

Personal Efficacy, the Information Environment, and Attitudes Toward Global Warming and Climate Change in the United States

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Despite the growing scientific consensus about the risks of global warming and climate change, the mass media frequently portray the subject as one of great scientific controversy and debate. And yet previous studies of the mass public's subjective assessments of the risks of global warming and climate change have not sufficiently examined public informedness, public confidence in climate scientists, and the role of personal efficacy in affecting global warming outcomes. By examining the results of a survey on an original and representative sample of Americans, we find that these three forces—*informedness, confidence in scientists, and personal efficacy*—are related in interesting and unexpected ways, and exert significant influence on risk assessments of global warming and climate change. In particular, more informed respondents both feel less personally responsible for global warming, and also show less concern for global warming. We also find that confidence in scientists has unexpected effects: respondents with high confidence in scientists feel less responsible for global warming, and also show less concern for global warming. These results have substantial implications for the interaction between scientists and the public in general, and for the public discussion of global warming and climate change in particular.

KEY WORDS: Global warming and climate change; information efficacy; risk perceptions

In recent years, information available to the mass public about both the causes and consequences of global warming and climate change has increased significantly. This information increase is reflected in longitudinal data on the number of scientific manuscripts, newspaper articles, and congressional hearings devoted to the issue.⁽¹⁾ Indeed, knowledge about global warming was formerly the exclusive purview of climatologists and a small subset of environmental activists. This situation has changed. Today, information about global warming and climate change is readily available to average Americans who watch television

news, and are able to see satellite pictures of changes in ocean temperatures, or of glaciers melting.

But discussions of global warming are spreading beyond the news media and into popular culture. The documentary about former Vice President Al Gore and his work, since leaving office, on raising awareness of climate change, *An Inconvenient Truth*, has received considerable attention as it opened to fanfare and critical acclaim at the Cannes Film Festival. Or, for those with kids, *Ice Age: The Meltdown*, presents the digital-animation thriller of three cute and furry animals trying to survive the breakdown of a glacial dam.¹ It is not hyperbolic to say that global warming and climate change are mainstream issues.

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¹ *Ice Age: The Meltdown* was released March 31, 2006, has gross revenues in the United States of over \$190,000,000, and worldwide revenues of over \$630,000,000, according to a movie industry website. See <http://www.the-numbers.com/movies/2006/ICEA2.php>, accessed June 19, 2006.

In differing ways, and for different audiences, these movies are intended to raise awareness of global warming. (That is clearly the explicit goal of *An Inconvenient Truth*, and seemingly an implicit one of *Ice Age: The Meltdown*.) An underlying assumption is that providing information about global warming—in effect, taking the scientific consensus and popularizing it—will lead to increased public concern about the risks of global warming. The lack of public outcry about global warming, then, is not because the public does not *care enough* about global warming; it is because they don't *know enough* about it. The more people know about global warming, the thinking seems to go, the more they will feel personally responsible for it, and also be concerned about it.²

Another way of saying this is to assert that scientific experts have a heightened perception of the risks of global warming, whereas the general public has (at least for now) a minimized perception of the risks. It tends to be assumed that the scientific assessment of the risks is both correct and objective, and that, by implication, the public's perceptions of the risks are both inaccurate and subjective.⁽²⁾ Such a disparity between expert and lay assessments of risk has been detected in other domains—such as the ongoing controversy about the safety of genetically modified foods—and is commonly referred to as the knowledge-deficit model.⁽³⁾

The goal of this article is to test this assumption. Using the results of an original survey of a random sample of the American public, we seek to uncover the role of information and personal efficacy in determining the public's assessment of the risks of global warming and climate change. What kinds of knowledge, if any, lead to heightened concerns about global warming? Or, paradoxically, does increased information decrease concern about global warming? Do information sources, and an individual's level of trust in those sources, make a difference? What kinds of people feel more personally responsible for global warming and climate change, and what kinds feel less responsible for it?

The article proceeds as follows. In the next section, we review the literature on the public's perceptions of risks of global warming and climate change,

² The website for *An Inconvenient Truth*, <http://www.climatecrisis.net>, contains specific information and printable tips that are meant to foster individual efficacy, including information about how each individual can reduce his or her impact on climate change at home, in commuting, and even nationally and internationally.

noting that the literature does not take into account how information and individual efficacy play a role in those perceptions. Next, consistent with the literature on risk perceptions of genetically modified organisms, we present an information-based theory of risk perception of global warming and climate change that questions the applicability of the knowledge-deficit model to the problem of global warming. Our focus on news media portrayals, information, and personal efficacy leads to several counterintuitive hypotheses that contrast with the assumption that raising awareness will raise concern. Then we describe a survey that we conducted to answer these very questions. We then present the results of that survey and build a multivariate model of concern about global warming and climate change. We conclude with speculation about directions for further research.

