

To: Communicating Uncertainty Research Group
From: Dustin Tingley and Michael Tomz
Subject: The Political Consequences of Communicating Uncertainty
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1. Introduction

Climate change is becoming an important political issue in the United States and other countries. Political discourse about climate change has focused on four issues:

1. Whether global warming is happening,
2. Whether humans are contributing to global warming,
3. Whether global warming would be harmful, and
4. Whether stiffer regulations could solve the problem.

We are investigating how politicians talk about global warming, and how voters respond when politicians express certainty—or uncertainty—about each dimension of the debate.

In this memo we briefly analyze the climate rhetoric of members of the U.S. Congress. We then present detailed findings from three experiments that we embedded in public opinion surveys. In each experiment we asked respondents to evaluate politicians who expressed opinions about global warming. We randomly varied which side the politicians took, and whether they confessed uncertainty about their opinions. These experiments help reveal the political consequences of communicating uncertainty.

There are several reasons why voters might dislike politicians who express uncertainty. Perhaps voters perceive uncertain politicians as weak and ineffective. Indeed, experts in the field of leadership routinely assert that confident leaders command more support and respect than unconfident ones. New research in psychology adds that people who exude confidence are rated as more likeable than people who hedge (Tormala et al. working). Finally, to the extent that voters are risk-averse or have a psychological need for closure, they might prefer politicians who state their positions confidently, instead of leaving room for doubt.

At the same time, there are good reasons why voters might tolerate—or even appreciate—politicians who admit uncertainty. Perhaps voters feel uncertain about complex issues such as global warming, and find it refreshing if not appealing to encounter like-minded politicians. Moreover, voters might perceive politicians who concede uncertainty as more honest, knowledgeable, and open-minded than politicians who profess to be certain. Thus, *ex ante*, it is not clear how democratic audiences would respond to politicians who confess uncertainty.

Our experiments shed light on this important question. We find that politicians would not suffer, and may actually improve their electoral appeal, by confessing uncertainty about global warming. This research has important implications for understanding representation and the role of science in policy debates.

2. How do politicians talk about global warming?

In this section we briefly analyze how members of Congress talk about global warming. Our preliminary analysis focuses on three sources of data: (1) an inventory of quotes that were compiled by a climate advocacy group; (2) a sample of Congressional press releases that mention global warming or climate change; and (3) the universe of Congressional tweets that contained climate-related language.

We find that politicians talk about all four issues in the introduction to this memo: they contest whether global warming is happening, whether humans are responsible, whether warming would be harmful, and what kinds of policy interventions could make a difference. Moreover, politicians not only take sides on these issues, but they also express varying degrees of certainty. Our analysis not only reveals the variety of positions in contemporary American debate, but also provides inspiration for our survey experiments.

Investigating this data prior to our experiments is important for several reasons. First, it helps us get a sense of what topics politicians discuss in the real world, and the distribution of these topics across a broad discourse about climate change issues. Is it the case that politicians spend most of their time discussing the economic consequences of policy interventions? Or, for example, do politicians focus any energy on debating questions about whether global warming is happening or whether humans are causing it? Second, when they talk about these topics, are politicians using language that makes them appear more or less certain?¹

Our first dataset comes from thinkprogress.org, an environmental advocacy group. The organization collected statements by 163 members of the 112th Congress (House and Senate) who had denied or questioned climate change. For each legislator in their sample, they collected a quote that epitomized the politician's views about the scientific foundations of climate change.

We classified the quotes according to two criteria: the topics they covered, and the level of certainty they expressed. The vast majority of quotes focused on whether global warming was happening (26%) or whether humans were causing it (34%). An additional 26% pertained to "Climategate," a controversial episode in which skeptics used stolen emails to argue that scientists were exaggerating the case for global warming. The remaining quotes combined several of these topics or raised doubts about the effectiveness of policy interventions.

When legislators discussed the existence and causes of global warming, approximately 42% communicated high levels of certainty. The following quote from Senator Ron Johnson (R-Wisconsin) is fairly typical: "I absolutely do not believe in the science of man-caused climate change. It's not proven by any stretch of the imagination." The remaining 58% acknowledged some uncertainty. Representative Dave Camp (R-Michigan), for example, said "What is the

¹ Compared to analyzing standard experimental data that is used in the majority of this paper, analyzing textual data is more difficult both in terms of methodology but also in providing easily consumable results. Nevertheless, we feel, like others (Jamal et al. 2014) that textual data is a rich supplement to many research designs, and that we should take advantage of methodological advances, as well as new data sources, as part of a larger research program.

science of climate change? What can it definitively tell us? Can it say who is responsible for it? Can it tell us what impact we can have on it, and if we can, what are the results both positive and negative? From what I have read, there remains a great deal of uncertainty with regard to the scientific evidence about climate change.”

While revealing, the quotes from thinkprogress.org were selected—and perhaps even “cherry picked”—to expose the skeptical views of American politicians. For a broader perspective on the views of both liberal and conservative politicians, we also analyzed press releases and tweets, which members of Congress use to communicate with constituents and the mass media.

We collected all Congressional press releases from 2005 to 2010 that contained phrases often associated with climate change. Our key phrases included climate change, global warming, greenhouse gases, carbon dioxide, cap and trade, energy taxes, among many others.² By casting such a wide net, we captured 5,301 press releases pertaining to all aspects of climate change, as well many releases that mentioned climate only in passing. We then used a Structural Topic Model to estimate the topics in these press releases.³ We estimated a 15 topic model, where each topic reflects sets of words that commonly co-occur. An output of this model is the proportion of the total corpus that comes from each topic.

Figure 1 shows the relative frequency of the 15 topics, which we labeled by listing the top three words for each topic. Many of the press releases dealt with the economics of climate change. The most prevalent topic was energy efficiency, and the second most common topic has “tax” and “job” as its prominent words. Nevertheless, legislators devoted considerable attention to existence and causes of climate change. For example, topic 12, which dealt with climate science (summarized by the words climate, global and change) comprised 8% of our corpus, making it the fourth most prevalent in the corpus.

[Figure 1 about here]

The following statement by Nancy Pelosi (D-California) illustrates the kinds of press releases that were associated with topic 12:

The new scientific report on global warming warns that global warming is already affecting the earth and that the effects are likely to be significant and widespread in this century, causing increased drought, drinking water shortages, and widespread extinction of species. Poor people around the world are especially vulnerable to the hazards of climate change. Global warming is already underway, but it is not too late to slow it down and reduce its harmful effects. We must base our actions on the moral imperative

² We thank Justin Grimmer for assistance and data.

³ The structural topic model (Roberts et al. 2014) is an unsupervised topic model that includes document covariates within the estimation. Our model allows each press release to be a mixture of different topics. In the future, we plan to supplement computerized coding with human coding.

and the scientific record, free of political interference in scientists' assessments of the effects of climate change on society and the environment.

Topic 12 also included press releases by Republicans. Some of these characterize climate science as certain,⁴ while others raising doubts about the evidence.⁵ Other pertinent material occurred in topic 9, which was estimated to be 7 percent of the corpus, and dealt with carbon emissions and greenhouse gases.

In summary, our topic model identified hundreds of press releases about the existence and causes of global warming. In the future, we will systematically code these documents, not only to distinguish skeptical from green positions, but also to measure how much confidence politicians attached to their opinions.

