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An attack on science? Media use, trust in scientists, and perceptions of global warming

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Abstract

There is a growing divide in how conservatives and liberals in the USA understand the issue of global warming. Prior research suggests that the American public's reliance on partisan media contributes to this gap. However, researchers have yet to identify intervening variables to explain the relationship between media use and public opinion about global warming. Several studies have shown that trust in scientists is an important heuristic many people use when reporting their opinions on science-related topics. Using within-subject panel data from a nationally representative sample of Americans, this study finds that trust in scientists mediates the effect of news media use on perceptions of global warming. Results demonstrate that conservative media use decreases trust in scientists which, in turn, decreases certainty that global warming is happening. By contrast, use of non-conservative media increases trust in scientists, which, in turn, increases certainty that global warming is happening.

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Consensus continues to grow within the scientific community that global warming poses serious risks to human societies and natural ecosystems (IPCC, 2007). A variety of impacts are already occurring in the United States (US Global Change Research Program, 2009). Many Americans, however, perceive climate change as a distant problem that will primarily affect future generations of people in other countries (Leiserowitz et al., 2011). In turn, global warming is consistently ranked as a relatively low public priority, compared to a range of other national issues (Pew Research Center for the People and the Press, 2012). Moreover, global warming, and the environment more generally, have become politically divisive issues (Dunlap and McCright, 2008; McCright and Dunlap, 2011a). For example, whereas Democrats tend to accept the evidence for global warming and believe that it is human-caused, significantly fewer Republicans hold these beliefs (Dunlap and McCright, 2008).

This political polarization is partly the product of a coordinated denial movement (Dunlap and McCright, 2011) that uses conservative media as a conduit for casting doubt on the science of climate change among ideologically receptive audiences (Hamilton, 2011). Part of this strategy includes undermining scientists and their research (Dunlap and McCright, 2011). Trust in scientists has been in decline for several decades among US conservatives (Gauchat, 2012), and trust in scientists as a source of information on global warming dropped sharply between 2008 and 2010, particularly among conservative Republicans (Leiserowitz et al., 2010). By contrast, Democrats and liberals have higher and more stable levels of trust in scientists (Brewer and Ley, 2012; Leiserowitz et al., 2010).

Previous research has found that people rely heavily on cognitive heuristics when reporting attitudes and opinions on prominent issues (Fiske and Taylor, 1991). The relative lack of public knowledge about global warming (Leiserowitz, Smith, and Marlon, 2010) suggests that many individuals use simple heuristics, such as trust, to make sense of conflicting information and form their opinions about climate change. Yet, given the conservative media's mobilization against climate science in the USA (Dunlap and McCright, 2011), Americans' levels of public trust in scientists and, in turn, beliefs about global warming, are likely to depend on the media sources they use.

This study explores the relationships between media use, trust in scientists and perceptions of global warming. Specifically, we utilize within-subject panel data from a nationally representative sample of Americans to test whether trust in scientists mediates the relationship between particular media use and beliefs about global warming. Prior research on the role of sociocultural factors in predicting attitudes toward controversial science and technology issues has treated media use and trust as independent factors (e.g. Brewer and Ley, 2011; Lee et al., 2005), rather than considering the interplay between these variables. Examining how these two variables uniquely influence attitudes may provide a more comprehensive understanding of why people hold particular beliefs about climate change. Moreover, the use of within-subject panel data allows us to examine whether there is an over-time influence of media use on global warming beliefs. We are thus able to make stronger claims about the direction of the relationship between US partisan media use and beliefs about global warming than have been possible in prior cross-sectional studies (e.g. Feldman et al., 2012; Krosnick and MacInnis, 2010).

Origins and strategy of the climate change skeptics movement

As the scientific research on global warming advanced, the nations of the world created the Intergovernmental Panel on Climate Change (IPCC). In its most recent assessment report, the

IPCC (2007) demonstrated that human activities, primarily the burning of fossil fuels in industrialized societies, are causing global warming. In addition to the IPCC, the international community negotiated and ratified the United Nations Framework Convention on Climate Change (UNFCCC) to assess and respond to this new threat to the global commons. In the USA, conservatives saw these organizations, and the environmental movement more generally, as a threat to free market capitalism. To counter these environmental organizations, conservatives embraced scholars who touted 'human ingenuity' as the 'ultimate resource,' which helped them 'deny the possibility of limits to economic growth' (Dunlap and McCright, 2010: 243). To effectively spread this message, conservatives developed a network of organizations focused on 'environmental skepticism', which Jacques defines as 'a position that rejects the authenticity of … ecological problems' (2009: 18).

Two types of organizations are primarily responsible for spreading and legitimizing environmental skepticism in the USA: conservative think tanks (CTTs) and conservative media. Conservative think tanks produce research reports that purport to demonstrate the benefits of deregulation and challenge existing empirical evidence highlighting the risks of global warming (Dunlap and McCright, 2010; Jacques, 2009). An analysis examining the origins of research studies questioning mainstream climate science found the studies were almost exclusively funded by CTTs (Dunlap and McCright, 2010, 2011). Once released, US conservative media then distribute the findings to the public (Dunlap and McCright, 2010, 2011).

