PUBLIC OPINION ON CLIMATE CHANGE: THE ROLES OF RISK PERCEPTION AND SCIENTIFIC KNOWLEDGE IN PREVENTING PASSIVITY

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By

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PUBLIC OPINION ON CLIMATE CHANGE: THE ROLES OF RISK PERCEPTION AND SCIENTIFIC KNOWLEDGE IN PREVENTING PASSIVITY

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ABSTRACT

Existing research shows that two factors stand out as the best predictors of people’s stated intention to take action against climate change: accurate understanding of the scientific processes by which the Earth warms, and a perception that the risks associated with its consequences are of higher magnitude. This research explores whether a similar but reverse relationship exists between these factors and the development of passivity or resignation in the face of the massive environmental challenge of climate change. It finds that while accurate knowledge and high risk are able to predict support for policy action, inaccurate knowledge and low risk perceptions also contribute significantly to the specific non-action sentiment of passivity.
I would like to express my gratitude for the guidance and encouragement of my advisor David Hunger, as well as the many other faculty members at the Georgetown Public Policy Institute who helped me to learn and grow in the time I spent here. My deepest appreciation is extended to my family and friends who provided constant and invaluable support during the pursuit of this graduate degree.
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I. INTRODUCTION

Although the concept of anthropogenic global climate change – and in particular, the warming effect of “greenhouse gases” – first appeared in academic literature more than a century ago, it has taken nearly that long for the general public to begin internalizing the possible consequences of such human interference with global environmental systems. In a relative sense, global awareness of the greenhouse effect skyrocketed in the late 1980s when extreme heat and drought events affected multiple continents within a short period of time. But to climate scientists, of course, the true evidence of global climate change is found in long-range global averages and paleosciences that confirm elevated global CO₂ levels, rising and increasingly acidic oceans, and changes in animal and plant life cycles – not in a couple sweltering days in Phoenix.

In recent years, scientific consensus has coalesced more firmly around a position that “the global net average of human activities since 1750 has been one of warming” (IPCC 2007). Although there is a growing field of scholars exploring the process by which the public opinion moves in the direction of concern about climate change, there is little or no research addressing the factors that move it in the direction

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1 The Intergovernmental Panel on Climate Change concludes this with “very high certainty,” – a confidence level that is defined as corresponding to at least a nine out of 10 chance of being correct.
of passivity or resignation. This thesis examines which factors are key in determining various attitudinal outcomes in the American public. But specifically, it seeks to provide insight into the factors that contribute to a public whereby individuals do not act in a way that expresses concern for the environment – act passively, as reflected in both their behavior and thought processes – due to their feeling that their own actions are insignificant in the face of anthropogenic environmental changes.
II. BACKGROUND

Basic Climate Science

The world’s top climate scientists now call the evidence “unequivocal:” the earth is warming. The fourth report of the Intergovernmental Panel on Climate Change (IPCC) connects anthropological activity to the global warming trend by drawing clear lines of logic through scientific findings. The assessment points out that current atmospheric concentrations of carbon dioxide (the most prevalent greenhouse gas) are more than 33% higher than their pre-industrial levels, as represented by a rise of 280 ppm to 379 ppm. Between 1995 and 2000 the annual concentration growth rate averaged 1.9 ppm per year, which was larger than it has been since the beginning of direct continuous measurements. Concentrations measured in 2005 exceeded any recorded in the past 650,000 years, as determined by sampling from ice cores (IPCC 2007). The Keeling Curve, below, shows the concentration of CO2 in the atmosphere based on continuous observations taken at Mauna Loa Observatory in Hawaii; it is considered the most accurate set of panel measurements of CO2 concentrations spanning the last half century.
Consequences of the increase in atmospheric carbon concentrations can be seen in a variety of temperature measurements. One of the most primary indicators of an overall warming trend is the persistent narrowing of the diurnal temperature range. This is considered alarming by climate scientists because it indicates a decreased ability of the Earth to cool after warming during the day. Since 1950, nighttime temperatures have increased at almost twice the rate of daytime temperatures (Easterling et.al 1997).

