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Perceived scientific agreement and support for government action on climate change in the USA

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Abstract Given the well-documented campaign in the USA to deny the reality and seriousness of anthropogenic climate change (a major goal of which is to "manufacture uncertainty" in the minds of policy-makers and the general public), we examine the influence that perception of the scientific agreement on global warming has on the public's beliefs about global warming and support for government action to reduce emissions. A recent study by Ding et al. (Nat Clim Chang 1:462–466, 2011) using nationally representative survey data from 2010 finds that misperception of scientific agreement among climate scientists is associated with lower levels of support for climate policy and beliefs that action should be taken to deal with global warming. Our study replicates and extends Ding et al. (Nat Clim Chang 1:462–466, 2011) using nationally representative survey data from March 2012. We generally confirm their findings, suggesting that the crucial role of perceived scientific agreement on views of global warming and support for climate policy is robust. Further, we show that political orientation has a significant influence on perceived scientific agreement, global warming beliefs, and support for government action to reduce emissions. Our results suggest the importance of improving public perception of the scientific agreement on global warming, but in ways that do not trigger or aggravate ideological or partisan divisions.

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1 Introduction

Over the last 20 years, an organized climate change denial movement has mobilized in the USA to undercut public belief in climate science and political support for climate policy (Dunlap and McCright 2011; Oreskes and Conway 2010; McCright and Dunlap 2010; Powell 2011). This "denial machine" challenges the scientific community's claims that global warming is happening, that it is primarily anthropogenic in origin, and that it produces impacts that are harmful to humans and the ecosystem services upon which we depend (Intergovernmental Panel on Climate Change 2007; National Research Council 2010). It makes a special point of challenging the scientific consensus by amplifying the views of contrarian scientists and generating petitions asserting the lack of consensus (Hoggan 2009), a strategy abetted by the media's proclivity to present a "balanced" view in its coverage of climate change by highlighting dissenting voices (Boykoff 2011). This sustained climate change denial, promoted largely by the American conservative movement (Dunlap and McCright 2011; McCright and Dunlap 2003, 2010), contributes to political polarization on climate change beliefs and concern in the USA (Hamilton 2011; Malka et al. 2009; McCright and Dunlap 2011).

Given this well-documented climate change denial campaign in the USA to deny the reality and seriousness of anthropogenic climate change (a major goal of which is to "manufacture uncertainty" in the minds of policy-makers and the general public), we examine the influence that perception of scientific agreement on global warming has on the public's beliefs about global warming and support for government action to reduce emissions. A recent study (Ding et al. 2011) using nationally representative survey data from 2010 finds that misperception of scientific agreement on climate change is associated with lower levels of support for climate policy and beliefs that action should be taken to deal with global warming. Indeed, Ding et al. (2011) find that misperception of scientific agreement is the critical factor reducing support for climate policy, and that this relationship is mediated by beliefs about the timing, cause, and impacts of global warming.

Our study replicates and extends Ding et al. (2011) using nationally representative survey data from March 2012. We similarly expect that (1) perceived scientific agreement on the reality of global warming will be associated with increased support for government action on climate change and (2) this relationship will be mediated by key beliefs about the timing, human cause, seriousness, and threat of global warming (Fig. 1).

In testing the robustness of these key findings crucial for understanding citizens' support for climate policies, we also engage the broader literature on the predictors of support for policies proposed for reducing our nation's greenhouse gas emission (Bord et al. 2000; Bostrom et al. 2011; Dietz et al. 2007; Ding et al. 2011; Krosnick et al. 2006; Leiserowitz 2006; McCright 2009; O'Connor et al. 1999, 2002; Zahran et al. 2006). Belief in and concern about global warming are positively related to support for proposed climate policies (Bord et al. 2000; Bostrom et al. 2011; Dietz et al. 2007; Krosnick et al. 2006; McCright 2009; O'Connor et al. 1999, 2002; Zahran et al. 2006). Citizens on the left (e.g., liberals and Democrats) express stronger support for climate policies than do citizens on the right (e.g., conservatives and Republicans) (Krosnick et al. 2006; McCright 2009; O'Connor et al. 2002; Zahran et al. 2006). Also, environmental values and identity are positively associated with climate policy support (Dietz, Dan, and Shwom 2007; Leiserowitz 2006; O'Connor et al. 1999, 2002; Zahran et al. 2006). We are particularly interested in extending Ding et al.'s (2011) emphasis on the pivotal role of perceived scientific agreement by showing that it is affected by political orientation and environmental identity and that it mediates the impact of these variables on global warming beliefs and policy support.