Impact of media coverage on the public's belief that global warming is happening

In recent years, cable and talk radio outlets in the USA have begun to differentiate themselves by offering more opinionated and partisan content. For example, several content analyses have revealed that Fox News and conservative radio programs (e.g. *The Rush Limbaugh Show*) cover issues and events – from the Iraq War to the campaign for the US presidency – in a way that is more supportive of conservative and Republican interests than CNN, MSNBC, and the national network news programs (Aday et al., 2005, Project for Excellence in Journalism, 2008). Consistent with this broader coverage, content analyses have shown that conservative media consistently claim a lack of scientific consensus on the reality of anthropogenic climate change (Dunlap and McCright, 2010). Studies have also found that Fox News airs significantly more stories that question the existence of human-caused climate change than stories that accept these scientific claims (Feldman et al., 2012).

In turn, survey and experimental research have found relationships between exposure to these information outlets and beliefs about global warming. For example, watching Fox News (Feldman et al., 2012; Krosnick and MacInnis, 2010), consuming news stories that present evidence questioning the certainty of climate change (Corbett and Durfee, 2004), and watching stories that include an interview with a skeptical scientist commenting on global warming (Malka et al., 2009) all decrease beliefs that global warming is happening and human caused. Thus, we propose that:

H1: Conservative media use will be negatively related to certainty that global warming is happening.

Although early content analyses found that US media outlets across the political spectrum overemphasized the 'debate' surrounding the existence of global warming (Zehr, 2000), recent studies suggest mainstream news sources (e.g. CNN) are now less likely to give equal time to global warming skeptics (Boykoff, 2007). An examination of CNN's broadcasts found more interview guests are concerned about global warming than dismissive, and that its stories are more likely to

emphasize that global warming is happening and caused by human activity than Fox News broadcasts (Feldman et al., 2012). In addition, liberal-leaning outlets such as MSNBC tend to convey similar coverage of global warming as mainstream media (Feldman et al., 2012).

This difference in coverage between conservative and non-conservative media outlets results in different patterns of media effects. Previous research has shown that providing context for climate skeptics' claims questioning global warming or including a mainstream scientist who challenges these claims reduces the effect of the skeptic on people's views of global warming (Corbett and Durfee, 2004). In addition, studies have found positive associations between viewing CNN and MSNBC and other non-Fox television news programming and acceptance of the problem of global warming (Feldman et al., 2012; Krosnick and MacInnis, 2010). Based on this evidence, we posit that:

H2: Non-conservative media use will be positively related to certainty that global warming is happening.

The mediating role of public trust in scientists

Public trust in scientists is an important variable to consider when attempting to understand the underlying process by which media use leads people to dismiss (or accept) the existence of global warming. Critchley characterizes trust as 'an expectation that a trustee is both able and motivated to behave in a way that is valued by a trustor' (2008: 311). Trust in scientists is a form of social or institutional trust, which denotes impersonal trust attributed to people working in institutions – as opposed to personalized trust in a known individual (Chryssochoidis et al., 2009). According to Chryssochoidis et al. (2009), institutional trust is malleable, shaped by sociocultural factors and value systems.

Several studies have identified the antecedents of trust in scientists (e.g. Anderson et al., 2011; Brewer and Ley, 2012). Of relevance to the present study, researchers focused on the US have documented ideological divisions in trust in scientists, with liberals generally more trusting than conservatives (Brewer and Ley, 2012, Gauchat, 2012). However, these studies have not specified how this ideological divide arises. We propose that, in the USA, the media sources preferred by liberals and conservatives play a role in shaping their respective levels of trust toward scientists. This argument is consistent with the finding that well-educated American conservatives have become more distrusting of scientists (Gauchat, 2012), likely due to their heightened attention to in-group messaging. Our explanation for this potential media effect on trust derives from the premise that institutional trust is built upon shared values (Siegrist et al., 2000). Further, because people's knowledge of most scientific issues, including climate change, is relatively limited (Leiserowitz et al., 2010), the salient values used to judge trustworthiness are likely to be general rather than specific (i.e. based on agreement and sympathy rather than on carefully reasoned arguments or direct knowledge). In this context, different media outlets help to cue audiences as to whether a particular institution or set of institutional actors, such as scientists, share a person's values and are thus trustworthy. They do this directly by reporting on scientific developments and controversies, but also by framing scientists and scientific issues in a way that makes certain values salient.

For example, by amplifying coverage of climate contrarians' claims regarding the reality and seriousness of anthropogenic climate change, Fox News and other American conservative media have served to marginalize scientists in general and climate scientists in particular (Dunlap and McCright, 2011; Feldman et al., 2012). According to Dunlap and McCright, 'conservative media consistently present contrarian scientists and CTT representatives as 'objective' experts, in stark contrast to their portrayal of scientists working with the IPCC as self-interested and biased' (2011:

152). This coverage often includes specific critiques of mainstream scientists such as 'the denigration of peer-reviewed, scholarly journals and scientific institutions by contrarian scientists' (Dunlap and McCright, 2010: 254) or equating the content of scientific journals with the editorial page of *The New York Times*, a perceived enemy of conservatives (Dunlap and McCright, 2010). Conservatives in the USA also argue that scientists manipulate their data to fund their research projects (Washington and Cook, 2011) and question the competency of scientists and their findings by setting unrealistic and unobtainable expectations for scientific research. McKnight further argues that News Corporation, the parent company of Fox News, characterizes science as a form of 'orthodoxy' and climate skeptics as 'brave dissidents against an oppressive set of beliefs' (2010: 704). In this way, conservative media are signaling to viewers who they should or shouldn't trust as sources of information on climate change on the basis of shared values.

