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Doing What Others Do: Norms, Science, and Collective Action on Global Warming

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Abstract

Does rhetoric highlighting social norms or mentioning science in a communication affect individuals' beliefs about global warming and / or willingness to take action? We draw from framing theory and collective-interest models of action to motivate hypotheses that are tested in two large web-based survey-experiments using convenience samples. Our results show that attitudes about global warming, support for policies that would reduce carbon emissions, and behavioral intentions to take voluntary action are strongly affected by norm-based and science-based interventions. This has implications for information campaigns targeting voluntary efforts to promote lifestyle changes that would reduce greenhouse gas emissions.

Keywords: Collective action, global warming, climate change, social norms, boomerang effects

Mounting scientific evidence suggests that global warming poses significant threats to humans and the wider environment. Nonetheless, opinion polls reveal a growing skepticism among the U.S. public about whether global warming is actually occurring, and if it is, whether human activities are the main cause of the observed warming trend over the past 150 years.[1] With skepticism on the rise, questions remain about what – if anything – can be done to influence public attitudes and behaviors toward global warming. Because climate represents an important common pool resource, understanding (and indeed, shaping) individuals' attitudes and behavioral intentions regarding global warming is critical.

What factors shape citizens' attitudes toward action on global warming? We theorize that norm-based communications can influence willingness to take action for the public good – e.g., encouraging voluntary reductions in greenhouse gas emissions and support for public policies targeting the nation's emissions. We focus on the issue of global warming because it presents a severe collective action problem: individuals alone cannot control the climate, and the recommended behaviors may have high costs and the benefits are non-excludable (Lubell et al., 2007). This paper has three interrelated contributions. First, it explores the role that communications that invoke social norms play in shaping individuals' attitudes and willingness to take action on global warming.[2] Second, we assess how global warming communications affect individuals' attitudes and willingness to act. These outcomes matter both to the extent that individual attitudes and behavioral intentions with regard to global warming matter from a policy perspective and because they reflect public beliefs about science and scientific evidence, which matter in their own right (Bauer et al., 2007; Pielke, 2007; Sarewitz, 2000; 2004). Third, given

[1] "Fewer Americans See Solid Evidence of Global Warming," The Pew Research Center, October 22, 2009: http://pewresearch.org/pubs/1386/cap-and-trade-global-warming-opinion.
[2] We use the term "global warming" as opposed to "climate change" throughout. Recent experimental evidence suggests that partisans may respond differentially to such changes in question wording (Schuldt et al. 2011).

the partisan divide in America on the issue of global warming, we explore the potential linkages between partisanship and these communications. That is to say, we do not examine the divide per se but instead consider under what potential conditions that divide might be mitigated by norm- and/or science-based communications.

In pursuit of the goals outlined above, we present two large survey experiments. Experiment 1 tests how norms shape attitudes and behavioral intentions toward global warming. We find that a norm-based communication that discourages action, e.g., by providing information that others are not cooperating, significantly reduces perceptions of efficacy and willingness to take action. Experiment 2 further tests the effects of norm-based communications in tandem with messages about the scientific consensus surrounding global warming. We begin by discussing the connections between collective action, norms, and global warming, then discuss the design of the experiments, and discuss the results thereof.

Norms and Collective Action on Global Warming

We focus on the determinants of behavior taken to secure a public good: any good that cannot feasibly be withheld from others in a group if it is provided for any member of that group (Olson, 1965). Individuals will tend to cooperate on this collective action problem only when they believe that others are also likely to cooperate (Kogut & Beyth-Marom, 2008; Alpizar et al, 2008; Axelrod, 1984; Frey & Meier, 2004; Shang & Croson, 2009). In a number of social comparison treatments in large-scale field experiments which examine how information about the behavior of others affects energy and water conservation,[3] it has been found that giving consumers feedback on their consumption, providing information on energy savings opportunities, comparing their use to their neighbors' use, facilitating public or private goal setting, and structuring commitment devices causes households to reduce consumption between

[3] See, for example, Nolan et al. (2008) and Stern (2007).

5 – 20 percent (Allcott, 2010). Thus, immediate action is taken by citizens when they are convinced that others will commit; however, we know little about how responsive individuals are to behavior change communications (McKenzie-Mohr, 2000; Allcott & Mullainathan, 2010) and, in particular, how individuals respond to behavior change communications concerning climate change.

Research on the factors that promote private action for the public good indicates that social norms often play a central role – e.g., providing cues about the efficacy of a collective action (Nolan et al., 2008; Cialdini, 2003). Here, "norms" refer to how most people behave in a given social context, but they are not uniform. Social psychologists refer to information describing how most people act in a decision context as a descriptive norm, while injunctive norms refer to information about how people ought to behave in a situation, regardless of how people are actually behaving (Cialdini, 2003). Norms can be especially strong in situations in which an individual's action causes negative effects on the lives of others and thus evolve in communities as a way to regulate social life (Biel & Thogersen, 2006; Thogersen, 2008). In these situations, norms serve to restrain egoistic impulses and induce cooperation among group members.[4]

Our research is novel in that it is one of the first attempts to shape beliefs and intentions to take action on global warming in an experimental context. To understand how exposure to communications invoking social norms, or highlighting the science related to global warming, affects opinions and willingness to take action, we develop a framework that links *framing theory* (Chong & Druckman, 2007) with expectancy-value models of collective action (Finkel et

[4] Norms also trigger social influence processes when people monitor and regulate their behavior so as to avoid sanctions from others (Green & Gerber, 2010; Noelle-Neumann, 1984). Norms create "social pressure" due to the fact that humans tend to praise those who uphold norms and scorn those who violate them.

al., 1989; Lubell, 2002; Lubell et al., 2007). First, in deciding whether or not to take a collective action, individuals evaluate the costs and benefits likely associated with the outcome from taking action (Ajzen & Fishbein 2005). In doing so, individuals form an attitude toward a specific behavior (i.e., an evaluation toward the target) that is a function of accessible considerations. For instance, in deciding whether to voluntarily reduce one's own personal travel as a way to combat global warming, an individual may consider the positive effects such actions might have for the collective environment or the personal costs associated with such sacrifices.

Framing theory also explains that one's overall attitude toward any object is a function of the salience and weight attached to various considerations toward the object. Thus, exposure to rhetoric – i.e., persuasive communications targeting attitude change – can affect one's attitude toward a behavior either through altering the salience associated with a particular consideration (i.e., a framing effect, see Druckman (2001, 2004) or through persuasion via attitude change (O'Keefe 2002). Our research goals necessitate the wedding of framing theory to collective-interest models of political and environmental action, not unlike Finkel et al. (1989), Lubell (2002), and Lubell et al. (2007). This literature explains that individuals consider not only the personal costs and benefits associated with taking a collective action, but also *collective interest* calculations such as the likelihood one's own actions will influence collective outcomes as well as the likelihood of the group achieving success. Communications that highlight social norms or scientific evidence may directly influence one's attitude toward and willingness to take collective action on the environment by altering the cost-benefit calculus at the individual level.