In recent years Congresspersons have increasingly turned to social media tools to communicate with their constituents (Barbera et al. 2014). Our next dataset is the universe of all “tweets” sent by members of Congress that contain a keyword related to the topic of global warming from 2009 to January of 2014.⁶ Like our press release data, this lets us see legislators actively engaging with their constituents and the public on climate change issues. In total there were 3827 tweets from Republicans (2126) or Democrats (1701).⁷ We again estimated a Structural Topic Model to understand the topics present in the data. Given that tweets are much

⁴ “Climate change is real, it is happening, and human activities are contributing to it. There is little question that increasing earth surface temperatures and increased carbon dioxide in the atmosphere have real and potential impact on rising sea levels, changes in agricultural patterns, or changes in distribution of disease. Left unchecked, climate change will have profound effects on the security, economy, environment and health in our nation and around the world. Considering the United States contributes 25 percent of the world's greenhouse gas emissions, we can no longer delay in implementing policies to address the effects of carbon dioxide in the atmosphere. We call on the President and on Congressional leaders to face climate change head on and develop concrete solutions.” (Mike Castle (R-DE); Judy Biggert (R-IL-13th); Wayne Gilchrest (R-MD-1st); Christopher Shays (R-CT-4th); Mark Kirk (R-IL-10th); Jim Saxton (R-NJ-3rd); Tom Petri (R-WI-6th); and Jim Ramstad (R-MN-3rd))

⁵ “Americans have become familiar with these terms over the years, as concern has grown that human activities particularly the burning of fossil fuels, which release carbon dioxide (CO₂) are leading to a warming of the Earth's climate. The effects of a permanent warming trend to the global climate are not precisely known. Some scientists believe a warmer climate could potentially have far-reaching effects (including some positive effects) on agriculture and forestry, managed and unmanaged ecosystems, including natural habitats, human health, and water resources. Others warn that climate change could have catastrophic results, including the deluging of coastal areas, species loss, and increased disease and poverty. In the absence of hard, empirical data, the public discussion of climate change has devolved into half-truths, polemics, and partisanship.” (Tom Davis VA-11)

⁶ We obtained this data through a special collaboration with voxgov.com. Our keywords for this search, which were more limited for technical reasons, include: "climate change" "global warming" "kyoto" "greenhouse gas" "east anglia" "climategate" "carbon" "cap and trade" "warming trend" "cooling trend" "emissions" "ipcc".

⁷ There were 129 tweets from Independents which we excluded.

more restrictive in length, we didn't expect to find as many distinct topics compared to our press release data and we use a 10 topic model. We used partisan affiliation and date as covariates that may explain variation in the propensity to tweet about a particular topic.

Once again, we are interested in the types of topics legislators tweet about when they tweet about climate change issues. Do legislators focus on economic issues like “cap and trade,” or do legislators also tweet on topics related to the causes and consequences of climate change, and indicate their varying degrees of uncertainty?

Figure 2 plots several results. The top left gives the proportion of the corpus across each topic and top right gives the words most highly associated with each topic. The most frequently tweeted two topics (topic 9 and 5) appear highly related to the topics we found in the press release data. Topic 9 picks up on discourse about whether or not climate change is happening. An example tweet highly associated with this topic was from Henry Waxman “I give these weekly speeches because climate change is real & we cannot let polluter-funded lies go unanswered.” Topic 5 was concerned with discussion about carbon emissions which picks up on the question of whether humans are causing climate change.⁸ Both of these topics are substantively different compared to topic 4, which focused on motivational issues—calls for action—rather than focusing on questions about whether climate change was happening. In many cases, such calls for action implicitly communicate a great deal of certainty that humans are causing climate change. Topic 1, while a small overall proportion of the corpus (estimated around 10%), was about scientific debates about global warming. Tweets associated with this category were very similar to those we saw in our first data set which highlight scientific uncertainties and debates between scientists.⁹ Examples of these topics are presented in figure 3.¹⁰

[Figure 2 about here]

[Figure 3 about here]

We observe that legislators communicate on climate change issues in a variety of ways, and this includes issues related to the causes and consequences of climate change. Furthermore, there is variation in the extent of certainty put forth. While topic 9 was associated with higher degrees of certainty, topic 1 communicated greater uncertainty.

An upshot of the Structural Topic Model is that it can relate covariate information about who generated the tweet to the propensity for the tweet to be about a particular topic. Examination of this auxiliary information gives us greater confidence in our results, as they accord with our expectations. The bottom left gives the relationship between party and several topics of interest. Values to the right of zero indicate a greater propensity for Democrats to talk about an issue, whereas topics to left indicate a greater propensity for Republicans to talk about the issues. We see, for example, Democrats being linked with confident statements about climate change happening, as well as broader calls for regulatory action. Republicans were highly associated with denying the science of global warming or tweeting about the Climategate issue.

⁸ Topic 7 picks up on a similar issue, but was relatively more focused on regulations.

⁹ Another parallel with the previous data was Topic 10 which was about ClimateGate.

¹⁰ As with the press release data we observe that legislators also tweet about economic issues.

While we see separation across parties, it is important to note that it is not a perfect separation. Partisans on both sides may communicate with the public using the types of topics identified in this section.

In summary, we identified many cases in which politicians discussed the existence, causes, and consequences of global warming, as well as the costs and benefits of potential solutions. In some cases politicians expressed extreme confidence in their positions; in other cases they acknowledged some degree of uncertainty. In the remainder of this memo we present three experiments, each inspired by the way politicians actually talk about global warming.

3. Experiment One: Communicating uncertainty about whether warming is happening

To see how voters respond to candidates who communicate (un)certainly about global warming, we designed a public opinion survey, which we administered over the internet to a sample of 1,814 adults in April 2014. Survey Sampling International recruited the respondents, who were selected to match the U.S. adult population on gender, age, and education. Table 1 provides a demographic profile of the respondents.

[Table 1 about here]

The survey began by asking people to express their personal beliefs about global warming. We explained, “Global warming refers to the idea that the world’s average temperature has been increasing over the past 150 years, may be increasing more in the future, and that the world’s climate may change as a result. What do you think? Do you think that global warming is happening?” The response options were yes, no, or don’t know. People who answered yes received a follow-up, “How sure are you that global warming is happening?” and could select either “extremely sure” or “somewhat sure.” Likewise, people who answered no were probed to see whether they were extremely or only somewhat sure. We used the answers to create a 5-point scale of belief in global warming, ranging from 1 (extremely sure global warming is not happening) to 5 (extremely sure global warming is happening). People who answered don’t know were placed in the center of the scale, at 3.

After measuring the respondent’s beliefs about global warming, we noted, “Politicians are often asked whether they think global warming is happening, and how certain they feel about their answer. We then presented two candidates (A and B) who varied randomly in their demographic attributes and their statements about global warming. Our presentation included three demographic variables: party, gender, and education. We selected these variables because they are salient during political campaigns and could affect public support for candidates. Table 2 shows the possible values for each demographic variable.

[Table 2 about here]

We also randomized what each candidate said when asked whether global warming is happening. Each candidate expressed express one of five positions, drawn randomly from the response options we had offered to participants in our study. Thus, candidate positions were

characterized as: extremely sure global warming is happening, somewhat sure global warming is happening; don't know whether global warming is happening; somewhat sure global warming is not happening; or extremely sure global warming is not happening. All this information was presented in tabular form, with one column for each candidate. The demographic attributes appeared in the first three rows, in random order; the candidate's view about global warming appeared in the fourth row. We concluded by measuring which candidate the respondent preferred.

Figure 4 gives an example of what respondents saw. In this example, Candidate A is somewhat sure that global warming is not happening, whereas Candidate B is somewhat sure that it is. Purely by chance, the candidates differed on education and party but had the same gender.