1. EXISTING STUDIES ON ATTITUDES ABOUT GLOBAL WARMING

Public risk perception affects natural hazards policy and management response systems.⁽²⁾ Because the regulation and management of hazards are subject to public debate and input, public perceptions are of considerable interest to policymakers.^(4,5) Public participation in hazards policy is well documented.^(6,7,8,9) In fact, researchers note that public risk perceptions drive policy as much as scientific risk assessments.^(10,11,12)

On the ecological risk of climate change, researchers find that public literacy is relatively low,⁽¹³⁾ though compared with the rest of the world, Americans know an average amount about global warming.⁽⁵⁸⁾ Studies from the 1990s show that mass publics confuse stratospheric ozone depletion, greenhouse effects, and climate variability,^(14,15,16) and misunderstand the physics of the relationship between CO₂ concentrations in the atmosphere and temperature change.⁽¹⁷⁾ Public risk perceptions of climate change appear to correspond more strongly with demographic, ideological, identity, and institutional trust variables.⁽¹⁸⁾

1.1. Demographics and Risk Perception

With regard to demographic variables, research consistently shows that women and racial minorities are more fearful of the risks of climate change.^(19,20) In the risk perception literature, this phenomenon is called the “white male effect.”^(21,22,23) Higher risk perception among racial minorities is said to be a function

of greater environmental hardship and distress—that is, minorities are disproportionately exposed to ecological hazards.⁽²⁴⁾ With regard to sex differences, researchers argue that traditional divisions of labor account for higher levels of environmental concern among women. According to this logic, women are underemployed in primary industries, and therefore less inclined to consider economic tradeoffs in evaluation of environmental risks.^(25,26,27)

Research on educational attainment and income indicates that persons of higher socioeconomic status are less likely to perceive climate change as risky.⁽²⁰⁾ Similarly, persons knowledgeable of the causes, properties, and effects of climate change have lower levels of risk perception. Empirical investigations of how people perceive both technological and ecological risks show that lower (not higher) levels of human capital predict heightened risk perception.⁽²⁸⁾

1.2. Identity, Ideology, Trust, Affect, and Risk Perception

Regarding ideology and identity variables, studies find that worldviews are highly correlated with risk perceptions of various technological and ecological dangers.^(29,30) Like so many aspects of political life, it is not surprising to expect that views of climate risk are almost certainly influenced by an individual's ideological perspective. Research has shown that the left-right dimension colors much of the way we perceive political events and choices, from candidates to policy options.^(31,32,33)

Trust has been shown to be an important correlate of interpretations of risk and resultant support or opposition to policy choices in the face of risk. Priest found that trust in “institutional actors” was a strong predictor of support for biotechnology.⁽⁵⁵⁾ Poortinga and Pidgeon examine the dimensions of trust and their relationship to risk regulation in five policy areas, including climate change.⁽⁵⁷⁾ They stress the importance of trust as a necessary construct in understanding risk perceptions.

Attitudes, values, and beliefs are also strongly associated with identification of risks and support for corrective action. For example, O'Connor *et al.*⁽¹⁸⁾ find that persons with pro-environmental attitudes are significantly more willing to support risk reduction efforts related to greenhouse gas emissions. Bord *et al.*⁽¹⁹⁾ find that persons regarding the biophysical world as “fragile” are more likely to adopt behaviors and support policies that mitigate climate change risks. Researchers find that political ideology and political party identification are significantly re-

lated to climate change risk perception. Democrats and persons of liberal ideology are more likely to regard climate change as risky, and are more likely to support costly risk mitigation public policies.⁽³⁴⁾ Leiserowitz^(53,54) argues strongly for the role of attitudes (affect) and values in determining risk perceptions and Krosnick *et al.*⁽⁵⁶⁾ emphasize the role of beliefs and attitudes about climate change certainty and causes as key policy influences.

Overall, existing research shows that climate change risk perceptions, as with other ecological risks like air pollution, ozone depletion, and contamination of water supplies, are strongly influenced by demographic, ideology, and identity variables.^(19,29,30) However, to date, studies have not sufficiently included measures of a person's information environment. The inclusion of such variables may reduce the level of unexplained variance in risk perception models.

2. GLOBAL WARMING AND THE KNOWLEDGE-DEFICIT MODEL

With any public policy issue that revolves around expanding scientific knowledge—including issues like genetically modified foods, embryonic stem cell research, or, as in the present case, global warming and climate change—members of the mass public are no more than casually aware of the key controversies and concepts involved in research at the frontiers of science. Scientific research is highly technical, after all, and the relevance of any type of research for a typical person's day-to-day life is far from obvious to the vast majority of people. That is not to say, of course, that research is not relevant for people's lives, or especially for their long-term futures. Rather, most people have far more immediate concerns—economic security, raising a family, and the like—that simply rank higher on the priority list.

But information about global warming—though still far from complete—has recently become both more widely available and more dramatic. Antarctic ice shelves collapse and fall into the ocean; an increasing number of hurricanes striking the coastlines of America raise the question of whether warmer oceans are contributing to the higher frequency and intensity of the storms. Combine this with the fact that scientists who conduct research on global warming and climate change agree with one another to a striking degree about both the existence of global warming, as well as its likely causes and potential consequences. A recent issue of *Science*, discussed widely in the mainstream press, contained an essay showing that, out of 928 published papers on climate change, exactly zero

disagreed with the consensus that “human modification of climate is compelling.”⁽³⁵⁾ Indeed, the scientific consensus on global warming and climate change is remarkable, and is not rife with ethical controversies like stem-cell research, where scientists will line up on opposing sides to debate the scientific merits of differing positions. In fact, Bord, O’Connor, and Fisher (2000, p. 215) report that “[a]ccurate knowledge of global warming is the strongest single predictor of behavioral intentions . . .”⁽⁵²⁾

