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THE POLITICIZATION OF CLIMATE CHANGE AND POLARIZATION IN THE AMERICAN PUBLIC'S VIEWS OF GLOBAL WARMING, 2001–2010

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We examine political polarization over climate change within the American public by analyzing data from 10 nationally representative Gallup Polls between 2001 and 2010. We find that liberals and Democrats are more likely to report beliefs consistent with the scientific consensus and express personal concern about global warming than are conservatives and Republicans. Further, the effects of educational attainment and self-reported understanding on global warming beliefs and concern are positive for liberals and Democrats, but are weaker or negative for conservatives and Republicans. Last, significant ideological and partisan polarization has occurred on the issue of climate change over the past decade.

INTRODUCTION

The Western experience of modernity—especially technological development, economic growth, material prosperity, urbanization, and democracy—has been built upon industrial capitalism, an economic system predicated on the accelerating extraction and consumption of fossil fuels for energy (Clark and York 2005). A major unintended consequence of the use of fossil fuels is anthropogenic global warming or climate change.[1] Recognizing and responding to climate change, arguably the most challenging social problem of the modern era (Giddens 2009), thus poses a fundamental critique of continued modernization processes around the world (Antonio 2009).

For two decades, European-based reflexive modernization theorists (e.g., Beck, Giddens, and Lash 1994; Mol 1996) have argued that forces of reflexivity, particularly science and environmentalism, compel us to confront threats to societal persistence such as climate change.[2] In contrast, stimulated by the United States's long-term, laggard response to climate change, a growing number of scholars have begun calling attention to forces of "anti-reflexivity" (McCright and Dunlap 2010)—particularly the industrial sector and the conservative movement—that defend the industrial capitalist order from critique by denying the significance of problems such as climate change (also see, e.g.,

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Lahsen 2005; Demeritt 2006; Jacques 2006). Analyzing the growing tension between reflexive and anti-reflexive forces is crucial for assessing the potential for effective societal responses to global environmental problems such as climate change.

Since it first emerged on the U.S. national agenda in the late 1980s, climate change has been strongly contested (Dunlap and McCright 2010), especially when specific policies such as the Kyoto Protocol were being considered, and increasingly politicized.[3] Scholarship on the politicization of climate change examines corporate lobbying and marketing activities (e.g., Kolk and Levy 2001; Layzer 2007), the mobilization of social movement organizations (e.g., McCright and Dunlap 2000, 2003; Bryner 2008), the political behaviors of scientists (e.g., Lahsen 2005, 2008; McCright 2007; Oreskes and Conway 2010), and the actions of congressional and administrative actors (Fisher 2006; McCright and Dunlap 2010). This body of research documents political polarization between elites and organizations identifying the negative environmental consequences of industrial capitalism represented by climate change (e.g., environmental organizations, science advocacy organizations, and Democratic policymakers on the Left) and those defending the economic system from such charges (e.g., conservative think tanks, industry associations, and Republican policymakers on the Right).

To date, scholars have paid less attention to the politicization of climate change within the American public. Yet, examining this issue not only allows for an assessment of the degree to which any observable political schisms within the mass public mirror those documented between elite actors, but also provides an opportunity to examine the distribution and diffusion of reflexive and anti-reflexive stances on climate change within the general public. Providing an understanding of the nature and drivers of public positions on climate change is a crucial social science contribution to efforts to develop effective responses to this vexing problem (Dietz, Dan, and Shwom 2007).

Research Purpose and Questions

Examining the politicization of climate change within the American public requires attention to the social science literature on polarization. Responding to popular claims of growing "culture wars" within American society over the last two decades, initial studies found little evidence of polarization between the 1970s and early 1990s, except for a few social and cultural issues (e.g., abortion) that became polarized on the basis of political ideology and party identification (e.g., DiMaggio, Evans, and Bryson 1996). However, studies extending to the late 1990s and early 2000s report substantial evidence of more recent polarization on a range of social, economic, and cultural issues, especially on the basis of ideology and party identification (e.g., Evans 2002, 2003; Brewer 2005; Jacobson 2005; Abramowitz and Saunders 2008; Baldassarri and Gelman 2008).

Our goal is to examine political polarization within the American public vis-à-vis climate change to (1) determine if the more widely analyzed elite polarization on climate change exists within the general public and (2) extend the public polarization literature into the environmental issue domain for the first time. We draw upon relevant theoretical perspectives from sociology and political science to analyze nationally

representative data on the global warming beliefs and concern of American citizens from 2001–2010 Gallup Polls. Specifically, we address three research questions.

To what extent do liberals/Democrats and conservatives/Republicans in the American public differ in their beliefs and concern about global warming? Scholarship on the political bases of environmental attitudes (Dunlap, Xiao, and McCright 2001), as well as evidence of elite polarization on climate change, informs our investigation of political cleavages on global warming within the general public. Examining cleavages on this issue within the general public can illuminate the tension between those defending the current economic system and those willing to acknowledge environmental degradation as a consequence of industrial capitalism, and consequent challenges to achieving broad-based public support for effective climate change policies.

To what extent does political orientation moderate the effects of educational attainment and perceived understanding on global warming beliefs and concern? Insights from two political science perspectives—the elite cues hypothesis and information-processing theory—inform our analysis of the extent to which political ideology and party identification moderate the relationships between educational attainment and self-reported understanding of global warming on one side and global warming beliefs and concern on the other. A few studies have found that higher educational attainment and greater self-reported understanding of global warming have differing effects on global warming beliefs and concern for conservatives and Republicans than for liberals and Democrats (Krosnick, Holbrook, and Visser 2000; Hamilton 2008, 2010; Hamilton and Keim 2009; Malka, Krosnick, and Langer 2009). Yet, these moderating effects of political orientation have been observed with data sets collected at specific points in time, often with limited samples. Replicating these analyses with 10 years of data from nationally representative samples allows us to determine the generalizability of these observed patterns. Widespread evidence of such moderating effects challenge the conventional wisdom, embodied in Al Gore's *An Inconvenient Truth*, that simply informing citizens about climate change will significantly increase their concern about the problem.

Has the American public become politically polarized over global warming in recent years? We draw upon theoretical, conceptual, and analytical insights from sociological and political science scholarship on political polarization to examine this question. As noted above, several studies report ideological and partisan polarization since the mid-1990s on a number of social, economic, and cultural issues. Such polarization likely has continued in recent years given the heightened balkanization of news media (e.g., MSNBC on the Left and FOX News on the Right), allowing Americans to obtain their news from outlets that reinforce their political beliefs (e.g., Hindman 2009; Iyengar and Hahn 2009). Dunlap and McCright (2008a) provide preliminary evidence of partisan polarization on climate change from 2001 to 2008, but here we provide a more methodologically rigorous analysis of *both* partisan and ideological polarization *and* we include data from 2009 and 2010. The latter is critical given the recent sharp drop in public concern about global warming documented by Gallup and other pollsters (Newport 2010).

In the following sections, we offer a brief history of climate change politicization in the United States, focusing on the activities of elites and organizations, before reviewing the relevant theoretical perspectives that generate our hypotheses on climate change politicization within the American public. After describing our data set, key variables, and the statistical analyses we employ, we present our results and discuss their contribution to polarization research and theory. We conclude with brief discussions of the implications of our findings for both policy-making and reflexive modernization theory.

CLIMATE CHANGE POLITICIZATION IN THE UNITED STATES

By the early 1990s, the U.S. environmental community—the environmental movement, mainstream climate scientists, and environmental policymakers—had successfully defined global warming as a legitimate problem deserving the attention of policymakers. Around this time a coordinated anti-environmental countermovement, spearheaded by conservative foundations, think tanks, and politicians, emerged in response to the rise of global environmentalism—symbolized by the 1992 Rio "Earth Summit"—and its perceived threat to the spread of neoliberal economic policies worldwide (Jacques, Dunlap, and Freeman 2008). The movement sought to delegitimize global environmental problems, particularly anthropogenic global warming, in order to undermine the call for regulatory action. Both the fossil fuels industry and its business allies and conservative think tanks (with support from oil and coal companies and conservative foundations) worked to debunk the scientific evidence for climate change (e.g., McCright and Dunlap 2000, 2003; Lahsen 2005; Layzer 2007; Oreskes and Conway 2010).

The environmental movement and the anti-environmental conservative movement both have drawn upon scientists sympathetic to their respective positions. Natural scientists have long played a central role in the environmental movement and have been instrumental in the development of key environmental organizations (Mitchell, Mertig, and Dunlap 1992). The conservative movement began to emphasize the use of "scientific expertise" when it mobilized in the early 1990s to challenge the legitimacy of global environmental change (Jacques et al. 2008).[4] Since then the conservative movement has promoted a small number of "contrarian" scientists who challenge mainstream climate science as part of its broader efforts to debunk the reality and seriousness of climate change (e.g., McCright 2007; Lahsen 2008).

The early 1990s saw only moderate levels of mobilization by the environmental movement to maintain global warming on the national agenda, perhaps easing up after pro-environmental Al Gore became vice president. The window of opportunity for the Clinton–Gore administration and the Democratic Congress to deal with climate change closed abruptly with the 1994 national election, when Republicans gained control of Congress in what became known as the "Republican Revolution." This new majority immediately challenged environmental science and policy (Brown 1997). Perhaps nowhere was this more evident than with the issue of climate change. Republican Congressional leaders launched an all-out assault on climate science, especially

debunking the peer-reviewed work of mainstream scientists while promoting the nonpeer-reviewed claims of climate change contrarians (Demeritt 2006; McCright and Dunlap 2003, 2010).

The rightward shift in U.S. political culture that paralleled the Republican Revolution increased opportunities for the conservative movement to oppose climate science and policy via mainstream media. Conservative think tanks and their allied climate change contrarians successfully exploited American news media norms—especially the "balancing norm," or the equation of "objectivity" with presenting "both sides of the story"—to achieve a level of media visibility incommensurate with the limited scientific credibility of their claims (McCright and Dunlap 2003; Boykoff and Boykoff 2004). The effectiveness of this strategy is reflected by comparative studies showing that U.S. newspapers are more likely to portray climate science as "uncertain" than are those in other developed nations (Dispensa and Brulle 2003) and that that American public is less knowledgeable about the causes of global warming and less supportive of the Kyoto Protocol than its European counterparts (Brechin 2003).

After a flurry of activities by the Left and the Right in the months leading up to the December 1997 Kyoto Conference, climate change lost policy salience and receded to the back burner of our national agenda following this international event. The politics of climate change went into a state of dormancy. During this time, many fossil fuels corporations (with the glaring exception of ExxonMobil) disengaged from their attacks on climate science and began pro-environmental public relations campaigns (Kolk and Levy 2001), provoking the anger of conservative movement activists (Layzer 2007:112). Climate change barely registered during the 2000 presidential campaign, being discussed only briefly during the second debate. Nevertheless, Al Gore and George W. Bush played their expected political roles. The former called for the nation to take urgent action to deal with climate change, while the latter challenged the scientific evidence of global warming—foreshadowing events to come.

The election of George W. Bush and the ascendance of his conservative administration heightened the politicization of climate change. Bush administration insiders engaged consistently in a wide range of practices to challenge climate science and undermine the need for policy action (McCright and Dunlap 2010). Building on its earlier experience in mobilizing against the anti-environmental Ronald Reagan administration (e.g., Dunlap 1987), the environmental movement worked to raise awareness of the Bush administration's anti-environmental agenda—including its treatment of climate change. While 9/11 and the subsequent "war on terror" and invasion of Iraq tended to push environmental issues like climate change off the public agenda (Brechin and Freeman 2004), the environmental community nonetheless achieved some success in raising awareness, as media attention to climate change since 2004 has dwarfed its previous peak in 1997 (McCright and Shwom 2010).

Yet, at the same time the environmental community was honoring the Intergovernmental Panel on Climate Change (IPCC) and Al Gore for receiving the 2007 Nobel Peace Prize for their efforts to increase public knowledge about climate change, the Right—conservative think tanks, media figures (such as Rush Limbaugh), Republicans

in Congress (such as Senator James Inhofe and Representative Joe Barton), and the Bush White House—continued its all-out assault on climate science and policy. The Right's efforts, supplemented by heavy lobbying from industry, have subsequently escalated in response to the Obama administration's receptivity to climate science and policy (Goodell 2010). This large divide between political elites[5] and organizations on the Left and the Right begs the question: is there a similar political divide within the general public regarding climate change?

