODS

2.1. Respondents and Procedure

This investigation is based on data collected between 2002 and 2010 from four nationally representative surveys of the American public’s global warming risk perceptions, policy preferences, and behaviors.

The first study was conducted between November 2002 and February 2003 and used a 16-page mail-out, mail-back survey using the Dillman⁽³²⁾ tailored design method. A total of 673 completed surveys were collected for overall Council of American Survey Research Organizations (CASRO) response rate of 56%. The second study was conducted in collaboration with Gallup in June 2007. Telephone interviews were conducted on a total sample of 1,014 adults, drawn from Gallup’s household panel that had originally been recruited using random selection criteria. The CASRO response rate was 40%.

The third study was conducted between September and October 2008 and was conducted by Knowledge Networks, using its nationally representative online research panel. A total sample of 2,164 American adults completed the questionnaire with a within-panel completion rate of 54%. Due to length, the questionnaire was divided into two stages and data collection occurred over a two-week period. The fourth study was conducted online between December 2009 and January 2010, also by Knowledge Networks. A total sample of 1,001 adults completed the questionnaire and the completion rate was 50%.

Data from all four surveys were weighted to match U.S. Census Bureau population parameters for each time period.

2.2. Measures⁴

2.2.1. Risk Perception

Two sets of risk perception measures were included in the 2010 survey. Respondents were asked to assess how much they thought global warming would harm them personally, their family, their community, people in the United States, people

⁴ Specific details of the affective imagery measure are provided for all years. Details for all other measures refer to analyses conducted on 2010 data only.

in other industrial countries, people in developing countries, future generations, and other plant and animal species. Respondents were also asked to assess the likely timing of harm to people in the United States and people around the world. For analysis, a single risk perception index integrating both the spatial and temporal dimensions was constructed ($\alpha = 0.96$; see Supporting Information for full questions).

2.2.2. Holistic Affect

Respondents were asked to rate whether global warming is a good or a bad thing using a unipolar, 6-point Likert scale ranging from +3 (Very good) to -3 (Very bad). This question was asked first in the survey to minimize potential question order effects.

2.2.3. Affective Imagery

Affective images were then collected from all respondents and contain two elements: a cognitive component (the image category) and associated affective rating (a goodness or badness evaluation). Images were collected using an open-ended word association methodology^(25,33) that enables context-free associations to emerge naturalistically. Images were collected by asking respondents to provide the first “word,” “thought,” “image,” or “phrase” that comes to mind when thinking about global warming.⁵ Responses took the form of single word associations (e.g., “apocalypse”) or short narrative statements (e.g., “the end of the world”). Once collected, respondents were then asked to provide an affective rating for their own images using a 10-point scale in 2002 (where +5 = a very good thing and -5 = a very bad thing) and a 6-point scale in 2007, 2008, and 2010 (where +3 = a very good thing and -3 = a very bad thing). This procedure produced rich data sets of associations that were analyzed using inductive content analysis. Ten percent of the images from each survey were also double coded to ensure transparency of the coding frame and agreement between both coders was satisfactory (80% or higher). Differences were resolved following discussion between the two coders. The mean affect of each image category was also calculated and affective ratings were normalized

⁵ Slightly different wording was used in the 2002: “What is the first thought or image that comes to your mind when you think of global warming?” versus 2007, 2008, and 2010 surveys: “When you think of ‘global warming,’ what is the first word or phrase that comes to your mind?”

to a +1 to -1 scale (where +1 = very good and -1 = very bad) to enable comparability analyses.

2.2.4. Values

The cultural worldviews of egalitarianism and individualism were operationalized using a series of questions derived from cultural theory and from scales used by Dake,^(34,35) Peters and Slovic,⁽³³⁾ Rippl,⁽³⁶⁾ and Leiserowitz.⁽²⁷⁾ Items were randomized to avoid potential order effects, and for analysis, egalitarianism and individualism indices were created, each with a high reliability score ($\alpha = 0.78$ and 0.85, respectively; see Supporting Information for full questions).

2.2.5. Sociodemographics

A range of sociodemographic variables was also collected including gender, age, race and ethnicity, educational attainment, political ideology (liberal-conservative), political party identification (Democrat, Independent, and Republican), religiosity (frequency of religious service attendance), and household income.

3. RESULTS

3.1. Affective Images

Using a codebook developed by Leiserowitz,⁶⁽³⁷⁾ a total of 24 image categories were coded, but associations for only the top nine categories are reported here (see Fig. 1). These top nine image categories accounted for 83% of respondents in 2002, 70% of respondents in 2007, 79% of respondents in 2008, and 75% of respondents in 2010. These categories were also not mutually exclusive, that is, a respondent image association could be coded both “icemelt” and “alarmist,” for example.