Thus, this increase in information about global warming and climate change, combined with the scientific consensus on the subject, produces perhaps an easy test for the knowledge-deficit hypothesis. As people are exposed to more information about what scientists know about how human activities like CO₂ emissions are related to increasing global temperatures, then one should expect two things. First, one should expect to see higher amounts of information to be related to higher degrees of personal efficacy and responsibility for global warming and climate change. Second, one should expect to see higher amounts of information to be related to heightened perceptions about the risks of global warming and climate change. Together, these hypotheses are straightforward applications of the knowledge-deficit model to the issue of global warming.

But there are reasons to doubt that the knowledge-deficit model will apply to the issue of global warming and climate change. Foremost among these is the disparity between the aforementioned near-unanimity of scientific opinion on the matter, on the one hand, and the way public policy controversies are presented in the mainstream media, on the other. The dominant theme of media coverage of nearly every problem—not just global warming—is that of debate and conflict.^(36,37,38,39) This applies to coverage of presidential candidates, as well as to debates in the halls of the U.S. Congress, where Republicans want one thing, and Democrats want something else. It also applies, though, to the issue of global warming, where the dominant media storyline of conflict and debate between opposing sides does not accurately reflect the scientific consensus on the topic, a condition Boykoff and Boykoff⁽⁴⁰⁾ refer to as “balance as bias.”³ From this perspective, one might not expect to see increasing degrees of information related to efficacy for and

risk-assessments of global warming because it is likely that the information that most people receive about global warming does not come from scientific journals (like *Science*), but from CNN and from Fox News, where the issue of global warming is treated just like any other political issue. Talking Head One makes a case that global warming is a problem, or that Hurricane Katrina was more devastating because of global warming than it would have been otherwise; Talking Head Two disagrees, and says that the research on the topic is far from conclusive. The information that members of the mass public consume about global warming, then, might not heighten their efficacy and sense of risk about global warming; the coverage, instead, might make them think that this issue is just another issue where the experts disagree, and that there are no immediate implications of that research to their lives.⁴

All of this suggests that personal efficacy for global warming, and assessments of the risks of global warming, might be related to individual perceptions of the press, and to views of how well scientists (as a whole) understand the problem. Efficacy and risk assessments, by the same line of reasoning, might be related to individual levels of trust in the experts on the subject. A representation of this model is presented in Fig. 1. Personal efficacy for global warming, in this representation, becomes an intervening variable between demographics, identities, and information, on the one hand, and concern for global warming, on the other.

The knowledge-deficit model—as well as the behavior of global-warming activists—leads us to suspect that increasing levels of information will heighten risk perceptions. But, on the other hand, the media’s framing of the global warming issue as an unsettled controversy leads us to expect that information levels will not produce increasing concern for global warming. We now turn to the results of an original survey of the mass public in the United States to answer this question.

3. RESEARCH DESIGN: SURVEY-BASED EVIDENCE REGARDING CLIMATE CHANGE

Survey data are derived from a national telephone survey of randomly selected adults in the

³ Note the complaint in *Science* magazine from Oreskes,⁽³⁵⁾ who writes: “Politicians, economists, journalists, and others may have the impression of confusion, disagreement, or discord among climate scientists, but that impression is incorrect.”

⁴ In the German context, Weingart, Engels, and Pansegrau (2000) find differences in the discourses of the media, politicians, and the mass public on climate change⁽⁵⁹⁾.

