



Internal and external influences on pro-environmental behavior: Participation in a green electricity program

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Abstract

This paper integrates themes from psychology and economics to analyze pro-environmental behavior. Increasingly, both disciplines share an interest in understanding internal and external influences on behavior. In this study, we analyze data from a mail survey of participants and non-participants in a premium-priced, green electricity program. Internal variables consist of a newly developed scale for altruistic attitudes based on the Schwartz norm-activation model, and a modified version of the New Ecological Paradigm scale to measure environmental attitudes. External variables consist of household income and standard socio-demographic characteristics. The two internal variables and two external variables are significant in a logit model of the decision to participate in the program. We then focus on participants in the program and analyze their specific motives for participating. These include motives relating to several concerns: ecosystem health, personal health, environmental quality for residents in southeastern Michigan, global warming, and warm-glow (or intrinsic) satisfaction. In a statistical ranking of the importance of each motive, a biocentric motive ranks first, an altruistic motive ranks second, and an egoistic motive ranks third.

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1. Introduction

For several decades, social scientists have investigated the motivations of individuals who engage in pro-environmental behavior (PEB). Gaining a detailed understanding of why individuals undertake PEB is important for policy makers and researchers seeking solutions to environmental problems that require behavioral change. Many research efforts thus far, however, tend to polarize around predominant themes in specific disciplines. Economists, for example, tend to examine the influence of external conditions, such as income, price, and socio-economic characteristics, upon behavior. Their approach is grounded in neoclassical economic theory, which presupposes that individual decisions are based on a specific definition of rational self-interest. Solutions to environmental problems that reward, penalize or regulate behavior result from this mode of analysis. Psychologists, on the other hand, concentrate on linking internal, or psychological, vari-

ables to behavior. Their literature suggests that PEB originates from values, beliefs, and attitudes that orient individuals toward particular actions. Consequently, psychologists recognize awareness, education, guilt, and persuasion as tools for invoking behavioral change.

Despite the dominant role psychologists attribute to internal factors for motivating PEB, a handful of researchers identify the need to formulate an interdisciplinary perspective. Van Liere and Dunlap (1980) argue that researchers should pay equal attention to cognitive variables and demographic determinants that underlie environmental concern. They assert that “the most powerful analyses of the social bases of environmental concern will likely be those which consider both its demographic and cognitive determinants” (p. 194). Messick and Brewer (1983) identify the need for researchers to integrate solutions derived from individual psychological processes and from structural, or external, factors. They fault research conducted within separate disciplines for limiting progress in the study of public-goods provision. Considering PEB in particular, Guagnano, Stern, and Dietz (1995) argue that “science and policy require a socioeconomic theory of behavior

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that incorporates both external conditions and internal processes” (p. 700). They note that reluctance of applied researchers to merge insights from economics and psychology has led to narrowly defined policies that often fall short of objectives.

Recognition that progress in understanding PEB needs to evolve from combined perspectives is also apparent in the economics literature on the private provision of public goods. From an economic perspective, PEB exemplifies an individual’s voluntary effort to provide an environmental public good. Traditional rational-choice models of private provision of a public good suggest that free riding will dominate (Olson, 1965; Cornes & Sandler, 1996). That is, these models predict relatively low levels of privately provided public goods. Empirically observed levels of provision, however, tend to exceed predicted levels (Andreoni, 1988; Piliavin & Charng, 1990). To explain this discrepancy, more recent models examine the role of psychological considerations in motivating private provision of public goods. In general, these models represent “a richer conception of individual utility functions and a base in cognitive psychology that incorporates the power of ideas and emotions in motivating behavior” (Rose-Ackerman, 1996, p. 701). In particular, these models consider different types of altruism and egoism that may influence private provision of a public good (Andreoni, 1990; Weaver, 1996; McConnell, 1997).

This paper integrates elements from psychology and economics to identify key internal and external variables that explain an actual instance of PEB: voluntary participation in a green electricity program. Green electricity refers to electricity that is generated from solar, wind or other renewable energy sources. We analyze participation in Detroit Edison’s green electricity program, the SolarCurrents program. The program generates solar electricity from two centralized facilities in the state of Michigan. Solar electricity generated by the program displaces an equivalent amount of electricity generated from fossil fuels. This gives rise to an environmental benefit through a reduction in air pollution emissions. Participation in the SolarCurrents program requires individuals to lease at least one 100-W block of solar electricity service for an additional fee of \$6.59 per block per month. This fee is separate from any other electrical service for which a household pays. Thus, participants in the SolarCurrents program reveal economic behavior that is PEB; participants voluntarily pay an additional fee for the environmental benefit of reduced pollution emissions.