Non-conservative American news sources, on the other hand, generally communicate the message that climate science and scientists should be trusted. The mainstream press (e.g. *New York Times, Washington Post* and *CNN.com*) now cover climate change in a way that is aligned with the prevailing scientific consensus on the issue (Boykoff, 2007) and largely ignore climate skeptics (Feldman et al., 2012; Nisbet, 2011).

Prior evidence for media effects on trust in scientists, while relatively limited, is nonetheless suggestive. Anderson et al. (2011) found that science media use and public affairs media use were positively associated with trust in scientists as sources of information on nanotechnology. In the context of climate change, Leiserowitz et al. (2010) found that of those Americans who had heard of 'Climategate' and followed the story, over half said the stories caused them to have less trust in scientists. This was especially true among conservatives. Further, Nisbet et al. (2002) demonstrated that media effects on perceptions of science, in general, are not monolithic and that when media sources portray negative images of scientists, they have the potential to dampen support for science and scientists. Thus, in light of how conservative and non-conservative media construct images of scientists, these discrepant sources are likely to have unique effects on public trust in scientists. Consistent with this expectation, Krosnick and MacInnis (2010) found that exposure to Fox News was associated with lower levels of trust in what scientists say about the environment, while exposure to news sources other than Fox was associated with higher levels of trust. Following from this prior research and theory, we posit that:

H3: Conservative media use will be negatively related to trust in scientists.
H4: Non-conservative media use will be positively related to trust in scientists.

Trust, in turn, is important to the formation of beliefs about global warming. This, in part, is because people are 'cognitive misers' (Fiske and Taylor, 1991), meaning that they rely on heuristics, or information shortcuts, when making judgments about complex issues, rather than carefully evaluating the full range of information at their disposal. Trust is one such heuristic to which people turn when forming opinions about science and risk issues (Brewer and Ley, 2011, 2012; Lee et al., 2005; Liu and Priest, 2009). Because most scientific phenomena are not experienced directly by ordinary individuals, the public's understanding of science often depends on its 'translation' by experts (Lidskog, 1996). However, the debate between climate scientists and contrarians creates uncertainty among the public. Lacking detailed knowledge about the issue at hand, people use trust to decide which experts' claims to accept or reject (Siegrist and Cvetkovich, 2000), ultimately accepting the claims of experts who share their values (Siegrist et al., 2000).

Several prior studies have found that institutional trust – and trust in scientists, in particular – is associated with attitudes toward controversial science and technology issues (e.g. Brewer and Ley,

2011; Critchley, 2008; Lee et al., 2005; Liu and Priest, 2009; Priest, 2001; Siegrist, 2000). Scholars have likewise argued that trust is an important factor in determining public perceptions of climate change and support for mitigation efforts (Nisbet and Myers, 2007). Indeed, opinions and perceptions of climate change are especially apt to be influenced by trust – given the issue's complexity, its politicization and connection to ideological values, its remoteness from everyday experience, and the public's lack of knowledge about the topic. Moreover, the way that the news media cover climate change emphasizes the competition between climate scientists and contrarians, thereby privileging the role of these individuals and their claims in shaping understanding of the issue (Boykoff and Boykoff, 2007). Because of this 'personalization bias', the credibility of the individual players in the climate change debate becomes a salient heuristic. Although there is limited empirical research that tests the relationship between trust in scientists and perceptions of climate change, one study found that trust in scientists regulates acceptance of global warming messages (Malka et al., 2009). Thus, we propose:

H5: Trust in scientists will be positively related to certainty that global warming is happening.

Ultimately, the hypotheses outlined in this article suggest an indirect effect of media use on beliefs about global warming through an individual's level of trust in scientists. In fact, Priest (2001) argues that the media's influence on public attitudes about science is most likely to occur indirectly, by shaping perceptions about 'the nature of science, of scientists, and of organizations and agencies that sponsor and make use of scientific results' (2001: 105). Thus, we propose the following hypotheses:

H6: There will be a negative indirect effect of conservative media use on certainty that global warming is happening through trust in scientists; that is, the negative association between conservative media use and certainty that global warming is happening will be explained, in part, by the negative influence of conservative media use on trust in scientists, which subsequently dampens belief certainty about global warming.

H7: There will be a positive indirect effect of non-conservative media use on certainty that global warming is happening through trust in scientists; that is, the positive association between non-conservative media use and certainty that global warming is happening will be explained, in part, by the positive influence of non-conservative media use on trust in scientists, which subsequently increases belief certainty about global warming.

