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Collective Action and Citizen Responses to Global Warming

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Abstract This paper expands the relevance of the collective interest model of mass political action to explain collective-action behavior in the context of global warming and climate change. The analysis is an attempt to answer Ostrom's call for a behavioral model of collective action that can be generalized beyond political protest to other collective-action problems. We elaborate, specify, and empirically test a collective interest model approach to citizen policy support, environmental political participation, and environmental behavior related to the issue of global warming. Key elements of the collective interest model—perceived risk, personal efficacy, and environmental values—are found to be directly, and positively, related to support of government policies and personal behaviors that affect global warming. We

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also discuss the links between the collective interest model and other important approaches to political behavior.

Keywords Collective action · Environmental behavior · Environmental activism · Global warming · Political participation · Climate change

Introduction

This paper adapts the collective interest (CI) model of collective-action behavior to analyze citizen responses to global warming. The CI model was first developed to explain protest behavior and social movement participation (Finkel & Muller, 1998; Finkel, Muller, & Opp, 1989; Gibson, 1997). Protest behavior entails a collective-action problem because the social benefits of protest are non-excludable, and thus create incentives for individuals to free ride on the efforts of others. The CI model posits that people will participate in a collective endeavor when the expected value of participation is greater than the expected value of non-participation. People judge the expected value of participation by assessing the total value of the public good, the probability their participation will affect collective outcomes, and the selective benefits and costs of participation. We believe the CI model is a good candidate for a general theory of collective-action behavior that can be applied to other types of collective-action situations beyond political protest (Lubell, 2002; Lubell, Vedlitz, Zahran, & Alston, 2006).

Global warming provides a particularly difficult test of the CI model. The global extent of the problem creates a severe collective-action problem because the probability that a single individual can influence the climate is virtually zero, the benefits of actions by other people are non-excludable, and many of the recommended behaviors have relatively high individual costs. Thus, the rational citizen will usually choose to free ride on the efforts of others. Nevertheless, our data show that citizens do support global warming policies in a variety of political venues, and are also willing to implement these policies by engaging in sustainable behaviors.

We will use the term ''global warming activism'' to encompass three dimensions of citizen behavior: (1) support for policies designed to reduce the risk of global warming; (2) environmental political participation such as joining an environmental group; (3) engaging in personal environmental behaviors that influence global warming. These dimensions are linked together psychologically and substantively. Following Azjen and Fishbein's (1980) theory of reasoned action, we argue that people employ similar considerations to evaluate behaviors and to form attitudes towards policies that target those behaviors (see also Stern & Dietz, 1994). Substantively, global warming policy will only succeed if citizens support these policies in a variety of political venues, and are also willing to implement these policies by engaging in recommended environmental behaviors.

It is instructive to highlight the connections between our adaptation of the CI model and other important theoretical approaches to political behavior. The CI model is one possible response to Ostrom's (1998) call for a behavioral theory of collective action, and our adaptation builds on her approach to institutional analysis (Ostrom, 1990, 2005). Like the CI model, Ostrom argues that collective-action behavior reflects the costs and benefits of different actions as determined by institutional rules and the choices of other actors. In complex action situations with high levels of uncertainty such as global warming, people make decisions on the basis of mental models that often deviate from classical rationality and may incorporate psychological mechanisms such as heuristics, other-regarding preferences, and intrinsic rewards. However, Ostrom does not directly specify an alternative behavioral theory that can be used as a general model of collective-action behavior.

From this perspective, the main advantage of the CI model is to provide an empirically testable model of behavior that specifies the decision calculus people use in collective-action situations like global warming. The CI model explicitly takes into account the strategic nature of collective-action behavior by assuming people consider how likely it is their cooperation will make a difference given the behavior of the other relevant actors (i.e., the personal and group efficacy factors described in the next section). The CI model also looks at the intrinsic benefits of cooperation using Olson's (1971) original ideas of expressive benefits, which in this case derive from expressing environmental values through global warming activism. We are not arguing the CI model is the only possible model of collective-action behavior; we agree with Ostrom that people may rely on different mental models especially in frequently repeated and stable situations, or in the context of strong institutional rules and norms. But in collective dilemmas like global warming involving massive populations, uncertainty, and relatively weak institutions, we believe the CI model is very useful.

The CI model also has a very close kinship to rational models of political participation as applied to non-environmental forms of political activity. Rational models of political participation focus on the benefits of participation, the probability of an individual making a difference, and the selective benefits and costs of participation (Aldrich, 1993; Downs, 1957; Leighley, 1995; Whiteley, 1995). Our adaptation of the CI model directly integrates additional concepts from the broader political participation models, such as citizen perceptions of policy elites and political discussion networks about global warming.

Lastly, we argue the collective interest model can integrate the diverse findings about environmental behavior explored in many disciplines. The majority of these studies ignore the logic of collective action, and hence theories that relate environmental behavior to perceived environmental threats, socioeconomic characteristics, and environmental values do not adequately link behavior to the strategic structure of the situation (Elliott, Seldon, & Regens, 1997; Jones & Dunlap, 1992; Mohai, 1985; Rohrschneider, 1990; Samdahl & Robertson, 1989; Seguin, Pelletier, & Hunsley, 1998). Even those

studies that do consider collective action fail to develop a general model to predict individual behavior (Diekmann & Preisendörfer, 1998; Everett & Peirce, 1992; Gutierrez Karp, 1996). By explicitly addressing the link between collective action and individual behavior, our adaptation of the CI model encompasses many of the variables considered important by other environmental researchers and puts them into a more integrated theoretical framework. Our purpose is not to throw out some of the variables considered important by this previous research, but rather to provide a theoretical framework that explains how these variables work together to provide a behavioral logic of collective action.

We analyze the hypotheses of the CI model using a national survey of 1094 U.S. citizens. An important advantage or our survey is the utilization of self-reports of actual environmental behaviors and political participation, instead of just behavioral intentions. Analyzing expensive, real behaviors increases the likelihood that survey respondents are truly considering and experiencing the benefits and costs of global warming activism (Aldrich, 1993).