Whereas just a few years ago, experts were careful to qualify statements regarding their level of certainty about climate change factors, much of the controversy has faded into almost banal comments. With the annual release of the NASA Goddard Institute for Space Studies (GISS) report on global surface temperatures, director James Hansen had this to say: "as we predicted last year, 2007 was warmer than 2006,
continuing the strong warming trend of the past 30 years that has been confidently attributed to the effect of increasing human-made greenhouse gases.” (NASA Press Release 2008)

Not only was 2007 warmer than the preceding year, it was also the second warmest year since instrumental recordings began in the late 1800s, according to the GISS. The warmth of 2007 was particularly unusual because unlike 2005 (the warmest year on record), solar irradiance was at a minimum and the Pacific Ocean was in the cooler phase of the El Nino/La Nina cycle. The GISS also states that the eight warmest years on its record have all occurred since 1998, and the 14 warmest have occurred since 1990 (Hansen et. al 2007).

Policy Relevance and Disconnect

One of the difficulties of discussing climate change implications and solutions in public policy is the lack of understanding of its causes among both private citizens and public figures. While most people recognize industrial and exhaust emissions as harmful to the environment, warming cannot be solely attributed to these causes. It is not commonly understood, for example, that water vapor acts as a greenhouse gas, or that the Earth actually needs such gases to keep it warm. Without any greenhouse gases to retain some of the thermal energy that is continually reflected and radiated back out to space, the Earth’s average surface temperature would be about 59°F cooler (around 0°F).
Because of this amalgamation of systemic factors, predicting the magnitude and chronology of climate change impacts involves making a considerable number of assumptions. Rather than have an official projection, most organizations and individuals that do research into climate change model various scenarios using different quantities of climate change factors. Combined with media “bias as balance” treatment of the issue, the net result is to exaggerate the amount of uncertainty about the extent by which scientists expect the climate to be altered (Boykoff 2004)\(^2\).

The policy relevance of evaluating the causes of passivity towards climate change lies in the fact that a significant portion of the policies that have been implemented thus far are directed at individual-level responses, and are voluntary. Most commonly, we think of these as taking the form of tax cuts or subsidies for conserving energy in our personal lives. Many national-level governments – and the U.S. in particular – have hesitated to enact laws mandating energy efficiency and emissions reductions. Outside of government-mandated policy, many of the decisions people make on a daily basis are private, personal decisions that our governed primarily by their own economic cost-benefit trade-off, but also shaped by their more subjective opinion about climate change. Understanding the process by which that opinion develops is the purpose of this research.

\(^2\) Maxwell Boykoff describes how the media’s tendency to present both sides of an issue distorts the representation of the relative amount and quality of evidence on each side of the global warming debate.
III. LITERATURE REVIEW

Two quantifiable factors have been shown to be good predictors of how concern for climate change relates to action: perceived level of personal risk as a result of climate change, and accuracy of knowledge about climate change. In any given society, both of these characteristics of the general public opinion develop within the context of mass media treatment of climate change.

The Role of Risk Perception

The term “danger” plays a central role in the lexicon of climate change. The UN Framework Convention on Climate Change (UNFCCC 1992) states its objective as the following: “to achieve… stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner.” And yet, there is almost no operational definition or agreement in the scientific community as to what constitutes dangerous levels. Few governments have laid out their interpretation of acceptable climatic changes (although a couple, such as the German Advisory Council and the EU Environmental Council Decision of 1996 give landmarks about rises they consider to be unacceptable, such as “in the range of 2 degrees C relative to pre-industrial levels”) (Lorenzoni et. al 2005).
Behavioral research establishes a “visceral” reaction towards a risky situation as a pre-condition to acting such that we protect ourselves from that risk (Weber 2006). Global warming fails to invoke this emotive response because its consequences are long-term, abstract, and surrounded by uncertainty in both intensity and time. Sheldon Unger has shown that public concern for climate change grows remarkably stronger during periods when the survey respondents are experiencing unusually dry and hot weather (Unger 1992). It follows that one possible means of instigating action on the part of the public would be to seek to invoke this reaction – essentially, make the effects of climate change more concrete and visual to the public.

In recent years public opinion has trended towards increased concern about climate change, but surveys by the Pew Research Center for the People & the Press revealed possible influences of the seasons; a survey question asked in August of 2006 found a majority (61%) of Americans agreed that global warming is a problem that required immediate government action, but that number was slightly down when the same question was asked the following January (Pew 2007).

