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### Public awareness of the scientific consensus on climate

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# Public Awareness of the Scientific Consensus on Climate

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Lawrence C. Hamilton<sup>1</sup>

## Abstract

Questions about climate change elicit some of the widest political divisions of any items on recent U.S. surveys. Severe polarization affects even basic questions about the reality of anthropogenic climate change (ACC), or whether most scientists agree that humans are changing the Earth's climate. Statements about scientific consensus have been contentious among social scientists, with some arguing for consensus awareness as a "gateway cognition" that leads to greater public acceptance of ACC, but others characterizing consensus messaging (deliberate communication about the level of scientific agreement) as a counterproductive tactic that exacerbates polarization. A series of statewide surveys, with nationwide benchmarks, repeated questions about the reality of ACC and scientific consensus many times over 2010 to 2016. These data permit tests for change in beliefs and polarization. ACC and consensus beliefs have similar trends and individual background predictors. Both rose gradually by about 10 points over 2010 to 2016, showing no abrupt shifts that might correspond to events such as scientific reports, leadership statements, or weather. Growing awareness of the scientific consensus, whether from deliberate messaging or the cumulative impact of many studies and publicly engaged scientists, provides the most plausible explanation for this rise in both series. In state-level data, the gap between liberal and conservative views on the reality of ACC did not widen over this period, whereas the liberal-conservative gap regarding existence of a scientific consensus narrowed.

## Keywords

sociology, social sciences, environment and technology, social change and modernization, science communication, human communication, communication studies, communication, environmental psychology, applied psychology, psychology, science, knowledge, technology

## Introduction

Studies by thousands of scientists have established that human activities are changing the Earth's climate, principally through raising the concentration of radiatively active (greenhouse) gases in the atmosphere. Reports from the Intergovernmental Panel on Climate Change (IPCC; 2013) bring much of this evidence together. National science academies, and organizations representing hundreds of thousands of scientists, have issued their own statements or reports on the risks of anthropogenic climate change (ACC; National Aeronautics and Space Administration [NASA], 2016). Direct surveys of scientists find levels of agreement on the reality of ACC ranging from 87% among American Association for the Advancement of Science members generally, to 93% among working PhD Earth scientists (Pew Research Center, 2015) or 97% among active climate research scientists (Anderegg, Prall, Harold, & Schneider, 2010; Doran & Zimmerman, 2009). Two analyses of published research similarly report high-90s agreement on the reality of ACC (Cook et al., 2013; Oreskes, 2004). Synthesizing recent studies, Cook et al. (2016) observe that the level of consensus rises with expertise of the scientists

considered: Agreement is strongest among the most active researchers.

In contrast to the overwhelming consensus among scientists, acceptance of ACC remains stubbornly lower among the U.S. public—until recently, polling mostly in the mid-50s on surveys (e.g., Hamilton, Hartter, Lemcke-Stampone, Moore, & Safford, 2015; Leiserowitz, Maibach, Roser-Renouf, Feinberg, & Rosenthal, 2015). Similar fractions of the public concede a scientific consensus on the reality of ACC. Individual perceptions that ACC is real, and that most scientists agree on this point, correlate with each other and have similar background predictors (e.g., Hamilton & Saito, 2015), to such an extent they could be two indicators for one underlying dimension (Kahan, 2015a; Kahan, Jenkins-Smith, & Braman, 2011). Other researchers have argued that their correlation reflects causality. According to this view,

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**Table 1.** Climate Change Questions, Respondent Characteristics, and Ideology.

Dependent variables
<p><i>Climate</i>—Which of the following three statements do you think is more accurate?</p> <p>Climate change is happening now, caused mainly by human activities (1; New Hampshire 63%, United States 63%).</p> <p>Climate change is happening now, but caused mainly by natural forces (0; New Hampshire 27%, United States 30%).</p> <p>Climate change is not happening now (0; New Hampshire 4%, United States 3%).</p> <p>Don't know/no answer (0; New Hampshire 6%, United States 4%).</p> <p><i>Consensus</i>—Which of the following three statements do you think is more accurate?</p> <p>Most scientists agree that climate change is happening now, caused mainly by human activities (1; New Hampshire 64%, United States 66%).</p> <p>There is little agreement among scientists whether climate change is happening now, caused mainly by human activities (0; New Hampshire 27%, United States 26%).</p> <p>Don't know/no answer (0; New Hampshire 8%, United States 7%).</p>
Independent variables
<p><i>Age</i>—Respondent age in years (range = 18-96 years; New Hampshire <math>M = 48</math>, United States <math>M = 46</math>).</p> <p><i>Female</i>—Respondent gender, female (1; New Hampshire = 51%, United States 51%) or male (0; New Hampshire 49%, United States 49%).</p> <p><i>Education</i>—Postgraduate (2; New Hampshire 24%, United States 21%), college graduate (1; New Hampshire 33%, United States 30%), some college or technical school (0; New Hampshire 24%, United States 31%), high school or less (-1; New Hampshire 20%, United States 18%).</p> <p><i>Ideology</i>—Conservative (2; New Hampshire 20%, United States 24%), moderately conservative (1; New Hampshire 23%, United States 20%), moderate (0; New Hampshire 15%, United States 16%), moderately liberal (-1; New Hampshire 21%, United States 21%), liberal (-2; New Hampshire 22%, United States 20%).</p>

Note. Shown with codes used for regressions in Table 2, and weighted response summaries from the 2016 New Hampshire and U.S. (POLES) surveys. POLES = Polar, Environment, and Science.

awareness of the scientific consensus comprises a *gateway cognition*: a key belief or understanding which, if accepted, makes people more likely also to accept that ACC is real, or that action is needed to slow it (van der Linden, Leiserowitz, Feinberg, & Maibach, 2014). Experimentally, *consensus messaging* or providing information about the extent of scientific agreement can increase subsequently expressed acceptance of ACC (Lewandowsky, Gignac, & Vaughan, 2013; Maibach, Myers, & Leiserowitz, 2014; van der Linden, Leiserowitz, Feinberg, & Maibach, 2015; van der Linden, Leiserowitz, & Maibach, 2016). Some analyses of survey questions about consensus and climate report findings consistent with this gateway role (Ding, Maibach, Zhao, Roser-Renouf, & Leiserowitz, 2011; McCright, Dunlap, & Xiao, 2013; also see Aklin & Urpelainen, 2014).