POLITICAL DYNAMICS OF CLIMATE CHANGE IN THE AMERICAN PUBLIC

Political Divide on Global Warming Beliefs and Concern

American conservatives champion ideals of individual freedom, private property rights, limited government, and the promotion of free markets (e.g., Meyer 1964), while American liberals promote collective rights, view market regulation as crucial for protecting citizens and public goods, seek to increase the quantity and quality of government's social service provision, and support governmental intervention to extend rights to previously underprotected groups (e.g., Domhoff 2003). Environmental protection typically entails governmental intervention into markets and restrictions on property rights, challenging conservative values, but is consistent with liberals' view that protecting collective welfare is a proper role of government. Given the increasing alignment between ideological and partisan positions among American voters (Abramowitz and Saunders 2008), similar differential responses to environmental protection can be expected from Republicans and Democrats. Four decades of research on both elites and the public has yielded supportive results, as Democrats and especially liberals are consistently found to be more pro-environmental than their Republican and conservative counterparts (Dunlap et al. 2001).

Political psychologists find that conservatives are more likely to express system justification tendencies, while liberals are more amenable to critiques of the established order (e.g., Feygina, Jost, and Goldsmith 2010). Compared with local environmental problems such as water and air pollution, global environmental problems like climate change pose a stronger challenge to conservatives' faith in unfettered industrial capitalism as the desirable and inevitable path to progress (Jacques 2006). More specifically, the possibility of an internationally binding treaty to curb greenhouse gas emissions is viewed as a direct threat to sustained economic growth, the spread of free markets, the maintenance of national sovereignty, and the continued abolition of governmental regulations—key goals of conservatives (Oreskes and Conway 2010). Thus, conservatives and Republicans can be expected to question the scientific consensus on climate change, as this body of knowledge highlights the deleterious consequences of industrial capitalism. On the other hand, liberals and Democrats can be expected to accommodate evidence of climate change and the necessity of dealing with it, as employing governmental regulations in an effort to reduce the danger of climate change is likely to seem quite legitimate to them. This leads to our first two hypotheses.

Hypothesis 1: Self-identified liberals/Democrats are more likely to report beliefs consistent with the scientific consensus on global warming than are self-identified conservatives/Republicans.

Hypothesis 2: Self-identified liberals/Democrats are more likely to express personal concern about global warming than are self-identified conservatives/Republicans.

The Moderating Effect of Political Orientation

Two political science perspectives on how laypeople process information to develop positions on issues suggest a nuanced relationship among (1) citizens' political orientations; (2) their exposure to information about, and perceived understanding of, an issue; and (3) their expressed beliefs about and attitudes toward that issue. According to information-processing theory (Wood and Vedlitz 2007), people's values, ideology, and experiences form the foundation of how they perceive and interpret issues. With increasing expertise and exposure to unambiguous information, such predispositions play a smaller role. However, in conditions of limited knowledge and exposure to ambiguous information, "people process information about issues through a filter containing a range of variables relating to their predispositions"—chiefly among them is their political orientation (Wood and Vedlitz 2007:556; see also Hamilton 2008).

Complementing information-processing theory is the elite cues hypothesis, which applies to controversial issues for which there is a bifurcated flow of conflicting information (Krosnick et al. 2000). In such situations, people often rely selectively on information from partisan leaders whom they trust, and thus political orientation filters new information and learning opportunities. For instance, liberal and conservative citizens take cues from different elites, organizations, and media outlets, exposing them to divergent beliefs and attitudes on controversial issues—even as they may both claim to understand the issues a great deal (Hindman 2009; Malka et al. 2009).

In sum, on controversial issues for which there is seemingly ambiguous information (and possibly a bifurcated flow of competing information) available to the general public, the information-processing and elite cues perspectives hold that people's political orientations influence the association between their learning capacity and perceived understanding of an issue and their expressed beliefs and attitudes about that issue. In the United States, climate change certainly fits this scope condition. The American media disproportionately report on the uncertainty and supposed controversy in climate science (e.g., Dispensa and Brulle 2003; Boykoff and Boykoff 2004). Political elites on the Left largely promote mainstream scientific knowledge regarding climate change (as reported, e.g., by the IPCC and the U.S. National Academy of Sciences), while those on the Right regularly challenge this scientific knowledge by promoting the views of a handful of contrarian scientists (McCright and Dunlap 2003, 2010).

Citizens' political orientations may lead them to perceive this politically contentious issue quite differently, as they take cues from favored ideological and partisan elites that reinforce their pre-existing political beliefs on global warming. For instance, liberal Democrats, who get their news from National Public Radio (NPR), MSNBC, and the *New York Times* and who follow the likes of Al Gore, are more likely to hear favorable

messages about the reality and significance of climate change than are their conservative Republican counterparts, who get their news from conservative talk radio, FOX News, and the *Wall Street Journal* and who follow the likes of Senator James Inhofe (Hindman 2009). Further, greater educational attainment and more focused attention to their, respectively, favored news outlets and political elites may increase how much citizens think they understand the issue. Yet, because of differences in the content of their selected cues, the assessed understandings of global warming by liberals and conservatives are likely to diverge significantly.

A few studies do find that political orientation moderates the influence of educational attainment and self-reported understanding on global warming beliefs and concern. Hamilton (2011) and Hamilton and Keim (2009) find that party identification moderates the relationship between educational attainment and global warming beliefs. Hamilton (2008) finds that political ideology moderates the association between education and concern about global warming. Finally, Krosnick and colleagues (Krosnick et al. 2000; Malka et al. 2009) and Hamilton (2011) report that party identification moderates the association between self-reported understanding of global warming and concern about the problem.

In each of these cases, educational attainment or self-reported understanding have a *positive* effect on beliefs and concern about global warming for liberals and Democrats, but a *weaker or negative* effect for conservatives and Republicans. While these results are intriguing, they come from studies employing a single dependent variable with regional samples collected at a specific time. Thus, the existing results are limited. Our analyses allow us to test the generalizability of these political interaction effects on multiple indicators of global warming beliefs *and* concern with data from 10 nationally representative surveys. This leads to our next two hypotheses.

Hypothesis 3: The effect of educational attainment on beliefs about climate science and personal concern about global warming is positive for liberals/Democrats, but is weaker or negative for conservatives/Republicans.

Hypothesis 4: The effect of self-reported understanding of global warming on beliefs about climate science and personal concern about global warming is positive for liberals/Democrats, but is weaker or negative for conservatives/Republicans.

Ideological and Partisan Polarization

Paul DiMaggio and colleagues (DiMaggio, Evans, and Bryson 1996; Evans, Bryson, and DiMaggio 2001; Evans 2002, 2003) initiated the recent wave of sociological scholarship on polarization within the American public. In their groundbreaking study, DiMaggio et al. (1996) found little evidence of polarization between the 1970s and early 1990s—except for ideological polarization on abortion and partisan polarization on a variety of social issues. More recent analyses that include data from the late 1990s and early 2000s find stronger evidence of polarization within the American public, especially a clear pattern of both ideological and partisan polarization on a range of social, economic, and cultural issues (e.g., Evans 2003; Brewer 2005; Jacobson 2005; Abramowitz and Saunders 2008; Baldassarri and Gelman 2008; but see Fiorina and Abrams 2008 for a dissenting view).

Political science offers the leading theoretical explanation for this recent trend in political polarization. The "party sorting" theory holds that political party activists drive a process of conflict extension among political elites, which then leads to party sorting within the general public (e.g., Fiorina and Abrams 2008). Party activists have driven ideological polarization between Republican and Democratic Party leaders and politicians since the late 1970s, with some acceleration in the 1990s (McCarty, Poole, and Rosenthal 2006). New partisan conflicts (e.g., on foreign policy issues) have not displaced older ones (e.g., on abortion). Rather, "party conflict has *extended* from older issues to newer issues" (Layman, Carsey, and Horowitz 2006:87), so that the two parties "have grown increasingly divided on all the major policy dimensions in American politics" (p. 83).

This then leads to party sorting within the general public, which transfers elite political polarization into the populace. Fiorina and Abrams (2008:581) note, "There seems to be general agreement that party sorting is largely a top-down process wherein the more visible and active members of a party, especially its elected officials and party activists, sort first and provide cues to voters that party positions are evolving." This is confirmed by sociologists Baldassarri and Gelman (2008:408), whose "findings suggest that opinion changes correspond more to a resorting of party labels among voters than to greater constraint on issue attitudes: since parties are more polarized, they are now better at sorting individuals along ideological lines."

We apply insights from political polarization theory to our analysis of public opinion on global warming. In the process, we extend the broader polarization literature in sociology by performing the first theoretically guided analysis of polarization in the environmental issue domain.[6] Dunlap and McCright (2008a) provide preliminary evidence of partisan polarization on global warming beliefs and concern by self-identified Republicans and Democrats in the American public between 2001 and 2008. We extend their analyses in three ways. First, we apply a more rigorous test of partisan polarization by controlling for a range of factors believed to influence climate change beliefs. Finding evidence of polarization in these more stringent analyses will strengthen the claim that such political polarization is in fact occurring. Second, we also examine evidence of ideological polarization. Third, we extend their analyses to include data from 2009 and 2010. This leads to our last two hypotheses.

Hypothesis 5: Ideological polarization on beliefs about climate science and personal concern about global warming occurred in the American public between 2001 and 2010.

Hypothesis 6: Partisan polarization on beliefs about climate science and personal concern about global warming occurred in the American public between 2001 and 2010.

THE STUDY

Our data come from the Gallup Organization's annual environment poll, conducted each March in anticipation of Earth Day (April 22). The 10 Gallup surveys covering 2001

to 2010 are based on telephone interviews with nationally representative samples of adults (age 18 years or older), ranging from 1,000 to 1,060, in the United States. For our multivariate statistical analyses, we combined the available data into pooled samples.[7] The March 2001 survey was the first to include all of the key variables employed in this study. Also, 2001 saw the publication of the IPCC's (2001) *Third Assessment Report* and the National Research Council's (2001) *Climate Change Science*. Both reports establish the current scientific consensus that global warming has already begun, that human activities are a significant contributor to global warming, and that mean global temperature will increase between 1.4 and 5.8°C by 2100.

Table 1 provides the description, coding, mean, and standard deviation for each of the variables we employ in the analyses. Two variables measure beliefs about climate science: timing of global warming (coded "1" for "already begun to happen") and primary cause of recent global warming (coded "1" for "effects of pollution from human activities"). This coding distinguishes between beliefs consistent with the scientific consensus (coded "1") and those inconsistent with the scientific consensus (coded "0"). Two

TABLE 1. Coding, Mean, and Standard Deviation for Variables in the Study[a]

Variable	Coding	Mean	SD
Timing of global warming[b]	0 (not yet begun to happen) to 1 (already begun to happen)	.54	.50
Primary cause of global warming[c]	0 (natural changes in the environment) to 1 (effects of pollution from human activities)	.58	.49
Worry about global warming[f]	0 (less than a great deal) to 1 (a great deal)	.32	.47
Perceived threat from global warming[g]	0 (will not) to 1 (will pose a serious threat to you and your way of life in your lifetime)	.35	.48
Political ideology[b]	1 (very conservative) to 5 (very liberal)	2.80	.98
Party identification[b]	1 (Republican) to 5 (Democrat)	3.08	1.67
Educational attainment[b]	1 (high school graduate or less) to 4 (more than college graduate)	2.05	1.06
Self-reported understanding[e]	1 (not at all) to 4 (very well)	2.87	.77
Year[b]	1 (2001) to 10 (2010)	5.48	2.89
Environmental movement identity[e]	1 (unsympathetic) to 4 (active participant in environmental movement)	2.77	.80
Gender[b]	0 (male) to 1 (female)	.52	.50
Age[b]	18 to 99 (number in actual years)	47.06	17.40
Race[b]	0 (white) to 1 (nonwhite)	.17	.37
Annual income[b]	1 (less than 20 K) to 5 (more than 75 K)	3.26	1.37
Religiosity[b]	1 (never attend church) to 5 (attend church once a week)	3.08	1.52

[a]Data is weighted.
[b]Data for 2001–2010.
[c]Data for 2001, 2003, 2006–2008, 2010.
[e]Data for 2001–2008, 2010.
[f]Data for 2001–2004, 2006–2010.
[g]Data for 2001, 2002, 2006, 2008–2010.

variables measure personal concern: worry about global warming (coded "1" for "a great deal") and perceived threat from global warming (coded "1" for "global warming will pose a serious threat to you and your way of life in your lifetime"). Since Gallup poses the perceived threat item[8] as a "yes/no" question, we dichotomize the worry variable[9] so all of our dependent variables are dichotomous. This allows us to utilize multivariate logistic regression models for all of our analyses and simplify the presentation of results.

