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TRUST IN SCIENTISTS' STATEMENTS ABOUT THE ENVIRONMENT AND AMERICAN PUBLIC OPINION ON GLOBAL WARMING

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Scientists have the potential to have tremendous influence on contemporary societies. Theory-based and empirically validated understanding of physical, social, and psychological processes can set the stage for practical interventions, improve quality of life, and help people manage profound challenges. Yet in order for scientists to have such impact, they must enjoy the public's trust in the integrity and motives of scientists as well as in the methods of investigation and the competence to employ such methods by scientists (Hardwig, 1991; Luhmann, 1979; Resnik, 2009).¹ Such trust justifies funding of research efforts, large-scale adoption of practices based on scientific principles, and young people's decisions to pursue scientific careers (Resnik, 2011; Siegrist et al., 2007).

In light of the importance of trust in science for society, it is interesting to consider the recent history of the issue of global warming in America. During the last decade, this issue has joined others (e.g., the creationism/evolution debate and its implications for public education, and the question of when life begins, with its implications regarding abortion and stem cell research) as raging public controversies with considerable political significance. Some politicians, including Barack Obama, John McCain, and others, asserted their views that global warming is real and a threat that should be addressed by government, while others (e.g., Mitt Romney) have expressed skepticism about whether global warming has been occurring, the degree to which warming has been caused by human activity, and the appropriateness of action at the time of a national recession.

Skepticism about climate science may be an important driver of the growing division between citizens who call themselves Republicans and who call

themselves Democrats on the issue of global warming (Kahan et al., 2012; McCright & Dunlap, 2011). Such skepticism has also been a source of great frustration for some in the natural science community and is seen by some observers to be evidence of a larger campaign being waged against science generally (Mooney, 2005, 2012; Mooney & Kirshenbaum, 2009; Oreskes & Conway, 2010). As a result, scientists have, understandably, expressed concern about the trajectories of their place in contemporary society and their potential to make positive contributions (Mooney, 2005).

These concerns were expressed often in late 2009 when the news media accorded coverage to two events thought to threaten the public's confidence in scientific research on global warming (Montford, 2010). The first was the so-called "Climategate" episode: emails among climate scientists were released to the public and characterized as revealing corruption: a mission to suppress the voices of researchers who were skeptical about whether global warming has been happening or who believed that it does not pose a significant threat. The second involved errors in a report published by the Intergovernmental Panel on Climate Change (IPCC). Both of these events were perceived by some observers to reduce the public's confidence in climate scientists and in their findings and perhaps to threaten the public's trust of scientists more generally. As a result, significant efforts have been devoted to repairing the damage thought to have occurred (Curry, 2010a, 2010b; IPCC, 2010a; Lempinen, 2010; Ward, 2010).

In this paper, we explore the impact of those events on public trust in and public acceptance of natural scientists' findings about global warming. We begin by describing the two controversies and then describe the methods and findings of a new investigation gauging the impact that these events have had on public beliefs about global warming and on the public's trust in scientists' statements about the environment. We describe evidence suggesting that few people recalled hearing or reading something in the news about the controversial events months later, and at most, an extremely small number of Americans changed their views about global warming as the result of the news about these events. Furthermore, we show that changes in public beliefs about global warming after 2008 might have resulted from annual changes in the world's average temperature among people who didn't trust scientists and not from changes in perceptions of the national economy or in the total volume of news media coverage on global warming. And we describe an experiment showing that the greatest impact of information from a mainstream scientist and from a skeptical scientist occurs among people who trust scientists' statements about the environment highly, while the impact of information from a mainstream scientist and from a skeptical scientist was minimal among people who do not trust scientists' statements about the environment highly. The latter finding that discredits the claim that change in the opinions of people who do not trust scientists' statements about the environment highly after 2008 was due to changes in the prominence of messages from mainstream scientists.

Climategate and the IPCC Report Errors

Climategate broke onto center stage in the national news media on November 19, 2009. Someone hacked into the computer system at the Climatic Research Unit of the University of East Anglia and released to the public thousands of emails and documents related to global warming research. Within days of the revelation, some people asserted that the emails revealed scientific misconduct within the climate science research community and that climate scientists should not be trusted; a firestorm of debate resulted (Norton, 2010).

Between the revelation of Climategate on November 19, 2009, and June 30, 2010, the emails were discussed in at least 506 articles in U.S. print newspapers and at least 348 U.S. television news programs, according to searches using Lexis Nexis.² Broadcast television networks (ABC, CBS, and NBC) aired 11 stories about Climategate on their national news programs. Fox News featured 75 stories, and mainstream cable news outlets (CNBC, MSNBC and CNN) featured 92 stories.³ The majority of the coverage occurred within the month after the initial release of the emails: about 80% of coverage by CNN/CNBC/MSNBC combined, about 70% by ABC/NBC/CBS combined, and 65% by Fox News. The greatest coverage of Climategate by these television news outlets occurred during the two weeks between November 30, 2009, and December 14, 2009. The same over-time pattern was manifested in Google searches for information related to Climategate (Norton, 2010).

The British government investigated the emails and rejected criticisms of climate scientists in reports issued in March and July 2010, concluding that there was no evidence of misconduct by the scientists at the Climatic Research Unit of the University of East Anglia. Consequently, some news media organizations then referred to Climategate as a “manufactured controversy” (*New York Times*, 2010).

On the heels of Climategate, in December 2009, a small number of alleged errors were found in the Fourth Assessment Report issued by the Intergovernmental Panel on Climate Change. The only real error in the report was the projected date of melting of Himalayan glaciers—it should have been 2350 instead of 2035 (IPCC, 2010b). Nonetheless, between December 2009, and June 30, 2010, 209 articles in U.S. print newspapers and 85 U.S. television news programs covered the alleged errors.⁴

Some observers claimed that Climategate and IPCC report errors cast doubt on the credibility of climate scientists and of scientific evidence on global warming (Curry, 2010a, 2010b; IPCC, 2010a; Lempinen, 2010; Ward, 2010). Describing those doubters, Ralph Cicerone, President of the National Academy of Sciences, said in a February 5, 2010 editorial in *Science* that:

[T]his incident ... has raised concern about the standards of science and has damaged public trust in what scientists do ... Public opinion has moved

toward the view that scientists often try to suppress alternative hypotheses and ideas and that scientists will withhold data and try to manipulate some aspects of peer review to prevent dissent. This view reflects the fragile nature of trust between science and society, demonstrating that the perceived misbehavior of even a few scientists can diminish the credibility of science as a whole.

Impact of These Events

Was Dr. Cicerone right? Did Climategate (and perhaps the IPCC report errors) actually decrease public confidence in climate science and in the findings of climate scientists? One sort of evidence taken as support for this view came from public opinion polls, some of which indicated a decline after 2008 in the proportion of Americans who said they thought the earth has been warming (Pew Research Center, 2010; PollingReport, 2012). However, this sort of evidence is hardly conclusive because other events that occurred during this time could have produced the shifts in public opinion.

Impact With Awareness

We assessed whether Climategate and the IPCC report errors might have reduced public confidence in climate science and scientists in a number of different ways. One method we employed explored whether the American public was so powerfully struck by the revelations that people remembered the revelations months later and drew a specific implication of the news regarding the trustworthiness of scientists. To do so, we first asked the following question to a nationally representative sample of 1,000 American adults in June 2010 (the methodology of the survey is described in the Appendix A):

*During the last six months, do you remember hearing or reading anything in the news about emails that were sent by scientists who study the world's climate, or do you not remember hearing or reading anything in the news about that?*⁵

About one-third (32%) of the respondents said they remembered hearing or reading something. Thus, a majority of the respondents, 68%, said they had no memory of this event at all. However, a respondent saying that he or she remembered hearing or reading something does not mean that he or she could recall the specifics of the content of the news stories.

Respondents who said they remembered were asked the following open-ended question:

What do you remember hearing or reading about that?

Interviewers were instructed to record verbatim answer exactly as the respondent said it, and probed with "What else do you remember hearing or reading about

that?" until the respondent said "nothing." We conducted a content analysis on respondents' answers to the open-ended question. Each respondent was coded "yes" or "no" for nine questions (see Appendix B for methodology details).⁶

- 1 Emails were hacked or stolen.
- 2 Research was inaccurate or invalid.
- 3 There was disagreement among scientists.
- 4 There was scientific misconduct.
- 5 There was misinterpretation by opponents or the media.
- 6 There were statements about polar bears, arctic, glaciers, ozone, volcanoes, oceans and other naturals.
- 7 There were statements about global warming.
- 8 Respondents didn't remember.
- 9 Respondents said something substantive other than 1–8.

Many of these recollections were not a basis for doubting the credibility of climate science: 6% of respondents remembered that the emails made statements about polar bears, the arctic, glaciers, ozone, volcanoes, or other natural phenomena. 4% remembered the emails showing that there was disagreement among scientists. 3% remembered that the emails were hacked. 1% said that the emails made statements about global warming. And 1% said that the emails were misinterpreted by the media or others.

Only 12% of the respondents were both aware of the emails and reported that they indicated that scientific misconduct had occurred or that research findings had been inaccurate. Thus, if the emails were ever prominent in the minds of large numbers of Americans, the emails faded from people's consciousness six months after the event broke off.

Respondents who said they remembered were also asked:

Do these emails indicate to you that scientists who study the world's climate should be trusted, indicate to you that these scientists should not be trusted, or do you not indicate anything whether these scientists should be trusted?

Only 9% of all survey respondents said that the emails suggested that climate scientists should not be trusted.⁷

To explore the impact of the IPCC report errors in a similar fashion, we asked the 1,000 respondents in the June 2010 survey:

During the last six months, do you remember hearing or reading anything in the news about mistakes in scientific reports that were written by the Intergovernmental Panel on Climate Change, or do you not remember hearing or reading anything in the news about that?

About one-quarter (24%) of the respondents said they remembered hearing or reading something in the news about the IPCC report errors. Thus, a majority of the respondents, 76%, said they had no memory of this event at all. Furthermore,

a respondent saying that he or she remembered hearing or reading something does not mean that he or she could recall the specifics of the content of the news stories.

Respondents who said they remembered were asked the following open-ended question:

What do you remember hearing or reading about that?

Interviewers were instructed to record verbatim answer exactly as the respondent said it, and probed with “What else do you remember hearing or reading about that?” until the respondent said “nothing.” We conducted a content analysis on respondents’ answers to the open-ended question. Each respondent was coded “yes” or “no” for six questions (see Appendix C for methodology details).⁸

- 1 There was disagreement.
- 2 There were mistakes or inaccuracies.
- 3 There was scientific misconduct.
- 4 There were statements about natural phenomena.
- 5 Respondents didn’t remember.
- 6 Respondents said something substantive other than 1–5.

Many of these recollections were not a basis for doubting the credibility of climate science: 8% of respondents remembered that there were mistakes in the reports. Four percent remembered that there was disagreement among scientists. Five percent remembered nothing specific. Two percent remembered that there were some statements about polar bears, arctic, glaciers, ozone, volcanoes, oceans and other naturals. Only 4% of the full survey sample said they had heard that the errors indicated scientific misconduct.