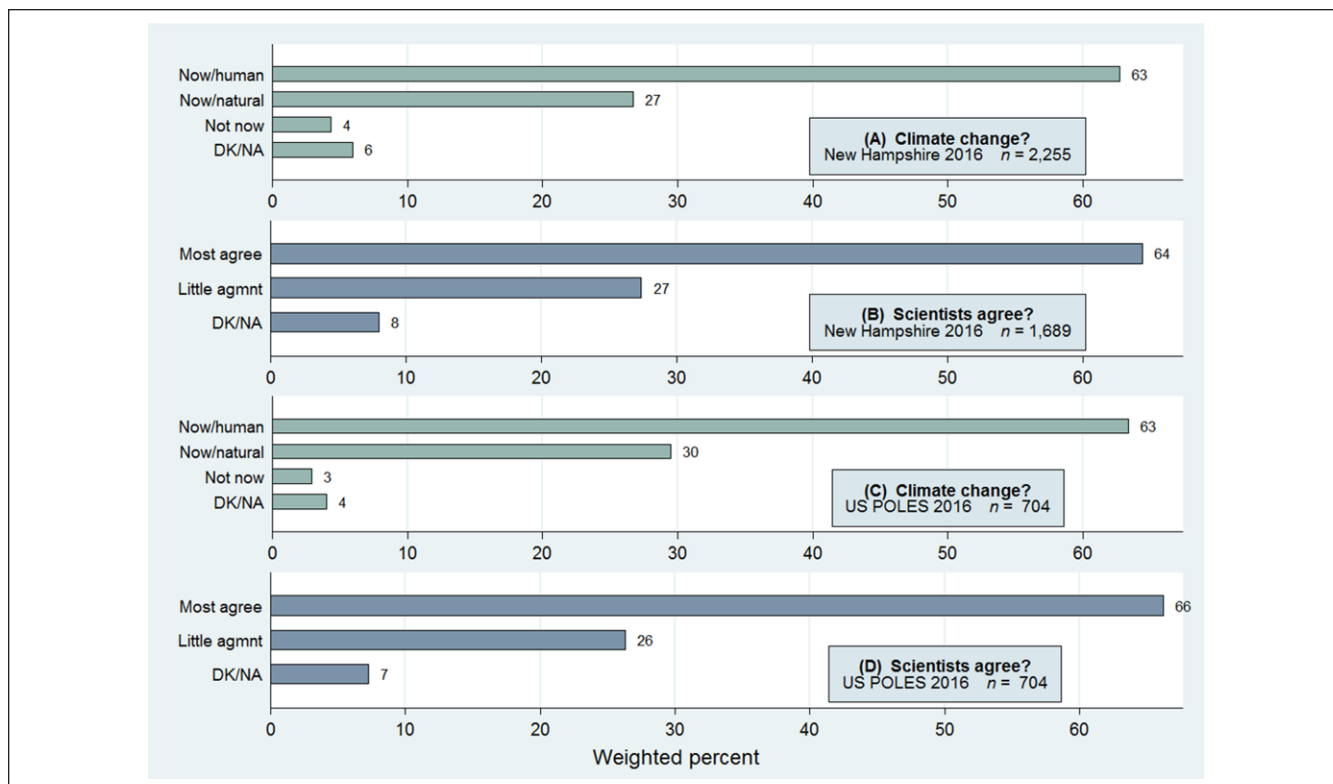
Experimental and survey approaches have complementary strengths and limitations. Experiments can show that certain responses change after exposure to information, which provides good evidence for causality in that context, but does not answer how effects scale up over longer periods in uncontrolled social environments where contrary information is abundant. Non-experimental surveys sample views from such uncontrolled environments, but provide mainly indirect evidence about causality. The gateway and same-dimension hypotheses need not be mutually exclusive, however. That belief in agreement among scientists might in some instances or for some people influence beliefs about ACC, whereas in other cases they measure essentially the same thing, is quite plausible although analytically intractable.

Kahan (2016) takes a position against consensus messaging: “All the ‘social marketing’ of ‘scientific consensus’ does is augment the toxic idioms of contempt that are poisoning our science communication environment.” In part, his view is based on data in which public perceptions about the scientific consensus show less polarization than perceptions about ACC itself. Also, the degree of polarization (the gap between people with opposite ideologies or worldviews) tends to be widest among those with higher education or information by several measures. More basically, he argues that there has been little movement in consensus or ACC perceptions despite “a decades-long social marketing campaign” to inform people (Kahan, 2015b).

But has there been recent movement on either question? Is polarization consistently rising? These questions are testable with data from a lengthening time series of random-sample surveys covering one northeastern U.S. state since 2010. The surveys carried two basic questions assessing public thoughts on the reality of ACC and agreement among scientists. Benchmarked by nationwide surveys that asked the same questions, the statewide data provide unique temporal resolution for tracking change.

## Survey Data

Since spring of 2010, the Granite State Poll (GSP), run by the Survey Center at the University of New Hampshire, has carried the same basic climate-change question alongside its usual mix of political and other topics including science and environment.<sup>1</sup> Table 1 gives the wording of the climate-change



**Figure 1.** Response to climate-change and scientific-agreement questions on New Hampshire and U.S. nationwide surveys in 2016. Note. DK/NA = Don't know/no answer.

