

A Macro Political Examination of the Partisan and Ideological Divide in Aggregate Public Concern over Climate Change in the U.S. between 2001 and 2013

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Abstract

Recent individual level analyses have detailed a progressive polarization between political parties in public concern and understanding of climate change. These micro political analyses are limited by the data and time-scale available in the use of a single surveying organization and instrument. In this paper, we employ macro political analysis of all relevant polling data available on the Roper iPoll Database to develop reliable and valid measures of aggregate public concern over the issue of climate change across a 13-year time-period. Aggregate public opinion is analyzed and separated by political ideology and party identification using Stimson's (1999) method for pooling multiple polls. Through statistical analysis of six measures of aggregate public opinion trends, we find significant differences between trends in public concern across political and ideological lines, and find that the political right and political left

have not only become more polarized on the issue of climate change between 2001 and 2013, but that the populations are not moving as parallel publics as previous literature suggests they might.

Keywords: Climate change, Public opinion, Political polarization

1. Introduction

Individual-level analyses have detailed a progressive polarization between political parties in public concern about climate change (Guber 2013, McCright 2011), but these analyses are often plagued by limitations in the availability of repeated survey items that track this issue over time. We have overcome previous limitations by developing separate quarterly measures of concern over global climate change by both party affiliation and political ideology utilizing Stimson's method of constructing aggregate public opinion measures (Stimson 1999). This aggregate measure of climate change concern is based on data from 69 surveys administered between 2001 and 2013. These measures present us with a significant divide between the political right and the political left. We also show that polarization in climate change concern has grown over the 13-year time period, and that these populations are not moving as "parallel publics" as previous literature suggests (Kellstedt 2003, Enns and Kellstedt 2008).

In a 2014 Gallup Poll, 83% of Democrats and only 38% of Republicans expressed concern over climate change, and several individual-level analyses detailed this progressive polarization (Guber 2013, McCright 2011, Krosnick et al 2006). There is, however, a great deal of variation in the data collected at the individual-level. For example, in Pew Research Center's 2014 report, 50% of Republicans indicated concern over climate change, with Democrats at 81%. While there has been some important work in this area, the existing analyses are limited in time-scale, to a single data source, and by question wording. McCright and Dunlap (2011) for instance, report an increase in political polarization on the subject of climate change but their study uses only annual data and relies exclusively on questions derived from Gallup polls. Guber (2013) also finds a polarization in climate change concern, but her analyses only examine changes across three cross-sectional polls administered at 10-year intervals, again drawing only from Gallup. While these individual-level studies do help identify the polarized nature of the debate about climate change, the data limitations from which they suffer beg for a more robust examination.

To remedy this problem, we utilize the "policy mood" approach developed by James Stimson to construct six separate climate change indices. With these indices, we present a robust indicator of the quarterly shifts in climate change concern between 2001 and 2013, disaggregated by party affiliation and political ideology, as well as for the overall population. Unlike prior studies in this area, this approach will allow us to incorporate all of the available U.S. national public opinion polls on climate change rather than relying on just one poll or organization. We compare these groups, and conclude with observations on the utility of these measures and areas for future research. This type of aggregation allows us to tell a more complete story than do individual-source analyses, by including a diverse set of survey items on climate change concern derived from multiple polling organizations, with questions administered multiple times per year.

1.1 Macro Politics and Aggregate Analysis

There are two different approaches to the measurement of public opinion. The first and most common is the analysis of *micro politics*. Based in psychology, this approach analyzes the individual-level characteristics that produce variations in specific attitudes, beliefs, and behaviors through the use of survey research. The second approach to the study of public opinion is known as *macro politics*. Instead of focusing on the individual, the unit of analysis is public opinion data aggregated to some larger unit (typically, the entire country). This approach focuses on the structural conditions that may drive changes in aggregate public opinion over time (Erikson et al 2002, Stimson 2004). Given that this research aims to study macro-level phenomenon and the movement of U.S. public concern over climate change across time, a macro political approach is more appropriate for this analysis (Keele 2007).

Periodic surveys of public opinion related to climate change have very recently been developed¹, but many years will pass before these measures provide sufficient cases to estimate shifts using time-series techniques. In addition, these surveys will do little to capture data from the past due to inconsistencies in question wording and survey administration. In 2012, Brulle *et al* developed the first valid trend measure of this subject, the Climate Change Threat Index (CCTI), for the years 2002 through 2010 using Stimson's "Policy Mood" analysis (Brulle 2012, Stimson 1999). In his research, Stimson developed an algorithm to measure "policy moods" over time by using all existing survey data related to a particular social issue to construct a longitudinal index of public opinion.