Respondents who said they remembered were also asked:

Does what you heard or read about mistakes in these reports indicate to you that reports written by the Intergovernmental Panel on Climate Change should be trusted, indicate to you that these reports should not be trusted, or do you not indicate anything whether these reported should be trusted?

Only 13% of all survey respondents reported that they remembered hearing or reading about the mistakes and that the mistakes indicated that the IPCC reports should not be trusted.

Among the very small groups of people who said that the Climategate emails or the IPCC report mistakes raised questions about the trustworthiness of climate scientists, these pieces of news may have changed opinions about global warming or climate scientists. But it is also possible that the news had no impact on these people, because they may have distrusted scientists’ statements about the environment and held skeptical views of global warming even before exposure to these news stories. To gauge the maximum possible effects of the Climategate and IPCC report error stories, we examined the distributions of beliefs and attitudes about global warming among respondents who thought that Climategate and the IPCC report errors raised doubts about the integrity of climate scientists.

Of the 9% of respondents who said that Climategate raised questions about the trustworthiness of climate scientists, 43% said that they trusted scientists' statements about the environment highly even after learning the news (4% of the full survey sample). Therefore, news of Climategate did not convince these people to become skeptical about these statements. The remainder, 57% of the 9% (5% of the full survey sample) is an upper bound estimate on the number of people who report having been influenced to become skeptical of scientists' statements about the environment by Climategate. A similar calculation indicates that 6% or less of the full survey sample report having been influenced to deny the existence of global warming. And a maximum of 5% report having been influenced to believe that past warming was not caused by humans.

Similar figures appeared with regard to the IPCC report errors. Of the 13% of respondents who said that the IPCC report errors raised questions about the trustworthiness of climate scientists, 41% said that they trusted scientists' statements about the environment highly even after learning the news (5% of the full survey sample). Therefore, news of the IPCC report errors did not convince these people to become skeptical about these statements. The remainder, 59% of the 13% (7% of the full survey sample) is an upper bound estimate on the number of people who report having been influenced to become skeptical of scientists' statements about the environment by the IPCC report errors. A similar calculation indicates that 8% or less of the full survey sample report having been influenced to deny the existence of global warming. And a maximum of 7% report having been influenced to believe that past warming was not caused by humans.

Of the people who believed that the news of Climategate or the IPCC report errors called scientists' trustworthiness into question and did not trust scientists' statements about the environment after the news broke, if a considerable number did not trust those statements before they heard about Climategate and the IPCC report errors, then the upper bound estimates in the prior two paragraphs may be substantial over-estimates of the numbers of people who were induced to think that scientists' statements about the environment should not be trusted, to doubt the existence of global warming, and to doubt the role of human activity in causing past warming.

However, it is also possible that all the above figures are underestimates of the numbers of people who were induced by the controversies to adopt skeptical views of scientists' statements about the environment and about global warming. Our analytic approach so far hinges on the assumption that people were not influenced unless they remembered the events and considered its implications to be damaging to climate scientists months after the news broke in the press. But perhaps some members of the public were influenced at the time the news was first disseminated and held onto their new skeptical views months later, even though these people could not recall Climategate or the IPCC report errors. Next section addressed this concern.

Impact Without Awareness

One may be concerned that we did not address the attitude change among people who did not remember exposing to new coverage of these events but whose trust in scientists was in fact influenced by these events. This seems a legitimate concern as numerous studies demonstrated that behavioral changes were induced to subjects without their awareness; that is, people were unaware of stimuli that affected their behavior (Nisbett & Wilson, 1977; Adams, 1957). In the traditional stimulus-response methodology whereby a response is predicted after exposure to stimulus, three sets of literature might pertain to our present study in terms of the perceptibility of stimulus of the exposure, the degree of attending to stimulus during the exposure, and cognitive process models of generating the response.

First set of literature pertains to subliminal stimulus, of which subjects could not conceivably be aware (Bornstein & D'Agostino, 1992; Bornstein, Leone & Galley, 1987; Greenwald & Draine, 1997). The effect of subliminal stimuli was found to be mainly on affect, such as people's moods (Hawkins, 1970) and liking for objects (Bornstein, Leone & Galley, 1987; Zajonc, 1968). While this literature shows that subliminal stimuli could influence behaviors, its applicability to our present study is limited for a number of reasons. The influence seemed to manifest on affect, but not on attitudes such as trust in scientists. The duration of the influence to subliminal stimuli was unspecified (Bornstein, Leone & Galley, 1987), though many subliminal perception studies measured immediate influence while our survey asked people about the events that occurred six months ago. Another important difference was that reading news stories or watching news programs is unlikely to be exposure to subliminal stimulus.

Second set of literature is concerned with the effect of exposure to perceptible stimulus without attending to it; that is, influence from learning without involvement, such as in television advertisements (Krugman, 1965; Pechmann & Stewart, 1988). With repeated exposure, various behavioral outcomes, such as people's attitudes toward, intent to purchase and actual purchase a brand in advertisements, were changed regardless people were able to recall the brand, in an immediate or delayed fashion (Pechmann & Stewart, 1988). Attitudinal changes without remembering the exposure in advertisements are related to our study: people voluntarily exposed themselves to news coverage of these events, many of them may have multiple exposures with variations of news stories about these events. While it is possible that people who had been exposed to news coverage of these events were influenced by the exposure but failed to recall the exposure when probed as asked in our survey months later, this literature suggests few people would fall into this scenario, though a quantitative upper bound was infeasible to obtain

given that studies in this literature involved non-representative samples of the American adult population.

Third set of literature pertains to the cognitive processing model of forming judgment—online versus memory-based judgment—when stimulus is perceptible and attention is paid to (Hastie & Park, 1986; Lavine, 2002). It could be that when news media covered these events, some people were aware of and attended to the coverage, the information in the news coverage affected their attitudes toward these events and climate scientists and their trust in scientists more generally, and these people formed or updated these attitudes during their exposure to the coverage of these events. As time progressed, these people subsequently forgot about their attending to news coverage of these events, but the influence of the news coverage on their trust in scientists remained, making it an online judgment. When asked in our survey about their trust in scientists, these people would perform an online judgment by directly retrieving their summary opinion without retrieving or processing the information upon which the summary opinion was initially formed and/or subsequently updated. In our case, these people reported their trust in scientists through an online task while the trust judgment had been influenced by their exposure to news coverage of these events, which they did not remember.

Of interest is to gauge who might be those people and how to characterize them; that is, what proportion of the respondents might have performed online judgment in responding to our survey questions. Ability and motivation are hypothesized to be factors determining which processing model—online or memory-based—that people engage in for their political attitudes; online processing requires more of both ability and memory than memory-based processing because directly retrievable summary opinions require that people possess both the willingness and ability to attend to politics and to form evaluative responses toward political objects (Lavine, 2002). We employed personal issue importance measure to delineate people who might be most likely to undertake online processing (Bizer et al., 2006). All respondents were asked:

How important is the issue of global warming to you personally—extremely important, very important, somewhat important, not too important, or not at all?

We considered respondents who said “extremely important” or “very important” as people likely to engage in online judgment. Thirty-two percent of the survey sample fell into this category and reported that they did not remember reading or hearing news coverage on Climategate; among these people, less than one-fourth, 24%, did not trust scientists' statements about the environment. Assuming that all these low-trust people had been high trust before Climategate and became low trust because of Climategate, an upper bound of the trust-reducing effect of Climategate through online processing and failure to remember would be 8% of the survey sample.^{9,10}

Trends in High Trust in Scientists and Global Warming Existence Belief

To overcome possible ambiguity in our results so far in this regard, we capitalized on two aspects of our survey data collection. First, since 2006, our annual national surveys have measured public trust in scientists' statements about the environment by asking:

How much do you trust the things scientists say about the environment—completely, a lot, a moderate amount, a little, or not at all?

As consistently throughout the paper, high-trust people or people who trust scientists' statements highly are defined as people who gave response "completely," "a lot" or "a moderate amount" to the trust question, and low-trust people or people who do not trust scientists' statements highly are defined as people who gave response "a little," or "not at all" to the trust question. The 2009 interviewing was done immediately after the Climategate news broke (November 17–29), and the 2010 interviewing occurred seven months later. Comparison of our 2008, 2009, and 2010 surveys allowed us to assess whether the aggregate distribution of Americans' opinions changed after news of the controversies broke. The observed fluctuations in percentages estimate the net change in opinions of (1) people whose opinions changed and who were aware of the Climategate or IPCC error report news months later, and (2) people whose opinions changed as the result of exposure to the news but later forgot these events.

Public trust in scientists' statements about the environment did not decline from 2008 to 2009 or from 2009 to 2010. The percent of high-trust people—respondents who said they trusted scientists' statements about the environment completely, a lot, or a moderate amount was equivalent in 2008 and 2009 (69% in 2008 vs. 70% in 2009; design effects adjusted $F = .16, p = .69$), in 2008 and 2010 (69% in 2008 vs. 71% in 2010; design effects adjusted $F = 1.17, p = .28$), and in 2009 and 2010 (70% in 2009 vs. 71% in 2010; design effects adjusted $F = .23, p = .63$).¹¹ This evidence is inconsistent with the claim that Climategate and the IPCC errors decreased the public's trust in scientists' statements about the environment.

Consonant with the same conclusion is another type of evidence: changes in public opinion about the existence of global warming. If news stories about Climategate and the IPCC errors reduced trust in scientists' statements about the environment, the percent of Americans saying that global warming has been occurring might have declined as a result. To test this possibility, we examined the measurements obtained by various survey organizations that asked a question either directly or indirectly indicating respondents' beliefs about the existence of global warming (1) before Climategate and the IPCC report errors were publicized, and (2) after they were publicized.

Perhaps the most informative data were collected by NBC and the Wall Street Journal. In their October 2009 survey, conducted just before the news stories broke,

56% of respondents either said that “global climate change has been established as a serious problem and immediate action is necessary” or said that “there is enough evidence that climate change is taking place and some action should be taken.” In a survey in December 11–14, 2009, just after the news stories broke, that figure was about the same: 54%. And seven months after the news stories broke, in June 2010, the figure was back to 56%. Neither of these shifts is statistically significant, suggesting that no real change in the distribution of opinions occurred.

The same conclusion is supported by data collected by the Pew Research Center. In their October 2009 survey, just before the news stories broke, 57% of respondents said that from what they had seen or heard, there was solid evidence that the earth’s temperature had been rising during the last few decades. Eleven months after the news stories broke, another Pew survey found this figure to be 59%, not significantly different from the 57%. Thus, again, this evidence is consistent with the conclusion that the events caused no lasting change in the distribution of opinions.

Other surveys did register statistically significant changes over longer time periods, but they were small. For example, in March 2009, eight months before the news stories broke, 83% of Gallup Organization survey respondents said they believed that effects of global warming had already begun to occur or will occur in the future. That figure was 79% in March 2010, four months after the news stories broke, a significant but small 4 percentage points lower. Likewise, in May 2009, six months before the news stories broke, 69% of respondents in a Fox News survey said that they believed global warming existed. In December 8–9, 2009, just after the news stories broke, that percentage was 63% in another Fox News poll, a significant six percentage point decline.

Our own surveys revealed a similar pattern. In our July 2008 survey, 80% of respondents said they thought that the earth’s temperature has probably been going up slowly over the past 100 years. That figure was 75% in our survey conducted just after the news stories broke (a significant decline) and was 74% seven months later, in June 2010.

