

Defining Problems and Solutions: How do knowledge and beliefs about climate change influence support for climate policies?

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Rough draft: Please do not circulate outside the workshop

This analysis provides an empirical test for an idea underlying many real-world environmental advocacy campaigns: that people who believe climate change exists are more likely to be concerned about its consequences, and in turn more likely to support climate mitigation policies. The analysis also seeks to disentangle the relative influences of factual knowledge and political predispositions on Americans' beliefs and opinions about climate change.

Introduction

Controversies over scientific and technical issues have long affected American policymaking processes. Conway and Oreskes (2011, 14) pinpoint the beginning of the “modern era” of “using science to fight science” as the early 1950s, when scientists backed by the cigarette industry publically disputed established links between smoking and cancer. But political contention over scientific evidence also occurs around issues with less obvious vested interests. For instance, decades of public controversy over the health risks of fluoridizing public water supplies began in the 1940s, despite scientific consensus that such measures safely prevent tooth decay. Further, in the 1980s Americans hotly debated whether vitamin C can control or palliate cancer, despite strong scientific evidence that it cannot (Martin and Richards 1995). As the pace of scientific and technological advancements quickens, policies dealing with contested scientific evidence are becoming increasingly common: in recent years the American public has become polarized over laws that constrain the use of stem cells in scientific research, require manufacturers to label genetically modified foods, mandate vaccination schedules for public school children, or impose science standards on public school curricula. The present study

focuses on public contention over climate change (CC), another issue that lies at the intersection of science and American politics, and which has become particularly polarizing since the mid-1990s.

The increasingly important role of scientific expertise in policy processes brings up foundational questions about democratic participation, echoing those that John Dewey raised in his seminal *The Public and its Problems* (1927). Recognizing that increasingly complex technology leads to asymmetries in the social distribution of knowledge, Dewey was concerned with how large-scale civic deliberation could be maintained to address technical and social problems. He asks how social inquiry can be organized so that popular consensus has a role in governing scientific practices and institutions, and resists the idea that rapid scientific progress necessarily creates technocratic regimes run by experts and elites. Applied to the case of climate change, these inquiries bring up several related, critical questions: How do ordinary citizens—who generally do not have much knowledge about climate science—form beliefs about climate change? To what extent do their political values or predispositions influence their judgments about climate policies? And in the absence of technical information, how do citizens arbitrate between competing elite claims about CC’s existence, causes, and consequences?

I address these questions by investigating the relationships between Americans’ beliefs about climate change and climate policies.¹ More specifically, I aim to shed light on the relative importance of factual knowledge and political predispositions for citizens’ opinions about three interrelated sub-issues: 1) whether climate change exists, 2) how severe its consequences will be,

1. Scholars and journalists often use “global warming” and “climate change” interchangeably. Although “climate change” is more accurate, I effectively use the terms interchangeably here. This is because I try to remain true to the terminology used in extant studies when describing this literature, and because some of the survey items I use in analysis refer to “global warming” or “rising global temperatures.” For brevity, I often use the acronyms GW and CC.

and 3) policies to reduce greenhouse gas (GHG) emissions. To do so, I conduct a series of analyses that examine the antecedents of each of these opinions in turn. The analyses build upon one another to clarify the relationships between people’s opinions about these three sub-issues.²

This research design allows me to address two ambiguities in extant research. First, while there is a growing interest in the American public’s beliefs about climate change, extant research is still fragmented—most studies examine opinions about these sub-issues in isolation, and thus it is still unclear how they are related and influence one another. Some research does consider the relationships between these sub-issues, but it often assumes that they “go together” in a particular manner: that is, it assumes that people with more factual knowledge³ are more likely to believe that climate change is real, to grasp the magnitude of its projected consequences, and in turn, will be more likely to support CC mitigation policies. Although such “information-based” mental models are logically compelling, they often remain implicit and empirically untested. My first aim is thus to elaborate and test the information-based hypothesis that people with more accurate “factual beliefs” about climate change find the issue more salient or concerning, leading them to support climate action.⁴

² Readers might question the omission of another important sub-issue: namely, whether climate change has natural or human causes. In reality, of course, all of these sub-issues are closely related and highly endogenous. To account for the multiple, mutually reinforcing relationships between these issues would paralyze the present analysis. Therefore, I impose the artificial (but theoretically plausible) assumption that people’s beliefs about the causes of CC come prior to, and inform, their beliefs about whether it exists.

3. Different studies use many different measures of information or knowledge to predict beliefs about climate change, including factual knowledge about CC, knowledge about science more broadly (“scientific literacy”) and educational attainment. To clarify the nature of information that influences citizens’ perceptions of CC, I use measures for all three of these.

4. I use “factual beliefs” rather than “knowledge” to describe beliefs about matters of scientific fact or evidence. (I do not, however, aim to imply that such “facts” are absolute or unchanging.) For example, as I discuss below, many Americans doubt that human activity is causing long-term climate change. Even though this is incorrect by the standards of mainstream scientific institutions, I consider this a “factual belief” rather than “incorrect knowledge” because it is

Second, information-based models need to be in closer dialogue with research showing that people’s political beliefs and values bias how they think about climate change. To put these strands of research into conversation, my second aim is to investigate how political predispositions are associated with opinions about climate change’s existence, severity, and emissions policies. As I explain below, I expect political predispositions to be particularly important for policy support because climate policies often invoke tradeoffs between salient political priorities. For instance, citizens whose political ideals emphasize limited government and free markets might oppose climate protection because these policies to imply economic and political tradeoffs (e.g., job losses, expanded government). If predispositions guide policy opinions in this way, it will be necessary to re-consider the effectiveness of climate advocacy strategies that focus on providing people with factual information. While I do not seek to refute the idea that people use available factual information to evaluate climate policies, I suggest that the reverse may also be true: that is, people’s perceptions of climate policies might also bias their “factual beliefs” about climate change’s existence and severity.

Background: The basis of public beliefs and controversy over climate change

While climate change has become unambiguously controversial, Americans were not always so divided over environmental issues. During The 1960s and 70s—the “golden era” of environmental lawmaking—the public widely supported government action on the environment. Bipartisan majorities in Congress passed twenty-two pieces of major environmental legislation,

probably shaped by a combination of factors unrelated to knowledge about CC, like perceived conflicts with religious or political values. Even those whose beliefs cohere with the scientific consensus on CC probably do not have specialized scientific knowledge. In short, I use “factual beliefs” to describe positions that might reflect factual knowledge, but are more likely matters of attitudes and beliefs.

which were signed into law by presidents of both parties (Klyza and Sousa 2013). Republican President Nixon—who was by no means an ardent environmentalist—nevertheless created the EPA by executive order in 1970 and signed the Clean Air (1970) and Clean Water Acts (1972) into law with strong bipartisan support. Thus when global warming first became an issue of mass public interest during the abnormally hot and extreme summer of 1988, it was not an inherently polarizing issue. As late as 1997, partisans on opposite ends of the political spectrum agreed on the basic proposition that climate change exists, with nearly identical percentages of Democrats (46%) and Republicans (47%) saying that the effects of global warming had already begun (Dunlap 2008).

However, Americans' opinions and beliefs about climate change began to diverge in the mid- to late-1990s and continue to cleave along well-documented political lines. By 2008, 76% of Democrats as opposed to 41% of Republicans believed warming was underway (Dunlap 2008). In 2013, most Democrats (84%) said that there is “solid evidence” for warming, while Republicans were split: 46% thought there is evidence, and 45% said there isn't (Pew Research 2014).⁵ More conservative Republicans were less convinced there is solid scientific evidence: 70% of Republicans who did not think there is evidence for warming identified with the Tea Party⁶. When asked about this further, 28% of Tea Party supporters (compared to 13% of other Republicans) attributed the lack of evidence to unsettled science (“we just don't know enough

5. For comparison with aggregate national opinion in 2013, 67% of Americans said there is “solid evidence” the Earth is warming. 44% said it was due to human activity.