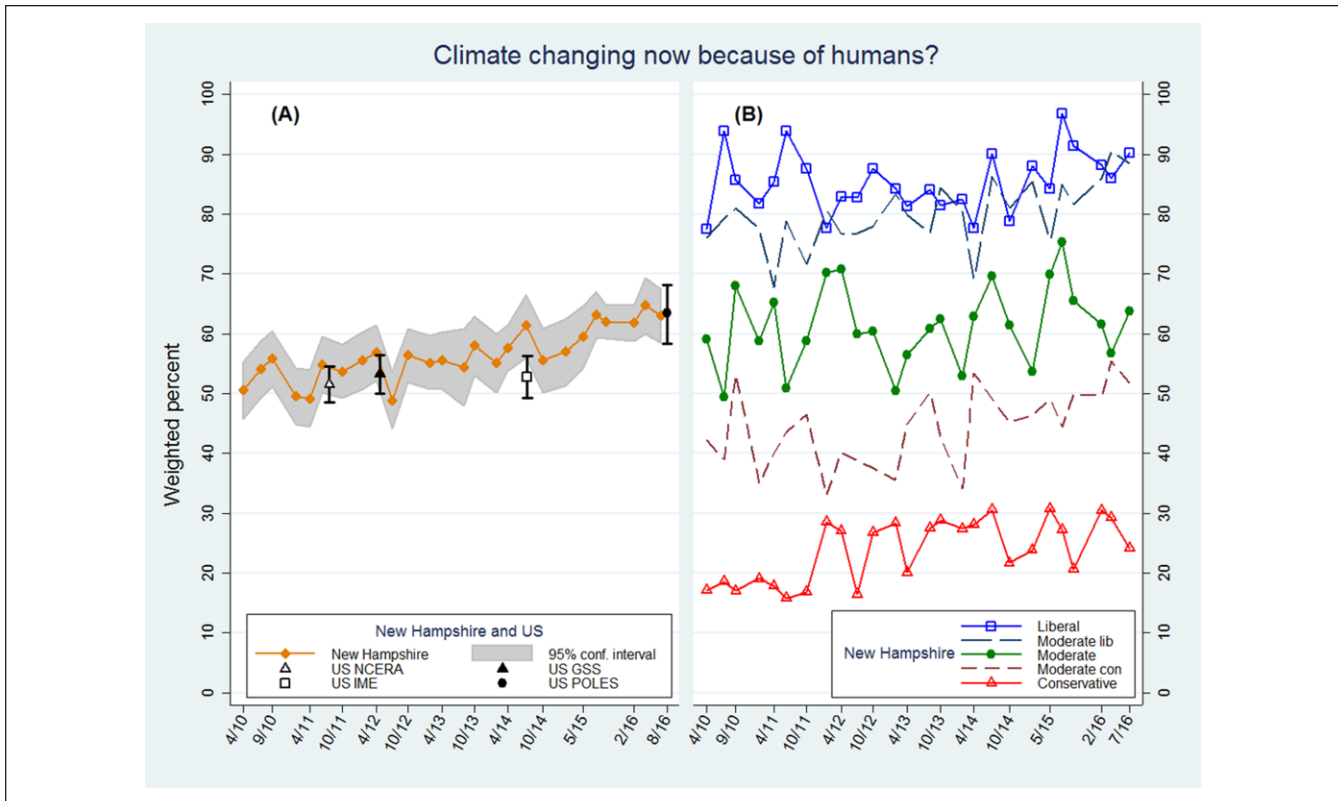
question (*climate*); the order of response choices is rotated by telephone interviewers to avoid possible bias. One of these choices—climate change is happening now, caused mainly by human activities—corresponds to the central point of many statements by scientific organizations (e.g., the first sentence in American Geophysical Union [AGU], 2013). As of summer 2016, this question had been asked in more than 15,000 interviews in 26 New Hampshire surveys, plus a similar number of interviews in other regional or national surveys (Hamilton et al., 2015; Hamilton, 2016).

A second question with parallel wording (*consensus*) asks whether respondents think most scientists agree that climate change is happening now, caused mainly by human activities. This question appeared on 11 of the New Hampshire surveys. Table 1 gives probability-weighted response percentages for *climate* and *consensus* from the most recent year of New Hampshire surveys (2016), and for comparison also the same questions on the U.S. nationwide Polar, Environment, and Science (POLES) survey conducted in August 2016 (Hamilton, 2016). Background characteristics *age*, *gender*, *education*, and *ideology* are summarized for both surveys as well.

Figure 1 graphically compares the *climate* and *consensus* responses. Sixty-three percent of both New Hampshire and U.S. respondents think that climate change is happening now, caused mainly by human activities; and 64% or 66%

think that most scientists agree on this point. The visual similarity between *climate* and *consensus* beliefs is striking, and its implication of substantial overlap is true. Of those who think that climate change is happening now, caused mainly by human activities, 85% (New Hampshire) or 86% (United States) also think that most scientists agree on this point.

How representative are the New Hampshire data? In terms of the overall percentages, Figure 1 suggests they are close. Hamilton et al. (2015) show overlapping confidence intervals across a larger set of New Hampshire and national surveys that asked the same *climate* question. A Gallup survey in March 2016, with differently worded questions, provides another national benchmark: 59% ± 4% believe the effects of global warming have already begun and 65% ± 4% believe that increases in global temperatures over the past century are due more to human activities than to nature (Saad & Jones, 2016). Although mildly inconsistent with each other, either Gallup result roughly agrees with the 63% ± 2% of New Hampshire respondents choosing now/human. Both Gallup percentages in 2016 were the highest for at least 8 years. The 63% now/human responses to *climate* on the 2016 POLES survey likewise is notably higher than on national surveys that had asked this question in 2011, 2012, or 2014. New Hampshire results conform to a similar pattern, with 2016 percentages that are highest in the 7-year history of this question.



**Figure 2.** Percentage who think climate change is happening now, caused mainly by human activities.

Note. Plotted by median interview date on four U.S. and 26 New Hampshire surveys (A); and separated by ideology on the New Hampshire surveys (B). NCERA = National Community and Environment in Rural America; IME = iMediaEthics Poll on Climate Change; GSS = General Social Survey; POLES = Polar, Environment, and Science.

From these comparisons and others, it appears that New Hampshire provides a usable proxy, giving similar-to-national overall percentages on climate issues although generally wider-than-national divisions by political party (Hamilton et al., 2015). The regional scope of the New Hampshire surveys is a limitation, but they also have strengths: sharper (quarterly) temporal resolution than national counterparts, with consistent frames, wording, and methods under the same investigators throughout the whole series.