Stimson's "Policy Mood" analysis and algorithm have been effectively applied to a number of topics in sociology and political science (Kellstedt 2003, Kellstedt et al 2008, Brulle 2013, Ramirez 2013, Krosnick 2006). There are several advantages of this aggregate approach over individual-level analyses. By developing an aggregate "Policy Mood", the Stimson algorithm can provide more accurate measures of issue or policy concern because it can utilize all the available survey data about a particular subject. The use of an algorithm to mathematically standardize data across multiple polling organizations has the advantage of minimizing the influence of researcher discretion in their specific survey item selection, and allows the measure to be invariant with respect to differences in question wording across polling organizations (Stimson 1999). A more complete explanation of Stimson's methodology and algorithm can be found in the Methods section of this paper.

1.2 Parallel Publics

The literature on aggregate public opinion measures posits that "parallel publics" exist, and that for some portions of the public, opinion is stable and fixed mainly by social and ideological identities (Enns and Kellstedt 2008, Brulle 2012, Kellstedt 2010). However, micro-political literature also shows a widening partisan divide on the issue of climate change, which indicates that individuals may be responding differently to media coverage and political cues depending on their own political beliefs. Furthermore, recent studies show that

¹ See the Six Americas Project at the George Mason University Center for Climate Change Communication (<http://www.climatechangecommunication.org/>) and the work of Jon Krosnick (<http://climatepublicopinion.stanford.edu/>).

self-identified liberals and democrats are more likely than political conservatives to report beliefs consistent with the scientific consensus about climate change (IPCC 2013), and that the ideological and partisan gap in climate change beliefs has increased significantly between 2001 and 2010 (Guber 2013, McCright 2011). A macro-political approach to this question, which has not been explored prior to this study, will allow for the testing of the existence of “parallel publics” on this subject.

Building on this literature, we seek to use a more robust, aggregate-level analysis to ask the following questions: 1) Does the gap in concern over climate change between Republican and Democrats (or Conservatives and Liberals) increase between 2001 and 2013?; and 2) Do the ideological and partisan groups move as “parallel publics” in their climate change concern over this 13-year time period? We answer these questions using Stimson’s algorithm to calculate a public mood using all available polling data since 2001. Doing so will help improve our understanding of the ideological divide in climate change beliefs by applying a more vigorous and reliable measure of public opinion.

2. Methods

In applying Stimson’s methodology, survey marginals for responses of interest are compiled from all relevant questions, making each nationwide survey a single data point. These data points can then be analyzed over time, using Stimson’s algorithm.⁸ The algorithm examines the relationship between the marginals, and places each survey on a common metric of ratios by comparing the survey marginal for a question with itself across time. The algorithm then averages the questions across question and time using backward and forward recursion, filling in missing data along the way (Kellstedt 2010). This develops a measure of central tendency, creating a comparable metric for each survey question. The resulting variations in the metric are used to measure the “policy mood.” One important advantage of this methodology is that existing data can be used to calculate any missing data, for example, in a year in which no survey was asked during a particular quarter. This aspect of the methodology solves a historical problem in measuring public opinion over time with traditional social research methodologies.

To measure and examine public opinion on climate change we constructed several time-series using data drawn from the Roper Center iPoll database. The database was searched for poll questions containing the words “climate change” or “global warming” and questions were selected from the search results that asked respondents to assess the level of threat they perceive from climate change. Our search identified 20 different questions from 8 different polling organizations that asked about climate change. For the majority of these polls, respondents were asked to indicate their political ideology and/or their party affiliation. Using this political identification data, combined with questions related to climate change, we were able to calculate both an Ideology Climate Change Threat Index (ICCTI) and a Party Climate Change threat Index (PCCTI).²

Between 2001 and 2013, the ICCTI included 65 surveys, which were administered to 88,711

² In ideological identification questions where respondents were given a choice between extreme and average ideology (e.g. very liberal and liberal), the two choices were combined.

respondents, and the PCCTI included 69 surveys, administered to 95,981 respondents³. The inclusion of these survey questions creates a comprehensive and robust sample of all climate change surveys conducted in the United States. A list of the specific questions, dates administered, survey marginals, and polling organizations can be found in Table S1, and the variable loadings for the commonality estimates can be seen in Table S3, both in the supplementary material accompanying this article online. The method of data collection for each survey variable was consistent across all of the administrations, insuring the comparability of the survey marginals across the time period⁴. The survey marginal scores were processed through Stimson's algorithm using the WCALC program⁵ to calculate the ICCTI and PCCTI on a quarterly basis. For the ICCTI this included three indices for conservatives, liberals, and all respondents. For the PCCTI the three indices were for Republicans, Democrats, and all respondents. Using these separate series, we are able to make meaningful comparisons about public concern over climate change separated by political identification between 2001 and 2013.