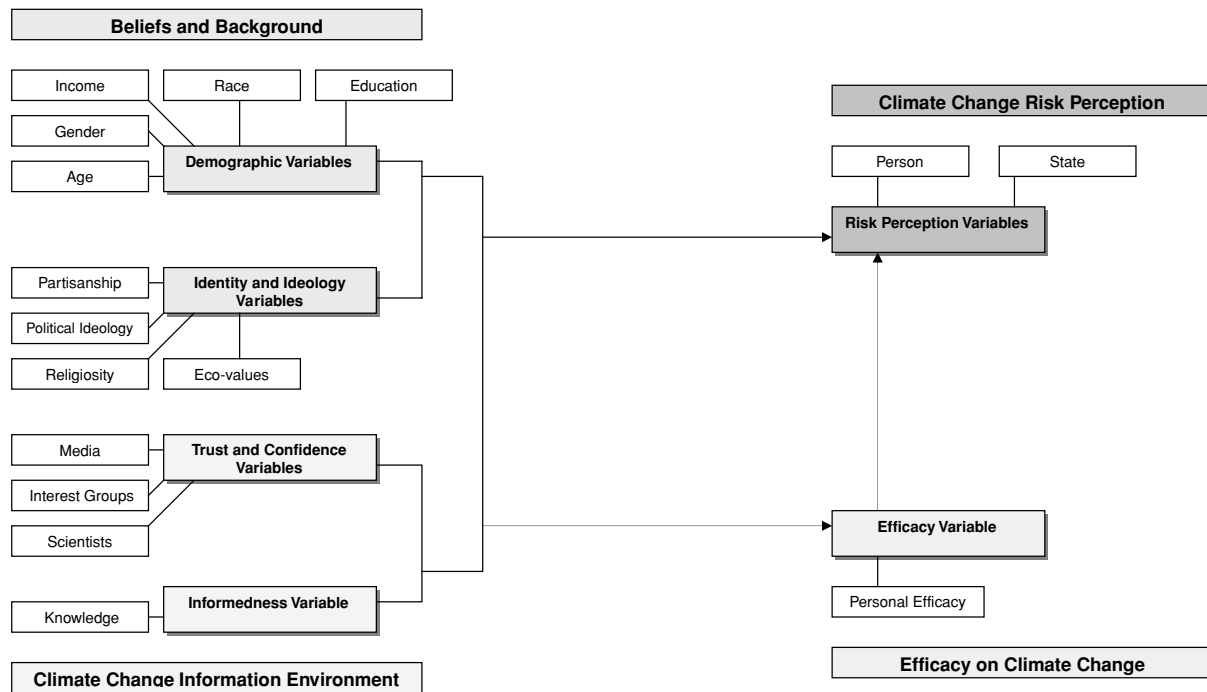


Fig. 1. A causal diagram of beliefs, background, information environment, and efficacy on climate change risk perceptions.

United States conducted from July 13 to August 10, 2004. The survey instrument was designed by research scientists at Texas A&M University. The survey probed citizen attitudes and behaviors on climate change. Telephone interviews were performed in English, averaging 37 minutes to complete. Based on the American Association for Public Opinion Research outcome calculator IV, the response rate was 37% and the cooperation rate was 48%. Overall, 1,093 interviews were completed, constituting $\pm 3\%$ sampling error.⁵

⁵ The majority of survey participants are female (55.6% vs. 44.4% percent male). The average age is 47.31 ($SD = 16.40$), and the range is 18–90. About 37% of respondents hold a college or post-graduate degree, and 2.5% have no high school diploma. The racial distribution of the sample is predominately white non-Hispanic (84.1%), followed by African American (8.1%), Hispanic (5.4%), Native American (1.2%), and Asian American (0.2%). On self-reported political ideology, 42.0% of respondents regard themselves as conservative, compared to 32.7% leaning liberal. Compared to the national U.S. Census figures, our sample is on average older in age (45.43 vs. 32.3), better educated (one-fifth of Americans are without a high school diploma), and undercounts males (44.4% vs. 49.1%), African Americans (8.1% vs. 12.3%), Hispanics (5.4% vs. 12.5%), and Asian Americans (0.2% vs. 3.6%).

3.1. Dependent Variable

The key dependent variable for the study, *climate change risk perception*, averages six survey questions on the risks of climate change. Respondents were asked to indicate their level of agreement with three statements on the threat of climate change to the respondent’s *personal* health, financial, and environmental welfare, as well as three statements on the risks of climate change to *public* health, economy, and environmental integrity. This six-item measure produces a robust variable that measures individual perceptions of the risks of climate change on a scale from 1 to 4, with higher numbers indicating greater concern. In Table I, we show the specific question wordings, as well as the results of a factor analysis combining the six items. The factor analysis confirms that the six items cohere as a sensible single dimension. All of the indicators load strongly onto the underlying factor, and the resulting scale is highly reliable (Cronbach’s $\alpha = 0.873$). (See the Appendix for scale constructions for all variables.)

3.2. Operationalizations of Independent Variables

Many information environment variables are estimated. Our climate change risk perception model

Table I. Factor Analysis of Six Items of Public Concern for Global Warming

Survey Question	Factor Loading
Global warming and climate change will have a noticeably negative impact on my health in the next 25 years.	0.743
Global warming and climate change will have a noticeably negative impact on my economic and financial situation in the next 25 years.	0.676
Global warming and climate change will have a noticeably negative impact on the environment in which my family and I live.	0.756
In your opinion, what is the risk of global warming and climate change exerting a significant impact on public health in your state?	0.766
In your opinion, what is the risk of global warming and climate change exerting a significant impact on economic development in your state?	0.716
In your opinion, what is the risk of global warming and climate change exerting a significant impact on the environment in your state?	0.782
Eigenvalue	3.290
Cronbach's alpha	0.873

Note: The survey items were asked in succession. The first three were preceded by the following stem: "Do you strongly agree, agree, disagree, or strongly disagree with the following statements?" Only one factor was retained.

includes a measure on *perceived efficacy*. This variable is a three-item measure estimating the perceived ability of a respondent to influence climate change outcomes, to induce others to behave in ways that mitigate human sources of climate change, and whether a respondent accepts climate change as a human responsibility. Table II presents the specific survey items used in the index, as well as the results of a factor analysis combining the items. The results show that the items all load acceptably on the latent dimension (Cronbach's alpha = 0.634). Based on the literature, we expect persons with higher perceived personal efficacy and acceptance of climate change as a personal responsibility to be more likely to define climate change as risky, and more likely to act on perceived risks (Bord & O'Connor, 1998; O'Connor *et al.*, 1999; Savage, 1993).

