The effect of information provision on public consensus about climate change*

Tatyana Deryugina, University of Illinois+

Olga Shurchkov, Wellesley College++

Current Draft: June 2015

Abstract. Despite over 20 years of research and scientific consensus on the topic, climate change continues to be a politically polarizing issue. We conduct a survey experiment to test whether providing the public with information on the exact extent of scientific agreement about the occurrence and causes of climate change affects respondents' own beliefs and bridges the divide between conservatives and liberals. First, we show that the public significantly underestimates the extent of the scientific consensus. We then find that those who are given concrete information about scientists' views are more likely to report believing that climate change is already underway and that it is caused by humans. However, their beliefs about the necessity of making policy decisions and their willingness to donate money to combat climate change are not affected. Information provision affects liberals, moderates, and conservatives similarly, implying that the gap in beliefs between liberals and conservatives is not likely to be bridged by information. Finally, we conduct a 6-month follow-up with respondents to see if the treatment effect persists; the results are statistically inconclusive.

Keywords: climate change, beliefs, skepticism, policy

* We are grateful to Seth Neumuller, Julian Reif, and the participants of the Wellesley Economics Department work-in-progress seminar, the University of Illinois Psychology Department seminar, and the University of Illinois research lunch seminar for valuable comments and discussion. In addition, we would like to acknowledge the generous research support we received from Urbana-Champaign Campus Research Board that funded our survey experiment. All remaining errors are our own.
+ Corresponding author. Department of Finance, University of Illinois at Urbana-Champaign, 1206 South Sixth St., Champaign, IL, USA. e-mail: deryugin@illinois.edu. Phone: 217-333-9498.
++ Department of Economics, Wellesley College, 106 Central St., Wellesley, MA, USA.
e-mail: olga.shurchkov@wellesley.edu.

1. Introduction

Climate change generates much public disagreement, despite the broad consensus of scientists that it is a real phenomenon caused by human emissions of greenhouse gases (IPCC 2013; Rosenberg et al., 2010). Because climate change is a high-profile issue, implementing meaningful policies to address it will almost surely require a significant degree of public consensus. However, differences between the beliefs of liberals and conservatives are stark and have recently widened. In 2001, nearly 70% of liberals and about 50% of conservatives believed the effects of global warming have already begun to happen; by 2010, that figure was 75% of liberals compared to a little over 30% of conservatives (Gallup, 2001-2010). Whether and how this divide can be bridged is an important public policy question.

There is a strong correlation between individuals' own views on global warming and their beliefs about scientists' views on the topic (Gallup, 2001-2010). It is possible that people are misstating their beliefs about scientists' views to match their own opinion about climate change. However, the absence of a disagreement with perceived scientific views suggests another hypothesis: that beliefs can be affected by providing respondents with objective information about the scientific consensus. In this paper, we investigate whether such information can steer the public toward a consensus on the science of global climate change.

Our survey experiment allows us to estimate the causal effects of providing objective information about climate scientists' views on climate change on respondents' own beliefs and their willingness to contribute to causes that aim to counter climate change. The treatment group receives precise information about the beliefs of US scientists who have published articles in top climate journals (Rosenberg et al., 2010), while the control group receives no information. Our main finding is that information significantly increases the treatment group's beliefs that climate change is happening and that humans are causing it. However, there is no effect on the willingness to donate to improve energy efficiency or on beliefs about the necessity of immediate policy decisions. A follow-up survey reveals that the estimated treatment effect is not significant 6 months later, although we cannot reject that it persists. Finally, our design allows us to uncover some of the underlying mechanisms behind the findings. First, by conducting a "soft information placebo" treatment that provides the respondents with vague information about climate change, we rule out the possibility that the short-run impact arises from the salience of information rather than its content. Second, we are able to measure the level of skepticism about the information we provide among the treated. We find that 65% of the treated group is skeptical of the information. This skepticism mostly stems from the view that the scientists surveyed were not representative of all scientists who are knowledgeable about climate change.