Applying the Collective Interest Model to Global Warming Activism

The purpose of the CI model is to ''incorporate the demand for the public good into an individual's utility calculus without violating the logic of free-riding,'' (Finkel et al., 1989, p. 886). Like rational models of political participation, the CI model adopts an expected value framework that hypothesizes people will participate in global warming activism when the subjective expected value of participation is greater than for non-participation. The expected value calculation depends on five factors: (1) the perceived value of the collective good produced by successful environmental action, (2) the increase in the probability of success if the individual participates, (3) the extent to which the actions of the group as a whole are likely to be successful, (4) the selective costs of participation, and (5) the selective benefits of participation. Olson (1971) defines selective benefits/costs as the material, social, or psychological consequences of participation that accrue only to participating individuals. The basic relationships are summarized with the following equation, which Finkel et al. (1989) refer to as the ''personal influence'' version of the CI model:

$$\text{EV (Global Warming Activism)} = [(p_g{*}p_i){*}V] - C + B$$

EV (Global Warming Activism) is the expected value of participation; p_g is the probability that the group will be successful (group efficacy); p_i is the marginal influence of the individual's contribution on the probability of success (personal influence); V is the value of the collective good; C is the selective cost of participation, and B is the selective benefit available from participation.

Finkel and Muller (1998) refer to the terms in braces (V, p_i, and p_g) as the ''collective interest'' variables. The collective interest variables incorporate the logic of free riding by acknowledging that the contribution of a single individual only raises the probability of successfully providing a public good by a small amount. This is the main overlap with rational models of participation; the expected value of collective action increases as perceived personal influence (p_i) increases. Olson's (1971) logic of collective action suggests that p_i is close to zero in large groups; when an individual has little chance of influencing collective outcomes, it is rational to free ride on the efforts of others.

The CI model relies on two ''useful fictions'' (Finkel et al., 1989, p. 886) that distinguish it from a model of pure rational self-interest (what Ostrom, 1998 calls ''thin rationality''). First, people systematically overestimate their personal influence, and thus are more likely to engage in collective action than Olsonian logic would predict. Early tests of the CI model using various scale measures of p_i provide considerable empirical evidence for this overestimation—Muller and Opp (1986) report a mean of $p_i = .73$, and Finkel et al. (1989) report means for p_i ranging from .17 to .58. In the sample reported here, the mean of $p_i = .58$, and 70% of the respondents agree or strongly agree that their actions influence global warming. Regardless of whether one believes that survey measures can be translated into probabilities, it appears that more people believe they can influence collective outcomes more than a thin rationality model would predict.

Second, individuals consider the probability the group will succeed (p_g) when making decisions, because it is not rational to contribute to an ineffective group. To support the group efficacy hypothesis, Finkel et al. appeal to an abstract ''unity'' principle, where the group will be successful only if every person cooperates. The unity principle plays a key theoretical role by linking individual and group actions. If the individual believes that group unity is necessary for success, then the individual expected value of collective action is *conditional* on the behavior of the other group members. It is clear that perceptions of group efficacy are an important empirical predictor in tests of the CI model, and also rational models of public participation (Godwin & Mitchell, 1982).

However, we argue the unity principle is a strong assumption, because unity is a theoretical abstraction that is extremely rare in real world collective action dilemmas. Hence, we argue for an alternative theoretical conceptualization, where group efficacy is a function of two critical elements of the political context: the level of social capital and reciprocity in a community, and the perceived competence of policy elites. These elements of the political context also serve to link individual actions and group actions, because the value of individual actions is conditional on the expected behavior of other citizens and policy elites. We will discuss these concepts in more detail in the next section.

By placing primary emphasis on the individual's subjective beliefs about the costs and benefits of collective action, the CI model suggests an analytical strategy of developing hypotheses concerning what types of individual beliefs and attitudes, demographic characteristics, and situational/institutional

Table 1 Variables hypothesized to influence global warming activism

Collective interest variables	(*B*) Selective benefits	(*C*) Selective costs
(*V*) Perceived risk (+)	Environmental values (+)	Global warming knowledge (+)
(p_i) Outcome influence (+)	Political discussion networks (+)	Income (+)
(p_g) Expected reciprocity (+)		Education (+)
(p_g) Policy elite competence (+)		Age (+)
(p_g) County civic engagement (+)		Male (–)
		Minority (–)

variables will raise or lower the expected value of global warming activism. Table 1 lists the major empirical variables we use to operationalize the concepts of the CI model. The signs in parentheses indicate the expected direction of influence for each variable on the level of global warming activism. The next sections discuss the logic of each hypothesis in more detail.

Collective Benefits of Global Warming Activism

The expected value of global warming response is an increasing function of the individual's valuation (*V* in the above equation) of the collective benefits of successful action. We argue that perceived risk of global warming is the most important measure of the expected collective benefits of global warming responses.[1] Citizens who believe that global warming poses a very high risk to human welfare and the environment will be more likely to support policies or take actions designed to reduce those risks. This hypothesis explicitly links the CI model to the many other studies that demonstrate a positive correlation between perceptions of environmental threats and environmental behavior (Mohai, 1985; Rohrschneider, 1990; Samdahl & Robertson, 1989; Seguin et al., 1998).

Personal Influence, Group Efficacy, and Political Context

Perceived personal influence (p_i) refers to the belief that individual participation in global warming activism will increase the probability of supplying the collective good. Finkel et al. (1989) find personal influence to be one of the strongest predictors of protest behavior, and Opp (2001) finds the same for voting behavior. Mohai (1985) reports similar findings for environmental activism, where people who believe they have an ability to influence the political system have higher levels of environmental concern. Consistent with these findings and the CI model, we hypothesize that people with higher

[1] The original version of the collective interest model emphasizes dissatisfaction with government policies as the most important motivator to political protest. We found no support for this hypothesis in a previous analysis in the context of air pollution activism. For environmental issues, risk reduction is the more relevant collective benefit.

perceptions of personal influence are more likely to participate in global warming activism.

Our measure of personal influence emphasizes the classic social movement rhetoric of ''you can make a difference''. The concept of personal influence highlights the link between personal behavior and political outcomes, which is similar to the traditional view on internal political efficacy that refers to beliefs about one's own competence to understand and effectively participate in politics (Niemi, Craig, & Mattei, 1991), and is also a central feature of rational models of political participation.

