Evidence-based Management in a Domain of Contested Information: Public Managers, Climate Change, and the Precursor of Knowledge Management

James W. Stoutenborough
Idaho State University

Kellee J. Kirkpatrick
Idaho State University

Arnold Vedlitz
Texas A&M University

Accurate information is necessary for addressing the many problems found in an increasingly complex world. Public managers are expected to embrace the evidence-based practice of emphasizing the role of scientific information in the decision making process. Nowhere should this be truer than in complex issue domains, like climate change. With a focus on the barriers to the use of scientific knowledge (cognitive influences, situational/organizational contexts, and the nature of scientific information), this project uses a survey of local, state, and regional-national agencies to examine the use of scientific information in climate change policy. This project presents a clearer picture of the conditions that aid an individual to overcome the barriers to the use of climate change information.

Keywords: evidence-based management, climate change, knowledge, public managers

In an increasingly complex world, the need for accurate scientific information is a necessity. An insufficient understanding of an issue or a lack of information in general can literally cost human life. For instance, scientific information is necessary to understand the impact of toxins on the human body. With this information, public health officials can work in conjunction with environmental regulators to ensure that toxic levels of these compounds are not released into the atmosphere, water supply, or found in consumer goods. However, without scientific information, we may be unaware of potential threats.

Consequently, the evidence-based practice (EBP) approach is important for modern policymaking. EBP emphasizes the role of information and knowledge in the decision making process (Bowen and Zwi 2005). It is defined as “the use of different types of information in a variety of forms and from a variety of sources, reflective of, and responsive to, the policy and practice context” (Bowen and Zwi 2005, 601). With imperfect information, public managers are more likely to make a mistake and choose improper policy solutions (V. Ostrom 2007). As information technologies continue to develop, public managers can easily access various sources of information (Pullin et al. 2004), which should increase the use of scientific information. This access to information also permits public managers to have more options at their disposal (Aggarwal et al. 2004; McNie 2007).

Policy actors increasingly desire to use scientific information (Joyce 2003), and scientists have responded. It is well known that scientists have influenced the drafting of legislation (e.g. Theobald et al. 2000), and the public has been supportive. The public tends to think that scientific information and knowledge can better guide this process by providing alternatives to solving the problem (Kørnøv and Thissen 2000). Information from scientific research is often considered objective (Herrick and Sarewitz 2000). With quantified and systemized information, public managers can avoid misunderstanding the issue and decrease the likelihood of mistakes (V. Ostrom 2007).

Responding to the needs of the policy process, scientists have produced a large amount of information (McNie 2007). Sometimes, though, this information is not well received by the public or policymakers. For instance, scientific information related to climate change is treated differently than other subject areas due to its widespread and complex, interrelated effects (Jäger 1998). Consequently, the benefit of the doubt that is frequently found (Herrick and Sarewitz 2000) is not always offered to climate change research (e.g. Bromley-Trujillo et al. 2014; Bromley-Trujillo et al. 2015). The consequences of climate change cross social and physical boundaries. Moreover, climate change affects environmental systems, agricultural industries, socioeconomic conditions, and human wellbeing (Aggarwal et al. 2004; Jäger 1998). All of this makes climate change a Herculean task to address. As a result, research suggests that bureaucrats tend to overestimate their level of understanding of climate change, which directly influences their policy preferences (Liu et al. 2017), making this a unique issue domain to examine from a knowledge management perspective.

Regardless, environmental policies are often initiated from scientific information (Norton 1998). Without scientific information, it can be difficult to identify goals for environmental policies (Cortner 2000; Doremus 2007; Kiker et al. 2005). As a critical part of the policy process, scientific information needs be "complete, accurate, and honestly presented" (Doremus 2007, 21). Since climate change is often thought of as an environmental issue, and, given its complexity, there is reason to believe that public managers consult scientific expertise when determining solutions to this problem.

Despite the inherent advantages of using scientific information and the apparent influence it has had, the extant literature provides little insight to explain the relationship between the collection of this information and its ultimate use in the policy process. According to Tribbia and Moser (2008), a disconnection between science and decision making exists. The relationship between the use of scientific information and factors surrounding public managers is rarely identified by experimental studies. This project will examine the determinants of the use of scientific information by public managers to combat climate change.