We measure political ideology (very conservative, conservative, middle of the road, liberal, very liberal) and party identification (Republican, lean to Republican, Independent, lean to Democrat, Democrat) using 5-point scales, with smaller numerals denoting a conservative/Republican orientation and larger ones a liberal/Democratic orientation. Our educational attainment indicator measures the highest level attained, ranging from "high school graduate or less" = 1 to "more than college graduate" = 4. A simple measure of self-reported global warming understanding asks respondents to assess how well they understand the issue of global warming ("not at all" = 1 to "very well" = 4).[10] Also, the survey year is measured as "2001" = 1 to "2010" = 10.

To rigorously examine the effect of political orientation on beliefs about climate science and personal concern about global warming (Hypothesis 1 and Hypothesis 2), we analyze the results of multivariate logistic regression models controlling for several social and demographic variables sometimes found to correlate with these global warming beliefs and attitudes: environmental movement identity,[11] gender, age, race, annual income, and religiosity (e.g., O'Connor, Bord, and Fisher 1999; Leiserowitz 2006; Wood and Vedlitz 2007; Brody et al. 2008; Hamilton 2008; Kellstedt, Zahran, and Vedlitz 2008; Hindman 2009; Malka et al. 2009; McCright 2010). These variables are coded as shown in Table 1.

To examine the moderating effect of political orientation on the associations between educational attainment (Hypothesis 3) and self-reported understanding (Hypothesis 4) on one side and beliefs about climate science and personal concern about global warming on the other, we create four slope interaction terms using centered scores:[12] political ideology × educational attainment; political ideology × self-reported understanding; party identification × educational attainment; and party identification × self-reported understanding. We test the statistical significance of these moderating effects in our multivariate logistic regression models, while controlling for other relevant correlates.

Finally, we examine evidence of political polarization on global warming beliefs and concern within the American public from 2001 to 2010 (Hypothesis 5 and Hypothesis 6), specifically utilizing DiMaggio and colleagues' (1996) operationalization of polarization as "consolidation."[13] According to the authors (DiMaggio et al. 1996:693), "Other things being equal, the greater the extent to which social attitudes become correlated with salient individual characteristics or identities, the more likely it is that they will become the foci of social conflict." In terms of political polarization, these characteristics are political ideology and party identification. The polarization literature features three ways of measuring consolidation: (1) comparing differences in groups' means over time (DiMaggio et al. 1996; Evans 2003);[14] (2) examining the performance of a "group

dummy variable × year" interaction effect in a regression model (Evans 2002); and (3) examining the correlation between issue items and group membership over time (Baldassarri and Gelman 2008; Dunlap and McCright 2008a). We focus here on the second operationalization. To examine political polarization over the time period, we created two interaction terms using centered scores: political ideology × year and party identification × year. We examine the performance of these interaction effects in our multivariate logistic regression models.

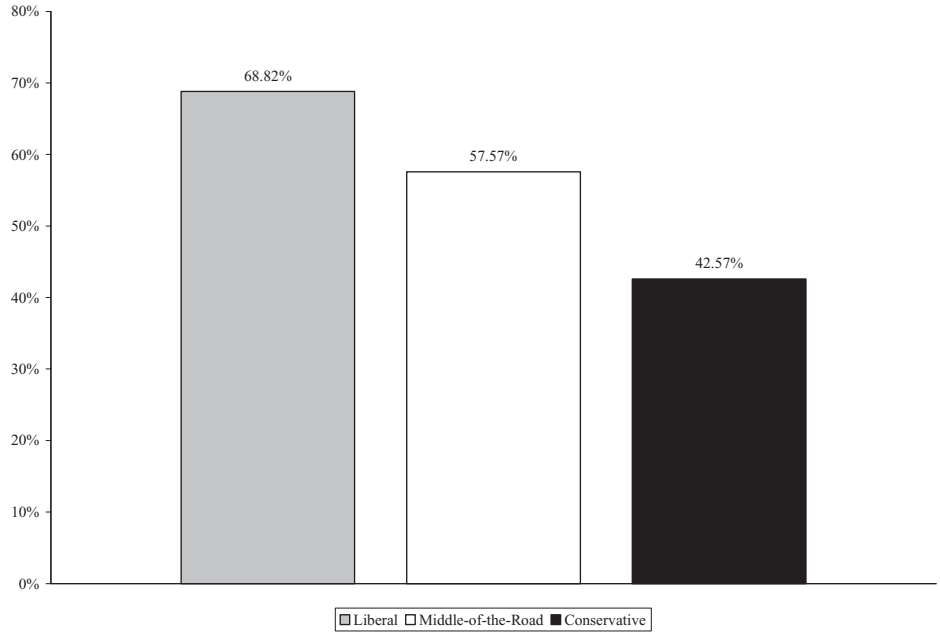
RESULTS AND DISCUSSION

We test each of the six hypotheses using results from our multivariate analyses. We also include a few figures to illustrate the patterns and trends under investigation. For each set of hypotheses, we present figures for only one dependent variable: Americans' beliefs about the timing of global warming. Patterns for other dependent variables are similar, and interested readers can find all relevant figures for each of our hypotheses in our Appendix.

Political Divide on Global Warming Beliefs and Concern

Since the late 1980s, liberal-leaning environmental organizations and the Democratic Party have promoted the global warming knowledge claims of the mainstream scientific community, especially those of elite arbiters of knowledge (e.g., U.S. National Academy of Sciences and the IPCC). On the other hand, conservative think tanks and the Republican Party have regularly disparaged mainstream scientists and the pronouncements of the scientific community's most prestigious bodies, while promoting the largely debunked claims of a handful of climate change contrarians (McCright and Dunlap 2003; Lahsen 2005; Demeritt 2006). This conflict reflects a deeper division between those who levy critiques of the industrial capitalist order and those who defend the economic system from such challenges (Jacques 2006; McCright and Dunlap 2010; Oreskes and Conway 2010). Our results provide strong evidence that the long-term divide over global warming between elites and organizations on the Left and the Right has in recent years emerged within the general public as well.

Figure 1 illustrates the ideological and partisan divide on Americans' beliefs about the timing of global warming between 2001 and 2010, using pooled data. The solid bars on the top (political ideology) and the dashed bars on the bottom (party identification) represent the percentages of Americans who believe the effects of global warming have already begun to happen. Moving from the left to the right of the political spectrum decreases the likelihood of holding a belief consistent with the scientific consensus. This obvious pattern—which also occurs for the other belief item and both concern items (see Appendix)—indicates that the historical tendency for liberals and Democrats in the general public to express stronger pro-environmental beliefs than do conservatives and Republicans extends to global warming. In fact, in the case of party, the tendency has clearly become stronger in recent years (Baldassarri and Gelman 2008:425–8; Dunlap et al. 2001:31–83).



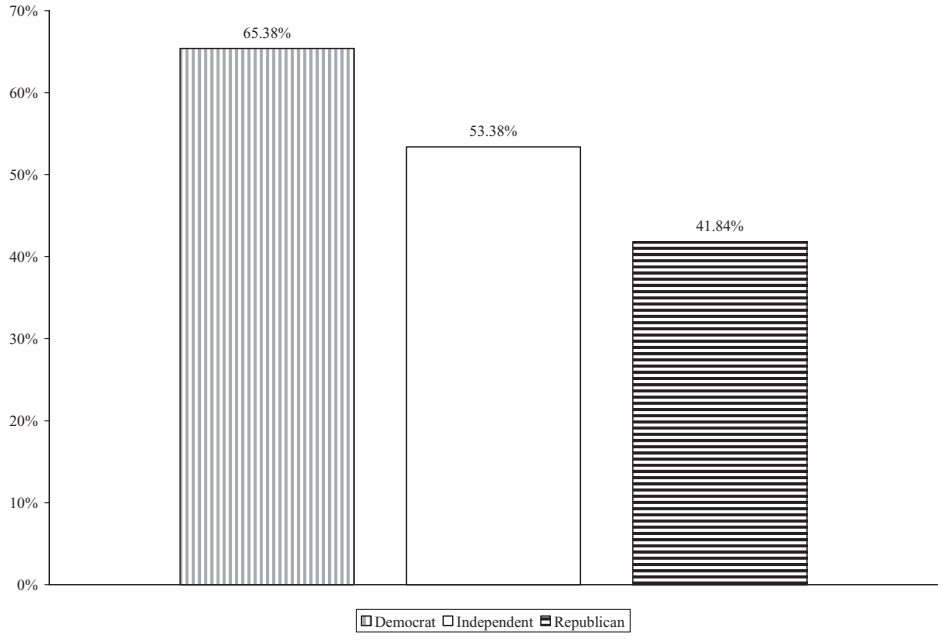


FIGURE 1. Percent of Americans Who Believe the Effects of Global Warming Have Already Begun to Happen by Political Ideology and Party Identification (2001–2010 Weighted Data).

Tables 2 and 3 report the results of several multivariate logistic regression models explaining beliefs about climate science (Table 2) and personal concern about global warming (Table 3). Models 1 and 4 in Table 2 explain Americans' beliefs about the current existence and the primary human cause of global warming, respectively, and models 7 and 10 in Table 3 explain Americans' levels of worry and perceived threat from

TABLE 2. Logistic Regression Models Explaining Beliefs about Climate Science

Independent variables	Global warming effects have already begun (N = 9,113)			Pollution from human activities is primary cause (N = 6,098)		
	1	2	3	4	5	6
Political ideology	.255***	.271***	.224***	.364***	.374***	.321***
	(.029)	(.030)	(.029)	(.036)	(.037)	(.037)
Party identification	.192***	.179***	.212***	.210***	.196***	.231***
	(.016)	(.016)	(.016)	(.019)	(.020)	(.020)
Educational attainment	.163***	.166***	.164***	.045	.048	.049
	(.023)	(.023)	(.023)	(.029)	(.029)	(.029)
Self-reported understanding	.332***	.363***	.363***	.142**	.172***	.169***
	(.033)	(.034)	(.034)	(.041)	(.042)	(.042)
Year	−.009	−.007	−.009	−.060***	−.058***	−.060***
	(.009)	(.009)	(.009)	(.010)	(.010)	(.010)
Environmental movement identity	.625***	.599***	.599***	.639***	.612***	.615***
	(.032)	(.031)	(.031)	(.038)	(.038)	(.038)
Gender	.268***	.265***	.262***	.293***	.290***	.284***
	(.049)	(.049)	(.049)	(.060)	(.060)	(.060)
Age	−.008***	−.008***	−.008***	−.007***	−.007***	−.007***
	(.001)	(.001)	(.001)	(.002)	(.002)	(.002)
Race	−.377***	−.358***	−.356***	−.227**	−.202*	−.193*
	(.070)	(.070)	(.071)	(.087)	(.087)	(.088)
Annual income	.082***	.081***	.081***	.017	.012	.014
	(.020)	(.020)	(.020)	(.024)	(.025)	(.025)
Religiosity	−.118***	−.112***	−.116***	−.089***	−.083***	−.089***
	(.016)	(.016)	(.016)	(.020)	(.020)	(.020)
Political ideology × educational attainment		.091***			.108***	
		(.024)			(.031)	
Political ideology × self-reported understanding		.317***			.316***	
		(.036)			(.045)	
Party identification × educational attainment			.030*			.077***
			(.013)			(.016)
Party identification × self-reported understanding			.177***			.188***
			(.020)			(.024)
Constant	−3.640***	−3.682***	−3.620***	−2.731***	−2.740***	−2.669***
	(.187)	(.189)	(.189)	(.230)	(.234)	(.233)
−2 log likelihood	10,834.020	10,723.503	10,735.375	7,121.716	7,041.260	7,018.113
Nagelkerke R^2	.226	.240	.238	.233	.248	.252

*$p < .05$, **$p < .01$, ***$p < .001$ (two-tailed tests).

Note: Standard errors in parentheses.