## Changing Views on Climate and Consensus

Figure 2A graphs the percentage of now/human responses to *climate* on 26 New Hampshire surveys ( $n = 15,931$ ) from April 2010 to July 2016, along with four national surveys. A July 2016 New Hampshire survey and the August 2016 U.S. POLES survey form the two rightmost data points in Figure 2A. This plot suggests an uneven upward trend in acceptance of ACC, amounting to about 10 points over this period. New Hampshire's confidence intervals overlap with each of the four national surveys.

National Community and Environment in Rural America (NCERA) is a representative 50-state telephone survey organized by University of New Hampshire researchers in summer 2011 ( $n = 2,006$ ).

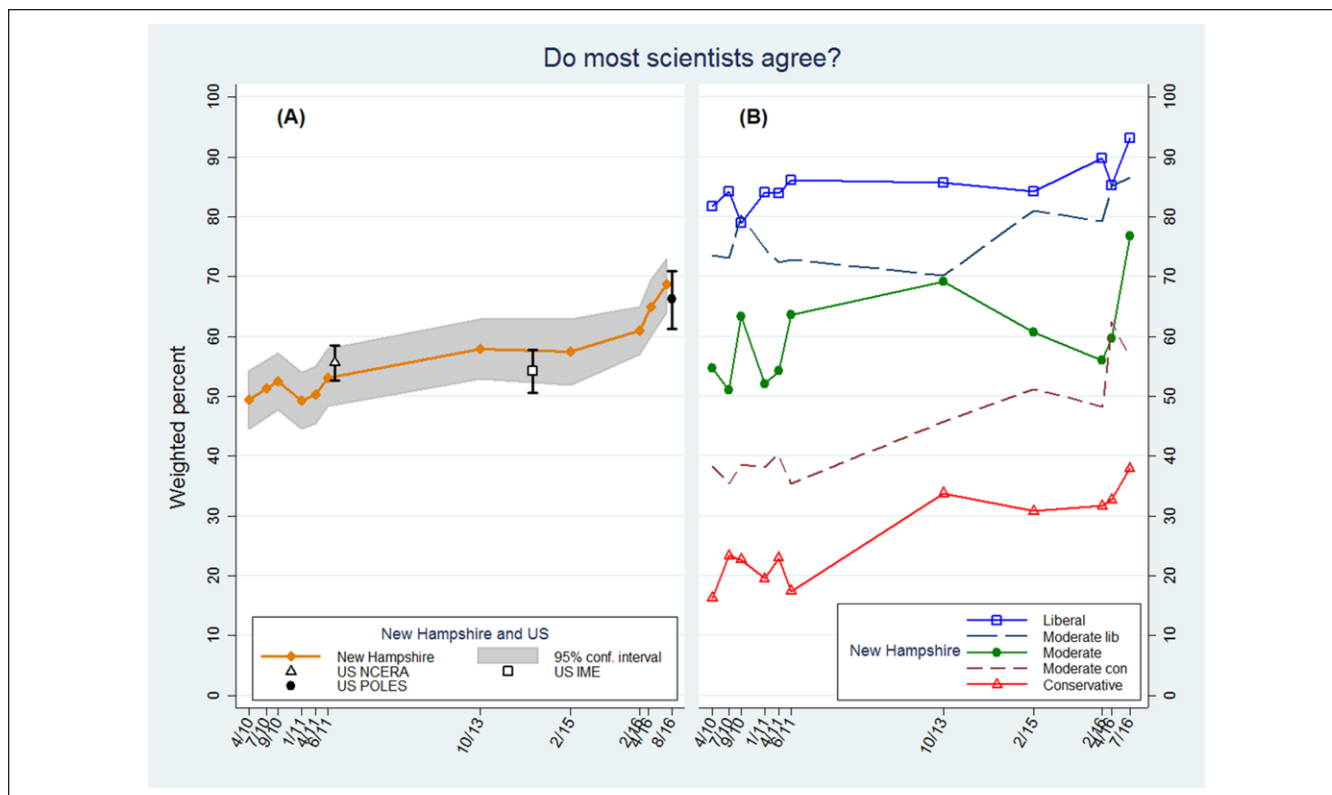
General Social Survey (GSS) is a representative national survey based on face-to-face interviews, conducted by the National Opinion Research Center, University of Chicago, in 2012 ( $n = 1,295$ ).

iMediaEthics Poll on Climate Change (IME) is a representative national telephone survey conducted by Princeton Survey Research Associates International in July 2014 ( $n = 1,002$ ).

POLES is a representative national telephone survey organized by University of New Hampshire and Columbia University researchers in August 2016 ( $n = 704$ ).

Hamilton et al. (2015) give references concerning the NCERA, GSS, and IME surveys. The supporting information archived with that paper includes complete NCERA and IME data sets. The August 2016 POLES survey is described by Hamilton (2016).

Ideological or partisan divisions are a dominant feature of climate-change questions in surveys. For the New Hampshire time series, Figure 2B breaks down the percentage of now/human responses to *climate* by ideology, on a 5-point scale from *liberal* to *conservative*.<sup>2</sup> Percentages based on the smaller subsamples forming each ideological category exhibit more random variation, but show a persistently wide gap between conservatives and liberals. Figure 2B visualizes the strong polarization of climate-change responses in surveys.



**Figure 3.** Percentage who think most scientists agree that human activities are changing the climate.

Note. Plotted by median interview date on three U.S. and 11 New Hampshire surveys (A); and separated by ideology on the New Hampshire surveys (B). NCERA = National Community and Environment in Rural America; IME = iMediaEthics Poll on Climate Change; POLES = Polar, Environment, and Science.

The most conservative respondents are farthest from other groups; see Hamilton and Saito (2015) for other instances of that pattern.

Figure 3 employs a similar format to display results for the *consensus* question, tracking the percentage of respondents who think most scientists agree that human activities are changing the climate. It bears emphasizing that this consensus question asks whether respondents think that most scientists agree about the *existence* of ACC, not about all of its details where scientific disagreements and new advances naturally occur.