Our analysis uses data from a mail survey of 900 participants and non-participants in the SolarCurrents program. We first analyze the decision of whether or not to participate. Internal variables consist of a newly developed scale for altruistic attitudes based on the Schwartz (1977) norm-activation model, and a modified

version of the New Ecological Paradigm (NEP) scale (Dunlap, Van Liere, Mertig, & Jones, 2000) to measure environmental attitudes. External variables consist of household income and standard socio-demographic characteristics. We then focus on only participants in the program and analyze their specific motives for participating. These include motives relating to several concerns: ecosystem health, personal health, environmental quality for residents in southeastern Michigan, global warming, and warm-glow (or intrinsic) satisfaction.

The remainder of this paper proceeds as follows. The next section explores common ground between psychology research on PEB and economic research on the private provision of public goods. We then provide background on the increasing number of green electricity programs in the United States. The Methods section describes our data collection and analytical techniques. The Results section is organized in three subsections relating to: the altruism and NEP scales, the participation decision, and the motives of participants. Finally, results are discussed as they relate to psychological and economic perspectives.

2. Psychological and economic perspectives on PEB

Psychology research on PEB and economic research on the private provision of public goods reveal the same underlying motive: to characterize individual behavior that results in collective benefits. This section provides a general review of research on this category of behavior from the perspective of both disciplines. An integrated perspective is shown to provide a more complete framework for analyzing PEB and the private provision of environmental public goods.

Much of the psychology research on PEB tends to focus on the relationship between internal variables and behavior. Fransson and Gärling (1999) provide a through review of this literature. Many studies establish attitudes as predictors of behavior and behavioral intentions (e.g. Ajzen & Fishbein, 1980; Ajzen, 1988; Heberlein, 1989; Ajzen & Driver, 1991; Ajzen & Driver, 1992). Similarly, several studies explore relationships between underlying value orientations and PEB, whereby value orientations precede and give rise to specific attitudes. Stern, Dietz, and Kalof (1993) conclude that motives for environmental behavior are derived from a combination of egoistic, social-altruistic, and biocentric value orientations. Although they find that all three value orientations predict willingness to take political action, only awareness of consequences for oneself (egoism) reliably predicts intended willingness to pay taxes for environmental protection. In a related study, Thompson and Barton (1994) find that ecocentric and anthropocentric value orientations independently

contribute to explanations of conservation behaviors, membership in environmental organizations, and apathy toward the environment. Schultz and Zelezny (1998) explore whether the relationship between values and PEB continues in countries and cultures other than the United States. Using survey data from Mexico, Nicaragua, Peru, Spain, and the US, they find a positive relationship between biospheric values and PEB, and a negative relationship between egoistic values and PEB.

Related research by Stern, Dietz, and Guagnano (1995) constructs a comprehensive social–psychological model of environmental concern. The model posits a series of sequential relationships. First, social and institutional structure exert an early and strong influence upon the formation of individual psychological variables. From social and institutional structure, values are derived, which then shape more general beliefs and worldviews, such as environmental concerns and altruistic norms. More specific beliefs and attitudes evolve from these general beliefs and worldviews. Specific beliefs and attitudes lead to formation of behavioral intentions and, ultimately, behavior.

The same authors (Guagnano et al., 1995) also adopt theory from other disciplines to develop a more comprehensive explanation of PEB. The authors test the hypothesis that interactions between internal and external variables affect the incidence of PEB. Their work is grounded in earlier research that proposes a complete framework linking environmentally relevant action to causally related external and internal factors (Stern & Oskamp, 1987). Guagnano, Stern, and Dietz's model suggests that attitudinal factors and external conditions act jointly to influence behavior. Specifically, external conditions affect the strength of attitude–behavior relationships, whereby attitudes are less likely to induce behavior in the presence of strong negative external conditions. In contrast, strong positive external conditions increase the likelihood of attitudes giving rise to particular behaviors. Therefore, they argue that "...a broader, context-sensitive theory is necessary because both external conditions and psychological interventions are sometimes used to change real behavior" (p. 715).