TABLE 3. Logistic Regression Models Explaining Personal Concern about Global Warming

Independent variables	Worry about global warming a great deal (N = 8,109)			Global warming will threaten way of life (N = 5,092)		
	7	8	9	10	11	12
Political ideology	.311***	.291***	.287***	.212***	.200***	.176***
	(.032)	(.033)	(.032)	(.039)	(.040)	(.040)
Party identification	.248***	.236***	.246***	.205***	.190***	.211***
	(.018)	(.018)	(.018)	(.022)	(.023)	(.023)
Educational attainment	−.186***	−.204***	−.205***	−.017	−.040	−.045
	(.026)	(.027)	(.027)	(.033)	(.033)	(.034)
Self-reported understanding	.612***	.589***	.578***	.181***	.163**	.149**
	(.040)	(.040)	(.041)	(.047)	(.048)	(.048)
Year	−.003	−.002	−.002	.028**	.029**	.028**
	(.009)	(.009)	(.009)	(.010)	(.010)	(.010)
Environmental movement identity	.599***	.585***	.586***	.454***	.437***	.437***
	(.037)	(.037)	(.037)	(.045)	(.045)	(.045)
Gender	.179**	.179**	.174**	.321***	.320***	.313***
	(.055)	(.055)	(.055)	(.068)	(.068)	(.068)
Age	.003	.003	.003	−.029***	−.029***	−.029***
	(.002)	(.002)	(.002)	(.002)	(.002)	(.002)
Race	.338***	.358***	.360***	.601***	.612***	.636***
	(.075)	(.075)	(.076)	(.092)	(.093)	(.093)
Annual income	−.071**	−.072**	−.072**	−.127***	−.131***	−.128***
	(.022)	(.022)	(.022)	(.027)	(.027)	(.027)
Religiosity	−.040*	−.033*	−.037*	.033	.042	.038
	(.018)	(.018)	(.018)	(.023)	(.023)	(.023)
Political ideology × educational attainment		.073**			.118***	
		(.026)			(.032)	
Political ideology × self-reported understanding		.207***			.178***	
		(.042)			(.048)	
Party identification × educational attainment			.036*			.064**
			(.015)			(.019)
Party identification × self-reported understanding			.116***			.132***
			(.024)			(.028)
Constant	−5.507***	−5.296***	−5.257***	−2.479***	−2.256***	−2.209***
	(.222)	(.222)	(.224)	(.256)	(.258)	(.258)
−2 log likelihood	8,671.922	8,631.304	8,636.371	5,578.235	5,544.262	5,537.721
Nagelkerke R^2	.222	.228	.227	.200	.208	.210

*$p < .05$, **$p < .01$, ***$p < .001$ (two-tailed tests).

Note: Standard errors in parentheses.

global warming, respectively. Each of these four models contains political ideology and party identification as explanatory variables, as well as nine other relevant social, demographic, and temporal variables.

The political ideology and party identification coefficients are statistically significant and positive in each of the four models of interest. Moving from the right to the left along the political spectrum increases respondents' likelihood of reporting beliefs consistent with the scientific consensus (models 1 and 4 in Table 2) and of expressing personal concern about global warming (models 7 and 10 in Table 3). These patterns persist even when controlling for a range of relevant variables that are expected to correlate with global warming beliefs and concern. Indeed, political ideology has the expected effect even controlling for party identification, and vice versa. These results strongly support our first two hypotheses. Self-identified liberals and Democrats are more likely to report beliefs about climate science consistent with the scientific consensus (Hypothesis 1) and express personal concern about global warming (Hypothesis 2) than are self-identified conservatives and Republicans. Thus, studies of global warming beliefs and concern that do not include these political variables have underspecified models that may affect their results for other variables of interest (O'Connor et al. 1999; Brody et al. 2008).

Before evaluating the evidence for our four remaining hypotheses, we highlight the direct effects of year, educational attainment, and self-reported understanding since these variables are used in our analyses of interaction effects. For reasons of space and to maintain continuity of focus, we relegate a discussion of the direct effects of the other social and demographic variables on global warming beliefs and concern to a footnote.[15]

Between 2001 and 2010, the percentage of Americans believing that global warming is already happening generally trended upward from 2001 (54.3 percent) to 2008 (60.8 percent), but the recent sharp decline (to 50.1 percent in 2010) eliminated the monotonic effect of year. The percentage believing that recent warming is primarily caused by human activities generally decreased over the time period (from 61.0 percent in 2001 to 49.9 percent in 2010). The percentage of Americans worrying a great deal about global warming fluctuated over the time period, from a low of 25.8 percent in 2004 to a high of 41.2 percent in 2007, with no monotonic effect for year. The increase in the percentage seeing global warming as a serious threat between 2001 (31.3 percent) and 2008 (40.3 percent) was sufficiently strong to produce a statistically significant positive effect for year, even though the percentage dropped down to 31.6 percent in 2010.

Like past studies, we find educational attainment to have mixed effects on global warming beliefs and concern. Greater education increases the likelihood of believing that global warming has already begun (model 1 in Table 2), but it has no effect on Americans' belief about the primary cause of recent warming (model 4). These results for the belief items are the opposite of those reported by Hindman (2009). Some studies find that education is negatively associated with concern about global warming (O'Connor et al. 1999; Wood and Vedlitz 2007; Malka et al. 2009), while at least one study finds education to be positively associated with such concern (Hamilton 2008).[16] The statistically significant negative coefficient for educational attainment in model 7

validates the results of past studies finding a negative association between education and concern, while the nonsignificant coefficient in model 10 does not. The inconsistent findings for education across studies likely stem from variation in the measures of global warming beliefs and concern they employ.

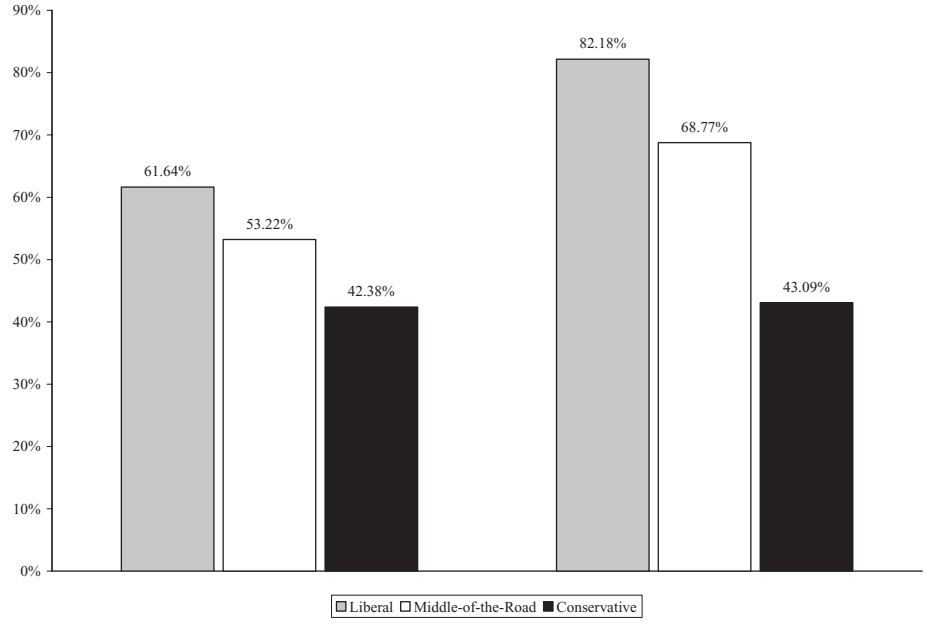
Finally, individuals self-reporting greater understanding of global warming are more likely to report beliefs consistent with the scientific consensus (models 1 and 4) and express great personal concern about global warming (models 7 and 10) than are those reporting lesser understanding. The positive effect of understanding on concern over global warming supports the results of Wood and Vedlitz (2007) and challenges those of Kellstedt et al. (2008) and Malka et al. (2009). As with education, these differences are likely attributed to variation in the measurement of these concepts across these studies.

The Moderating Effect of Political Orientation

Since the early 1990s a bifurcated flow of information has existed for the issue of global warming. The scientific community, environmental movement, and Democratic Party leaders present information that global warming is problematic and already occurring, while climate change contrarians, conservative think tanks and pundits, and the Republican Party leaders challenge these claims. The cacophony of competing voices on this issue not only creates the appearance of ambiguity (Boykoff and Boykoff 2004), but also provides liberals/Democrats and conservatives/Republicans in the general public ample opportunity to select information from a range of sources. In this situation, both the elite cues hypothesis and information-processing theory predict that educational attainment and learning opportunities are filtered by political orientation, as Americans on both ends of the political spectrum are likely to rely on their respective trusted sources.

New information on climate change (e.g., an IPCC report) is thus unlikely to reduce the political divide. Instead, citizens' political orientations filter such learning opportunities in ways that magnify this divide. Political elites selectively interpret or ignore new climate change studies and news stories to promote their political agendas. Citizens, in turn, listen to their favored elites and media sources where global warming information is framed in a manner consistent with their pre-existing beliefs on the issue (Hindman 2009). We believe this occurred within the American public between 2001 and 2010, and our results seem to bear this out.

Figure 2 reveals that political orientation moderates the influence of educational attainment on Americans' belief about the timing of global warming, while Figure 3 reveals that political orientation moderates the influence of self-reported understanding of global warming on the same variable. In Figure 2, the larger spread between liberals/Democrats and conservatives/Republicans for the bars on the right (those with at least a college degree) than for the bars on the left (those without a college degree) is evidence that political orientation moderates the effects of educational attainment. A similar pattern occurs in Figure 3, where the larger spread between liberals/Democrats and conservatives/Republicans on the right (those who self-report understanding global



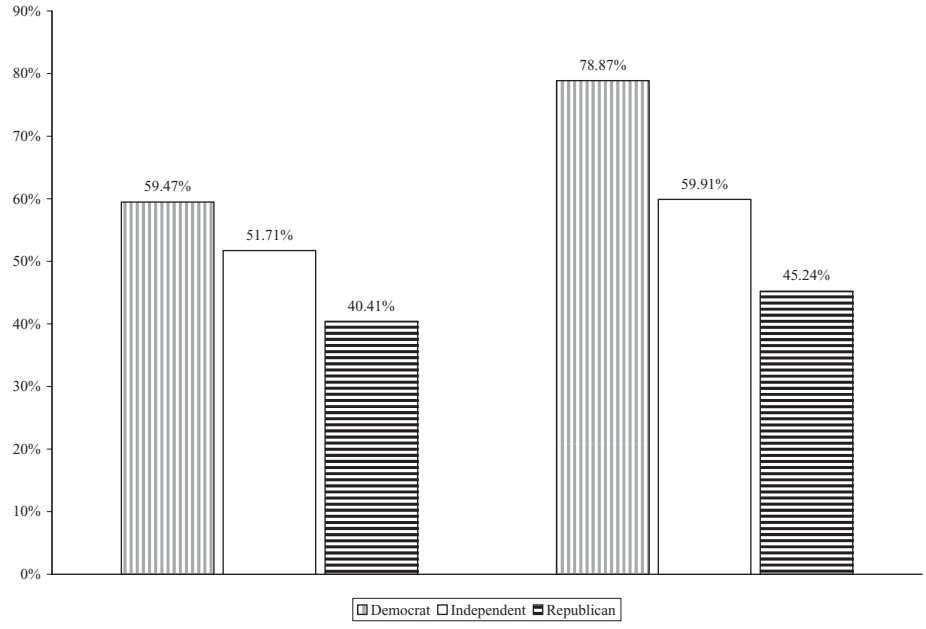


FIGURE 2. Percent of Americans Who Believe the Effects of Global Warming Have Already Begun to Happen by Political Ideology and Party Identification, Controlling for Educational Attainment (2001–2010 Weighted Data).

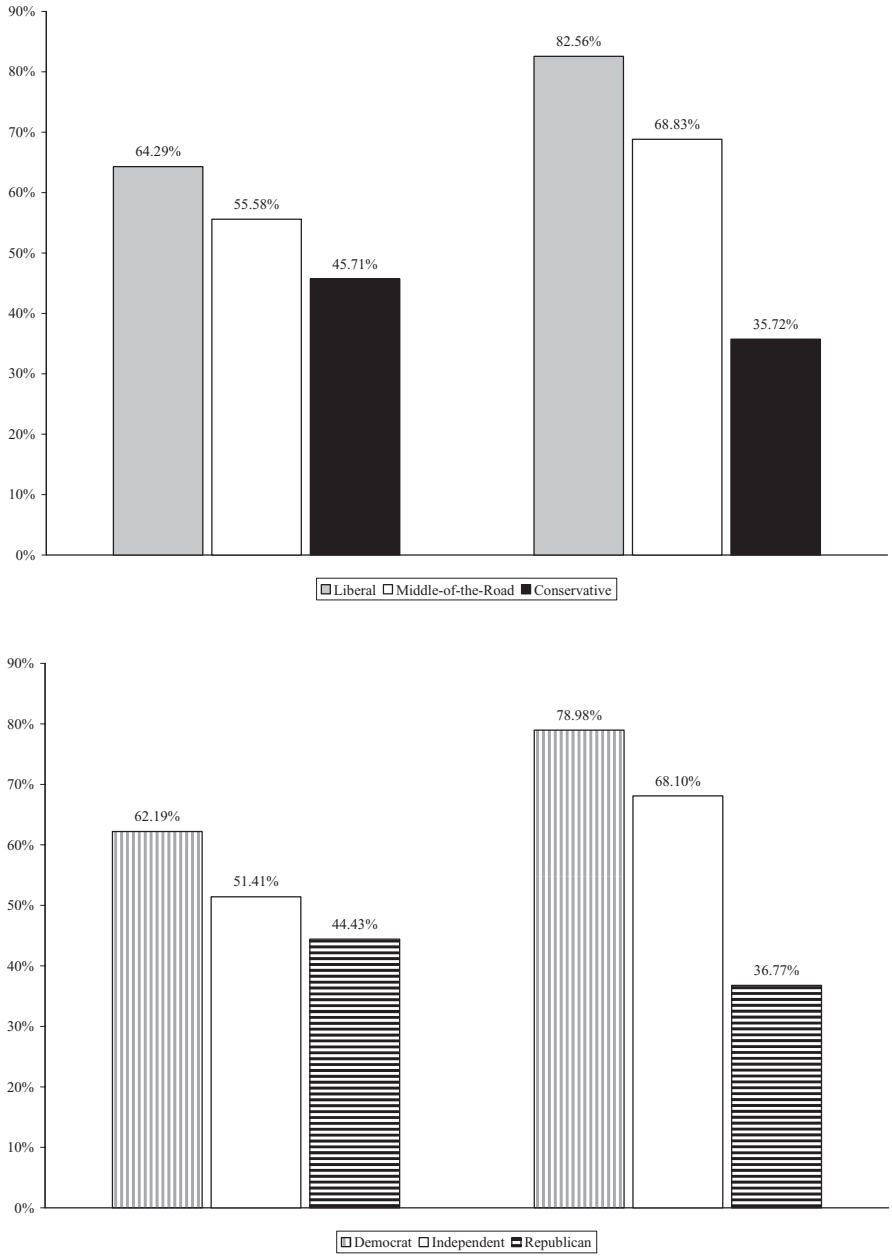


FIGURE 3. Percent of Americans Who Believe the Effects of Global Warming Have Already Begun to Happen by Political Ideology and Party Identification, Controlling for Self-Reported Understanding (2001–2010 Weighted Data).

warming very well) than between those on the left (who report lesser understanding) is evidence that political orientation moderates self-reported understanding of global warming.