Only one survey organization produced a different pattern of results. In a survey done in April 2009, CNN found that 81% of respondents said that global warming was a proven fact. That figure dropped to 68% in a survey done in December 2–3, 2009, and dropped a little more to 64% in May 2010. The drop from 81% to 68% was statistically significant, though the drop from 68% to 64% was not.

Averaging across all of the nine pre-November 2009 to post-November 2009 comparisons that these surveys permit, the drop potentially attributable to Climategate and the IPCC report errors is six percentage points. Because other events occurred during the time period between each pair of surveys, we cannot know with confidence what caused this apparent decline. But it does seem reasonable to conclude that at most, the impact of these events was very small.^{12,13}

The Impact of Trust in Scientists' Statements about the Environment

Every one of the surveys reviewed above showed that a majority of Americans believed that global warming was real, and some surveys documented huge majorities holding that belief. Is this evidence that most Americans have been persuaded by the scientific evidence on this point? We believe not. The reason is that Americans can come to believe that the earth has been warming by a variety of different routes, some of which do not involve scientists at all.

Conceptually, what might shape public perception of the existence of global warming and what might account for the variability of such perception? Weber (2010) proposed two learning models through which beliefs about global warming are formed: learning from personal experience and learning from a statistical description. Learning from a statistical description involves cognitive processes that require analytical processing skills that need to be acquired as well as cognitive efforts, while learning from personal experience involves associative and affective processes that are automatic provided by the basic human ability and require neither acquired analytical processing skills nor cognitive efforts. While climate scientists formed their perceptions of global warming based primarily on analytic processing, nonscientists or laypersons typically rely more on associative and affective processing of climate-related information that they are exposed to.

When laypersons rely on external sources of scientific evidences and scientific expertise to form their opinions about global warming, the effectiveness of this reliance depends on attention to and trust in external sources, i.e. scientists who study the world's climate. This route hinges on trust in an expert source. According to a great deal of theory and empirical evidence in social psychology, people are more likely to accept a person's assertion if that person is perceived to be expert on the topic (Hovland, Janis, & Kelley, 1953; Petty & Cacioppo, 1986; Petty, Cacioppo, & Schumann, 1983; Sternthal, Phillips, & Dholakia, 1978). Trust in the source of a message has been shown to regulate attitude change in this way in many domains, such as social capital formation (Putnam, 1993), the impact of the news media on evaluations of presidents (Miller & Krosnick, 2000), and vote choice (Heatherington, 1999). Therefore, when deciding whether the earth has been warming over the last 100 years, relying on scientific research findings is likely to occur among citizens who trust the scientists who generated the evidence (Malka, Krosnick & Langer, 2009).

But about one quarter of Americans are low-trust people, people who have trusted scientists' assertions about the environment only a little or not at all?¹⁴ Unable or unwilling to rely on external sources of scientific evidences and expertise provided by climate scientists, how should such a citizen decide whether the earth has been warming over the last 100 years? According to some recent research, these individuals might execute experiential processing (Marx et al., 2007) and generalize

from their own personal experiences observing what they believe to be the effects of global warming (Myers et al., 2013) or with changes in local temperatures (Borick & Rabe, 2012; Deryugina, 2013; Egana & Mullina, 2012; Joiremana, Trueloveb, & Duellc, 2010; Li, Johnson, & Zava, 2011). That is, low-trust people tend to form perception about global warming based on some personal experience; for example, low-trust people who believe they have seen effects of global warming or who believe that temperatures have been warmer recently or who are warm at the time of answering a survey question might therefore be especially inclined to report that long-term warming has been occurring.

In summary, these theories and empirical evidences suggest that laypersons who trust external sources of scientific evidences and expertise form science-related beliefs such as whether global warming has been happening based on assertions from these sources, while those who do not form theirs based on their own personal experience. That trust in scientific sources regulates how laypersons form their beliefs about scientific constructs not only sheds light on what route laypersons take to form their perceptions of global warming, but also provides predictions what accounts for the variability of such beliefs. First, the moderating role of scientific trust predicts between-route variations in perceptions formed from the two routes. For beliefs about the existence of global warming whereby there is a strong consensus among scientists that the warming is unequivocal, people who trust scientists and rely on scientists' findings would be more likely to believe in the warming than people who do not trust scientists and rely on their own personal experience such as witnessing climate events that might be manifested by global warming. Drawing from anecdotal evidence and general observations that suggest a pattern of generally underweighting small-probability climate events, Weber (2010) stated that judging whether global warming has been happening based on personal experience will lead to judgments that are low. This prediction also sheds light on the role of personal experience of high-trust people in forming science-related beliefs. Having not assumed that high-trust people would completely ignore their own personal experience, it follows from this prediction that high-trust people who have a higher level of judgment about global warming existence would supersede any judgment drawn from personal experience which is lower.

Second, the moderating role of scientific trust also predicts within-route variation in perceptions formed from each of the two routes. For beliefs about the existence of global warming whereby scientific evidences supporting the occurrence of warming has been consistent over time, people who trust scientists and rely on scientists' findings would be consistent in their perceptions about global warming and there will be thus little variations in their perceptions over time, while people who do not trust scientists and rely on their own personal experience would show large variations in their perceptions over time because personal experience is more variable and volatile (Weber, 2010).

Here, we propose another possible reasoning strategy that low-trust individuals might implement. Rather than generalizing from their own personal experiences to the entire planet, low-trust people could rely on planet-level data that are not collected or analyzed by scientists. Specifically, low-trust citizens might rely on reports of trends in world temperatures. We suspect that many people believe that temperature measurements are not complex scientific assessments subject to controversy and are instead objective facts that can be obtained indisputably with a thermometer, with no scientific competence necessary. And low-trust individuals might be inclined to base their beliefs about long-term warming of the planet on such data.

In fact, news media stories published in recent years have routinely trumpeted the prior year's average world temperature (Banerjee, 2013), because the National Oceanic and Atmospheric Administration has issued a report on this annually, accompanied by a press release (NOAA, 2012a), and headlines have often made claims that the world's temperature has been unusually high or low (Banerjee, 2013; Durando, 2013; Samenow, 2013). Advocates of concern about global warming have often encouraged using the prior year's global temperature to make inferences about long-term planetary warming. For example, such advocates were quick to point out in 2011 that 2010 was the warmest year on record and that this should be viewed as evidence that global warming is real (Eilperin, 2010). By the same token, 2011 was the coolest year worldwide between 2001 and 2011, which was viewed by some skeptical observers as evidence questioning global warming (NOAA, 2012b). Because average world temperature has gone up and down from year to year in small increments, perhaps the proportion of low-trust citizens who believed in the existence of global warming has risen and fallen in parallel, because these individuals have over-generalized from the most recent year.

To test for this possibility, we separated our survey samples into people high in trust in scientists' statements about the environment and people low in such trust¹⁵. As shown in Figure 13.1, among high-trust people, the proportion who believed that the earth has been gradually warming held relatively steady between 2006 and 2012. It was highest in 2007 (88%) and lowest in 2010 (81%), a statistically significant difference. However, among low-trust people, the percent who thought that gradual warming had been occurring dropped from a high of 77% in 2006 to a low of 55% in 2009, a much more dramatic and statistically significant shift, three times the size of the drop among high-trust people.

The pattern among low-trust people matches remarkably closely the world's average temperature over those years, lagged by one year (so 2006's temperature appears in the column labeled 2007), shown in Figure 13.1.¹⁶ From 2006 to 2007, the world's temperature (lagged) declined (by almost one-tenth of a degree Celsius), and so did the percentage of low-trust people who believed in the existence of global warming (a decrease of 6 percentage points). A similar pattern occurred from 2008 to 2009: world temperature declined (by nearly

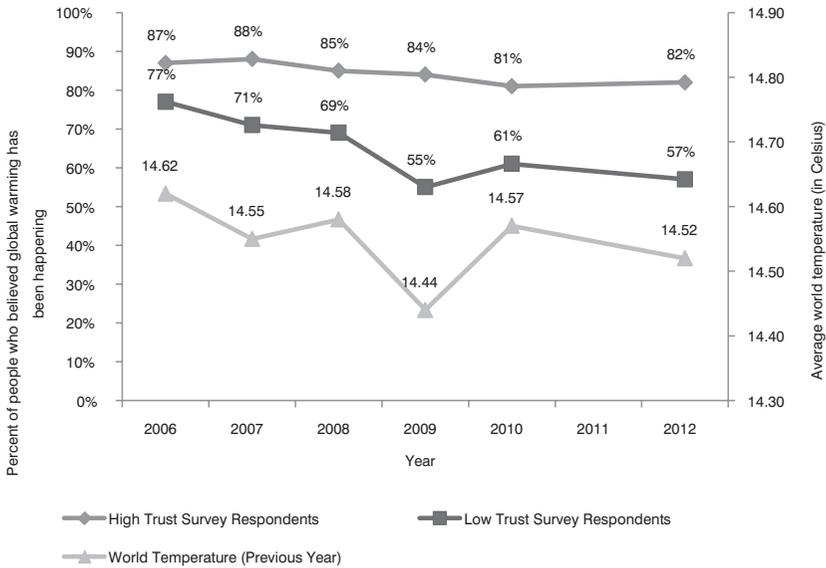


FIGURE 13.1 Public Opinion about the Existence of Global Warming and Recent World Temperatures (Notes: Data on the average world temperature were compiled by the Earth Policy Institute using information from the National Aeronautics and Space Administration, the Goddard Institute for Space Studies, and the “Global Land-Ocean Temperature Index in 0.01 Degrees Celsius,” available at: data.giss.nasa.gov/gistemp/tabledata/GLB.Ts+dSST.txt, updated January 2012. Data on trust in scientists and global warming were obtained from national surveys conducted by Stanford University and affiliates.)

one and half tenths of a degree Celsius), and this was accompanied by a large reduction (14 percentage points) in the fraction of low-trust people who believed that global warming had been happening. Conversely, when world temperature increased (e.g., from 2008 to 2009), the proportion of low-trust people who believed in global warming’s existence also increased.

Consistent with this logic are results of regressions predicting belief in the existence of global warming. Among low-trust people, for every one-tenth degree increase in the previous year’s average temperature, belief that global warming had been happening increased by a significant 10 percentage points ($b = .10, p < .01$). This relation was absent among high-trust people ($b = .01, p = .26$). This is consistent with the notion that the dynamics of low-trust people’s opinions about the existence of global warming were partly driven by recent world temperatures.

Time series data of this sort are routinely used to evaluate the plausibility of causal propositions (e.g., Shumway, 1988). The fact that temperature changes in one year anticipated changes in public opinion the next year rules out the possibility of reverse causation or simultaneity. Nonetheless, the decline in existence beliefs

in 2009 might be attributable to other causes, such as the substantial drop in news media coverage of global warming that occurred then (Boykoff & Nacu-Schmidt, 2013). According to the agenda-setting hypothesis, when news stories devote considerable attention to an issue, the issue becomes more salient to the public, and the public infers that more salient problems are more nationally significant (McCombs & Shaw, 1972). If the public infers the existence of the problem (i.e., whether the planet has been warming) from the frequency with which they've heard it discussed in news stories, then public belief about the existence of long-term warming might covary with the extent of news coverage of global warming.