[Figure 4 about here]

After measuring preferences about A versus B, we displayed three additional pairs of candidates, who varied randomly in their demographic attributes and their positions on global warming. We referred to these politicians as C versus D, E versus F, and G versus H. This design efficiently allowed us to collect a large number of evaluations. Each participant evaluated four pairs of candidates, resulting in $1,814 \times 4 = 7,256$ dyadic comparisons. Because the demographic features of candidates and their opinions about global warming were completely randomized, the design makes it possible to estimate and compare the effects of each consideration.

Figure 5 shows how party, gender, education, and statements about global warming affected the average level of support candidates. We computed how much of a difference each attribute made, integrating over the candidate's other attributes and averaging over all opponents.

[Figure 5 about here]

The top portion of Figure 5 confirms the importance of party, gender, and education. Other factors equal, Democratic voters gave an extra 14 percentage points to Democratic candidates, and Republican voters gave a 16-point bonus to Republican candidates. Male voters did not exhibit a significant gender bias, but female voters preferred female candidates by approximately 3 percentage points. Respondents also wanted educated politicians. Vote shares were significantly higher for candidates with college degrees, law degrees, master's degrees, medical degrees, and Ph.D.'s than for candidates who had only completed high school. The large bonus for Ph.D.'s suggests that we academics may have a future in politics!

The bottom portion of Figure 5 shows that voters preferred candidates who agreed with their side of the global warming debate. For this analysis we divided respondents into three groups: those who said global warming was happening (75% of the sample), those who didn't know (10%), and those who claimed global warming was not happening (15%). Respondents in each of these three categories awarded a substantial bonus—between 18 and 24 percentage points—to candidates who agreed with their perspective.

We next investigated the effects of communicating (un)certainty. Did voters prefer candidates who not only took their side of the global warming debate, but also shared their level of certainty? To find out, we divided the sample into five groups: respondents who felt extremely sure (44%) or somewhat sure (31%) that global warming was happening, respondents who didn't know (10%), and respondents who felt somewhat sure (7.6%) or extremely sure (7.4%) that warming was not happening. These groups correspond to levels 5, 4, 3, 2, 1 of our global warming belief scale. Within each voter group, we computed the average performance of candidates who expressed positions 5, 4, 3, 2, and 1 and plotted the results.

As Figure 6 shows, voters preferred candidates who not only took side their but also shared their level of certainty. Voters at 5 were most enthusiastic about candidates at 5, voters at 4 gave the most support to candidates at 4, etc. There were statistical ties in two voter groups: voters at 1 were equally happy with candidates at 1 and 2, and voters at 3 were equally content with candidates at 2, 3, and 4. Overall, though, voters wanted candidates whose certainty levels were close to their own.¹¹

[Figure 6 about here]

Moreover, candidates who overclaimed or underclaimed—expressing more or less confidence than the voter—paid a heavy price. Voters at 4, for example, felt somewhat certain that global warming was happening. When they encountered a candidate who agreed, they voted for the candidate 66% of the time in pairwise competition against all opponents. The same voters gave only 55% support to candidates who were extremely certain of warming, essentially penalizing those candidates by $66-55=11$ percentage points for being overconfident. Voters at 4 also shunned politicians for expressing too little confidence. They backed “don't know” candidates only 50% of the time, implying a $66-55=16$ point penalty for communicating too much uncertainty.

A similar pattern emerged among voters at 2, who felt somewhat sure that warming was not happening. These voters supported like-minded candidates at a rate of 67%, on average. In contrast, they gave only 60% support to candidates who expressed extreme skepticism about warming, and only 51% to candidates who did not know. Consequently, this group punished overconfident candidates by 7 points underconfident ones by 16 points.

Voters at the extremes had no opportunity to criticize candidates for expressing too much faith in their side of the global warming debate, but they could—and did—punish candidates for hedging. Voters at 5 deducted 11 points from candidates who were only somewhat sure about global warming, and 30 points from candidates who professed not to know whether warming was happening. Voters at 1 showed a more muted response; they deducted only 2 percentage points from candidates who took their side with only some certainty (a substantively small and statistically insignificant difference), and 16 points from candidates who said “don't know.”

Finally, voters in the middle—those at 3 on our belief scale—tolerated mild certainty but shunned candidates who felt extremely confident. They subtracted 21 points from candidates

¹¹ We also investigated whether responses to (un)certainty varied, depending on whether candidates were Democratic or Republican. We saw no substantial differences.

who emphatically believed in global warming, and deducted 17 points from candidates who emphatically denied it.

How do the responses of these five groups affect the strategic incentives of politicians? To find out, we estimated how much support candidates would receive by playing 5, 4, 3, 2 or 1 against each type of opponent, assuming that opinion in the actual electorate matches the distribution in our sample. Our findings, which appear in Figure 7, imply that communicating uncertainty is an optimal political strategy. More technically, given the distribution of opinion today, candidates can maximize their share of the vote by professing to be only somewhat certain that the earth is warming.

[Figure 7 about here]

We will now develop this conclusion by moving through the graphs one at a time. The graph in the upper left shows how a generic candidate (A) would fare against a generic opponent (B) who expresses extreme confidence in global warming. If A adopted the opponent's position, he would completely neutralize the issue of global warming. Voters would be indifferent between A and B, causing each to win half of the vote on this issue. Interestingly, our data show that A could do just well by playing 4, but would fare substantially worse by playing 3, 2, or 1. Thus, when the opponent stands at 5, A will perform best by playing either 4 or 5. The same conclusion holds when the opponent stands at 4: A would attract approximately half of the vote by playing either 4 or 5, but earn markedly less by playing 3, 2, or 1.

The second row of graphs summarizes the incentives A would face when competing against politicians at 3 or 2. In either scenario, A would maximize his share of the vote by playing 4. Finally, when paired against an opponent at 1, A would do best by playing 5, but could perform nearly by playing 4. The difference in value between these two strategies is only 2 percentage points, an amount that is substantively small and statistically indistinguishable from zero. In summary, then, strategy 4 is weakly optimal when competing against three types of opponents (5, 4, and 1), and is strictly optimal when competing against the remaining types.

Finally, we searched for the Nash Equilibrium in a game between two candidates who could freely choose their positions on global warming. In equilibrium, both candidates should play 4. If that occurred, neither candidate would have a strong incentive to deviate unilaterally. In our data, strategy 5 performed nearly as well strategy 4, so candidates could switch from 4 to 5 without incurring a substantial cost. Thus, we cannot rule-out equilibria in which one or both candidates play 5. Nonetheless, our data imply that communicating uncertainty is not electorally costly, and may in fact be the optimal strategy.

Figure 7 presumes that our sample approximates the actual distribution of public opinion about global warming. Approximately 75% of our respondents believed in global warming. Some readers might regard that estimate as too high. Leiserowitz et al. (2013), for example, surveyed a representative sample of Americans in November 2013 and found higher levels of skepticism. In his study, 37% of respondents were highly certain that warming was happening, 26% felt somewhat sure, 14% didn't know, 10% felt somewhat sure that warming was not happening, and the remaining 12.9% felt highly certain that it was not happening.

We reexamined the strategic incentives of candidates, conditional on the distribution of opinion in Leiserowitz et al. (2013). With this distribution the strategic incentives are even clearer: against each possible opponent, candidate A always does best by playing 4. This makes sense, since a more skeptical public should be more receptive to candidates who are somewhat sure of global warming, than of candidates who characterize global warming as an inconvenient truth. Thus, our data show that in the current political environment, politicians who are competing in general elections have a strategic incentive to hedge about global warming.