A closer look at both figures clarifies the crucial patterns. In Figure 2, greater percentages of liberals and Democrats—as well as those in the middle of the political spectrum—with at least a college degree report a belief consistent with the scientific consensus than do liberals and Democrats—and those in the middle—without a college degree. The same is the case in Figure 3, where liberals and Democrats—as well as those in the middle of the spectrum—who report understanding global warming very well are more likely to endorse the scientific consensus than their counterparts who report lesser understanding. Yet, the pattern is different for those on the political Right. In Figure 2, only slightly greater percentages of conservatives and Republicans with at least a college degree report a belief consistent with the scientific consensus than do conservatives and Republicans without a college degree. In Figure 3, this pattern is actually reversed. For instance, 46 percent of conservatives who report understanding global warming less than very well believe it has already begun, while only 36 percent of conservatives reporting great understanding believe it has already begun.

The moderating effect of political orientation—which occurs for all four global warming items as apparent in the relevant figures in the Appendix—is obvious in these simple analyses. Tables 2 and 3 show that it is statistically significant and remains so while controlling for other relevant variables. Models 2 and 5 (for the moderating effects of political ideology) and models 3 and 6 (for the moderating effects of party identification) in Table 2 show coefficients for these interaction effects on beliefs about climate science. Models 8 and 11 (political ideology) and models 9 and 12 (party identification) in Table 3 show coefficients for these interaction effects on personal concern about global warming. These results are quite clear, and we can use them to validate the results of earlier studies.

As discussed earlier, a few studies find that political orientation moderates the influence of educational attainment and self-reported understanding on global warming beliefs and concern. The robustness of the interaction term coefficients in Tables 2 and 3 allows us to expand the generalizability of these earlier results. The statistically significant positive coefficients for the "party identification × educational attainment" interaction term in models 3 and 6 (explaining beliefs) replicate the findings of Hamilton (2011) and Hamilton and Keim (2009), while the comparable interaction effects for ideology and education in models 8 and 11 in Table 3 (explaining concern) confirm Hamilton's (2008) results. Also, like previous studies (Krosnick et al. 2000; Malka et al. 2009; Hamilton 2011), we find party identification to moderate the influence of self-reported understanding on global warming concern (models 9 and 12 in Table 3).

Clearly, though, what is most important is the consistent moderating effect of political ideology *and* party identification on the influence of *both* educational attainment and self-reported understanding on *both* global warming beliefs and concern. In fact, *all* of the sixteen interaction effects in the eight models are statistically significant. Their positive direction and the coding of the original variables lead to the

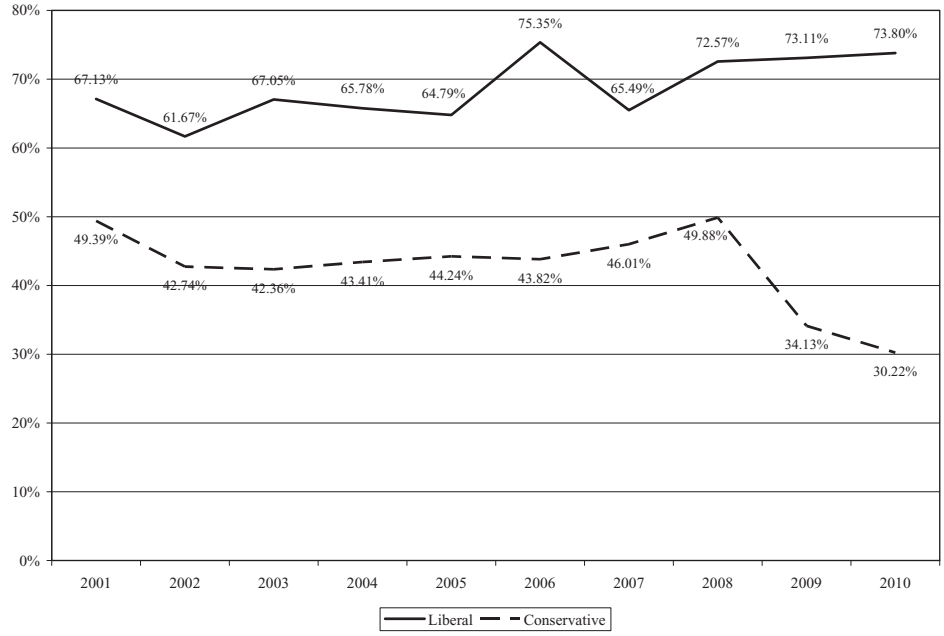
following interpretation: the effects of educational attainment and self-reported understanding on beliefs about climate science and personal concern about global warming are *positive* for liberals and Democrats, but are *weaker or negative* for conservatives and Republicans.

These results persist even while controlling for other relevant variables, thus increasing our confidence in the existence of this general moderating effect. The results thus provide strong support for our hypotheses that political orientation moderates the association between educational attainment (Hypothesis 3) and self-reported understanding (Hypothesis 4) on one side and beliefs about climate science and personal concern about global warming on the other. As anticipated, these results are consistent with the expectations of the elite cues hypothesis and information-processing theory that political orientation filters educational attainment and perceived understanding on controversial issues for which there is a bifurcated flow of competing information.

Ideological and Partisan Polarization

Has the political divide over global warming documented above grown wider over time, indicating that the American public has become politically polarized over climate change in recent years? Figure 4 displays the percentages of liberals and conservatives (top) and the percentages of Democrats and Republicans (bottom) who believe the effects of global warming have already begun to happen. We ignore the middle-of-the-road and Independent categories to make it easier to identify polarization trends.[17] Scanning the top and bottom of Figure 4 provides visual evidence of polarization. The 18-point difference between the percent of liberals (67.1 percent) and the percent of conservatives (49.4 percent) who believe global warming has already begun in 2001 becomes a 44-point difference in 2010—74.8 percent for liberals and 30.2 percent for conservatives. A similar trend exists for party identification, as the gap between Democrats and Republicans grows from 11 percent to 41 percent over the decade.

To rigorously test our polarization hypotheses (Hypothesis 5 and Hypothesis 6), we examine the performance of a "political orientation × year" interaction effect in multivariate logistic regression models. This allows us to control for correlates that may affect beliefs and concern over time. Table 4 displays the unstandardized coefficient values, standard errors, and significance levels of the relevant variables necessary to evaluate these interaction effects. The coefficients in the top half of Table 4 allow us to examine ideological polarization on both global warming beliefs and concern items over time, while the coefficients in the bottom half allow us to examine partisan polarization. The models from which these coefficients are taken included all of the other variables used in this study. For space reasons, we report only the political orientation, year, and interaction effect coefficients that test for polarization. The models producing the coefficients in the top of the table only utilize data from conservatives and liberals (with "middle-of-the-roaders" removed), and the models producing the coefficients in the bottom half only utilize data from Republicans and Democrats (with "Independents" removed). Thus, the interaction effects are indicators of the divergence or convergence



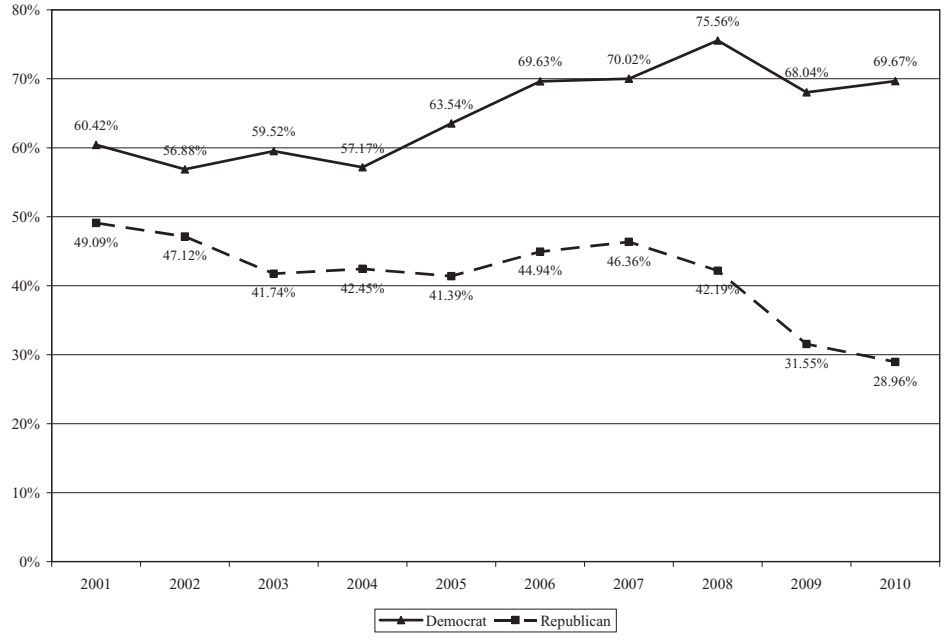


FIGURE 4. Percent of Americans Who Believe the Effects of Global Warming Have Already Begun to Happen from 2001–2010, by Political Ideology and Party Identification.

TABLE 4. Selected Logistic Regression Coefficients to Test for Ideological and Partisan Polarization in Global Warming Beliefs and Concern

	Belief items		Concern items	
Independent variables	Global warming is happening now	Global warming is caused by humans	Worry about global warming a great deal	Global warming will threaten way of life
Ideological polarization models ("Middle-of-the-road" is removed)				
Political ideology	.233***	.324***	.298***	.194***
	(.032)	(.040)	(.035)	(.043)
Year	−.015	−.044**	−.016	.033*
	(.012)	(.013)	(.012)	(.013)
Political ideology × year	.033**	.025*	.040***	.033**
	(.010)	(.011)	(.010)	(.010)
Sample size	5,394	3,601	4,788	3,014
Partisan polarization models ("Independent" is removed)				
Party identification	.214***	.198***	.255***	.212***
	(.016)	(.020)	(.019)	(.023)
Year	.000	−.053***	−.003	.027*
	(.009)	(.010)	(.010)	(.011)
Party identification × year	.037***	.017**	.019***	.016**
	(.005)	(.006)	(.006)	(.006)
Sample size	8,230	5,487	7,309	4,581

*$p < .05$, **$p < .01$, ***$p < .001$ (two-tailed tests).

Notes: The coefficient values reported here come from models also containing the following variables: political ideology, party identification, educational attainment, self-reported understanding, environmental movement identity, gender, age, race, annual income, religiosity, and year. Because of space concerns, we report only those coefficients relevant to determine polarization.

over the time period between liberals/Democrats and conservatives/Republicans. Given the coding of political ideology and party identification, a statistically significant positive value for an interaction effect represents polarization over time.

The eight statistically significant, positive interaction effects in Table 4 confirm that there has been both ideological and partisan polarization on the issue of climate change within the American public between 2001 and 2010. These results provide strong support for both Hypothesis 5 (predicting ideological polarization) and Hypothesis 6 (predicting partisan polarization).[18] Thus, liberals/Democrats and conservatives/Republicans in the American public diverged significantly in their beliefs about climate science and on their personal concern about global warming between over the last decade.