Based on this framework, we make the following predictions:

> Hypothesis 1a: A norm-based communication promoting action to reduce the nation's greenhouse gas emissions will *increase* individuals' beliefs that taking action toward global warming is efficacious (i.e., makes a difference).

> Hypothesis 1b: A norm-based communication discouraging action to reduce the nation's greenhouse gas emissions will *decrease* individuals' beliefs that taking action toward global warming is efficacious (i.e., makes a difference).

Again, we argue that norms provide a signal about the willingness of others to cooperate in securing a public good. When others are perceived as taking action, individuals will be more likely to take action for the public good because their behavior is perceived as *efficacious* – i.e., as making a difference in terms of the collective outcome; when others are perceived as not cooperating, individuals will be less likely to take costly action for a public good.

> Hypothesis 2a: A norm-based communication promoting action to reduce the nation's greenhouse gas emissions will *increase* individuals' willingness to take action for the public good (e.g., drive a smaller vehicle and support a carbon tax).

> Hypothesis 2b: A norm-based communication discouraging action to reduce the nation's greenhouse gas emissions will *decrease* individuals' willingness to take action for the public good (e.g., drive a smaller vehicle and support a carbon tax).

In addition to norms, information about a scientific consensus regarding the existence of global warming should also directly affect the public's attitudes and behavior. First, communications highlighting the views of a credible group – scientists conducting research on the phenomena of global warming, for instance – may increase the perceived strength of communications promoting action (Lupia & McCubbins 1998; Zaller 1992). It may also influence individuals' attitudes about the existence and anthropogenic causes of global warming, which according to our cost-benefit model of collective action should increase the likelihood of motivating individual action. Thus, we make the following predictions:

> Hypothesis 3: Invoking beliefs among scientists about the existence and causes of global warming will *increase* individuals' beliefs that global warming is occurring and anthropogenic.

> Hypothesis 4: Invoking beliefs among scientists about the existence and causes of global warming will *increase* individuals' willingness to take action for the public good (e.g., drive a smaller vehicle and support a carbon tax).

Finally, there is a clear partisan divide in America with regard to the anthropogenic nature and potentially harmful effects of global warming (Dunlap & McCright, 2008; Krosnick et al, 2000; Klick & Smith, 2010; Villar & Krosnick, 2010), and we therefore expect party identification will play a significant moderating role on the effects of social norms and science-related communications about global warming. The lack of public engagement on this issue may be, in part, attributable to ineffective frames in the debate over global warming (Nisbet & Scheufele, 2009; Malka et al., 2009; Nisbet 2009). Alternatively, it could simply be a function of one's party affiliation, which has been found to have significant (Nisbet & Goidel, 2007) and insignificant (Evans, 2011) effects on the receipt of scientific information. We approach this at an exploratory level to the extent that we are looking not only at the effects of social norms on beliefs and willingness to act on global warming, but also at the interaction of such norms with scientific communications. To our knowledge, few examinations of potential linkages between partisanship and the receipt of these kinds of communications have been conducted. An exception is Hart and Nisbet (2011) who find that Republicans and Democrats respond differently to communications targeting action on global warming. Another exception is a recent study which finds that Republicans households in California increased their energy consumption in response to a norm-based social comparison intervention designed to promote conservation; the intervention significantly reduced consumption among Democrats (Costa & Kahn, 2012).

> Exploratory Hypothesis: Republicans are more likely than Democrats to discount (or react negatively to) social norms and science-based communications promoting action on global warming.

Data / Methods

We test our predictions in two large survey experiments involving 622 and 390 undergraduate students, respectively, at Georgia State University in December, 2010 and

December, 2011. Participants for the two studies were recruited from a first-year political science course, which is required for all students at the university.[5] Participants who chose to participate were compensated with extra course credit for their participation.[6]

Experiment 1, which tests Hypotheses 1 and 2, contained two manipulations: (1) the direction of a norm toward action on global warming – i.e., Americans were described as either willing or unwilling to take specific actions toward global warming (e.g., drive smaller vehicles and support a tax on carbon); and, (2) the content of the communication itself – i.e., either a descriptive norm communication alone or a combination of descriptive and injunctive communication components.[7] Table 1 outlines the designs for each experiment, treatment group sample sizes, and reiterates our expectations regarding treatment effects relative to a baseline (control group) not exposed to any treatment. Students were randomly assigned to one of the treatment groups or the control group. Those in the pro norm conditions read the following paragraph of text:

> A recent poll showed that over 85% of Americans believe that the world's average temperature is rising primarily because of human activities. In addition, the vast majority

[5] We acknowledge that the use of student participants inevitably raises questions about external validity; however, student subjects do not necessarily pose a problem for a study's external validity. Druckman and Kam (2011: 41) explain that "any convenience sample poses a problem only when the size of an experimental treatment effect depends on a characteristic on which the convenience sample has virtually no variance." Given that our sample is skewed toward well-educated individuals who are likely to hold crystallized attitudes on this issue, any treatment effects we uncover are likely a conservative estimate of the impact of the content of these communications on related attitudes and behaviors among the general population.

[6] For Experiment 1, the average age of participants was 20 years old (Std. dev. = 4.59). Sixty-four percent of the sample was comprised of females and 36% males. Democrats comprised 68% of the sample, Independents 10%, and Republicans 22%. The composition of Experiment 2 is nearly identical to that of Experiment 1. Data and replication code for all analyses are available on the Dataverse Network.

[7] Although we anticipate the combination of the descriptive and injunctive communication content will result in the largest treatment effects, we do not list these expectations as hypotheses above because there is little research that explores the differential impact of various types of norm-based communications (but see Schultz et al., 2007; Cialdini et al., 2004).

> of respondents said they would consider driving smaller cars, reducing travel, and supporting legislation (e.g., a tax) to reduce the nation's emission of greenhouse gases.

Those in the injunctive norm condition additionally read that: "Respondents said the most important reason for taking these actions is because it is "the right thing to do for all of us."

Those in the con norm conditions similarly read that:

> A recent poll showed that less than 15% of Americans believe that the world's average temperature is rising primarily because of human activities. In addition, only a small minority of respondents said they would consider driving smaller cars, reducing travel, and supporting legislation (e.g., a tax) to reduce the nation's emission of greenhouse gases.

Those in the con injunctive condition additionally read that: "Respondents said the main reason they are unwilling to take these actions is because reducing our standards of living is the "wrong thing to do."

Experiment 2, which further tested Hypotheses 3-5, also contained two manipulations: (1) the inclusion or exclusion of a pro social norm toward action on global warming similar to that mentioned above; and, (2) the inclusion or exclusion of the science-based information about global warming indicating that scientists have achieved a consensus that global warming is occurring (a "science" communication). Those in the social norm condition read the following paragraph of text:

> A 2010 report by the Pew Research Group found that a solid majority of Americans (59%) believe the Earth is experiencing a long-term warming trend because of humans' activities. The poll also showed that the vast majority of Americans are willing to drive a smaller car and support legislation that taxes polluters of greenhouse gases.