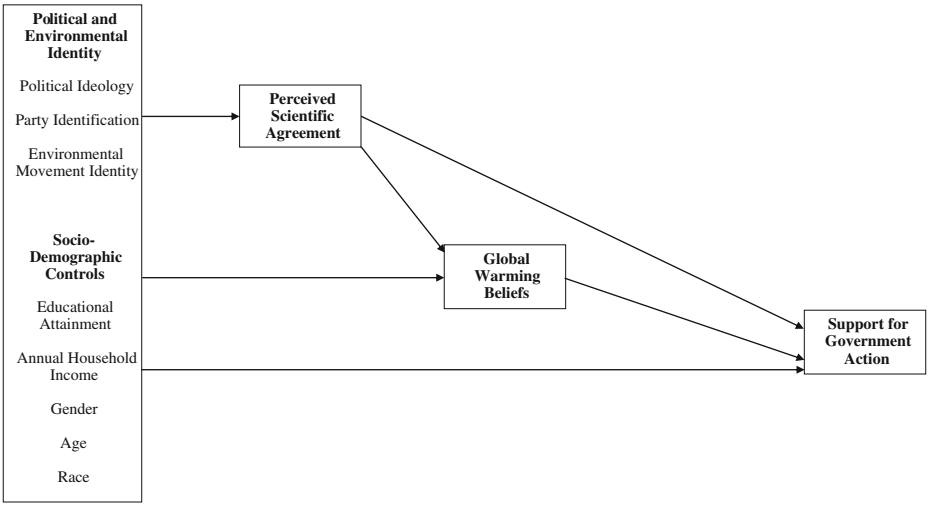

Fig. 1 Analytical model. Relationship of political, social, and demographic variables and support for government action through mediators (perceived scientific agreement and global warming beliefs)

2 The study

Our data come from the Gallup Organization's annual environment poll, conducted each March in anticipation of Earth Day (April 22). The March 2012 Gallup survey is based on telephone interviews with a nationally representative sample of 1024 adults (age 18 years or older). This survey includes items on perceived environmental problems, support for environmental protection, and global warming beliefs and attitudes—all the key items necessary to replicate (at least approximately) the recent study by Ding et al. (2011). Table 1 shows the global warming questions and response options used in the study. Table 2 describes measures of respondents' political orientations and identification with the environmental movement (predictors in our model) and socio-demographic characteristics (controls in our model).

We used the structural equation modeling (SEM) technique to examine the effect of perceived scientific agreement on support for government action that is potentially mediated by global warming beliefs. More specifically, we estimated the direct effects of perceived scientific agreement on support for government action as well as the indirect effects of the former on the latter that are mediated by (channeled through) global warming beliefs. Similarly, in extending Ding et al.'s (2011) analysis, we examined the overall impacts of the two political variables and environmental movement identity on support for government action by estimating their direct and indirect effects. We chose SEM for its ability to simultaneously estimate both direct and indirect effects while controlling for other relevant variables in our model—ideal for modeling mediating effects (Xiao and Hong 2010). We performed our SEM analyses with AMOS 16.0.

One distinctive feature of SEM is the ability to incorporate measurement modules (confirmatory factor analysis or CFA models) for complex constructs in the overall structural model. We took full advantage of this feature by including two CFA models: multi-item measures of global warming beliefs (five items) and support for government action to reduce emission (three items). CFA results show that these items have factor loadings ranging from 0.50 to 0.77, indicating adequate to very good measurement reliability. Therefore, in our

Table 1 Measures of key variables in the model

	Survey items	Coded responses
Dependent variable		
Support for government action	'Next, I am going to read some specific proposals. For each one please say whether you generally favor or oppose it:' (3 items; factor loadings in parentheses)	1 = oppose
	'Setting higher auto emissions standards for automobiles' (0.71)	2 = favor
	'Setting higher emissions and pollution standards for business and industry' (0.77)	
	'Imposing mandatory controls on carbon dioxide emissions and other greenhouse gases' (0.75)	
Mediator variables		
Perceived scientific agreement	'Just your impression, which one of the following statements do you think is most accurate:'	3-point scale: (1) 'most scientists believe that global warming is occurring' (n=1215), (0) most scientists believe that global warming is not occurring'(n=115), or (.5) 'most scientists are unsure about whether global warming is occurring or not' (n=634)
Global warming beliefs	(5 items; factor loadings in parentheses) 'Which of the following statements reflects your view of when the effects of global warming will begin to happen: (0.71)	5-point scale: (1) 'they have already begun to happen', (.75) 'they will start happening within a few years', (.5) 'they will start happening within your lifetime,' (.25) 'they will not happen within your lifetime, but they will affect future generations', (0) or they will never happen'
	'And from what you have heard or read, do you believe increases in the Earth's temperature over the last century are due more to:' (0.68)	(1) 'the effects of pollution from human activities' or (0) natural changes in the environment that are not due to human activities'
	'I'm going to read you a list of environmental problems. How much do you personally worry about . . . global warming?' (0.77)	4-point scale: (1) 'a great deal', (.67) 'a fair amount', (.33) 'only a little', or (0) 'not at all'
	'Do you think that global warming will pose a serious threat to you or your way of life in your lifetime? (0.50)	0 = no 1 = yes
	'Thinking about what is said in the news, in your view is the seriousness of global warming:' (0.71)	(0) 'generally exaggerated', (.5) 'generally correct', or is it (1) 'generally underestimated'