We measure a respondent's level of *information* by asking each respondent to report "how informed do you consider yourself to be" about global warming and climate change, which produces an 11-point scale.⁶ We measure *media trust* using a three-item index (Cronbach's alpha = 0.703) asking respon-

⁶ Higher numbers indicate a more informed respondent. The sample mean is 6.32, with a standard deviation of 2.33. Approximately 9% of respondents rated their level of information at the high endpoint; approximately 2% rated their information level at the lowest level.

Table II. Factor Analysis of Three Items of Personal Efficacy for Global Warming

Survey Question	Factor Loading
I believe my actions have an influence on global warming and climate change.	0.659
My actions to reduce the effects of global warming and climate change in my community will encourage others to reduce the effects of global warming through their own actions.	0.453
Human beings are responsible for global warming and climate change.	0.586
Eigenvalue	1.442
Scale reliability coefficient (alpha)	0.634

Note: The survey items were asked in succession, and were preceded by the following stem: "The following statements are about climate change and global warming. Please tell me if you strongly agree, agree, disagree, or strongly disagree with each of them?" Only one factor was retained.

dents to rate newspapers, television news, and the radio "in terms of the trustworthiness of information provided on global warming and climate change." We measure *trust in experts* similarly, using a four-item index (Cronbach's alpha = 0.773) asking respondents to evaluate the trustworthiness of government agencies, nonprofit organizations, environmental interest groups, and other interest groups in terms

of the information they provide about global warming and climate change. Finally, we measured *confidence in scientists* by asking respondents to assess, on a four-point scale, how well they perceive scientific understanding of global warming and climate change.

We measured and included in the models several ideology and identity variables. We employ an abbreviated version of the New Ecological Paradigm (NEP) scale developed by Dunlap *et al.*⁽⁴¹⁾ to estimate environmental ideology. Our abbreviated measure excludes human exemptionist paradigm (HEP) items that appear in the original index. The exclusion of HEP items does not dramatically alter the performance of the original index, as HEP beliefs are the theoretical and empirical inverse of NEP beliefs. The New Ecological Values scale (Cronbach's $\alpha = 0.776$) averages responses on eight items derived from the NEP Scale. Respondents were asked to indicate agreement (4 = strongly agree; 1 = strongly disagree) with statements on resource scarcity, human impacts on nature, and ethical responsibility toward nonhuman life. As with previous literature,⁽¹⁸⁾ we expect our ecological values measure to behave positively in our regression model, with individuals who evidence greater new ecological values showing greater concern about the risks of global warming and climate change. *Political ideology* is measured on a 7-point scale ranging from 1 = strongly liberal to 7 = strongly conservative. *Political party identification* is measured dichotomously as 1 = Republican and 0 = Democrat and other. Finally, *religious-service attendance* is measured nominally, depending on whether the respondent attended religious services in the past week (1) or not (0).

We also measure and control for the potential effects of numerous demographic variables. *Education* was measured on a 6-point scale, ranging from elementary school (1) to postgrad degree (6). *Household income* is an 11-point scale with \$10,000 intervals (1 = less than \$10,000; 10 = more than \$100,000). Consistent with previous literature, we hypothesize education and income to be negatively associated with climate change risk perceptions.^(20,28) *Race* is measured discretely, with whites receiving a score of 1, and nonwhites receiving a score of 0. *Gender* is included in the model as a dichotomous variable where female = 0 and male = 1. Because environmental behavior studies typically indicate that women are more aware of environmental risks and more readily support environmental and climate initia-

tives,^(42,43,44,45,46) we expect gender to behave negatively in our prediction model. *Age* is measured in years.

Because our dependent variable, risk assessments of global warming and climate change, is an index that is measured continuously, we will estimate the effects of the standard demographic background and identity variables, as well as the variables representing efficacy and information sources, by using OLS regression. We turn now to those results.

4. FINDINGS

We begin in Column 1 of Table III with a baseline model in which the dependent variable is our index of concern for global warming and climate change. The independent variables in the model are the demographic variables and the identity variables; for the moment, we ignore the potential effects of efficacy and information. Most of the coefficients are in the direction predicted by the literature. Whites and males, for example, exhibit significantly greater concern for global warming and climate change than nonwhites and females, respectively. The remainder of the demographic variables, though—age, income, education, and attendance at religious services—do not have effects that are statistically discernable from zero. With respect to the identity variables, conservatives and Republicans show more concern for global warming and climate change than liberals and Democrats, controlling for other variables. The unusual results with respect to race, gender, Republican partisanship, and conservative political ideology are attributable to the new ecological values control. In bivariate analyses (not shown), these variables are negatively associated with climate change risk perception. Those with a stronger grounding in new ecological values are considerably more concerned about global warming and climate change than are those who do not share those values. In all, the model accounts for roughly 32% of the variance in the dependent variable.