However, the available data do not confirm this claim. The total volume of mainstream U.S. news media coverage of global warming increased substantially from 2006 to 2007 and then decreased in 2008 and decreased more in 2009, increased a bit after that, and declined thereafter until 2011 (Boykoff & Nacu-Schmidt, 2013). This pattern (even with a one-year lag) does not match the dynamics of opinions shown in Figure 13.1: although news media coverage of global warming was dramatically greater in 2007 than in 2006, public belief in the existence of global warming did not rise between those years—indeed, the proportion of low-trust people who believed in the existence of long-term warming declined.

Another hypothesis that might explain the drop in existence beliefs in 2009 involves Americans' perceptions of the economic health of the nation. Perhaps when economic conditions are tough, people are motivated to deny the significance of environmental threats, so that public energy can be focused on improving the economy without distraction by environmental issues. Therefore, perhaps recession-induced economic hardships that began in late 2008 created economic insecurity and dampened confidence in the economy, which in turn led to a decline in the proportion of people who believed that global warming had been occurring, so as to rationalize non-attention to that issue (Brulle, Carmichael, & Jenkin, 2012; Kahn & Kotchen, 2010; Scuggs & Benegal, 2012; Shum, 2012).

To test this hypothesis, one might be tempted to use objective indicators of the health of the economy, such as the unemployment rate, the inflation rate, average stock prices, or many others. However, we see no obvious conceptual grounds to select among the numerous possible such indicators for use in analysis. More importantly, such indicators seem likely to influence public judgment only to the extent that people use them to make inferences about the health and trajectory of the economy. We therefore measured such perceptions directly via assessments of consumer confidence, which are individual-level perceptions of and optimism about the state of the national economy. The Index of Consumer Sentiment (measured monthly in the University of Michigan's Survey of Consumers) increased from 2006 to 2007, declined smoothly until late 2008, remained low in 2009, and rose in 2010 and 2011 (Consumer Sentiment Index, 2013). In contrast, among low trust Americans, the proportion who believed in the existence of global warming declined from 2006 to 2007, remained steady

from 2007 to 2008, dropped in 2009, rose in 2010, and dropped by 2012. Thus, the two time series do not exhibit matching trajectories.

Furthermore, even if it were true that the changes in public beliefs about the existence of global warming shown in Figure 13.1 are attributable to changes in the volume of news coverage of the issue or to the 2008 economic recession, there is no strong theoretical rationale for why such impact would be confined to people low in trust in scientists' statements about the environment. In fact, one might anticipate the opposite relation: mainstream news media coverage of global warming has been dominated by coverage of claims by natural science experts that the earth has been warming and has rarely devoted attention to claims by such experts that global warming has not been happening (Boykoff & Boykoff, 2004; Boykoff & Roberts, 2007). Therefore, changes in the volume of such coverage would presumably influence highly trusting people more than low-trust people.¹⁷

Yet another possible explanation for the decline in the number of people who believed in global warming's existence in 2009 is Downs' "Issue Attention Cycle" (Downs, 1972). According to Downs, controversial issues often progress through five stages: (1) the pre-problem stage, before the public is aware of its seriousness; (2) a dramatic event (such as the *Exxon Valdez* Oil Spill) suddenly calls people's attention to a highly undesirable situation and causes elites to commit to solving the problem, which in turn causes a surge in public concern about it; (3) people begin to realize that solving the problem won't be easy; (4) people begin to feel threatened by solutions or to become bored with the topic; and (5) public concern disappears. This perspective might explain the decline in existence beliefs in Figure 13.1 from 2008 to 2009 if that was a time period when the public became especially aware of the difficulties that would be entailed by trying to address global warming, became bored with the issue, and sought to rationalize inattention by denying the existence of the problem. But this theory would not predict, nor could it explain, the increase in existence belief that occurred between 2009 and 2010, nor does this theory anticipate that over-time changes would be concentrated among people low in trust in scientists.

The argument we have made so far is that among people high in trust in scientists' statements about the environment, opinions about the existence of global warming were constant over time because these people were especially likely to rely on these scientists' statements, whereas low trust individuals were not. Support for this general perspective comes from an experiment we conducted. The experiment was embedded in a survey of American adults who signed up with a firm to complete surveys regularly via the Internet in exchange for cash or prizes and completed our questionnaire during January 2009 (see Appendix D for the data collection methodology of the survey).¹⁸ Respondents were randomly assigned to watch one of four television news stories, and then answered questions reporting their opinions on global warming. The four news stories were as follows.

- 1 **Existence without Skeptic** (1 min., 45 sec.): An ABC News story describing IPCC-endorsed research suggesting that the earth's temperature has been increasing due to human activity.
- 2 **Existence with Skeptic** (2 min., 23 sec.): The **Existence without Skeptic** story plus an additional 38 seconds featuring a skeptical scientist arguing that current carbon emissions are not influencing global temperature.
- 3 **Consequences without Skeptic** (1 min., 20 sec.): A PBS news interview with a natural scientist describing the likely harmful consequences of global warming, including floods and hurricanes, harm to a variety of plant and animal species, and undesirable economic consequences.
- 4 **Consequences with Skeptic** (2 min., 14 sec.): The **Consequences without Skeptic** story plus an additional 54 seconds of an interview with a skeptical economist arguing that more carbon dioxide will produce more plants, will produce more food for animals, and will favorably impact the American economy.

Upon watching one of the above four new stories, respondents answered questions reporting their opinions on global warming: global warming has been happening and certainty of this belief, five degrees Fahrenheit warming in 75 years would be bad, global warming will be a serious problem for the world, and desired amount of government action to deal with global warming (see Appendix D for question wording and response coding).

Comparisons across these conditions allowed us to explore two issues.

- 1 Does exposure to someone presented as an expert expressing skeptical views about climate change increase acceptance of those skeptical views?
- 2 Does the impact of exposure to a message from someone portrayed as a skeptical expert have more impact on the opinions of people who place more trust in scientists?

Adding a skeptic to the mainstream science messages reduced expression of the mainstream scientific views by the survey respondents. Compared to respondents who watched the mainstream scientific message without a skeptic, exposure to the skeptic led to an 8 percentage point decrease in the percent of people who believed that global warming had been happening with high certainty ($d = -.08, p < .01$), as well as decreases in the percent of people who said global warming would be bad ($d = -.07, p < .10$), who said that global warming is a globally serious problem ($d = -.05, p < .05$), and who supported more federal government action on global warming ($d = -.05, p < .05$).

Furthermore, the impact of the skeptics was greater among people who trusted scientists' statements about the environment. For example, exposure to the skeptics reduced belief in the existence of global warming among people

who were highly trusting of scientists' statements about the environment ($d = -.05$, $p < .05$), but no change in this proportion occurred among people who were low in trust in scientists' statements about the environment ($d = .03$, *n.s.*). The same pattern of moderation by trust appeared with judgments of the seriousness of global warming and in policy support: the decrease was apparent among people who trusted scientists' statements about the environment but not among those who did not (global warming is a globally serious problem: $d = -.08$, $p < .01$; $d = .06$, *n.s.*, respectively; desire for more government actions about global warming: $d = -.09$, $p < .05$; $d = .04$, *n.s.*, respectively). Thus, not surprisingly, people who were more trusting of scientists' statements about the environment relied more on their opinions, including the opinions of people portrayed as scientific experts who expressed skepticism.

The Origins of Trust in Scientists' Statements about the Environment

Next, we explored the causes of trust in scientists' statements about the environment (Critchley, 2008; Das & Teng, 2004; Siegrist, 2000; Siegrist & Cvetkovich, 2000; Slovic, 1993). We hypothesized that more formal education might cause more exposure to the scientific method and that such exposure may engender more trust in that method. Furthermore, because younger adults' exposures to science in school, in the news across their lifetimes, in their work settings are likely to have illustrated more sophisticated research methods and findings, these individuals may end up with more confidence in science and scientists. Furthermore, because trusted leaders can persuade citizens to adopt their views, visible attacks on the credibility of science by prominent Republicans during the last decade (8) might have induced citizens who think of themselves as Republicans or conservatives to express more skepticism about scientists (Zaller, 1992). Likewise, more exposure to conservative-leaning presentations of news (e.g., by Fox News) might have reduced trust in scientists' statements, whereas more exposure to mainstream news might entail more sympathetic portrayals of science and therefore increase trust.¹⁹

Results consistent with these predictions emerged from a logistic regression predicting trust using our 2010 survey data (see Appendix A for the data collection methodology of the survey; see also Table 13.1). The more educated an individual was, the more likely he or she was to express trust. Also as expected, younger adults were more trusting than older adults. Third, Democrats were expectedly significantly more trusting than Independents, whose trust levels were equal to those of Republicans (Mooney & Kirshenbaum, 2009). And conservatives were significantly less trusting than moderates, whose trust levels were equal to those of liberals (Gauchat, 2012).

TABLE 13.1 Predictors of High Trust in Scientists' Statements about the Environment (Survey Data Collected in November 2010)

<i>Predictor</i>	<i>Marginal Effect</i>
Democrat	0.13***
Republican	-0.03
Liberal	0.05
Conservative	-0.09**
Female	0.11***
Having child(ren)	0.06
Hispanic	0.06
African American	-0.11
Asian and other races	0.08
Married	-0.01
High school graduate	0.11*
Some college	0.12**
College graduate	0.19***
Age 25–34	-0.17
Age 35–44	-0.18
Age 45–54	-0.25**
Age 55–64	-0.28**
Age 65 and older	-0.31***
Midwest	-0.07
South	-0.06
West	-0.11
(10) Days viewing Fox News	-0.10***
(10) Days viewing TV News	0.07***
N	1001

Notes: Presented are the marginal effects from a logistic regression predicting high trust in scientists' statements about the environment adjusting for sampling weights. Omitted categories are Independent, moderate, non-Hispanic, White, non-married, having no child, less than high school education, ages 18–24, and lived in the Northeast. Dummies variables identifying people with missing values for each predictor were included in the regression but are not shown here. The dependent variable was coded 1 for respondents who trusted what scientists say about the environment completely, a lot, or a moderate amount, and 0 for respondents who said they trusted what scientists said about the environment a little or not at all or did not answer (excluding the five people who did not answer did not change the results).

*** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

As expected, more exposure to Fox News was associated with lower levels of trust in scientists' statements about the environment.²⁰ And more exposure to non-Fox television news was associated with more trust in scientists' statements about the environment (for similar findings, see Hmielowski et al., 2012).²¹

Trust did not vary across racial groups, between parents and non-parents, or across regions of the country. However, women were more trusting of scientists' statements about the environment than were men.

Our finding regard sex contrasts with some evidence in other domains finding no differences between men and women in other sorts of trust (Croson & Buchan, 1999; Scott, 1983) or finding that women were less trusting of scientific research than were men (e.g. Siegrist, 2000, in the domain of gene technology). Therefore, the gender gap in trust in science or scientists might be domain-dependent, and what was observed here might be specific to global warming.