Although some experimental studies on climate change exist (e.g., Corbett and Durfee, 2004; Cameron, 2005), ours is one of the first to test the effects of providing objective information and to gauge the persistence of the effects over time. Research has shown that providing objective information alters behavior in contexts other than climate change (Abaluck, 2011; Bollinger et al., 2011; Keskin, Shastry, and Willis, 2013; Kiesel and Villas-Boas, 2010). At the same time, numerous correlational studies have explored the relationships between climate change beliefs and various individual characteristics, such as political ideology, age, and education (e.g., Kellstedt et al., 2008; Sturgis and Allum, 2004). However, correlational findings often have

ambiguous causal implications. For example, Ding et al. (2011) and McCright et al. (2013) find that individuals who underestimate the degree of scientific consensus are also less likely to support policies that would combat climate change. This finding has at least two possible explanations. One is that becoming informed about the scientific consensus increases support for policies aimed at combating climate change. Another is that those who are most concerned about climate change seek out more knowledge about the scientific consensus, thus becoming more informed. Experimental variation in our study allows us to determine which interpretation is correct: we find no evidence that providing information about the scientific consensus affects policy preferences or raises willingness to pay to combat climate change. The lack of updating based on objective information in this context is consistent with a number of explanations, including strong priors, self-justification bias, selective attention, cultural norms, partisanship bias, and information discounting (Bauer et al., 2007; Gentzkow and Shapiro, 2010; Schwartzstein, 2014; Ramirez and Erickson, 2014).

Although past research has examined the role of various psychological cues in belief formation, the impact of providing objective information remains largely unknown.[1] For instance, seemingly trivial information, such as local weather or exposure to a single climate skeptic, has been found to significantly affect people's stated beliefs about climate change (see e.g., Herrnstadt and Muehlegger, 2014; Deryugina, 2013; Egan and Mullin, 2012; Malka et al., 2009; Risen and Critcher, 2011). One potential explanation is that credible information is so scarce that the public relies on information that is at best marginal. Alternatively, people could form their beliefs based on the availability heuristic, overweighting recent or salient experiences (Tversky and Kahneman, 1973, 1974). These two explanations have very different policy implications. If credible scientific information is simply unavailable to most people, relevant scientific bodies could do more to educate the public. On the other hand, if beliefs are based on heuristics, communication policy is less likely to be informative, except over very short periods of time. By comparing our informative treatment with the vague placebo treatment, we are able to reject the hypothesis that it is the salience of the information rather than the content that is driving beliefs, at least in the context of our survey.

The rest of the paper is organized as follows. Section 2 describes the survey experiment. Section 3 outlines the empirical framework. Section 4 reports and discusses the findings. Section 5 concludes and provides policy implications and directions for future research.

2. Survey Experiment

The baseline survey was conducted by Marketing Systems Group (MSG) between April 9 and April 17, 2013.[2] Out of the 2,484 invited participants, 1,593 respondents initiated and 1,300 completed the baseline survey. All respondents first answered questions that elicited general attitudes toward climate change science and assessed knowledge about climate science (e.g., being able to name greenhouse gases).

[1] An exception is van der Linden et al. (2014, 2015), who conducted an information experiment around the same time as this study.

[2] The survey was programmed online using SurveyMonkey.com. Each question appeared on a new screen. Participants could not go back to change answers to previous questions. Order of answers within each multiple choice question was randomized. The full survey text is available in the online appendix.

Next, the participants were randomly assigned to one of three equal groups. The control group received no information to provide benchmark measurements of (a) beliefs about the scientific consensus and (b) the relationships between beliefs about the scientific consensus, beliefs about climate change, and political ideology.

The treatment group viewed a screen with the following passage that informed them about scientists' beliefs about climate change ("hard information treatment," hereafter HI).

> *"There is strong scientific consensus about the occurrence and cause of global warming. In a 2005 academic survey of US scientists who have published articles in the top climate science journals, 94 percent of scientists agreed with the statement "Scientists can say with great certainty that global warming is a process that is already underway." 88 percent agreed with the statement "Scientists can say with great certainty that human activities are accelerating global warming." 9 percent agreed with the statement "There is enough scientific uncertainty about the rate and extent of global warming and climate change that there is no need for immediate policy decisions."*
>
> *Source: Rosenberg S., Vedlitz A., Cowman D., and S. Zahran. 2010. "Climate change: a profile of U.S. climate scientists' perspectives", Climatic Change 101 (3--4): pp. 663-668.*

The third group viewed a screen with the following vague information about climate change ("soft information placebo," hereafter SI). This treatment allows us to test whether the salience (rather than the content) of the information affects beliefs.