The results of our expanded model that accounts for the effects of efficacy and the information environment are presented in Column 2 of Table III. The effects of two of the variables that were also included in the baseline model—age and partisanship—changed considerably. In the baseline model, age was not statistically significant, but in the expanded model, it is. Older respondents show less concern for global

Table III. Two Models of Public Concern for Global Warming and Climate Change

Independent Variable	(1)	(2)
Race (white)	0.233* (0.061)	0.184* (0.057)
Gender (male)	0.110* (0.045)	0.085* (0.043)
Education	-0.001 (0.019)	0.008 (0.018)
Income	0.007 (0.008)	0.010 (0.007)
Age	-0.001 (0.001)	-0.003* (0.001)
Religious-service attendance	-0.014 (0.048)	-0.004 (0.045)
Partisanship (Republican)	0.128* (0.057)	0.067 (0.053)
Ideology (conservative)	0.068* (0.015)	0.042* (0.014)
New ecological values	0.647* (0.056)	0.407* (0.058)
Information about global warming		-0.018* (0.009)
Efficacy		0.420* (0.050)
Trust media		-0.019 (0.014)
Trust experts		-0.004 (0.013)
Confidence in science		-0.057* (0.027)
Constant	0.355* (0.155)	0.456* (0.219)
Adj. R^2	0.318	0.427
N	627	600

* $p < 0.05$.

Note: Cell entries are unstandardized OLS regression coefficients; standard errors are in parentheses. The dependent variable in both columns is a factor-analyzed scale of concern for global warming that ranges from 1 (low concern) to 4 (high concern). See Table I for details.

warming and climate change than do younger respondents. In addition, the coefficient for partisanship in Column 2 is half the size it was in Column 1, and is now no longer statistically significant. Many of the other variables, once controlling for the new variables in the model, remain statistically significant, but their effects are somewhat attenuated—race (0.184 in Column 2 compared to 0.233 in Column 1); gender (0.085 vs. 0.110); ideology (0.042 vs. 0.068); and new environmental values (0.407 vs. 0.647). In short, controlling for the new variables estimated in our model reduces the impact of variables previously considered to have significant influences on attitudes to-

ward global warming and climate change; while many of these variable still have statistically significant effects, these effects are smaller—in some cases, 50% smaller—than had previously been believed.

Turning to the coefficients for the new variables estimated in Column 2, we see that, in sharp contrast with the knowledge-deficit hypothesis, respondents with higher levels of information about global warming show *less* concern about global warming.⁷ The effects here are statistically significant, but they are modest in magnitude. Moving from the least-informed respondents to the most-informed ones produces, on average, about two-tenths of a point shift in concern about global warming and climate change. On a scale ranging from 1 to 4, a shift of two-tenths of a point should not be overstated; the effect, though modest, is discernible from zero.

Much larger is the effect of personal efficacy and responsibility for climate change. Respondents who

⁷ The negative partial correlation between informedness and risk perception, all things held equal, is striking. This result needs explanation. As smartly suggested by an anonymous reviewer, because informedness is a self-reported measure, respondents who feel themselves less responsible for climate change and global warming may mistakenly perceive they possess all the information required. That is, their perceived level of informedness is biased upward by their underweighting of the risks of climate change and their contribution to the problem. By this logic, informedness ought to be negatively correlated with concern. First, our data show that self-reported knowledge of climate change and global warming is highly correlated with self-reported knowledge on a host of environmental policy issues from pollution ($r = 0.616$), genetically modified organisms (GMO) ($r = 0.428$), to energy ($r = 0.584$). That is, persons who regard themselves as highly informed on global warming tend to define themselves as highly informed on other environmental issues. Minus controls, our data also show that informedness is positively associated with concern for all environmental issues—for example, as self-reported informedness on GMO increases, so, too, does the level of reported concern on GMO ($r = 0.202$). The same is true of informedness and concern on climate change and global warming ($r = 0.259$). Similarly, if one divides respondents on the variable of concern for climate change into two groups, with those reporting a 9 or 10 (or extremely concerned) slotted in Group I, and all others in Group 0, differences on self-reported informedness remain ($t = 8.816$, $p = 0.000$). Therefore, for bivariate tests, we find no evidence that, on average, downing the level of concern amplifies perceived levels of informedness. Instead, we theorize that the sign flip for informedness is caused by the introduction of perceived efficacy measures. As shown in our model of perceived efficacy, as the level of self-reported knowledge increases, the perceived ability to affect global warming outcomes decreases. This is a reasonable finding. Global warming is an extreme collective action dilemma, with the actions of one person having a negligible effect in the aggregate. Informed persons appear to realize this objective fact. Therefore, informed persons can be highly concerned and reasonably pessimistic about their ability to change climate outcomes.

feel personally responsible for climate change show far greater concern for the future effects of global warming and climate change. These effects are large: moving from the least efficacious to the most efficacious respondents produces, on average, almost 1.7 points of movement on the four-point scale for the dependent variable. The size of this effect, in standardized terms, is roughly comparable to the large effects for the well-established effects for new ecological values (data not shown).

Respondents who showed a great deal of confidence that scientists understand global warming and climate change showed significantly *less* concern for the risks of global warming than did those who have lower trust in scientists. Though this effect differs from our expectations, it is consistent with the notion that people trust that scientists will be able, somehow, to devise technical solutions to any problems that arise because of global warming and climate change. The effect is statistically significant, but not particularly large: moving from the extreme of a “very unclear” understanding to the other of a “very clear” understanding produces, on average, a movement of approximately one-quarter of a point shift on our four-point scale for the dependent variable. The effect is discernible from zero, but its magnitude should not be overstated.