Several significant trends in Americans’ associations with “global warming” over time were identified. Perhaps most notable was the large increase in the proportion of naysayer images (e.g., “hoax”). The proportion of naysayer images rose from less than 10% in 2002 to over 20% of total responses in 2010 ($\chi^2(3) = 84.65, p < 0.001$). Associations to melting ice, which in 2002 were the most salient image category (20%), accounted for just over 10% in 2010 ($\chi^2(3) = 16.24, p < 0.01$). Similarly, associations to

⁶ Available from the authors, upon request.

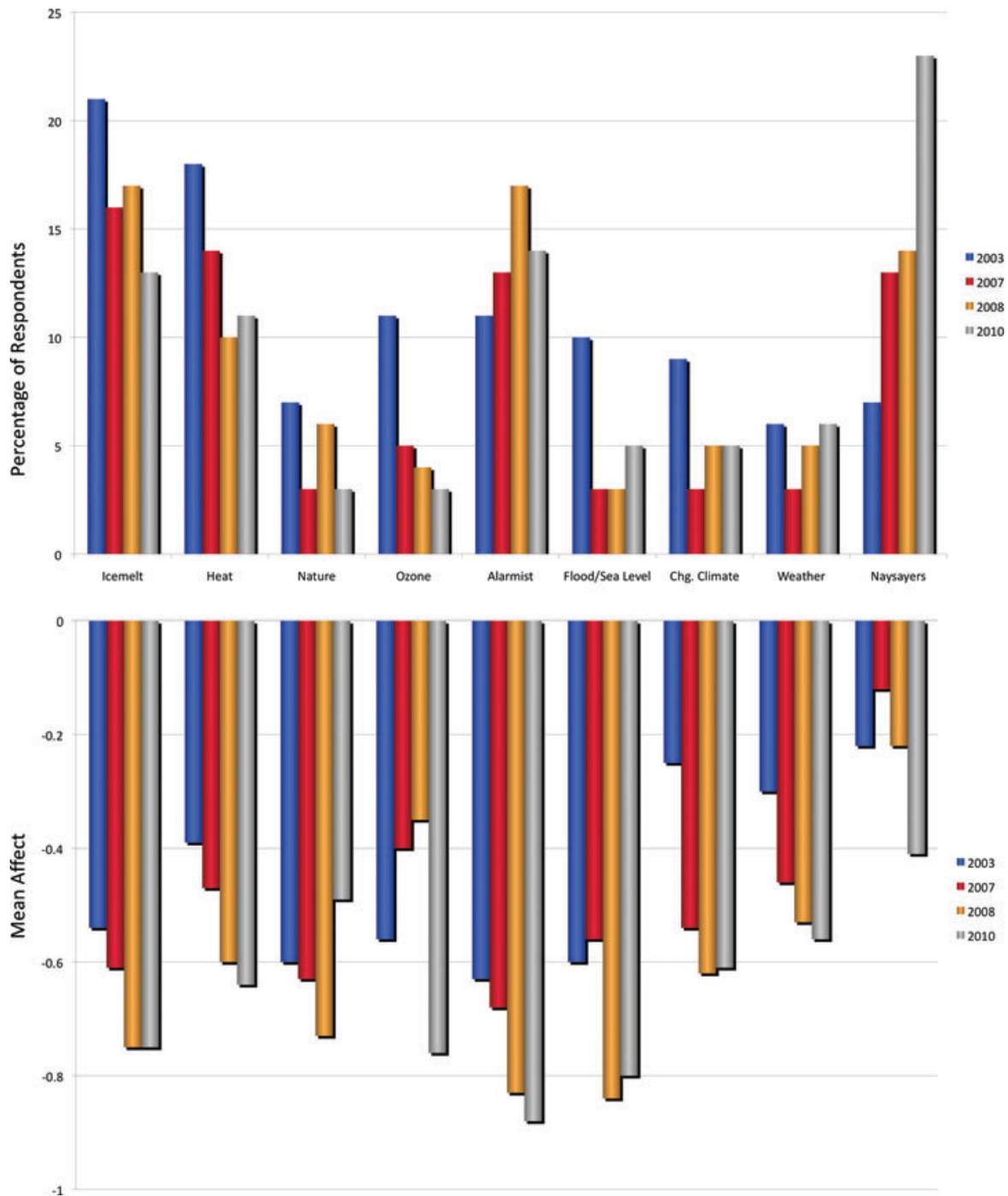


Fig. 1. Images of global warming and associated affect over time. Affect ratings were normalized to be between 1 (very good) and -1 (very bad).

heat, climate change, nonhuman nature, flooding and sea level rise, all decreased significantly (Heat: $\chi^2(3) = 28.47, p < 0.001$; Climate Change: $\chi^2(3) = 24.71, p < 0.001$; Nature: $\chi^2(3) = 19.82, p < 0.001$;

Flood/Sea Level: $\chi^2(3) = 52.16, p < 0.001$). Alarmist images of disaster, however, increased significantly from 2002 to 2008 ($\chi^2(3) = 20.87, p < 0.001$), but with a slight decrease in 2010. There was no

significant shift in the proportion of associations to weather. Finally, associations to ozone depletion decreased significantly after 2002, with only 3% of respondents providing this response in 2010 ($\chi^2(3) = 55.75, p < 0.001$).