The distribution of the surveys including climate change concern questions used for the PCCTI and ICCTI are shown in Table S2 in the online supplementary material. It should be noted that in 2004, only three questions were available from the database, and these were all asked in the first quarter of the year. The data from the other three quarters are interpolated by averaging survey marginals from the first quarter of 2004 and from the first quarter of 2005. The use of the Stimson algorithm allows for this missing data to be interpolated and filled in, but it should be noted that the measurement is not as robust for 2004 as it is in other years.

A two-tailed, Pearson correlation was performed to determine whether the ICCTI and the PCCTI were comparable given the small differences in the included survey administrations (Table 2). We find that the PCCTI and ICCTI were highly correlated with an r value of .990, and a significance at of $p < .001$.

3. Results

A longitudinal measure of public climate change concern was constructed by applying the Stimson algorithm to the polling data drawn from the Roper iPoll database. The demographic data from these surveys was used to create two indices for all respondents (PCCTI and ICCTI)⁶, and one index each for Republicans, Democrats, conservatives, and liberals. Descriptive statistics for the indices are shown in Table 1 and the graphed indices over the 13-year time period can be seen in Figure 1.

Table 1 and Figure 1 show distinct separation between the political left (Democrats and liberals) and the political right (Republicans and conservatives) in the mean aggregate scores and the trend across the time series. The significance between the two political and ideological

³ The ICCTI only includes 65 of the 69 surveys because five of the surveys did not ask respondents about their ideological positions.

⁴ All of the polling organizations except for Yale/George Mason used telephone surveys for each administration of their survey. Yale/George Mason administered all of the variables included in this study online.

⁵ The WCALC program is available online at <http://www.unc.edu/~jstimson/>

⁶ Two separate indices were created for party identification (PCCTI) and political ideology (ICCTI) because 4 of the surveys did not ask respondents about their ideological identification

extremes, and the apparent increase in the gap between these extremes, are analyzed below to answer the research questions.

With the comparability of the PCCTI and ICCTI established in the *Methods* section, Pearson correlations were run between all of the indices (Table 2). The results show that the liberal and Democratic indices vary together ($r=.876, p<.001$), as do the conservative and Republican indices ($r=.905, p<.001$). It appears that public concern about climate change is not influenced by whether one measures climate change ‘mood’ by party or by political ideology. There is, however, a sizable difference (Figure 1) between the political left and political right in their climate change concern. The correlations presented in Table 2 show that a statistically significant difference in climate change concern exists between Republicans and Democrats ($.083, p>.05$) and between conservatives and liberals ($r=.055, p>.05$). When we compile all available polling data since 2001, it is clear that climate change has been exceptionally polarized for both party affiliation and political ideology.

Table 1. Descriptive statistics for the U.S. climate change threat indices based on party affiliation and political ideology.

	Minimum	Maximum	Mean	Std. Deviation
Overall PCCTI	40.03	54.46	45.61	4.13
Republicans	18.84	34.04	25.31	3.76
Democrats	52.25	69.46	59.38	4.98
Overall ICCTI	40.31	53.27	45.27	3.81
Conservatives	22.15	40.33	30.53	4.27
Liberals	54.49	69.30	60.70	4.82

Table 2. Pearson correlations

	PCCTI	Reps	Dems	ICCTI	Cons	Libs
Overall PCCTI	-	.603**	.739**	.990**	.662**	.708**
Republicans	-	-	.083	.616**	.905**	.001
Democrats	-	-	-	.735**	.179	.876**
Overall ICCTI	-	-	-	-	.662**	.702**
Conservatives	-	-	-	-	-	.055
Liberals	-	-	-	-	-	-