> *"There is strong scientific consensus about the occurrence and cause of global warming. The overwhelming majority of scientists agree that global warming is already underway and that human activities are accelerating it. Moreover, most scientists agree that there is enough certainty about the rate and extent of global warming to warrant immediate policy decisions."*

Following the information screen, the HI group answered questions about the credibility of the information we provided in order to gauge their level of skepticism. The SI and the control groups answered questions about their perception of what scientists believe.

All groups then answered key questions of interest, which elicited respondents' own beliefs about climate change and their willingness to sacrifice a portion of a monetary prize in order to contribute toward a cause that counters climate change by promoting energy efficiency. Specifically, questions regarding beliefs about climate change were phrased in the following way.

> *In your opinion, what is the probability that each of the following is true, out of 100%?*
>
> 1. *Global warming is a process that is already underway.*
> 2. *Human activities are accelerating global warming.*

3. *There is enough scientific uncertainty about the rate and extent of global warming and climate change that there is no need for immediate policy decisions.*[3]

By how many degrees Fahrenheit do you expect temperatures on earth to rise or fall by the year 2050, on average? (a change of 1 degree Fahrenheit is about equal to a change of 0.56 degrees Celsius)

What do you think is the probability that the temperature will increase/decrease by at least 2.5/5 degrees Fahrenheit by 2050? (4 questions total)

We then asked the following question to gauge whether beliefs translate into willingness to pay.

After completing the survey, you will be entered in a drawing for one of six $50 prizes. You have the option to send part of your winnings to Alliance to Save Energy, a nonprofit organization that is working to prevent the onset of climate change through promoting energy efficiency. Should you win, the amount will be deducted prior to you receiving the prize money and anonymously sent to Alliance to Save Energy.

If you win one of the prizes, how much of your winnings do you want sent to Alliance to Save Energy? Enter a dollar amount between $0 and $50.

The decision about donations was thus incentivized by asking respondents to sacrifice their own potential winnings. The survey concluded with detailed demographic questions including ideology and educational attainment.

Finally, in order to see whether the treatment produced lasting effects, we conducted a follow-up survey 6 months later (September 30-October 28, 2013). Out of the 1,300 participants who completed the baseline survey, 886 initiated and 747 completed the follow-up survey. The key questions were identical to the baseline except that the follow-up survey did not contain any treatment or treatment-specific questions.

3. Empirical Strategy

Due to the randomized nature of our study, the basic empirical strategy is straightforward: we compare the beliefs of respondents who were and were not exposed to the treatment. To increase efficiency, we also control for respondent characteristics, estimating the following equation:

$$Belief_i = \alpha + \gamma Treat_i + \theta SoftInfo_i + \boldsymbol{X}_i'\beta + \varepsilon_i \qquad (1)$$

The variable $Belief_i$ is the reported belief of respondent i about some aspect of climate change, such as whether or not it is caused by humans. We use the indicator $Treat_i$ to denote treated individuals and the indicator $SoftInfo_i$ to denote those who were in the soft information

[3] The wording of the statements was chosen to correspond closely to the scientist survey in Rosenberg et al. (2010).

placebo group. Finally, $\boldsymbol{X_i}$ is a vector of respondent characteristics, including age, age squared, gender, as well as sets of race, income, employment, education, and ideology indicators.

Thus, γ is the difference in the average outcome between the treated and control groups, conditional on respondent characteristics. Similarly, θ measures the difference between the beliefs of the soft information placebo group and the control. Testing whether $\gamma = \theta$ reveals whether the effect of information is coming from its content or is simply a salience phenomenon.

To examine treatment heterogeneity, we interact the treatment indicator with respondent characteristics, such as their ideology, education, and the degree to which they trust scientists. The last measure is elicited before the treatment and thus should not be affected by it.

4. Results

4.1 Basic findings

The responses of the control group about scientists' views on climate change reveal that the public underestimates the degree of scientific consensus. In particular, respondents in the control group believe that only 72% of scientists agree that global warming is a process that is already underway (different from 95% at $p < 0.001$), that only 69% of scientists believe that human activities are accelerating global warming (different from 88% at $p < 0.001$), and that 32% of scientists would say that there is no need for immediate policy decisions (different from 9% at $p < 0.001$).