6. Skocpol (2013) characterizes Tea Party supporters as “ultra-conservative” insofar as they are highly attentive to conservative political media, extremely distrustful of government, and typically take anti-tax and anti-environment stances. The Tea Party formed in 2009 in reaction to the new Obama Administration's priorities in the realms of health care and cap-and-trade. Tea Party arguments against cap-and-trade legislation claimed that nature shouldn't take precedence over human needs and property rights, and that a free marketplace will protect the environment better than “big government” initiatives (Skocpol 2013).

yet”), indicating that these respondents might be receptive to additional information about scientific evidence for climate change. But 41% of “Tea Partiers” (compared to 16% of other Republicans) rejected the possibility of evidence more staunchly, saying that global warming is “just not happening” (Pew Research 2014). Although the Tea Party comprises a relatively small portion of the electorate,⁷ at times its supporters mobilized with remarkable efficiency to influence policy processes. For instance, vocal opposition by grassroots Tea Party activists was a crucial element of conservative efforts to defeat comprehensive cap-and-trade legislation in 2009.⁸

This partisan divergence over the existence of and evidence for climate change is rooted in a host of scientific and political factors. First, the intrinsic features of climate change as a complex, long-term phenomenon make it essentially invisible and imperceptible, and therefore it is salient for much of the public. Climate science is also a highly specialized, technical field that is inaccessible to ordinary citizens—unless they happen to be involved in some aspect of physical sciences research. Further, in contrast to more immediate and localized environmental problems like acid rain or particulate pollution, climate change occurs on imperceptible, long-term, and global scales.⁹ Without immediate or perceptible effects, climate change has not sustained public engagement since the sweltering summer of 1988. Though concern about the issue rises periodically in the wake of sensational media discourses or disastrous weather events,

7. In 2013, 22% of the electorate supported the Tea Party, a decrease from its peak of 32% in 2010 (Saad 2013).

8. The American Clean Energy and Security Act, also known as the Waxman-Markey Bill, died in the Senate after protracted partisan debate.

9. Immediate problems are more salient than abstract, distant problems, but this is not a claim that people necessarily make better decisions when scientific information is widely available and understandable. For example, most adults now know and accept the medical consensus that smoking causes cancer, but this widespread information has not eradicated habitual smoking.

Americans systematically rank climate change as the least of their socio-political worries (Riffkin 2014).

These characteristics of climate change—its technical complexity and invisibility—have proved advantageous for corporate and political actors whose interests conflict with climate regulation, such as business lobbies, carbon industries, wealthy individuals with stakes in extractive industries, and ideologically conservative foundations. McCright and Dunlap (2003) pinpoint the 1994 midterm elections in which Republicans took over Congress as a crucial moment for these actors: increased Republican representation gave them (and particularly the conservative think tanks that serve as their “mouthpieces”) greater political and institutional access, heightening their influence in Congressional hearings and national print media. As Congress has grown more polarized over the past two decades, elites within the conservative movement and fossil fuel industries “have sent a consistent message—via conservative talk radio, television news, newspapers, and websites—to the American public” that “climate change is not real and thus does not warrant ameliorative action” (McCright and Dunlap 2011). These messages successfully generated controversy, first, because most citizens cannot make unmediated judgments about climate science. Second, “skeptical” claims benefit from journalistic norms that heighten their credibility.¹⁰ For instance, “balancing” norms require reporters to give equal time to both sides of controversial issues, creating media discourses that portray climate scientists as divided over basic facts related to climate change.¹¹

10. The term “skepticism” covers a range of beliefs about scientific evidence for CC and its existence, causes, and potential consequences. I follow McCright and Dunlap’s general characterization of “skeptics” as people who challenge some aspect of what they perceive as the false consensus of “mainstream” climate science (2003, 355).

11. Although the mainstream media often depicts climatologists as divided, 97-98% of the climate researchers most actively publishing the field agree with the Intergovernmental Panel on Climate Change’s (IPCC) basic tenets on climate change: i.e., that “anthropogenic greenhouse

On the whole, longitudinal public opinion reflects the intensity of political controversies, rather than the increased scientific consensus, on climate change. Notably, Americans have become both more entrenched and more confident in their stances as CC has cycled in and out of mainstream media discourses over time.¹² But those who are most confident in their knowledge have also become least likely to concur with the scientific consensus that warming is predominantly due to human activity. Thus only 47% of those saying they understand GW “very well” believed it has human causes, compared to 62% of those who think they understand it “fairly well,” and 59% who did not think they understand the issue well (Saad 2014). These trends indicate that the politicization of climate science is occurring not only at the elite level among those with vested material interests, but also among the general public. Yet unlike political and economic elites, ordinary citizens do not have obvious incentives to deny matters of scientific consensus on climate change. What considerations, then, inform people’s opinions about these matters?

To answer this question I argue that it is important to consider how controversy about climate change has evolved beyond questions of science to encompass the political and symbolic implications of climate *policies*. That is, legislators and elites associated with extractive industries have “politicized” the issue not only by questioning scientific evidence and institutions, but by imputing political motives to those who support environmental regulations, and claiming that these policies are at odds with economic growth and job creation. Such appeals have become particularly common in states and regions where extractive industries play a large

gases have been responsible for most of the unequivocal warming of the Earth’s average global temperature over the second half of the 20th century.” These researchers’ expertise has been found to “vastly” overshadow that of skeptical climatologists (Anderegg et al. 2010).

12. The proportion of Americans saying they understand the issue of global warming “very well” went up gradually from 11% in 1992, to 21% in 2008, to a high of 33% in 2014 (Saad 2014).

role in the economy and are enmeshed with local cultural identity. In West Virginia, for instance, where coal mines and chemical plants have historically been important sources of employment, the state's Republican Party often portrays industrial production as a matter of regional pride and "cultural and existential survival"¹³ (Osnos 2014). At the same time, these appeals invoke politically polarizing, anti-regulatory themes. WV's Republican Party chairman made a statement representative of such claims when the EPA rescinded a permit for what would have been the largest mountaintop removal operation in WV history, stating: "The Spruce Mine, in the heart of West Virginia coal country, is where we must join this battle against the liberal Democrats of DC. Obama's foot-soldiers seek to destroy our very way of life for the sake of an agenda that guts our economy" (Mancini 2013; Osnos 2014, 43).

This example illustrates how contentious discourses about natural resource development intersect with, and have reframed, national discussions about climate change. While the object of controversy was here not climate change *per se* (but rather, the scope of executive authority to revoke the mining permit), many climate policies do seek to regulate fossil fuel industries. Opposition to these policies has thus become tied to bigger political conversations about government overreach and tradeoffs between environmental regulation and economic growth. In turn, discourses about climate change have taken on these conversations' symbolic and material dimensions. Symbolically, what is at stake in the quote above is a cherished "way of life" that is threatened by, and antithetical to, the proverbial "liberal Democrats of DC." Materially, West Virginia's long-suffering economy—which is characterized by extreme poverty and income

13. Such claims exaggerate the role of the coal industry as a local employer. Though coal production increased in West Virginia since the 1970s, coalmining employment has decreased substantially throughout the postwar period (Bell and York 2010). Because most accessible seams have been depleted, the coal industry now directly employs only 3% of the state's

inequality—is at stake. As a further example, high-profile Republicans such as House Majority Leader Mitch McConnell, conservative commentators, and Democrats from coal-dependent states have recently used the rhetoric of “Obama’s war on coal” to oppose EPA regulations on emissions from coal-fired plants. The phrase implies tight connections between a host of issues, including fossil fuel development, climate change mitigation, political values and identity, and economic self-interest.

I’ve traced the evolution of CC controversy to highlight a discrepancy between the ways “skeptics” perceive the issue, and the tactics whereby climate activists try to change their minds. On the one hand, I have described how debates about CC are often rooted in oppositional stances towards CC mitigation policies, rather than scientific evidence. On the other hand, as I describe in the next section, proponents of climate change mitigation often use communication strategies that emphasize scientific evidence and consensus. Thus, to address enduring public polarization over the issue, it is important to consider if climate advocates and climate skeptics might be concerned about related—but fundamentally different—problems. If some citizens are predominantly concerned about the symbolic or material costs of climate change mitigation, climate activists may be “talking past” their audience.

Before fleshing out the reasoning behind my research design, I should note that conservatives have diverse reasons for opposing CC mitigation policies, and do not solely or necessarily oppose government regulation and resource development. Inglis (2014) enumerates other objections: that climate action stifles economic growth in the developing world, that it will

workforce (Osno 2014). Wal-Mart is now the state’s largest private employer (WorkForce West Virginia 2014).

increase taxes at home, or that it clashes with a “sacred Christian worldview”¹⁴. [However, my own argument focuses on attitudes towards regulation/big government, because it seems like these are the issues that come up the most in controversial discourses about the issue.]

Climate communication

Many initiatives to raise concern about CC seek to correct public misinformation about climate science. Gauchat’s research on science controversies (2012) has characterized such informational approaches as following a “deficit model,” whereby greater public scientific literacy will lead to increased public trust in scientists and scientific institutions, and this, in turn, should lead polarized groups to converge on issues about which there is broad scientific consensus. A number of successful environmental campaigns in the 1970s and 80s, such as those dealing with acid rain, followed this model. These initiatives mobilized in a sequence of strategic steps: environmental advocacy groups would identify a problem, solicit physical and social scientists to propose technical or policy solutions, and conduct public education campaigns to develop support for legislative action on preferred solutions (Cox 2010).