Method

Data for this study are drawn from a multi-wave survey that measured respondents' climate change beliefs, risk perceptions, policy preferences and related behaviors. Participants were members of a nationally representative, online panel of Americans maintained by Knowledge Networks. Knowledge Networks recruits its 50,000-member panel using random digit dialing and address-based sampling. The use of this dual sampling strategy covers both listed and unlisted phone numbers, telephone, non-telephone and cell-phone-only households. Panelists complete an average of two 5 to 20 minute surveys per month for which they receive small incentives, in the range of $4 to $6. Those without a home computer receive a free netbook and internet service to ensure that

Table 1. Demographic statistics.

	Knowledge Networks study sample (N = 1,036)	Benchmarks from the March 2008 Current Population Survey
	%	%
Sex		
Female	48.2	47.8
Age		
18–29	12.3	21.3
30–39	14.3	16.5
40–49	20.1	19.5
50–59	23.0	18.3
60–69	20.7	12.1
70 and older	9.5	12.2
Race/ethnicity		
White	83.7	73.9
Education		
Less than high school	5.9	11.9
High school diploma	26.5	31.4
Some college	28.2	29.2
Bachelor's degree or higher	39.4	27.6

segments of the population without computers are represented in the panel. Study participants were randomly drawn from this larger Knowledge Networks' panel. A total of 2497 respondents participated in the first wave of data collection in the fall of 2008 (completion rate 62.5%, cumulative response rate 7.6%); of these respondents, 1036 participated in a second survey wave in the spring of 2011 (completion rate 83.7%, cumulative response rate 7.7%[1]). Sample characteristics are presented in Table 1, along with comparative statistics from the 2008 Current Population Survey. In general, our sample compares favorably to US census data, although we have somewhat underrepresented non-whites, those with minimal formal education, and 18–29 year-olds.

Survey context

To contextualize the time periods in which our data were collected, Figure 1 plots the results of a Lexis Nexis search for stories from news outlets in the US mentioning 'global warming' or 'climate change' in the headline or lead from 1 January 2008 to 31 December 2011. The TV/radio line depicts the number of stories appearing each month totaled across ABC, CBS, NBC, MSNBC, CNN, NPR and Fox News, all of which were included in our survey measures of non-conservative and conservative[2] media use. The newspaper line includes stories from *The New York Times* and *The Washington Post*, widely considered to be the newspapers of record in the USA. Finally, the total line depicts the number of stories across all nine outlets. Consistent with previous research (see Boykoff, 2012; Nisbet, 2011), our results show that global warming continues to receive a moderate amount of media coverage, with spikes occurring around important events (e.g. the December 2009 United Nations Climate Change Conference in Copenhagen, Denmark). Specific to our study, results show that during October and November 2008, which correspond to wave 1 data collection, approximately 35 stories per month appeared

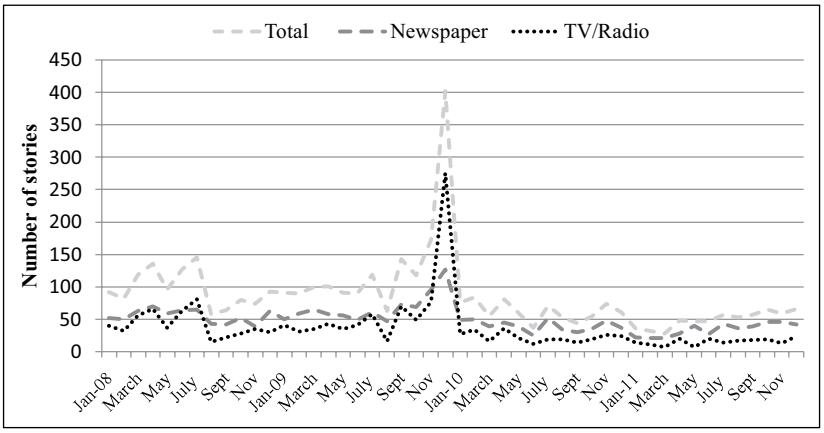

Figure 1. News coverage of global warming from 2008 to 2011.
Note: Number of articles or transcripts with 'climate change' or 'global warming' appearing in headline or lead. Newspaper sources include the *New York Times and Washington Post*. TV/radio sources include ABC, NBC, CBS, CNN, MSNBC, Fox News, and NPR.

in the TV and radio outlets. Approximately 15 stories per month appeared in these outlets during wave 2 of data collection, which occurred in April, May and June 2011. These numbers are consistent with the general level of media coverage, as represented by the two newspapers included in our graph.

Independent variables

Conservative media use. Two items that asked respondents how often they watched Fox News and listened to *The Rush Limbaugh Show* (0 = never, 3 = often) were averaged to create an index of conservative media use ($M_{T1} = .83$, $SD_{T1} = .83$, $r_{T1} = .35$ $p < .05$; $M_{T2} = .72$, $SD_{T2} = .83$, $r_{T2} = .44$ $p < .05$).

Non-conservative media use. Individuals' use of four news sources known to align more closely with mainstream scientists' views of climate change were used as indicators of non-conservative media use: CNN, MSNBC, National Public Radio, and network news. Respondents were asked how often they used each outlet (0 = never, 3 = often), and these four items were averaged together ($M_{T1} = 1.17$, $SD_{T1} = .74$, $\alpha_{T1} = .67$; $M_{T2} = 1.03$, $SD_{T2} = .72$, $\alpha_{T2} = .63$)

Mediating variable

Trust in scientists. Trust in scientists was measured with one item that asked respondents how much they trust or distrust scientists as a source of information about global warming (0 = strongly distrust, 3 = strongly trust) ($M_{T1} = 2.08$, $SD_{T1} = .73$; $M_{T2} = 1.93$, $SD_{T2} = .78$).