PUBLIC MANAGERS AND SCIENTIFIC INFORMATION

There are many factors that public managers need to consider in the policy process, such as "uncertain outcomes, a political system, and complicated situations and problems" (Kørnøv and Thissen 2000, 194). As one part of the policy process, the use of scientific information can be influenced by these factors. Hammond and colleagues (1983) suggest fundamental barriers that hamper the use of scientific information in policymaking:

1) The situational context of the policy processes,
2) The cognitive limitations of policymakers, and
3) The nature of scientific information.

While these factors appear separate, they are not mutually exclusive, and all influence how public managers use scientific information. Kørnøv and Thissen (2000) identify similar characteristics to explain strategic decision making for the use of environmental assessment at the individual level.

First, the situation that public managers face is not simple (Kiker et al. 2005). These situational effects are often organizationally dependent, as the norms, rules, and expectations of organizations differ within an executive branch and between different levels of government. Although scientific information presumes value neutrality, social value is added during the decision making process (Hammond et al. 1983). Timmerman and colleagues (2002, 178) argue that conflicts are inherent in environmental policymaking because of "socio-political, environmental, and economic value judgment." This is because the roles of public managers differ from those of scientists. Public managers need to consider "policy, practice, and people" (Choi et al. 2005, 632). Public managers cannot ignore public preferences or the desires of diverse stakeholders that advocate their preferences during the policy process, while scientists try to stay above the fray by concentrating on narrow and specific areas of research (Choi et al. 2005; Morss et al. 2005). Moreover, an individual public manager cannot make decisions unilaterally because she is in a complex web that is composed of "local, regional, state, and federal government employees; elected officials; private consultants; professional associations; private business people; and members of the public" (Morss et al. 2005, 1594). Under limited time and resources, public managers tend to think uncertainty is an inevitable factor for creating policy, and prefer easily accessible information (Morss et al. 2005). Consequently, public managers may choose easier to obtain, less scientific information to ease interpretation, which may be overly simplified, at best, misleading, or completely wrong, at worst.

Additionally, public managers are constrained by organizational conditions: goals, structure, culture, capacity, and professionalism (e.g. Bowen and Zwi 2005; Cortner 2000; E. Ostrom 2005; Provan et al. 2013). Each agency carries out a task in accordance with its own procedures and issue domain. In response to climate change, some agencies actively prepare related policies, while other agencies do not show any actions (Tol, Fankhauser, and Smith 1998). Therefore, the way agencies utilize information can result in drastically different decisions.

Previously, Jennings and Hall (2012) examined whether different agencies prefer different information sources. The results revealed that different sources of information were distinctively scored by agencies. For example, the Environmental Protection Agency scores lower the use of sources of innovation and professional/scientific information than political and agency/client factors. While Jennings and Hall (2012) reveal that agencies will use different information according to their organizational characteristics, it does not tell us who is using what information. Additionally, they are unable to determine which agencies will prefer specific information sources over other sources.

What kinds of organizational characteristics influence the use of information? According to Aarons (2005), there are supportive organizational factors including the structures, processes, and procedures that facilitate utilizing EBP. O'Reilly (1982) finds that the organization whose work is more uncertain tries to find updated information. Some studies (e.g. Aarons 2005; Aarons and Sawitzky 2006) determined that adopting EBP is based on organizational culture and climate. In short, some organizational cultures and climates encourage EBP more than others.

From this situational/organizational perspective, each agency likely has different connections to scientists to obtain scientific information. In the policy process, interactions with independent organizations are inevitable (Kørnøv and Thissen 2000). Climate scientists represent an excellent resource for public managers to consult when dealing with issues related to climate change. Within EBP, scientist participation is strongly encouraged (Poff et al. 2003). Nevertheless, some agencies may have effective organizational structures that support contacting scientists and even developing formal relationships, while other agencies do not. To create policies, each agency makes an effort to "gather, interpret, synthesize, and coordinate" information by developing their own structure and strategies (Burns and Wholey 1993, 110). Therefore, collaborating with scientists through network ties can be understood as a part of an agency's operational structure. According to Provan and colleagues (2013), instrumental/technical ties based upon organizational needs and objectives are enough to encourage the transferring of evidence-based knowledge. This suggests that maintaining contacts with scientists to exchange information about climate change will also have an impact on policy process. Unfortunately, seeking information within the agency has the potential of relying upon outdated information. To overcome this, agencies make an effort to find external sources (Provan et al. 2013). One such effort requires directly contacting experts for their input. This discussion suggests that the use of scientific information is a product of situational contexts (Λ), which are dictated by the differences in organizations.