Group efficacy (p_g) refers to the expectation that the relevant group will succeed in achieving its collective goal. As we mentioned earlier, we adapt the CI model to consider the level of social capital in a community and the competence of policy elites as two critical elements of group efficacy. The literature on the evolution of cooperation and social capital suggests that collective action is more likely to succeed when members of the group are playing reciprocal strategies across a network of social interactions (Axelrod, 1984; Coleman, 1990; Putnam, 2000). The strategic nature of the situation implies that it is not rational to contribute to a collective endeavor when others will not reciprocate. We use both subjective and objective measures of reciprocity and social capital to capture our interpretation of group efficacy. The survey directly asks whether respondents think others will reciprocate their own global warming activism. We also use a county-level measure of civic engagement to identify citizens embedded in communities with different levels of social capital.

In addition to the behavior of other citizens, public policy outcomes depend heavily on how politicians translate citizen preferences and political resources into policy implementation. The expected value of global warming activism is lower if a citizen believes that policy elites are incompetent or untrustworthy, and therefore their contribution would be wasted. The reasoning parallels Aldrich's (1993, p. 273) argument about declining voter turnout and political participation: ''Problems are too complex, politicians are too corrupt or incompetent, and the political system is too unwieldy to expect that the election of any single individual will make any appreciable difference, no matter how desirable the program of the preferred candidate.'' Global warming is a similarly complex problem, and is being addressed by multiple and possibly unresponsive agencies (e.g., the failure of the US to ratify the Kyoto protocol).[2]

[2] Another potential component of political context is the existence of local or state policies that might influence various components of the CI model. To test this hypothesis, we estimated versions of the models below that included a dummy variable for whether a citizen lived in a city that was a member of the Cities for Climate Protection campaign. The CCP began in 1993 and has the goal of reducing carbon dioxide emissions by 20% of 1990 levels, which is more ambitious than the Kyoto Protocol targets. We found no evidence that city policy context influenced citizen behavior. While it is possible state policies could influence behavior, we did not gather data to test the influence of state policies. We also believe local policies are a better measure of policy context because they more narrowly target local citizen behaviors, and cities have become involved in climate change policies earlier on average than states.

Selective Benefits and Costs of Global Warming Responses

Global warming responses may also provide material, social, and psychological selective benefits (B) and costs (C). Most importantly, citizens with strong environmental values are more likely to receive psychological benefits from expressing their preferences through global warming activism, or enjoy the social benefits of participating with like-minded citizens (Olson, 1971). The importance of expressive or ideological benefits is well-established in empirical studies on traditional forms of political participation (Leighey, 1995; Whiteley, 1995).

Solidary benefits of interacting with other citizens are another incentive to participate in global warming activism. Following the argument of Huckfeldt and Sprague (1987), Kenny (1992), we argue that political discussion networks will increase selective benefits by providing citizens with positive reinforcements from their friends and family. Political discussion networks may also reduce the costs of global warming activism by exposing people to recruitment networks or information about proper actions. Discussion networks might also increase group efficacy because they are a manifestation of reciprocal strategies. The integration of political discussion networks provides another link between global warming activism and broader political participation.

The ability to pay the selective costs of global warming responses is related to the availability of the money, time, and civic skills necessary for effective participation (Brady, Verba, & Schlozman, 1995). In turn, the availability of these political resources is linked to many demographic variables that are traditionally considered in research on environmental behavior. The majority of research suggests that better educated and higher income individuals are more likely to engage in environmental activism (Jones & Dunlap, 1992; Samdahl & Robertson, 1989). The costs of global warming activism should be lower for educated citizens because they have more civic skills. Environmentally knowledgeable citizens will also face lower costs, because they are better able to target their activities. The flexible budget constraints of higher income individuals allow them to better absorb the costs of activism.

There is less agreement on the effects of age, gender, and race. Younger people may have more post-material values that support environmentalism, but older people may have learned more civic skills for political participation (Jones & Dunlap, 1992; Mohai & Twight, 1987). Van Liere and Dunlap's (1980) literature review shows that most studies find that older citizens are less likely to engage in environmental behaviors.

Most studies of traditional political participation find females to be less active, perhaps because they are less likely to be in social roles that provide the necessary civic skills (Schlozman, Burns, & Verba, 1994). However, for environmental issues, particularly those that involve site-specific risks, females are more likely to express environmental concern and participate. One possible reason for this is a ''gendered'' division of labor, where women are underrepresented in industrial occupations and overrepresented in culturally

defined nurturing roles (Davidson & Freudenberg, 1996; South & Spitze, 1994; Steel, 1996).

The disproportionate exposure of minorities to risk may increase their support for environmental policy, but they may also face significant barriers to participation derived from a history of discrimination or lack of access to political resources (Parker & McDonough, 1999).[3] While the expectations of environmental activism cross demographic groups is not entirely clear from existing theory and studies, all of the possibilities can be interpreted as related to differences in the costs and benefits of collective action.

Research Design and Analysis: Global Warming Citizen Survey

Data for our study are derived from a national telephone survey of adults in the United States conducted from July 13 to August 10 of 2004. Using the American Association for Public Opinion Research outcome rate calculator, the response rate was 37% and the cooperation rate was 48%. Overall, 1093 interviews were completed, constituting ±3% sampling error.[4]

Dependent Variable Measurement

Our main analysis uses OLS regression to predict three measures of global warming activism: policy support, environmental political participation, and environmental behaviors (see Appendix A for specific question wording and descriptive statistics for all variables). The *policy support* scale ($\alpha = .86$) averages eleven different questions (4-point Likert; 1 = Strongly oppose, 4 = Strongly support) that measure respondent support for different global warming policies. The *political participation* scale ($\alpha = .71$) is an additive scale that sums the number of ''yes'' answers from a list of six environmental political activities. Separate factor analyses of these two dependent variables produces only single-factor solutions, which in addition to the high reliability coefficients, supports treating each dependent variable as a single composite scale.