4. Experiment Two: Communicating uncertainty about the causes of global warming

Our second experiment focused on another important theme in the climate debate: the controversy about whether humans are responsible for global warming. We randomized what politicians said about this important issue. We further enriched the experiment by presenting two types of politicians: those who had consistently advocated tougher regulations on fossil fuels, and those who had recently shifted from opposing regulations to favoring them. The experimental design allowed us to investigate whether politicians could cite changes in scientific certainty as a justification for flip-flopping.

We recruited subjects through an online service called Amazon Mechanical Turk. Researchers have found that psychology experiments on MTurk yield approximately the same treatment effects as experiments with nationally representative samples (e.g., Berinsky, Huber, and Lenz 2012). Nonetheless, MTurk subscribers are younger, more likely to be female, and less likely to be Republican than the national population. These demographic differences could prove consequential for certain types of political experiments, including ones in which people evaluate policies to deal with global warming.

As a step toward addressing this issue, we oversampled Republicans. Specifically, we opened one survey to all members of MTurk, and fielded a parallel survey that was available only to self-professed Republicans. We continued recruiting Republicans until the proportions of Democrats, Independents, and Republicans in our sample were about same as in the population as a whole. The experiment was conducted in March 2013. We paid each respondent between \$0.75 and \$1.00 to complete the questionnaire, which lasted about 5-7 minutes.

The survey began by measuring each respondent's views about regulating the use of fossil fuels. We asked, "should the U.S. government pass new laws that would require American citizens and companies to significantly reduce their use of fossil fuels, including coal, oil, and gas? The response options were "Yes, the government should" or "No, the government should not."

We then invited respondents to evaluate a Democratic politician from the Midwest, who had served in Congress since being elected 2008. We randomized what the candidate said about fossil fuel regulations four years ago and what he said about the issue this year. Some respondents evaluated a candidate who had espoused the liberal position in both time periods (LL), whereas others evaluated a candidate who had switched from the conservative side to the liberal one (CL). We independently randomized whether the politicians talked about science and, if so, whether they portrayed scientists as being certain (SC) or uncertain (SU) about the human contribution to climate change. There were, therefore, six distinct experimental conditions.

LL: Four years ago, he said the government should pass new laws that would require Americans to use significantly less fossil fuel. This year, he said the same thing.

LL-SC: Four years ago, he said the government should pass new laws that would require Americans to use significantly less fossil fuel. This year, he said the same thing. He

explained: For many years, scientists have known that people are causing global warming by burning fossil fuels. They have been certain about this issue for a long time.

LL-SU: Four years ago, he said the government should pass new laws that would require Americans to use significantly less fossil fuel. This year, he said the same thing. He explained: For many years, scientists have said there is an 80 percent chance that people are causing global warming by burning fossil fuels. Although 80 percent is not “certain,” it is a high chance.

CL: Four years ago, he said the government should not pass new laws that would require Americans to use significantly less fossil fuel. This year, he said the government should pass new laws that would require Americans to use significantly less fossil fuel.

CL-SC: Four years ago, he said the government should not pass new laws that would require Americans to use significantly less fossil fuel. This year, he said the government should pass new laws that would require Americans to use significantly less fossil fuel. He explained: Years ago, scientists were not sure whether humans were causing global warming. But after doing more research, scientists are now certain that humans are heating the earth by burning fossil fuels.

CL-SU: Four years ago, he said the government should not pass new laws that would require Americans to use significantly less fossil fuel. This year, he said the government should pass new laws that would require Americans to use significantly less fossil fuel. He explained: Years ago, scientists thought there was only a 50-50 chance that humans were causing global warming. But after doing more research, scientists now say it is 80 percent likely that humans are heating the earth by burning fossil fuels. Although 80 percent is not “certain,” it is a high chance.

After presenting the vignette, we asked: “Based on this information, how much do you like or dislike the candidate?” There were six response options: like him a lot, like him a moderate amount, like him a little, dislike him a little, dislike him a moderate amount, and dislike him a lot. We used the responses to create a six-point scale, which ran from 0 (dislike a great deal) to 100 (like a great deal).

The first row of Figure 8 compares the average ratings of three consistently liberal (LL) candidates: those who did not use scientific rhetoric; those who said scientists were certain (SC), those who admitted to scientific uncertainty (SU) by saying that that scientists were only 80% sure. The second row presents the analogous evaluations for candidates who recently switched from the conservative position to the liberal one (CL). Within each row, the left graph summarizes the opinions of voters who favored tougher regulations on fossil fuels, while the right side shows the responses of voters who opposed such regulations.

[Figure 8 about here]

Figure 8 supports two main conclusions. First politicians who acknowledged scientific uncertainty were at least as popular as ones who alleged that scientists were certain. The only

exception arose among pro-regulation voters, who slightly preferred LL candidates who emphasized scientific certainty (LL-SC) over ones who admitted a modest amount of doubt (LL-SU). In general, though, politicians did not suffer by communicating uncertainty about the role of humans in global warming.

Second, the bottom row of Figure 8 shows that scientific rhetoric can substantially enhance the ratings of candidates with inconsistent policy histories (CL). Candidates who cited science as a reason for shifting in the liberal direction were far more popular than candidates who did not offer a justification. In related research (not reported here) we explain why: candidates who invoked science were seen as more honest, knowledgeable, open-minded and strong in leadership than candidates who never mentioned science.

5. Experiment Three: Communicating uncertainty about consequences and solutions

The previous experiments focused on beliefs about whether global warming is happening and whether humans are responsible. We now describe a related experiment, in which we randomized what candidates said about the consequences of global warming and the effectiveness of new laws. We embedded the experiment in a survey that was administered by YouGov to a nationally representative sample of 1,499 adults in September-October 2013. Once again, our experiments show that politicians can safely hedge.

The survey began by measuring each respondent's views about regulating the use of fossil fuels. The text read:

More than 100 years ago, people started burning fossil fuels such as coal, oil, and natural gas to power their homes, factories, and cars. Today, people rely on fossil fuels for most of their energy needs. When people burn fossil fuels to make energy, a gas called carbon dioxide gets released into the air. Some people say that carbon dioxide traps heat on Earth, causing global warming. Other people disagree.

In your opinion, should the U.S. government pass new laws that would require American citizens and companies to significantly reduce their use of fossil fuels, including coal, oil, and gas? [The response options were "Yes, the government should" or "No, the government should not."]

Next we explained, "Political candidates have been talking about this issue. We would like your opinion about one candidate, whose name will remain confidential. He is a Democrat from the Midwest, and has served in Congress since 2008." We randomly assigned each respondent to read one of four speeches that we attributed to the candidate. All four speeches discussed consequences and solutions, but they varied in their level of certainty.

In half of the speeches, the candidate expressed complete confidence that warming would increase sea levels, flooding cities on the U.S. coast. In the other half, the candidate confessed some uncertainty, but said the odds of coastal flooding were approximately 80 percent. We also varied the politician's views about fossil fuel regulations. In half the speeches, the politician was

completely sure that new regulations on fossil fuels would delay global warming. In the other half, the politician put the odds of success at approximately 80 percent.

Overall, the experiment included two treatments, each with two levels, resulting in four experimental conditions. We use the abbreviation CC when candidate expressed certainty about both consequences and solutions; UC when he was uncertain about consequences but certain about solutions; CU when he was certain about consequences but uncertain about solutions; and UU when he was uncertain on both dimensions. The full text of the four speeches appears below.