Researchers studying climate change are increasingly applying what is known from studies of cognitive and psychological reactions in order to better understand the development of risk perceptions. One conclusion they have drawn is that people identify danger with specific impacts or consequences, and much less so with probabilities. The other major identifiable factor is that in climate change there are considerable differences in personal versus societal risk levels. People recognize that
on a societal scale climate change may have extreme consequences, but often consider
its effects on their personal daily life to be of manageable proportion; this personal
interpretaion serves as justification for disassociating themselves from responsibility
for addressing the problem (Lorenzoni et. al 2005).

**The Role of Accurate Scientific Knowledge**

Public opinion surveys consistently reveal a misunderstanding of basic scientific concepts as they apply to environmental problems. This shortcoming is particularly important for climate change policy-makers because numerous studies have found accuracy of knowledge about the subject to be a major factor in how people prioritize it within their list of long-term concerns (Stamm, Clark and Eblacas 2000). Others have found that accurate understanding of climate science is not only important, but is *the best predictor* of a person’s intentions to take voluntary action or to vote positively on government referenda to reduce greenhouse gas emissions (Bord, O’Connor, and Fischer 2000).

Of course, the relationship is not completely straightforward. For example, incorrect identification of the causes of global warming is correlated with a belief that the climate is changing, but barely (if at all) related to personal support for government policy or voluntary action (Bord, O’Connor, and Fischer 2000).
Mass Media Influence on Risk Perceptions and Knowledge about Climate Change

While risk perception and accuracy of knowledge arise often as strong predictors of climate change mitigation attitudes, it would be myopic to examine those factors without also considering the major societal forces that contribute to their development. As with all science-based issues, the information about climate change that reaches the public passes first through the translation of mass media and government sources. Although undoubtedly necessary, this indirect dissemination likely increases the potential for the introduction of skewed or improperly weighted information into the discourse.

Because climate change is a scientific process, the information that reaches the general public must be translated into lay terms; in most countries, this role is filled naturally by mass media. In addition to the inherent difficulties of making a smooth, concise, and clear translation of the state of scientific knowledge, journalists (and all mass media actors) operate under the demands of an “attention-economy.” In the US, reporting on climate change has tended to emphasize the role of uncertainty regarding the level of danger, time-frame for the changes, and even whether the anthropogenic activity is a factor in the warming that has thus far been observed.

In addition to shaping understanding of climate change science, the media has the power to shape people’s impressions of their fate; a doomsday story may resign its audience to passivity, while a piece emphasizing the real but not inevitable possible
devastation from climate change may incite action. Clearly -- and problematically -- the line separating these two separate inputs into the equation is a thin one.

Other Factors

The field of literature on public opinion is broad, and although the factors discussed thus far have been shown to be the determinants of the outcomes of interest, there are, of course, other influences.

As described, the American paradox of environmentalism manifests itself strongly in the case of climate change. One important place where Americans tend to show this contradiction between “opinions” and stated behavior is when financial cost is made clear. While they are unopposed to the possibility paying, in a general sense, to mitigate climate change consequences, they generally seek to avoid concrete policy actions when the costs and prices are clarified (Jamieson 2006). Historically, candidates espousing environmental standards that are more than just slightly harsher than existing laws fail to gain significant public support. Dale Jamieson posits that one of the reasons for the existence of “American style paradoxical environmentalism” is that overcoming it requires a level of self-consciousness, or “ability to plan the development of one’s own character” that is rarely seen, regardless of nationality. Jamieson does not hypothesize as to why, then, this paradox is seen most strongly in Americans.
Additionally, while researchers Dietz, Dan, and Shwom do examine risk perceptions in their 2007 survey, they also look closely at other variables such as race, income, and trust. They find that being black, being older, having higher incomes, greater trust in environmental groups and less trust in industry were correlated with support for government mandated emissions reductions (Dietz, Dan and Shwom 2007).

Much of the research on public perception of climate change recognizes, and seeks to explain, the divergence between stated American public opinion about climate change and intention to act. Most Americans consider themselves to be environmentalists and believe that anthropogenic climate change is taking place, but fail to behave in ways that reflect those purported views.
IV. DATA AND METHODS

Data

The dataset used was the “Environment II” survey of the International Social Science Program, which was accessed through the Inter-University Consortium for Political and Social Research data. The survey was randomly administered to people in 26 countries, with varying sampling techniques.