[3] The effect of race on environmental activism is subject to the most disagreement among the demographic variables. While most theories suggest that minorities face barriers to participation, some theories of environmental justice suggest that minorities may be more motivated to participate in environmental activism in the face of disproportionate risk exposure. However, this is more likely to be the case of immediate and visible problems like air pollution rather than future and diffuse problems like global warming. Providing a theoretical framework to understand the distinctions between different types of environmental issues remains a major task.

[4] The majority of survey participants are female (55.6% vs. 44.4% male), and the average age is 47.31 (SD = 16.40). 36.9% of respondents hold a college or post-graduate degree, and 2.5% have no high school diploma. The ethnicity of the respondents was white non-Hispanic (84.1%), followed by African American (8.1%), Hispanic (2.9%), Native American (1.2%), and Asian American (.2%). On self-reported political ideology, 42.0% of respondents regard themselves as conservative, compared to 32.7% leaning liberal. Compared to the national US Census figures, our sample is older in terms of average age (45.43 vs. 32.3) and better educated (1/5 of Americans are without a high school diploma), and undercounts males (44.4% vs. 49.1%), African Americans (8.1% vs. 12.3%), Hispanics (2.9% vs. 12.5%), and Asian Americans (.2% vs. 3.6%).

Our measurements of environmental behavior require a more nuanced analysis. First, we construct an *environmental behavior* scale ($\alpha = .53$) that averages questions about the respondent's self-reported frequency (4-point scales; 1 = Never, 4 = Always) of eight specific behaviors known to reduce the risk of global warming. Previous research (see Stern, 2000 for review) has found environmental behavior to be empirically distinguishable from policy support and participation, and factor analysis of our eight behavior items does suggest a single factor solution. Furthermore, if one assumes that collective action issues are implicated for some portion but not all of the decision-making regarding environmental behaviors, the aggregate scale is more likely to be sensitive to the variables of the CI model. Thus, it is worth analyzing the composite environmental behavior scale in the same manner as the other two dependent variables.

However, the reliability of the scale is not high enough to be satisfied with analyzing only the composite scale. As Stern (2000) notes, different types of environmental behaviors often entail considerations other than collective-action, such as direct economic benefits (e.g., turning off lights and appliances when not in use) and habitual behaviors. Furthermore, each type of environmental behavior may be influenced by unmeasured structural features that influence the costs and benefits of collective action, such as being in a location with an opportunity to engage in a particular behavior (e.g., the availability of carpool lanes or bike lanes). Hence, we expect environmental behaviors will be more difficult to explain than political participation and policy support. Moreover, the CI variables (V, p_i, p_g) may play only a small role for some environmental behaviors, which would suggest the average citizen is not considering the collective-action aspects of those behaviors. Thus, we will also analyze each of the eight behaviors separately and pay attention to differences across behaviors in the magnitude of the CI variable coefficients. These separate analyses of the frequency of individual behaviors will provide a more nuanced understanding of the dynamics of the CI model as applied to actual environmental behaviors.

Independent Variable Measurement

The *Perceived risk* scale ($\alpha = .89$) averages six questions that measure perceptions of risk (4-point Likert scales; 1 = No risk; 4 = High risk) from global warming to human health, natural resources, and economic development. *Personal influence* is a single 4-point Likert scale (1 = Disagree, 4 = Agree) measuring the belief that individual actions will have an influence on global warming and climate change. *Expected reciprocity*, the subjective measure of group efficacy, is a single 4-point Likert scale (1 = Disagree, 4 = Agree) measuring the belief that other members of the community will reciprocate your own efforts.

The objective measure of *Civic engagement* ($\alpha = .82$) is a county-level average percentage of county residents engaged in eight different community activities. The county-level estimates are assembled from surveys conducted

in a probability sample of US Census Block Groups, where block group respondents indicate whether or not they engaged in each community activity in the last 12 months.[5] The sample block group estimates are generalized to other block groups in the county, and then the total estimated number of participants in a particular county is divided by the total number of adult county residents. The validity of the civic engagement measure is corroborated by a strong correlation ($r = .30$, $p < .01$) with the number of 501(c)(3) non-profit organizations in each county identified by the National Center for Charitable Statistics.

The *Policy elite competence* scale ($\alpha = .89$) averages questions (11-point Likert scales; 0 = Not at all competent, 10 = Completely competent) about the perceived competence of seven organizations involved with climate change, including international agencies (e.g., Intergovernmental Panel on Climate Change), national agencies (e.g., Environmental Protection Agency), and environmental groups.

We measure two selective benefit variables. The *Environmental values* scale ($\alpha = .82$) averages eight questions (4-point Likert scales; 1 = Strongly disagree, 4 = Strongly agree) from the ''New Environmental Paradigm'' survey battery developed by Dunlap, Van Liere, Mertig, and Jones (2000), reflecting a respondent's level of agreement with statements on resource scarcity and the intrinsic value of nature. Higher scores on the environmental values scale indicate pro-environmental values. The *Discussion networks* variable ($\alpha = .70$) is a sum of the number of ''yes'' answers to five different opportunities to discuss global warming (e.g., have you talked with friends; has anybody asked you for your opinion).[6]

We measure a range of demographic variables that should affect the ability of the respondent to absorb the selective costs of global warming activism. *Income* is an 11-category measure of annual household income that is truncated at greater than $100,000. *Education* is a six-category education scale ranging from elementary school to post-graduate degree. *Age* is self-reported. *Gender* is a dummy variable coded [1 = male, 0 = female]. *Race* is coded with three dummy variables: African American, Hispanic, and other minority; Caucasian is the excluded category. *Global warming knowledge* is the

[5] The civic engagement survey data is collected bi-annually by Mediamark Research (http://www.mediamark.com/). Adults are selected randomly from a national population list of 90 + million households on an area probability basis. Each wave consists of 12,000 + field interviews, totaling 25,000 per year since 1979. Researchers at Applied Geographic Solutions Inc. (www.appliedgeographic.com) use Geographic Information Systems technology to map the MRI household records to the county level.