From an economic perspective, PEB exemplifies an individual's voluntary effort to provide an environmental public good. Public goods are goods that exhibit "non-rivalry" and "non-excludability." Non-rivalry implies that one person's consumption of the good does not diminish the amount available for others. Non-excludability implies that once the good is provided, other people cannot be excluded from enjoying the benefits, even if they contribute nothing to its provision. Many of the benefits from PEB, including pollution reductions from support of green electricity, satisfy these characteristics of a public good.

Beginning with Olson's (1965) classic analysis, economists have developed theoretical models to examine different external conditions for the private provision of public goods. A general result of these models is that individuals have little incentive to privately provide a public good. Instead, many individuals will choose to free ride: to enjoy benefits of a public good provided by others, without paying any of the associated costs. This result holds even though all individuals would be better off if no individuals were free riders. More recent research attempts to predict which individuals in the group actually make contributions to the public good (e.g. Bergstrom, Blume, & Varian, 1986; Andreoni, 1988). This inquiry yields three general predictions. First, voluntary contributions depend on individual "tastes" for the public good, as well as income. Second, individuals sort into two groups: those with relatively high income and a taste for the particular public good, and those with relatively low income and/or little taste for the public good. The former will choose to contribute, while the latter will choose to free ride. Finally, the fraction of individuals making contributions decreases as group size increases.

Literal predictions of these models are rarely demonstrated empirically; actual contributions to public goods generally exceed predicted contributions. Accordingly, economists are now examining the role of various types of altruism in motivating individuals to make contributions to public goods. Andreoni (1990) considers "warm-glow" altruism, which parallels the psychologists' notion of intrinsic satisfaction (De Young, 1996). From both perspectives, this motive refers to satisfaction that goes beyond the benefit derived from aggregate provision of a public good through PEB. With warm-glow altruism, an individual feels rewarded by the very act of making a donation or undertaking PEB. Another form of altruism that is used to explain individual contributions originates from paternalistic motives (e.g. McConnell, 1997). Paternalistic altruism arises when an individual is concerned about the satisfaction that others derive from a particular public good. For example, individuals may be motivated to contribute money to a local park so that others may enjoy the park.

Together, psychology models of PEB and economic models of the private provision of a public good establish a framework for testing internal and external influences on such behaviors. Recent developments in psychology emphasize the need to consider external influences. Similarly, recent developments in economics emphasize the need to consider internal influences. This paper takes advantage of insights from both disciplines to answer the question: what internal and external variables influence participation in a green electricity program?

3. Green electricity as a household option

Throughout the United States, green electricity is being offered to households as a supplement to electricity derived from fossil fuels and nuclear power. Production of green electricity displaces the pollution emissions and resource consumption associated with electricity generation from conventional fuels. Participants in programs offering green electricity volunteer to pay a price premium to meet part or all of their households' electricity demand with green electricity. The number of utility-sponsored green electricity programs in the United States has grown in response to marketing studies that indicate a resounding preference and a willingness to pay more for renewable energy (Holt, 1997). Over 80 electric utilities have established or designated green electricity programs (US Department of Energy, 2001).

The number of green electricity programs is likely to continue growing as the United States deregulates the public utility industry (Wiser & Pickle, 1997). Recent rulings at the federal and state level have opened the door for retail competition among electricity producers. As a consequence, utilities that were once guaranteed monopoly status will be forced to compete for customers. Thus, utilities will increasingly look to sponsor green electricity programs to help secure environmentally minded consumers.

Green electricity programs provide a natural experiment to examine PEB. Benefits associated with green electricity production typically fall into three general categories: environmental benefits; potential to reduce long-term electricity costs through research and development; and reduced risk of future fuel supply interruptions (Wiser & Pickle, 1997). Each of these categories is representative of non-rival and non-excludable benefits, thereby implying that green electricity gives rise to a pure public good. For psychologists and economists alike, voluntary participation in green electricity programs creates an actual behavioral setting to examine PEB in the form of a monetary contribution to a public good.

The empirical setting for this study is Detroit Edison's SolarCurrents program. Detroit Edison supplies electricity to over 2 million customers in the state of Michigan. The SolarCurrents program began operation in August 1996. Solar energy is generated at two centralized photovoltaic facilities in the Detroit metropolitan area with a total capacity of 54.8 kW. Electricity produced at these facilities is fed directly onto the company's regional power grid and displaces an equivalent amount of electricity generated by Detroit Edison's conventional power plants. Detroit Edison customers were solicited to enroll in the program with informational inserts in monthly billing statements. Customers who chose to enroll in the program pay an

additional fee of \$6.59 per block per month to lease one or more 100-W block(s) of solar electricity service. Each 100-W block produces an average of 12 kWh of solar electricity per month. Customers sign a 2-year contract to enroll in the program.