CC: “After reviewing the scientific evidence, I am completely certain that global warming will cause sea levels to rise, flooding cities on the U.S. coast. This is an indisputable fact. I want new laws requiring Americans to use significantly less fossil fuels. I know the laws will work; I am absolutely sure that the laws will delay global warming, giving us time to adapt.”

UC: “After reviewing the scientific evidence, I think there’s a good chance that global warming will cause sea levels to rise, flooding cities on the U.S. coast. I’m not certain, but I think the odds are around 80 percent. I want new laws requiring Americans to use significantly less fossil fuels. I know the laws will work; I am absolutely sure that the laws will delay global warming, giving us time to adapt.”

CU: “After reviewing the scientific evidence, I am completely certain that global warming will cause sea levels to rise, flooding cities on the U.S. coast. This is an indisputable fact. I want new laws requiring Americans to use significantly less fossil fuels. I think there’s a good chance that the laws will work. I’m not absolutely sure, but I believe there’s an 80 percent chance that the laws will delay global warming, giving us time to adapt.”

UU: “After reviewing the scientific evidence, I think there’s a good chance that global warming will cause sea levels to rise, flooding cities on the U.S. coast. I’m not certain, but I think the odds are around 80 percent. I want new laws requiring Americans to use significantly less fossil fuels. I think there’s a good chance that the laws will work. I’m not absolutely sure, but I believe there’s an 80 percent chance that the laws will delay global warming, giving us time to adapt.”

After describing the candidate and presenting the speech, we asked, “how much do you like or dislike this candidate?” We used the responses to create a six-point scale, which ran from 0 (dislike him a great deal) to 100 (like him a great deal).

Figure 9 shows that voters did not penalize candidates for communicating uncertainty. On average, candidate CC received a score of 54 on our 100-point likability scale. Mean scores for the other three candidates were within 2 points of this benchmark, and none of the differences was statistically distinguishable from zero. Thus, we find no evidence that voters systematically preferred candidates who conveyed certainty over candidates who hedged.

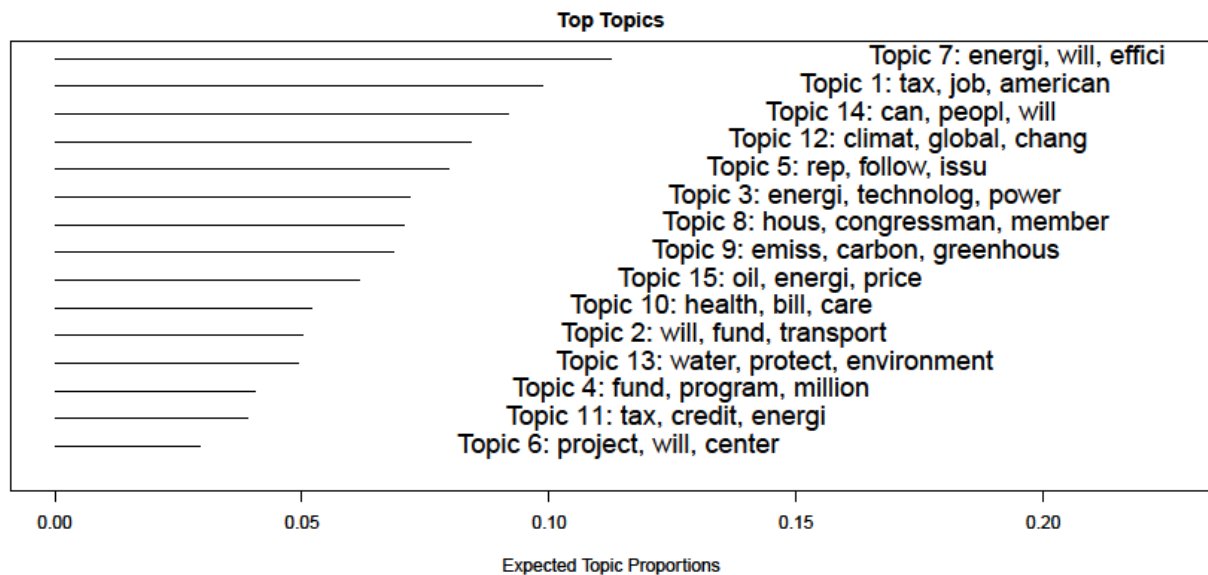
[Figure 9 about here]

The same conclusions held when we split the sample into two groups: voters who supported new regulations on fossil fuels (49% of the sample) and voters who opposed regulations (51% of the sample). Pro-regulation voters naturally rated the candidate much more favorably than anti-regulation voters. Within each voter group, though, all four candidates received similar scores, regardless of whether they communicated uncertainty.

These findings are surprising, given that the candidate was recommending major changes in government policy. Voters could have penalized the candidate for recommending stiffer regulations without being confident that such laws were warranted. In our experiment, though, voters tolerated uncertainty, even when candidates were not sure about the consequences of global warming and/or the effectiveness of new laws. Of course, our experiments do not imply that voters are immune to uncertainty. In future experiments we could randomize the level of uncertainty that candidates express, to find the point at which voters might punish candidates for recommending policies without having a compelling warrant.

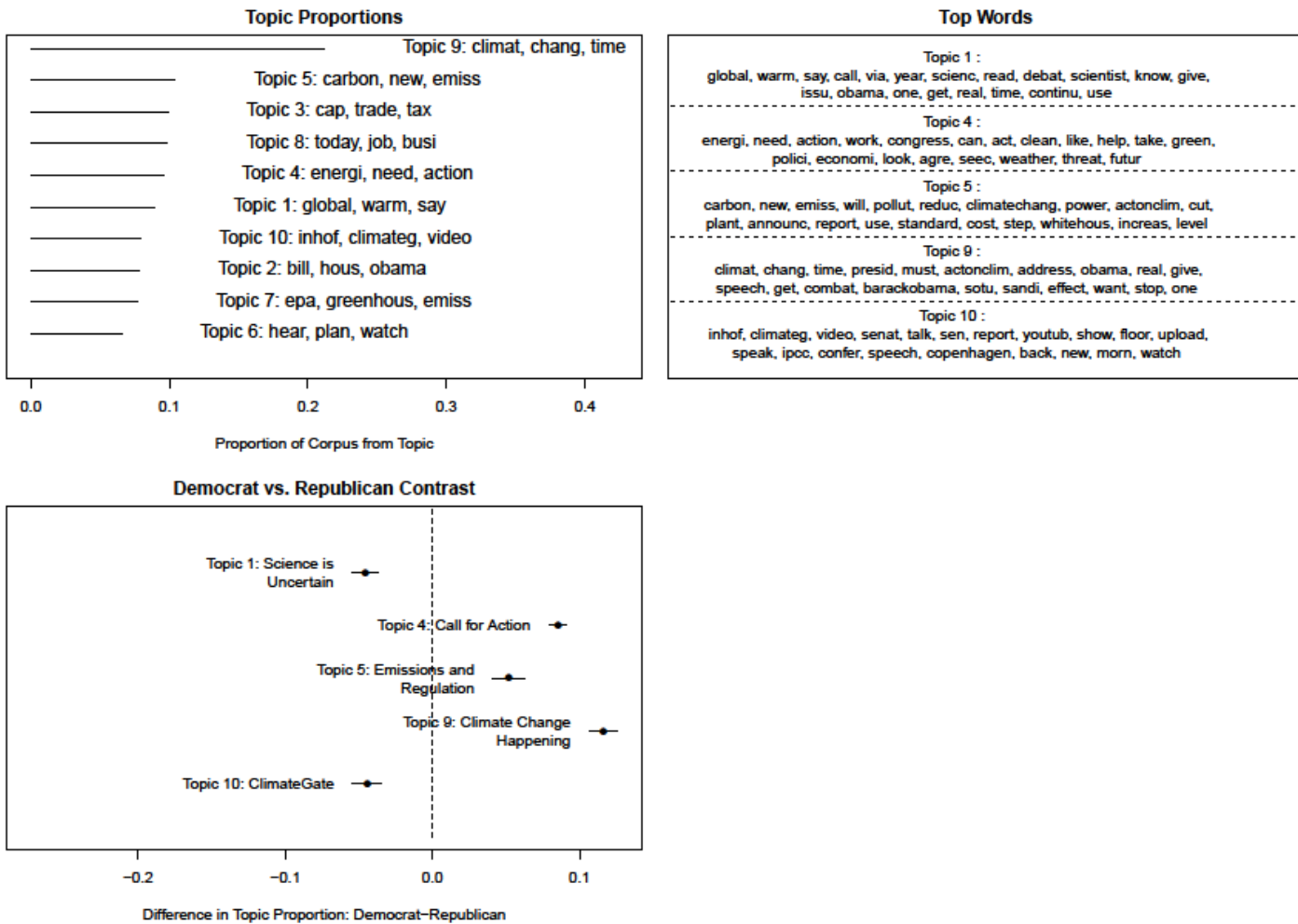
In summary, we find that politicians would not suffer—and may actually improve their electoral appeal—by confessing uncertainty about global warming! We look forward to discussing these findings with you and getting your advice about the next phase in our research.