** $p<.001$ (two-tailed). Correlations of interest for addressing research questions in bold.

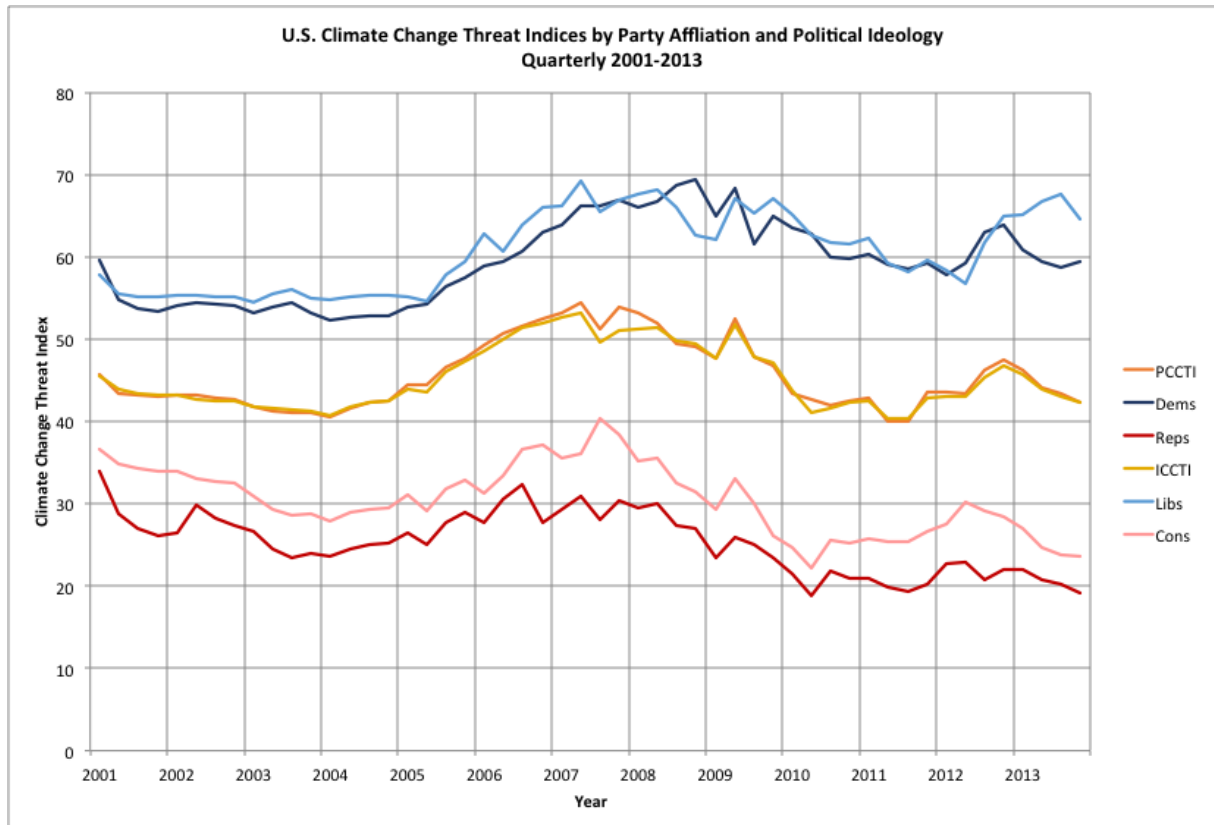


Figure 1. U.S. climate change threat indices based on party affiliation and political ideology, quarterly from 2001 to 2013.

To further analyze the relationship between the political right and the political left, we calculate a set of gap scores indicating the difference between our CCTI scores for party and ideology. Figure 2 shows partisan and ideological gaps for the climate change threat indices across the time period. A larger gap between groups suggest a greater divide in concern on the issue of climate change, while smaller gap numbers suggest that the groups are closer in opinion. We see from Figure 2 that the gap in 2013 was twice that of 2001, indicating that climate change concern has grown substantially more politically polarized. Also, we see that the gap between Republicans and Democrats is consistently higher than it is between liberals and conservatives

To test the difference in the movements of the indices, and determine whether these groups move in parallel, several statistical analyses were employed. Tests of the difference of means reveal that the CCTI for Liberals, $M_{liberals} = 60.70$, is higher than the average concern amongst Conservatives, $M_{conservative} = 30.52$ ($t=34.78$, $p<.001$). A similarly significant gap also exists between Democrats and Republicans. Descriptive statistics also reveal that those on the right of the political spectrum appear to be more willing than those on the left to change their position over time about climate change. Specifically, the range of movement for Conservatives (18.2) is larger than the range for Liberals (14.8).