Those in the science-based communication group read the following:

> A 2010 report by the Pew Research Group found that the vast majority of scientists (over 90%) believe the Earth is experiencing a long-term warming trend. Indeed, there is broad scientific consensus about this issue and nearly all research conclusively finds that the planet will continue to warm over time.

Finally, those in the social norm and science condition read both paragraphs.[8] Those in the no-norm/no-science condition simply answered the outcome questions. As was the case for Experiment 1, students were randomly assigned to one of the treatment groups or the control group.

Table 1. Experimental Design and Predictions

Experiment 1

	Pro Norm	**Con Norm**
Descriptive	Increase action relative to baseline (n=117)	Decrease relative to baseline (n=135)
Descriptive + Injunctive	Largest increase relative to baseline (n=153)	Largest decrease relative to baseline (n=140)
Control Group (No norm)	Baseline (n=77)	

Experiment 2

	No Social Norm	**Social Norm**
No Information	Baseline (n=97)	Increase relative to baseline (n=92)
Scientific Consensus Communication	Increase relative to baseline (n=109)	Largest increase relative to baseline (n=92)

Note that neither experiment emphasizes the source of information. Instead, we present non-partisan polling information about what Americans, scientists, or both feel about global warming's anthropogenic nature and potential effects. We acknowledge that global warming is so politically charged (in the United States) that it may not make a difference as to the source

[8] They read the norm-based paragraph first and the science-based paragraph was modified slightly for readability to say "The same report" instead of repeating "A 2010 report by the Pew Research Group" in each paragraph.

and/or content (Mutz, 2008), but we expect that this method reduces any potential confounding effects.

In both experiments, we included two key dependent measures of individuals' willingness to take action. The first measure taps support for a carbon emissions cap, "even if it increases costs to consumers" (1-7 scale, where 1= strongly oppose, 7= strongly support) and the second measure explores behavioral intentions to change one's habits (e.g., driving habits) as a way to reduce carbon emissions (1-7 scale, where 1=extremely unlikely, 7=extremely likely).

For Experiment 1 only, we measured perceptions about the efficacy of action with two measures. The first asked participants to indicate the extent to which they agreed with a statement that taking personal action has an impact on the nation's carbon emission (1-7 scale, where 1= strongly disagree, and 7=strongly agree).[9] The second item measures expected behavioral reciprocity from others by asking participants to respond to a statement about whether their actions "encourage others in my community" to take actions to reduce carbon emissions (1-7 scale, where 1=strongly disagree, and 7=strongly agree).

Both experiments also included two belief items: (1) belief about whether global warming is happening (where 1=definitely is not happening, and 7= definitely is happening), and (2), if it is happening, whether the trend is a result of human activities or natural changes (1-7 scale, where 1=definitely naturally induced, and 7=definitely human induced).

All variables were measured on seven-point scales, exact wordings for which can be found in the Appendix. For the analysis, all variables are rescaled from -1 to +1 to ease interpretability. In presenting the results, we report treatment effects as linear regression coefficients controlling for partisanship (as well the interactions between partisanship and the

[9] This item taps perceived personal influence, which has been associated with environmental activism (Lubell et al., 2007), voting behavior (Opp, 2001), and willingness to engage in other forms of collective action (Finkel et al., 1989).

treatment indicators). We report linear regression results, following the advice of Angrist and Pischke (2009), and rely on bootstrapped (n=2000) standard errors to avoid imposing parametric assumptions on our inference. The reported results are robust to alternative functional forms, including ordered probit regression. For both experiments, we include party identification as a control.[10]

Results

Our hypotheses anticipated that beliefs and behaviors toward global warming would be influenced by norm-based and science-based communications. The stickiness of global warming beliefs (and to a lesser extent behavioral intentions) is, however, reflected in our relatively mixed findings. We begin with results from Experiment 1, which tests our norm-based hypotheses and explores the influence of partisanship, before turning to Experiment 2, which further tests those hypotheses as well as our predictions regarding science-based communications.

[10] Party identification in our samples was distributed as follows. For Experiment 1, 22.0% of the sample identified as Republicans, 67.5% identified as Democrats, and the remainder identified as politically independent. For Experiment 2, 24.1% of the sample identified as Republicans, 67.7% as Democrats, and the remainder as politically independent.

Table 2. Treatment Effects (Experiment 1)

	Perceived Personal Influence	Expected Reciprocity	Believe Global Warming is Happening	Believe Global Warming is Human Induced	Support Cap on Carbon Emissions	Willingness to Take Personal Action
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.38**	0.23**	0.37**	0.25**	0.28**	0.20**
	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)	(0.07)
Pro Descriptive (D)	-0.04	0.02	0.05	-0.03	-0.06	-0.02
	(0.08)	(0.08)	(0.09)	(0.09)	(0.09)	(0.09)
Pro Descriptive +	-0.08	0.07	0.09	0.06	-0.02	-0.05
Injunctive (D+I)	(0.08)	(0.08)	(0.09)	(0.09)	(0.09)	(0.08)
Con D	-0.18**	-0.06	-0.06	-0.05	-0.16**	-0.17**
	(0.08)	(0.08)	(0.09)	(0.09)	(0.09)	(0.09)
Con D+I	-0.10	0.11*	0.03	-0.06	-0.08	-0.06
	(0.08)	(0.07)	(0.09)	(0.09)	(0.09)	(0.09)
PartyID	0.21**	0.21**	0.28**	0.31**	0.21**	0.13*
	(0.08)	(0.08)	(0.11)	(0.09)	(0.10)	(0.09)
PartyID * Pro D	-0.05	-0.04	-0.10	-0.04	-0.05	0.04
	(0.11)	(0.11)	(0.14)	(0.13)	(0.13)	(0.13)
PartyID * Pro D+I	-0.10	-0.12	-0.06	-0.13	-0.14	0.04
	(0.11)	(0.11)	(0.13)	(0.12)	(0.13)	(0.11)
PartyID * Con D	-0.10	-0.19**	0.00	-0.10	0.03	0.11
	(0.11)	(0.11)	(0.14)	(0.13)	(0.13)	(0.13)
PartyID * Con D+I	-0.13	-0.21**	0.01	-0.15	0.01	0.04
	(0.11)	(0.10)	(0.13)	(0.12)	(0.13)	(0.11)
SER	.48	.47	.52	.53	.51	.54
n	612	612	612	611	612	612

*p<.10, **p<.05, one-tailed test

Note: D = Descriptive, I = Injunctive. Cell entries are unstandardized linear regression coefficients with bootstrapped standard errors in parentheses. Baseline is the control condition. Party identification is coded with seven categories from Republican (-1) to Independent (0) to Democrat (+1). SER is the Standard Error of the Regression (Beck, 2010).