We also find a great degree of skepticism toward the information we show to the HI treatment group.[4] Almost two-thirds (65%) of the treated group did not think the information from the scientist survey was accurately representing the views of all scientists who were knowledgeable about climate change. Only about 20% of the skeptical respondents thought that participating scientists misstated their true views. The skepticism largely stems from the concern that the scientists polled ("US scientists who published in top journals") were not representative of all scientists knowledgeable about climate change: 85% of skeptical respondents chose that as a reason for thinking that the information was inaccurate.[5] Being unemployed, liberal or conservative (v. moderate) were the only significant predictors of not trusting the information from the survey of US climate scientists.

Those in the treatment group who were skeptical of the information also believed that scientists were less certain about climate change than the control group (by about 4 percentage points, on average). On the other hand, the control group did not think that there would be significant differences in the answers by the following two groups of scientists: (a) all scientists knowledgeable about climate change, and (b) only US scientists who published in top journals. The fact that the treated respondents reported that (b) would not be representative of (a) while the control group does not expect there to be significant differences between them suggests that the public may suffer from "self-justification" bias. Alternatively, it may be that learning about US

[4] A more detailed analysis of skepticism can be found in the online appendix.
[5] Respondents could choose multiple reasons for why the information was not accurate.

climate scientists' views on climate change causes some of the treated respondents to rationally conclude that these scientists' views differ from the views of all scientists knowledgeable about climate change.

4.2 The immediate effect of information

In this section, we econometrically estimate the short-run effects of information on respondents' beliefs about climate change and their willingness to contribute toward preventing the onset of climate change. Table 1 shows the treatment effect of information on our various measures of beliefs, conditional on extensive respondent controls, including age, age squared, and indicators for gender, race, employment status, education, income, and political ideology. All specifications also include an indicator for soft information placebo treatment.[6] Columns (1) and (2) reveal a significant treatment effect: receiving the information about scientists' beliefs raises respondents' beliefs that climate change is already underway and that it has been caused by human activity by 6 and 5 percentage points, respectively. The beliefs of those in the soft information placebo group, on the other hand, do not differ significantly from those in the control group, which suggests that beliefs are impacted by the content, rather than by the availability of information.

Columns (3)-(6) report the effects of information on expected temperature changes due to climate change by year 2050. Overall, the treatment group believes that an increase in temperatures of 2.5 or 5 degrees Fahrenheit is about 6 percentage points more likely than the control group (Columns 3 and 4). On the other hand, there is no difference between the treated and control group in terms of the probability that temperatures *decrease* over this time (Columns 5 and 6). Finally, the treatment group's answers about the expected change in temperature by 2050 in degrees Fahrenheit does not differ significantly from the control group (Column 7).

Table 2 investigates whether the effect of information on beliefs translates into policy preferences or actions. Column (1) estimates the effect on information on the belief that "there is enough scientific uncertainty about the rate and extent of global warming and climate change that there is no need for immediate policy decisions". We find no significant treatment effect. This is consistent with a model where people look to scientists for objective scientific information but not public policy recommendations. The point estimates of the effect of information on the willingness to donate some of the potential winnings (Column 2) and on the donation amount (Column 3) are positive, but not significant. We find a significant difference between the hard information treatment and the soft information placebo, however. In fact, vague information seems to decrease donations.[7]

4.3 Heterogeneity in the short-run effects

[6] All subsequent specifications include these controls, unless otherwise specified. Excluding the soft information indicator or doing the analysis using the treated and control groups only does not substantively change the results. All specifications cluster standard errors at the state level.

[7] This finding is consistent with previous work by Nyhan, et. al (2014) who find that information reduces misperceptions that vaccines cause autism but nonetheless decreases intent to vaccinate among parents who had the least favorable vaccine attitudes.

Next, we decompose the treatment effect according to respondents' political ideology, education, and climate change knowledge. Table 3 shows the effects of information broken down by reported political ideology. In Column 1, the belief that climate change is already underway seems to be most strongly affected by information among the liberals and the conservatives. However, the standard errors are large and we are unable to reject that the three coefficients are significantly different from one another. Columns 2, 4, and 5 suggest that information most strongly affects moderates' beliefs about humans causing climate change and about the probability of temperature increases, although once again, we are unable to reject that the three ideological groups respond to information in an identical manner. Beliefs about policy actions are not significantly affected by information for any of the ideological groups (Column 3). Finally, treated conservatives donate marginally more to climate change causes, although we fail to reject that the point estimates for the three groups are equal (Column 6).