Although based on fewer interviews ( $n = 5,872$  from 11 surveys for New Hampshire, along with the NCERA, IME, and POLES national surveys), the *consensus* results in Figure 3 generally resemble those for *climate* in Figure 2. There is an uneven upward drift of roughly 10 points overall (Figure 3A). Again, the confidence intervals of New Hampshire results overlap with those of contemporary national surveys. The liberal-conservative gap in Figure 3B is slightly narrower than that in Figure 2B: Beliefs about agreement among scientists are marginally less polarized than beliefs about ACC itself.

### Individual Background and Ideology Effects

In Figures 2 and 3, climate and consensus beliefs exhibit similar patterns of slow upward drift. To test formally

whether the percentage accepting ACC or recognizing agreement among scientists has risen, we can include *year* in a standard regression framework that has been widely used to model individual-level predictors of climate beliefs.

Table 2 gives results from weighted logit regression of *climate* and *consensus* on respondent *age*, *sex*, *education*, and *ideology* (questions and coding defined in Table 1).<sup>3</sup> Models 1 and 2, based on New Hampshire data, also test for net effects from survey *year* (2010–2016). Model 1 does so using data from all 26 New Hampshire surveys that carried the *climate* question (estimation sample,  $n = 14,265$ ), whereas Model 2 employs only the 11 surveys that asked the *consensus* question (estimation sample,  $n = 5,313$ ). Models 3 and 4 give results from the POLES survey for a national comparison (2016 only). The fit of each model is summarized by probability-weighted versions of the count  $R^2$  and adjusted count  $R^2$  statistics described in Long and Freese (2014).

Interaction effects involving education and ideology have been detected in many survey and experimental data sets. Their common form is that ideological divisions regarding climate change widen with education, such that the best educated partisans stand the farthest apart. This occurs not only with education but also with other information indicators such as self-assessed understanding, or more objective tests

**Table 2.** Ideology, Background Characteristics, and Year of Survey as Predictors of Climate-Change and Scientific-Agreement Responses (Variables Defined in Table 1).

Predictor	Model			
	1. NH <i>Climate</i>	2. NH <i>Consensus</i>	3. U.S. <i>Climate</i>	4. U.S. <i>Consensus</i>
Age	0.988***	0.993**	0.984**	0.985**
Female	1.315***	1.029	1.463	0.938
Education	1.208***	1.240***	1.262*	1.303**
Ideology	0.528***	0.543***	0.542***	0.562***
Education × Ideology	0.828***	0.837***	0.725***	0.849*
Year	1.057***	1.094***	—	—
Estimation sample	14,266	5,313	601	601
F statistic	301.5***	125.3***	171.1***	126.0***
Count $R^2$	.72	.71	.75	.73
Adjusted count $R^2$	.34	.33	.29	.18

Note. Odds ratios from weighted logistic regressions using NH or national POLES (U.S.) survey data. NH = New Hampshire; POLES = Polar, Environment, and Science.

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

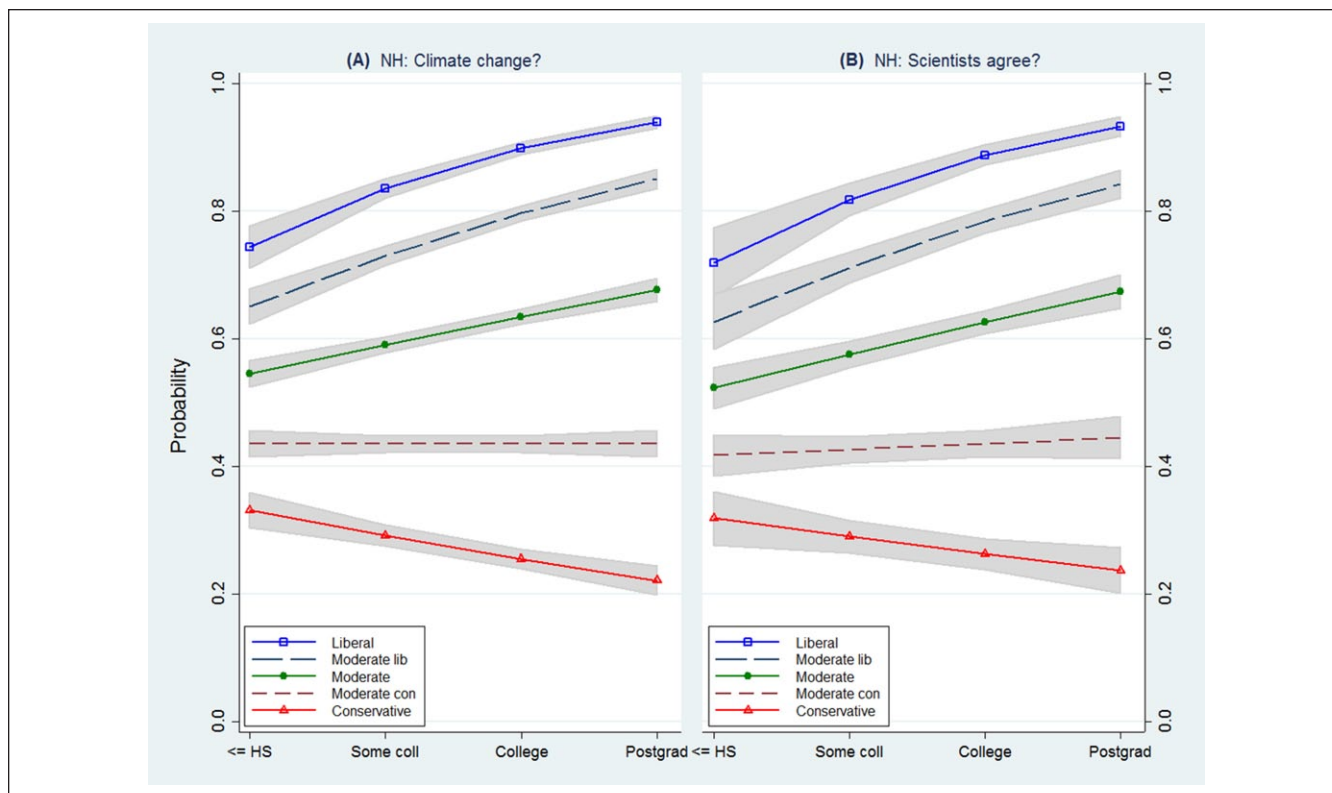
of science literacy, numeracy, cognitive reflection, or science intelligence. It occurs also whether ideology is indicated by respondent's self-identification on a liberal to conservative scale, political party, religiosity, or more elaborate measures of worldview (e.g., Hamilton, 2008, 2011; Hamilton & Keim, 2009; Hamilton, Cutler, & Schaefer, 2012; Kahan, 2015a; Kahan et al., 2011; McCright & Dunlap, 2011; Shao, Keim, Garland, & Hamilton, 2014). Finally, such interactions affect some non-climate views too—for example, regarding evolution, vaccines, scientists, or environmental protection in general (e.g., Hamilton, Colocousis, & Duncan, 2010; Hamilton, Hartter, & Saito, 2015; Hamilton & Safford, 2015; Hamilton & Saito, 2015).