While we expected norms promoting action to influence both beliefs (Hypothesis 1a) and behavioral intentions (Hypothesis 2a), we find little support our hypotheses. Table 2 reports regression results with indicators for each treatment condition (relative to a control condition), including a control for party identification. Looking at the rows for the Pro Norm conditions, we do not see any effect on any outcome. Indeed for several outcomes (perceived personal influence and support for a carbon emissions tax), we find effects in the opposite direction of our

expectations at a non-significant level. Norm-based communications that stress others' actions to affect global warming appear to have little impact on individuals' attitudes or behavioral intentions.[11]

In contrast, when communications invoke con norms, in which other Americans are characterized as unwilling to take action on global warming, there are some quite interesting patterns. The descriptive con norm treatments (as seen in Table 2) significantly reduced perceived personal influence on global warming ($p<.05$), consistent with our Hypothesis 1b. The descriptive con norm treatment also significantly reduced support for a carbon emissions tax ($p<.05$) and willingness to take personal action ($p<.05$), consistent with Hypothesis 2b. Effects were also in the expected direction (though not statistically significant) for some of the other outcomes. We had no clear expectations about the different effects of descriptive versus injunctive norms and the results here suggest that descriptive rather than injunctive norms are more efficacious with regard to global warming-related attitudes.

While there are not consistent effects from each of the treatments, the results suggest that norms may have the potential to influence beliefs and behaviors, though only under particular conditions. The con norms, in particular, seem to have powerful effects. A separate analysis, pooling all pro norm conditions and the control group (which does not differ significantly from the pro norm conditions on most measures) compared to the pooled con norm conditions, shows that con norms suppressed belief that global warming was human induced ($p=.02$), willingness to take personal action ($p=.06$), support for an emissions cap ($p=.11$),[12] perceived personal influence ($p=.00$), and expected reciprocity ($p=.08$). While most research (including our

[11] We present in the appendix ("Robustness Checks") a series of alternative specifications to confirm the findings presented in Table 2 above and Table 3 below.

[12] Though a p-value above .10 is typically deemed non-significant, comparisons of significant to non-significant results has been criticized by statisticians (see, for example, Gelman & Stern (2009)).

Experiment 2) has focused on the positive impacts of pro norms, these findings suggest con norms are particularly important. The results presented in Table 2 also suggest that party identification has a strong impact on global warming-related outcomes. Figure 1 presents the means scores by party within each treatment for belief that global warming is happening, belief that it is human induced, support for an emissions cap, and willingness to take personal action. Again, con norms without an injunctive statement tend to push Republicans further negative on these measures. We take up the impact of party identification in greater detail below.

Figure 1. Conditional Influence of Partisanship on Global Warming Belief

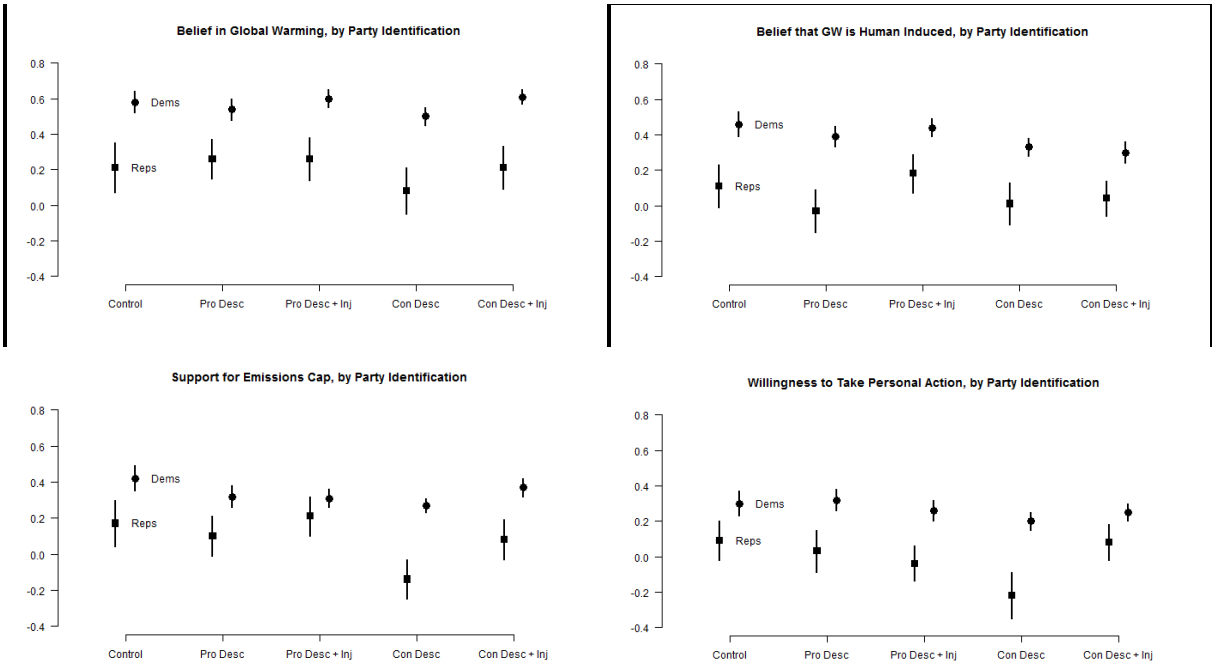


Table 3. Treatment Effects (Experiment 2)

	Believe Global Warming is Happening	Believe Global Warming is Human Induced	Support Cap on Carbon Emissions	Willingness to Take Personal Action
	(1)	(2)	(3)	(4)
Intercept	0.40**	0.17**	0.38**	0.19**
	(0.05)	(0.06)	(0.05)	(0.06)
Norm / No Science	-0.13*	0.03	0.05	0.23**
	(0.08)	(0.08)	(0.08)	(0.09)
No Norm / Science	0.08	0.07	0.12**	0.17**
	(0.07)	(0.08)	(0.07)	(0.09)
Norm / Science	0.05	0.09	0.07	0.18**
	(0.07)	(0.08)	(0.07)	(0.08)
Party ID	0.18**	0.36**	0.19**	0.26**
	(0.07)	(0.07)	(0.08)	(0.09)
Party ID * Norm / No Science	0.05	-0.17*	0.00	-0.17*
	(0.12)	(0.11)	(0.11)	(0.13)
Party ID * No Norm / Science	-0.11	-0.27**	-0.15*	-0.10
	(0.10)	(0.12)	(0.10)	(0.13)
Party ID * Norm / Science	-0.03	-0.31**	-0.04	-0.08
	(0.10)	(0.11)	(0.10)	(0.11)
SER	.46	.48	.46	.42
n	382	382	382	382

*p<.10, **p<.05, one-tailed test

Note: Cell entries are unstandardized linear regression coefficients with bootstrapped standard errors in parentheses. Baseline is the control (no norm / no science) treatment condition. Party identification is coded with seven categories from Republican (-1) to Independent (0) to Democrat (+1). SER is the Standard Error of the Regression (Beck, 2010).