Climate communication initiatives often continue to follow this model, and aim to make basic facts about climate science more widespread and accessible. Perhaps the most well-known such initiatives are Al Gore’s *The Climate Project* and his 2006 documentary *An Inconvenient*

14. It is well known that citizens who identify with the American “religious right” are often skeptical about climate change because the issue raises conflicts with their religious beliefs. Here, however, I do not deal separately with religious conservatives’ views because the predominant discourses about CC taking place within this community reflect those happening within the broader conservative movement—that is, they tend to revolve around issues of scientific certainty and the economy (Kearns 2011). While the discourses unique to the Christian community (e.g., those drawing on dominion theology, creationism, or End Times scenarios) are relevant to the present analysis, they are less widespread. They deserve deeper consideration in research that focuses on this sub-group of the conservative population.

Truth, both of which aimed to generate concern about CC by making factual information more understandable and visually compelling (Nisbet and Kotcher 2009). Major environmental advocacy groups have also launched information-based campaigns to lobby the public at critical political moments. In 2009, The League of Conservation Voters and the Natural Resources Defense Council, for instance, invested tens of millions of dollars in public communication initiatives to raise support for cap-and-trade legislation. These initiatives “presumably...were meant to get citizens to register more ‘concern’ about global warming, which in turn would supposedly make it easier for legislators to support cap and trade” (Skocpol 2013, 52). Here, Skocpol articulates the implied, mental model underlying well-funded climate communication initiatives. That is, given at least a basic factual understanding of climate change, citizens will become concerned about the issue, and in turn will support mitigation policies like cap-and-trade.¹⁵ (Figure 1 depicts this mental process in schematic form.¹⁶)

Despite the volume of resources these actors devote to climate communication, it is difficult to gauge their effect on public perceptions of climate change and climate policies. On the one hand, *An Inconvenient Truth* received critical acclaim for increasing viewers’ awareness of and concern about climate change. Globally, a majority (66%) of viewers said the documentary led them to “change their mind” about global warming, that it had made them more aware of the problem (89%), and that they had changed their habits as a result of watching the film (74%) (The Nielsen Company 2007). In a *GeoJournal* symposium on the film’s scientific

15. I also refer to these as “information-based models” since they assume that scientific knowledge or information drives people’s opinions about scientific controversies.

16. Figure 1 does not represent any particular scholar’s research, but rather my interpretation of the cognitive model implicit in the approaches of environmentalist initiatives and some environmental psychology research. The schematic is intentionally general because different researchers have tended to use different measures of factual knowledge, concern, and policy support.

accuracy, climatologist Steven Quiring (2008) wrote, “*An Inconvenient Truth* is a powerful example of how scientific knowledge can be communicated to a lay audience. Scientists may argue about the accuracy of the message of AIT, but there is no debating its effectiveness.” On the other hand, despite this recognition for effective communication, the film does not appear to have had particularly durable impacts. Jacobsen (2011), for instance, found a significant but short-lived influence on consumer behavior: in the months following the film’s release, purchases of carbon offsets increased by 50% in areas where theaters showed the documentary. Most people, however, did not re-purchase the offsets when they expired after a year.¹⁷ Further, while it is difficult to gauge the effectiveness of public education initiatives such as those intended to create support for the cap-and-trade bill, the bill’s fate (it died in the Senate in the face of strong conservative opposition) indicates that they did not successfully mobilize voters.

Mental models of climate change opinions

The foregoing discussion juxtaposed two types of elite “information flows” that might reach the public: pro-mitigation messages addressing public misinformation about CC, and political discourses that frame the issue to appeal to deeply-held social and political values. The critical corollary of these information flows is, of course, how the public perceives them—and more specifically, whether people’s opinions about CC informed more by their factual knowledge or political predispositions. Extant studies on the relationship between knowledge and concern about climate change present varied results, with different scholars emphasizing these factors to different degrees.

17. Carbon offset retailers provide financial support toward projects estimated to offset customers’ own carbon emissions (e.g., from a year of driving or a year of home energy

Some, like Van der Linden et al. (2015), find evidence for an information-based cognitive process like that depicted in Figure 1. Respondents who received information about the scientific consensus on human-caused climate change became significantly more likely to believe that it is happening, is anthropogenic, and poses a “worrisome threat.”¹⁸ These increases, in turn, predicted support for public action on climate change.¹⁹ The authors posit that knowledge about the scientific consensus on CC serves as a “gateway belief” that supports (or undermines) other key beliefs and attitudes about the issue. Bord, O’Connor, and Fisher’s work (2000) indicates that people’s beliefs about the causes of CC might also be an important “gateway belief,” since participants who thought CC is anthropogenic were also more likely to believe it is real and harmful. But interestingly, this was true for respondents who correctly identified the human causes of climate change *and* those who identified incorrect human causes (e.g., insecticides, aerosols, and nuclear power plants). This example indicates that there are factual misperceptions on both sides of climate change debates, and raises the question of how accurate or detailed one’s knowledge about an issue needs to be in order to define that issue as a problem.

Relatedly, some studies find that climate change “skeptics” do not necessarily lack information about the scientific consensus on CC. Kahan (2014) found substantial differences between conservative Republicans and liberal Democrats when they were asked if climate change is real and anthropogenic—but these gaps disappeared when the same questions were prefaced with the phrase “Climate scientists believe that...”²⁰ (Kahan 2014). Thus it appeared

consumption). The study investigated purchases among people living in zip codes within ten miles of theaters showing the documentary.

¹⁸ Respondent read the message: “97% of climate scientists have concluded that human-caused climate change is happening.”

¹⁹ The authors did not specify their measure of “support for public action” on CC.

²⁰ Under this condition, liberal respondents also became slightly less likely to correctly answer “trick” questions overemphasizing the risks of climate change.

that conservative respondents know what climate scientists believe, but do not necessarily believe it themselves. Campbell and Kay (2014) found that people's factual beliefs about CC were motivated by the ideological implications of policy solutions (a form of reasoning they call "solution aversion"): Republicans who read about a regulatory climate policy became substantially less likely to say that humans are causing CC than those who read about a "free market" emissions policy. That is, their skepticism about climate science increased when they considered ideologically aversive policies. Hardisty, Johnson, and Weber (2010) found that Republicans and Independents were willing to pay more for a product (such as an airline ticket) to support a carbon "offset," but not to support an otherwise identical carbon "tax." Importantly, the authors found that subjects reasoned differently when considering the different policies. When asked about the "offset," both Democrats and Republicans first considered the advantages of the more expensive offset as opposed to cheaper options. In the "tax" condition, however, Republicans generally considered the advantages of the cheaper (i.e., non-tax) option first. Since subjects' ultimate choices were associated with the order in which they weighed the benefits of the different options, it seems the "tax" frame provoked negative associations for Republicans and Independents that influenced their willingness to pay to reduce carbon emissions.

In light of these findings, it is unclear exactly what information might increase public support for climate policies, and the extent to which people's preexisting political commitments could influence their receptivity to factual information about CC. To evaluate the relative importance of these factors, I test the information-based hypothesis depicted in Figure 1, but I add an additional variable to control for the influence of political predispositions. This updated information-based model is pictured schematically in Figure 2. If factual information drives the way that people think about scientific issues like climate change, as the "gateway beliefs" model

predicts, measures of respondent knowledge will have a discernible impact on beliefs about CC's existence and severity—and in turn, these beliefs will be associated with greater support for mitigation policies. While I do expect this to be the case, I also expect to see some evidence of the “solution aversion” model. That is, I expect political predispositions to have a greater influence on people's support for mitigation policies than on their beliefs about CC's existence and severity.

[Figure 2 about here.]

This analysis proceeds in three stages in order to test the hypothesized directional relationship between opinions about climate change's existence, severity, and related policies. First, I examine how factual beliefs (or knowledge) are associated with respondents' certainty that CC exists. I regress certainty about CC's existence on measures of general scientific knowledge and domain-specific knowledge about climate change (i.e., beliefs about the scientific evidence for GW and its anthropogenic causes) to evaluate the relative importance of these different “types” of information. To assess how important political predispositions are for the basic question of existence, I also construct a measure of policy liberalism. This also provides a point of comparison to evaluate the role of predispositions in the subsequent analyses.

The second part of the analysis builds on the first, but shifts focus from beliefs about the existence of CC to beliefs about how bad it will be. I test the second step of the process depicted in Figure 2, where people who believe that climate change exists are more likely to become concerned about it. It seems intuitive that individuals with more factual knowledge will be more likely to accept scientific information about CC's existence and negative consequences, thus

making the issue more salient and concerning. But this crucial link between “believing in” and being concerned about has not been established empirically.