Use of Scientific Information = f(Situational Contexts) = f(Λ) (1)

The second barrier for public managers concerns the cognitive limitations that influence their ability to handle scientific information, particularly when there are uncertain outcomes (Hammond et al. 1983). These are the personal factors that may influence an individual's motivation, and in some cases ability, to understand scientific information. Often this is associated with imperfect information (e.g. Simon 1965; 1972). Ideally, public managers choose high quality information (O'Reilly 1982). However, public managers sometimes make irrational decisions and may not have perfect information (Kørnøv and Thissen 2000). When public managers face complex issues, such as environmental policies, they are likely to prefer "intuitive or heuristic approaches to simplify the complexity until the problem seems more manageable" (Kiker et al 2005, 95). Consequently, these public managers may suffer from overconfidence in their understanding of an issue like climate change (Liu et al. 2017), an overconfidence likely based on relying on overly simplified explanations of inherently complex issues. This calls for a second component for a model of scientific information use: cognitive influences (Γ).

Use of Scientific Information = f(Λ + Cognitive Influences) = f(Λ+ Γ) (2)

The third barrier recognizes that scientific information can be difficult to understand (Hammond et al. 1983). This barrier is related to the characteristics of the organization that offers the information. Scientists use scientific jargon to explain a phenomenon, which makes it difficult for public managers to understand (Choi et al. 2005). Sometimes, scientific information is too complex and technical for the public managers to fully comprehend (Timmerman et al. 2002), essentially making it inaccessible. With so much diverse information, public managers may find it difficult to analyze (Hammond et al. 1983). Maynard (2007) suggests that this may cause public managers to be confused by the accumulated evidence and information on a complex issue. Indeed, evidence suggests that a background in science, usually through post-secondary education, is necessary to accurately evaluate scientific information (Wilson 2000). Furthermore, even with an understanding of scientific information, there is often too much uncertainty to predict the future (Morss et al. 2005; Hammond et al. 1983). Futhermore, public managers consider certain criteria to select information sources, and uncertainty may cause public managers to ignore potentially useful sources (Hammond et al. 1983; Sapolsky 1968). Consistent with extant research, this suggests a third component for our comprehensive model of scientific information use: the nature of scientific information (Φ).

Use of Scientific Information = f(Λ + Γ + Nature of Scientific Information) = f(Λ + Γ + Φ) (3)

METHODS

To determine the use of scientific information by public managers, we utilize a survey of public managers. The sample was constructed consisting of local, state, and regional-national agencies whose responsibilities might include planning for the possible effects of climate change.[1] The project targeted 780 public managers from around the country, and successfully completed 579 interviews from March to October 2006 as part of a larger project for the National Oceanic and Atmospheric Administration.[2]

The dependent variable offers an assessment of the use of scientific information by public managers. It is based on the question, "On a scale of 0 to 10, where 0 is never and 10 is very frequently, how often do you use scientific-based information on global warming and climate change to evaluate policy alternatives?"