As it is a study of public opinion, questions that were asked in the survey can only be considered relative proxies for assessing attitudes in respondents, just as the dependent variables are only best approximations of the attribute or quality we are trying to measure. The key independent variables of interest measure accuracy of knowledge about climate change and perceptions of danger due to climate change. The independent variables, along with demographic controls, were regressed on variables that measured passivity, willingness to pay, and support for government-mandated action.

Because the survey is not extremely recent (it was fielded from January 2000 to May 2002), this research was intended to focus less on describing the actual “state” of public opinion on climate change and more on analysis of the factors by which opinion develops and leads to subsequent action (or inaction). This plan relied on the assumption that although individual and public opinion certainly change over time, the relationship of the factors that determine opinion should not change. Neither should
the factors that influence the process by which people absorb and internalize information have changed significantly in the past five to seven years.

For the purpose of this research, the dataset was limited to U.S. respondents. This initial limitation brought the number of observations to 1276, however additional restrictions were imposed through coding in order to exclude the effect of those who had weak opinions.

Methods

Although the primary motivation of this research is to understand the development of the feeling of passivity or resignation, equations leading to three different outcomes were modeled using logistic regression; each outcome is represented by a dichotomous dependent variable in one of three logit models. In each of the three models, the control and independent variables were identical in order to more closely compare the processes leading to each outcome. Each model controls for gender, age, income, and liberal or conservative (American system) political leaning.

With the exception of income, all variables in the models were binary/indicator variables with values limited to zero or one.

\[
\text{PASSIVITY} = \beta_0 + \beta_1 \text{INCKNOWLEDGE} + \beta_2 \text{LOWRISK} + \beta_3 \text{MALE} + \beta_4 \text{LEFT} + \beta_5 \text{INCOME} + \beta_6 \text{AGE}
\]

\[
\text{GOVT} = \beta_0 + \beta_1 \text{INCKNOWLEDGE} + \beta_2 \text{LOWRISK} + \beta_3 \text{MALE} + \beta_4 \text{LEFT} + \beta_5 \text{INCOME} + \beta_6 \text{AGE}
\]
\[
SACRIFICE = \beta_0 + \beta_1 INCKNOWLEDGE + \beta_2 LOWRISK + \beta_3 MALE + \\
\beta_4 LEFT + \beta_5 INCOME + \beta_6 AGE
\]

Variables are defined as follows:

\textit{PASSIVITY} = respondent demonstrates a sentiment that their own actions are insignificant in preventing or mitigating climate change

\textit{GOVT} = respondent agrees that government should mandate environmental protection

\textit{SACRIFICE} = Willingness to pay in personal time and money to “do what is right” for the environment

\textit{INCKNOWLEDGE} = respondent incorrectly identifies causes of global warming

\textit{LOWRISK} = respondent considers climate change effects to pose little or no personal danger

\textit{MALE} = control variable for male

\textit{LEFT} = control variable for self-identifying as American liberal

\textit{INCOME} = control variable for household income

\textit{AGE} = control variable for age
Variables of Analysis

Key Independent Variables

Two key independent variables were used: low risk perceptions (LOWRISK), and inaccurate understanding of climate change processes (INCKNOWLEDGE). In the interest of simplifying the discussion of results, the variable representing knowledge was recoded so that a positive value for that variable corresponded with “incorrect knowledge.” Likewise, rather than using a positive indicator value to represent a high risk perception, a value of “one” for that variable corresponded with “low risk.” While perhaps slightly counterintuitive, these coding definitions enable discussion of the results as the presence of a quality (incorrect knowledge, low risk perception) rather than as the absence of one.

Inaccurate understanding of climate change processes

The key dependent variable used to measure whether a respondent had an accurate understanding of scientific processes was measured by strong agreement or strong disagreement with the question “The greenhouse effect is caused by a hole in the atmosphere.” This (false) statement represents a widely misunderstood fact about climate change; and 63% of Americans who answered this question erroneously thought this was true.
Table 1. Independent variable: incorrect knowledge