Third, I build on the preceding two analyses to test if those who believe climate change is real and concerning also support CC mitigation policies.²¹ The dependent variables are measures of support for three emissions reduction policies: (1) higher restrictions on power plant emissions, (2) better fuel economy standards for new cars, and (3) higher taxes on gasoline. The analysis tests the extent to which “factual beliefs” about CC’s existence and severity, as well as policy liberalism, predict support for these policies. Since political discourses about climate change often frame mitigation policies as highly regulatory and bad for economic growth, I expect policy liberalism to be more strongly associated with policy opinions than with beliefs about CC’s existence and severity. I also expect greater conservatism to predict greater opposition to the policies, even when controlling for prior scientific knowledge and factual beliefs about climate change.

Analysis Part 1: Beliefs about the existence of climate change

All data were collected as part of the 2008-09 American National Election Study (NES).²²

Measures. The dependent variable combines two items that asked respondents if they believe that the world’s temperature has been increasing gradually over the past century and how

21. Here, “climate-related policies” are government actions aiming to reduce the volume of greenhouse gas emissions that contribute to climate change.

22. The data were collected over the internet in 20 cross-sectional “waves” between January 2008 and August 2009.

certain they are about this belief (see Table 1).²³ Although the popular press emphasizes Americans' lack of knowledge about climate change, a large majority of the NES sample (86%) said that temperatures probably have risen, and only 14% said that they probably have not. While the majority both of these groups were "somewhat," "very," or "extremely" certain of their beliefs, a higher proportion of the "skeptical" group was very uncertain: 79% of "believers" and 72% of the "skeptics" were at least somewhat certain, while 10% of "believers" and 18% of "skeptics" were "not sure at all" about warming.

[Table 1: Certainty of beliefs about the existence of global warming here]

Two measures gauge the influence of "domain-specific" beliefs and information on the dependent variable. One asked about the scientific consensus on GW: respondents indicated how much they agree that "There is not enough scientific evidence to support claims that the Earth is getting warmer."²⁴ The second measure asked about the anthropogenic causes of GW. Respondents indicated if the following statement is true or false: "The primary human activity that causes global warming is the burning of fossil fuels such as coal and oil." 57% answered "True," in line with the scientific consensus on the human causes of warming. The association

²³ The combined measure ranges from -4 (those who are "extremely sure" that world temperatures have not risen) to 4 (extreme certainty that temperatures have risen), $M = 1.75$, $SD = 1.96$. Since respondents did not have a neutral or "don't know" option, the 0 position represents all respondents who said they were "not sure at all" about whether temperatures are (or aren't) rising.

²⁴ This variable was reverse-coded and ranges from -5 (skepticism about scientific evidence) to 5 (disagreement with the skeptical statement), $M = 1.06$, $SD = 3.52$.

between beliefs about GW's causes and existence are featured in Table 2.²⁵ Among respondents who had said warming is probably happening, 62% answered "true," while this figure was 27% for those who said that warming probably is not happening. Among the "believers," those who were more certain GW is happening were more likely to say it has anthropogenic causes than those who were only slightly or not at all certain. Within the smaller "skeptical" group, certainty does not appear to be closely related to beliefs about anthropogenic causes of global warming.

[Here: *Table 2: Correct answers on anthropogenic causes item*]

In addition to these variables specifically about CC, I examine the influence of broader scientific knowledge on beliefs about GW's existence. This variable comprises a scale of respondents' scores (the percent of correct answers) on 11 true-or-false questions about basic scientific constructs that "form the intellectual foundation for reading and understanding contemporary scientific issues," such as items about the atomic structure of DNA (Miller 2010).²⁶ The last measure associated with knowledge or information is educational attainment.²⁷

To evaluate how people bring their broader political preferences or values to bear on issues related to climate change, I created a measure of policy liberalism.²⁸ I used principal components analysis (PCA) to assess if a common latent dimension underlies support for government action on five contentious socio-political issues (i.e., they tend to divide self-

25. Clearly, one must believe that climate change exists in order to attribute it to any cause, anthropogenic or not. Still, I include this variable to disentangle the relative importance of people's domain-specific beliefs about CC and more general scientific knowledge.

26. The original science quiz contained 14 questions, and I removed three because they pertained specifically to climate change. See the appendix for a full list of questions and percentages of respondents answering each item correctly.

27. The education variable includes five categories: (1) Less than a high school degree; (2) a high school diploma; (3) some college, but no Bachelor's degree; (4) a Bachelor's degree; and (5) a graduate degree.

identified liberals and conservatives) unrelated to climate change, energy, or the environment.²⁹

The first component conformed closely to expectations for attitudes that liberals and conservatives would express on these issues in 2008, suggesting that it is suitable as an index of general ideological liberalism.³⁰ The items included in the PCA were chosen on the basis that they evoke broader socio-cultural values on a range of political issues (e.g., related to the meaning of citizenship and the function of government). It is possible, of course, that these scores simply reflect respondents' attention to elite positions rather than their pre-existing values; but even people who do not follow political discourses probably hold opinions about these issues that are rooted in personal values acquired through family, religious, or social groups.

Lastly, I control for partisan identification with four dummy variables.³¹ Since mass partisan polarization tends to trace elite polarization (Zaller 1992; Hetherington 2001), comparing the effects of policy liberalism and partisanship will yield insight into the relative importance of predispositions, as opposed to elite discourses, on beliefs about climate change.

²⁸ I prefer not to use available measures of political ideology (i.e., respondents' self-placement on a uni-dimensional, liberal-conservative scale) because they are highly correlated with partisanship, making it difficult to distinguish these variables' influences.

29. Respondents were asked whether they favor or oppose government action on: (1) a constitutional amendment to ban gay marriages; (2) raising taxes on incomes over \$200,000 per year; (3) government payment for all health care; (4) suspending habeas corpus for terror suspects; and (5) granting citizenship to illegal immigrants. Respondents were then asked how strongly they hold their position ("a great deal," "moderately," "a little"). All items were coded on a seven-point scale ranging from -3 (the most conservative position) to 3 (the most liberal position). The 0 position represents respondents who said that they "neither favor nor oppose" a given proposition.

30. The component has an eigenvalue of 1.67 and explains 33.35% of the total variance. Despite its poor alpha score ($\alpha=.49$), each of the items comprising the scale had relatively large positive coefficients. (See appendix for component loadings.)

31. (1) Those who identified as "strong" and "not very strong" Democrats, (2) "strong" and "not very strong" Republicans, and partisan "leaners" who identified as (3) independent Democrats and (4) independent Republicans. The reference group for each variable includes all respondents whose partisanship was not covered by that variable.

Analysis and Results. The results of a nested regression analysis are reported in Table 3. The table features two models: (1) a base model examining the direct effects of partisanship and education, and (2) an expanded model including the variables for policy liberalism, scientific knowledge, and the two measures of “factual beliefs” about climate change (i.e., whether humans’ primary contribution to GW comes from using fossil fuels, and whether there is enough scientific evidence to indicate that the Earth is warming).³²

[Table 3: Summary of Nested Regression Analysis for Variables Predicting Belief that World Temperature is Rising here]

The results from Model 1 generally bear out expectations about how partisanship and education are related to people’s beliefs about whether global warming’s existence. But while higher educated significantly predicted certainty that GW is happening, this effect is not particularly large in absolute terms. Each additional level of education is associated with an average increase of .20 points (recall that the outcome variable is measured on a 9-point scale centered at 0), and thus those at the highest level of education typically are only .80 points “more certain” that warming is happening than those who did not finish high school.

Further, Model 1 indicates that partisanship has more substantial effects than education for all groups except independent Republicans. On average, Democrats and independent Democrats were one point (or about 11%) higher their certainty about GW variable than other adults. Unsurprisingly, Republican partisanship was associated with greater conviction that global warming is not happening: these respondents placed on average .79 points lower than

32. For brevity, Table 3 only reports two (the first and last) of the four steps in the nested

others. The coefficients for these groups were all statistically significant. Independent Republicans did not have strong views, but their negative coefficient indicates that they generally did not think temperatures are rising. That the coefficients for Democrats and Democratic “leaners” are larger than Republicans’ indicates that partisanship may have asymmetric effects on beliefs about GW, with Democrats perceiving the issue in more partisan terms than Republicans.