The coefficients for the other variables that correspond to the respondent’s information environment did not achieve statistical significance. Respondents who showed high trust in the media and in policy experts on the topic of global warming showed trivially less concern for the problem than those with low trust. But these effects are not reliably different from zero.

Overall, the model in Column 2 of Table III accounted for approximately 43% of the variance in concern for global warming and climate change, compared with approximately 32% for the baseline model in Column 1. Thus, the expanded model provides a more complete accounting of public concern for global warming.⁸

4.1. The Sources of Personal Efficacy for Global Warming

The strong effects of a respondent’s sense of personal efficacy about global warming and climate

change on concern for the problem—effects, we reiterate, that are independent of the effects of new environmental values more generally—raise provocative questions about what causes some people to feel personally responsible for global warming and climate change, and why others feel no sense of responsibility for the problem. We investigate this in Table IV, with a multivariate model with personal efficacy for global warming as our dependent variable. Lacking any guidance from the literature, we use as exogenous variables the same six demographic variables—race, gender, education, income, age, and religious-service attendance—and the three

Table IV. The Sources of Personal Efficacy Regarding Global Warming and Climate Change

Independent Variable	Coefficient (s.e.)
Race (white)	0.035 (0.046)
Gender (male)	0.004 (0.035)
Education	−0.008 (0.014)
Income	−0.005 (0.006)
Age	0.003* (0.001)
Religious-service attendance	−0.015 (0.037)
Partisanship (Republican)	0.004 (0.044)
Ideology (conservative)	0.018 (0.012)
New ecological values	0.431* (0.044)
Information about global warming	−0.026* (0.007)
Trust media	−0.009 (0.012)
Trust experts	−0.035* (0.011)
Confidence in science	−0.132* (0.022)
Constant	1.907* (0.162)
Adj. R ²	0.370
N	627

**p* < 0.05.

Note: Cell entries are unstandardized regression coefficients; standard errors are in parentheses. The dependent variable is a factor-analyzed scale of personal efficacy for global warming that ranges from 1 (low efficacy) to 4 (high efficacy). See Table II for details.

⁸ The findings for the statistically significant variables in Table III are robust to the exclusion of any of the statistically insignificant variables.

identity variables—partisanship, ideology, and new ecological values—as in the models in Table IV. We also estimate the effects of informedness about global warming, trust in the media and in experts, and confidence in scientists' understanding of global warming.

The results are suggestive. Of the demographic variables, only age exerts a statistically significant impact on personal responsibility for global warming. (In this case, that effect is positive, with older respondents feeling more responsible for it than do younger respondents.) Among the identity variables, neither partisanship nor ideology has a significant effect, but endorsement of new environmental values does: those with a greater sense of new environmental values feel far more personally efficacious and responsible for global warming than those who do not endorse new environmental values.

As was the case for overall concern for global warming, when it comes to personal efficacy regarding global warming, respondents who are better informed about the issue feel less (not more) responsible for it. This effect is rather modest in strength—moving from extremely uninformed to extremely informed leads to, on average, a shift of 0.3 points along our four-point scale of efficacy—but it is statistically reliable nonetheless. In addition, respondents who show a greater confidence that scientists understand the problem of climate change feel less (not more) personal efficacy for global warming than those with little confidence in scientists. This effect is somewhat larger, with a total effect from one endpoint of the scale to the other yielding a shift of about six-tenths (or three-fifths) of one point on the scale of the dependent variable.⁹ Respondents who show higher confidence in the government experts on global warming feel less (not more) efficacious for causing global warming. Trust in the media was unrelated to a sense of efficacy and responsibility for global warming. Overall, this rather exploratory model accounted for a sub-

stantial portion—37%—of the variability in personal efficacy regarding global warming.¹⁰

5. DISCUSSION AND CONCLUSIONS

The combined findings of Tables III and IV provide considerable support for the causal flow leading to concern for global warming and climate change outlined in Fig. 1. Along with new environmental values, a sense of personal responsibility for global warming serves as a prominent cause of respondents' subjective risk assessments of global warming. Though the size of this effect might be surprising, the direction of it is not. Those who feel responsible for global warming are more concerned about its risks.

Perhaps ironically, and certainly contrary to the assumptions underlying the knowledge-deficit model, as well as the marketing of movies like *Ice Age* and *An Inconvenient Truth*, the effects of information on both concern for global warming and responsibility for it are exactly the opposite of what were expected. Directly, the more information a person has about global warming, the less responsible he or she feel for it; and indirectly, the more information a person has about global warming, the less concerned he or she is for it. These information effects, while striking, are consistent with the findings of Durant and Legge⁽⁴⁷⁾ with respect to genetically modified foods, and with those of Evans and Durant⁽⁴⁸⁾ with respect to embryo research.¹¹ Thus, we contribute another parcel of evidence that the knowledge-deficit model is inadequate for understanding mass attitudes about scientific controversies.