Table 4 decomposes the effect of information by educational attainment. In our survey, educational attainment is broken up into 8 categories, ranging from less than high school to doctoral degrees (PhD) and professional degrees (MD, JD, DDS, etc.). For the purpose of this analysis, however, we combine the categories into two bins: some college or 2-year degree and below (low education) and 4-year college degree and above (high education). We find that receiving hard information significantly impacts the highly educated in terms of increasing their beliefs about climate change being already underway, beliefs that there would be an increase in temperature by more than 5 degrees Fahrenheit by 2050, and the amount donated to climate change causes (Columns 1, 5, and 6). On the other, the low education treatment group is more likely to believe that climate change has been caused by human activities (Column 2). However, once again, in all cases, we cannot reject that the high and the low education groups respond to the treatment in the same way.

Finally, Table 5 breaks down the effect of information by prior knowledge about climate science. We measure this knowledge by the number of correct answers to questions about climate science, such as being able to name greenhouse gases (see detailed survey in the online appendix for the specific questions). The high knowledge group answered more than two questions correctly, while the low knowledge group answered 2 or fewer questions. Overall, the precision of our estimates does not allow us to statistically distinguish between the two groups. We find that both high and low knowledge respondents are positively affect by information in terms of their beliefs about climate change being underway (Column 1) and the probability that global temperature will rise by more than 5 degree Fahrenheit by 2050 (Column 5). The beliefs that climate change is caused by humans and that temperature would rise by more than 2.5 degree Fahrenheit by 2050 are significantly increased for the treated low knowledge respondents (Columns 2 and 4), although the coefficients for the high knowledge group are not significantly different.

4.4 Long-run effects of information

A 6-month follow-up survey allows us to gauge whether the short-run effects persist over time. In the follow-up, we ask the same questions about beliefs about climate change as we do in the baseline survey, but do not re-administer the treatment. Tables 6 and 7 summarize the results. Although the point estimates on the hard information treatment indicator are positive, we no longer find a significant effect of information, except for the probability that temperatures

increase or decrease by 2.5 degrees Fahrenheit or more (Table 6, Columns 3 and 6). At the same time, the standard errors are large, so that we cannot reject the hypothesis that the treatment effects are persistent. Because only roughly half of the original respondents completed the follow-up survey, our small sample size may mask the existence of a long-run effect (or lack thereof).

5 Conclusion

The results of our survey experiment indicate that objective information about the scientific consensus has a short-run effect on the public's beliefs about climate change. However, we do not observe an increase in either the public's view that policy action is warranted or their willingness to donate real funds toward climate change causes.

The experiment also reveals a great degree of skepticism among the treated respondents toward the information about what scientists believe. The skeptics among the treated also believed that scientists were less certain about climate change relative to the control group. It is also possible that this "information discounting" stems from the partisanship bias associated with the issue of climate change (Ramirez and Erickson, 2014). Finally, our findings are also consistent with the randomized survey evidence of skepticism toward information in other contexts, such as views and policy preferences for taxation and redistribution (Kuziemko et al., 2014). To shed light on the optimal design of information provision, further exploration of the different mechanisms behind the observed updating patterns would be useful.

Our sample was not large enough to make further conclusions about the heterogeneity of the effects by demographic characteristics of the respondents, such as ideology, education, or prior climate change knowledge. We are also unable to make definitive conclusions about the long-run persistence of informational effects. Replicating the experiment with a larger sample size would be a fruitful path for future research.

References

Abaluck, J. 2011. "What Would We Eat if We Knew More: The Implications of a Large-Scale Change in Nutrition Labeling," working paper.

Bauer, M., Allum, N. and S. Miller. 2007. "What can we learn from 25 years of PUS survey research? Liberating and expanding the agenda," *Public Understanding of Science*, 16(1): 79-95.

Bollinger, B., Leslie, P. and A. Sorensen. 2011. "Calorie Posting in Chain Restaurants," *American Economic Journal: Economic Policy*, 3(1): 91–128.

Cameron, T. A. 2005. "Updating subjective risks in the presence of conflicting information: an application to climate change." *Journal of Risk and Uncertainty*, 30(1): 63-97.

Corbett, J. and J. Durfee. 2004. "Testing Public (Un)Certainty of Science: Media Representations of Global Warming," *Science Communication*, 26(2): 129-151.