This evidence of polarization, combined with the findings of earlier research on the politics of climate change discussed earlier, support the prevailing theoretical explanation for political polarization in the American public. In recent decades, the Democratic and Republican Parties have become polarized on environmental issues (Dunlap et al. 2001), especially as stakes have increased for recognizing and dealing with global environmental problems that challenge the economic order, such as climate change (McCright and Dunlap 2003, 2010; Jacques et al. 2008). This elite polarization trend is likely driven by liberal environmental activists and scientists and conservative movement activists closely aligned with the Democratic and Republican Parties, respectively. This increasing divide between the two parties and between ideological elites on the Left and the Right has made it easier for American citizens to sort themselves along ideological and partisan lines (Layman et al. 2006; Abramowitz and Saunders 2008). Not only do we find strong evidence of party sorting over climate change in the American public in recent years (consistent with Baldassarri and Gelman 2008), but we also find substantial evidence of ideological sorting—confirming and extending the earlier results of Dunlap and McCright (2008a).

SUMMARY AND CONCLUSION

In response to our first research question, we find a sizable political divide between liberals/Democrats and conservatives/Republicans in the American public on the issue of global warming. Just as elites are politically divided on this issue, so too is the general public. Liberals and Democrats are more likely to hold beliefs about global warming consistent with the scientific consensus and to express concern about this environmental problem than are conservatives and Republicans. Furthermore, this divide has grown substantially over the past decade.

Current flows of political messages and news concerning global warming are likely contributing to the growing divide. Americans' political orientations moderate educational attainment and self-reported understanding in ways consistent with the predictions of the elite cues hypothesis and information-processing theory. Given the bifurcated flow of conflicting information on global warming from elites on both sides of the political spectrum, ideological, and partisan camps in the general public likely

receive very different information on global warming—in ways that reinforce their existing political differences (Hindman 2009). In fact, in terms of our second research question, we find that the effects of educational attainment and self-reported understanding on beliefs about climate science and personal concern about global warming are *positive* for liberals and Democrats, but are *weaker or negative* for conservatives and Republicans. Finding this strong pattern increases the generalizability of the few other studies that have documented such an effect, typically at single points in time.

The moderating effect of political orientation challenges the common assumption of climate change communicators (e.g., scientists and policymakers) that more information or education will help convince Americans of the need to deal with climate change. Particularly for those on the Right, this seems unlikely to prove effective. Our results, along with those of prior studies, show that education and self-reported understanding of global warming have little effect on the views of climate change held by Republicans and conservatives. Reducing climate skepticism among this large segment of the American populace will require far more than simply providing additional information.

In recent decades, ideological and party elites in the United States have become polarized on a wide range of social, economic, and cultural issues—including environmental issues such as climate change. In response to our third research question, we find that the American public has also experienced polarization on this vital global environmental problem. Specifically, we find strong evidence of both ideological and partisan polarization on global warming beliefs and concern over the past decade. Even if this polarization trend slows and perhaps reverses slightly in the next few years, the remaining political divide within the American public will still be much larger than it was in 2001—the year that the IPCC's *Third Assessment Report* clearly established the current scientific consensus on climate change. Our results thus extend Baldassarri and Gelman's (2008) recent analysis of political polarization in the American public, as we find significant polarization on a science-based environmental issue—a domain largely ignored in the existing literature.

Our findings have clear policy implications. To be sure, the existing divide on global warming between political elites poses a serious impediment to creating and implementing an effective federal climate policy with any potential of significantly reducing our nation's greenhouse gas emissions. However, given that public opinion can have a significant impact on policy-making (e.g., Burstein 1998), we expect that the political divide within the general public may further inhibit the creation of effective climate policy. For instance, Republican politicians are unlikely to support efforts to reduce greenhouse gas emissions that party activists and members believe to be unnecessary. Indeed, the rise of the Tea Party and rightward drift of the Republican party created a situation in which skepticism toward climate change became a litmus test for party candidates in the 2010 election (Brownstein 2010; Lehmann 2010), resulting in a 2011 to 2012 House of Representatives expected to be hostile to climate science and steadfastly opposed to climate policies (Goode and Bravender 2010).[19]

More generally, our results raise questions about theories of reflexive modernization that suggest that forces of reflexivity, such as the scientific community and social movements, impel modern societies to confront the negative consequences of industrial capitalism (e.g., Beck et al. 1994; Mol 1996). McCright and Dunlap (2010) argue that these theories give insufficient attention to forces of anti-reflexivity, such as the American conservative movement, that defend the current economic system by challenging critiques mounted by the scientific community, environmentalists, and liberal policymakers (also see Lahsen 2005; Jacques 2006; Demeritt 2006; Oreskes and Conway 2010). Indeed, among elites and organizations within our society, there is an enduring conflict between forces of reflexivity (those mostly on the Left who identify problems with our economic system) and forces of anti-reflexivity (those mostly on the Right who defend the industrial capitalist order of modernity against such critiques). Perhaps nowhere is this more evident than in the debate over climate change, the most challenging global environmental problem and one with the greatest regulatory implications.

Our results indicate that this conflict is also diffusing throughout the American public. Liberals and Democrats are more likely to take the side of the scientific consensus and many environmental movement organizations, proclaiming that global warming is real, is human-caused, and is a worrisome threat. On the other hand, conservatives and Republicans are more likely to dispute or deny the scientific consensus and the claims of the environmental community, thereby defending the industrial capitalist system.

This trend poses a challenge for proponents of reflexive modernization, as a growing percentage of the American public—and not just self-interested industrial/conservative elites—denies the scientific evidence documenting anthropogenic climate change and thus the need for ameliorative action. This diffusion of anti-reflexivity throughout society results in a declining portion of the populace willing to acknowledge a major negative consequence of industrial capitalism. The culture wars have thus taken on a new dimension, with serious implications for long-term societal resilience.

ACKNOWLEDGMENTS

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NOTES

[1]We use climate change and global warming interchangeably, although the former technically connotes all forms of climatic variability introduced by the warming of Earth's surface and oceans stemming from the increased accumulation of greenhouse gases in the Earth's atmosphere (see National Research Council 2001).

[2]Although reflexive modernization has received a critical response from some American theorists (e.g., Alexander 1996), it has been influential among those working on environmental/risk issues (e.g., Alario and Freudenburg 2003).

[3]We use the terms "politicized" and "politicization" to refer to how the science underlying policy decisions is increasingly the object of promotion and attack by advocates and opponents of regulatory policies. Politicization also means that the defense and denial of scientific findings that have implications for regulatory policy increasingly align with existing political divisions between those who oppose regulations on economic markets and those who see regulations as necessary to protect the public good.

[4]This strategy builds on those employed earlier by polluters and producers of dangerous products (e.g., tobacco companies) to "manufacture uncertainty" regarding the scientific evidence used by those seeking regulations on their industries (Michaels 2008; see also Freudenburg, Gramling, and Davidson 2008). A few conservative think tanks, most notably the Marshall Institute, were already attacking climate science in the late 1980s (Oreskes and Conway 2010).

[5]A 2007 *National Journal* poll of Congress found 95 percent of the 41 Democratic respondents but only 13 percent of the 31 Republican respondents agreeing that "it's been proven beyond a reasonable doubt that the Earth is warming because of man-made [sic] problems" (Cohen and Bell 2007:6). More recently, virtually all Republican candidates for Congress in the 2010 election have endorsed varying degrees of climate change denial (Brownstein 2010).

[6]Baldassarri and Gelman (2008:426) examine polarization on "federal spending on the environment" as one of the 47 issue items they analyze.

[7]Not all of the global warming items we employ are asked every year, and thus when we used pooled samples in our analyses the Ns vary across the dependent variables. Also, as typical for most national surveys, the Gallup Organization employs weighting procedures to ensure that its samples are representative of the American adult population. We ran all of our multivariate analyses with both weighted and unweighted data and achieved similar results. We report the results of multivariate models with unweighted data here.

[8]The perceived threat variable is similar to standard risk perception items (see, e.g., Slovic 2001).

[9]The results of the logistic models with the dichotomized worry variable reported here are similar to the results of linear models using the original four-category worry item.

[10]Past research finds such self-assessments to be associated with objective measures of knowledge (Pierce et al. 1989).

[11]This simple measure of environmental movement identity predicts membership in environmental movement organizations, assessment of environmental organizations and the overall movement, and performance of pro-environmental behaviors (Dunlap and McCright 2008b).

[12]Utilizing higher-order (e.g., interaction) terms in regression models often leads to multicollinearity problems. Since interaction terms based on centered scores have a different scale than the original variables, these multicollinearity problems are reduced (e.g., Aiken, West, and Reno 1991).

[13]DiMaggio et al. (1996; see also Evans et al. 2001; Evans 2002, 2003) identify four dimensions of polarization: dispersion within a population (increasing variance over time); bimodality within a population (increasing kurtosis over time); constraint within subgroups of a population (increasing Cronbach's alpha among issue items over time); and consolidation. After their 1996 publication, the authors dropped analyses of the constraint dimension.

[14]See Mouw and Sobel's (2001) critique of this approach when using ordinal or categorical variables and the reply by Evans et al. (2001).

[15]Individuals self-identifying as active participants in the environmental movement are more likely to report beliefs consistent with the scientific consensus and express personal concern about global warming than are individuals unsympathetic to the movement, supporting earlier

findings that environmental group membership (Leiserowitz 2006) and pro-environmental values (Brody et al. 2008; Kellstedt et al. 2008) have positive effects on concern about global warming. Females and whites are more likely to report beliefs consistent with the scientific consensus than are their male and nonwhite counterparts (McCright 2010). Further, largely consistent with past findings, females (O'Connor et al. 1999; Leiserowitz 2006; Brody et al. 2008; Hamilton 2008; Malka et al. 2009; McCright 2010) and nonwhites (Wood and Vedlitz 2007; Malka et al. 2009; McCright 2010) are more likely to express concern. Higher income increases the likelihood of believing that global warming is happening now (though not that it is human caused); yet, income is negatively related to concern, confirming the results of O'Connor et al. (1999). More religious adults are less likely to report beliefs consistent with the scientific consensus than are their less religious counterparts. Religiosity has no significant effect on people's perceived threat of global warming—consistent with Kellstedt et al. (2008)—but it does have a weak, negative effect on people's worry about global warming. Younger adults are more likely to report beliefs consistent with the scientific consensus than are older adults; yet, the effect of age on concern is inconsistent, as it is across previous studies (Wood and Vedlitz 2007; Kellstedt et al. 2008; Malka et al. 2009).

[16]Hamilton (2008) finds that two test-based measures—a "polar quiz" and a science literacy index—also correlate positively with concern about global warming.

[17]Interested readers can see the trend lines for the middle categories in Figures A6 and A7 in the Appendix.

[18]One reviewer asked whether the decrease in Republican Party identification (and possible shift in the social and demographic characteristics of those remaining in the party) since 2003 might influence partisan polarization trends. We do find evidence of a decline in Republican Party self-identification in the general public: the relationship between year and Republican Party self-identification was statistically significant from 2003 to 2010 ($r = -.028$, $p = .011$). Yet, the characteristics of those identifying with the Republican Party changed little during this time period. We ran a series of one-way ANOVAs for the other eight political, social, and demographic characteristics in this study. Between 2003 and 2010, average respondents self-identifying with the Republican Party: became slightly more conservative ideologically—from a mean of 2.39 to 2.25 ($F = 13.292$, $p < .001$); became a little older—46.80 to 50.19 ($F = 30.548$, $p < .001$); and had higher annual incomes—3.25 to 3.58 ($F = 13.509$, $p < .001$). Our multivariate analyses control for the direct effects of these variables. We maintain that the partisan polarization trends documented in Table 4 are due not to slight compositional changes within the group of Republican Party self-identifiers but to actual changes in their beliefs and attitudes on climate change in this time period. Indeed, challenging climate science and rebutting claims about the seriousness of global warming seemed to become Republican Party orthodoxy during this time period (Brownstein 2010; McCright and Dunlap 2010). In fact, recent patterns tend to support this argument. Political polarization accelerated in the last two years of the study, 2009 and 2010, at the same time when Republican Party self-identifiers were actually trending more politically liberal (compared to in 2008).

[19]While this trend appears to reflect a good example of activist-driven "party sorting," it should be noted that the Tea Party was stimulated by some of the same political-economic elites that have directly supported climate change denial. Most notable are Charles and David Koch, of Koch Industries, who have funded organizations that actively promote the Tea Party as well as climate change denial (Greenpeace 2010; Mayer 2010).