While a substantial gaps can be seen in Figure 2 between the positions of those on the political left and those on the political right, we must rely on statistical evidence to determine whether or not these separate trends move in parallel. A simple t -test reveals that the mean gaps between

political parties and between the political ideologies are statistically significant in each year from 2001 through 2013 (in each year the gap was significant at the $p < .001$ level or greater).

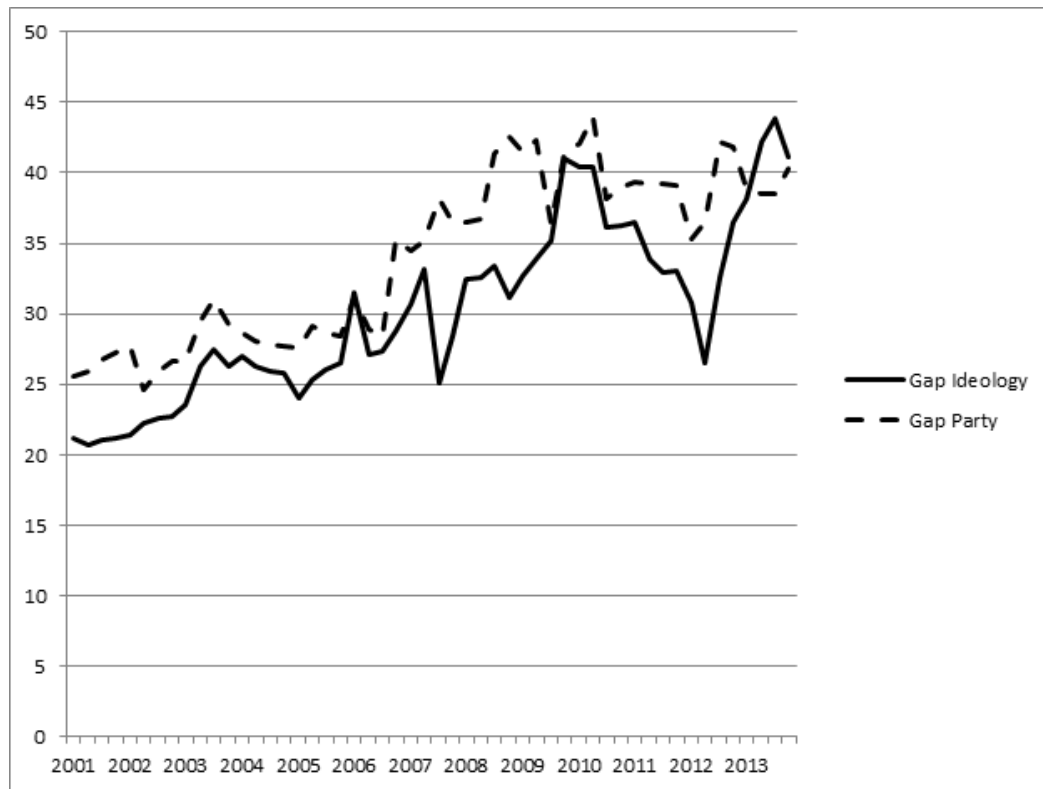


Figure 2. Gaps in the U.S. climate change threat indices based on party affiliation and political ideology, quarterly from 2001 to 2013.

4. Discussion and Conclusion

Utilizing Stimson’s algorithm and “policy mood” technique, we find that individuals on the political left and the political right had significantly different levels of concern for climate change between 2001 and 2013, and that the polarization between these two groups has increased over this time period. In particular, the mood measure of the political right dropped by nearly half between 2007 and 2010. Since 2006, Liberals and Democrats showed more concern, while Republicans and conservatives were less concerned in 2013 than they have been since the beginning of our time-series. Our findings of a growing partisan and ideological divide in public climate change concern are further supported by simple calculations of the gap, or the difference between partisan and ideological average threat index scores. The increase in the partisan gap between 2001 and 2013 supports the assertions about the polarization of the climate debate made in much of the recent literature, but does so using a more appropriate and methodologically stronger, aggregate-level approach (Guber 2013, McCright 2011, Brulle 2012, Kellstedt et al 2008).