Recall that Experiment 2 tested the impact of communications that invoked pro norms, which showed little impact in Experiment 1, in combination with messages that communicate scientific consensus about global warming. We find additional evidence that beliefs and behavioral intentions about global warming are quite sticky, even in the face of both pro norm and scientific communications. We again examine Hypotheses 1a and 2a regarding the effects of pro norms and provide our first tests of Hypotheses 3 and 4, regarding science-based messages. As is clear in Table 3, the effects of our manipulations are generally not statistically significant except on our measure of willingness to take action. As is clear from the large, positive, and

statistically significant coefficients on party identification, much of the variation in all four outcomes is explained by partisan differences (as it was also the case in Experiment 1). Yet, at least as it relates to willing to take personal action, a pro norm significantly increases behavioral intent ($p<.05$). That the size of this effect is comparable to the effect of a scientific consensus message alone ($p<.05$) or both the norm and science message together ($p<.05$) suggests that efforts to influence personal behavior with regard to global warming can benefit from either approach. Yet the combination of these communications appears to have little added benefit: the strongest effects seem to come from the pro norm alone (providing support for Hypothesis 2a, but little for Hypothesis 4). This is consistent with the evidence from Experiment 1 that (con) descriptive norms alone had the largest and most significant effects on outcomes. The evidence thus lends little support to the expectations (as outlined in Hypotheses 3 and 4) that communicating scientific consensus has an impact on beliefs, attitudes, or behavioral intentions.

Finally, we turn to the question of partisan moderation effects – the "boomerang effect" (Hart & Nisbet, 2011) – that we described in our exploratory hypothesis. In both experiments, party identification was consistently and significantly associated with higher scores on all outcome measures (that is, Democrats reported higher scores on measures of beliefs, attitudes, and behavioral intentions).[13] As an example, strong Democrats in the control condition reported, on average, a score 0.52 points higher on willingness to take personal action than strong Republicans, a full 25% of the response scale. (We find a similar pattern of partisan effects in Experiment 1.)

These results are perhaps unsurprising given prior evidence of a partisan divide on global warming. More interesting are interactions between partisanship and the treatment indicators,

[13] This pattern is clear in the coefficients for party identification, which indicate the effect of partisanship in the baseline/control conditions of both experiments.

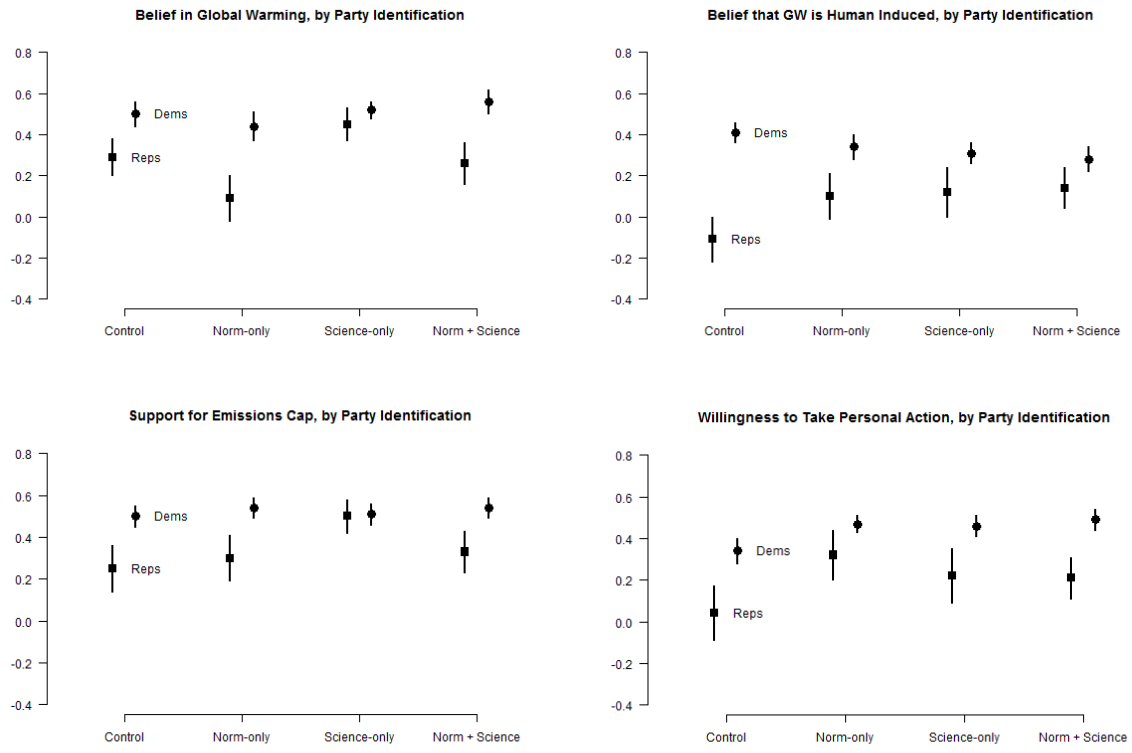
which report the effect of partisanship under each type of norm-based communication. Our results suggest an interesting pattern that runs somewhat contrary to Hart and Nisbet's (2011) boomerang hypothesis. In the regression models reported in Tables 2 and 3, we can interpret each coefficient on an interaction term (between partisanship and a treatment) as follows: a coefficient of zero implies no partisan differences in the outcome (i.e., under that treatment, Democrats and Republicans do not significantly differ from one another), a positive coefficient indicates that the treatment exacerbates partisan differences (e.g., Democrats are even more willing to take action and Republicans less than they otherwise would be), while a negative coefficient on an interaction implies that the treatment reduces partisan differences.[14] These coefficients indicate that norm communications (in Experiment 1 and Experiment 2) and scientific consensus communications (in Experiment 2) undercut partisan differences.[15] In Experiment 1, partisan differences are almost entirely eliminated by norm-based communications for perceived personal influence, expected reciprocity, and belief that global warming is anthropogenic. In Experiment 2, we find a similar pattern for both willingness to take action and belief that global warming is anthropogenic. With regard to willingness to take action, a pro norm alone nearly eliminates partisan differences in behavioral intention though the other treatments have less dramatic effects. Much more dramatic are the effects of norms and science communications in reducing partisan differences in belief that global warming is happening, in belief that global warming is human induced, in support for an emissions cap, and in willingness to change, all from Experiment 2. We display this pattern in Figure 2, which shows the mean scores by party within each treatment condition. Looking at the plot whether global warming is

[14] In the control condition, the overall effect of partisanship is simply the coefficient on the party identification variable. In the other conditions, the overall effect is the sum of the coefficient on partisanship and the coefficient for the interaction.

[15] These are not driven by differences in knowledge, which we present in the appendix (see "Robustness Checks", Experiment 2, column 6).

human induced, in particular, shows that combinations of science and norm-based communications can be particularly powerful in mitigating the partisan divide about global warming. And, norms alone are nearly sufficient to bridge the divide on willingness to take personal action, whereas science alone is sufficient to bridge the (smaller) divide on support for a carbon emissions cap.