structural model (Fig. 1) all predictors and the single-item measure of perceived scientific agreement are observed variables, while global warming beliefs and support for government action are latent factors. This model generally has a good fit as shown by a greater-than-0.95

Table 2 Descriptive statistics of the study sample

	Total sample (n=1024)
Political ideology (1–5 scale: very conservative-very liberal)	2.78 (1.07)
Party identification (1–5 scale: Republican-Democrat)	3.08 (1.61)
Environmental movement identity (1–4 scale: unsympathetic-active participant)	2.65 (0.88)
Educational attainment (bachelor's degree %)	31.20
Annual household income (1–5 scale: less than $20 K–$75 K and more)	3.40 (1.35)
Gender (female %)	51.00
Age (years)	46.83 (17.72)
Race (white %)	82.20

Standard deviation is given in parentheses

goodness-of-fit index (GFI), incremental fit index (IFI), and comparative fit index (CFI), as well as a greater-than-0.90 adjusted goodness-of-fit index (AGFI) and a reasonably small root mean squared error of approximation (RMSEA = 0.06).

Missing data were imputed using the built-in maximum likelihood imputation tool of AMOS 16.0. To account for the categorical nature of many items, we examined the robustness of our Maximum Likelihood (ML) estimation by applying the Weighted Least Squares technique (Bollen 1989; Kline 2011) as well as 5,000 cycles of bootstrapping (Hayes 2009). Since we found no problems, we report ML results here. Significance tests for indirect effects are based on bias-corrected bootstrap standard errors.

3 Results and discussion

Table 3 reports the standardized direct, indirect, and total effects from structural equation models predicting perceived scientific agreement, global warming beliefs, and support for government action. Political ideology (standardized total effect = 0.13), party identification (0.25), and environmental movement identity (0.17) are significant and moderately powerful predictors of perceived scientific agreement in the first column (Table 3). Self-identified liberals, Democrats, and active participants in the environmental movement more accurately perceive the scientific consensus on global warming than do their respective counterparts. Here and in other parts of the model, the control variables perform pretty much as expected and largely consistent with existing research.

Turning to the next three columns of Table 3, the most powerful predictor of global warming beliefs—i.e., beliefs about the timing, human cause, seriousness, and threat of global warming—is perceived scientific agreement (standardized total effect = 0.44), a finding consistent with Ding et al. (2011). Similar to what we saw earlier, political ideology (0.21), party identification (0.27), and environmental movement identity (0.37) are moderately powerful predictors of global warming beliefs.

In the final three columns in Table 3, global warming beliefs is the most powerful predictor of support for government action to reduce emissions (standardized total effect = 0.69), consistent with existing research (Bostrom et al. 2011; Bord et al. 2000; Dietz et al. 2007; Krosnick et al. 2006; McCright 2009; O'Connor et al. 1999, 2002; Zahran et al. 2006). These final three columns also confirm Ding et al.'s (2011) key finding that the relationship between perception of scientific agreement on global warming and climate policy support (standardized total effect = 0.21) is mediated by global warming beliefs (standardized

Table 3 Standardized direct, indirect, and total effects from structural equation models predicting perceived scientific agreement, global warming beliefs, and support for government action (N=1024)