Figure 1: Relative Frequency of Topics in Congressional Press Releases



Note: Estimates are based on a structural topic model with 15 topics.

Figure 2: Relative Frequency of Topics in Congressional Twitter Posts, Top Words, and Covariate Relationships to Topic Proportions



Note: Top left figure gives the relative frequency of topics; the top right figure gives the words most associated with those topics; and the bottom left figure calculates how the predicted frequency of topics would change if the legislator were a Democrat instead of a Republican.

Figure 3. Example quotes for topics 1, 4, 5, 9 and 10 using Congressional Twitter data

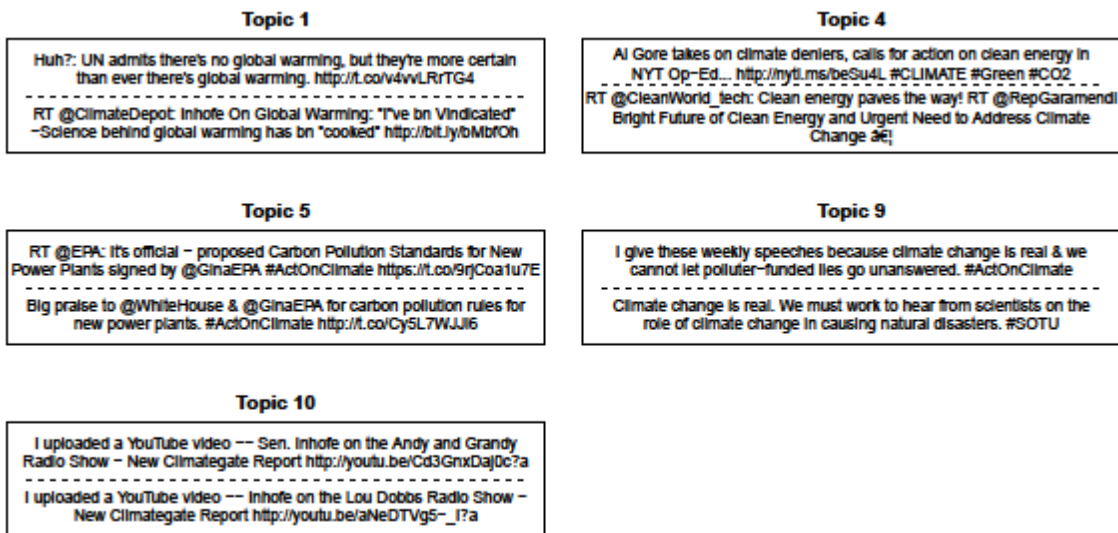


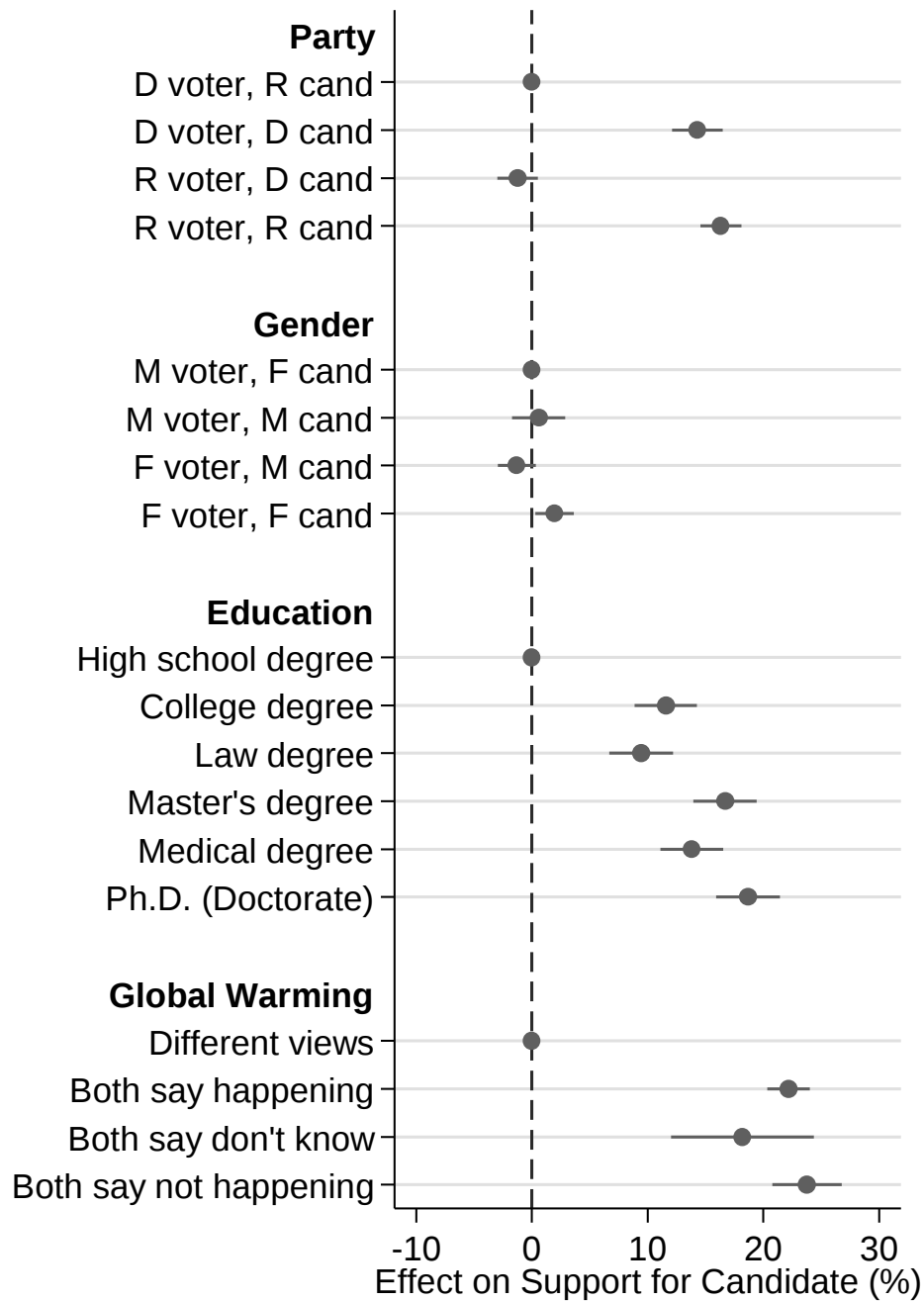
Figure 4: Example of a Scenario from Experiment One

	Candidate A	Candidate B
Education	Law degree	Master's degree
Party	Republican	Democrat
Gender	Male	Male
Is global warming happening?	<u>Somewhat sure</u> global warming is <u>not</u> happening	<u>Somewhat sure</u> global warming is happening

Which of these candidates do you prefer?