4. Methods

Mail surveys were sent to 281 participants and 619 non-participants in Detroit Edison's SolarCurrents program. The sampling regime was choice-based sampling. The 281 participants comprise the complete population of participants, while the sample of 619 non-participants was randomly selected from 80,000 Detroit Edison customers. The survey was administered in the winter of 1998 using the Dillman (1978) Total Design Method. Seventy-two surveys were not deliverable due to address changes. Response rates were 95% for participants, 67% for non-participants, and 76% overall.

Participants and non-participants received different versions of the survey instrument. The two versions differed only in the section where respondents were asked about their personal motivations for enrolling or not enrolling in the program. The customized set of questions for participants focused on their environmental reasons for enrollment. Drafts of the surveys were refined in two separate focus groups. The survey instrument was modified to increase clarity based on focus group input.

The survey asked all respondents to complete two scales: a nine-item altruism scale and a ten-item modified NEP scale. A five-point Likert response scale was used for each item in both scales. The altruism scale was constructed as a new scale for this research and applies the Schwartz norm-activation model to measure altruistic attitudes. According to the Schwartz (1970, 1977) model, altruistic behavior arises from personal norms if two criteria are met: an individual must be aware that particular actions (or inactions) have consequences for the welfare of others (awareness of consequences, AC); and an individual must ascribe responsibility for consequences of those actions to himself or herself (ascription of responsibility, AR). The simultaneous presence of AC and AR in a specific situation enables pertinent personal norms to motivate behavior. The research presented here applies the Schwartz model in the form of a general altruism scale. The scale contains a total of nine items that test for the presence of individual personal norms, AC, and AR. Specific items are listed in Table 1. Items 1, 3, and 4 state personal norms; items 2, 5, and 8 represent AC; and items 6, 7, and 9 represent AR.

The modified NEP scale consists of 10 items from the original 15-item NEP scale (Dunlap et al., 2000). Two

Table 1
Percentage distributions, item–total correlations, and factor loadings for altruism scale items

Item	SA	SWA	U	SWD	SD	r_{i-t}	Factor loading
(1) I worry about conserving energy only when it helps to lower my utility bills.	7.7	19.7	4.9	36.0	31.8	0.42	0.58
(2) Contributions to community organizations can greatly improve the lives of others.	34.4	44.3	14.0	4.9	2.4	0.38	0.58
(3) The individual alone is responsible for his or her satisfaction in life.	22.6	36.7	7.7	21.8	11.1	0.24	0.34
(4) It is my duty to help other people when they are unable to help themselves.	25.2	51.7	10.8	9.5	2.8	0.40	0.60
(5) Many of society's problems result from selfish behavior.	44.5	39.2	7.5	5.7	3.1	0.26	0.41
(6) Households like mine should not be blamed for environmental problems caused by energy production and use.	11.3	27.0	23.4	29.6	8.8	0.35	0.49
(7) My responsibility is to provide <i>only</i> for my family and myself.	5.1	13.6	5.4	42.6	33.3	0.58	0.74
(8) Use of renewable energy is the best way to combat global warming.	22.2	34.2	34.8	5.6	3.3	0.30	0.45
(9) My personal actions can greatly improve the well being of people I don't know.	22.9	51.7	17.6	6.2	1.6	0.44	0.68

Notes: SA is "strongly agree"; SWA is "somewhat agree"; U is "unsure"; SWD is "somewhat disagree"; and SD is "strongly disagree"; r_{i-t} is item–total correlations. Percentages may not sum to 100 due to rounding.

statements are used from each of the five facets of environmental concern in the scale. Specific items for the NEP scale are listed in Table 2. The five facets are: the reality of limits to growth (items 7 and 9 in the table); anti-anthropocentrism (items 2 and 6); the fragility of nature's balance (items 1 and 10); rejection of the idea that humans are exempt from the constraints of nature (items 3 and 8); and the possibility of an eco-crisis or ecological catastrophe (items 4 and 5). The five items excluded from the original scale were selected based on low item–total correlations reported in previous studies (Dunlap et al., 2000; Kotchen & Reiling, 2000). They were excluded to reduce the length of the survey instrument.

Our use of the NEP scale and the Schwartz norm-activation model is related to previous research by Stern et al. (1995). They construct a scale for general beliefs using NEP items and items based on the Schwartz model. We construct two scales to analyze the distinct influence of environmental and altruistic attitudes.