Dependent variable

Global warming belief certainty. To measure global warming belief certainty, respondents were first asked whether they thought global warming was happening, with options being yes, no, or I don't

know. Individuals who answered yes or no responded to a follow-up question asking how sure they were about their position (0 = not at all sure, 3 =extremely sure). Responses to these items were combined to create a final belief certainty measure, ranging from 0 (extremely sure global warming is not happening) to 8 (extremely sure global warming is happening) ($M_{T1} = 5.81$, $SD_{T1} = 2.19$; $M_{T2} = 5.09$, $SD_{T2} = 2.43$).

Control variables

We have included several control variables in our regression models to reduce the chances that the relationships between our endogenous variables are spurious. Previous research has shown religiosity (Sherkat and Ellison, 2007), political ideology (McCright and Dunlap, 2011a) and gender (McCright and Dunlap, 2011b) to be significant predictors of people's attitudes toward issues concerning the environment. Therefore, we included these variables along with other traditional demographic controls in our analyses. We also controlled for forms of news media use that were not captured in our conservative and non-conservative media use measures. All control variables were measured in the first wave of data collection.

Other media use.[3]. *Local TV news use* was measured by asking respondents how often they watch local broadcast news (0 = never, 3 = often) ($M = 2.14$, SD = .99). *Online news use* ($M = 3.36$, SD = 2.73) and *print newspaper use* ($M = 3.15$, SD = 2.87) were each measured with one item that asked respondents how often they read the newspaper in each format (0 to 7 days a week).

Religiosity. Respondents were asked how often they attend church (0 = never, 5 = more than once a week) ($M = 2.27$, SD = 1.72).

Political ideology. Respondents were asked if they see themselves as a liberal or conservative (0 = very liberal, 4 = very conservative) ($M = 2.17$, SD = 1.00).

Demographics. Gender, race, age, education, and income were included as demographic controls. *Annual household income* was measured using a 19-point scale that ranged from less than $5000 a year to more than $175,000 dollars a year ($M = 11.90$, SD = 4.04 [$50,000 to $59,999]). Descriptive statistics for the other demographic variables are reported in Table 1.

Missing data

As is typical in survey data, some people did not respond to one or more questions used in the analyses. To reduce the amount of missing data, we used a hotdeck imputation procedure (Myers, 2011). To impute non-responses, the rows (i.e. respondents) of the survey data file were randomly permuted within sex and education. Any respondent missing on a given variable was assigned the value of the respondent with the same sex and education level nearest to him or her in this randomly permuted data file. Most respondents (90.8%) did not require any imputation, and no variables required imputation on more than 2.5% of cases.

Analysis

We utilized structural equation modeling (SEM) to estimate fixed effects models and lagged models. Fixed effects modeling is ideal for longitudinal panel data and strengthens the analysis of processes using non-experimental data (see Allison, 2009: Ch. 1; Bollen and Brand, 2008). Fixed

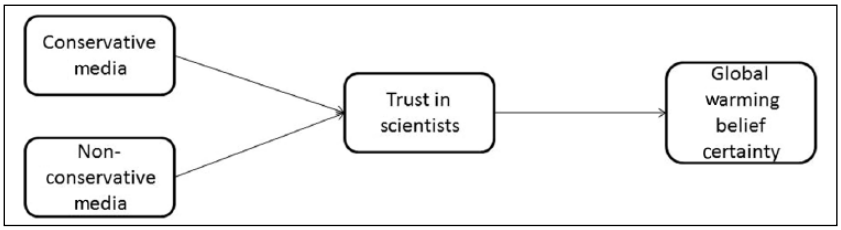

Figure 2. Path model predicting global warming belief certainty.
Note: Statistical controls were modeled, but not shown for the sake of space; controls included: political ideology, education, race (white vs. non-white), age, gender, income, church attendance, newspaper use (print and online), and local TV news use. These controls were also correlated with conservative and non-conservative media use. Lagged model 'A' tested whether media use at time 1 was associated with time 2 measures of trust in scientists and global warming belief certainty, controlling for the time 1 levels of the mediating and dependent variables. Lagged model 'B' tested whether media use and trust at time 1 was associated with the outcome variable at time 2.

effects modeling simultaneously models proposed relationships between independent and dependent variables at each time point, fixing the effects between these variables to be equal at both times. This method produces estimates that 'represent the effects of each variable in a given year on the value of the dependent variable in the same year' (Allison, 2009: Kindle location 401). Utilizing the individual as his or her own control allows these estimates to be free of the effect of any and all time-stable characteristics of the individual – even those not measured or included in the analysis (see Allison, 2009: Ch. 1). This increases the confidence that any observed effect is not a result of a spurious association (although unmeasured time-varying variables might still compete as explanations for spuriousness).