Several statistic analyses were employed to determine whether or not the political left and the political right move in parallel for these measures. We find a significant gap between the political left and the political right in the difference of mean, a difference in the range of motion in public concern, and statistically significant mean gaps in each year of the study. These

findings challenge arguments made in previous literature in which aggregate opinion measures from subsets of the population move in parallel across groups (Kellstedt 2003, Enns and Kellstedt 2008, Kellstedt et al 2008). Our findings indicate that for climate change concern across party lines, this does not hold true.

Using Stimson's "policy mood" technique allowed for the inclusion of more survey data, from a more diverse set of polling organizations than previous scholarship has been able to utilize without such an approach. Our more robust mood measure disaggregated by the political right and left allowed us to precisely track the increase in polarization on this issue. We also found that climate change concern over time moves independently between the political right and the political left. Future scholarship should work to reveal what factors influence the concern of the different, politically divided populations, and to uncover ways of moving the public past the partisan sorting and the resulting stalemate on climate change in the U.S.

Acknowledgement

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Supplementary Material

Table S1. Survey Questions used in the Partisan and Ideology Climate Change Threat Indices

Variable Name	Dates Administered	Survey Variable	Source	Not in ICCTI
I'm going to read you a list of environmental problems. As I read each one, please tell me if you personally worry about this problem a great deal, a fair amount, only a little, or not at all. First, how much do you personally worry about...the 'greenhouse effect' or global warming?	March 2001, April 2001, March 2002, March 2003, March 2004, March 2006, March 2007, March 2008, March 2009, March 2010, March 2011, March 2012, March 2013	Q12	Gallup Poll (AIPO)	
Do you think that global warming will pose a threat to you or your way of life in your lifetime?	March 2001, March 2002, March 2006, March 2008, March 2009, March 2010, March 2012, March 2013	Q38	Gallup/CNN/USA Today Poll	
Thinking about what is said in the news, in your view is the seriousness of global warming--generally exaggerated, generally correct, or is it generally underestimated?*	March 2001, March 2002, March 2003, March 2004, March 2005, March 2006, March 2007, March 2008, March 2009, March 2010, March 2011, March 2012, March 2013	Q64	Gallup/CNN/USA Today Poll	
Which of the following statements reflects your view of when the effects of global warming will begin to happen? They have already begun to happen. They will start happening within a few years. They will start happening within your lifetime. They will not happen within your lifetime, but they will affect future generations. They will never happen.	March 2001, March 2002, March 2003, March 2004, March 2005, March 2006, March 2007, March 2008, March 2009, March 2010, March 2011, March 2012, March 2013	Q71	Gallup/CNN/USA Today Poll	
And in the next 10 years, how likely are you to be personally affected by the following threat?...Very likely, somewhat likely, not too likely, not at all likely...How likely are you to be personally affected by the effects of global warming?	June 2005, June 2007, June 2008	Q2	Transatlantic Trends Survey	June 2007

(I am going to read you a list of possible international threats to the United States in the next 10 years. Please tell me if you think each one on the list is an extremely important threat, an important threat, or not an important threat at all.)...The effects of global warming	June 2005, June 2006	Q999	Transatlantic Trends Survey	
Do you think global warming is an environmental problem that is causing a serious impact now, or do you think global warming isn't having a serious impact?	September 2003, May 2006, August 2006, January 2007	Q34	CBS News Poll	
Do you think global warming is an environmental problem that is causing a serious impact now, or do you think the impact of global warming won't happen until sometime in the future, or do you think global warming won't have a serious impact at all?	June 2001, April 2007, October 2007, December 2007, February 2009, April 2010, August 2010, October 2010	Q35	CBS News/New York Times Poll	
How important is the issue of global warming to you personally--extremely important, very important, somewhat important, not too important, or not at all important?	March 2006, April 2007, July 2008	Q46	ABC News/Time/Stanford University Poll	March 2006
If nothing is done to reduce global warming in the future, how serious of a problem do you think it will be for the United States--very serious, somewhat serious, not so serious or not serious at all?	March 2006, June 2007, September 2007	Q47A	ABC News/Time/Stanford University Poll	March 2006
Scientists use the term 'global warming' to refer to the idea that the world's average temperature may be about five degrees Fahrenheit higher in 75 years than it is now. Overall, would you say that global warming would be good, bad, or neither good nor bad? If Good, ask: Would you say it would be very good or somewhat good? If Bad, ask: Would you say it would be very bad or somewhat bad? If Neither, ask: Do you lean toward thinking it would be good, lean toward thinking it would be bad, or don't you lean either way?	April 2007, July 2008	Q58	ABC News/Washington Post/Stanford University Poll	
In your view, is global warming a very serious problem, somewhat serious, not too serious, or not a problem?	June 2006, July 2006, January 2007, April 2007, April 2008, April 2009, May 2009, September 2009, October 2010, November 2011, October 2012, March 2013	Q53	Pew News Interest Index/Believability Poll	
I'd like to ask you about priorities for President [Obama/Bush] and Congress this year. As I read from a list, tell me if you think each should be a top priority , important but lower priority, not too important or should it not be done....Dealing with global warming	January 2007, January 2008, January 2009, January 2010, January 2011, January 2012, January 2013	Q30	Pew Research: Center for the People and the Press	