Three categories of statistical analysis are conducted. First, the NEP and altruism scales are assessed for internal consistency. Specific techniques include item–total correlations, Cronbach's coefficient alpha, and factor analysis. Second, the SolarCurrents participation decision is analyzed using a logit regression model. The logit model explains the binary choice of whether or not to participate in the program as a function of internal and external variables. Third, we assess specific motives for participation. Survey questions asked about the importance of various environmental and non-environmental reasons for program participation. Analysis of these data includes summary statistics and a non-parametric test for comparing rank-ordered data (the Friedman test).

5. Results

5.1. Internal consistency of altruism and NEP scales

Table 1 contains a summary of responses and internal consistency results for the altruism scale. Response categories for each item are "strongly agree", "somewhat agree", "unsure", "somewhat disagree", and "strongly disagree". Agreement with items 2, 4, 5, 8, and 9, and disagreement with items 1, 3, 6, and 7 indicate attitudes consistent with the presence of AC, AR, and a personal norm in the Schwartz model. The percentage distributions of responses reveal that respondents tend to have pro-altruistic attitudes with respect to most items. For example, 84% of the respondents "somewhat" or "strongly" agree with the statement that "many of society's problems result from selfish behavior".

Table 2
Percentage distributions, item–total correlations, and factor loadings for New Ecological Paradigm (NEP) scale items

Item	SA	SWA	U	SWD	SD	r_{i-t}	Factor loading
(1) The balance of nature is very delicate and easily upset.	43.7	38.1	8.6	7.6	2.1	0.51	0.66
(2) Plants and animals have as much right as humans to exist.	49.8	30.0	4.5	10.0	5.8	0.46	0.61
(3) Humans will eventually learn enough about how nature works to be able to control it.	7.1	21.4	21.9	24.4	25.2	0.32	0.42
(4) The so-called “ecological crisis” facing humankind has been greatly exaggerated.	6.3	21.0	21.8	21.3	29.7	0.59	0.71
(5) If things continue on their present course, we will soon experience a major ecological catastrophe.	22.0	29.4	26.9	14.7	6.9	0.47	0.62
(6) Humans were meant to rule over the rest of nature.	11.9	22.5	8.9	21.2	35.4	0.50	0.62
(7) The earth is like a spaceship with very limited room and resources.	33.9	33.6	9.9	15.7	6.8	0.42	0.56
(8) Human ingenuity will insure that we do not make the earth unlivable.	8.9	26.4	28.8	22.6	13.2	0.43	0.53
(9) We are approaching the limit of the number of people the earth can support.	14.5	24.1	28.8	22.2	10.4	0.46	0.59
(10) The balance of nature is strong enough to cope with the impacts of modern industrial nations.	3.5	13.7	20.1	32.1	30.6	0.59	0.71

Notes: SA is “strongly agree”; SWA is “somewhat agree”; U is “unsure”; SWD is “strongly disagree”; and SD is “somewhat disagree”; r_{i-t} is item–total correlations. Percentages may not sum to 100 due to rounding.

Before combining the items into a single scale, it is necessary to have a high degree of internal consistency among the items. We examine internal consistency in three ways. First, Table 1 reports item–total correlations for each item. These range from a low of 0.24 to a high of 0.58. All correlations are reasonably strong and statistically significant ($p < 0.05$). Second, Cronbach’s coefficient alpha for all items is 0.7, which is a reliable level for a new scale (Nunnally, 1978). Finally, we assess internal consistency with factor analysis. Table 1 contains factor loadings for each item on the first unrotated factor. These loadings range from a low of 0.34 to a high of 0.74. The factor has an eigenvalue of 2.77 and explains 20.6% of the variance among items. These results suggest that it is appropriate to treat all nine items as constituting a single scale of altruistic attitudes. Although we examined dimensionality of the scale, the results are not reported here since there is no compelling evidence to create subscales from the nine items.

Results for NEP scale items follow a similar pattern and are reported in Table 2. Agreement with items 1, 2, 5, 7, and 9, and disagreement with items 3, 4, 6, 8, and 10 indicate pro-environmental attitudes. As with previous studies involving the NEP scale, respondents tend to indicate pro-environmental attitudes. This is particularly true for the statements “the balance of nature is very delicate and easily upset” and “plants and animals have as much right as humans to exist”. Respectively, 44% and 50% of the respondents strongly agree with these statements. Item–total correlations are relatively high with a range from 0.32 to 0.59. All correlations are statistically significant ($p < 0.05$). Cronbach’s coefficient alpha for all items is 0.8. Factor loadings on the first unrotated factor are also relatively high, with a low of 0.42 and a high of 0.71. This factor’s eigenvalue is 3.69, and it explains 28.5% of the variance among items. Here again, we find a high degree of internal consistency among the NEP items, and the results support combining them into a single measure of environmental attitudes. These results are consistent with findings from previous studies that use the NEP scale (Stern et al., 1995; Dunlap et al., 2000; Kotchen & Reiling, 2000).