Model 2 introduces the variables for liberalism, scientific knowledge, and factual beliefs about climate change, which drastically attenuate the direct effects of partisanship and education on beliefs about the existence of warming. Nevertheless, it is noteworthy that Democrats were still more certain than other groups that warming exists ($b = .36, p < .05$. The coefficient for independent Democrats was the same, but not significant.) When controlling for the effects of policy liberalism, Republicans no longer express a distinct opinion on GW’s existence. In short, Model 2 demonstrates that when controlling for specific knowledge and political predispositions, partisanship does not play a role for any group other than strong Democrats.

Policy liberalism’s significant and positive coefficient ($b = .25, p < .001$) indicates that people with a generally liberal orientation to socio-political issues are more certain than other adults that GW is happening. This indicates that the partisan polarization evident in public opinion polls does not predominantly reflect the influence of partisan elites. Rather, the same latent dimension that structures people’s ideological stances on political issues also appears to orient beliefs about climate change.

With the more fine-grained measures of knowledge included in the analysis, education no longer has any predictive power, and thus does not tell us much about how factual information or

regression.

“sophistication” influences beliefs about climate change. Scores on the science knowledge scale do a notably better job than any other variable in predicting people’s certainty that temperatures are rising ($b = 1.39, p < .001$). Factual beliefs about CC are also significantly and positively related to certainty GW is happening, though correctly answering the question about anthropogenic causes was more than twice as predictive as people’s beliefs about whether there is “enough scientific evidence” for GW. In light of the large influence of scientific knowledge, this indicates that there may be an important distinction between agreeing with matters of scientific consensus (e.g., that humans’ greatest contribution to warming is from using fossil fuels), and beliefs about whether such a consensus exists. The former can better be characterized as knowledge: those who agree with the scientific consensus on anthropogenic causes have a better understanding of the greenhouse effect. In contrast, believing that there is (or isn’t) enough evidence to warrant a consensus on warming is more likely related to people’s trust in the scientific community.

In sum, this analysis reinforces claims that scientific knowledge, beliefs about climate science, and political predispositions are important for whether people “believe in” climate change. This is not entirely surprising, but these results do challenge pervasive narratives emphasizing correlations between partisanship and climate skepticism. This analysis also coheres with prior research that does not find any connection between education and “believing in” CC. However, in contrast to researchers who conclude that factual knowledge is inconsequential for public beliefs about CC, I find that it is important to differentiate between “types” of factual knowledge. This reveals that objective scientific knowledge is extremely influential. People who believe that there is scientific evidence for warming, Democrats, and liberals also express more certainty that warming is happening, but not to the same extent as

those who understand basic physical and life science constructs that are taught in middle and high school science classes. Thus greater public knowledge about science and climate change may induce a more widespread “belief in” climate change. At the same time, public education initiatives may be ineffective if they overlook the ideological factors that structure people’s stances towards controversial political issues more broadly.

Analysis Part 2: Beliefs about existence and severity of climate change

Extant research is inconclusive on the relationship between beliefs about the existence of CC and perceptions of its consequent risks. On the one hand, van der Linden et al. (2015) found that people who received information about the scientific consensus on CC became more likely to believe that it exists, is anthropogenic, and poses a “worrisome threat.” On the other hand, the relationship between factual beliefs and concern about CC may be reciprocal, rather than unidirectional—other studies have found that people’s evaluations of CC risks are influenced by pre-cognitive affective factors (Leiserowitz 2006), cultural worldviews (Kahan et al. 2011), and political priorities (Zia and Todd 2010). If these factors make the risks associated with CC more salient and accessible, they may also influence people’s willingness to accept that CC is real. In other words, there may be an endogenous relationship between acknowledging the factual existence of CC, and perceiving it as a salient or concerning problem.

Since concern is ultimately important for behavioral or political action, in this section I test the idea that accepting the factual existence of CC is a “gateway” belief that heightens concern about it, or whether a reciprocal relationship better characterizes these stances. As above, I also examine the relative influences of scientific knowledge and policy liberalism.

Measures. The measure for beliefs about GW's existence is the same as that used in the analysis above. The measure for concern asked about perceptions of GW's severity: "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?"³³ Responses clustered around the categories expressing relative indifference (34% said GW will be "good" or "neither good nor bad") and great concern (38% said it will be "extremely bad").

As expected, there is a positive correlation between beliefs about the existence of CC and perceptions of its risks: those who thought that GW will be more severe tended to be more certain about its existence (Table 4).³⁴ Among those who were "extremely sure" GW is occurring, 85% thought it would be extremely bad (and only 6% said that it would be "neither good nor bad"). Conversely, of those who were "not sure at all" if warming is happening 65% said it will be "good" or "neither good nor bad," and only 8% thought it would be extremely bad. Of the very small group who were "extremely sure" global warming is not happening, nearly all (32 of 33 respondents) said it would be good or neither good nor bad.

[Insert Table 4 here.]

Because there may be simultaneous or reverse causation between the Existence and Severity variables, I use instrumental variables estimation and structure the analysis as a system

33. I coded this variable to range from 0 to 3, with 0 combining the small number of people who said GW would be good ($n = 31$) and those who said it would be "neither good nor bad" ($n = 459$). The remaining categories represent beliefs that global warming will be slightly (1), moderately (2), or extremely (3) bad.

of two equations with two endogenous dependent variables. The first equation posits the Existence measure as a dependent variable and thus is nearly identical to the analysis reported above in Model 2, Table 3—but with the addition of the Severity measure as a predictor. Conversely, the second equation regresses perceptions of severity on beliefs about rising temperatures.

Each equation includes two instrumental variables that are assumed to directly influence its endogenous regressor. In the first equation, these are the “Anthropogenic causes” and “Not enough evidence” variables described above. Since these items asked about the causes of and evidence for GW, I assume that they directly predict respondents’ beliefs about GW’s existence. But since these items do not invoke the consequences of GW, I assume that they are not directly related to perceptions of GW’s severity.

Conversely, the instruments for the Severity measure should affect how bad respondents think GW will be, but should not directly impact beliefs about its existence. One instrument evoked the environmental consequences of using fossil fuels. Respondents rated their agreement with the statement: “If the present state of coal and oil use continues, serious long-term environmental damage will occur.”³⁵ Since most respondents presumably do not favor “serious long-term environmental damage,” those who think this is a likely consequence of GW will have a heightened perception of its severity.³⁶ The other instrument measures skepticism about GW’s severity. Participants rated their agreement with the statement: “The dangers of global warming

34. The relationship between the two variables is statistically significant ($p < 0.01$ ((24) = 579.20)).

35. Responses were recorded on an 11-point scale. I coded responses to range from -5 (completely disagree) to 5 (completely agree).

36. This item does not mention climate change explicitly, but alludes to it indirectly by mentioning coal and oil. Thus, it may conflate people who are worried about climate change and

are being over emphasized for political reasons.”³⁷ I assume that there is a direct relationship between responses to this item and evaluations about how bad GW will be: if respondents think that the dangers of GW are overblown, they also should not think of it as a severe threat.³⁸

Results. Table 5 displays the results of the instrumental variables regression. The instrumental variables are italicized and listed directly below the regressors they are hypothesized to predict.

[Insert Table 5 here]

The results indicate that there is a reciprocal relationship between the Existence and Severity measures—most strikingly, perceptions of severity had a substantially greater influence on beliefs about existence than vice versa. As compared to the analysis in Part 1 above, including the Severity measure in the first equation also reduced the effects of scientific knowledge and policy liberalism on beliefs about GW’s existence. Though scientific knowledge still had a

people who are worried about the other types of environmental damage from extractive processes like mountaintop removal or offshore drilling.

³⁷ Responses were recorded on an 11-point scale and reverse-coded to range from -5 (strongly agree that the dangers are politicized) to 5 (strongly disagree that dangers are politicized). The item’s negative wording was probably intended to identify people who did not read questions closely. Unfortunately, this phrasing and the statement’s passive voice probably confused some respondents.

³⁸ Using the data at hand, I have tried to specify the model using instrumental variables that are logical antecedents of their instrumented regressors, and that do not directly influence the primary relationship under consideration (i.e., the relationship between recognizing that a phenomenon is occurring, and making judgments about how problematic it is). However, it should be disclaimed that it is particularly challenging to define valid exclusion restrictions when modeling the reasoning processes related to climate change. The evolving social, political, and cultural factors surrounding discourses about CC have created conditions in which public debates over its existence, causes, and consequences are enmeshed. Thus, in reality, there is probably a degree of endogeneity between all of the instruments and regressors included in this system. As CC has cycled in and out of the public arena over the past two decades, some citizens have probably developed general attitudes of skepticism or concern that bind together opinions about more specific aspects of the issue.

substantial effect on beliefs about GW's existence, interestingly, it was not associated with judgments about how bad GW will be. In fact, none of the exogenous independent variables were meaningfully related to judgments about GW's severity.³⁹

On the one hand, these results provide evidence for information-based cognitive models. People with more scientific knowledge were also significantly more certain that GW is happening, and in turn, thought that GW will be more severe. Since scientific knowledge predicts how people think about the factual reality of GW—but not how they make judgments about its consequences—believing in GW's existence is plausibly a “gateway belief” that mediates the relationship between scientific knowledge and concern about GW.