[6] We also tried an interaction term that multiplied the social discussion variable with a survey question asking about the overall level of concern about global warming within the respondents overall social network (Likert scale, 0 = not concerned, 10 = concerned). The interaction effect was significant and positive in some models, and suggests that ''concerned'' social networks have a stronger positive effect on global warming activism. However, ''unconcerned'' networks do not have a negative effect, and the magnitude of the interaction effect is always very small. The most likely explanation for this is a significant and positive correlation ($r = .27$, $p < .05$) between contact frequency and network concern—discussion about global warming tends to be among people who are worried about the problem.

proportion of correct answers to three factual questions about global warming and climate change.

OLS Regression Analysis: Testing the Collective Interest Model

We test the collective interest model using a series of ordinary least squares (OLS) regression models.[7] The linear, additive functional form of OLS regression does not directly represent the multiplicative elements of the CI model. However, as we will detail below, neither of the two most common alternative strategies for estimating the multiplicative elements of the model strictly represent the mathematical structure of the theory. At the same time, OLS has empirical qualities that are superior to the alternative strategies.

Two strategies have been employed in the literature to attempt a more direct representation of the multiplicative elements of the CI model. Finkel and his colleagues in several papers use log-log models, which log both the dependent variables and the independent collective interest variables. Finkel et al. (1989, p. 895) provides the best example of this strategy. They specify an exponential version of the CI model as, with the CI variables defined as in our analysis, *a* as a constant, and *b, c*, and *d* are weights for each variable:

$$\text{Protest} = \text{a}^{*}V^{b} * p_{\text{g}}^{c} * p_{i}^{d} * e_{i}$$

Taking the log of both sides yields an equation that can be estimated using linear regression:

$$\log(\text{Protest}) = \log(a) + b^{*}\log(V) + c^{*}\log(p_{\text{g}}) + d^{*}\log(p_{\text{i}}) + \log(e_{\text{i}})$$

Finkel and Opp (1998) estimate a variant of the log model, which adds in linear terms for selective costs and benefits:

$$\begin{aligned}\log(\text{Protest}) = {} & \log(a) + b^{*}\log(\text{V}) + c^{*}\log(\text{p}_{\text{g}}) + d^{*}\log(\text{p}_{\text{i}}) \\ & + e^{*}\text{Benefits} - f^{*}\text{Costs} + \log(e_{\text{i}})\end{aligned}$$

[7] Because the policy support and environmental behavior scales are averaged responses over multiple questions, they are no longer categorical variables. For example, the policy support scale has 80 unique values and the environmental behavior scale has 43 unique values. The number of unique values for the scales justifies using OLS instead of an alternative model such as ordered probit. Further justification is provided by the predicted values, which do not fall outside of the range of the dependent variables except a very small percentage (2.8%) below zero for the political participation model. We also analyzed the political participation model with Poisson regression, and found no differences in the direction or significance of the independent variables. Thus, in the interest of methodological consistency and simplicity, we report regression results for all three variables. Results of the Poisson regression are available upon request from the corresponding author.

Note that none of these models directly represents the multiplicative structure posited in the CI model. Finkel (personal communication 2005) confirms that no existing empirical specification of the CI model maintains perfect fidelity with the mathematical structure of the theory.

A second strategy is to multiply the interactive components of the CI model together into a single variable such that CI (multiplicative) = (V*p_i*p_g), and directly enter the multiplicative scale into a linear regression equation. This strategy is often used in empirical studies of ''rational'' models of political participation (e.g. Whiteley, 1995). The multiplicative scale also departs from the mathematical structure of the CI model, merely because there are regression coefficients on the multiplicative term.

In addition to not directly representing the theory, the log-log and multiplicative scale strategies have drawbacks as empirical methods. Both models are sensitive to measurement scales and any choices made with respect to rescaling of variables. For example, both Finkel et al. and Whiteley measure p_i with a Likert scale, which they rescale to [0,1] to represent a probability. If these scales had been maintained in their original 1–4 measurement units, then the logged and multiplicative scales would have much different variances (e.g., how do you handle a log of zero? Finkel reports they just added 1 to any scale with a zero value) and therefore different regression results.

The multiplicative scale in particular makes it impossible to distinguish which variables have the most explanatory power. Suppose an analysis finds the regression coefficient on the multiplicative scale is significantly greater than zero. One cannot tell which of the three components of the multiplicative scale is driving the results (is it V, p_i, p_g, or some combination of two or three of the components that matter?). One reason that Finkel et al. opted for the log–log models is to separate out the effects of individual components of the model.

The linear, additive model does not suffer from the empirical weaknesses of the log–log or multiplicative strategies. The regression slope coefficients are not sensitive to rescaling of the variables. It is possible to disentangle the effects of different components of the CI model. The specification is more parsimonious in the sense of the being mathematically simple. We feel these arguments justify using OLS models to empirically test the hypotheses of the CI model in the absence of a fully parameterized empirical model that directly reflects the mathematical structure of the CI theory.

To facilitate interpretation, all attitude measures, including the dependent variables, are linearly rescaled to the continuous [0,1] range before any statistical estimates are calculated. Linear rescaling does not throw away any information regarding the variance or covariance of the variables. The resulting regression slope coefficients can be interpreted as the change in the expected value (expressed as an absolute percentage of the range of the dependent variable in the sample) of the dependent variable moving across the entire range of the explanatory variable. For example, if the expected value of policy support = .10 when perceived risk equals zero, and the regression coefficient for perceived risk = .17, then ceteris paribus the

Table 2 Regression models for global warming activism

	Policy support	Political participation	Environmental behaviors
Collective interest variables			
Perceived risk	.18 (.02)**	.16(.04)**	.05 (.03)*
Personal influence	.09 (.02)**	.11(.04)**	.07(.03)**
Expected reciprocity	–.005(.02)	.11 (.04)**	.08(.03)**
Policy elite competence	.12 (.02)**	.02 (.04)	.05(.03)
County civic engagement	–.006 (.003)**	.01 (.006)*	.006(.004)
Selective benefits			
Environmental values	.27 (.03)**	.36(.07)**	.10 (.04)**
Political discussion	.004 (.003)	.06 (.01)**	.01(.004)**
Selective costs			
Global warming knowledge	.02 (.01)*	–.01(.02)	.0003(.02)
Education	.01 (.003)**	.03 (.006)**	.012(.004)**
Age	.0004(.0002)	.0007 (.0005)	.001(.0003)**
Income	.0003(.001)	.006 (.002)**	.007(.002)**
Male	–.005 (.008)	–.01 (.02)	–.02(.01)
African American	–.02 (.01)	–.06 (.03)**	–.06(.02)**
Hispanic	.05 (.02)**	–.11 (.05)**	–.01(.03)
Other minority	–.01 (.02)	.01 (.03)	–.02(.02)
Constant	.25(.04)**	–.64 (.09)**	.17(.06)**
Model fit	F = 41.854**	F = 31.77**	F = 13.64**
	Adj. R^2 = .45	Adj. R^2 = .38	Adj. R^2 = .20