Our results are in line with other findings discovered in previous studies and are sometimes strikingly different. For example, a survey of residents of the Milwaukee area did show that older people and more politically conservative people trusted university scientists' statements about the environment less (as did we) but revealed no relation of trust with sex or education, and showed African-Americans to be less trusting than Whites (Brewer & Ley, 2013). As did we, Hmielowski et al. (2012) found that trust in scientists as a source of information about global warming was greater among more educated people, among people who were less exposed to conservative television news and talk radio, among people who were more exposed to non-conservative news media, and among people with more conservative political ideologies, and found no relation of trust with race (Hmielowski et al., 2012). Perhaps like us, these authors also found trust in scientists' statements about global warming to be significantly related to sex, but the authors did not explain how sex was coded in their regressions, so it is not possible to tell whether men or women manifested higher levels of trust. However, Hmielowski et al. (2012) found no relation of trust with age. Another study revealed that trust in scientific statements about offshore oil drilling were lower among people who were more conservative but did not vary with political party identification (Carlisle et al., 2010). Gauchat (2011) found that trust in science was higher for more educated people but lower for non-whites than for whites and unrelated to age or sex or political conservatism (Gauchat, 2011). Gauchat (2012) found, as did we, that trust in science increased with education, decreased with increasing age, and was lower among conservatives and moderates than among liberals (Gauchat, 2012). But unlike us, Gauchat (2012) found that women trusted science less than did men, that Southerners trusted science less than people in other regions, and that Republicans were no less trusting than Democrats. Thus, findings regarding the correlates of trust in science and scientists have been quite inconsistent across studies and therefore seem to merit further investigation.

In summary, some of these findings match those in past studies of predictors of trust in scientists, but other findings do not, so it appears that more research in this area is needed to clarify these inconsistencies.

Differentiating Types of Scientists

In our past surveys, we have routinely measured trust by asking respondents about their trust in scientists' statements about the environment. One might imagine that the public differentiates scientists' statements about the environment from scientists' statements about global warming in particular. To investigate this possibility, we asked all the respondents in our June 2012 survey two questions about trust:

How much do you trust the things scientists say about the environment—completely, a lot, a moderate amount, a little, or not at all?

and

How much do you trust the things scientists say about global warming—completely, a lot, a moderate amount, a little, or not at all?

(See Appendix A for the data collection methodology of the survey.) These two trust questions were spaced out during the survey administration; the first trust question was asked of respondents at the beginning of the survey while the second one was asked toward the end of the same survey.

The distributions of responses to the two questions were nearly identical. As consistently throughout the paper, high-trust people or people who trust scientists' statements highly are defined as people who gave response "completely," "a lot" or "a moderate amount" to the trust question, and low-trust people or people who do not trust scientists' statements highly are defined as people who gave response "a little," or "not at all" to the trust question. When asked about scientists' statements about the environment, 64% said completely, a lot, or a moderate amount.²² That number was 61% when asked about scientists' statements about global warming. A paired *t*-test showed these proportions not to be significantly different from one another.

Furthermore, answers to the two questions matched for the vast majority of the respondents. Among respondents who trusted scientists' statements about the environment highly, an overwhelming majority (81%) trusted scientists' statements about global warming highly. And among respondents who did not trust scientists' statements about the environment highly, nearly as large a majority (75%) did not trust scientists' statements about global warming highly. In total, only 21% of respondents offered different opinions in response to the two questions (high trust to one, low trust to the other). And of these individuals, 62% did so because their ratings differed by the very small distance of only one

point on the 5-point rating scale (from a moderate amount to a little or from a little to a moderate amount). Thus, there is no notable difference between the public's trust in scientists' statements about the environment generally and in scientists' statements about global warming in particular. These survey questions did not differentiate subgroups of scientists from one another. We asked respondents about trust in what "scientists" say about the environment or global warming; we did not ask about "scientists who specialize in studying the earth's climate," for example. Therefore, our questions presumably referred both to statements made by such scientists and statements made about the environment or global warming by scientists who do not specialize in the latter issue. Future research might explore whether asking about "scientists who specialize in studying the earth's climate" yields different results than do the questions we have asked to date.

Conclusion

More than a decade of public opinion research on global warming supports three conclusions. First, only a very small portion of Americans were aware of the Climategate and IPCC error controversies and maintained the view that these controversies raised questions about the integrity of climate science. Second, most Americans have trusted scientists' statements about the environment at least moderately, and public trust did not decline after the two controversies hit the front pages of newspapers. Third, the percent of Americans who believed in the existence of global warming was lowered by a very small amount after publicity of these controversies. All this suggests that these controversies, which captured the attention of many natural scientists and many observers of science, had little if any measurable impact on relevant opinions of the nation as a whole.

We saw evidence suggesting that trust in scientists' statements about the environment has been consequential in the process of opinion formation, just as social psychologists would anticipate. Among people who did not trust scientists' statements about the environment, opinions about the existence of global warming rose and fell since 2006 in ways paralleling the prior year's average world temperature, suggesting that that signal may have been a basis for those opinions. No such relation was apparent among people who did trust scientists' statements about the environment—these individuals were more likely to believe that global warming has been occurring than were less trusting people. This suggests that public acceptance of scientific research findings was not notably affected by Climategate, nor by the IPCC report errors.

Furthermore, we saw that the impact of scientists who are climate skeptics is regulated by trust in scientists' statements about the environment. People who trust scientists' statements about the environment were more persuaded by skeptical experts than were people who do not. There is no small amount of

irony in this finding. Some mainstream scientists may be disappointed to learn that the credibility of their profession generally lends credibility to all members of the community, regardless of whether an individual scientist's views are in line with the majority or not. This raises the intriguing notion that perhaps future surveys should measure public trust in research findings of scientists who believe global warming is real and human-caused vs. research findings of scientists who do not express these views. Our data suggest that efforts to enhance the public's trust in scientists' statements about the environment may increase the degree to which people accept the views of mainstream climate scientists and of climate skeptics.

Finally, our findings suggest that as Americans receive increasing amount of formal education, exposure to scientific training may become more widespread, and national trust levels may rise as a result. But if climate skepticism becomes more prominent on Fox News and/or if people's exposure to such news outlets rises in the future while their content remains the same as it has been, and if national exposure to mainstream news media continues to decline while its content remains the same, this may cause a decrease in public trust in scientists' research findings about the environment. If such a decline does occur, then the influence on global warming beliefs of signals such as annual world temperatures may rise.

References

- Adams, J. K. (1957). Laboratory studies of behavior without awareness. *Psychological Bulletin*, 54(5): 383–405.
- Banerjee, N. (2013). 2012 was among the 10 hottest years on record globally. *Los Angeles Times*, January 15, 2013.
- Bizer, G. Y., Tormala, Z. L., Rucker, D. D., & Petty, R. E. (2006). Memory-based versus online processing: Implications for attitude strength. *Journal of Experimental Social Psychology*, 42(5): 646–653.
- Bornstein, R. F., & D'Agostino, P. R. (1992). Stimulus recognition and the mere exposure effect. *Journal of Personality and Social Psychology*, 63(4): 545–552.
- Bornstein, R. F., Leone, D. R., & Galley, D. J. (1987). The generalizability of subliminal mere exposure effects: Influence of stimuli perceived without awareness on social behavior. *Journal of Personality and Social Psychology*, 53: 1070–1079.
- Borick, C. P., & Rabe, B. G. (2012). Weather or not: Examining the impact of meteorological conditions on public opinion regarding climate change. The American Political Science Association Annual Meeting 2012 Paper.
- Boykoff, M. T., & Boykoff, J. (2004). Bias as balance: global warming and the US prestige press. *Global Environmental Change*, 14(2): 125–136.
- Boykoff, M. T., & Nacu-Schmidt, A. (2013). 2000–2013 US Newspaper Coverage of Climate Change or Global Warming. University of Colorado. Accessed in April 2013 at http://sciencepolicy.colorado.edu/media_coverage/us/graph.jpg.

- Boykoff, M. T., & Roberts, J. T. (2007). Media coverage of climate change: Trends, strengths and weaknesses. New York: UN Human Development Report Office.
- Brewer, P. R., & Ley, B. L. (2013). Whose science do you believe? Explaining trust in sources of scientific information about the environment. *Science Communication*, 35(1): 115–137.
- Brulle, R. J., Carmichael, J., & Jenkin, J. C. (2012). Shifting public opinion on climate change: An empirical assessment of factors influencing concern over climate change in the U.S., 2002–2010. *Climatic Change*, 114(2): 169–188.
- Carlisle, J. E., Feezell, J. T., Michaud, K. E. H., Smith, E. R. A. N., & Smith, L. (2010). The public's trust in scientific claims regarding offshore oil drilling. *Public Understanding of Science*, 19(5): 514–527.
- Consumer Sentimental Index (2013). University of Michigan. Accessed in April 2013 at <http://www.sca.isr.umich.edu/documents.php?c=tr>.
- Critchley, C. R. (2008). Public opinion and trust in scientists: the role of the research context, and the perceived motivation of stem cell researchers. *Public Understanding of Science*, 17: 309–327.
- Crosan, R., & Buchan, N. (1999). Gender and culture: International experimental evidence from trust games. *The American Economic Review*, 89(2): 386–391.
- Curry, J. (2010a). On the credibility of climate research, part II: Towards rebuilding trust. Accessed in April 2013 at http://curry.eas.gatech.edu/climate/towards_rebuilding_trust.html.
- Curry, J. (2010b). Opinion: Can scientists rebuild the public trust in climate science? Accessed in April 2013 at http://icecap.us/images/uploads/Opinion_Curry.pdf.
- Das, T. K., & Teng, B. S. (2004). The risk-based view of trust: A conceptual framework. *Journal of Business and Psychology*, 19(1): 85–116.
- Deryugina, T. (2013). How do people update? The effects of local weather fluctuations on beliefs about global warming. *Climatic Change*, 118: 397–416.
- Downs, A. (1972). Up and down with ecology: The “issue-attention” cycle. In D. L. Protes, & M. E. McCombs (Eds.), *Agenda Setting: Readings on Media, Public Opinion, and Policymaking* (pp. 48–59). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Durando, J. (2010). NOAA: Global temperature in 2010 ties for hottest on record. *USA Today*, October 15, 2010.
- Egana P. J., & Mullina, M. (2012). Turning personal experience into political attitudes: The effects of local weather on Americans' perceptions about global warming. *The Journal of Politics*, 74(3): 796–809.
- Eilperin J. (2010). Hottest climate year on record, NASA says. *Washington Post*, December 10, 2010.
- Feldman, L., Maibach, E. W., Roser-Renouf, & Leiserowitz, A. (2011). Climate on cable: The nature and impact of global warming coverage on Fox News, CNN, and MSNBC. *The International Journal of Press/Politics*, 17(1): 3–31.
- Gaucht, G. (2011). The cultural authority of science: Public trust and acceptance of organized science. *Public Understanding of Science*, 20(6): 751–770.
- Gaucht, G. (2012). Politicization of science in the public sphere: A Study of public trust in the United States, 1974–2010. *American Sociological Review*, 77(2): 167–
- Greenwald, A. G., & Draine, S. C. (1997). Do subliminal stimuli enter the mind unnoticed? Tests with a new method. In J. D. Cohen & J. W. Schooler (Eds.), *Scientific Approaches to Consciousness* (pp. 83–108). Mahwah, NJ: Erlbaum.