At the same time, while the model does not tell us what causes concern about climate change, it is clear that how people think about its severity has a large, independent effect on they believe the problem exists. Since judgments about severity are not predicted by scientific knowledge, they may be more closely related to people's affective or intuitive associations with climate change. Leiserowitz's research (2006) found that although most Americans do not perceive GW as a big local or personal concern, the mental images associated with their risk perceptions (e.g., melting polar ice) carry a positive or negative emotional valence. Further, despite the highly politicized media discourses surrounding the issue, political liberalism and partisanship did not bear directly on perceptions of CC's severity. Thus, when people considered how bad GW will be, it does not seem that they deferred instinctively to the positions of political

39. This model's fit is not quite as good as that of the first analysis. The instrumental variables also perform more poorly than expected, and likely introduce inefficiencies into the model. Though the instruments were chosen on the logical grounds explained above and within the ramifications of a pre-existing dataset, this analysis indicates that further research needs to consider what other, unobserved factors might be affecting the primary relationship. For instance, a person's attitudes towards fossil fuel companies (e.g., as polluters or as job creators) may influence both their beliefs about whether GW is real and how bad it would be.

elites, or that they were guided by ideological predispositions. Perceptions about GW's severity might be driven, rather, by other emotional or ideological factors related to concerns about the environment, future generations, or personal property.

These possibilities indicate that there may not be one "issue public" that is particularly invested in mitigating climate change. Rather, within the broad issue area of climate change, there may be different types of "issue publics" that care about different aspects of the problem: people who are concerned about the longer-term consequences of CC have different priorities than people who are more focused on the short-term effects of climate policies. The former might advocate for CC mitigation because they are concerned about issues of environmental justice or degradation. The latter may oppose mitigation out of concern about, for example, policies' effects on domestic jobs or perceived unfairness in the allocation of costs between developed and developing countries. In the final stage of analysis below, I explore this idea by testing the full model depicted in Figure 2. This allows me to compare how opinions about emissions policies are informed by beliefs about CC (its existence and severity), on the one hand, and the predispositions represented by policy liberalism, on the other hand.

Analysis Part 3: Belief that world temperature is rising, concern, and policy support

To test the full model depicted in Figure 2, I conducted a series of OLS regressions predicting support for three climate change mitigation policies, as well as a series of similar analyses using structural equation modeling (SEM). Using SEM provides a check on the OLS results, and more importantly, the SEM approach yields estimates for direct and indirect relationships between variables. Thus it is ideal for testing the extent to which the data bear out the hypothesized multi-step model.

Measures. All independent variables were described in the analyses above. The dependent variables measured support for three “ways that the federal government might try to reduce future global warming”: (1) imposing more stringent restrictions on GHG emissions from power plants; (2) requiring better fuel economy in new cars; and (3) increasing taxes on gasoline.⁴⁰ Table 6 indicates that the majority of the sample supported the policies impacting power plants (75%) and automakers and (88%). Conversely, most respondents (66%) opposed the gas tax, and only 20% supported it.

[Insert Table 6 here.]

Most striking about these figures is people’s staunch and overwhelming opposition to the gas tax, which was the only policy that imposes an obvious personal cost. This coheres with prior research finding chronically low public support for emissions policies that require increased gas or electricity taxes (Krosnick and MacInnis 2013). Thus, while the majority of respondents thought that GW is happening and that it will probably be bad, most people also were not willing to pay for mitigation personally. If a policy invokes clear personal costs, it seems unlikely that it will receive support unless a portion of the public is extremely dedicated to solving the related problem.

In contrast, the broad appeal of the fuel economy policy indicates that fuel-efficient cars are inherently unobjectionable. This policy does not impose any explicit financial or behavioral costs, and consumers may even anticipate savings from more efficient vehicles. Restrictions on power plant emissions were also widely popular, though not quite to the extent of the fuel economy policy. It may be that some respondents associate the proposed increase in regulations with social costs like job losses, personal costs such as higher electricity bills, or symbolic costs

⁴⁰ Responses are coded to range from -3 (“Oppose a great deal”) to 3 (“Favor a great deal”).

related to perceptions of “big government.” Regarding the latter, the power plant restrictions are related (albeit not explicitly) to politically contentious “cap-and-trade” policies: since controversy over cap-and-trade was intensifying in early 2008 when these survey items were in the field, and “denialist” frames were becoming increasingly common in the media (Gillis 2010; Skocpol 2013), many citizens had probably been exposed to the partisan and ideological dimensions of the issue.

Analysis and Results. Table 7 presents the results from three OLS regressions predicting support for the three emissions policies (which, recall, are scored on a 7-point scale).

[Insert Table 7 about here.]

The OLS results indicate that respondents thought somewhat differently about the two regulatory policies as opposed to the gas tax. In particular, there might be an important distinction to draw between predictors representing “factual beliefs” specifically about climate change, and broader, abstract scientific knowledge. Respondents who believed GW exists were slightly more likely to support the regulatory policies (for reducing power plant emissions and increasing fuel economy, $b = .10, p < .001$) but not the gas tax. Respondents who believed GW will be more severe were more likely to support all three policies, particularly the one reducing power plant emissions ($b = .37, p < .001$).

Interestingly, respondents with more scientific knowledge strongly supported the gas tax ($b = 1.35, p < .001$) but did not have strong opinions about the regulatory policies. Similarly, education predicted opinions about the gas tax ($b = .39, p < .001$) but not about regulating power plants and fuel economy standards.

Policy liberalism was significantly associated with support for all three policies, and with effects of similar magnitude. Thus people's opinions about emissions policies seem to be influenced by the same values that shape their stances on socio-political issues unrelated to energy and the environment. Taken together with the foregoing, these results paint a somewhat unexpected picture of the relationship between people's beliefs about climate change and their opinions about emissions policies. Opinions are shaped by people's predispositions towards more (or less) liberal political values—but “factual beliefs” about CC's existence and severity also influenced support for emissions regulations on power plants and carmakers. This may indicate that a modified “gateway beliefs” model is warranted, in which accurate beliefs about CC serve as a gateway to concern and policy support, but in which exogenous, predispositional factors also play a role. By comparison, when respondents considered increased gas taxes, their beliefs about CC were not very important; only those with a broader scientific background, the highly educated, and more liberal respondents expressed policy support. These results highlight the possibility that there is a real distinction between “factual beliefs” and objective factual knowledge, and that these variables might have independent effects on how people think about technical problems and proposed solutions. To clarify the extent to which scientific knowledge informs beliefs about scientific issues—and ultimately, policy support, I conducted SEM analyses to supplement and illuminate the results of the OLS analyses.

SEM specification and assessment. As in the OLS analyses (Table 7) I estimate three models, each predicting support for one of the three emissions policies. The Existence, Severity, and policy variables are all modeled as endogenous, dependent variables—thus I use the same instruments for Existence and Severity as above (in Part 2, Table 5) in the present models.

Analysis and Results. Table 8 displays unstandardized estimates from the three SEM analyses, and reports path coefficients for indirect and total effects. (I do not include estimates for direct effects here because they are already contained in the OLS results reported above.) The two leftmost columns report estimates from the first and second steps of the analysis: the first predicts beliefs about GW’s existence, and the second predicts beliefs about how bad it will be. The results in these columns are constant across all three models, thus I only report them once.⁴¹

[Insert *Table 8* here.]

Overall, the SEM results cohere with those of the OLS analyses (Table 5) while providing additional insight into the relationships between the endogenous dependent variables. Taken together with the foregoing analyses these results provide mixed support for a “gateway beliefs” model in which foundational beliefs guide the ways that people define problems and assess potential solutions. Models 1 and 2 (predicting support for the power plant and automobile policies, respectively) provide evidence for this type of process. Scientific knowledge did not affect support for these policies directly. But when it is mediated by the beliefs that GW exists and that it will have bad consequences, it has moderate, significant indirect effects on support for restricting power plant emissions ($b = .49, p < .001$) and improving fuel economy ($b = .39, p < .001$).