It is worth emphasizing, as well, that the findings reported herein, and hence the generalizability of our conclusions, are limited to the United States. Recent research in comparative public opinion shows that, compared to the rest of the world, the United States has average knowledge levels about global warming, despite the fact that America is among the best-educated countries in the world.⁽⁵⁸⁾ It is possible, perhaps likely, that a similar pattern of findings would emerge in comparably developed democracies like Japan or those in Europe. How, if at all, these findings would be altered in developing countries such as India or China, where greenhouse-gas emissions will

⁹ The finding here about the connection between confidence in scientists and personal responsibility is somewhat different from the finding in Table III about the connection between confidence in scientists and overall concern about the risks of global warming and climate change. While the results in Table III can be interpreted as indicating extreme confidence in the power of science to solve problems through technology, why increasing confidence in scientists would foster a diminished responsibility for global warming is less transparent. Clearly, further research is needed on the causes of feeling personal responsibility for global warming.

¹⁰ As was the case with Table III, the findings for the statistically significant variables in Table IV are robust to the exclusion of any of the statistically insignificant variables.

¹¹ For a different conclusion about the effects of information on public opinion about genetically modified food, see Cuite, Aquino, and Hallman.⁽⁴⁹⁾

become an increasing global issue, will be an interesting area for future research.

It should be noted that the information effects reported in this article are limited to *self-reported* information. Objective measures of informedness about global warming and climate change might produce different effects. And indeed there is some scholarly evidence to suggest that this might be the case. In their models of mass assessments of the risks of genetically modified foods, Durant and Legge⁽⁴⁷⁾ found that self-reported informedness and objective measures of informedness were almost entirely uncorrelated, and that their effects worked in opposite directions. Clearly, this is an area that is ripe for subsequent research.

The exclusively cross-sectional nature of this study, of course, has both benefits and limitations. We have been able to shine a rather bright light on the snapshot of the relationship between information and attitudes at a single point in time. But by relying on survey-based evidence from a single point in time, we are unable to uncover the dynamic elements of the relationship between information and attitudes about global warming. This matters because Trumbo (1996) shows that media coverage that emphasizes scientists differs from that which emphasizes politicians and, importantly, that the amount of media coverage emphasizing scientists has declined as time passes.⁽⁶⁰⁾

This research also has implications for the evolving relationship between scientists and the mass public.¹² For despite the overwhelming scientific consen-

sus that global warming and climate change are real phenomena that create risks for the earth's future, among the mass public, the more confidence an individual has in scientists, the less responsible he or she tends to feel for global warming, and the less concerned he or she is about the problem. Perhaps this simply reflects an abundance of confidence that scientists can engineer a set of solutions to mitigate any harmful effects of global warming.¹³ But it can not be comforting to the researchers in the scientific community that the more trust people have in them as scientists, the less concerned they are about their findings.

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¹³ Indeed, a survey in the Netherlands showed that confidence is extremely high that scientists can solve problems of various diseases through the use of genetic information. See Henneman, Timmermans, and van der Wal.⁽⁵¹⁾

¹² For a helpful recent history of this issue, see Miller.⁽⁵⁰⁾

Appendix: Variable Definitions and Hypotheses

Variable	Operation	Hypothesis
Demographic Variables		
Race	Measured nominally as 1 = white, and 0 = nonwhite.	–
Household income	Measured as the estimated annual household income for 2003 (11 categories in \$10,000 increments; range from <\$10,000 to >\$100,000).	–
Gender	Measured nominally as 1 = male, and 0 = female.	–
Education	Measured with 6 categories, with 1 = less than high school, and 6 = postgraduate.	+
Age	Measured in years.	±
Identity/Ideology Variables		
Political ideology	Measured as a 7-point scale, with 1 = strongly liberal, and 7 = strongly conservative.	–
New ecological values	Measured as an index (alpha = 0.776) that averages respondent agreement with 8 statements about the environment, including: (1) We are approaching the limit of people the earth can support; (2) When humans interfere with nature it produces disastrous consequences; (3) Humans are abusing the environment; (4) Plants and animals have as much right to exist as humans; (5) The earth is like a spaceship with limited resources; (6) Balance of nature is delicate; (7) If things continue on their present course, we will experience a major ecological catastrophe; and (8) Today's policies must consider the needs of future generations.	+
Religious attendance	Measured nominally as 1 = yes (attended a religious service in the last 7 days); 0 = no (did not attend a religious service).	±
Republican	Measured nominally as 1 = Republican, and 0 = Democrat or no preference.	–
Information/Efficacy Variables		
Media trust	Measured as an index (alpha = 0.703) that averages responses to 4 items. Using an 11-point scale, respondents were asked to indicate the trustworthiness of information on climate change provided by newspapers, television news, radio, and the Internet, with 10 = very trustworthy, and 0 = not trustworthy at all.	±
Trust experts	Measured as an index (alpha = 0.773) that averages responses to four items. Using an 11-point scale, respondents were asked to indicate the trustworthiness of information on climate change provided by government agencies, nonprofit organizations, environmental interest groups, and other interest groups, with 10 = very trustworthy, and 0 = not trustworthy at all.	±
Perceived efficacy	See Table II.	±
Information use	Using an 11-point scale, respondents were asked to indicate how well-informed they consider themselves to be on climate change and global warming, with 0 = not at all informed, and 10 = very well informed.	±
Confidence in scientists	Measured using a 4-point scale. Respondents were asked "How clearly do you think scientists understand Global Warming and Climate Change," with 1 = very unclear understanding and 4 = very clear understanding.	+
Dependent Variable		
Risk perception	See Table I.	

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