- Hardwig, J. (1991). The role of trust in knowledge. *Journal of Philosophy*, 88(12): 693–708.
- Hastie, R., & Park, B. (1986). The relationship between memory and judgment depends on whether the task is memory-based or online. *Psychological Review*, 93: 258–68.
- Hart, P. S. (2008). Market influences on climate change frames in CNN and Fox News climate change broadcasts. Presented at the International Communication Association Annual Meeting, Montreal, Quebec, Canada.
- Hawkins, D. (1970). The effects of subliminal stimulation on drive level and brand preference. *Journal of Marketing Research*, 7: 322–326.
- Heatherington, M. J. (1999). The effect of political trust on the presidential vote, 1968–96. *American Political Science Review*, 93 (June): 311–326.
- Hmielowski, J. D., Feldman L., Myers, T. A., Leiserowitz, A., & Maibach, E. (2012). An attack on science? Media use, trust in scientists, and perceptions of global warming. *Public Understanding of Science*, 22(3): 1–18.
- Hovland, C. I., Janis, I. L., & Kelley, H. H. (1953). *Communication and Persuasion: Psychological Studies of Opinion Change*. New Haven, CT: Yale University.
- Intergovernmental Panel on Climate Change (IPCC) (2010a). Statement of the IPCC chairman on the establishment of an independent committee to review IPCC procedures. Accessed in April 2013 at http://www.ipcc.ch/pdf/press/PA_IPCC_Chairman_Statement_27Feb2010.pdf
- Intergovernmental Panel on Climate Change (IPCC) (2010b). IPCC statement on the melting of Himalayan glaciers. Accessed in August 2012 at <http://www.ipcc.ch/pdf/presentations/himalayastatement-20january2010.pdf>.
- Joiremana, J., Trueloveb, H. B., & Duellc, B. (2010). Effect of outdoor temperature, heat primes and anchoring in belief in global warming. *Journal of Environmental Psychology*, 30(4): 358–367.
- Kahan D. M., Peters, E., Wittlin M., Slovic, P., Ouellette, L. L., Braman, D., & Mandel, G. (2012). The polarizing impact of science literacy and numeracy on perceived climate change risks. *Nature Climate Change*, 2: 732–735.
- Kahn, M. E., & Kotchen, M. J. (2010). Environmental concern and the business cycle: The chilling effect of recession. National Bureau of Economic Research Working Paper No. 16241.
- Krosnick J. A., & Fabrigar, L. R. (forthcoming). *The Handbook of Questionnaire Design*. New York: Oxford University Press.
- Krugman, H. E. (1965). The impact of television advertising: Learning without involvement. *Public Opinion Quarterly*, 29(3): 349–356.
- Leiserowitz, A., Maibach, E., Roser-Renouf, C., Smith, N., & Dawson, E. (2013). Climategate, public opinion, and the loss of trust. *American Behavioral Scientist*, 57(6): 818–837.
- Lempinen, E. W. (2010). Science leaders urge new effort to strengthen bonds with public. *Science*, 327(5973): 1591–1593.
- Lavine, H. (2002). Online versus memory-based process models of political evaluation. In K. R. Monroe (Ed.), *Political Psychology* (pp. 225–247). Mahwah, NJ: LEA.
- Li, Y., Johnson, E. J., & Zava, L. (2011). Local warming: daily temperature change influences belief in global warming. *Psychological Science*, 22(4): 454–459.
- Luhmann N. (1979). *Trust and Power*. New York, NY: John Wiley and Sons.

- Malka, A., Krosnick, J. A., & Langer, G. (2009). The association of knowledge with concern about global warming: Trusted information sources shape public thinking. *Risk Analysis*, 29: 633–647.
- Marx, S. M., Weber, E. U., Orlove, B. S., Leiserowitz, A., Krantz, D. H., Roncoli, C., & Phillips, J. (2007). Communication and mental processes: Analytical and experiential processing of uncertain climate information. *Global Environmental Change*, 17: 47–58.
- McCombs, M. E., & Shaw, D. L. (1972). The agenda-setting function of mass media. *Public Opinion Quarterly*, 36(2): 176–187.
- McCright, A. M. & Dunlap, R. E. (2011). The politicization of climate change and polarization in the American public's view of global warming, 2001–2010. *The Sociological Quarterly*, 52: 155–194.
- McKnight, D. (2010). A change in the climate? The journalism of opinion at News Corporation. *Journalism* 11(6): 693–706.
- Miller, J. M., & Krosnick, J. A. (2000). News media impact on the ingredients of presidential evaluations: Politically knowledgeable citizens are guided by a trusted source. *American Journal of Political Science*, 44(2): 301–315.
- Montford, A. W. (2010). *The Hockey Stick Illusion: Climategate and the Corruption of Science (Independent Minds)*. London, UK: Stacey International Publishers.
- Mooney, C. (2005). *The Republican War on Science*. New York: Basic Books.
- Mooney, C. (2012). *The Republican Brian: The Science of Why They Deny Science and Reality*. Hoboken, NJ: Wiley Press.
- Mooney, C., & Kirshenbaum, S. (2009). *Unscientific America*. New York: Basic Books.
- Myers, T. A., Malibach, E. W., Roser-Renouf, C., Akerlof, K., & Leiserowitz, A. A. (2013). The relationship between personal experience and belief in the reality of global warming. *Nature Climate Change*, 3: 343–347.
- National Oceanic and Atmospheric Administration (NOAA) (2012a). National Climatic Data Center, “State of the Climate”, accessed in April 2013 at <http://www.ncdc.noaa.gov/sotc/>; “News”, accessed in April 2013 at <http://www.ncdc.noaa.gov/news/2012-global-temperatures10th-highest-record>.
- National Oceanic and Atmospheric Administration (NOAA) (2012b). State of the climate, global analysis, annual 2011. Accessed in August 2012 at <http://www.ncdc.noaa.gov/sotc/global/2011/13>.
- New York Times (2010). A climate change corrective. Editorial, *New York Times*, July 10, 2010.
- Nisbett, R.E., & Wilson, T.D. (1977). Telling more than we can know: Verbal reports on mental process. *Psychological Review*, 84(3): 231–259.
- Norton, D.W. (2010). Constructing “Climategate” and tracking chatter in an Age of Web n.0.
- Working Paper, American University. Accessed in April 2013 at http://www.centerforsocialmedia.org/sites/default/files/documents/pages/david_norton_climateate.pdf.
- Oreskes, N., & Conway, E. M. (2010). *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. London, UK: Bloomsbury Press.
- Pechmann, C. & Stewart, D. W. (1988). Advertising Repetition: A critical review of wearin and wearout. *Current Issues and Research in Advertising*, 11(1–2): 285–329.

- Petty, R. E., & Cacioppo, J. T. (1986). *Communication and Persuasion: Central and Peripheral Routes to Attitude Change*. New York: Springer-Verlag.
- Petty, R. E., Cacioppo, J. T., & Schumann, D. (1983). Central and peripheral routes to advertising effectiveness: The moderating role of involvement. *Journal of Consumer Research*, 10 (September): 135–146.
- Pew Research Center (2010). Wide partisan divide over global warming. Accessed in August 2012 at <http://pewresearch.org/pubs/1780/poll-global-warming-scientists-energy-policiesoffshore-drilling-tea-party>.
- PollingReport (2012) Environment. Accessed in August 2012 at <http://www.pollingreport.com/enviro2.htm>.
- Putnam, R. D. (1993). *Bowling Alone*. New York: Simon and Schuster.
- Resnik, D. B. (2009). *Playing Politics with Science*. New York: Oxford University Press.
- Resnik, D. B. (2011). Scientific research and the public trust. *Science and Engineering Ethics*, 17(3): 399–409.
- Samenow, J. (2013). Earth had third warmest May on record (tie with 1998 and 2005). *The Washington Post*, June 20, 2013.
- Scott, D. (1983). Trust differences between men and women in superior and subordinate relationships. *Group and Organization Studies*, 8(3): 319–336.
- Scuggs, L., & Benegal, S. (2012). Declining public concern about climate change: Can we blame the great recession? *Global Environmental Change*, 22(2): 505–515.
- Shum, R. Y. (2012). Effects of economic recession and local weather on climate change attitudes. *Climate Policy*, 12(1): 38–49.
- Shumway, R. H. (1988). *Applied Statistical Time Series Analysis*. Englewood Cliffs, NJ: Prentice Hall.
- Siegrist, M. (2000). The influence of trust and perception of risks and benefits on the acceptance of gene technology. *Risk Analysis*, 20(2): 195–203.
- Siegrist, M., & Cvetkovich, G. (2000). Perception of hazards: The role of social trust and knowledge. *Risk Analysis*, 20(5): 713–719.
- Siegrist, M., Keller, C., Kastenholz, H., Frey, S., & Wick, A. (2007). Laypeople's and experts' perception of nanotechnology hazards. *Risk Analysis*, 27: 59–69.
- Slovic, P. (1993). Perceived risk, trust, and democracy. *Risk Analysis*, 13(6): 675–682.
- Sternthal, B., Phillips, L. W., & Dholakia, R. (1978). The persuasive effect of source credibility: A situational analysis. *Public Opinion Quarterly*, 42 (Fall): 285–314.
- Ward, B. (2010). A reputation in tatters. *New Scientists*, 206(2762): 26–27.
- Weber, E. U. (2010). What shapes perceptions of climate change. *WIREs Climate Change*, 1 (May/June): 332–342.
- Zajonc, R. B. (1968). Attitudinal effects of mere exposure. *Journal of Personality and Social Psychology*, 9(2): 1–27.
- Zaller, J. (1992). *The Nature and Origins of Mass Opinion*. Cambridge, UK: Cambridge University Press.

Appendix A

Data Collection Methodology for National Global Warming Surveys

Data Collection Methodology of the Stanford 2006 Survey

The 2006 survey was a random digit dialing telephone survey that involved calling landline telephone numbers of a national probability sample of 1,002 U.S. adults ages 18 and older, conducted by TNS of Horsham, PA, between March 9 and March 14, 2006, commissioned by ABC News, Time, and Stanford University. The sample was provided by Survey Sampling International, and interviews were conducted in both English and Spanish. The results have a 3-point margin of error.

Data Collection Methodology of the Stanford 2007 Survey

The 2007 survey was a random digit dial landline telephone survey of a national probability sample of 1,002 U.S. adults ages 18 and older, conducted by TNS of Horsham, PA, between April 5 and April 10, 2007, commissioned by ABC News, Washington Post, and Stanford University. The sample was provided by Survey Sampling International, and interviews were conducted in both English and Spanish. The results have a 3-point margin of error.

Data Collection Methodology of the Stanford 2008 Survey

The 2008 survey was a random digit dial landline telephone survey of a national probability sample of 1,000 U.S. adults ages 18 and older, conducted by TNS of Horsham, PA, between July 23 and July 28, 2008, commissioned by ABC News, Planet Green, and Stanford University. The sample was provided by Survey Sampling International, and interviews were conducted in both English and Spanish. The AAPOR Response Rate 3 was 29%.

Data Collection Methodology of the Stanford 2009 Survey

The 2009 survey was conducted by GfK Roper Public Affairs & Media, commissioned by Stanford University and the Associated Press. This telephone poll involved interviews with a nationally-representative probability sample of 1,005 adults age 18 or older. Interviews were conducted between November 17 and November 29, 2009, with 705 respondents on landlines and 300 on cellular telephones. The landline and cell phone samples were provided by Survey Sampling International. Interviews were conducted in both English and Spanish. The AAPOR Response Rate 3 was 12%.