Figure 2. Conditional Influence of Partisanship on Global Warming Belief



As either a pro norm or a science communication are added, partisan differences are significantly reduced. When both are expressed, there are almost no partisan differences in belief that global warming is anthropogenic. Though both experiments showed that pro norms seem to have minimal ability to increase the public's *aggregate* beliefs and attitudes about global warming, they may undercut partisan differences on the issue, which are known to be severe.

This suggests that these types of communications are effective even on those who are predisposed to not believe in global warming. As well, given that it is Republicans who are responding to the science-only treatment in most cases, we reject Hart and Nisbet's (2011) boomerang hypothesis.

Discussion

Despite the frequently null effects, the results of our experiments do show that norm-based treatments can to some extent directly shape beliefs, policy support, intentions, and actions. Supporting previous work, perceptions of efficacy appear to be central to the process by which norms influence behavior in collective action settings (Finkel et al., 1989; Lubell et al., 2007; Lubell 2002). It is especially important to read the results in the context of the particular issue under examination. Global warming is not a new issue nor is one that individuals are likely to be unfamiliar with or have no attitudes about. To the extent that individuals' attitudes toward these types of issues are well-formed and strongly held, it can be quite difficult to influence attitudes and behavioral intentions (Druckman & Leeper, 2012*a*). While much experimental work avoids these types of issues to focus instead on novel or obscure issues (Druckman & Leeper, 2012*b*), our interest in collective action necessitates a focus on a real and important issue. That we find any treatment effects at all and that some of those effects are large suggests the potential of norm-based communications to influence even well-entrenched social dilemmas. The results regarding con norms are particularly important: Experiment 1 clearly demonstrates that when others are perceived as less supportive of a carbon tax or driving less, individuals are significantly *less likely* to support or engage in the collective endeavor themselves. Norms can both serve to solve and exacerbate collective action problems. Experiment 2 showed that

science-based communications, which are commonly referenced in discussions of global warming, are relatively less influential.

Additionally, the absence of consistently significant main effects of the treatments for both experiments reveals challenges in properly measuring beliefs and willingness to act. These hazards are well documented in the existing research, of which the preponderance of null effects here is additional evidence. It is also possible, though, that the null effects are due to the apolitical nature of the treatments (i.e., non-partisan polls; Montpetit (2011)). Without an identifiable media source, participants in our experiments had little basis for evaluating the credibility or trustworthiness of the communications they received. This could create a problem, especially as information source plays a significant role in how citizens judge scientific evidence (Nisbet & Goidel, 2007). Particularly in light of evidence that partisanship biases the acceptance of science-based communications (Nisbet, 2005; Jasanoff, 2011), and that the politicization of science-based communications is a key confounding mechanism (Kitcher, 2001; Jasanoff & Wynne, 1998; Sarewitz, 1996, 2004; Jasanoff, 1987; Pielke, 2002, 2004, 2007), future research should explore how the politicization of science, which necessarily involves the partisan communication of scientific information, influences public attitudes toward global warming.

Inconsistencies between the results for Experiment 1 and Experiment 2 could be driven by differences in the language of the pro-norm treatments, but we suspect that exact percentages may not matter. As Kahneman (2011) points out, the human mind does not process numbers well but is instead responsive to impressions that anyone (rather than no one) is doing something. Attempts to increase external validity are best addressed with an ongoing research program replicating these experiments across populations, experimental treatments, and time (Druckman and Kam, 2011).

This is one of the first studies to explore the causal process by which norms influence attitudes and behavior toward the issue of global warming. Though our results are mixed, we isolate some conditions where norms do influence beliefs, attitudes, and behaviors. Our results also highlight the need to focus more on the influence of con norms (from our results in Experiment 1), focus on the combination of norm-based and science-based information into theorizing about collective action (from our results in Experiment 2), and the need to incorporate individuals' partisanship in work on all of these issues. The results shed light on the process by which norms affect behavior in collective action settings, and also provide insight for policymakers regarding how communications that promote social comparisons may be used to foster voluntary behavior change (e.g., by including information about the *efficacy* of individual action and/or highlighting cooperation by others). Despite the stickiness of attitudes toward global warming, norms seem to have some impact on behavioral intentions – the one area where individuals are able to make an immediate impact on climate mitigation efforts.

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Appendix. Question Wordings

Believe Global Warming is Happening

Experiment 1 and Experiment 2: Global warming refers to the idea that the world's average temperature has been increasing over the past 150 years and may be increasing more in the future."

How much do you agree with the previous statement?

strongly disagree	*moderately disagree*	*Slightly Disagree*	*neither disagree nor agree*	*slightly agree*	*moderately agree*	*strongly agree*

Believe Global Warming is Human Induced

Experiment 1 and Experiment 2: If global warming is happening, to what extent do you think it is caused by human activities, as opposed to natural changes in the environment?

definitely human induced	*very likely human induced*	*Probably human induced*	*neither human nor naturally induced*	*probably naturally induced*	*very likely naturally induced*	*definitely naturally induced*

Support for Carbon Emissions Cap

Experiment 1: To what extent do you oppose or support setting caps on emissions of greenhouse gases and forcing companies that exceed the cap to pay other companies or the government, even if this increases costs to consumers?

Experiment 2: To what extent do you oppose or support setting caps on companies' emissions of greenhouse gases?

Strongly oppose	*moderately oppose*	*Slightly Oppose*	*neither oppose nor support*	*slightly support*	*moderately support*	*strongly support*

Willingness to Take Personal Action

Experiment 1: How likely is it that you will make lifestyle changes such as driving a smaller car in order to reduce your own personal carbon emissions?

Experiment 2: To what extent are you willing to take personal action to reduce your own carbon emissions?

Extremely unwilling	*moderately unwilling*	*Somewhat unwilling*	*neither willing nor unwilling*	*somewhat willing*	*moderately willing*	*extremely willing*

Perceived Personal Influence

Experiment 1: Indicate the extent to which you disagree or agree with the following statement: "Taking actions that reduce my own personal consumption have an impact on the nation's energy situation."

strongly disagree	*moderately disagree*	*Slightly disagree*	*neither disagree nor agree*	*slightly agree*	*moderately agree*	*strongly agree*

Expected Reciprocity

Experiment 1: Indicate the extent to which you disagree or agree with the following statement: "Taking action to conserve energy encourages others in my community to take similar steps that increase our energy independence."

strongly disagree	*moderately disagree*	*Slightly disagree*	*neither disagree nor agree*	*slightly agree*	*moderately agree*	*strongly agree*

Party Identification

Experiment 1 and Experiment 2: Generally speaking, do you consider yourself a Democrat, Independent, or Republican? [Branched question]

strong Democrat	*Weak Democrat*	*Independent leans Democrat*	*Independent*	*Independent leans Republican*	*weak Republican*	*strong Republican*

Appendix. Robustness Checks

In order to test the robustness of our regression models, we regressed each dependent variable (from both experiments) on several different combinations of independent variables. We report these regressions here. Those models are as follows:

(1) A "treatment effect" model, which regresses each outcome only on indicator variables for each treatment condition.
(2) A "partisan moderation" model, as reported in the body of the paper with a continuous measure of partisanship.
(3) An alternative partisan moderation model, using an indicator variable for party identification (1=Democrat).
(4) A "Republicans-only" model, which examines the effects of each treatment only among Republican respondents.
(5) A "Democrats-only" model, which does the same for Democratic respondents.
(6) For Experiment 2 only, a model that includes an interaction between our treatment indicators and a continuous measure of general political knowledge constructed from nine political knowledge questions asked on the survey. (Alternative coding of the knowledge measure has no impact on the results).