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APPENDIX

Figure A1, which expands on Figure 1, illustrates the ideological and partisan divide on global warming beliefs and concern between 2001 and 2010. For each of the four quadrants of this figure, the solid bars on the left half (political ideology) and the dashed bars on the right half (party identification) represent the percentages of Americans reporting beliefs consistent with the scientific consensus (A1A and A1B) and the percentages reporting a high level of concern about global warming (A1C and A1D).

Figures A2 and A3, which expand on Figure 2, illustrate the moderating effect of political orientation on the relationship between educational attainment and beliefs about climate science (A2) and personal concern about global warming (A3). The top half in both figures (solid bars in A and C) show patterns for political ideology, while the bottom half (dashed bars in B and D) show patterns for party identification. Within each quadrant in a given figure (e.g., A2A), there are two sets of three bars. The three bars on

the left represent Americans with less than a college degree, while the three bars on the right represent those with at least a college degree.

Figures A4 and A5, which expand on Figure 3, illustrate the moderating effect of political orientation on the relationship between self-reported understanding of global warming and beliefs (A4) and concern (A5). Within each quadrant in a given figure (e.g., A4A), there are two sets of three bars. The three bars on the left represent Americans who self-report understanding global warming less than very well, while the three bars on the right represent those who self-report understanding global warming very well.

Figures A6 and A7 expand on Figure 4. Figure A6 displays the means for the political ideology groupings and the party identification groupings on the two belief items over time (A6A and A6B for timing; A6C and A6D for primary cause). Figure A7 does the same for the two concern items (A7A and A7B for worry; A7C and A7D for perceived threat). In these figures, the top halves represent trends for political ideology, and the bottom halves represent trends for party identification.

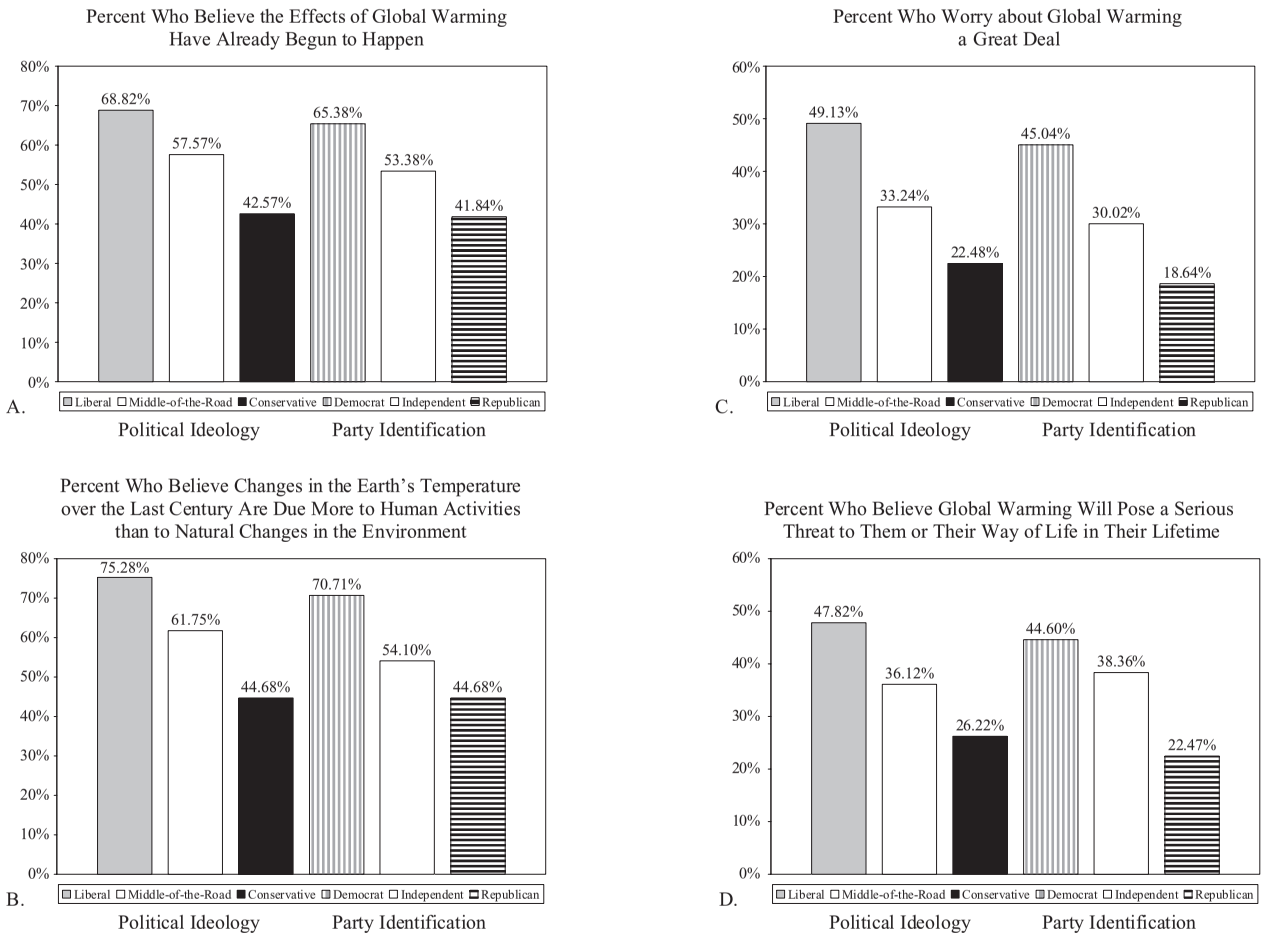

FIGURE A1. Americans' Beliefs (A, B) and Concern (C, D) about Global Warming by Political Ideology and Party Identification (2001–2010 Weighted Data).

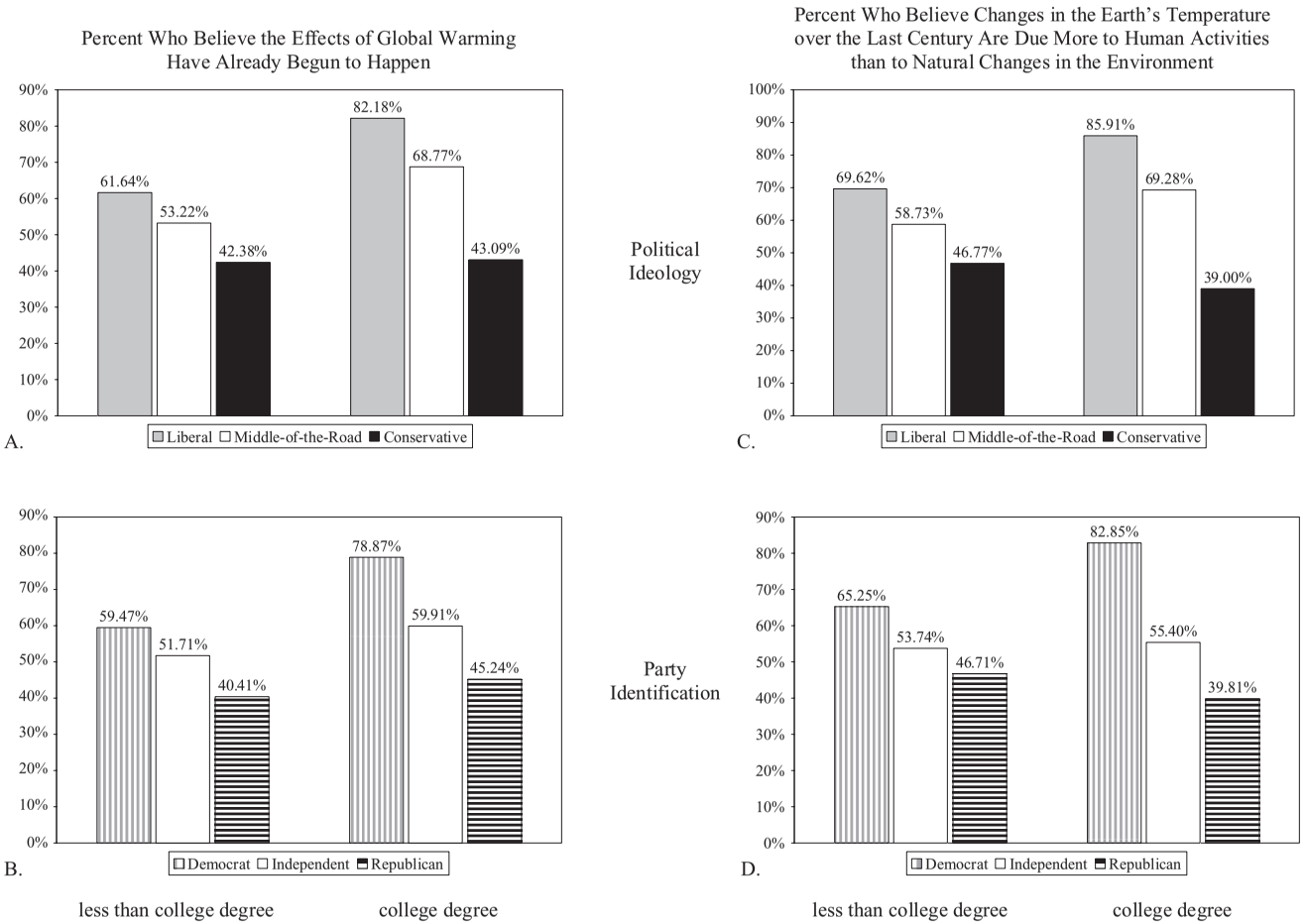

FIGURE A2. Americans' Beliefs about Climate Science by Political Ideology and Party Identification, Controlling for Educational Attainment (2001–2010 Weighted Data).

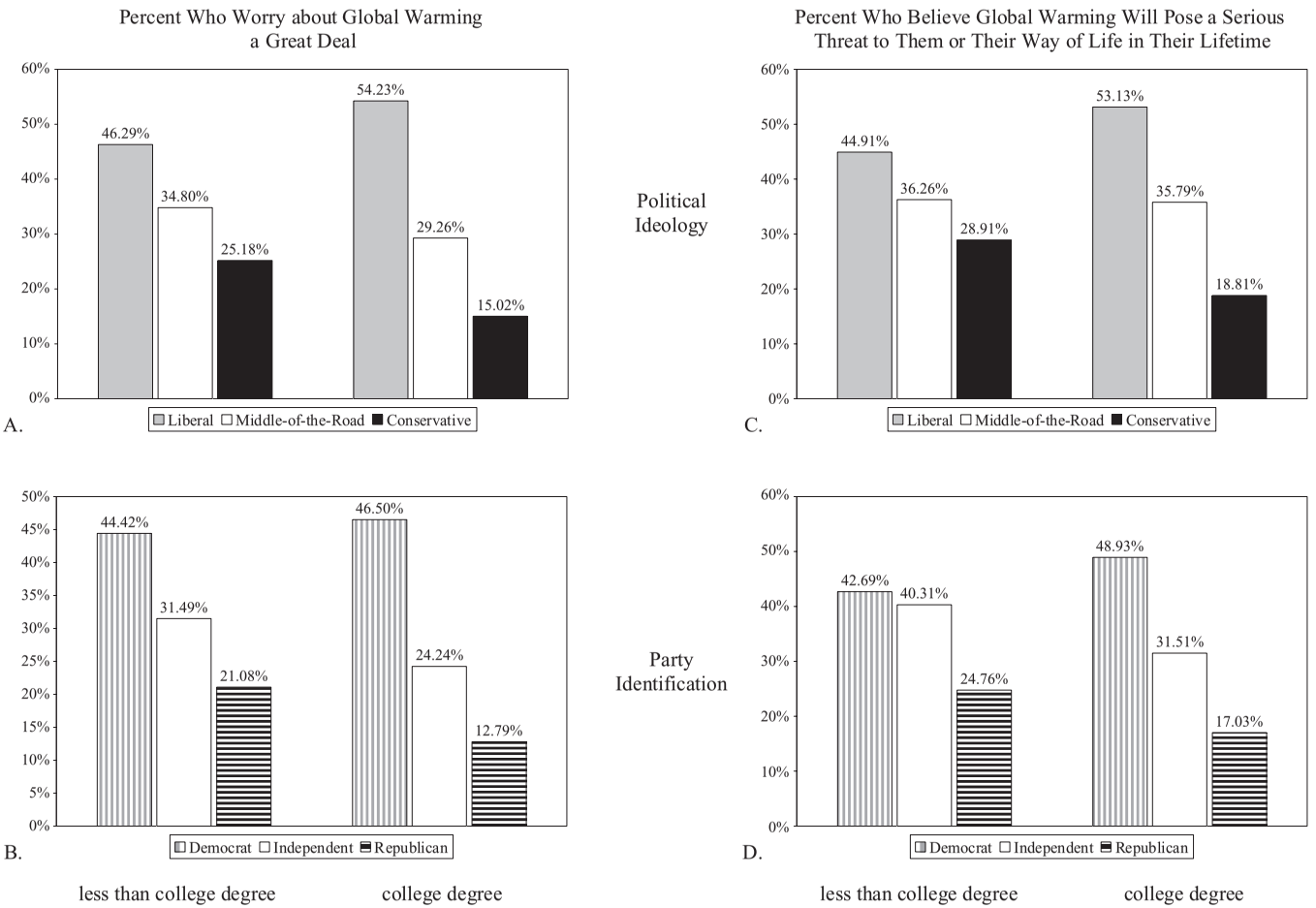

FIGURE A3. Americans' Concern about Global Warming by Political Ideology and Party Identification, Controlling for Educational Attainment (2001–2010 Weighted Data).