In addition, we estimated two lagged models to test the proposed causal relationships (see Figure 2). Model 'A' tested whether media use at time 1 was associated with time 2 measures of trust in scientists and global warming belief certainty, controlling for the time 1 levels of these latter two variables. Model 'B' tested whether media use and trust at time 1 were associated with global warming belief certainty at time 2, after controlling for time 1 levels of belief certainty. Lagged analysis allows us to model variation in the outcome variables, over and above what is predicted by their earlier reported levels at time 1. Thus, we can assess whether media use at time 1 is associated with a change in trust or belief about global warming at time 2, strengthening the evidence of a causal influence of the predictors (for a description of lagged dependent variable analysis, see Cohen et al., 2003).

To address potential concerns about multicollinearity, we first examined the zero order correlations among our time 1 independent variables. As shown in Table 2, correlations between variables were small to moderate. We also examined the estimated correlation matrices for the latent variables from our structural equation models; the absolute correlations ranged from .003 to .403, indicating a minimal multicollinearity threat.

We examined univariate and multivariate skewness using Mardia's (1970) test of multivariate skeweness and kurtosis. Mardia's coefficient of skewness ($M_3 = 2.638$, $p < .001$) and kurtosis ($M_4 = 28.182$, $p < .001$) indicated the assumption of multivariate normality was violated. To address this issue of non-normality, we estimated our models using the robust maximum likelihood estimator in Mplus (MLR). MLR fits Huber/White sandwich estimates of the standard errors, correcting for violations of normality and heteroskedasticity (Wang and Wang, 2012; White, 1980).

Table 2. Zero order correlations for all time 1 variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Education	1													
(2) Race	.05	1												
(3) Age	−.03	.13*	1											
(4) Gender	−.02	−.00	.05	1										
(5) Income	.35*	.13*	−.15*	−.07*	1									
(6) Religiosity	.04	−.11*	.06	.08*	.01	1								
(7) Ideology	−.08*	.06	.13*	−.08*	−.03	.25*	1							
(8) Newspaper (print)	.10*	.07*	.41*	−.03	.10*	.10*	.08*	1						
(9) Newspaper (online)	.29*	.06	−.06	−.10	.20*	−.05	−.05	.03	1					
(10) Local TV	−.10*	−.02	.34*	.04	−.07	.06	.01	.26*	−.05	1				
(11) Conservative media	−.08*	−.00	.21*	−.09*	−.00	.18*	.41*	.10*	.02	.15*	1			
(12) Non-conservative media	.09*	−.14*	.25*	.06	.01	−.02	−.23*	.21*	.19*	.41*	.06	1		
(13) Trust in scientists	.11*	−.03	−.01	.09*	.04	−.13*	.29*	.07*	.07*	−.01	−.22*	.22*	1	
(14) Global warming belief certainty	.07*	−.10*	−.01	.11*	−.01	−.17*	−.39*	.04	−.01	.05	−.33*	.24*	.43*	1

Table 3. Results of fixed effects and lagged regression.

	Fixed effects model		Lagged model 'A'		Lagged model 'B'	
	Tr Sci	GW Bel Cert	Tr Sci (T2)	GW Bel Cert (T2)	Tr Sci (T1)	GW Bel Cert (T2)
Global warming belief certainty	—	—	—	—	—	—
T1	—	—	—	.501***	—	.513***
Trust in scientists	—	.407***	—	—	—	—
T2	—	—	—	.550***	—	—
T1	—	—	.481***	.156+	—	.410***
Conservative media	−.097***	−.589***	−.075**	−.347***	−.107***	−.381***
Non-conservative media	.171***	.505***	.086**	.409***	.191***	.452***
Ideology (conservative high)	−.155***	−.558***	−.117***	−.288***	−.121***	−.346***
Education	.054**	.107+	.039+	.023	.046+	.043
White	−.054	−.385**	.006	−.313*	−.076	−.306+
Age	.000	.002	.001	−.003	.000	−.002
Gender	.081*	.131	.021	−.031	.089+	−.021
Income	−.004	−.018	−.014**	−.026*	.004	−.034*
Religiosity	−.028*	−.100**	−.009	−.031	−.031*	−.034
Newspaper (print)	.017*	.029	.004	.013	.019*	.015
Newspaper (online)	.007	−.017	.004	−.023	.003	−.020
Local TV	−.049*	−.011	−.034	−.081	−.050*	−.100+
Ind. effect of conservative media	—	−.039**	—	−.041**	—	−.044**
Ind. effect of non-conservativ media	—	.070***	—	.047*	—	.078***
Fit Indices	RMSEA = .046, CFI = .952		RMSEA = .050, CFI = .998		RMSEA = .291, CFI = .903	

Note: Entries are unstandardized regression coefficients.
Note: Intercorrelations between conservative media use, non-conservative media use, and all controls were modeled, but not shown here to preserve space.
***$p < .001$, ** $p < .01$, *$p < .05$, + $p < .10$

Results

Using fixed effects, we estimated the proposed relationships between media use, trust in scientists and global warming belief certainty; model fit was adequate (RMSEA = .046, CFI = .952). As hypothesized, greater use of conservative outlets was associated with lower levels of certainty that global warming is happening (β = -.559, $p < .001$), while greater use of non-conservative news was associated with greater certainty that global warming is happening (β = .481, $p < .001$). In addition, greater use of conservative news outlets was associated with lower levels of trust in scientists (β = -.094, $p < .001$), while greater use of non-conservative news was associated with higher levels of trust in scientists (β = .180, $p < .001$).[4] More trust in scientists, subsequently, was associated with an increase in global warming belief certainty (β = .424, $p < .001$), after controlling for included covariates and all other time-invariant personal characteristics (see Table 3).