Overall, the term global warming evoked negative affective connotations for the majority of respondents for each of the four years sampled (Fig. 1). Naysayer images, on average, evoked the least negative affect of all the images associated with global warming. Alarmist images, on average, evoked strong negative affect. Affect for both of these images, however, became significantly more negative over time (Alarmist: $F(3, 645) = 8.27, p < 0.001$; Naysayer: $F(3, 617) = 5.39; p < 0.01$). Affect also became significantly more negative for Icemelt, Heat, and Flood/Sea Level (Icemelt: $F(3, 712) = 11.30, p < 0.001$; Heat: $F(3, 522) = 5.79, p < 0.01$; Flood/Sea Level: $F(3, 191) = 6.65, p < 0.001$). Thus the term “global warming” evoked steadily more negative affective responses across all images, over the years.

One of the most striking results is the steady rise in the number of Americans who express strong doubt or denial of global warming through their free associations. By 2010, the number of naysayer images accounted for 23% of all associations. A more detailed analysis of this category revealed five distinct reasons why these respondents are skeptical of global warming (see Fig. 2). Associations with conspiracy theories (e.g., “the biggest scam in the world to date”) accounted for the largest portion of 2010 naysayer images with over 40% of total responses for this category. This was followed by flat denials that global warming exists (e.g., “there really is no such problem”), belief that global warming is natural (e.g., “it is a natural occurrence”), and references to media hype (e.g., “media is taking it way too far”). Finally, several respondents doubted the reliability of climate science (e.g., “unscientific theory”). Mean affect scores for these naysayer image categories also reveal that most of these skeptical and cynical images associated with global warming evoked negative connotations for these respondents (see Fig. 2). Associations with conspiracy theories and hype evoked the most negative affect, whereas flat denials evoked the least negative affect. Interestingly, associations indicating a belief that global warming is natural evoked marginally positive affect.

A breakdown of alarmist images was also conducted. In 2010, alarmist images accounted for 14% of all associations and were classified into two broad subcategories: 34% were general in concern, with

respondents providing images of generic concern (e.g., “bad for the planet”), whereas 66% were apocalyptic (e.g., “end of everything”). Mean affect scores for both of these subcategories were negative with apocalyptic imagery rated as most negative (-0.93).

3.2. The Influence of Affective Imagery on Risk Perceptions

A series of multiple regressions was conducted on the 2010 data set to test the individual and combined influence of global warming imagery, affect, and other variables on risk perception (see Table I). Individual variables were initially entered into separate linear regressions to determine significance. All significant variables were then entered into multiple regression models.

Model 1 examined the influence of both the holistic affect associated with the term “global warming” and the individual affect associated with specific cognitive images. It found that holistic affect was a significant predictor of global warming risk perception and explained 32% of the variance ($F(2, 886) = 212.70, p < 0.001, \text{Adj. } R^2 = 0.32$). As holistic affect became more negative, the perception of global warming risks increased. In a linear regression, image affect by itself was a significant predictor of risk perception, but failed to explain any unique variance when combined with holistic affect. Model 2 found that a variety of cognitive image categories significantly predicted global warming risk perception, explaining 34% of the variance ($F(9, 976) = 58.28, p < 0.001, \text{Adj. } R^2 = 0.34$). The image categories Naysayer, Don't know, and Politics were associated with lower perceived risk whereas Alarmist, Icemelt, Climate Change, and Dry/Desert were associated with higher perceived risk. Pollution and flood/sea level images were both significant predictors in separate linear regressions, but failed to account for any unique variance when combined with all other images.

Model 3 examined the influence of cultural worldviews on global warming risk perception. Both egalitarianism and individualism were significant predictors and explained 29% of the variance ($F(2, 946) = 193.57, p < 0.001, \text{Adj. } R^2 = 0.29$). More specifically, egalitarian values were associated with increased risk perception whereas individualist values were associated with decreased risk perception. Model 4 tested different sociodemographic variables and found that party identification and political ideology were significantly correlated with global