<table>
<thead>
<tr>
<th>Response</th>
<th>Variable Coding</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definitely true</td>
<td>Incorrect knowledge (1)</td>
<td>202</td>
<td>19.9</td>
</tr>
<tr>
<td>Probably true</td>
<td>Missing</td>
<td>443</td>
<td>43.6</td>
</tr>
<tr>
<td>Probably not true</td>
<td>Missing</td>
<td>221</td>
<td>21.8</td>
</tr>
<tr>
<td>Definitely not true</td>
<td>Correct knowledge (0)</td>
<td>149</td>
<td>14.7</td>
</tr>
</tbody>
</table>

Low Risk Perception

Risk, as a concept, is difficult to discuss and more difficult to measure. While the conventional equation (risk = hazards x vulnerability), provides a very specific calculation, the practical translation can mean many things. A good definition for applying risk to environmental circumstances comes from the United Nations International Strategy for Disaster Reduction (UN/ISDR). The UN/ISDR defines risk as “The probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions” (ISDR 2004).

The variable used as a proxy for representing risk perceptions does not likely capture the sentiment that should be involved in a precise measurement, however it should be considered a fair approximation. The question asks what level of danger the respondent would assign to a rise in the Earth’s temperature due to greenhouse gases, and gives options ranging from “extremely dangerous” to “not at all dangerous.” Here,
the use of the words “dangerous to you and your family” should invoke in respondents a consideration of the *hazard* (dangerous) and the *vulnerability* (to you and your family) of global warming.

### Table 2. Independent variable: low risk

*In general, do you think that a rise in the Earth's temperature is...*

<table>
<thead>
<tr>
<th>Response</th>
<th>Variable Coding</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely dangerous for you and your family</td>
<td>Not low risk (0)</td>
<td>202</td>
<td>18.9</td>
</tr>
<tr>
<td>Very dangerous</td>
<td>Not low risk (0)</td>
<td>312</td>
<td>29.1</td>
</tr>
<tr>
<td>Somewhat dangerous</td>
<td>Missing</td>
<td>420</td>
<td>39.2</td>
</tr>
<tr>
<td>Not very dangerous</td>
<td>Low risk (1)</td>
<td>116</td>
<td>10.8</td>
</tr>
<tr>
<td>Not at all dangerous for you and your family</td>
<td>Low risk (1)</td>
<td>21</td>
<td>2.0</td>
</tr>
</tbody>
</table>

### Key Dependent Variables

**Passivity**

The label of “passivity” was assigned in response to the question that assessed agreement or disagreement with the statement “it is just too difficult for a person like me to do much about global warming.” Observations where the respondent neither agreed nor disagreed with the statement were set to missing. Because the assessment of this variable is the most compelling reason for this research, the reasons for its inclusion are discussed in other parts of this paper.

### Table 3. Dependent variable: passivity

*It is just too difficult for someone like me to do much about the environment*

<table>
<thead>
<tr>
<th>Response</th>
<th>Variable Coding</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>Passivity (1)</td>
<td>71</td>
<td>6</td>
</tr>
<tr>
<td>Agree</td>
<td>Passivity (1)</td>
<td>269</td>
<td>22.6</td>
</tr>
<tr>
<td>Neither agree nor disagree</td>
<td>Missing</td>
<td>241</td>
<td>20.3</td>
</tr>
<tr>
<td>Disagree</td>
<td>Not passivity (0)</td>
<td>516</td>
<td>43.4</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>Not passivity (0)</td>
<td>92</td>
<td>7.7</td>
</tr>
</tbody>
</table>
Support for government policies

For the purposes of policy formation, a secondary purpose of this research was to investigate how these same factors of knowledge and risk perceptions affect support for government mandates to protect the environment.

<table>
<thead>
<tr>
<th>Table 4. Dependent variable: support for government policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
</tr>
<tr>
<td>Government should let ordinary people decide for themselves how to protect the environment, even if it means they don't always do the right thing.</td>
</tr>
<tr>
<td>Government should pass laws to make ordinary people protect the environment, even if it interferes with people's rights to make their own decisions.</td>
</tr>
</tbody>
</table>

Willingness to pay

Similar to the variable measuring support for government-mandated policy, the willingness to pay variable was the dependent outcome of the third regression in order to provide additional policy insights.