Thus, news media use was associated with trust in scientists, which, in turn, was associated with increased certainty that global warming is happening. Tests of the indirect effects of media use demonstrated significant paths consistent with our hypothesized model. Results show a negative indirect effect, via trust, of conservative news use on global warming belief certainty (indirect effect = - .040, $p < .01$) and a positive indirect effect, via trust, of non-conservative news use (indirect effect = .076, $p < .001$).

Results from lagged model 'A', which examined the influence of media use at time 1 on outcomes at time 2, and lagged model 'B', which examined the influence of media use and trust at time 1 on global warming belief certainty at time 2, showed a similar pattern (model fit for lagged model 'A' was sufficient, RMSEA = .050, CFI = .998, although model fit for lagged model 'B' was sub-optimal, RMSEA = .291, CFI = .903, likely due to more over-time links). Frequent use of conservative media was negatively associated with certainty that global warming is happening in both models ($\beta_{Lagged\ 'A'} = -.346\ p < .001$; $\beta_{Lagged\ 'B'} = -.382$, $p < .001$), while use of non-conservative media increased people's certainty that global warming is happening ($\beta_{Lagged\ 'A'} = .412$, $p < .001$; $\beta_{Lagged\ 'B'} = .452$, $p < .001$) (see Table 3).

News media use was also associated with trust in both lagged models, with conservative media decreasing ($\beta_{Lagged\ 'A'} = -.077\ p < .01$; $\beta_{Lagged\ 'B'} = -.105$, $p < .001$) and non-conservative media increasing trust in scientists ($\beta_{Lagged\ 'A'} = .079$; $p < .01$; $\beta_{Lagged\ 'B'} = .191$, $p < .001$). In addition, these results once again showed that trust was associated with an increase in certainty that global warming is happening ($\beta_{Lagged\ 'A'} = .556\ p < .001$; $\beta_{Lagged\ 'B'} = .406$, $p < .001$).

These analyses also examined whether there is an indirect effect of media use on global warming belief certainty. The indirect effect of conservative media use via trust was significant in both models (indirect $\text{effect}_{\text{Lagged 'A'}} = - .043$, $p < .01$; indirect $\text{effect}_{\text{Lagged 'B'}} = - .043$, $p < .01$), as was the indirect effect of non-conservative media use via trust (indirect $\text{effect}_{\text{Lagged 'A'}} = .044$, $p < .05$; indirect $\text{effect}_{\text{Lagged 'B'}} = .078$, $p < .001$).

Discussion

The results of this study expand on previous research examining the relationship between media use and beliefs about global warming. Consistent with previous research (Feldman et al., 2012; Krosnick and MacInnis, 2010), this study finds that the more Americans use conservative media, the less certain they are that global warming is happening. Conversely, the more Americans use non-conservative media, the more certain they are that global warming is happening. Moreover, we found an over-time influence of media use on global warming beliefs. Our longitudinal research design extends this previous research by demonstrating that, over time, people's media use influences their beliefs about global warming. The present study also goes beyond previous efforts by considering trust in scientists as a mediating variable between media use and perceptions of global warming. The results demonstrate that the negative effect of conservative media use on global warming belief certainty is due, at least in part, to the negative effect of conservative media use on trust in scientists. The positive effect of non-conservative media use on belief certainty is likewise explained by the positive effect of non-conservative media use on trust. Furthermore, the use of within-subject panel data and longitudinal analysis shows that media affects people's level of trust in scientists.

Adding trust in scientists as a mediating variable provides a more comprehensive understanding of the relationship between media use and perceptions of global warming. In this article, we propose that people use trust as a cognitive heuristic to make judgments about the issue of global

warming (Lee et al., 2005; Priest, 2001). As we explain, the public's low level of knowledge (Leiserowitz et al., 2010) and the media's conflicting, often value-laden messages about global warming lead people to use heuristics to make sense of this complex issue (Chryssochoidis et al., 2009; Critchley, 2008; Siegrist and Cvetkovich, 2000).

As with any study, there are several limitations that should be kept in mind. The most notable being the time lag of two and a half years between the first and second rounds of data collection. As we are unable to account for what else may have occurred during this stretch of time, it is possible that uncontrolled outside influences produced a spurious association between media use at time 1 and trust in scientists and beliefs about global warming at time 2, or between trust at time 1 and beliefs at time 2. However, the implementation of fixed effects modeling strengthens our results by controlling for the effects of unobserved, stable trait variables, thus increasing the confidence that these relationships were not the result of a spurious association. In addition, because of the convergent evidence of significant relationships in both lagged models, together with statistically controlling for previous levels of the lagged dependent variables (thus modeling only the *change* in trust and beliefs), we believe there is strong evidence of a relationship between media use, trust and beliefs about global warming. Still, it is important to recognize that we have not fully corrected for self-selection bias. Moreover, this study did not account for the dynamic nature of the communication process – namely, the potential for media use to reinforce beliefs, which, in turn, affect future media use (e.g. Slater, 2007) – which remains an important avenue for future research. Furthermore, as the context for our study was the USA, it is unclear how generalizable our results are across other contexts; however, to the extent that media outlets in other contexts demonstrate similar patterns of coverage, we would anticipate effects in line with what we demonstrate here.