5.2. The participation decision

Several variables are considered as possible determinants of the SolarCurrents participation decision. These include both internal and external variables. For attitudinal variables, *ALT* and *NEP* represent summed responses to the altruism and NEP scales, respectively. Responses are coded such that higher scores indicate stronger altruistic attitudes or pro-environmental attitudes. *ALT* responses are bounded between a high of 45 and a low of 9. *NEP* responses are bounded between a high of 50 and a low of 10. Socio-economic variables

include *AGE*, *ASTHMA* (whether or not any household members have asthma or other respiratory diseases, no=0, yes=1), *GENDER* (female=0, male=1), *HOUSEHLD* (number of individuals living in the household), and *INCOME* (1997 household income before taxes).

Table 3 provides a comparison of means between participants and non-participants in the SolarCurrents program. Both participants and non-participants appear to demonstrate reasonably strong pro-environmental and altruistic attitudes, although mean responses for *NEP* and *ALT* are higher for participants. *AGE* and *ASTHMA* appear similar for participants and non-participants. The average age of respondents is just above 50 years, and the proportion reporting asthma or other respiratory diseases is above 20%. The proportion of respondents that are female is greater for participants, and the number of individuals living in the household is greater for non-participants. Finally, participants show greater household income.

Statistical comparisons of means between groups are not presented due to the degree of choice-based sampling. Unbiased statistical comparisons of means between participants and non-participants require weighting observations. The high degree of disproportionate sampling in this case renders all comparisons statistically insignificant. Instead, differences between groups are studied using a multivariate logit regression model, which has the advantage of readily handling

choice-based sampling. Maddala (1983) shows that the logit model with choice-based sampling produces consistent coefficient estimates.

The logit model is used to analyze the decision of whether to enroll in the SolarCurrents program. All internal and external variables are included in the model (Table 4). The overall model fits the data reasonably well. The percentage of correct predictions is approximately 71% and the Nagelkerke R^2 is 0.26.

Estimated coefficients on *NEP* and *ALT* are statistically significant in the expected direction. The positive signs on both attitudinal variables indicate that stronger pro-environmental and altruistic attitudes lead to higher probabilities of participating in the green electricity program. The coefficients for *AGE* and *ASTHMA* are not significantly different from zero, indicating that neither affects the probability of participation. The signs and significance of *HOUSEHLD* and *INCOME* indicate that larger households are less likely to participate, and households with greater *INCOME* are more likely to participate. Finally, although *GENDER* appears to differ between participants and non-participants, the variable is not statistically significant in the multivariate regression model, when the effect of other variables is accounted for.

Results of the logit model indicate the importance of both psychological and economic perspectives for understanding why individuals participate in a premium priced, green electricity program. The statistical significance of *NEP* and *ALT* provides insight on internal variables. Our results are consistent with previous studies finding a link between environmental attitudes and PEB (e.g. Guagnano et al., 1995; Widegren, 1998). With the altruism scale, we also find support for the Schwartz model in motivating PEB.

The statistical significance of *INCOME* and *HOUSEHLD* provides insight on external variables. Economic theory on private provision of public goods

Table 3
Comparison of means between participants and non-participants in the green electricity program

Variable	Participants	Non-participants
<i>NEP</i>	37.84 (7.32)	33.93 (6.9)
<i>ALT</i>	35.08 (4.55)	31.0 (5.2)
<i>AGE</i>	52.34 (12.93)	51.3 (13.53)
<i>ASTHMA</i> (proportion "yes")	0.22 (0.42)	0.24 (0.43)
<i>GENDER</i> (proportion "male")	0.58 (0.49)	0.70 (0.46)
<i>HOUSEHLD</i>	2.53 (1.29)	2.94 (1.48)
<i>INCOME</i>	79,714 (46,651)	66,753 (42,480)

Notes: Standard deviations are given in parentheses. The number of observations for each variable ranges from 245 to 264 for participants and from 308 to 351 for non-participants. Median *INCOME* for participants and non-participants is 75,000 and 55,000, respectively.