FIGURE A4. Americans' Beliefs about Climate Science Political Ideology and Party Identification, Controlling for Self-Reported Understanding (2001–2010 Weighted Data).

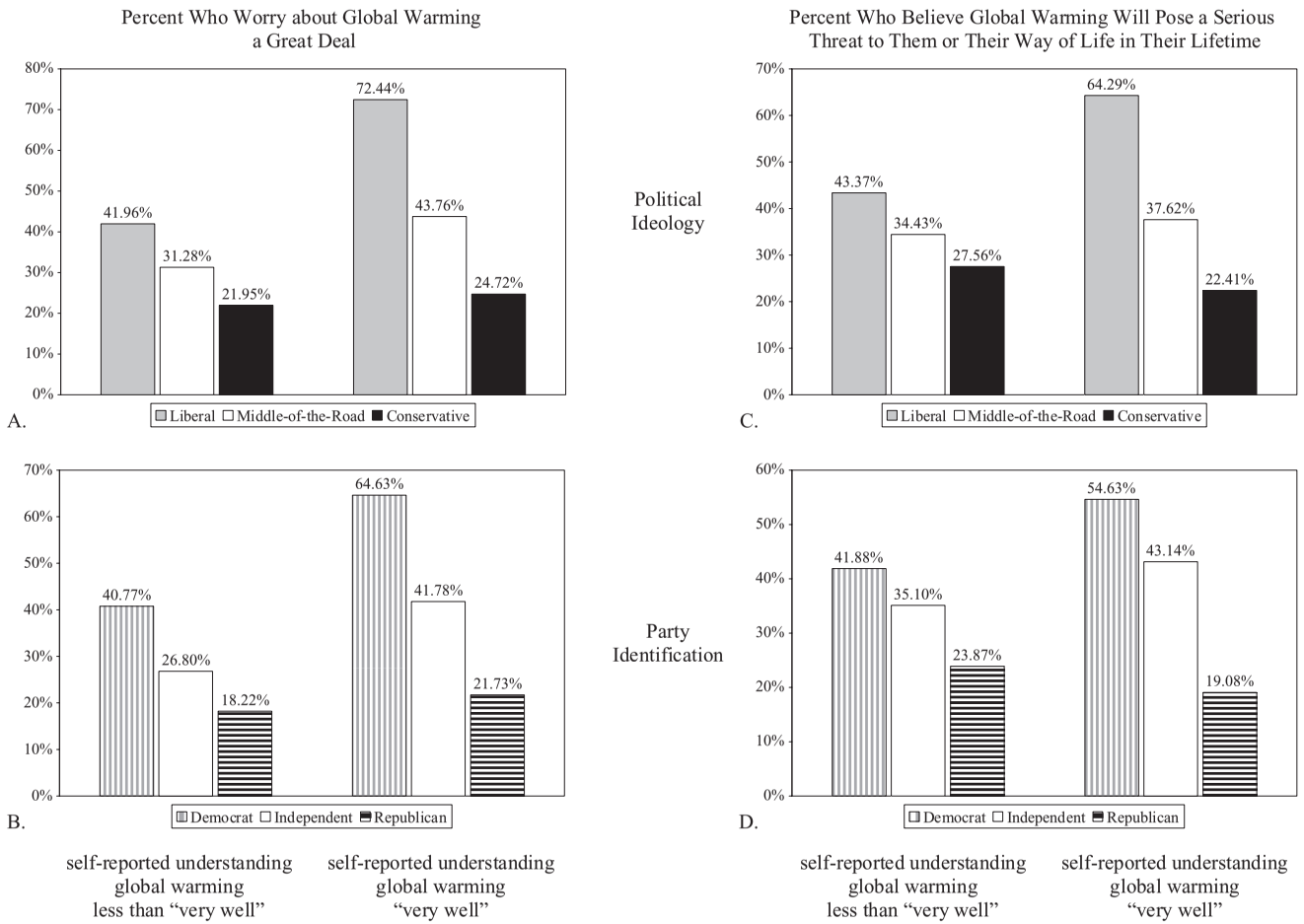

FIGURE A5. Americans' Concern about Global Warming by Political Ideology and Party Identification, Controlling for Self-Reported Understanding (2001–2010 Weighted Data).

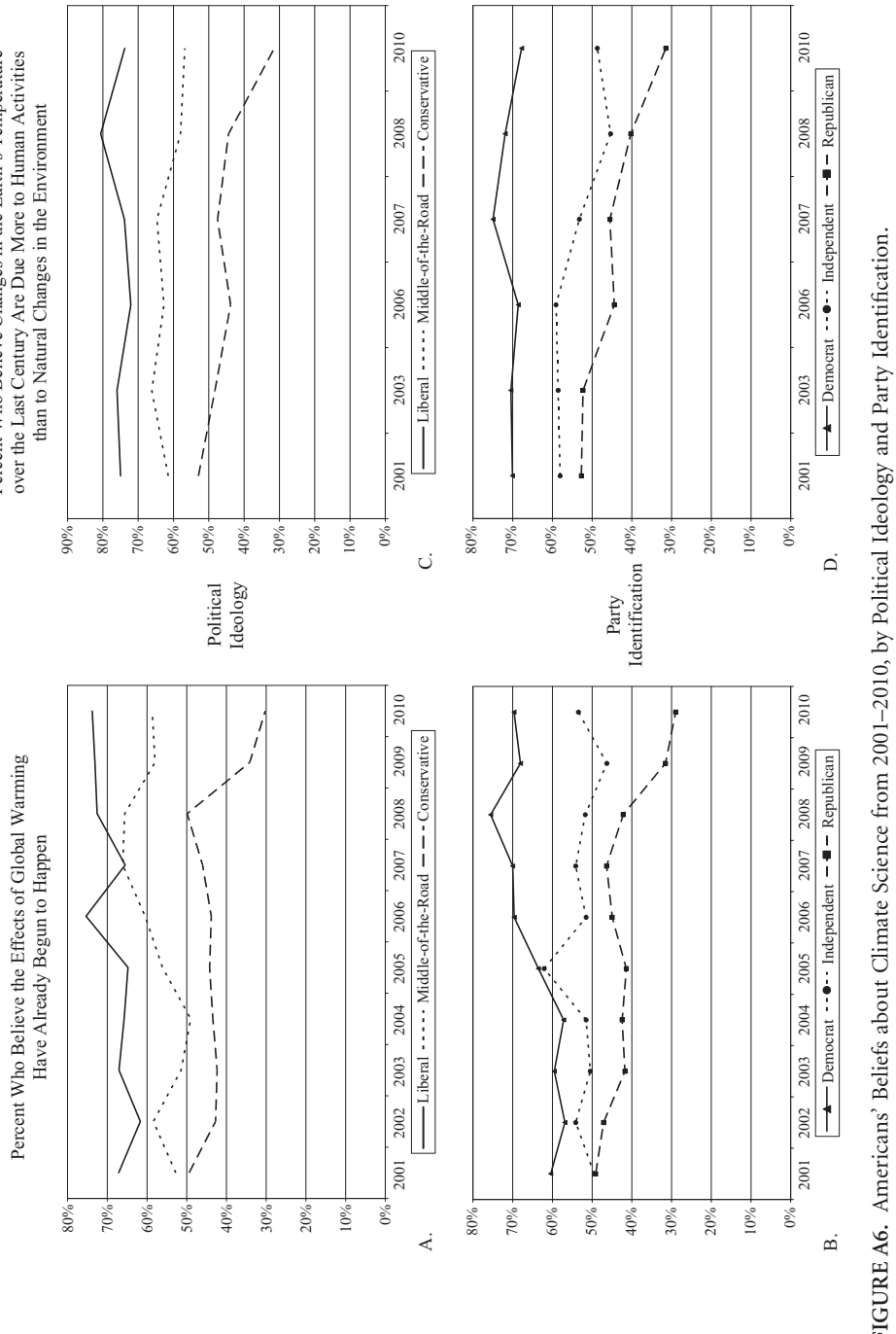

FIGURE A6. Americans' Beliefs about Climate Science from 2001–2010, by Political Ideology and Party Identification.

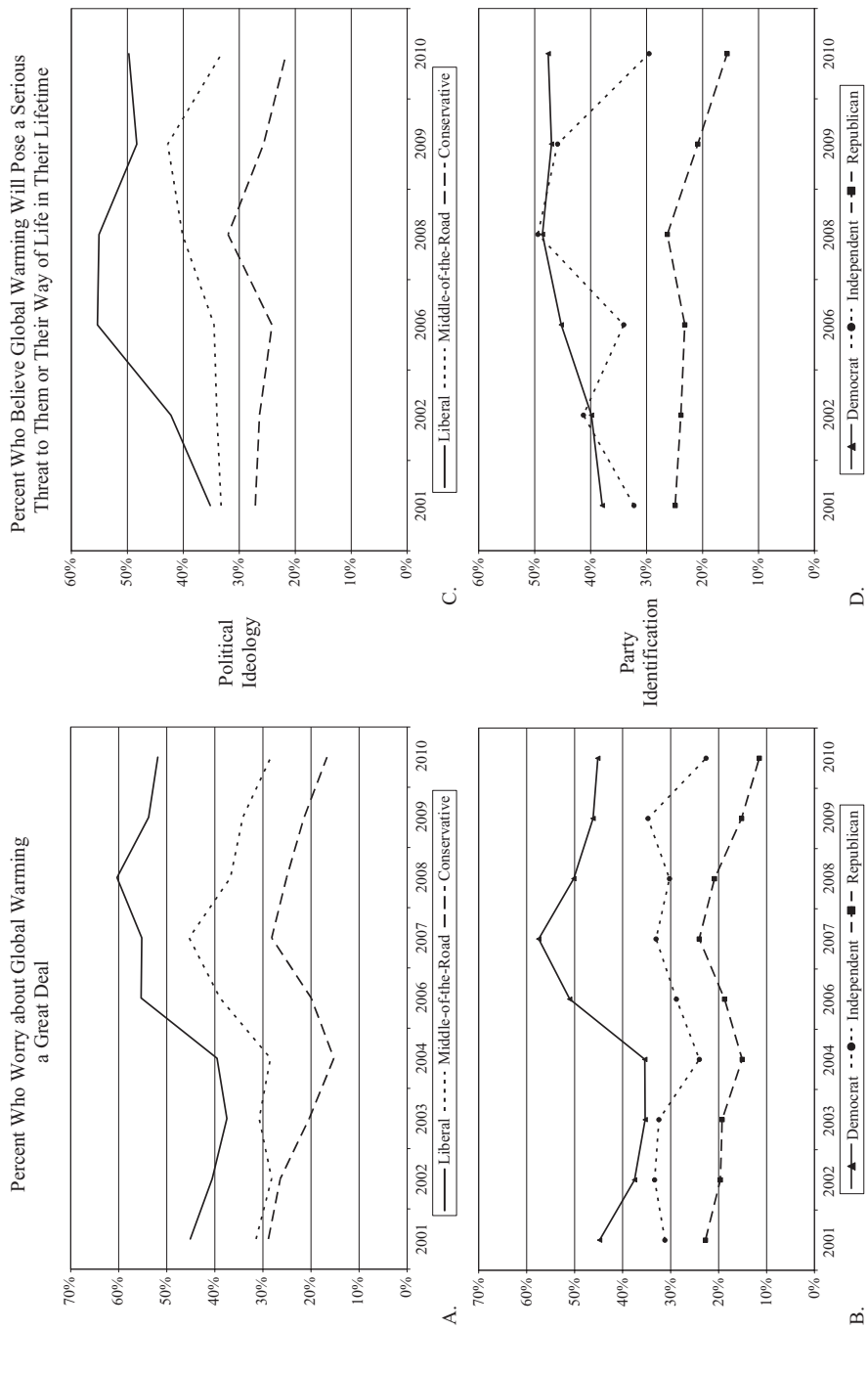

FIGURE A7. Americans' Concern about Global Warming from 2001–2010, by Political Ideology and Party Identification.