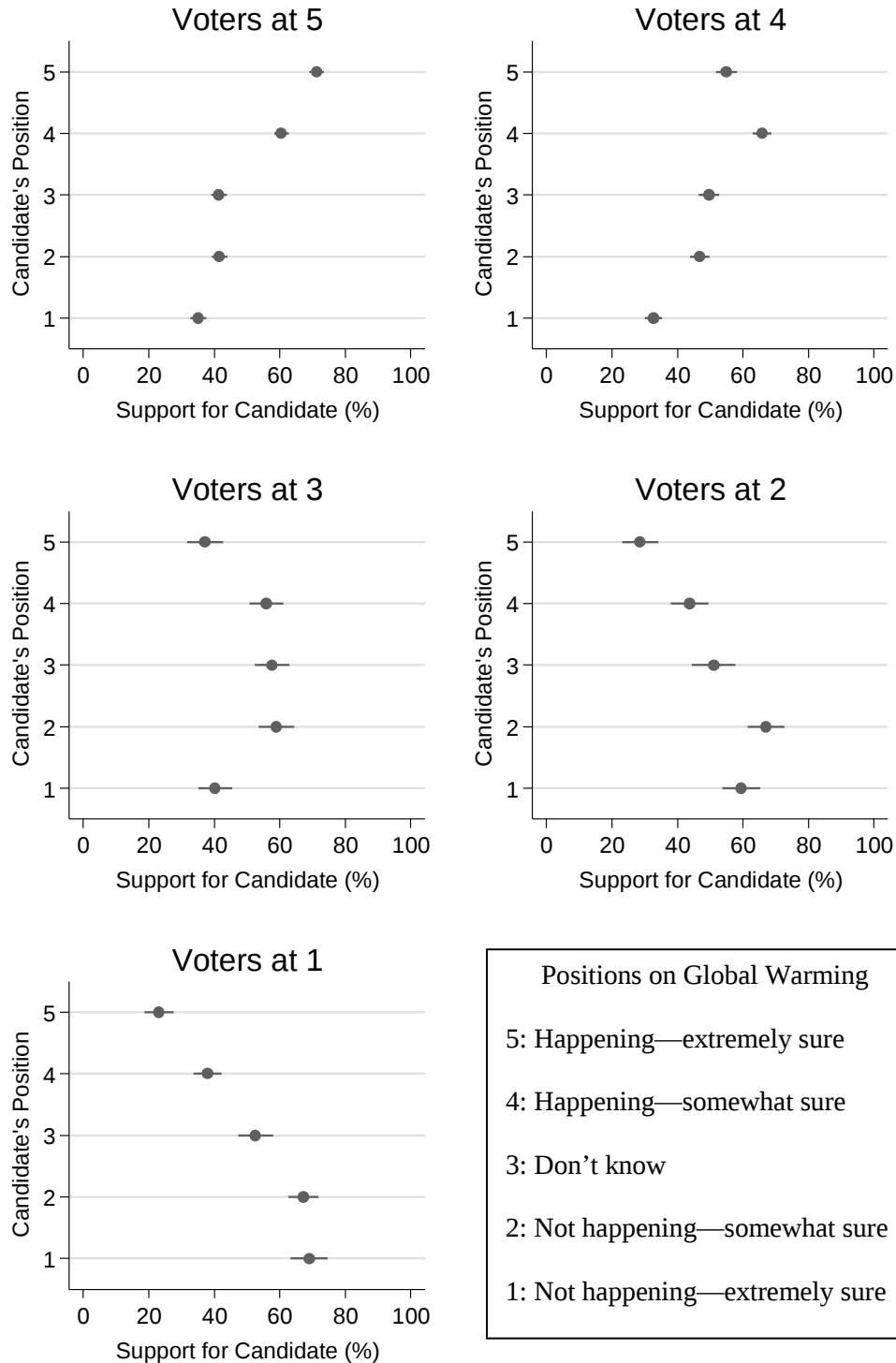
- ☐ Candidate A
- ☐ Candidate B

Figure 5: Effects of Candidate Attributes (From Experiment One)



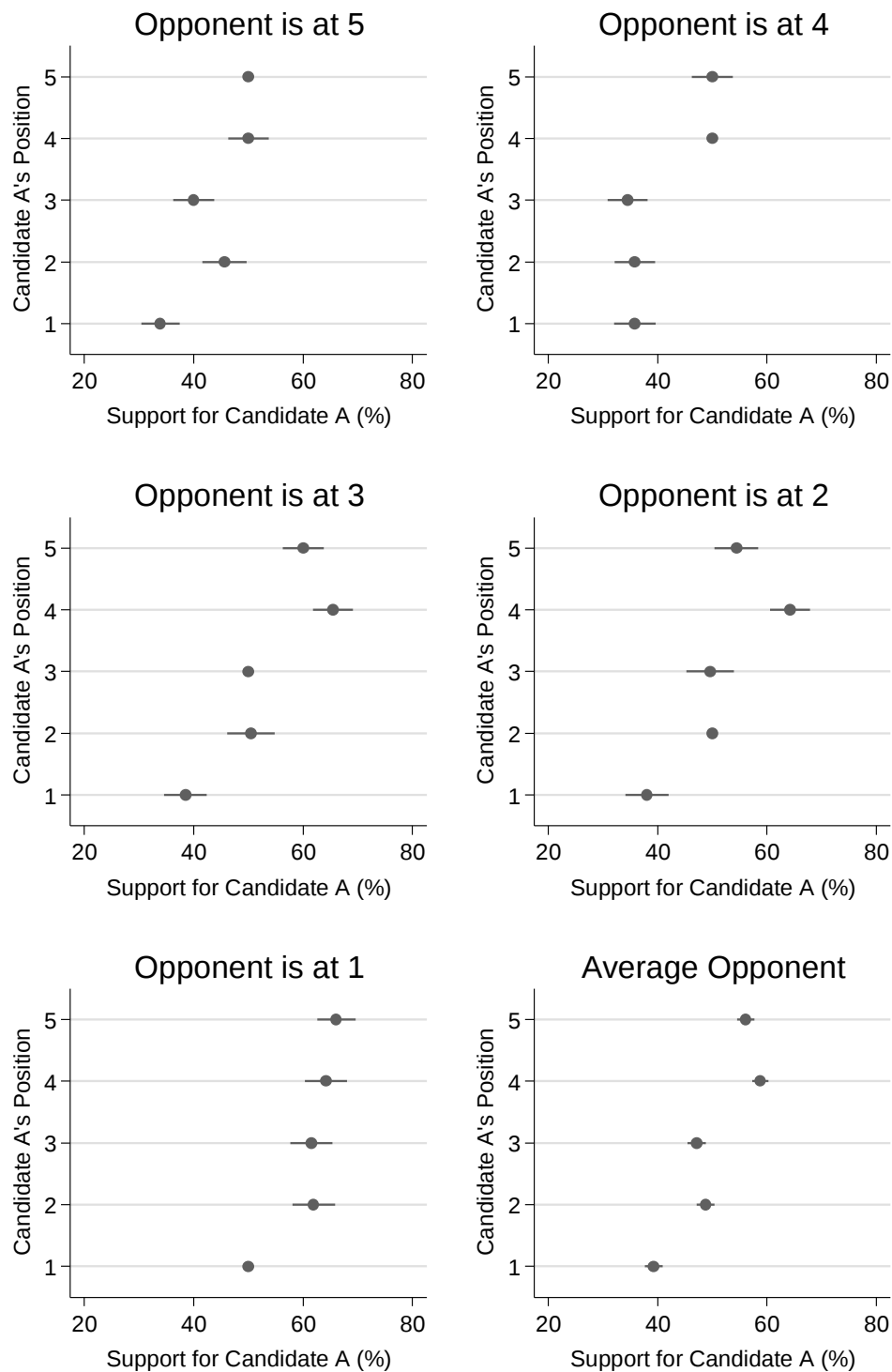
Note: The dots show how party, gender, education, and statements about global warming affected support for a candidate, when competing against a random opponent.