Data Collection Methodology of the Stanford June 2010 Survey

The Stanford June 2010 survey was a random digit dial telephone survey of a national probability sample of 1,000 U.S. adults aged 18 and older conducted by GfK Custom Research North America between June 1 and June 7, 2010, with 699 respondents on landlines and 301 on cellular telephones. Both landline and cell phone samples were provided by Survey Sampling International. Data were weighted to account for probabilities of selection due to varying numbers of telephone lines that could reach the respondent and varying numbers of adults living in each household, and then post-stratified on age, sex, education and race, using targets from the March 2009 supplement of the Current Population Survey. The weighting also took into account the patterns of land and cell phone usage by region from the 2009 fall estimates provided by Mediamark Research Inc. The survey had margin of error of plus or minus 4.4 percentage points.

Data Collection Methodology of the Stanford November 2010 Survey

The November 2010 survey, sponsored by Stanford University, was a random digit dial telephone survey of a national probability sample of U.S. adults aged 18 and older conducted by Abt SRBI, November 1 and November 14, 2010. Some 671 respondents were interviewed on a landline phone, and 330 were interviewed on a cell phone. Interviews were administrated in English and Spanish.

Samples were drawn from both landline and cellular random digit dial (RDD) frames to represent people with access to either a landline or cell phone. Both samples were provided by Survey Sampling International, LLC, according to specifications from Abt SRBI. Numbers for the landline sample were drawn with equal probabilities from active blocks (area code + exchange + two-digit block number) that contained one or more residential directory listings. The cellular sample was drawn through a systematic sampling from 1000-blocks dedicated to cellular service according to the Telcordia database.

The data were weighted to ensure that the sample composition reflected the U.S. population in terms of demographics documented by figures from the U.S. Census Bureau. Weights were created to adjust for differential probabilities of selection due to the number of adults in the household, the number of voice-use landlines and cell phones, and the overlap of landline and cell phone RDD frames, as well as non-coverage and nonresponse through post-stratification. Post-stratification matched the population proportions of age, sex, education, ethnicity, race, and Census region, using targets from the September 2010 Current Population Survey conducted by the U.S. Census Bureau. The weighting combined the interviews done on landlines and cell phones taking into account the rates of landline and cell phone usage documented by the 2009 National Health Interview Survey. The AAPOR Response Rate 3 was 17%.

Data Collection Methodology of the Stanford 2012 Survey

The Stanford 2012 survey was a random digit dial telephone survey of a national probability sample of 804 U.S. adults aged 18 and older conducted by Abt SRBI, between June 13 and June 21, 2012. 603 respondents were interviewed on a landline phone, and 201 were interviewed on a cellular phone. Interviews were administered in English only.

Samples were drawn from both landline and cellular random digit dial (RDD) frames by Survey Sampling International. Numbers for the landline sample were drawn with equal probabilities from active blocks (area code + exchange + two-digit block number) that contained one or more residential directory listings. The cellular phone sample was drawn through a systematic sampling from 1000 blocks dedicated to cellular service according to the Telcordia database.

The data were weighted to ensure that the sample composition reflected the U.S. population in terms of demographics documented by figures from the U.S. Census Bureau. Weights were created to adjust for differential probabilities of selection due to the number of adults in the household, the number of voice-use landlines and cell phones, and the overlap of landline and cell phone RDD frames, as well as non-coverage and nonresponse through post-stratification. Post-stratification matched the population proportions of age and sex, education and sex, ethnicity and race, and region using targets from the 2010 American Community Survey conducted by the U.S. Census Bureau. The weighting combined the interviews done on landlines and cell phones taking into account the rates of landline and cell phone usage documented by the 2009 National Health Interview Survey. The AAPOR Response Rate 3 for the survey was 15%.

Appendix B

Instructions for Content Analysis of Survey Responses on Climategate

You will read answers that survey respondents gave to an open-ended survey question and make nine coding decisions about what each person said. Survey respondents—nationally representative sample of American adults—were asked, on phone interviews, the following question:

During the last six months, do you remember hearing or reading anything in the news about emails that were sent by scientists who study the world's climate, or do you not remember hearing or reading anything in the news about that?

The respondents who answered “yes” to the above question were asked the following question:

What do you remember hearing or reading about that?

And their answers are for you to read and make six coding decisions. Please do your work completely independently. Do NOT talk with anyone other than the study investigators about anything you do on this project. Please read the text very carefully and follow the instructions below.

9 Coding Questions

Note: The pronoun “they” in responses can be interpreted to be referring to scientists.

Q1. “emails were hacked”

Type “yes” if the respondent said anything that indicates *any* of the following:

- a someone hacked or stole emails OR
- b someone leaked emails OR
- c emails scientists wrote about their research (data, figures, methods, results) OR
- d emails scientists made comments on others (other scientists).

Type “no” if the respondent said none of the above.

Q2. “inaccuracy of research”

Type “yes” if the respondent said anything that indicates *any* of the following:

- a research, including data, methods, and findings, or other information, was not accurate OR
- b research, including data, methods, and findings, or other information, was not valid OR
- c research, including data, methods, and findings, or other information, was exaggerated or overestimated OR
- d research, including data, figures, methods, findings, or other information, was questionable or was questioned OR
- e research findings show that climate change is not as serious a problem as some scientists have claimed.

Type “no” if the respondent said none of the above.

Q3. “disagreement among scientists”

Type “yes” if the respondent said anything that indicates *any* of the following:

- a there was disagreement among scientists OR
- b some scientists said one thing, and other scientists said the opposite OR
- c there was an argument among scientists OR
- d there is controversy about what scientists’ findings mean.

Type “no” if the respondent said none of the above.

Q4. “scientific misconduct”

Type “yes” if the respondent said anything that indicates *any* of the following:

- a one or more scientists did something unethical in their research OR
- b one or more scientists did something unethical with their data—they withheld the data, or they manipulated or falsified the data OR
- c one or more scientists did something unethical in their statistical analysis—they skewed the analysis or biased their results OR
- d one or more scientists should not be trusted
- e one or more scientists did research for their own personal or financial gains (including to get more funding for their research) OR
- f one or more scientists did research for political reasons.

Type “no” if the respondent said none of the above.

Q5. “misinterpretations of the content of the emails”

Type “yes” if the respondent said anything that indicates *any* of the following:

- a the content of emails was described in a misleading way by taking quotes out of context (by opponents, or by the media), or people misinterpreted the emails OR
- b controversies or disagreement among scientists were exaggerated by the news media.

Type “no” if the respondent said none of the above.

Q6. “polar bears, arctic, glaciers, ozone, volcanoes, oceans, or other natural phenomena”

Type “yes” if the respondent said anything that indicates *any* of the following:

- a about polar bears or other animals OR
- b about arctic icebergs or glaciers melting or receding OR
- c about ozone, or volcanoes, or oceans, or storms, or other natural phenomena.

Type “no” if the respondent said none of the above.

Q7. “green or not-green statements”

Type “yes” if the respondent said anything that indicates *any* of the following:

- a the emails were about global warming or climate change OR
- b the emails were about the evidence on or causes of global warming or climate change OR
- c the emails said that global warming or climate change has been happening, or has been caused by human actions OR
- d the emails indicate that actions should be taken to mitigate the effects of global warming or climate change OR

- e the emails indicate that global warming or climate change has NOT been happening, or is NOT caused by human action OR
- f the emails indicate that no actions should be taken to mitigate the effects of global warming or climate change OR

Type “no” if the respondent said none of the above.

Q8. “don’t remember”

Type “yes” if the respondent said anything that indicates *any* of the following:

- a don’t or can’t remember, or don’t or can’t remember the specifics OR
- b don’t know the specifics OR
- c not sure about the specifics.

Type “no” if the respondent said none of the above.

Q9. “other”

Type “yes” if the respondent said anything in addition to 1(a)–1(b), 2(a)–2(e), 3(a)–3(d), 4(a)–4(f), 5(a)–5(c), 6(a)–6(c), 7(a)–7(c), 8(a)–8(c).

Type “no” otherwise.

Appendix C

Instructions for Content Analysis of Survey Responses on IPCC Report

You will read answers that survey respondents gave to an open-ended survey question and make six coding decisions about what each person said. Survey respondents—nationally representative sample of American adults—were asked, on phone interviews, the following question:

During the last six months, do you remember hearing or reading anything in the news about mistakes in scientific reports that were written by the Intergovernmental Panel on Climate Change, or do you not remember hearing or reading anything in the news about that?

The respondents who answered “yes” to the above question were asked the following question:

What do you remember hearing or reading about that?

And their answers are for you to read and make six coding decisions. Please do your work completely independently. Do NOT talk with anyone other than the study investigators about anything you do on this project. Please read the text very carefully and follow the instructions below.

6 Coding Questions

Note: The pronoun “they” in responses can be interpreted to be referring to scientists or members of IPCC committee.

Q1. “disagreement”

Type “yes” if the respondent said anything that indicates *any* of the following:

- a there was disagreement, or argument, or debate OR
- b some conflicting or contradictory reports with some saying one thing while others saying the opposite OR
- c there was a controversy.

Type “no” if the respondent said none of the above.

Q2. “mistakes or inaccuracies”

Type “yes” if the respondent said anything that indicates *any* of the following:

- a the IPCC reports contained any statements that were incorrect or based any statements on other research reports that themselves were not credible
- b the IPCC reports, including data, methods, and findings, was not accurate OR
- c the IPCC reports, including data, methods, and findings, was not valid OR
- d the IPCC reports, including data, methods, and findings, was exaggerated or overestimated OR
- e the IPCC reports, including data, figures, methods, findings, was questionable or was questioned.

Type “no” if the respondent said none of the above.

Q3. “scientific misconduct”

Type “yes” if the respondent said anything that indicates *any* of the following:

- a one or more scientists (or members of IPCC committee) did something unethical in their research OR
- b one or more scientists (or members of IPCC committee) did something unethical with their data—they withheld the data, or they manipulated or falsified the data OR
- c one or more scientists (or members of IPCC committee) did something unethical in their statistical analysis—they skewed the analysis or biased their results OR
- d one or more scientists (or members of IPCC committee) should not be trusted
- e one or more scientists (or members of IPCC committee) did research for their own personal or financial gains (including to get more funding for their research) OR

f one or more scientists (or members of IPCC committee) did research for political reasons.

Type “no” if the respondent said none of the above.

Q4. “natural phenomena”

Type “yes” if the respondent said anything that indicates *any* of the following:

- a about polar bears or other animals OR
- b about arctic icebergs or glaciers melting or receding OR
- c about ozone, or volcanoes, or oceans, or storms, or other natural phenomena.

Type “no” if the respondent said none of the above.

Q5. “don’t remember”

Type “yes” if the respondent said anything that indicates *any* of the following:

- a don’t remember the specifics, or not sure about the specifics.

Type “no” if the respondent said none of the above.

“other”

Type “yes” if the respondent said anything in addition to 1(a)–1(c), 2(a)–2(e), 3(a)–3(f), 4(a)–4(c), 5(a).

Type “no” otherwise.