The models in Table 2 fit reasonably well (adjusted count  $R^2$  from 18%-34%) and confirm that climate-change and consensus beliefs have mostly the same individual-level predictors. Coefficients shown are odds ratios, or multiplicative effects on the odds of thinking that humans are changing the climate (*climate* = 1) or that most scientists agree (*consensus* = 1). The odds of thinking that humans are changing the climate, or that most scientists agree on this, decline with age. Women more often than men accept that humans are changing the climate, but gender makes little difference in perceptions of the scientific consensus. Odds ratios significantly above 1.0 for the main effect of *education* indicate that among moderate respondents (*ideology* = 0), the odds of accepting ACC, or that scientists agree, increase with higher education. Odds ratios below 1.0 for the main effect of *ideology* indicate that among respondents with technical school or some college education (*education* = 0), the odds of accepting ACC, or that scientists agree, decline as ideology becomes more conservative.

Figure 4 visualizes the New Hampshire *education* × *ideology* interaction effects, which are significant and similar in the U.S. POLES data as well. These adjusted marginal plots

(Mitchell, 2012) depict probabilities and 95% confidence intervals. Their right-opening megaphone shapes resemble those found in many studies cited above. Here, we see that among liberals and moderates, the probability of thinking that humans are changing the climate, or that most scientists agree on this point, rises with education. Among moderately conservative respondents, however, education has virtually no effect. Among the most conservative, belief that humans are changing the climate or that most scientists agree declines with higher education.

Viewing plots of this general type, some analysts have concluded that information itself causes polarization. Given the occurrence of similar patterns with diverse information or education indicators, however, it seems more plausibly attributed to general processes of *biased assimilation* (Corner, Whitmarsh, & Xenias, 2012; McCright & Dunlap, 2011), *elite cues* (Brulle, Carmichael, & Jenkins, 2012; Darmofal, 2005), and related concepts (Campbell & Kay, 2014; Kahan et al., 2011; Taber & Lodge, 2006; Wood & Vedlitz, 2007). Better educated or informed individuals more actively acquire information, which sometimes involves filtering to support ideological beliefs. In reactions to experimental scenarios, such processes might appear left/right symmetrical, with opposite bias affecting both ends of the spectrum. In practice, however, it is much easier to find topics (such as climate or evolution) where liberal and moderate views align with a major scientific consensus, whereas conservatives oppose it, rather than the reverse. A corresponding asymmetry appears in survey findings that liberals and moderates express greater trust than conservatives regarding science in general (Gauchat, 2012; Nadelson et al., 2014), or as a source of information in specific domains including not only climate and evolution but also vaccines, nuclear power safety, and genetically modified organisms (Hamilton, 2015; Hamilton et al., 2015).



**Figure 4.** Interaction of education and ideology affecting respondents' beliefs about the reality of ACC (A), and whether most scientists agree on this reality (B).

Note. Adjusted marginal plots based on Models 1 and 2 in Table 2. ACC = anthropogenic climate change; NH = New Hampshire.

Time plots in Figures 2A and 3A suggest that public acceptance of ACC and a scientific consensus have drifted upward over the past 7 years. Models 1 and 2 in Table 2 test this hypothesis by including survey year along with respondent characteristics among the predictors. Both find significant ( $p < .001$ ) positive effects. The odds of thinking that human activities are changing the climate increased about 6% (multiplied by 1.06) per year over this period, whereas the odds of thinking that most scientists agree increased somewhat faster, by about 9% per year. If awareness of the scientific consensus acts as a gateway cognition, then we might expect acceptance of ACC to change a bit more slowly as it seems to do here.