Evidence of an indirect effect of media use on global warming belief certainty through trust in scientists should motivate scholars to look for additional mediating variables to explain this process. Scholars could also extend this work by looking at trust in other prominent institutions such as government or commercial industry. It is also likely that trust in scientists is a multidimensional concept, encompassing trust in climate scientists, trust in medical scientists, trust in physicists, etc. Thus, future research may want to account for these different dimensions and their potential relationships with media use and global warming beliefs. Additional research should also expand on the theoretical model presented in this article by including moderating variables to explain *which* individuals are using these heuristic cues. For example, future studies could examine whether those with low levels of global warming knowledge are more reliant on heuristic cues such as trust in scientists when reporting their opinion about global warming.

Despite some limitations, these results have a number of important implications. First, it appears that climate change contrarians have successfully raised questions about scientists in the public mind. Polling data from 2008 showed that 83 percent of the US population at least somewhat trusted scientists as a source of information about global warming (Maibach et al., 2009); however, trust declined in 2010 to 74 percent (Leiserowitz et al., 2011). By contrast, these results demonstrate that use of non-conservative media outlets increases trust in scientists, suggesting that mainstream and liberal-leaning media coverage plays an important role in limiting (and countering) the effects of the climate skeptic movement. Therefore, continued use of mainstream news media outlets by the public (Webster, 2007) should help sustain the credibility of scientists as a source of information about global warming. Thus, mainstream news media should be cognizant of this role and continue to highlight scientists as a trustworthy source of information on climate change.

This raises the question of how scientists can defend their credibility from attacks by environmental skeptics via American conservative media sources, while capitalizing on high levels of public trust to increase certainty about the reality of global warming. Scientists could remain on the

sidelines and exclusively produce research for peer-reviewed journals and reports. Although this strategy may help keep scientists above the fray, this does not mean that they will remain neutral actors in the eyes of the public. Indeed, climate contrarians and conservative media outlets are already attacking the credibility of climate science and individual scientists (Dunlap and McCright, 2011). Remaining uninvolved gives climate contrarians and conservative media free rein to redefine how the public thinks about climate scientists and their research. Alternatively, scientists could use their trusted position in society to engage the public by providing them with understandable analysis and information about the causes, risks and potential solutions to climate change. However, this proactive stance may lead some members of the public to view scientists as increasingly politicized. In both scenarios, some members of the public may lose trust in scientists, which may be difficult to regain (see Slovic, 1993). Importantly, however, the sidelines strategy will likely lead to a greater total loss of public trust than the public engagement strategy – especially among the Cautious, Disengaged, and Doubtful audiences identified in prior research (Maibach et al., 2009), if climate contrarians are allowed to shape public discourse uncontested. Regardless, scientists will play an important role in how different publics perceive the issue of global warming. The question is whether it is on their terms or the terms of climate contrarians and their allies.

Finally, this research highlights the consequences of the contemporary American media landscape. The increasing fragmentation of audiences across diverse media outlets likely inhibits consensus-building and compromise on important issues, as exemplified by our findings regarding the global warming beliefs of conservative and non-conservative media audiences in the USA. Moreover, the gravitation of conservatives and Republicans to conservative media outlets and liberals and Democrats to non-conservative outlets (e.g. Stroud, 2011) could help explain the widening partisan divisions in public opinion about global warming and trust in scientists. This political polarization is contributing to national climate change policy paralysis in the USA, and it is becoming clear that the news media itself plays an important role in this process.

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Notes

1. For more information about how Knowledge Networks calculates these different response rates for online panels see Callegaro and DiSogra (2008).
2. Lexis Nexis does not include transcripts of *The Rush Limbaugh Show*.
3. These items were not included in the non-conservative media use variable for specific reasons. First, there is little research examining local news coverage of global warming. Second, with the available measures of online news and print newspaper use, there was no way to know whether the content of the website or newspaper came from mainstream (e.g. *The New York Times* or Politico.com) or conservative outlets (e.g. *The Washington Times* or redstate.com).
4. We also tested whether political ideology moderated the relationship between media use and scientific trust, exploring, for instance, whether liberals attending to liberal news outlets displayed an increased effect of that attention on perceptions of scientific trust compared to those individuals who are more politically conservative. Thus, we included interaction terms multiplying political ideology and news use in lagged model 'A'. Results demonstrated that the influence of media use on scientific trust was *not* moderated by political ideology; that is, the effect of attending to these news outlets did not depend on an individual's political leaning ($\beta_{\text{Conservative News by Ideology}} = -.004$, $p = .867$; $\beta_{\text{Non-Conservative News by Ideology}} = .013$, $p = .628$).

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