Deryugina, T. 2013. "How do people update? The effects of local weather fluctuations on beliefs about global warming", *Climatic Change*, 118(2): 397-416.

Ding, D., Maibach, E. W., Zhao, X., Roser-Renouf, C., & Leiserowitz, A. 2011. "Support for climate policy and societal action are linked to perceptions about scientific agreement," *Nature Climate Change*, 1(9): 462-466.

Egan, P. and M. Mullin. 2012. "How Citizens Integrate Information without Ideological Cues: Local Weather and Americans' Beliefs about Global Warming", *Journal of Politics*, 74(3): 796-809.

Gallup Environmental Poll. 2001-2010.

Gentzkow, M. and J. M. Shapiro. 2010. "Ideological Segregation Online and Offline," *Quarterly Journal of Economics*, 126, 1799 – 1839.

Herrnstadt, E., & Muehlegger, E. 2014. "Weather, salience of climate change and congressional voting." *Journal of Environmental Economics and Management*. 68(3): 435-448.

Hoffman, A. 2012. "Climate Change Science as Culture War," *Stanford Social Innovation Review*.

Human Development Report. 2013. United Nations Development Program.

IPCC. 2013. Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung,

A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)] Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Kellstedt, P., Zahran, S. and A. Vedlitz. 2008. "Personal Efficacy, the Information Environment, and Attitudes toward Global Warming and Climate Change in the United States," *Risk Analysis*, 28(1): 113-126.

Keskin, P., Shastry, G. K., and H. Willis. 2013. "Water Quality Awareness and Infant Health: The Role of Breastfeeding," Working paper.

Kiesel, K. and S. Villas-Boas. 2010. "Can Information Costs Confuse Consumer Choice? - Nutritional Labels in a Supermarket Experiment," *International Journal of Industrial Organization*.

Kuziemko, I., Norton, M. I., Saez, E., and S, Stantcheva. 2014. "How Elastic Are Preferences for Redistribution? Evidence from Randomized Survey Experiments," NBER Working Paper 18865.

van der Linden, S. L., Leiserowitz, A. A., Feinberg, G. D., & Maibach, E. W. 2014. "How to communicate the scientific consensus on climate change: plain facts, pie charts or metaphors?" *Climatic Change*, 126(1-2): 255-262.

van der Linden, S., Leiserowitz, A. A., Feinberg, G. D., & Maibach, E. W. 2015. "The scientific consensus on climate change as a gateway belief: Experimental evidence." *PloS one*, 10(2): e0118489.

Malka, A., Krosnick, J., Debell, M., Pasek, J. and D. Schneider. 2009. "Featuring Skeptics in News Media Stories about Global Warming Reduces Public Beliefs in the Seriousness of Global Warming," Stanford mimeo.

Manski, C. 2004. "Measuring Expectations", *Econometrica*, 72 (5): 1329-1376.

McCright, A. M., Dunlap, R. E., & Xiao, C. 2013. "Perceived scientific agreement and support for government action on climate change in the USA," *Climatic Change*, 119(2): 511-518.

Nyhan, B., Reifler, J., Richey, S. and G. L. Freed. 2014. "Effective Messages in Vaccine Promotion: A Randomized Trial," *Pediatrics* peds. 2013-2365.

Ramirez, M. and N. Erickson. 2014. "Partisan Bias and Information Discounting in Economic Judgments," *Political Psychology*, 35(3): 401-415.

Risen, J. and C. Critcher. 2011. "Visceral Fit: While in a Visceral State, Associated States of the World Seem More Likely", *Journal of Personality and Social Psychology*, 100(5): 777-793.

Rosenberg S., Vedlitz A., Cowman D., and S. Zahran. 2010. "Climate change: a profile of U.S. climate scientists' perspectives", *Climatic Change*, 101 (3–4): 663-668.

Sturgis, P. and N. Allum. 2004. “Science in society: re-evaluating the deficit model of public attitudes,” *Public Understanding of Science*, 13(1): 55-74.

Schwartzstein, J. 2014. “Selective Attention and Learning,” *Journal of the European Economic Association*, 12(6), 1423–1452.

Tversky, A. and D. Kahneman. 1973. “Availability: A Heuristic for Judging Frequency and Probability,” *Cognitive Psychology*, 4: 207-232.