Note: Cell entries are unstandardized OLS regression coefficients, with standard errors in parentheses. Null hypothesis test of coefficient equal zero, ** $p < .05$; * $p < .10$

expected value of policy support when perceived risk = 1 (maximum value) will be .27 (.10 + .17 = .27, or an absolute change of 17% points). Another way to interpret the coefficients for the attitude variables is as the maximum possible effect of the variable.

Table 2 reports the results of the regression models for all three composite variables. The results largely confirm the expectations of the collective interest model, although there are important differences in the estimates across each model that provide additional insights into the dynamics of collective-action behavior. One of the first differences to note are the decreasing model fits from policy support (Adj. R^2 = .45), to political participation (Adj. R^2 = .38), to environmental behaviors (Adj. R^2 = .20). Although the amount of explained variance is relatively good for survey data, it is clear that attitudes are much easier to explain than behaviors. As discussed earlier, the relative difficulty of explaining environmental behavior reflects the possibility of unmeasured individual and structural factors; we will provide further analysis of individual environmental behaviors in the next section.

Of the collective interest variables (V, p_g, p_i), perceived risk (V) is the strongest predictor for policy support and political participation, but is about the same as the other CI variables for environmental behavior. Personal influence (p_i) has a consistently strong and positive effect on all dimensions of global warming activism. Personal influence is nearly as important as perceived risk for policy support, and is more important than perceived risk for

political participation and environmental behaviors. The subjective and objective measures of group efficacy (p_g) show some important differences across dependent variables. Expected reciprocity from other citizens is significant only in the political participation and environmental behavior models, where it is slightly less important than personal influence. Similarly, the county civic engagement coefficients are positive in the political participation and environmental behaviors models. At the same time, the policy elite competence variable has the strongest influence in the policy support model, only borders significance (in models without the income variable, it becomes significant due to increased observations) in the environmental behavior model, and is insignificant in the political participation model.

The differences across dependent variables for the personal influence and group efficacy measures suggest a shift from a vertical (or top-down) ''citizen-government'' framework to a more horizontal (or bottom-up) ''community framework''. In the case of policy support, because most policy ideas originate from government or political elites, the competence of government officials is more important than the actions of other citizens. In fact, the negative coefficient on county civic engagement in the policy support model may indicate that citizens look to the government for help when local activity is absent. However, when looking at community action—to influence either the government or the environment—the ability to make a difference and the actions of other citizens in the community become more important. The policy elite competence variable may be insignificant in the political participation model because some citizens actually participate more in politics in the hope of changing what they view as an incompetent government.

Of the potential selective benefits (B), the expressive benefits of articulating environmental values appear to be particularly powerful. The effects of environmental values on policy support (27% point increase) and political participation (36% point increase) are the largest in the analysis. Environmental values do not have as strong an influence on environmental behaviors, which again highlights the potential structural constraints on behavior. There also appear to be some solidary benefits from political discussion of global warming; each instance of political discussion increases political participation by 6% and environmental behaviors by 2%. The influence of political discussion corroborates the findings of Huckfeldt and Sprague (1987) in the context of a specific collective dilemma.

The demographic variables that reflect selective costs (C) perform as expected in light of previous findings. Better-educated respondents report higher levels of all three dimensions of global warming activism, wealthier individuals have higher levels of political participation and environmental behaviors, and older people report a slightly higher frequency of environmental behaviors. The relatively weak effect of age may reflect the competing forces of younger people with post-material values and older people with civic skills. The effect of education is corroborated by the positive coefficient for global warming knowledge in the policy support model, but the direct measure of knowledge is not consistently significant. This is not entirely surprising

given the complexity of the global warming issue, and the overall lack of scientific consensus that is portrayed in the mainstream media. Furthermore, our measure of global warming knowledge is based on only three questions; further research should include a more extensive battery of knowledge questions. Of the variables that are clearly related to the selective costs of global warming activism, education appears to provide the highest level of civic skills for absorbing those costs.

Race is the last example of important differences across types of dependent variables. African Americans are not less supportive of global warming policies than whites, and Hispanics are actually more supportive than whites (5% point increase). However, African Americans have lower levels of political participation (6% point decrease) and environmental behavior (6% point decrease), and Hispanics engage in less political participation (11% point decrease). What these differential effects suggest is that while minority support for global warming policies is not much different from whites, their willingness or ability to follow through on those preferences is limited, perhaps by structural factors associated with racial discrimination or living in poorer communities.

Ordered Probit Models: Analyzing Individual Environmental Behaviors

As noted in the variable construction section, there may be many different constraints on environmental behaviors that weaken the reliability of the composite scale and make it worth analyzing each behavior separately. Ordered probit models are necessary because the individual environmental behavior items are 4-category ordinal variables. The full estimates for these ordered probit models are presented in Table A2 in the Appendix.

The most important function of these analyses is to assess the extent to which the CI model is appropriate for understanding each specific environmental behavior. To accomplish this, Fig. 1 displays the average size of the coefficients for the three collective interest variables—perceived risk, personal influence, and expected reciprocity—found to be significant in the environmental behavior model in Table 2.[8] As can be seen, the magnitude of these variables does vary substantially across each type of environmental behavior. We interpret these coefficients as representing the extent to which the collective benefits and strategic aspects of the CI model enter into the decision calculus of the average citizen. From this perspective, collective-action considerations appear strongest for recycling and preferences for low-emission vehicles, and weakest for insulating homes and adjusting thermostats.