In contrast, in scientific knowledge has a very large and direct effect on support for increasing gas taxes (Model 3, $b = 1.81, p < .001$) while “factual beliefs” about CC’s existence

41. Modification indices for each of the models suggest several alterations that would improve the fit of the models with the data. However, I limit the present discussion to the hypothesized

and severity are not particularly important.⁴² It is not entirely obvious why people with more scientific knowledge are more willing to pay for CC mitigation. When asked to think about increased taxes in relation to CC mitigation, these individuals might readily access the connections between the policy's cost and the effectiveness of the policy solution (i.e., limiting driving would limit tailpipe emissions, and therefore greenhouse gases, and therefore climate change). In contrast, people who do not have a strong science background, but who nevertheless believe climate change is real and severe, are not more likely to support the gas tax. Thus, for many people, Policies with overt personal costs seem to evoke affective, aversive judgments that are relatively unrelated to their opinions on problems these policies aim to solve.

Two additional findings are noteworthy. First, the results of Models 1 and 2 indicate that people's beliefs about the severity of GW are not necessarily contingent on the certainty with which they believe GW exists, indicating that these "factual beliefs" about CC might have independent sources and influences on policy opinions. There is, of course, no question that one must believe GW is happening to be concerned about its consequences. But the results indicate that people do not necessarily form these beliefs sequentially. When people's beliefs about GW's existence were mediated through perceptions of its severity, they had only small indirect effects on opinions about power plant regulations ($b = .06, p < .001$) and fuel economy standards ($b = .03, p < .001$). The overall effects of the Existence and Severity variables appear to be relatively distinct. Further, support for all three policies was more strongly associated with respondents' perceptions of Severity than with their certainty that GW is happening. Taken together, these results indicate that people form opinions about GW's severity even if they haven't first taken a

model, and consider why future analyses might benefit from adding some of the suggested constraints.

definitive stance on its causes and existence. When people are asked if GW would be bad, and to what extent, they may call to mind extreme or popularized predictive scenarios about the consequences of CC, regardless of whether they have thought much about its existence.

Second, the liberalism scale moderately affected support for all of policies, and there was some variation in the magnitude of effects: for the emissions policy, $b = .41$ ($p < .001$); for the fuel economy policy, $b = .27$ ($p < .001$), and for an increased gas tax, $b = .34$ ($p < .001$). (As in the analyses above, partisanship was not meaningfully associated with policy support.) These effects represent (almost entirely) the direct influence of the liberalism variable, which supports the hypothesis that political predispositions are directly associated with perceptions of CC mitigation policies. But these results do not unequivocally support my hypothesis that predispositions are more important for policy opinions than for the “factual beliefs” about climate change—this was generally true, but there was not a big difference the magnitude of the effects of liberalism on “believing in” CC, and supporting the fuel economy policy.

Conclusion

(This section is very much still under construction; workshop help is most appreciated here!)

These empirical findings point to several broad conclusions about the ways that the American public thinks about the issue of climate change. First, although many citizens believe that CC is happening and that it will be bad, these beliefs inform policy opinions in heterogeneous ways; when policies impose direct personal costs, beliefs about climate change are not important in and of themselves; rather, having a broader base of scientific knowledge is

42. To ensure that income does not confound the effects of scientific knowledge, I examined the

really important. This poses a particularly big challenge to those invested in climate communication: to have a meaningful effect on personal behavior or policy support, communication initiatives do not need to focus on convincing people that climate change exists. The biggest change would probably come from broader, comprehensive civic scientific education, which it is outside the purview of environmental organizations to provide.

On other types of policies, there is evidence of a “gateway beliefs” process, leading from scientific knowledge, to beliefs about climate change’s existence, to judgments about its severity and opinions about emissions regulations. However, believing GW is occurring doesn’t have a particularly big effect on being concerned about it; in fact, there is an endogenous relationship between these two measures, and concern had independent effects on these policies. This indicates that it’s important to establish the antecedents of concern about climate change.

Predispositions, as measured by policy liberalism, also had at least a moderate independent influence on support for all three policies. The effect was most pronounced on the policy that would regulate power plant emissions. Because this policy is the most substantially related to political debates and discourses that evoke value-laden symbolism, it is important for climate communicators to consider these factors in their rhetorical approaches.

correlation between these two variables and found it to be relatively small ($r = .24$).

Figures

Figure 1: Information-based model of policy support

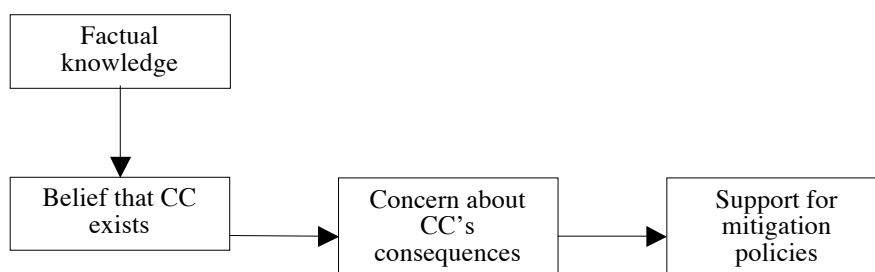
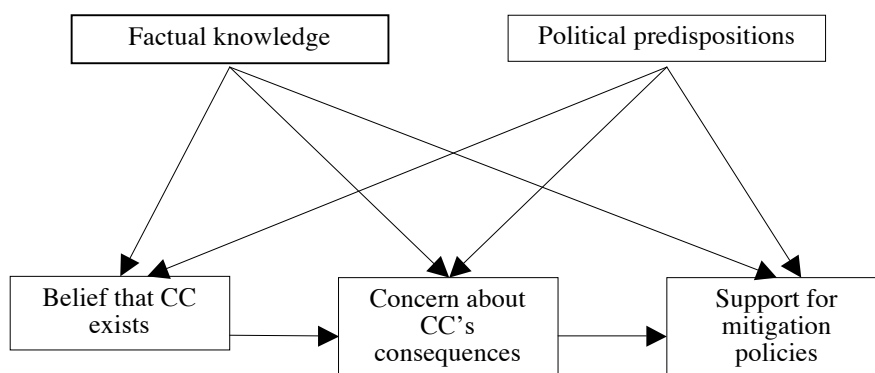


Figure 2: Updated information-based model of policy support



Tables

Table 1: Certainty of beliefs about the existence of global warming

	Extremely	Very	<u>Certainty^b</u> Somewhat	Slightly	Not at all
<u>Existence of GW^a</u>					
Probably happening (N = 1,244)	250	346	382	146	120
% within row	20.10	27.81	30.71	11.74	9.65
Probably not happening (N = 203)	33	40	73	20	37
% within row	16.26	19.70	35.96	9.85	18.23

^a“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 has probably been happening, or do you think it probably hasn’t been happening?”

^b“How sure are you that the world’s temperature has/hasn’t been going up?”

Table 2: Correct answers on anthropogenic causes item^a

	Certainty about GW existence ^b					Total
	Extremely	Very	Somewhat	Slightly	Not at all	
<u>GW is happening</u> (freq.)	187	254	291	113	93	938
% Correct (w/in row)	25.56	31.90	28.64	7.72	6.17	100%
% Incorrect (w/in row)	10.70	19.15	34.93	19.15	16.06	100%
<u>GW not happening</u> (freq.)	27	33	62	15	27	164
% Correct (w/in row)	13.64	15.91	45.45	6.82	18.18	100%
% Incorrect (w/in row)	17.50	21.67	35.00	10.00	15.83	100%

^a True or false: “The primary human activity that causes global warming is the burning of fossil fuels such as coal and oil.” (May 2008)

^b “How sure are you that the world’s temperature has/hasn’t been going up?” (Feb 2008)

Table 3: Summary of Nested Regression Analysis for Variables Predicting Belief that World Temperature is Rising

	Model 1		Model 2	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Democrat	.97***	(.21)	.36*	(.19)
Ind Democrat	1.02***	(.27)	.36	(.23)
Republican	-.79***	(.21)	-.09	(.19)
Ind Republican	-.12	(.27)	.24	(.23)
Education	.20**	(.06)	.004	(.06)
Liberalism Scale			.25***	(.05)
Science knowledge			1.39***	(.33)
Anthropogenic Causes			.49***	(.13)
Not enough evidence			.21***	(.02)
Constant	.97***	(.27)	.38	(.25)
<i>N</i>	848		848	
<i>R</i> ²	.16		.39	
<i>F</i>	31.94***		59.76***	
<i>F</i> for change in <i>R</i> ²			82.23***	