The non-continuous, ordered nature of the dependent variable indicates that ordered logit is the most appropriate analytical tool. The 11-point scale is skewed toward the lower end. Since the data is ordered and non-continuous, this skew creates concerns for the ability of the model to accurately estimate the relationships between the variables due to too many unpopulated bins in the upper limits of the scale (see McCullagh and Nelder 1989).[3] This concern was quickly confirmed using the post-estimation Brant Test following an ordered logit. The Brant Test failed to estimate, which indicates that there are too many unpopulated bins within the data. Accordingly, the dependent variable had its scale collapsed in an effort to sufficiently populate these bins while retaining the original nature of the measures.[4]

Using an ordered logit requires meeting the parallel regression assumption (Long 1997), which holds that the influence of an independent variable is constant across the range of the dependent variable. If the impact of a variable changes across this range, it is in violation of the assumption, and any interpretation of the coefficient estimates from that analysis are potentially inaccurate (e.g. Robinson et al. 2013; Stoutenborough et al. 2013). The Brant Test is also used to determine if any of the independent variables violate the assumption (Williams 2006). If violations exist, the analysis should be estimated using a generalized ordered logit (GOLOGIT) because it allows the variables in violation to vary across the range of the dependent variable (Williams 2006). The Brant Test indicated that there were three violations of the parallel regression assumption. Consequently, the analysis is estimated using a GOLOGIT.

The independent variables used in this analysis are derived from the three fundamental barriers to the use of scientific information. As general organizing principles, we asked public managers to provide their views on several aspects of the three barriers. Consequently, we measured nine aspects of the situational context, three cognitive influences, and one perspective on the nature of scientific information.[5]

By their nature, situational contexts can be very diverse. However, they appear to be largely dependent upon organizational context. Accordingly, we capture several aspects of this context. The size of one's constituency may influence the likelihood of using scientific information. If the respondent's organization serves a relatively small population, she may be less concerned with addressing climate change, whereas someone that represents a large population may be much more likely to act since inaction may impact more people. Therefore, we control for public managers who work in an organization that serves more than 1 million constituents.

An additional set of situational contexts directly measures the organizational influences that could impact the use of scientific information. If the norms in a particular organizational domain encourage the use of scientific information, this would result in those domains being systematically more likely to use scientific information. We control for the influence of several organizational policy domains, including agriculture, transportation planning, environmental management, economic development, public health, public administration, and urban/rural planning.

The survey included three measures that capture potential cognitive influences that may increase the likelihood of using scientific information. Recall, these are the personal factors that influence an individual's ability to understand/process scientific information. Those who have greater concern ought to be more likely to try to overcome any barriers to their understanding of climate change in order to fix the problem. Similarly, public managers with greater environmental efficacy tend to care more for the environment. Efficacy "involves the regulation of thought processes, affective states, motivation, behaviour or changing environmental conditions. These beliefs are critical in approaching novel or difficult situations" (Luszczynska et al. 2011, 152-153). Consequently, public managers with greater efficacy should be more likely to try to overcome any barriers. We also control for knowledge. Public managers who are more knowledgeable about climate change should have fewer barriers.

We also capture an aspect of the third fundamental barrier to the use of scientific research – the nature of scientific information. Perhaps the most important component to this barrier is the perception that scientists actually understand what it is they are researching. If you do not believe that scientists understand climate change, why would you want to rely upon that information when drafting policy suggestions? We expect that public managers who believe scientists understand climate change would be more likely to use scientific information.

Finally, research into attitudes, beliefs, and opinions consistently reveals that demographic characteristics are often important predictors. Subsequently, we control for several demographic variables including age, education, gender, party identification, ideology, and race.

RESULTS

Before we explore the results of the analyses, we would like to briefly familiarize the reader with the presentation of these estimates. The GOLOGIT's treatment of variables that violate the parallel regression assumption allow for a more nuanced assessment of the data that reflect the differing influences of that variable across the range of the dependent variable. Sometimes, this will result in a variable gaining or losing statistical significance at different levels of the dependent variable. In a traditional ordered logit, the coefficient estimated for a variable is expected to have a constant influence across the range of the dependent variable. The GOLOGIT allows the variables in violation of the parallel regression assumption to vary, which allows for a more precise estimation.