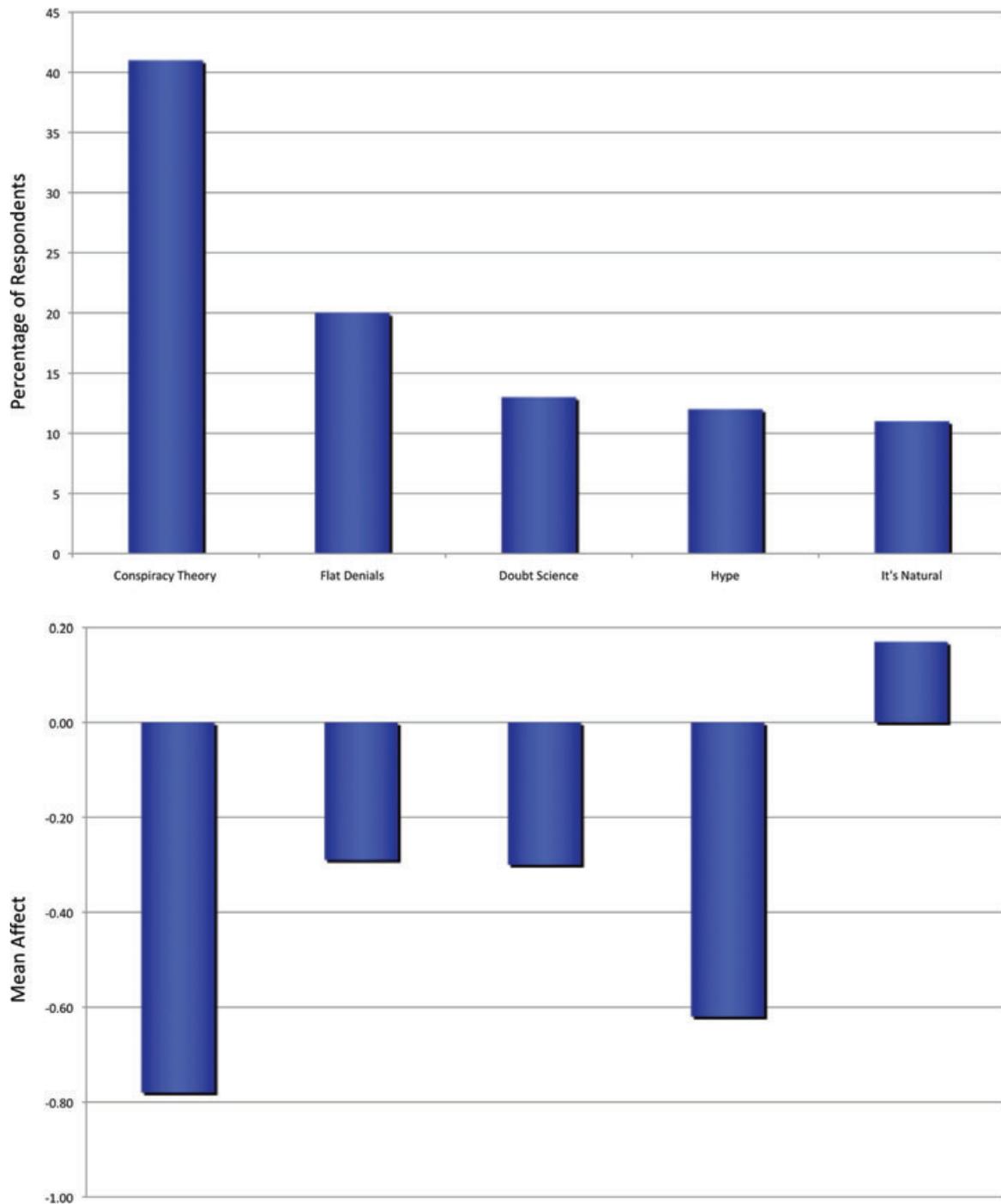


Fig. 2. 2010 naysayer categories and associated affect. Affect rating was normalized to be between 1 (very good) and -1 (very bad).

warming risk perception and explained 22% of the variance ($F(6, 929) 44.02, p < 0.001, \text{Adj. } R^2 = 0.22$). Democrats and those with liberal political views were associated with increased risk perception, whereas Republicans and those with a conservative

political ideology were associated with decreased risk perception.

Finally, all four models were combined to identify the strongest predictors of global warming risk perception. The full model accounted for 52% of

Table I. Multiple Regressions for Global Warming Risk Perception

Independent Variables	Model 1 Affect	Model 2 Images	Model 3 Values	Model 4 Sociodems	Model 5 Full
Holistic affect	-0.58***	-	-	-	-0.30***
Image affect	0.04	-	-	-	0.03
Alarmists	-	0.13***	-	-	0.05
Naysayers	-	-0.46***	-	-	-0.26***
Don't know	-	-0.14***	-	-	-0.04
Icemelt	-	0.10***	-	-	0.05
Pollution	-	0.05	-	-	0.04
Flood/sea level	-	0.05	-	-	0.00
Chg. climate	-	0.07**	-	-	0.05
Politics	-	-0.16***	-	-	-0.13***
Dry/desert	-	0.08**	-	-	0.06*
Egalitarianism	-	-	0.31***	-	0.11***
Individualism	-	-	-0.33***	-	-0.12***
Political party identification	-	-	-	0.22***	0.07*
Political ideology	-	-	-	0.28***	0.01
Religiosity	-	-	-	-0.05	-0.01
Gender	-	-	-	0.05	0.04
Ethnicity (white)	-	-	-	-0.05	-0.02
Household Income	-	-	-	-0.04	-0.01
<i>F</i>	212.70***	58.28***	193.57***	44.02***	49.70***
Adjusted <i>R</i> ²	0.32	0.34	0.29	0.22	0.52
<i>N</i>	889	986	949	936	849

Note: Dependent variable: Risk perception index. Entries are standardized regression coefficients.