Figure 6: Support for Candidate, by Voter Group (From Experiment One)



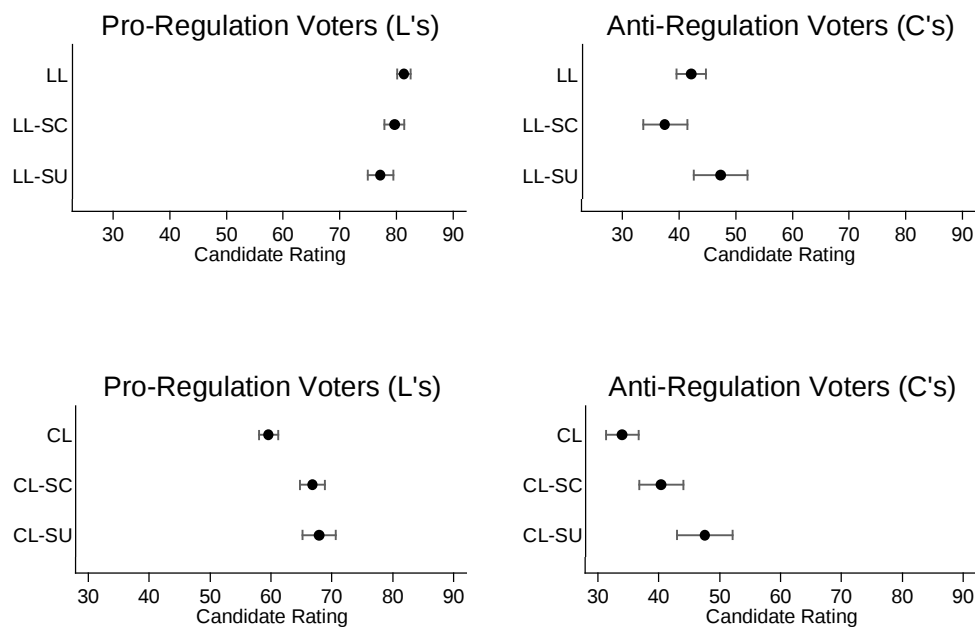
Note: Each dot represents the average level of support the candidate received from the specified group of voters, when competing against random opponents. The dark horizontal lines are 95% confidence intervals.

Figure 7: Support for Candidate against Each Possible Opponent (From Experiment One)



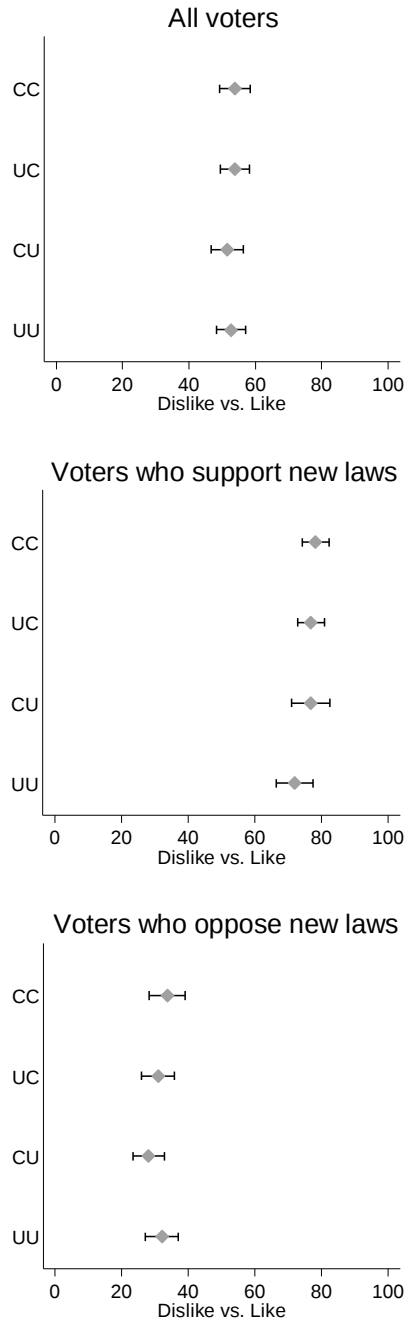
Note: Assumes an electorate for which 44.4% of voters are at 5 (extremely sure global warming is happening); 30.7% are at 4 (somewhat sure it's happening); 10% are at 3 (don't know), 7.6% are at 2 (somewhat sure it's not happening, and 7.4% are at 1 (extremely sure it's not happening).

Figure 8: Evaluation of Candidates in Experiment Three



Note: Candidates with history LL consistently advocated the liberal position in both time periods, whereas candidates with history CL recently switched from the conservative position to the liberal one. Candidates with the label SC justified their positions by claiming that scientists were certain about the human role in global warming. Candidates with the label SU, on the other hand, claimed that that scientists were still uncertain about the human contribution to global warming.

Figure 9: Evaluation of Certain and Uncertain Candidates (From Experiment Three)



Note: We use the abbreviation CC when candidate expressed certainty about both consequences and solutions; UC when he was uncertain about consequences but certain about solutions; CU when he was certain about consequences but uncertain about solutions; and UU when he was uncertain on both dimensions. The dots represent average evaluations, and the horizontal bars are 95% confidence intervals.

Table 1: Characteristics of Sample for Experiment One

Sample		Frequency	
Gender		Political Party	
Female	51 %	Democrat	42 %
Male	49	Independent	31
Age		Republican	24
18-44 years	48 %	Other	3
45-64 years	36	Ideology	
65 and over	16	Very liberal	11 %
Education		Somewhat liberal	15
High school or less	22 %	Moderate, middle road	35
Technical/trade	5	Somewhat conservative	20
Some college	29	Very conservative	14
College degree	28	Not sure	5
Some graduate school	5	Is Warming Happening?	
Graduate degree	12	Yes - Extremely sure	44 %
Race		Yes - Extremely sure	31
White	71 %	Don't know	10
Black	17	No - Somewhat sure	8
Latino	11	No - Extremely sure	8
Asian	4		
Native american	1		
Other	1		
Household Income			
Less than \$30,000	29 %		
\$30,000 - \$59,999	31		
\$60,000 - 100,000	25		
\$100,000 or more	15		

Table 2: Demographic Attributes of Candidates in Experiment One

Attribute	Possible values
Party	Democrat or Republican
Gender	Male or Female
Education	High school degree, College degree, Master's degree, Law degree, Medical degree, or Ph.D. (Doctorate)

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