In the table presented below, variables that were identified in a Brant Test to violate the parallel regression assumption have their estimates presented for each level of the dependent variable. Because there are five possible values for the dependent variable, there are four levels to the dependent variable. Level 1 refers to the contrast between 0 against all of the other ordered categories. At Level 1, the dependent variable is coded such that a value of 0 is coded 0, and categories 1, 2, 3, and 4 are coded 1. Level 2 refers to the contrast between the 0 and 1 categories against the 2, 3, and 4 categories. Here, the 0 and 1 categories are coded 0, and 2, 3, and 4 are coded 1. Level 3 examines the contrast between the 0, 1, and 2 categories (coded 0) against the 3 and 4 categories (coded 1). Finally, Level 4 corresponds to the contrast between 4 (coded 1) against all of the previous ordered categories (coded 0). Specific estimates at any given level are similar to a traditional logit, but they differ slightly from what would be obtained if the levels were modeled separately because the GOLOGIT estimates these influences simultaneously (Williams 2006).

The tables below also report Gamma estimates. Gamma estimates are used to determine if a coefficient estimate at any level above Level 1 is significantly different from the estimates found at Level 1. This can be used to identify the specific levels of the dependent variable where the independent variable violates the parallel regression assumption.[6]

Our analysis of the use of science-based information can be found in Table 1. The results indicate that aspects of the three barriers influence the likelihood of using scientific information. We find that five situational contexts are predictors of use. Specifically, public managers working within a department of agriculture, environmental management, resource management, or public administration were more likely to use scientific information. The GOLOGIT reveals that those who work in public health were generally no more, or less, likely to use scientific information. However, at Level 3, which compares responses in the three lowest levels of the dependent variable against the two highest, we find that public health employees were less likely to use scientific information about climate change in their jobs.

All three of the cognitive influences predict information use. Public managers with greater climate change concern or greater knowledge about climate change were more likely to use scientific information. The GOLOGIT reveals that public managers with greater efficacy were more likely to use information. However, at the highest level of use, there is a decrease in the separation in use caused by efficacy, though it is still a statistically significant influence.

The analysis fails to identify the measure of the nature of scientific information barrier as a significant influence. Specifically, public managers who believe that scientists understand climate change were no more likely to use scientific information than those who do not.

Finally, we find evidence that demographic characteristics exert a predictive influence on information usage. Public managers who are older in age or male were more likely to report using scientific information. The GOLOGIT indicates that public managers who are white were moderately more likely to use scientific information than report that they did not use any at all, which is reflected in the estimates at Level 1. However, we do not find a significant difference based on race at the higher levels of the dependent variable.

TABLE 1
PUBLIC MANAGER USE OF SCIENTIFIC INFORMATION

	Coefficient	Prob.
Situational/Organizational Context		
Agriculture	1.440 (.521)	.006
Transportation Planning	.017 (.348)	.961
Environmental Management	1.132 (.382)	.003
Resource Management	.665 (.358)	.064
Economic Development	-.028 (.345)	.935
Public Health		
Level 1	.112 (.378)	.767
Level 2	-.321 (.361)	.374
Level 3*	-.811 (.418)	.052
Level 4	-.830 (.613)	.176
Public Administration	.700 (.308)	.023
Urban and Rural Planning	-.026 (.308)	.931
Serve more than 1 Million Constituents	-.229 (.194)	.238
Cognitive Influences		
Climate Change Concern	.221 (.096)	.021
Efficacy		
Level 1	1.478 (.270)	.000
Level 2	1.542 (.261)	.000
Level 3	1.0238 (.269)	.000
Level 4†	.760 (.323)	.019
Knowledge	.651 (.117)	.000
Nature of Scientific Information		
Scientists Understand Climate Change	.188 (.143)	.189
Demographics		
Age	.019 (.009)	.041
Education	-.044 (.069)	.524
Female	-.442 (.229)	.054
Democrat	-.226 (.200)	.260
Ideology	.160 (.170)	.344
White		
Level 1	.977 (.586)	.095
Level 2	.384 (.561)	.493
Level 3†	-.026 (.572)	.964
Level 4**	-.941 (.628)	.134
Cut Point 1	-4.991 (1.484)	
Cut Point 2	-5.751 (1.496)	
Cut Point 3	-5.682 (1.521)	
Cut Point 4	-5.565 (1.574)	
Number of Cases	488	
Wald Chi^2	169.43	.0000
McFadden’s R^2	.1376	
Log Likelihood	-658.532	

Standard errors are in parentheses. Two-tailed test. For variables in violation of the parallel regression assumption: Level 1 corresponds to the contrast between 0 against all of the other ordered categories; Level 3 examines the contrast between the 0, 1 and 2 categories against the 3 and 4 categories; Level 4 corresponds to the contrast between the 0, 1, 2, and 3 categories against the 4 category. The Gamma test determines if the coefficient estimates at Levels 2, 3, or 4 are significantly different than at Level 1: † $p < .100$; * $p < .05$; ** $p < .01$; *** $p < .001$. The Gamma test identifies where a violation of the parallel regression assumption occurs.