Tversky, A. and D. Kahneman. 1974. “Judgment under Uncertainty: Heuristics and Biases,” *Science*, 185: 1124-1131.

US Census Bureau. 2010. Census Briefs: Age and Sex Composition: 2010.

Tables

Table 1: Average short-run effects of information on beliefs about climate change

	Under -way	Caused by Humans	Prob Chg > 2.5	Prob Chg > 5	Prob Chg < -5	Prob Chg < -2.5	Change by 2050
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Hard info	5.91***	5.09**	5.80**	5.92***	1.63	2.02	-0.02
	(1.67)	(1.91)	(2.67)	(2.10)	(1.19)	(1.47)	(0.41)
Soft info	0.30	0.94	2.15	2.92	0.51	0.84	0.11
	(1.39)	(1.67)	(2.05)	(2.13)	(1.37)	(1.42)	(0.45)
Soft = hard p-val	<0.001	0.05	0.16	0.21	0.42	0.47	0.76
Dep. var. mean	74.29	68.04	56.43	41.33	14.04	18.74	5.05
Observations	1,259	1,259	1,259	1,259	1,259	1,259	1,258
R-squared	0.12	0.16	0.10	0.12	0.05	0.04	0.08

Notes: Standard errors clustered at the state level in parentheses; All specifications include controls for age, age squared, gender, race, employment status, education, income, and political ideology. Significance levels: *10%, **5%, ***1%.

Table 2: Average short-run effects of information on policy actions

	Belief about Policy	Prob. Donate	Donation Am't
	(1)	(2)	(3)
Hard info	-0.83	0.09	0.78
	(2.00)	(0.08)	(0.77)
Soft info	-0.61	-0.09	-1.05*
	(1.98)	(0.07)	(0.53)
Soft = hard p-val	0.90	0.03	0.02
Dep. var. mean	33.58	0.50	8.72
Observations	1,259	1,259	1,259
R-squared	0.09	0.12	0.05

Notes: Standard errors clustered at the state level in parentheses; All specifications include controls for age, age squared, gender, race, employment status, education, income, and political ideology. Significance levels: *10%, **5%, ***1%.

Table 3: Short-run effects of information by ideology

	Underway	Humans	Policy	P(Chg > 2.5)	P(Chg > 5)	Don. Am't
	(1)	(2)	(3)	(4)	(5)	(6)
H.I.: liberal	6.45***	2.27	2.14	0.81	0.33	-0.79
	(2.24)	(2.61)	(4.28)	(3.55)	(3.38)	(2.14)
H.I.: moderate	4.21	8.67***	-3.72	10.77**	11.14***	0.71
	(2.65)	(3.16)	(2.82)	(4.59)	(3.83)	(2.00)
H.I.: conservative	7.79**	2.52	0.81	2.90	2.90	1.86*
	(3.42)	(3.74)	(3.59)	(3.41)	(3.62)	0.95)
S.I.: liberal	1.27	1.56	3.51	-2.57	-0.15	-1.78
	(2.68)	(2.21)	(4.36)	(3.90)	(6.48)	(1.87)
S.I.: moderate	0.15	3.81	-6.20*	6.21**	7.60***	-1.34
	(2.44)	(3.06)	(3.69)	(2.72)	(2.81)	(1.45)
S.I.: conservative	-0.30	-3.66	4.72	0.13	-1.45	-0.13
	(4.02)	(3.29)	(4.05)	(3.92)	(3.27)	(1.33)
Dep. var. mean	74.29	68.04	33.58	56.43	41.33	8.72
Observations	1,259	1,259	1,259	1,259	1,259	1,259
R-squared	0.12	0.16	0.09	0.11	0.13	0.05

Notes: Standard errors clustered at the state level in parentheses; All specifications include controls for age, age squared, gender, race, employment status, education, income, and political ideology. Significance levels: *10%, **5%, ***1%.