<table>
<thead>
<tr>
<th>Table 5. Dependent variable: willingness to pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>I do what is right for the environment, even when it costs more money or takes more time</td>
</tr>
<tr>
<td>Response</td>
</tr>
<tr>
<td>Strongly agree</td>
</tr>
<tr>
<td>Agree</td>
</tr>
<tr>
<td>Neither agree nor disagree</td>
</tr>
<tr>
<td>Disagree</td>
</tr>
<tr>
<td>Strongly disagree</td>
</tr>
</tbody>
</table>

Demographic profile and limitations of the sample

As with many surveys, the one that provides data for this study may be biased towards people of lower income and who are unemployed. Only 56% of respondents
were employed full-time (35+ hours per week). 14% were retired, and people worked part-time or as full-time housewives at rate of about 11% each. The median yearly income in US dollars was $32,500.

Other demographic variables were more representative of the general population. The average age of respondents in the sample was 46, with a minimum age of 18, a maximum of 89, and a standard deviation of 17 years. Nearly half (45%) of the sample was married or living as married, while about a quarter (26%) was single or not married.

In addition to the slight demographic bias mentioned above, the dataset used here is subject to certain other limitations. One concern is the very unspecific and broad wording of the questions that are used to represent two of the dependent variables of interest. Most notably, the question for determining whether the respondent is willing to sacrifice time and money for the environment. This question would be far more informative if it elicited the amount of time or money that people were willing to give up in order to protect the environment.

Additionally, as the survey was fielded between 2000 and 2002, it should be noted that certain limitations in data interpretation and policy extrapolation arise. The relationships predicted by the regression models should have remained relatively constant over the period of lag, but the frequencies reported should not be considered reflections of the current state of public opinion on any particular questions.
Finally, the variable of race, which should have been included in the controls, was not recorded in this dataset and therefore not controlled for in the models.
V. RESULTS SUMMARY

Regressions

While reasonably strong research gives us some understanding of the factors that motivate action, the main contribution of this research was to confirm the existence of a directly comparable reverse effect. That is, while accurate knowledge and high risk are able to predict support for policy action, inaccurate knowledge and low risk perceptions also contribute significantly to the isolated non-action sentiment of climate change apathy. Furthermore, the expected effects of these variables were confirmed to extend to support for government policies mandating environmental protective efforts, and to a public willingness to pay personally in time and money to act environmentally responsible.

Model A: predicting passivity

Results from this model conformed largely to expectations by confirming the statistical significance and positive relationships between having inaccurate scientific knowledge or low risk perceptions and an attitude of resignation towards the environment. It demonstrates that someone who has incorrect scientific knowledge is almost three times as likely as a person with accurate knowledge to be classified as passive, with a confidence level of 1%. The other independent variable of interest, low risk perception, has an effect of a similar magnitude. It indicates that a person with
low risk perception is expected to be 2.5 times as likely as a person with higher risk perception to be passive.

Both the Likelihood chi-square test ($p > 0.03$) and the Score chi-square test ($p > 0.048$) show, at the 5% level, that at least one of the coefficients in the model is not equal to zero; the Wald chi-square test confirms this finding at the 1% level. The degree of concordance is reasonably strong at 67.6% of cases being correctly classified.

**Table 6. Results from model predicting probability of possessing passivity measure**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>Effect Size (log odds)</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inaccurate knowledge</td>
<td>1.0146</td>
<td>2.758***</td>
<td>0.3951</td>
</tr>
<tr>
<td>Low risk perception</td>
<td>0.9465</td>
<td>2.577**</td>
<td>0.4879</td>
</tr>
<tr>
<td>Male</td>
<td>0.6002</td>
<td>1.822*</td>
<td>0.3517</td>
</tr>
<tr>
<td>Left</td>
<td>0.1486</td>
<td>1.16</td>
<td>0.3834</td>
</tr>
<tr>
<td>Income</td>
<td>-0.0018</td>
<td>(-) 0.996</td>
<td>0.1485</td>
</tr>
<tr>
<td>AGE</td>
<td>0.0026</td>
<td>1.003</td>
<td>0.7983</td>
</tr>
</tbody>
</table>

*denotes statistical significance at 10%; **denotes statistical significance at 5%; ***denotes statistical significance at 1%

**Model B: predicting support for government mandates**

In the regression of the key and control independent variables on the measure of willingness to let the government mandate environmental protection, results were similarly significant and in the direction hypothesized. They were not, however of magnitude as great as those measuring effect on the state of passivity. Both inaccurate knowledge and low risk perception were highly significant ($p < 0.01$), but predicted that positive values for those variables led to the respondent being about 25% as likely
to support government mandates than people with accurate knowledge and higher risk perceptions. This model confirms a gender effect as well (only borderline significant in the previous model), with males being only 37% as likely as females to support this measure of government intervention.