DISCUSSION

We began this project seeking to understand the extent to which public managers utilize scientific information related to climate change in their organizational decision making. After reviewing the relevant literature, we formulated an analytical strategy to empirically examine information usage by public managers. The results of these analyses allow us to draw several observations about scientific information use.

As anticipated, the fundamental barriers to the use of scientific information in policy making played an important role in our analyses. We capture several aspects of these, with only one barrier failing to appear as a significant predictor in the model. Our indicator of the nature of scientific information failed to achieve statistical significance. This suggests that public managers are not influenced by the ongoing debate surrounding the validity of climate change research that is constantly playing out in the media. However, this also suggests that public managers are not concerned with how well scientists understand an issue when deciding whether to use scientific information, which is a bit concerning.

The analysis indicates that environmental efficacy provides a shortcut around cognitive barriers that typically inhibit the use of scientific information. These results indicate that the more responsible one feels for the environment, the more likely she is to overcome the barriers that may prevent them from understanding the issue. This sense of responsibility appears to compel these public managers to be more likely to utilize scientific information within their organization. Similarly, the level of concern that a public manager has about climate change provides a motivation to overcome these cognitive barriers.

In some ways these results are a bit concerning. We hope that public managers within an executive branch would seek out scientific information and determine whether there is a need to act regardless of their personal concern or efficacy for an issue. However, we find that these are strong motivators to overcome the cognitive barriers associated with scientific information. Between concern and efficacy, this suggests that public managers are more motivated by their own beliefs than simply doing what is in the best interest of their constituents. Max Weber would surely disapprove. This may help to shed light into how public managers can come to be overconfident in their understanding of climate change (Liu et al. 2017).

Not surprisingly, public managers who are more knowledgeable about climate change are more likely to use scientific information. The act of becoming informed naturally combats the effect of cognitive barriers. Additionally, we expect that the more a public manager understands climate change, the more she would recognize the need for scientific information.

The analysis indicates that organizational norms likely influence the use of scientific information. Four areas of organizational specialization – agriculture, environmental management, resource management, and public administration – appear to encourage the use of climate change information in their decision-making. Three of these are not surprising. We expect agricultural departments to be concerned about climate change related issues like drought or increasing temperatures and what these mean for crop yields. Similarly, environmental and resource management departments will need to address the potential impacts of climate change. However, it is unclear why those in public administration would utilize climate change information in their work.

Overall, we believe that this project begins the process of shedding light into the behaviors of public managers to educate themselves on an incredibly complex issue – climate change. This should help to provide a backdrop to understanding knowledge management by public managers. It should also provide insight into the way members of various organizations determine the extent to which they utilize scientific information because the predictors utilized in this study are not necessarily unique to public managers. Public managers are people too, and the constraints to overcoming the barriers to information should be universal for nearly all organizations.