*significant at 0.05, **significant at 0.01, and ***significant at 0.001.

the variance with Holistic Affect, Naysayer, and Politics image associations, egalitarianism, individualism, and political party identification as the most significant predictors ($F(19, 829) = 49.70, p < 0.001, \text{Adj. } R^2 = 0.52$). More specifically, Holistic Affect and Naysayer and Politics images were the most significant predictors, with negative affect strongly associated with increased risk perception, whereas skeptical and politics-based imagery were associated with decreased risk perception. Egalitarian and individualist worldviews were associated with increased and decreased risk perceptions, respectively, whereas identification with the Democrat Party was associated with increased risk perception. In summary, these results demonstrate that Holistic Affect and Imagery were stronger predictors of global warming risk perception than either cultural worldviews or a range of sociodemographic and political variables.

4. DISCUSSION

This research demonstrates the important roles affect and imagery continue to play in how the American public conceptualizes and thinks about global warming and its attendant risks. The time-series analysis found that Americans have become less likely to associate global warming with melting ice and heat since 2002. However, these image categories also became affectively more negative. At the same time, slightly more Americans now associate global warming with alarmist imagery, which is also rated more negatively, suggesting that some Americans have become more worried about the possibility of catastrophic climate change.

By contrast, this research also found that many more Americans are now associating global warming with naysayer imagery, ranging from skepticism that global warming is real or a serious threat to outright conspiracy theories. In 2002, only 7% of Americans provided naysayer associations; by 2010, however, this rose to over 20%. Furthermore, the accompanying affect ratings of these images became significantly more negative, perhaps reflecting anger by conservatives at climate policies proposed by President Obama and a Democratic Congress, and a general political polarization of the issue in recent years.⁽³⁸⁾ More broadly, these findings contribute to a growing body of research on climate change denial.^(29–31)

Several factors may have contributed to these trends. Most Americans have learned about global warming from the mass media, which has a particularly important agenda-setting effect⁽³⁹⁾ for this complex issue. Climate change seems distant and abstract to most Americans, while carbon dioxide, other greenhouse gases, and the impacts that have already been observed around the world are largely invisible and outside of most people's direct experience. Thus, how climate change is portrayed in the mass media can have a large influence on public affective imagery and risk perceptions. The visual images used to represent the issue and disseminated by the media, for example, often emphasize particular aspects of this hazard and help concretize the issue in the public mind.⁽⁴⁰⁾

The increase of alarmist images found in the present investigation may reflect a general proliferation of "climate porn" evident in media coverage of global warming.⁽⁴¹⁾ Research from the United Kingdom, for example, has documented the rise of sensationalist television and newspaper coverage

describing apocalyptic climate change scenarios and has been blamed for public despair and helplessness associated with the issue.⁽⁴²⁾ It is possible that similar coverage by the U.S. media may have contributed to the rise of alarmist images found in this study.

The recent scandal, dubbed “Climategate,” over the unauthorized release of e-mails from several climate scientists in the United States and United Kingdom probably also had an important influence on public associations to global warming (the January 2010 survey was fielded a couple of months after the scandal broke). Climate skeptics pounced on several of the e-mails, which they described as “proof” that scientists were changing their results to make global warming appear worse than it is, conspiring to suppress research they didn’t agree with, or conclusive evidence that global warming is not happening. Circulated widely among climate skeptic blogs in November and then in the mainstream media in December 2009, the scandal subsequently eroded public belief that global warming is happening and trust in climate scientists. However, political conservatives and Americans with individualistic worldviews were the most likely to have been influenced by the scandal.⁽⁴³⁾ Similarly, this study on affective imagery found that conspiracy-related associations to global warming increased significantly in January 2010 and several respondents explicitly mentioned the e-mail “scandal” (examples include “hide the decline” and “phony e-mails”).

It is also important to note the significant decline in public associations of ozone depletion and the ozone hole as synonymous with, a cause, or consequence of global warming. Previous research had found that many Americans confused or conflated global warming with the ozone hole, based on a set of faulty mental models.^(3,7,44,45,46) Although the current investigation did not specifically measure to what extent this flawed mental model is still held by the American public, it is encouraging that fewer Americans immediately associate global warming with this different environmental issue.