### Trends in Polarization

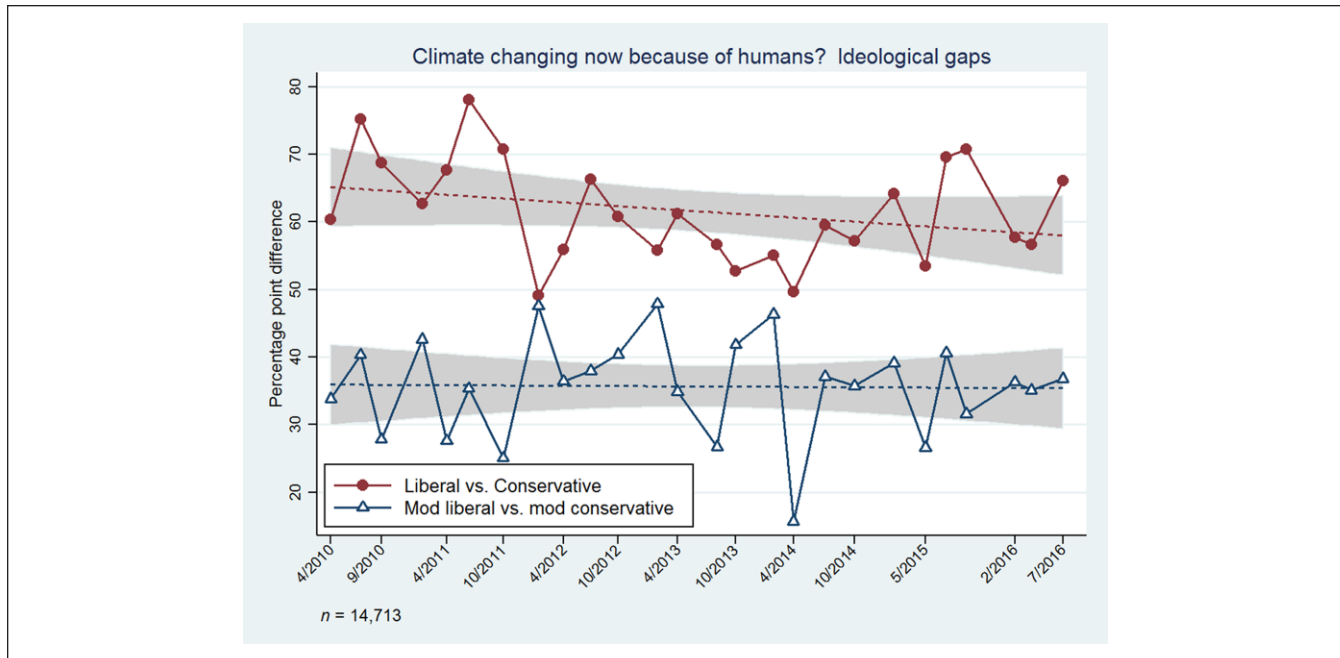
The New Hampshire analysis agrees with national reports that public belief in the reality of ACC, and of a scientific consensus on this point, have recently risen (Saad & Jones, 2016). There also is evidence that national polarization concurrently increased (Dunlap, McCright, & Yarosh, 2016), but in New Hampshire, it appears to have decreased. Figure 5 quantifies polarization as the distance between *climate* views of liberal and conservative respondents, or between those of moderately liberal and moderately conservative respondents.

Graphed points correspond to distances from lowest to highest lines (or from second lowest to second highest) in Figure 2B. Averaged by simple regression in the graph, the liberal/conservative gap narrows slightly, and not significantly, from 66 to 58 points. The moderately liberal/moderately conservative gap remains unchanged at about 36.

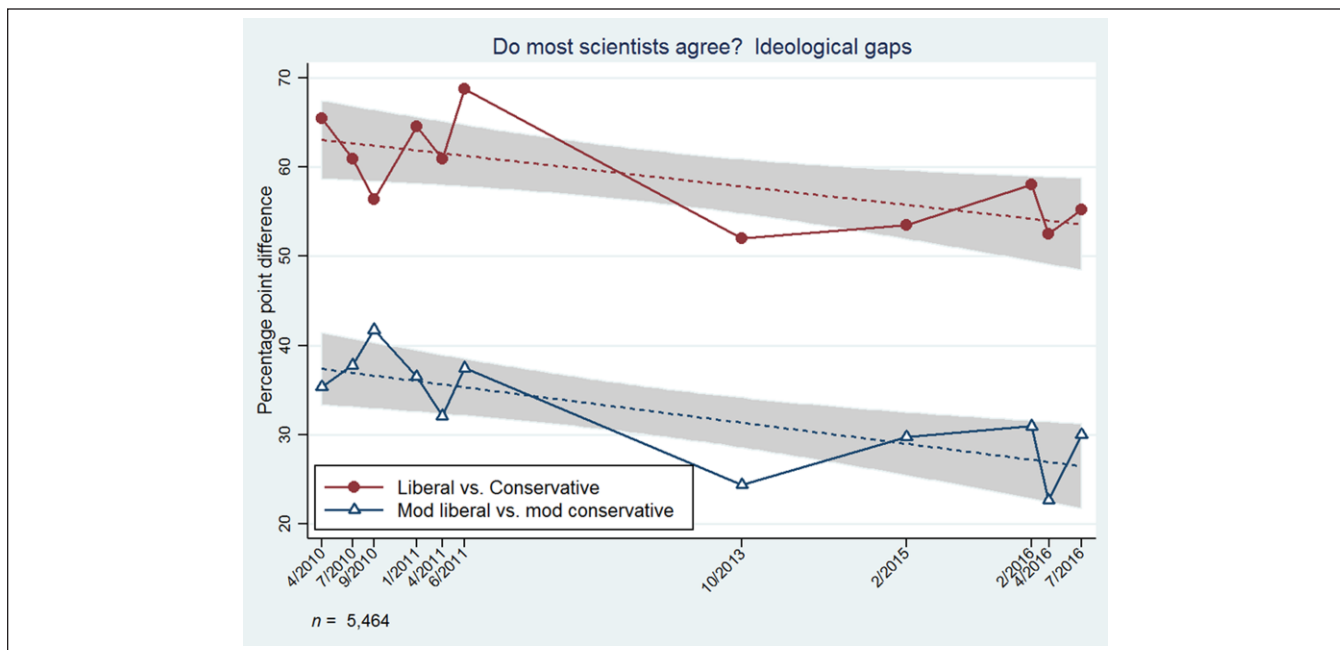
Figure 6 performs a similar analysis addressing the more contentious (among researchers) issue of polarization about the scientific consensus. In this case, both trend lines show mild but statistically significant narrowing, by about 10 points, of the gap between liberals and conservatives. Thus, our New Hampshire time series indicate that contrary to national trends (Dunlap et al., 2016), polarization regarding ACC did not increase over this period, and regarding the scientific consensus it clearly declined.

Although trends in ideological polarization are inconsistent, national and state data agree that overall public acceptance of ACC and consensus has been rising through small gains across the ideological spectrum. Whether ideological divisions have decreased from high levels (as in New Hampshire), or increased from somewhat lower levels (as nationally), they remain presently quite wide. Ideological indicators dominate the variation in individual views, and ideology moderates effects from education, otherwise the second most important background predictor.





**Figure 5.** Liberal-conservative and moderately liberal-moderately conservative gap on acceptance of ACC, 26 New Hampshire surveys 2010-2016 (with linear trends).  
Note. ACC = anthropogenic climate change.



**Figure 6.** Liberal-conservative and moderately liberal-moderately conservative gaps on whether most scientists agree, 11 New Hampshire surveys 2010-2016 (with linear trends).