Table 4. Certainty about existence of GW by perception of its severity

<u>GW Existence</u>		<u>GW Severity</u> ^{a, b}			<u>Total</u>	
		<u>Good/ Neither</u>	<u>Slightly bad</u>	<u>Moderately bad</u>		<u>Extremely bad</u>
<u>Not happening</u>						
Extremely sure	N	32	0	1	0	33
	% w/in row	96.97	0.00	3.03	0.00	100.00
Very sure	N	29	2	5	4	40
	% w/in row	72.50	5.00	12.50	10.00	100.00
Somewhat sure	N	45	4	16	8	73
	% w/in row	61.64	5.48	21.92	10.96	100.00
Slightly sure	N	11	3	6	0	20
	% w/in row	55.00	15.00	30.00	0.00	100.00
Not sure at all	N	102	13	29	13	157
	% w/in row	64.97	8.28	18.47	8.28	100.00
<u>Is happening</u>						
Slightly sure	N	70	18	39	19	146
	% w/in row	47.95	12.33	26.71	13.01	100.00
Somewhat sure	N	124	16	128	114	382
	% w/in row	32.46	4.19	33.51	29.84	100.00
Very sure	N	59	9	91	184	343
	% w/in row	17.20	2.62	26.53	53.64	100.00
Extremely sure	N	16	4	18	211	249
	% w/in row	6.43	1.61	7.23	84.74	100.00
Total	N	488	69	333	553	1,443
	% w/in row	33.82	4.78	23.08	38.32	100.00

Pearson $\chi^2(24) = 579.20$ Pr = 0.00, Cramér's V = 0.37, gamma = 0.63 ASE = 0.02, Kendall's tau-b = 0.49 ASE = 0.01

^a“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?”

^b“Would you say it would be extremely, moderately, or slightly [good/bad?]”

Table 5: Summary of 2SLS regression for beliefs about existence and severity of global warming

	GW Existence		GW Severity	
	B	SE	B	SE
<u>GW Existence</u>			0.44*** (0.11)	
<i>Anthropogenic Causes</i>	0.04	(0.17)		
<i>Not Enough Evidence</i>	0.09**	(0.03)		
<u>GW Severity</u>	1.01*** (0.21)			
<i>Environmental Damage</i>			0.03	(0.02)
<i>Politicization</i>			0.06**	(0.02)
Democrat	0.16	(0.21)	0.01	(0.14)
Ind Democrat	0.11	(0.26)	0.03	(0.17)
Republican	-0.14	(0.21)	0.08	(0.14)
Ind Republican	0.24	(0.26)	-0.08	(0.17)
Education	-0.08	(0.07)	0.07	(0.04)
Liberalism Scale	0.12*	(0.06)	-0.04	(0.04)
Science Knowledge	0.88*	(0.38)	0.04	(0.31)
Constant	-0.28	(0.31)	0.53**	(0.19)
<i>N</i>	779		757	
<i>R</i> ²	0.34		0.29	

Standard errors in parentheses, *** p<0.01, ** p<0.05, *p<0.1

Table 6: Distribution of support for emissions policies

	Power plant emissions ^a		Fuel economy ^b		Gas tax ^c	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
Oppose	135	9.33	66	4.55	944	65.2
Neither favor nor oppose	229	15.83	115	7.94	214	14.78
Favor	1,083	74.84	1,267	87.5	290	20.03
Total	1,447	100	1,448	100	1,448	100

^a “Power plants put gases into the air that could cause global warming. Do you favor, oppose, or neither favor nor oppose the federal government lowering the amount of these gases that power plants are allowed to put into the air?”

^b “Do you favor, oppose, or neither favor nor oppose the federal government requiring automakers to build cars that use less gasoline?”

^c “Do you favor, oppose, or neither favor nor oppose increasing taxes on gasoline so people either drive less or buy cars that use less gas?”

Table 7: Summary of OLS Regression Analyses for Global Warming Mitigation Policies

	<u>Cap power plant emissions</u>		<u>Improve fuel economy</u>		<u>Raise gas tax</u>	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
GW existence	.10***	.03	.10***	.02	.05	.04
GW severity	.37***	.04	.19***	.04	.15**	.06
Democrat	.12	.16	.14	.13	.24	.20
Ind Democrat	.15	.19	.15	.16	-.01	.25
Republican	.07	.16	-.01	.13	-.21	.21
Ind Republican	.18	.20	.20	.17	-.002	.26
Education	.03	.05	.01	.04	.39***	.06
Liberalism scale	.28***	.04	.25***	.04	.31***	.06
Science knowledge	.25	.26	-.37	.22	1.35***	.35
Constant	.60**	.20	1.92***	.17	-	.26
					3.67***	
R^2	.25		.21		.20	
N	1,066		1,066		1,066	

*p < 0.05, ** p < .01, ***p < .001

Table 8: Unstandardized SEM model parameters

Effects	<u>GW Existence</u>	<u>GW Severity</u>		<u>Model 1: Cap power plant emissions^a</u>		<u>Model 2: Improve fuel economy^b</u>		<u>Model 3: Raise gas tax^c</u>	
	Total	Indirect	Total	Indirect	Total	Indirect	Total	Indirect	Total
<u>GW Existence</u>		--	.15***	.06***	.18***	.03***	.17***	.02***	.06
<i>Anthro causes</i>	.45***	.07**	.07**	.08**	.08**	.08**	.08**	.03	.03
	(.13)	(.02)	(.02)	(.03)	(.03)	(.03)	(.03)	(.02)	(.02)
<i>Not enough evidence</i>	.21***	.03***	.03***	.04***	.04***	.04***	.04***	.01	.01
	(.02)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
<u>GW Severity</u>				--	.38***	--	.22***	--	.16**
					(.05)		(.04)		(.07)
<i>Environmental damage</i>		--	.07***	.03***	.03***	.02***	.02***	.01*	.01*
			(.02)	(.01)	(.01)	(.004)	(.004)	(.01)	(.01)
<i>Politicization</i>		--	.11***	.04***	.04***	.02***	.02***	.02*	.02*
			(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
Dem	.35	.05	.15	.10	.25	.08	.15	.04	.26
	(.20)	(.03)	(.12)	(.06)	(.19)	(.04)	(.16)	(.03)	(.24)
Ind Democrat	.29	.04	.15	.09	.19	.07	.14	.03	-.16
	(.24)	(.04)	(.15)	(.07)	(.23)	(.05)	(.20)	(.03)	(.30)
Rep	-.18	-.03	.02	-.02	.24	-.02	-.11	-.004	-.34
	(.20)	(.03)	(.13)	(.06)	(.19)	(.04)	(.16)	(.02)	(.25)
Ind Republican	.16	.02	.04	.03	.33	.03	.09	.01	.09
	(.24)	(.04)	(.15)	(.07)	(.24)	(.05)	(.20)	(.03)	(.30)
Liberalism	.23***	.03***	.04	.04**	.41***	.04**	.27***	.01	.34***
	(.05)	(.01)	(.04)	(.02)	(.05)	(.01)	(.04)	(.01)	(.07)
Scale	-.004	-.001	.08*	.03	.03	.02	.03	.01	.46***
	(.06)	(.01)	(.04)	(.02)	(.06)	(.01)	(.05)	(.01)	(.08)
Science knowledge	1.55***	.23***	.81***	.49***	.59	.39***	-.0007	.18*	1.81***
	(.34)	(.06)	(.21)	(.11)	(.32)	(.09)	(.27)	(.08)	(.01)
<i>N</i>				779		779		779	
$\chi^2(8)$				78.45***		90.76***		70.98***	
RMSEA				.11		.12		.10	
CFI				.94		.93		.94	

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Appendix

Science Literacy Quiz: Scores on these items comprise the Science Literacy Score used in analysis above.

For each statement, please indicate if you think that it is true or false. If you don't know or aren't sure, just check the "not sure" box.		% Correct	N
1	Nuclear power plants destroy the ozone layer. (False)	48	1150
2	The earliest humans lived at the same time as the dinosaurs. (False)	53	1148
3	The continents on which we live have been moving their location for millions of years and will continue to move in the future. (True)	75	1146
4	Human beings, as we know them today, developed from earlier species of animals. (True)	39	1147
5	More than half of human genes are identical to those of mice. (True)	32	1148
6	Antibiotics kill viruses as well as bacteria. (False)	67	1142
7	Ordinary tomatoes, the ones we normally eat, do not have genes, whereas genetically modified tomatoes do. (False)	57	1138
8	Lasers work by focusing sound waves. (False)	53	1140
9	Electrons are smaller than atoms. (True)	59	1149
10	The universe began with a huge explosion. (True)	32	1146
11	All plants and animals have DNA. (True)	85	1149

Component loadings on Liberalism scale

	<u>Component 1</u>
Gay marriage	0.39
Taxes on 200k	0.52
Health care	0.52
Habeas for suspects	0.40
Citizenship	0.39
Eigenvalue = 1.67, Proportion of variance explained = 33.35%	
Overall KMO = 0.62	

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