Table 4: Short-run effects of information by education

	Underway	Humans	Policy	P(Chg > 2.5)	P(Chg > 5)	Don. Am't
	(1)	(2)	(3)	(4)	(5)	(6)
H.I.: low educ	2.12	6.38**	-2.06	3.68	3.68	-0.32
	(3.17)	(2.74)	(3.45)	(3.34)	(3.37)	(1.35)
H.I.: high educ	10.47***	3.79	1.62	6.82	7.79***	2.54**
	(3.43)	(3.38)	(3.34)	(4.73)	(2.84)	(1.18)
S.I.: low educ	0.93	2.56	-2.51	2.27	2.72	-1.50
	(2.66)	(2.50)	(2.95)	(3.30)	(2.64)	(0.90)
S.I.: high educ	1.73	1.01	0.54	3.67	3.90	-0.41
	(3.54)	(3.57)	(2.90)	(3.52)	(3.77)	(1.16)
H.I. low = high educ p-val	0.14	0.60	0.50	0.59	0.37	0.14
Dep. var. mean	74.27	68.08	33.63	56.31	41.47	8.72
Observations	1,223	1,223	1,223	1,223	1,223	1,223
R-squared	0.11	0.15	0.08	0.09	0.11	0.04

Notes: Standard errors clustered at the state level in parentheses; All specifications include controls for age, age squared, gender, race, employment status, education, income, and political ideology. Significance levels: *10%, **5%, ***1%.

Table 5: Short-run effects of information by knowledge

	Underway	Humans	Policy	P(Chg > 2.5)	P(Chg > 5)	Don. Am't
	(1)	(2)	(3)	(4)	(5)	(6)
H.I.: low know	6.04*	5.69**	-0.87	8.11***	5.75**	0.32
	(3.10)	(2.62)	(3.46)	(2.82)	(2.79)	(1.30)
H.I.: high know	5.45**	4.33	-0.58	3.52	5.85**	1.15
	(2.28)	(2.60)	(2.36)	(3.90)	(2.85)	(1.74)
S.I.: low know	-0.83	-3.25	-1.50	0.98	0.33	-1.11
	(1.87)	(2.18)	(3.30)	(2.55)	(2.71)	(0.98)
S.I.: high know	1.80	5.31*	0.03	3.69	5.67	-0.98
	(2.31)	(2.65)	(2.77)	(2.74)	(3.51)	(1.10)
H.I. low = high know p-val	0.89	0.70	0.95	0.28	0.98	0.76
Dep. var. mean	74.29	68.04	33.58	56.43	41.33	8.72
Observations	1,259	1,259	1,259	1,259	1,259	1,259
R-squared	0.16	0.19	0.09	0.13	0.13	0.05

Notes: Standard errors clustered at the state level in parentheses; All specifications include controls for age, age squared, gender, race, employment status, education, income, and political ideology. Significance levels: *10%, **5%, ***1%.

Table 6: Average long-run effects of information on beliefs about climate change

	Under -way	Caused by Humans	Prob Chg > 2.5	Prob Chg > 5	Prob Chg < -5	Prob Chg < -2.5	Change by 2050
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Hard info	3.27	2.49	6.19**	4.25	3.50	4.89**	0.15
	(2.58)	(2.48)	(2.51)	(2.70)	(2.33)	(2.22)	(0.51)
Soft info	-0.70	-0.60	3.96	1.76	-0.96	-0.18	-0.14
	(2.76)	(2.74)	(3.07)	(2.47)	(1.90)	(2.18)	(0.43)
Soft = hard p-val	0.17	0.33	0.55	0.43	0.04	0.06	0.51
Dep. var. mean	72.59	68.33	57.24	40.89	13.12	18.93	4.53
Observations	746	746	728	728	727	728	728
R-squared	0.12	0.13	0.10	0.13	0.09	0.06	0.06

Notes: Standard errors clustered at the state level in parentheses; All specifications include controls for age, age squared, gender, race, employment status, education, income, and political ideology. Significance levels: *10%, **5%, ***1%.

Table 7: Average long-run effects of information on policy actions

	Belief about Policy	Prob. Donate	Donation Am't
	(1)	(2)	(3)
Hard info	-1.13	-0.14	-0.77
	(2.26)	(0.12)	(1.20)
Soft info	-1.57	-0.04	-0.79
	(2.25)	(0.10)	(1.16)
Soft = hard p-val	0.86	0.39	0.99
Dep. var. mean	33.25	0.44	8.01
Observations	746	726	726
R-squared	0.12	0.06	0.06

Notes: Standard errors clustered at the state level in parentheses; All specifications include controls for age, age squared, gender, race, employment status, education, income, and political ideology. Significance levels: *10%, **5%, ***1%.