ENDNOTES

1. This sampling tool excluded departments like education, state, corrections, insurance, vital statistics, and others that are not related to issue domains that would likely need to make policy choices/recommendations to combat climate change. Instead it focused on agriculture, transportation planning, environmental management, economic development, public health, emergency management, and urban/rural planning, all of which represent issue domains that may need to make policy choices/recommendations to combat climate change. Sampling frames for organizations represent exhaustive lists provided by national organizations within each issue domain (e.g. the National Association of County & City Health Officials, the Association of Metropolitan Planning Organizations, environmental agencies were identified by the National Wildlife Federation Conservation Directory, and emergency management agencies were identified by the Federal Emergency Management Agency) or lists including every possible organization (e.g. the county planning organization frame included every county in the United States as listed by the U.S. Census Bureau, all fifty state public health departments, state economic development divisions, and state agriculture departments). For frames of fewer than fifty-five, no sampling was conducted, as the entire frame was contacted. Larger frames were sampled using simple random samples. The contact targets for each organization were associate or assistant directors.
2. While this data is a little dated, it is still the only known survey of public managers on the subject of climate change. Additionally, given the politicization of bureaucracies around the US, this data is likely just as relevant today as it was when initially collected. Regardless, it gives us unique insight into the knowledge management practices of public managers, a traditionally slow changing group.
3. For instance, prior to the removal of cases due to missing observations, only thirteen public managers indicated that they personally use science-based information at a level of 9. With so few observations at any given level, it increases the likelihood that there are several first-level dependent/independent variable relationships that do not have any observations (i.e. no females indicated a 9 for use of science-based information). This can result in biased standard errors.
4. The dependent variable was recoded as, 0 = 0, 1 and 2 = 1, 3 and 4 = 2, 5 through 7 = 3, and 8 through 10 = 4.
5. Appendix A presents a summary of how each variable is measured.
6. To simplify the presentation of these results, we only identify which levels are significantly different from Level 1. Specific coefficient estimates and standard errors for the Gamma estimates are available upon request.

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APPENDIX A

TABLE 1
VARIABLE DEFINITIONS

Variable	Operation
Dependent Variable	
Use of Scientific Information	Measured as an 11-point scale. Respondents were asked, "On a scale of 0 to 10 where 0 is Never and 10 is Very Frequently, how often do you use science-based information on global warming and climate change to evaluate policy alternatives?" Rescaled such that 0=0, 1-2=1, 3-4=2, 5-7=3, and 8-10=4.

Situational/Organizational Context	
Organization Battery Prompt	Respondents were asked, “In which of the following do you do most of your work? Please select one.”
Agriculture	Agriculture = 1, all others = 0.
Transportation Planning	Transportation Planning = 1, all others = 0.
Environmental Management	Environmental Management = 1, all others = 0.
Resource Management	Resource Management = 1, all others = 0.
Economic Development	Economic Development = 1, all others = 0.
Public Health	Public Health = 1, all others = 0.
Public Administration	Public Administration = 1, all others = 0.
Urban and Rural Planning	Urban and Rural Planning = 1, all others = 0.
1 Million Constituents	Respondents were asked, “What is the size of the population your agency/organization serves?” Any population greater than or equal to 1 Million = 1, all others = 0.
Cognitive Influences	
Efficacy	Measured as an index that average respondent concern for GW using a 4-point scale where 3 = strongly agree and 0 = strongly disagree, respondents were asked to state their agreement with (1) I believe my actions have an influence on GW; (2) My actions to reduce the effects of GW in my community will encourage others to reduce their effects; (3) I have an obligation to future generations to reduce my impact on GW.
Knowledge	Measured using an 11-point scale. Respondents were asked, “How informed do you consider yourself to be about the global warming and climate change issue? Place yourself on a scale from 0 to 10, with 0 indicating Not at All Informed and 10 indicating Very Well Informed.” Rescaled such that 0-1 = 0, 2-3=1, 4-6=2, 7-8=3, and 9-10=4
Concern	Average concern for GW using a 4-point scale where 3 = strongly agree and 0 = strongly disagree, respondents were asked their agreement with (1) GW having a noticeably negative impact on their health, (2) GW will have a noticeably negative impact on their economic and financial situation, and (3) GW will have a noticeably negative impact on the environment where they live.
Nature of Scientific Information	
Scientists Understand CC	Measured using a 4-point scale. Respondents were asked “How clearly do you think scientists understand Global Warming and Climate Change,” with 1 = very unclear understanding and 4 = very clear understanding.
Demographics	
Female	Measured nominally as 1 = female, and 0 = male
White	Measured nominally as 1 = white, and 0 = nonwhite
Age	Measured in years.
Education	Measured in years of education.
Democrat	Measured nominally as 1 = Democrat, and 0 = Republican or no preference
Ideology	Measured as a 7-point scale, with 1 = strongly liberal, and 7 = strongly conservative.