These differences across behaviors could happen for two reasons. First, people may be unaware of the global warming consequences of a particular behavior and how their own choices are linked to those of other people. Such

[8] The relative influence of the collective interest variables could also be assessed by computing the marginal effects of each variable on the probability of observing a certain response category for each individual behavior. The probability analysis provides the exact same ordering except that ''walk/ride bike'' moves between ''turn off electricity'' and ''buy low emission vehicles''.

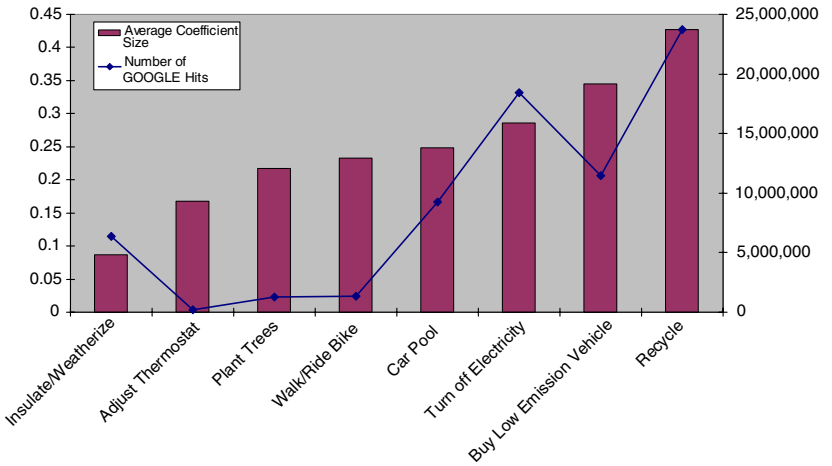

Fig. 1 Average size of ordered probit coefficients for collective interest variables (perceived risk, personal influence, expected reciprocity) and Number of GOOGLE Hits for Environmental Behaviors

awareness may be linked to the amount of public discourse (e.g., the number of relevant Google ''hits'' provides illustrative evidence; see Fig. 1)[9] about the environmental consequences of individual behavior. This suggests that public information campaigns and messages from policy elites (Zaller, 1992) about global warming could function to increase or decrease the relevance of CI variables to decision-making. A second possibility is that the private costs and benefits of these behaviors, some of which are influenced by unmeasured constraints, overwhelm the influence of the collective interest variables. For example, regardless of global warming issues, people may decide to insulate their homes and adjust their thermostats merely to save utility costs, with the amount of savings determined by the size and architecture of the house and their own personal preferences.

While more research is needed to fully understand why the relevance of the CI model varies across different environmental behaviors, the ordered probit results in general support the usefulness of the CI model. With the exception of the negative influence of environmental values on insulating/weatherizing a home, none of the significant coefficient estimates in the ordered probit models contradict the predictions of the CI model. Clearly, collective-action considerations do not strongly influence every environmental behavior and there is important heterogeneity among the various demographic indicators of selective costs that demand further research into

[9] The count of GOOGLE hits comes from using the following search terms on August 14, 2006: insulate home, adjust thermostat, citizen tree planting, walk ride bike, car pool, turn off electricity, low emission vehicles, recycle. Each of these terms was then paired with ''global warming'' and ''climate change'', and the results summed for each environmental behavior. Obviously different search terms for each behavior will elicit greater or fewer hits, so this should only be considered illustrative data. However, we do think the GOOGLE data reflects an increasing amount of public discourse along the gradient shown in Fig. 1.

constraints on specific types of actions. But when conceptualizing these behaviors as a suite of decisions, as implied by the composite scale, our results suggest collective-action considerations are an important aspect of citizen responses to global warming.

Conclusion

The main contribution of this analysis is to take a first step in response to Ostrom's (1998) call for a behavioral model of collective action by generalizing the collective interest model to the context global warming activism. Several factors important to the core concepts of the CI model stand out as predictors of global warming activism: people who believe the risk from global warming is high (V), believe their actions will make a difference in collective outcomes (p_i), and subscribe to environmental values (B) are more likely to express support for global warming policy, and more willing to take action. More educated and higher income citizens appear to have the civic skills and resources necessary to absorb selective costs and recognize opportunities for participation.

There are important differences between each dimension of global warming activism that highlight how collective action behavior must be understood in light of the broader political context. In particular, collective action behavior cannot be fully understood without reference to how individuals are embedded in a particular set of political relationships vis-à-vis policy elites and other citizens. Most theories of collective action and experiments in collective action behavior assume a fairly austere world, where the collective action problem at hand is isolated from other elements of the political system. However, our results indicate that such a ''clinical'' view of collective action behavior should be revised. Our results suggest that the citizen–government relationship is more relevant for policy support, while the citizen–citizen relationship is more important for participation and environmental behaviors.

Our results also demonstrate that the CI model is not equally relevant for every type of environmental behavior. Collective-action considerations do play a role on average across the suite of environmental behaviors engaged in by citizens. But that role is weak for some specific behaviors because people are unaware of the social consequences of their individual behavior, or the collective-action considerations are overwhelmed by the influence of private costs and benefits. This may not be surprising from the perspective of economic theory, because at the heart of most collective-action problems is the tendency for individuals to ignore the social costs and benefits of their decisions. But a more political behavior or political psychology perspective would argue that such unawareness is not immutable, and is heavily influenced by the social and political discourse in which a citizen is embedded. If there is a real link between individual behavior and collective outcomes, it is possible for public discourse to increase or decrease the salience of that link, which would have commensurate effects on the relevance of the CI model. This possibility awaits further research on the dynamics of collective-action over long time periods.

Appendix A: Survey Question Wording

Dependent variables (response frequency distributions in parentheses)

Policy support

A number of policy options have been proposed to deal with the problem of Global Warming and Climate Change. I am going to read a number of policy options to you. For each policy option, please indicate whether you: strongly support (4), support (3), oppose (2), or strongly oppose that policy (1).