Table 4
Logit regression results of green electricity participation decision

Variable	Coefficient	Standard error
Constant	-6.660**	1.019
<i>NEP</i>	0.032*	0.016
<i>ALT</i>	0.151**	0.024
<i>AGE</i>	0.013	0.008
<i>ASTHMA</i>	-0.091	0.228
<i>GENDER</i>	-0.322	0.206
<i>HOUSEHLD</i>	-0.247**	0.081
<i>INCOME</i>	0.006**	0.002
<i>N</i>	557	
% Correct predictions	70.6	
Log likelihood	-323.24	
Nagelkerke R^2	0.26	

Notes: * and ** indicate significance at the 0.05 and 0.01 levels, respectively. *INCOME* is recoded to 1000s of dollars in this model.

predicts that willingness to contribute will increase with income. This prediction is verified here, as participants have higher incomes. Furthermore, the presence of more members of a household decreases the amount of discretionary income, after controlling for income differences. Therefore, the sign and significance of *HOUSEHLD* identifies another external condition that may influence monetary-based PEB. Finally, the fact that *GENDER* appears to differ between the two groups is consistent with prior research demonstrating that women engage in more pro-environmental behaviors (Zelezny, Chua, & Aldrich, 2000) and are more likely to be altruistic when altruism is expensive (Andreoni & Vesterlund, 2001). However, when other variables are accounted for in the logit model, *GENDER* is insignificant.

5.3. Motives for participation

We examine motives for participation with questions directed only to participants. Initially, participants were asked to indicate which of five general reasons were important to them when deciding to enroll in the green electricity program. Table 5 reports the proportion of “yes” responses for each general reason. Over 90% of the participants responded “yes” to the reason that solar energy is an environmentally sound way to generate electricity. Another important reason is that participants believe their support of the program will reduce the costs of solar energy in the future, as 76% responded “yes” to this reason. Over 65% also indicated the importance of

encouraging new technology and reducing reliance on imported oil. The idea that participants find the program personally satisfying independent of its impact was less important, with only 30% responding “yes”.

Specific environmental motives are investigated with a ranking question. Participants were asked to rank five environmental motives, in order of importance, for their participation in the green electricity program. Table 6 states the five motives. The motives are designed to reflect: air quality benefits to Michigan residents (*MICHRES*); improvements in ecosystem health (*ECOHLTH*); warm-glow (intrinsic) satisfaction from program participation (*WARMGLOW*); improvements in personal or family health (*OURHLTH*); and addressing global warming (*GLOBWARM*). More generally, these statements are designed to elicit responses that reflect (respectively) altruism, biocentrism, warm-glow altruism, egoism, and altruism/biocentrism. To gain familiarity with each item, respondents were first asked to complete a 5-point Likert scale for each motive. Then, the relative importance of the motives was determined by asking participants to rank each motive in order of importance.

Table 6 reports mean ranks and percentile distributions of the five specific environmental motives. Beliefs about ecosystem health have the highest mean rank, followed, respectively, by beliefs about benefits to southeastern Michigan residents, personal and family health, global warming, and warm-glow altruism. Improving ecosystem health is ranked as the top motive

Table 5
Importance of general reasons for green electricity participation

Reason	Proportion responding “yes”	Standard deviation
My support of SolarCurrents may help lower the costs of solar energy in the future.	0.76	0.43
Solar Energy is more environmentally sound than other ways of producing electricity.	0.92	0.27
I like to encourage development of new technology.	0.65	0.48
Supporting SolarCurrents is personally satisfying independent of the program’s impacts.	0.30	0.46
Solar energy helps reduce our reliance on imported oil.	0.68	0.47

Notes: Proportion responding “yes” corresponds to the proportion of respondents indicating the reason was important to their participation decision. The number of observations included is 262 participants.

Table 6
Percentage distributions and relative rankings of environmental motives for green electricity participation

Motives	Mean rank ^a	Percentage for each rank				
		1	2	3	4	5
Reducing air pollution from electricity production will improve the health of natural ecosystems.	2.08	39.4	25.9	23.5	9.6	1.6
Reducing air pollution from electricity production will benefit residents of southeastern Michigan.	2.49	20.6	32.0	27.7	17.4	2.4
My health, and the health of my family, may improve because the program will improve air quality.	2.85	17.9	22.6	22.6	31.0	6.0
Decreasing carbon dioxide emissions from electricity production will slow the rate of global warming.	3.04	19.0	16.3	20.2	31.0	13.5
I take satisfaction in participating in this program, regardless of its environmental effects.	4.51	4.0	3.2	6.1	10.9	75.7

Notes: Within a row, percentages may not sum to 100 due to rounding. Mean rank is calculated such that 1 = most important, 2 = second most important, 3 = third most important, 4 = fourth most important, and 5 = least important.