Experiment 1

Perceived Personal Influence

	1	2	3	4	5
Intercept	0.43 (0.06)	0.38 (0.06)	0.17 (0.10)	0.17 (0.11)	0.53 (0.07)
Pro Desc	-0.04 (0.07)	-0.05 (0.08)	-0.05 (0.14)	-0.05 (0.15)	-0.11 (0.09)
Pro Desc + Inj	-0.10 (0.07)	-0.09 (0.07)	0.04 (0.13)	0.04 (0.14)	-0.15 (0.08)
Con Desc	-0.20 (0.07)	-0.19 (0.08)	-0.08 (0.14)	-0.08 (0.15)	-0.28 (0.08)
Con Desc + Inj	-0.12 (0.07)	-0.10 (0.07)	0.17 (0.13)	0.17 (0.14)	-0.20 (0.08)
PartyId	-	0.21 (0.08)	0.37 (0.12)	-	-
PartyId * Pro Desc	-	-0.05 (0.11)	-0.06 (0.17)	-	-
PartyId * Pro Desc + Inj	-	-0.10 (0.11)	-0.19 (0.16)	-	-
PartyId * Con Desc	-	-0.10 (0.11)	-0.20 (0.16)	-	-
PartyId * Con Desc + nj	-	-0.14 (0.11)	-0.36 (0.16)	-	-
SER	0.49	0.48	0.48	0.52	0.47

Expected Reciprocity

	1	2	3	4	5
Intercept	0.29 (0.05)	0.23 (0.06)	0.04 (0.10)	0.04 (0.10)	0.39 (0.07)
Pro Desc	0.03 (0.07)	0.02 (0.08)	0.01 (0.14)	0.01 (0.15)	-0.02 (0.08)
Pro Desc + Inj	0.04 (0.07)	0.06 (0.07)	0.22 (0.13)	0.22 (0.14)	-0.01 (0.08)
Con Desc	-0.11 (0.07)	-0.07 (0.07)	0.08 (0.13)	0.08 (0.14)	-0.22 (0.08)
Con Desc + Inj	0.06 (0.07)	0.11 (0.07)	0.37 (0.13)	0.37 (0.13)	-0.06 (0.08)
PartyId	-	0.21 (0.08)	0.34 (0.12)	-	-
PartyId * Pro Desc	-	-0.03 (0.11)	-0.04 (0.16)	-	-
PartyId * Pro Desc + Inj	-	-0.12 (0.10)	-0.23 (0.15)	-	-
PartyId * Con Desc	-	-0.18 (0.11)	-0.31 (0.16)	-	-
PartyId * Con Desc + nj	-	-0.21 (0.10)	-0.43 (0.15)	-	-
SER	0.47	0.47	0.46	0.49	0.45

Belief in Global Warming

	1	2	3	4	5
Intercept	0.44 (0.06)	0.37 (0.06)	0.21 (0.11)	0.21 (0.14)	0.58 (0.07)
Pro Desc	0.04 (0.08)	0.05 (0.08)	0.05 (0.15)	0.05 (0.19)	-0.04 (0.09)
Pro Desc + Inj	0.09 (0.08)	0.09 (0.08)	0.05 (0.14)	0.05 (0.18)	0.02 (0.08)
Con Desc	-0.03 (0.08)	-0.06 (0.08)	-0.13 (0.15)	-0.13 (0.19)	-0.09 (0.08)
Con Desc + Inj	0.06 (0.08)	0.03 (0.08)	-0.01 (0.14)	-0.01 (0.18)	0.03 (0.08)
PartyId	-	0.28 (0.09)	0.37 (0.13)	-	-
PartyId * Pro Desc	-	-0.10 (0.12)	-0.09 (0.18)	-	-
PartyId * Pro Desc + Inj	-	-0.06 (0.11)	-0.03 (0.17)	-	-
PartyId * Con Desc	-	0.00 (0.12)	0.05 (0.18)	-	-
PartyId * Con Desc + nj	-	0.01 (0.11)	0.03 (0.17)	-	-
SER	0.54	0.52	0.52	0.65	0.47

Belief that Global Warming is Human Induced

	1	2	3	4	5
Intercept	0.33 (0.06)	0.25 (0.06)	0.11 (0.11)	0.11 (0.13)	0.46 (0.07)
Pro Desc	-0.01 (0.08)	-0.03 (0.09)	-0.14 (0.16)	-0.14 (0.18)	-0.07 (0.09)
Pro Desc + Inj	0.05 (0.08)	0.06 (0.08)	0.07 (0.15)	0.07 (0.17)	-0.02 (0.09)
Con Desc	-0.06 (0.08)	-0.06 (0.08)	-0.09 (0.15)	-0.09 (0.17)	-0.13 (0.09)
Con Desc + Inj	-0.08 (0.08)	-0.06 (0.08)	-0.07 (0.15)	-0.07 (0.16)	-0.16 (0.09)
PartyId	-	0.31 (0.09)	0.36 (0.14)	-	-
PartyId * Pro Desc	-	-0.04 (0.12)	0.06 (0.19)	-	-
PartyId * Pro Desc + Inj	-	-0.13 (0.12)	-0.09 (0.17)	-	-
PartyId * Con Desc	-	-0.10 (0.12)	-0.04 (0.18)	-	-
PartyId * Con Desc + nj	-	-0.15 (0.12)	-0.09 (0.17)	-	-
SER	0.54	0.53	0.53	0.6	0.51

Support for Emissions Cap

	1	2	3	4	5
Intercept	0.33 (0.06)	0.28 (0.06)	0.17 (0.11)	0.17 (0.13)	0.42 (0.07)
Pro Desc	-0.06 (0.08)	-0.07 (0.08)	-0.07 (0.16)	-0.07 (0.18)	-0.10 (0.09)
Pro Desc + Inj	-0.05 (0.07)	-0.02 (0.08)	0.04 (0.15)	0.04 (0.17)	-0.11 (0.09)
Con Desc	-0.13 (0.08)	-0.16 (0.08)	-0.31 (0.15)	-0.31 (0.17)	-0.15 (0.09)
Con Desc + Inj	-0.05 (0.07)	-0.07 (0.08)	-0.09 (0.14)	-0.09 (0.16)	-0.04 (0.09)
PartyId	-	0.21 (0.09)	0.25 (0.14)	-	-
PartyId * Pro Desc	-	-0.04 (0.12)	-0.04 (0.18)	-	-
PartyId * Pro Desc + Inj	-	-0.13 (0.11)	-0.15 (0.17)	-	-
PartyId * Con Desc	-	0.03 (0.12)	0.16 (0.18)	-	-
PartyId * Con Desc + nj	-	0.01 (0.11)	0.04 (0.17)	-	-
SER	0.53	0.51	0.53	0.6	0.5