	Perceived scientific agreement	Global warming beliefs			Support for government action		
Predictors	Total	Direct	Indirect	Total	Direct	Indirect	Total
Political orientation and environmental identity							
Political ideology	0.13*	0.16*	0.06*	0.21*	0.03	0.13*	0.17*
Party identification	0.25*	0.17*	0.11*	0.27*	0.08*	0.17*	0.24*
Environmental movement identity	0.17*	0.30*	0.07*	0.37*	0.17*	0.24*	0.41*
Socio-demographic controls							
Educational attainment	0.08*	−0.01	0.03*	0.02	−0.01	0.01	0.00
Annual household income	0.00	−0.07*	0.00	−0.08*	0.06*	−0.05*	0.01
Gender	0.05	0.09*	0.02	0.11*	0.03	0.07*	0.10*
Age	−0.11*	−0.04	−0.05*	−0.09*	−0.03	−0.05*	−0.09*
Race	−0.04	0.05*	−.02	0.04	−0.02	0.03	0.01
Mediators							
Perceived scientific agreement		0.44*	N/A	0.44*	−0.09*	0.30*	0.21*
Global warming beliefs					0.69*	N/A	0.69*
R^2	0.22			0.66			0.65
Goodness-of-Fit Index (GFI)			0.97				
Adjusted Goodness-of-Fit Index (AGFI)			0.92				
Incremental Fit Index (IFI)			0.96				
Comparative Fit Index (CFI)			0.95				
Root Mean Squared Error of Approximation (RMSEA)			0.06				

Missing data were imputed using the built-in maximum likelihood imputation tool of AMOS 16.0

* p<.05

indirect effect = 0.30). Perceived scientific agreement has a much stronger and positive indirect effect on support for government action through global warming beliefs (0.30) than its smaller, negative direct effect (−0.09). Judging by the sizes of the indirect effects of the two political orientation variables and environmental movement identity on support for government action, global warming beliefs also mediate these relationships.

Identification with the environmental movement is positively related to support for government action (standardized total effect = 0.41), consistent with existing research (Dietz et al. 2007; Leiserowitz 2006; O'Connor et al. 1999, 2002; Zahran et al. 2006). Indeed, environmental movement identity is a fairly strong predictor of support for government action, nearly twice as strong as is perceived scientific agreement.

Similar to earlier studies (Krosnick et al. 2006; McCright 2009; O'Connor et al. 2002; Zahran et al. 2006), self-identified liberals (0.17) and Democrats (0.24) express stronger support for

government action than do their conservative and Republican counterparts. These two political orientation variables are moderately strong predictors of both global warming beliefs and support for government action, further support that global warming is politically polarized in the USA (Hamilton 2011; Malka et al. 2009; McCright and Dunlap 2011). The effects of party identification on perceived scientific agreement, global warming beliefs, and support for government action are slightly stronger than are those of political ideology. Indeed, party identification even has a statistically significant, positive direct effect (0.08) on support for government action after controlling for both mediating factors—meaning that party has a distinctive impact on policy support independent of other global warming beliefs. In contrast, the total effect of political ideology on support for government action (0.17) is almost entirely the result of its indirect effect through perceived scientific agreement and global warming beliefs (0.13).

Our study differs somewhat from the Ding et al. (2011) study we aim to replicate. First, our measures of the mediator variables and the dependent variable vary slightly in wording, as is typical across social surveys. Second, our study focuses on explaining only policy support and not also injunctive beliefs as did Ding et al. (2011). Third, we use three rather than two categories to measure "perceived scientific agreement." Separating those respondents who believe that most scientists are simply unsure about whether global warming is occurring or not from those who believe that most scientists believe that global warming is not occurring allows us to preserve what we think is meaningful variation in this belief. Finally, we use structural equation modeling rather than mediation analysis because of the former's ability to simultaneously estimate both direct and indirect effects while controlling for other relevant variables.

Regardless of these differences in measurement and analytical technique, this study and the Ding et al. (2011) study both document the pivotal role of the public's belief in scientific agreement on global warming on its other views of global warming, including support for emissions reduction policies. Examining data from different sources and different years, both studies find that perception of scientific agreement on global warming has a significant effect on support for climate policy, and that this relationship is mediated by global warming beliefs. This adds robustness to Ding et al.'s (2011) claims of the vital importance of public belief in scientific agreement on climate change. We further show that political orientation and environmental movement identity influence perceived agreement, as well as global warming beliefs and policy support.

4 Conclusion

While not the sole driver, the climate change denial machine has nevertheless been effective in generating in the American public the belief that scientists do not agree about anthropogenic global warming (Dunlap and McCright 2011; McCright and Dunlap 2003, 2010, 2011; Oreskes and Conway 2010; Powell 2011). Replicating Ding et al. (2011), we confirm that the crucial role of perceived scientific agreement on global warming beliefs and support for climate policy is robust. Further, we show that political orientation has a significant influence on perceived scientific agreement, global warming beliefs, and support for government action to reduce emissions.

Climate change communicators should therefore identify opportunities and employ techniques to effectively counter the denial machine's campaign of challenging the scientific consensus. Overcoming its success in generating belief that scientists do not agree about anthropogenic global warming seems to be crucial for increasing public support for emissions reduction policies. Doing so in a fashion that does not trigger motivated cognition, and thus rejection of the efforts by Republicans and conservatives, will be a major challenge (Mooney 2012).

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