I'd like your opinion about some possible international concerns for the US. Do you think that...global climate change is a major threat, a minor threat or not a threat to the well being of the United States?	November 2009, November 2013	Q32	Pew Research: Center for the People and the Press	
(As I read a list of possible long-range foreign policy goals which the United States might have, tell me how much priority you think each should be given.)...Dealing with global climate change...Do you think this should have top priority, some priority, or no priority at all?	October 2005, September 2008, November 2009, May 2011, November 2013	Q33E	Pew Research: Center for the People and the Press	
Do you think global warming is a problem that requires immediate government action, or don't you think it requires immediate government action?	July 2006, January 2007, April 2010, October 2010	Q63	Pew Research: Center for the People and the Press	
How worried are you about global warming?	November 2008, January 2010, June 2010, May 2011, November 2011, March 2012, September 2012, April 2013	QYM1	Yale and George Mason	
How much do you think global warming will harm you personally?	November 2008, January 2010, June 2010, May 2011, November 2011, March 2012, September 2012, April 2013	QYM2	Yale and George Mason	
Six Americas Poll - % Concerned or Alarmed	November 2008, January 2010, June 2010, May 2011, November 2011, March 2012, September 2012, April 2013	Q99	Yale University	
I am going to read you a list of possible threats to the vital interests of the United States in the next 10 years. For each one, please tell me if you see this as a critical threat, an important but not critical threat, or not an important threat at all.... Global warming	June 2002, June 2006	Q9	CCFR Survey of American Public Opinion and U.S. Foreign Policy	June 2002, June 2006
Is the following something that you worry about a lot, is this something you worry about somewhat or is this something you do not worry about?...Global warming	September 2006, March 2008	Q13	Public Agenda Confidence in US Foreign Policy Index Poll	

** Due to the wording of this question, the survey marginals used for this item were for the response “generally underestimated” to get a positive measure of concern

Table S2. Distribution of Surveys including climate change concern questions used in the PCCTI and ICCTI

YEAR	PCCTI		ICCTI	
	Number of Surveys	Number of Questions	Number of Surveys	Number of Questions
2001	3	6	3	6
2002	2	5	2	5
2003	2	4	2	4
2004	1	3	1	3
2005	3	5	3	5
2006	9	11	7	8
2007	10	12	9	11
2008	8	14	8	14
2009	6	9	6	9
2010	8	9	8	9
2011	6	10	6	10
2012	5	9	5	9
2013	5	11	5	11
Total	69	108	65	104

Table S3. Variable Loadings and Descriptive Statistics

Variable	Cases	Dim 1 Loading	Mean	Std. Deviation
Q12	13	.961	31.538	4.466
Q13	2	-1.000	36.000	3.000
Q2	2	1.000	35.500	5.500
Q34	4	.984	65.500	4.031
Q35	10	.624	42.941	7.793
Q38	8	.563	35.125	3.018
Q46	2	1.000	49.000	3.000
Q47A	2	1.000	64.500	5.500
Q53	11	.875	40.000	4.954

Q58	2	1.000	39.000	1.000
Q64	13	.164	31.769	3.285
Q71	13	.893	53.769	3.445
Q99	8	.879	42.375	3.672
Q999	2	1.000	42.500	3.500
Q30	7	-.500	30.000	4.440
Q32	2	-1.000	44.500	.500
Q33E	5	.922	38.400	5.200
Q63	3	.679	63.000	3.742
QYM1	8	.798	54.375	3.967
QYM2	8	.338	33.750	4.841
Dimension 1 Information				
Eigen Estimate 1.44 of possible 2.4				
Pct Variance Explained: 60.04				