This model overall is highly significant. The chi square statistics of both the Likelihood Ratio and the Score tests are significant at the 1 % level (p < 0.005 and p < 0.007, respectively), while the chi square for the Wald test is significant at the 5% level.

**Table 7. Results from model predicting probability of supporting government mandated environmental restrictions**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>Effect Size (log odds)</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inaccurate knowledge</td>
<td>-1.3168</td>
<td>(-) 0.268***</td>
<td>0.4966</td>
</tr>
<tr>
<td>Low risk perception</td>
<td>-1.2555</td>
<td>(-) 0.285***</td>
<td>0.5807</td>
</tr>
<tr>
<td>Male</td>
<td>-0.9957</td>
<td>(-) 0.369***</td>
<td>0.4288</td>
</tr>
<tr>
<td>Left</td>
<td>0.5095</td>
<td>1.665</td>
<td>0.4443</td>
</tr>
<tr>
<td>Income</td>
<td>-0.0005</td>
<td>(-) 0.999</td>
<td>0.0009</td>
</tr>
<tr>
<td>AGE</td>
<td>0.00549</td>
<td>1.006</td>
<td>0.0128</td>
</tr>
</tbody>
</table>

*denotes statistical significance at 10%; **denotes statistical significance at 5%; ***denotes statistical significance at 1%

**Model C: predicting willingness to pay**

A final equation was modeled to predict the effect of the variables of interest on the willingness of the respondent to sacrifice their own money or time in support of environmental causes. Although only inaccurate knowledge was a significant predictor of the outcome, its effect was considerably large and in the direction opposite of expectations: a person with inaccurate knowledge was predicted to be more than twice
as likely to say they “do what is right for the environment, even when it takes more money or time.”

Consistent with the unexpected results, the model as a whole was only borderline significant. The Likelihood Ratio chi square statistic was significant only at 10% (p < 0.08), while the other two chi-square statistics were not significant at conventional levels.

Table 8. Results from model predicting probability of agreeing with willingness to pay measure

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>Effect Size (log odds)</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inaccurate knowledge</td>
<td>0.7327</td>
<td>2.081**</td>
<td>0.4080</td>
</tr>
<tr>
<td>Low risk perception</td>
<td>-0.2729</td>
<td>(-) 0.761</td>
<td>0.5290</td>
</tr>
<tr>
<td>Male</td>
<td>0.3354</td>
<td>1.398</td>
<td>0.3861</td>
</tr>
<tr>
<td>Left</td>
<td>-0.0428</td>
<td>(-) 0.958</td>
<td>0.4166</td>
</tr>
<tr>
<td>Income</td>
<td>0.000146</td>
<td>1.000</td>
<td>0.0009</td>
</tr>
<tr>
<td>Age</td>
<td>0.0364</td>
<td>1.037***</td>
<td>0.0130</td>
</tr>
</tbody>
</table>

*denotes statistical significance at 10%; **denotes statistical significance at 5%; *** denotes statistical significance at 1%

Multicollinearity was excluded as a concern by running correlations of all variables used in the final models (table 9). In this test, no pair of variables showed a correlation of more than 0.19.

Table 9. Correlations

<table>
<thead>
<tr>
<th></th>
<th>Sacrifice</th>
<th>Passivity</th>
<th>Govt</th>
<th>Incorrect Knowledge</th>
<th>Low Risk Perception</th>
<th>Male</th>
<th>Left</th>
<th>Income</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sacrifice</td>
<td>1.000</td>
<td>-0.114</td>
<td>0.153</td>
<td>0.073</td>
<td>-0.046</td>
<td>0.010</td>
<td>-0.003</td>
<td>0.093</td>
<td>0.156</td>
</tr>
<tr>
<td>Passivity</td>
<td>-0.114</td>
<td>1.000</td>
<td>-0.100</td>
<td>0.091</td>
<td>0.109</td>
<td>-0.021</td>
<td>0.083</td>
<td>-0.127</td>
<td>0.159</td>
</tr>
<tr>
<td>Govt</td>
<td>0.153</td>
<td>-0.100</td>
<td>1.000</td>
<td>-0.137</td>
<td>-0.267</td>
<td>-0.051</td>
<td>0.066</td>
<td>0.067</td>
<td>0.0188</td>
</tr>
<tr>
<td>Incorrect</td>
<td>0.073</td>
<td>0.091</td>
<td>-0.137</td>
<td>1.000</td>
<td>-0.257</td>
<td>-0.131</td>
<td>0.047</td>
<td>-0.146</td>
<td>-0.115</td>
</tr>
</tbody>
</table>
V. POLICY IMPLICATIONS AND DISCUSSION