This investigation also employed multiple regression analyses to examine how well affect and imagery predict American global warming risk perceptions. Overall, we found that holistic affect was the single strongest predictor of risk perceptions. Due to the cross-sectional nature of these survey data, we cannot determine the causal relationship between these variables. Depending on the circumstances, however, affect can be either a cause or a consequence of cognitive assessments of the likelihood and

severity of risks. For example, some individuals may develop a negative association to global warming in response to learning about the potential risks. Others, however, may first learn that trusted others or opinion leaders have determined that climate change is dangerous, and thus adopt a negative association to climate change without knowing about the likelihood or severity of specific impacts. Similarly, our research on affective imagery has found that a number of Americans associate global warming with former Vice President Al Gore, whom some of them intensely dislike. Their negative affect for Gore thus becomes associated with “global warming” despite the fact they may know little to nothing about the risks. Finally, at a neurological level affective responses typically occur prior to conscious awareness or cognitive processing, and subsequent cognitive processing draws substantially upon these prior feelings to decide whether to pay attention, how to interpret the stimulus, and especially to prime the body for action before the threat has been analytically identified and labeled.^(23,47) Affect can therefore deeply influence subsequent cognitive risk assessments. Thus, there is a constant “dance” between affect and reason, emotion and cognition, with one or the other partner at different times taking the lead.⁽⁴⁸⁾

The image categories Naysayer and Politics, both containing skeptical associations with global warming, were the next two strongest predictors. This research thus replicates the findings of prior studies of the predictors of global warming risk perceptions.^(3,27) Additionally, these results contribute further empirical evidence for the important role of “risk as feelings” in explaining public risk perceptions,^(20,22) in particular for the issue of climate change.

Although affect and imagery predicted more of the variance in global warming risk perceptions than all other variables in the regression model, the influence of cultural worldviews and other demographic variables remain important. More specifically, the current investigation found that respondents who held an egalitarian worldview were more likely to perceive global warming as a serious threat whereas respondents who held an individualist view were more likely to perceive global warming as low risk. This finding also corroborates prior research that has used worldviews to predict global warming risk perceptions and policy preferences, among other issues.⁽²⁷⁾ Egalitarianism and individualism have also been found to be important predictors

of environmental consciousness, pro-environmental behaviors,⁽⁴⁹⁾ and perception of other hazards, including nuclear power, water pollution, and nanotechnology.^(33,50–53)

Political party identification was also significantly associated with global warming risk perception in the sociodemographic model. Respondents who identified themselves as a Democrat were more likely to perceive global warming as a risk than those who identified themselves as a Republican. A widening gap between the two political parties was first identified in 1997 in response to the fight over the Kyoto Protocol.⁽⁵⁴⁾ Dunlap and McCright⁽³⁸⁾ using Gallup Poll data also found that Democratic and Republican views of global warming have increasingly diverged and polarized in recent years.

In 2008, the American political context also shifted dramatically, with the election of President Barack Obama and Democratic majorities in both chambers of Congress. Candidate Obama campaigned in part upon a promise to pass climate change legislation, and the House of Representatives subsequently passed a climate change bill in 2009, which the Senate began to consider. The prospect of actual legislation to reduce greenhouse gas emissions generated strong resistance from special interests, lobbyists, and congressional Republicans, who increased their criticisms of climate science in the wake of the Climategate and IPCC scandals and who condemned the proposed legislation as a hidden tax and/or “job-killer” in the midst of an economic recession. Global warming and the proposed legislation furthermore became a political litmus test with conservative Republicans using the issue to identify themselves as global warming skeptics and distinguish themselves not only from Democrats, but from other Republicans in primary races leading up to the 2010 fall elections.^(55,56) The increase in naysayer images among the public identified by this study in 2010 probably both reflects and has contributed to this shift in elite political positioning and rhetoric.

Thus, this study demonstrates that while affective images are individual mental representations and feelings, they cannot be separated from larger-scale political, economic, and cultural dynamics. Risk-related affective images and connotative meanings diffuse through complex social networks where they are subject to reinterpretation, amplification, or attenuation by different actors within the social system.⁽⁵⁷⁾ Some of these images are used by advocates in an attempt to increase public risk perceptions to motivate individual and collective action to mitigate

risk, whereas other images are promulgated by opponents who seek to raise public doubts, dampen public concerns, and delay action. Affective imagery analysis thus provides a powerful tool to measure, track, and explain shifting public perceptions of risk over time.