^aThe Friedman test, applied to mean ranks for each motive, shows that all rankings are statistically different ($p < 0.05$).

39% of the time; the motive based on warm-glow altruism is ranked as least important 76% of the time. The Friedman test (see Gibbons, 1993), a non-parametric test that compares ranked data for three or more paired groups, is applied to all possible bivariate combinations of the five ranked motives. Mean rankings for each of the five motives are shown to be statistically different ($p < 0.05$) for all possible pairings. Thus, the summary ranking of reasons from most to least important is statistically valid.

These findings indicate the presence of distinct motivations for PEB. This occurs even within the reasonably homogeneous, self-selected group of participants in a green electricity program. Stern et al. (1993) identify egoistic, social-altruistic, and biospheric value orientations as predictors of PEB. When PEB involves willingness to pay for environmental protection, however, they find that only egoism is a reliable predictor of such behaviors. Our results differ. The rank ordering shows that, in the form of monetary contributions to green electricity, PEB is most highly motivated by biocentrism, followed by altruism, then egoism. One possible explanation for this difference may be that Stern, Dietz, and Kalof consider payment through taxes, while our study considers voluntary contributions. Moreover, we examine actual willingness to pay, while they examine statements about willingness to pay.

6. Summary and conclusions

This research explores complementary explanations of behavior from the psychology literature on PEB and the economics literature on the private provision of public goods. A general review of these literatures suggests that an improved understanding of PEB can result from integrating insights, models, and techniques from the two disciplines. Our analysis of participation in a green electricity program provides an example. Both internal and external influences are statistically significant in a logit model of the participation decision. These results reinforce previous findings of psychology research on PEB and economic research on the private provision of public goods.

Internal variables include scales for altruistic and environmental attitudes. The former is measured with an original scale based on the Schwartz norm-activation model; the latter is measured with a modified version of the NEP scale. Both scales demonstrate a relationship to actual behavior. Results of the logit model indicate that the scales are significant explanatory variables of the participation decision. This implies that, after controlling for altruistic attitudes, environmental attitudes independently influence the participation decision, and vice versa. Thus, altruism and environmentalism appear to be internal variables that independently influence

PEB. This result provides perspective on the role of internal conditions. Green electricity requires personal costs to secure public benefits. Guagnano et al. (1995) suggest that, in such public-goods cases, the problem “is best conceptualized as... the activation of altruistic moral norms rather than as a direct function of general environmental concern” (p. 705). Our analysis suggests that these two influences are both important. Both altruism and environmentalism may be necessary conditions to promote PEB in the form of voluntary provision of an environmental public good.

Analysis of external variables indicates that participants tend to have higher incomes and fewer members in the household. These results, combined with significance of the internal variables, emphasize the importance of considering both internal and external influences on behavior. Bagozzi (1992) suggests that models of attitude-behavior relationships need to consider the context in which behavioral decisions are made. In particular, the models should incorporate the influence of externally imposed boundary conditions on behavior. Guagnano et al. (1995) extend this analysis to a natural experiment with curbside recycling. They find that attitudes, along with increased convenience of recycling, help to explain observed behavior. We find further evidence of the importance of internal and external influences on PEB. Altruistic and environmental attitudes, along with greater ability to pay (in terms of greater income and fewer household members), reliably predict participation in a premium-priced, green electricity program.

Finally, two results are particularly informative from the relative rankings of participants' environmental motives for program enrollment. First, altruism toward the environment (biocentricism) is generally more important than selected forms of altruism toward regional residents and health-based egoism. This may suggest that the notion in environmental economics of existence value is quantitatively important, at least to a subset of the population. Existence value is roughly defined as an individual's economic value from simply knowing that a certain natural environment exists, independently of her use of that environment (Krutilla, 1967). Second, local concerns about benefits for south-eastern Michigan residents (ranked second) are more important than global concerns associated with climate change (ranked fourth). The greater importance attached to a local environmental issue, as opposed to a global issue, suggests that PEB may be more likely when associated with local, rather than global, environmental concerns.

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