Appendix D

Methodology of January 2009 Non-probability Survey

Data Collection Methodology of January 2009 Non-probability Survey

The participants were 2,885 members of Luth Research’s SurveySavvy panel. Most of the members of this panel volunteered to complete surveys in exchange for a chance to win prizes, so this panel is not a representative sample of American adults. The panel members were recruited in several ways. Initially, random digit dialing phone calls were made to invite some American adults to sign up to receive email invitations to complete surveys via the Internet. Similar recruitment phone calls were made to professionals working in the information technology sector who were listed in professional directories. These initial panel members (a total of approximately 5,000) were then offered a chance to win cash or gift certificates in exchange for referring other people to join the panel. Referred panel members were offered the same incentives to refer other people. Panel members were also recruited through online advertisements (posted on the Luth Research website, news sites, blogs, and search engines) and through

emails sent by businesses and non-profit organizations with which prospective panelists were affiliated. Panel members were rewarded when one of their referrals, or one of their referrals' referrals, completed a survey.

A total of 89,918 SurveySavvy panelists were invited to complete this surveys between January 15 and 18, 2009. Invitees were selected to maximize the match of the participants to the nation in terms of the distributions of some demographic variables. A total of 3,013 people completed the 12–15 minute survey, 2,885 of whom indicated that they were able to see and hear a test streaming video and were therefore included in the analyses reported here. Five respondents were dropped because their reported age was under 18, resulting in a usable sample size of 2,880 for the analysis.

Global Warming Measures in January 2009 Non-probability Survey

Upon watching one of the above four new stories, respondents answered questions reporting their opinions on global warming as follows.

Global warming existence. “You may have heard about the idea that the world’s temperature may have been going up slowly over the past 100 years. What is your personal opinion on this—do you think this probably has been happening, or do you think it probably hasn’t been happening?” Answers were coded 1 and 0, respectively.

Certainty about global warming existence. Participants who said that global warming has been happening were then asked, “How sure are you that the world’s temperature has been going up – extremely sure, very sure, somewhat sure, or not sure at all?” Participants who said that global warming has not been happening were asked the same question with the word “hasn’t” substituted for the word “has.” Participants who said that they were extremely sure or very sure were coded 1, and all other participants were coded 0.

Attitude toward global warming. “Scientists use the term ‘global warming’ to refer to the idea that the world’s average temperature may be about five degrees Fahrenheit higher in 75 years than it is now. Overall, would you say that global warming would be good, bad, or neither good nor bad?” Participants who said that global warming would be bad were coded 1, all others were coded 0.

Global seriousness. Participants who thought global warming had been happening were asked, “If nothing is done to reduce global warming in the future, how serious of a problem do you think it will be for the world—very serious, somewhat serious, not so serious, or not serious at all?” Participants who thought global warming had not been happening were asked, “Assuming it’s happening, how serious of a problem do you think it will be for the world—very serious, somewhat serious, not so serious, or not serious at all.” Participants who said that global warming would be very serious were coded 1, and all others were coded 0.

Support for government action. “Do you think the federal government should do more than it’s doing now to try to deal with global warming, should do less than it’s doing now, or is it doing about the right amount?” Participants who said the government should do more were coded 1, and all others were coded 0.

Notes

- 1 A great deal of research has explored trust more generally, and this construct has been defined in many different ways (see, e.g., Das & Teng (2004)). In line with much of that work, we define trust in scientists as having two components: (1) a belief in competence; and (2) a belief that motives are well-intentioned.
- 2 The search results were obtained from Lexis Nexis as follows: time span was between November 17, 2009 and June 30, 2010; full-text search terms were “climategate” OR “climate gate” OR “Climatic Research Unit” OR CRU; sources were U.S. Print Newspapers and “TV & Radio News Transcripts” for the two searches, respectively.
- 3 These search results were obtained from Lexis Nexis as follows: time span was between November 17, 2009 and June 30, 2010; full-text search terms were “climategate” OR “climate gate” OR “Climatic Research Unit” OR CRU; sources were “Fox News Network”; “ABC News”, “CBS News”, and “NBC News”; and “CNBC News”, CNN”, and “MSNBC”, under the category of “TV & Radio News Transcripts”, respectively.
- 4 The search results were obtained from Lexis Nexis as follows: time span was between November 17, 2009 and June 30, 2010; full-text search terms were (IPCC OR “Intergovernmental Panel on Climate Change”) AND (error OR mistake OR errors OR mistakes); sources were U.S. Print Newspapers and “TV & Radio News Transcripts” for the two searches, respectively.
- 5 This question wording is called “balanced” because it acknowledges both sides of the issue equally saliently and thereby avoids acquiescence response bias (Krosnick & Fabrigar, forthcoming).
- 6 The agreement level between coders was 93% and 81% for questions 1 and 2, respectively; 87% and 82% for questions 3 and 4, respectively; 97% and 96% for questions 5 and 6, respectively; 96% and 96% for questions 7 and 8, respectively; and 76% for question 9. For respondents for whom the two coders gave different answers to at least one coding question, a third coder performed another round of coding independently using the same coding process the first two coders followed. The discrepancy in coding answers among three coders was resolved by the majority rule.
- 7 Another 9% said that the emails suggested that climate scientists should be trusted, and 11% said that these emails did not indicate anything to them about whether climate scientists should be trusted. These findings are broadly consistent with the results of a national survey done in January 2010 (Leiserowitz et al., 2012), in which 29% of respondents said they had heard of news stories about Climategate (similar to the 32% found in our study) and about 15% of respondents said they had heard of the stories and thought these stories caused them to trust climate scientists less (53% of the 29% of all respondents), not very different from the 9% of the respondents in our survey who remembered the stories and thought the emails indicated that scientists should not be trusted.
- 8 The agreement level between coders was 91% for question 1, 83% for question 2, 85% for question 3, 97% for question 4, 94% for question 5 and 80% for question

6. For respondents for whom the two coders gave different answers to at least one coding question, a third coder performed another round of coding independently using the same coding process the first two coders followed. The discrepancy in coding answers among three coders was resolved by the majority rule.
- 9 If we considered people who thought the issue of global warming was extremely important to them personally, the upper bound of the trust-reducing effect of Climategate through online processing and failure to remember would be 2% of the survey sample. If we required people likely to engage in online processing to have high ability by imposing the assumption of college graduate, the upper bound of the trust-reducing effect of Climategate through online processing and failure to remember shrank to less than 1% of the survey respondents.
- 10 We employed an alternative measure—opinion strength—to characterize people likely to engage in online processing as follows, and all respondents were asked: “How strong are your opinions on the issue of global warming—extremely strong, very strong, somewhat strong, not too strong, or not at all strong?” We obtained similar estimates of upper bounds of the trust-reducing effect of Climategate through online processing and failure to remember as the estimates using the issue importance measure.
- 11 The same conclusion is reinforced if we dichotomize trust differently or if we treat it as a continuous variable.
- 12 One might imagine that the effect of the focal events was very short-lived, so surveys done months after November 2009, would fail to document this effect on public beliefs. However, the NBC/Wall Street Journal sequence of polls challenges the notion of an immediate effect of the revelations (during December 11–14, 2009) or an effect that emerged more slowly over the next few months.
- 13 An alternative approach to assessing the impact of Climategate and the IPCC report errors could be to ask survey respondents whether news of these events changed their opinions (see, e.g., Leiserowitz et al. (2012)). However, a huge literature in psychology suggests that this is unlikely to yield valid results. Hundreds of studies reviewed by and inspired by Nisbett and Wilson’s (1977) landmark paper show that people are not aware of the forces that shape their thinking and action. And dozens of studies show that people cannot accurately describe changes that occurred in their opinions in the past (for a review, see Krosnick & Fabrigar (forthcoming)). Another approach one might take is asking people to agree or disagree with various statements about the Climategate and IPCC report errors (see, e.g., Leiserowitz et al. (2012)). But dozens of studies have shown that answers to agree/disagree questions are biased by acquiescence response bias (Krosnick & Fabrigar, forthcoming).
- 14 As consistently throughout the paper, high-trust people or people who trust scientists’ statements highly are defined as people who gave response “completely,” “a lot” or “a moderate amount” to the trust question: “How much do you trust the things scientists say about the environment—completely, a lot, a moderate amount, a little, or not at all?”, and low-trust people or people who do not trust scientists’ statements highly are defined as people who gave response “a little,” or “not at all.”
- 15 Consistently throughout the paper, we use the response to the trust question: “How much do you trust the things scientists say about the environment—completely, a lot, a moderate amount, a little, or not at all?” to categorize respondents as high-trust and low-trust people, respectively, with the former defined as respondents who gave response “completely,” “a lot” or “a moderate amount” and the latter defined as respondents who gave response “a little,” “a moderate amount” to the trust question, respectively. The terms “high trust people” and “people who trust scientists’ statements highly” are used interchangeably, and so

are the terms “low-trust people” and “people who do not trust scientists’ statements highly.”

- 16 This one year lag is sensible because the public typically learns about a year’s average world temperature in news stories disseminated early the following year.
- 17 Brulle, Carmichael, and Jenkins (2012) reported evidence that might seem to offer a series of alternative explanations for the changes in public opinion shown in Figure 13.1. But there are many reasons to hesitate before reaching such a conclusion. First, Brulle et al. (2012) did not predict changes over time in beliefs about whether the earth has been warming during the last 100 years, as we did. Instead, they predicted an index that they dubbed “concern about the threat of climate change,” which was measured by responses to a wide variety of survey questions on many different topics. Second, the over-time dynamics of that index did not parallel the over-time changes in our (or others’) measures of belief in global warming’s existence—Brulle’s index rose from 2006 to 2007, whereas our surveys showed no such increase in existence beliefs. And although our surveys documented a decrease in existence beliefs between 2008 and 2009, Brulle et al. (2012) reported an increase in concern during that time. Third, from Brulle et al.’s (2012) regressions, it is impossible to tell which of their predictors would anticipate an increase in concern from 2009 to 2010, because the annual values of the predictors are not reported. And reports of annual world temperatures were not among the predictors those investigators examined. So we do not see a basis for concluding that Brulle et al.’s (2012) findings conflict with those reported here or suggest alternative explanations for the patterns we observed.
- 18 Because the participants were not randomly sampled from the American adult population, this should not be viewed as a nationally representative sample.
- 19 Consistent with the notion that Fox News coverage of global warming was more skeptical, Hart (2008) found that between 1998 and 2004, Fox News was notably more skeptical about climate change than was CNN (Hart, 2008). Likewise, in an analysis of editorials, columns, and commentators from all newspapers and television stations owned by News Corp in the U.S., Britain, and Australia between 1997 and 2007, McKnight (2010) found that Fox News program hosts regularly expressed skepticism about climate change. And Feldman et al. (2011) found that during 2007 and 2008, Fox News took a more dismissive tone toward climate change than did CNN and MSNBC (Feldman et al., 2011).
- 20 Respondents reported the number of the last 30 days on which they watched a Fox news program and the number of days on which they watched a non-Fox television news program.
- 21 Because these regressions reveal cross-sectional partial correlations, the coefficients might reflect the influence of media exposure on trust and/or the effect of trust in scientists on choices of media exposure.
- 22 Similar patterns are observed when dichotomizing in different ways.