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REFERENCES

1. Intergovernmental Panel on Climate Change. *Climate Change 2007: The Scientific Basis*. Cambridge: Cambridge University Press, 2007.
2. United Nations. *United Nations Framework Convention on Climate Change*. Rio de Janeiro: United Nations, 1992.
3. Leiserowitz AA. American risk perceptions: Is climate change dangerous? *Risk Analysis*, 2005; 25(6):1433–1442.
4. Lorenzoni I, Pidgeon NF, O'Connor RE. Dangerous climate change: The role for risk research. *Risk Analysis*, 2005; 25(6):1387–1398.
5. IEA. *CO₂ Emissions from Fuel Combustion: Highlights*. Paris: International Energy Agency, 2009. Available at: <http://www.iea.org/co2highlights/CO2highlights.pdf>, Accessed March 24, 2010.
6. Nisbet MC, Myers T. The polls—Trends—Twenty years of public opinion about global warming. *Public Opinion Quarterly*, 2007; 71(3):444–470.
7. Brechin SR. Public opinion: A cross-national view. Pp. 179–209 in Lever-Tracy C (ed). *Routledge Handbook of Climate Change and Society*. Abingdon, Oxon: Routledge, 2010.
8. Pew Research Center for the People & the Press. *Public's Priorities for 2010: Economy, Jobs, Terrorism*. Washington, DC: Pew Research Center for the People & the Press, 2009. Available at: <http://people-press.org/report/584/policy-priorities-2010>, Accessed March 24, 2010.
9. Leiserowitz A, Maibach E, Roser-Renouf C. *Climate Change in the American Mind: Americans' Global Warming Beliefs and Attitudes in January 2010*. Yale University and George Mason University. New Haven, CT: Yale Project on Climate Change, 2010. Available at: <http://environment.yale.edu/uploads/AmericansGlobalWarmingBeliefs2010.pdf>, Accessed March 23, 2010.
10. Gallup. *Increased Number Think Global Warming is “Exaggerated.”* Princeton, NJ: Gallup, 2009. Available at: <http://www.gallup.com/poll/116590/increased-number-think-global-warming-exaggerated.aspx>, Accessed March 24, 2010.
11. Gallup. *Americans Global Warming Concerns Continue to Drop*. Princeton, NJ: Gallup, 2010. Available at: <http://www.gallup.com/poll/126560/Americans-Global-Warming-Concerns-Continue-Drop.aspx>, Accessed March 24, 2010.
12. Pew Research Center for People & the Press. *Fewer Americans See Solid Evidence of Global Warming*.