Willingness to Take Personal Action

	1	2	3	4	5
Intercept	0.23 (0.06)	0.20 (0.07)	0.09 (0.11)	0.09 (0.12)	0.30 (0.08)
Pro Desc	0.02 (0.08)	-0.02 (0.09)	-0.06 (0.16)	-0.06 (0.17)	0.02 (0.10)
Pro Desc + Inj	-0.03 (0.08)	-0.05 (0.08)	-0.13 (0.15)	-0.13 (0.16)	-0.04 (0.09)
Con Desc	-0.12 (0.08)	-0.17 (0.08)	-0.31 (0.16)	-0.31 (0.17)	-0.10 (0.09)
Con Desc + Inj	-0.03 (0.08)	-0.05 (0.08)	-0.01 (0.15)	-0.01 (0.16)	-0.04 (0.09)
PartyId	-	0.13 (0.09)	0.21 (0.14)	-	-
PartyId * Pro Desc	-	0.05 (0.13)	0.08 (0.19)	-	-
PartyId * Pro Desc + Inj	-	0.04 (0.12)	0.10 (0.18)	-	-
PartyId * Con Desc	-	0.11 (0.12)	0.21 (0.18)	-	-
PartyId * Con Desc + nj	-	0.04 (0.12)	-0.03 (0.18)	-	-
SER	0.55	0.54	0.54	0.57	0.52

Experiment 2

Belief in Global Warming

	1	2	3	4	5	6
Intercept	0.45 (0.05)	0.40 (0.05)	0.29 (0.09)	0.29 (0.09)	0.50 (0.06)	0.32 (0.13)
Norm Only	-0.11 (0.07)	-0.13 (0.07)	-0.20 (0.13)	-0.20 (0.13)	-0.07 (0.08)	0.08 (0.21)
Science Only	0.05 (0.07)	0.07 (0.07)	0.16 (0.13)	0.16 (0.13)	0.02 (0.08)	0.03 (0.18)
Norm + Science	0.03 (0.07)	0.05 (0.07)	-0.03 (0.13)	-0.03 (0.13)	0.06 (0.08)	0.15 (0.21)
PartyId	-	0.18 (0.07)	0.21 (0.11)	-	-	-
PartyId * Norm Only	-	0.06 (0.11)	0.14 (0.16)	-	-	-
PartyId * Science Only	-	-0.11 (0.11)	-0.15 (0.15)	-	-	-
PartyId * Norm + Science	-	-0.03 (0.10)	0.09 (0.16)	-	-	-
Knowledge	-	-	-	-	-	0.03 (0.03)
SER	0.47	0.46	0.46	0.46	0.46	0.47

Belief that Global Warming is Human Induced

	1	2	3	4	5	6
Intercept	0.27 (0.05)	0.17 (0.05)	-0.11 (0.10)	-0.11 (0.10)	0.41 (0.06)	0.30 (0.14)
Norm Only	-0.02 (0.07)	0.03 (0.08)	0.21 (0.14)	0.21 (0.15)	-0.07 (0.08)	0.05 (0.22)
Science Only	-0.00 (0.07)	0.06 (0.08)	0.23 (0.14)	0.23 (0.15)	-0.09 (0.08)	-0.06 (0.19)
Norm + Science	-0.00 (0.07)	0.09 (0.08)	0.24 (0.14)	0.24 (0.15)	-0.12 (0.08)	-0.04 (0.22)
PartyId	-	0.36 (0.08)	0.51 (0.11)	-	-	-
PartyId * Norm Only	-	-0.18 (0.12)	-0.28 (0.16)	-	-	-
PartyId * Science Only	-	-0.26 (0.11)	-0.32 (0.16)	-	-	-
PartyId * Norm + Science	-	-0.31 (0.11)	-0.37 (0.16)	-	-	-
Knowledge	-	-	-	-	-	-0.01 (0.03)
SER	0.5	0.48	0.48	0.52	0.47	0.5

Willingness to Take Personal Action

	1	2	3	4	5	6
Intercept	0.26 (0.05)	0.19 (0.05)	0.04 (0.09)	0.04 (0.11)	0.34 (0.05)	0.14 (0.13)
Norm Only	0.18 (0.07)	0.22 (0.07)	0.28 (0.13)	0.28 (0.17)	0.13 (0.07)	0.25 (0.21)
Science Only	0.15 (0.07)	0.16 (0.07)	0.19 (0.13)	0.19 (0.17)	0.12 (0.07)	0.21 (0.18)
Norm + Science	0.14 (0.07)	0.18 (0.07)	0.17 (0.13)	0.17 (0.16)	0.15 (0.08)	0.28 (0.21)
PartyId	-	0.26 (0.07)	0.30 (0.11)	-	-	-
PartyId * Norm Only	-	-0.17 (0.11)	-0.15 (0.16)	-	-	-
PartyId * Science Only	-	-0.09 (0.11)	-0.07 (0.16)	-	-	-
PartyId * Norm + Science	-	-0.09 (0.10)	-0.02 (0.16)	-	-	-
Knowledge	-	-	-	-	-	0.03 (0.03)
SER	0.47	0.46	0.46	0.57	0.41	0.47

Support for Emissions Cap

	1	2	3	4	5	6
Intercept	0.43 (0.04)	0.38 (0.05)	0.25 (0.08)	0.25 (0.10)	0.50 (0.05)	0.35 (0.12)
Norm Only	0.05 (0.06)	0.05 (0.07)	0.05 (0.12)	0.05 (0.15)	0.04 (0.07)	0.02 (0.19)
Science Only	0.06 (0.06)	0.11 (0.07)	0.25 (0.12)	0.25 (0.15)	0.00 (0.06)	0.24 (0.16)
Norm + Science	0.05 (0.06)	0.07 (0.06)	0.08 (0.12)	0.08 (0.14)	0.04 (0.07)	-0.07 (0.19)
PartyId	-	0.19 (0.07)	0.25 (0.10)	-	-	-
PartyId * Norm Only	-	0.00 (0.10)	-0.01 (0.14)	-	-	-
PartyId * Science Only	-	-0.17 (0.10)	-0.24 (0.14)	-	-	-
PartyId * Norm + Science	-	-0.04 (0.09)	-0.04 (0.14)	-	-	-
Knowledge	-	-	-	-	-	0.02 (0.03)
SER	0.43	0.42	0.42	0.5	0.39	0.42