- Use market incentives to encourage industries to reduce emissions (SS: 19%, S: 67%, O: 11%, SO: 2%).
- Impose a tax on industry to discourage industry practices that contribute to global warming and climate change (SS: 21%, S: 54%, O: 19%, SO: 5%).
- Impose a tax on individuals that discourages them from practices that contribute to global warming and climate change (SS: 10%, S: 43%, O: 39%, SO: 8%).
- Educate the public on the human causes of global warming and climate change (SS: 42%, S: 52%, O: 5%, SO: 2%).
- Set higher prices for types of energy and other consumer goods that are not environmentally friendly (SS: 25%, S: 55%, O: 17%, SO: 3%).
- Ratify the Kyoto Protocol, committing the US to reducing carbon dioxide emissions (SS: 21%, S: 61%, O: 13%, SO: 4%).
- Legally require more energy efficient appliances, and industrial systems (SS: 24%, S: 62%, O: 13%, SO: 2%).
- Develop renewable energy sources, like hydro power, solar power, and windmills that emit no carbon dioxide (SS: 44%, S: 52%, O: 3%, SO: 0%).
- Improve agricultural management practices by reducing the level of methane produced in raising cattle and in rice farming (SS: 16%, S: 65%, O: 17%, SO: 2%).
- Protect coastal settlements and water supplies from rising sea levels with publicly funded dikes and sea walls (SS: 10%, S: 64%, O: 23%, SO: 2%).
- Require automobile companies to build more fuel-efficient vehicles (SS: 37%, S: 54%, O: 8%, SO: 1%).
- Increase the price of fossil fuels (like gasoline) to encourage people to save energy, and encourage the development of energy efficient devices (SS: 10%, S: 37%, O: 41%, SO: 12%).

Environmental political participation

Please indicate by stating "yes" or "no" if you have done any of these things in the past year.

- Contacted a public official about an environmental issue (Y: 23%, N: 77%).
- Signed an environmental petition or appeal (Y: 30%, N: 70%).
- Attended an environmental demonstration or rally (Y: 8%, N: 92%).
- Donated money to an environmental organization (Y: 37%, N: 63%).
- Talked with neighbors or friends about an environmental problem (Y: 67%, N: 33%).
- Currently belong or previously belonged to any environmental groups or organizations (Y: 21%, N: 79%).

Environmental behaviors

Please indicate whether you do any of the following things: always (4), often (3), rarely (2), or never (1).

- Car pool (A: 6%, O: 21%, R: 25%, N: 50%).
- Walk or ride a bike instead of driving a car (A: 8%, O: 37%, R: 26%, N: 29%).
- Insulate and weatherize your home or apartment (A: 62%, O: 25%, R: 5.5%, N: 8.4%).

Appendix A: continued

	When you buy vehicles, choose the one with the lowest emissions (A: 35%, O: 26%, R: 16%, N: 22%). Turn off lights and appliances when not in use (A: 75%, O: 23%, R: 1.2%, N: 1.2%). Plant trees (A: 35%, O: 27.4%, R: 19%, N: 19%). Set the thermostat lower and winter and higher in summer (A: 53%, O: 25%, R: 9%, N: 13%). Recycle (A: 54%, O: 24%, R: 11%, N: 10%).
Independent variables (See Table A1 for descriptive statistics)	
Perceived risk from global warming	Do you strongly agree (4), agree (3), disagree (2), or strongly disagree (1) with the following statements?: Global Warming and Climate Change will have a noticeably negative impact on my health in the next 25 years. Global Warming and Climate Change will have a noticeably negative impact on my economic and financial situation in the next 25 years. Global Warming, Climate Change will have a noticeably negative impact on the environment in which my family and I live. In your opinion, what is the risk of Global Warming and Climate Change exerting a significant impact on the following (1 = No risk, 2 = Small; 3 = Moderate, 4 = High): Public health in your state? Economic development in your state? Impact on the environment in your state?
Personal influence	I believe my actions have an influence on global warming and climate change (1 = Strongly Disagree; 4 = Strongly Agree)
Expected reciprocity	My actions to reduce the effects of global warming and climate change in my community encourage others to reduce the effects of global warming through their own actions (1 = Strongly Disagree; 4 = Strongly Agree).
Policy elite competence	I am going to read a list of public and private groups that make decisions that have an impact on global warming and climate change. Using a scale of 0 to 10, where 0 means not at all competent, and 10 means completely competent, how would you rate the competence of each group to make decisions about global warming and climate change? Environmental Protection Agency National Oceanic and Atmospheric Administration Intergovernmental Panel on Climate Change US Geological Survey University scientists Non-Profit Organizations Environmental groups
Environmental values	I am going to read you some statements about human beings and the physical environment. For each statement, please indicate whether you: strongly agree (4), agree (3), disagree (2), or strongly disagree (1).

Appendix A: continued

	We are approaching the limit of the number of people the earth can support. When humans interfere with nature it often produces disastrous consequences. Humans are severely abusing the environment. Plants and animals have as much right as humans to exist. The earth is like a spaceship with very limited room and resources. The balance of nature is very delicate and easily upset. If things continue on their present course, we will soon experience a major ecological catastrophe. Today's policies must consider the needs of future generations.
Political discussion networks about global warming	Scale sums up the number of "Yes" answers to the following questions: Have you talked with members of your family about global warming and climate change? Have you talked to friends about global warming and climate change? Has anyone ever asked you for your opinion on global warming and climate change? Has anyone tried to influence your opinion on global warming and climate change? Have you ever contacted anyone to tell him/her about global warming and climate change?
Global warming knowledge	I'm going to read you a list of statements about the possible causes and effects of global warming. For each one, tell me whether you think the statement is true or false (proportion of correct answers to three statements): Nitrous oxide is a greenhouse gas (True). The major cause of increased atmospheric concentration of greenhouse gasses is human burning of fossil fuels (True). Aerosols are airborne particles that are known to contribute to the formation of clouds and precipitation (True)
Income	What was the estimated annual income for your household for 2003 (11 categories in $10,000 increments; range from < $10,000 to > $100,000).
Education	What is the highest level of education you have completed? 1 Elementary or some high school 2 High school graduate/GED 3 Trade or vocational certification 4 Some college/Associates degree 5 College graduate, or 6 Post-grad degree
Age	How old are you?
Gender	Are you male or female?
Race	From the following options, do you consider yourself to be: White non-hispanic, American Indian, Asian, Black, Hispanic, Native Hawaiian or other Pacific Islander.

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