- Washington, DC: Pew Research Center for People & the Press, 2009. Available at: <http://pewresearch.org/pubs/1386/cap-and-trade-global-warming-opinion>, Accessed March 24, 2010.
13. Washington Post-ABC WP. Washington Post—ABC News Poll—November. Washington, DC: Washington Post, 2009. Available at: http://www.washingtonpost.com/wp-srv/politics/polls/postpoll_111609.html, Accessed September 5, 2011.
 14. AP-Stanford. Associated Press-Stanford University Environment Poll. Palo Alto, CA: Stanford, 2009. Available at: <http://woods.stanford.edu/docs/surveys/AP-Stanford-University-Environment-Poll-2009.pdf>, Accessed September 5, 2011.
 15. Leiserowitz A, Maibach E, Roser-Renouf C, Smith N. Climate Change in the American Mind: Americans' Global Warming Beliefs and Attitudes in May 2011. Yale University and George Mason University. New Haven, CT: Yale Project on Climate Change Communication, 2011. Available at: <http://environment.yale.edu/climate/files/ClimateBeliefsMay2011.pdf>, Accessed July 29, 2011.
 16. Slovic P. Perception of risk. *Science*, 1987; 236: 280–285.
 17. O'Connor RE, Bord RJ, Fisher A. Risk perceptions, general environmental beliefs, and willingness to address climate change. *Risk Analysis*, 1999; 19(3):461–471.
 18. Stedman RC. Risk and climate change: Perceptions of key policy actors in Canada. *Risk Analysis*, 2004; 24(5):1395–1406.
 19. Slovic P, Finucane ML, Peters E, MacGregor DG. The affect heuristic. Pp. 397–420 in Gilovich T, Griffin D, Kahneman D (eds). *The Psychology of Intuitive Judgment*. New York: Cambridge University Press, 2002.
 20. Slovic P, Peters E. Risk perception and affect. *Current Directions in Psychological Science*, 2006; 15(6):322–325.
 21. Finucane ML. Emotion, affect, and risk communication with older adults: Challenges and opportunities. *Journal of Risk Research*, 2008; 11(8):983–997.
 22. Finucane ML, Alhakami A, Slovic P, Johnson SM. The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making*, 2000; 13(1):1–17.
 23. Damasio AR. *The Feeling of What Happens*. New York: Harcourt Inc, 1999.
 24. Slovic P, MacGregor DG, Peters E. *Imagery, Affect, and Decision-Making*. Eugene, OR: Decision Research, 1998.
 25. Szalay LN, Deese J. *Subjective Meaning and Culture: An Assessment Through Word Associations*. Hillsdale, NJ: Lawrence Erlbaum Associates, 1978.
 26. Joffe H. Risk: From perception to social representation. *British Journal of Social Psychology*, 2003; 42:55–73.
 27. Leiserowitz A. Climate change risk perception and policy preferences: The role of affect, imagery, and values. *Climatic Change*, 2006; 77(1–2):45–72.
 28. Lorenzoni I, Leiserowitz A, Doria MD, Poortinga W, Pidgeon NF. Cross-national comparisons of image associations with “global warming” and “climate change” among laypeople in the United States of America and Great Britain. *Journal of Risk Research*, 2006; 9(3):265–281.
 29. Dunlap RE, McCright AM. Climate change denial: Sources, actors and strategies. In Lever-Tracy C (ed). *Routledge Handbook of Climate Change and Society*. Abingdon, Oxon: Routledge, 2010.
 30. Poortinga W, Spence A, Whitmarsh L, Capstick S, Pidgeon N. Uncertain climate: An investigation into public scepticism about anthropogenic climate change. *Global Environmental Change: Human and Policy Dimensions*, 2011; 21:1015–1024.
 31. Whitmarsh L. Scepticism and uncertainty about climate change: Dimensions, determinants and change over time. *Global Environmental Change: Human and Policy Dimensions*, 2011; 21(2):690–700.
 32. Dillman DA. *The Tailored Design Method*, 2nd ed. New York: J. Wiley, 2000.
 33. Peters E, Slovic P. The role of affect and worldviews as orienting dispositions in the perception and acceptance of nuclear power. *Journal of Applied Social Psychology*, 1996; 26(16):1427–1453.
 34. Dake K. Orienting dispositions in the perception of risk—An analysis of contemporary worldviews and cultural biases. *Journal of Cross-Cultural Psychology*, 1991; 22(1):61–82.
 35. Dake K. Myths of nature—Culture and the social construction of risk. *Journal of Social Issues*, 1992; 48(4):21–37.
 36. Rippl S. Cultural theory and risk perception: A proposal for a better measurement. *Journal of Risk Research*, 2002; 5:147–165.
 37. Leiserowitz A. *Global Warming in the American Mind: The Roles of Affect, Imagery, and Worldviews in Risk Perception, Policy Preferences and Behavior*. Oregon: University of Oregon, 2003.
 38. Dunlap RE, McCright AM. A widening gap—Republican and democratic views on climate change. *Environment*, 2008; 50(5):26–35.
 39. Dearing J, Rogers E. *Agenda-Setting*. London: Sage, 1996.
 40. Smith NW, Joffe H. Climate change in the British press: The role of the visual. *Journal of Risk Research*, 2009; 12(5):647–663.
 41. Ereat G, Segnit N. Warm worlds: How are we telling the climate story and can we tell it better? Institute for Public Policy Research, 2006. Available at: <http://www.ippr.org.uk/publicationsandreports/publication.asp?id=485>, Accessed March 25, 2010.
 42. BBC. Media attacked for “climate porn,” 2006. Available at: <http://news.bbc.co.uk/2/hi/science/nature/5236482.stm>, Accessed March 25, 2010.
 43. Leiserowitz A, Maibach E, Roser-Renouf C, Smith N, Dawson E. Climategate, public opinion, and the loss of trust. *American Behavioral Scientist*, in press.
 44. Kempton W. Lay perspectives on global climate change. *Global Environmental Change: Human and Policy Dimensions*, 1991; 1(3):183–208.
 45. Bostrom A, Morgan MG, Fischhoff B, Read D. What do people know about global climate-change. 1. Mental models. *Risk Analysis*, 1994; 14(6):959–970.
 46. Dunlap, RE. Lay perceptions of global risk: Public views of global warming in cross-national context. *International Sociology*, 1998; 13:473–498.
 47. Damasio AR. *Descartes' Error: Emotion, Reason, and the Human Brain*. New York: Grosset/Putnam, 1994.
 48. Finucane ML, Peters E, Slovic P. Judgment and decision making: The dance of affect and reason. Pp. 327–364 in Schneider SL, Shanteau J (eds). *Emerging Perspectives on Judgment and Decision Research*. Cambridge: Cambridge University Press, 2003.
 49. Meader N, Uzzell D, Gatersleben B. Cultural theory and quality of life. *European Review of Applied Psychology-Revue Europeenne De Psychologie Appliquee*, 2006; 56(1):61–69.
 50. Slovic P, Peters E. The importance of worldviews in risk perception. *Risk, Decision and Policy*, 1998; 3:165–170.
 51. Langford IH, Georgiou S, Bateman IJ, Day RJ, Tumer RK. Public perceptions of health risks from polluted coastal bathing waters: A mixed methodological analysis using cultural theory. *Risk Analysis*, 2000; 20(5):691–704.
 52. Kahan DM, Braman D, Slovic P, Gastil J, Cohen G. Cultural cognition of the risks and benefits of nanotechnology. *Nature Nanotechnology*, 2009; 4(2):87–90.

53. Kahan DM, Jenkins-Smith H, Braman D. Cultural cognition of scientific consensus. *Journal of Risk Research*, 2011; 14(2):147–174.
54. Krosnick JA, Holbrook AL, Visser PS. The impact of the fall 1997 debate about global warming on American public opinion. *Public Understanding of Science*, 2000; 9(3):239–260.
55. New York Times. Sen-elect Brown's win adds more question marks to Senate climate debate. 2010. Available at: <http://www.nytimes.com/cwire/2010/01/20/20climatewire-sen-elect-browns-winadds-more-question-mark-48190.html>, Accessed June 22, 2010.
56. ABC. Fiorina backs delaying global warming law. 2010. Available at: <http://abclocal.go.com/kgo/story?section=news/politics&id=7649235>, Accessed November 22, 2010.
57. Pidgeon NF, Kasperson RE, Slovic P. *The Social Amplification of Risk*. Cambridge: University of Cambridge Press, 2003.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article.

Table S1: Risk Perception Index.

Table S2: Egalitarianism Index.

Table S3: Individualism Index.

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