## Discussion

The scientific case for ACC was well developed before these surveys began (Weart, 2008), with evidence from many disciplines that seemed persuasive to most scientists (Oreskes,

2004). Incremental advances have continued over the past 7 years, but from a public perspective, the contributions of individual studies are hard to judge, and prominent new studies are quickly dismissed with scientific-sounding counterarguments from contrarians (Dunlap & McCright, 2015). Recognizing

that the general public has limited ability to evaluate research, or weigh contradictory but scientific-sounding claims, a growing number of science organizations and individual scientists engaging with the public have moved to emphasize the extent of scientific agreement (consensus messaging). This is meant as a useful heuristic to help non-scientists sort through competing claims, without asserting that whatever scientists agree upon must be true—broad agreement on the reality of ACC reflects scientists' own evaluations of the evidence, rather than being evidence for climate change in itself.

Some commentators have proposed that people acknowledge a scientific consensus, while rejecting the reality of ACC, because they think most scientists are not credible—and that this group of doubters is growing. Accusations of hoax and conspiracy fuel such a narrative (Dunlap & McCright, 2015; Lewandowsky, Gignac, & Oberauer, 2013), although the partisan sources making those accusations tend also to deny the existence of a scientific consensus, painting climate research instead as the project of relatively few individuals and organizations.<sup>4</sup>

In terms of background characteristics, however, survey respondents who say they think that ACC is not happening, but also think most scientists agree that it is (i.e., respond *climate* = 0 but *consensus* = 1) resemble an unsure and possibly transitional group, rather than committed believers. In several data sets, those with mixed views tend to be somewhat younger, less educated, and more likely to identify as moderate or liberal, compared with more “consistent” respondents who reject both ACC and consensus (i.e., *climate* = 0 and *consensus* = 0).<sup>5</sup>

## Conclusion

Tracked by a series of closely spaced statewide surveys (benchmarked by nationwide surveys), public acceptance of the reality of ACC and of scientific agreement rose gradually from the low fifties in 2010 to low sixties by 2016. The observation that acceptance of ACC and consensus both increased is compatible with the proposition that implicitly or explicitly communicating evidence of agreement among scientists encourages public acceptance of ACC itself. It appears incompatible with the reverse, that communicating evidence of scientific agreement could depress overall public acceptance of ACC.

At the individual level, perceptions regarding the reality of ACC and consensus have similar background predictors. Ideology is the strongest of these predictors. Moreover, ideological differences on ACC and consensus tend to be greatest among respondents with higher education. Over 2010 to 2016, the gap between consensus perceptions of liberals and conservatives decreased in New Hampshire, although it increased nationwide, and in both cases remains large.

Has deliberate or incidental communication reinforcing public awareness of the scientific consensus helped to shift people's views, or raised acceptance of ACC itself? Our survey results cannot establish causality. But given the lack of visible impacts from events, cumulative efficacy in communicating

the scientific consensus appears a plausible explanation for gradually rising public acceptance of the reality of ACC.

Although public acceptance of ACC rose over the years studied, it remains well below the level of agreement among scientists. Public concern also has not translated into voting behavior because parties have become social identities in the United States. People's social commitment to keeping the other party from power overcomes the mixture of views they might hold on particular issues (Dunlap et al., 2016; Mason, 2015). Our findings give encouragement but no cause for complacency among scientists engaged with the public; if public engagement has had some success, it still has a long way to go. And public opinion, unlike melting ice sheets, can reverse course very quickly. Future surveys in this series will continue monitoring, for good or bad news.

## Author's Note

Opinions, findings, and conclusions or recommendations in this article are those of the author and do not necessarily represent the views of supporting agencies.

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## Notes

1. The Granite State Poll (GSP) employs trained and supervised interviewers, calling randomly selected landline and cell telephone numbers. Interviews last about 15 min and cover approximately 40 questions, including without emphasis a few about climate. Response rates over this period ranged from 16% to 32% by the American Association for Public Opinion Research's (AAPOR; 2006) definition 4. Probability weights are calculated to allow minor adjustments for design or sampling bias, and applied to all analyses in this article. The GSP faces reality testing with each election, and becomes nationally prominent every 4 years in the context of New Hampshire's presidential primary (Moore & Smith, 2015). It has proven to be a capable platform for basic research (e.g., Hamilton, 2012).
2. The GSP asks respondents to place themselves on a 9-point scale from *extremely liberal* (1) to *extremely conservative* (9), with moderate (*leaning neither way*) in the center (5). Detailed analysis finds that in practice, some of these are not very different. For example, the distinction between *moderate*, *leaning a little more toward the*

*conservative side* (6 on the scale where 5 is simply *moderate*) and *somewhat conservative* (7) does not seem to be sharp in many people's minds, judging by the similar answers these two groups give to other questions. We obtain more consistently interpretable results using a simpler scheme with five categories: *liberal* (originally 9 or 8), *moderately liberal* (7 or 6), *moderate* (5), *moderately conservative* (4 or 3), or *conservative* (2 or 1). People who say they do not know or otherwise declined to answer the ideology question (about 7% of the total) do not appear to form a coherent group, so are set aside for analyses involving ideology.

3. Some studies employ much longer lists of predictors, but these often reduce precision (raise standard errors and reduce sample size) while showing inconsistent effects. In contrast, the compact set of predictors used here has proven replicable across dozens of independent data sets, often with agreement not only on statistical significance but effect magnitudes (e.g., odds ratios) as well. For example, Hamilton et al. (2015) apply this general regression framework to the *climate* question asked in 35 separate surveys.
4. Michael Mann (2013) characterizes the politically focused attacks on individual scientists (rather than large organizations or disciplines that hold similar views) as a "Serengeti strategy," referencing the way African predators separate individual prey animals from the herd.
5. Similar observations apply to the mirror-image group (about the same size) who accept anthropogenic climate change (ACC) but do not think most scientists agree (*climate* = 1 and *consensus* = 0). They likewise tend to be younger, less educated, and more ideologically diverse than others who share their acceptance of ACC.

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