Certain structural characteristics of climate change make mitigation policy particularly difficult to discuss and implement. First, every member of the global population shares in the creation and consequences of the problem. Because the atmosphere is a border-crossing public good, successful policy solutions require multi-lateral commitments that are difficult to both craft and enforce. In this way, climate change mitigation policy is very much subject to the economic problem of free riding – non-participants do not have incentive to sacrifice their own economic development because they cannot realistically be excluded from reaping the benefits created by others who do.

Second, the risk-benefit trade-off makes climate change policy a difficult sell to voters and industries. Any economic or regulatory policy requires agreeing to short-term costs in order to minimize a risk that is both very long-term and of a magnitude that is highly uncertain. Payoffs that come from addressing climate change today are unlikely to be realized during the lifetime of those who bear the immediate cost. The
extent to which current generations feel removed from the problem of climate change was demonstrated in an ABC/Washington Post poll in June 2004. In response to a question that asked "do you think that global warming will pose a serious threat to you or your way of life in your lifetime?" (emphasis added) only one-third said yes, while two-thirds said no.3 When asked by ABC/WP whether global warming will pose a serious threat to future generations, an overwhelming 79% said yes, while only 17% said no.

Finally, overcoming the tragedy of the commons aspect of climate change is a problem even greater than any localized environmental issue. Atmospheric changes are so large-scale that making any substantial impact must involve concerted behavioral changes from massive numbers of individuals, households, and firms.

In addition to these difficulties, using this research to inform policy decisions requires the assumption that the policy-making body in question wants to influence individual-level climate change mitigation responses. At the time of this research, federal level government in the U.S. has failed to make climate change a priority by enforcing serious mandatory action from the country’s citizens and businesses.

This analysis focused on evaluating aspects of the dilemma that fall under the latter two structural problems, with the ultimate goal of isolating what affects individual passivity towards the environment and related measures. Positive and

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3 Responses to this question were not significantly changed from the 2001 version of the same poll. This gives credit to the assumption that, on measures of risk perceptions, relative relationships remain largely similar across time.
significant coefficients for both inaccurate knowledge and low risk perceptions imply that these are areas that could be targeted as possible measures for affecting informal change.

When added to the body of existing research, this study very strongly confirms the importance of targeting the variable of accurate scientific knowledge. Relative to other countries, it has long been known that understanding of science among American children consistently lags behind those in other countries. On the subject of the climate change process in particular, American respondents in this dataset performed surprisingly well relative to others. They were significantly outperformed only by those respondents from the Scandinavian countries of Norway and Sweden, which each had correct response rates of more than 40% (versus 36% for the United States).

If American policy continues to rely on voluntary measures, understanding and leveraging the power of knowledge and risk perceptions to strengthen personal commitment to the environment could be useful. On the other hand, because of the three structural problems addressed at the beginning of this section, such measures are really only short-term, small steps that must be the precursors to larger government-mandated action. Since knowledge is also a significant predictor of constituent support for such regulatory and economic policy action, as shown in the secondary hypothesis of this study, it makes sense for this to be a priority addressed now at the more progressive levels of government; state and local policy-makers can lay the
groundwork for there to be a more receptive public when federal level policy finally catches up.

**VI. CONCLUSION**

The main finding of this study is that, as expected and proposed by the primary hypothesis, both inaccurate understanding of climate processes and lower perception of the personal risk associated with it are significant predictors of the development of passivity. A secondary outcome – that accurate knowledge significantly predicts support for government-mandated environmental policies – is particularly important given the structural challenges of implementing policy at the federal level. The ability of state and local governments to influence education and to implement smaller scale climate change policy make them ideal instigators of a movement that can eventually expand to higher levels of government.
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