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Integrating Factors that Predict Energy Conservation: The Theory of Planned Behavior and Beliefs about Climate Change

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Abstract

A survey of college students was used to examine predictors of four types of energy conservation behavior. Our proposed predictors were derived from Ajzen's Theory of Planned Behavior (TPB) and from problem awareness variables (environmental concern, and knowledge and beliefs about global warming) thought to have indirect effects on conservation via TPB constructs. TPB constructs were significant direct predictors of target behaviors. Perceived behavioral control (PBC) was the strongest and most consistent predictor, predicting all four behaviors, followed by perceived worth (attitude), predicting three behaviors. TPB variables mediated the effects of either environmental concern or beliefs about the consequences of global warming on three behaviors. Finally, there were also significant mediating relationships among TPB variables themselves. Subjective norm predicted perceived worth and PBC, and perceived worth predicted PBC for all but one behavior. Theoretical implications and implications for intervention are discussed. To our knowledge this is the first study to separately demonstrate, in one sample, the predictive value of TPB with respect to different types of energy conservation, and to integrate TPB variables with climate-change beliefs.

Keywords: beliefs about global warming, energy conservation, environmental concern, theory of planned behavior

1. Introduction

Environmental problems such as pollution, destruction of habitat, and global warming must be addressed by changes in both societal policy and individual behaviors. However, these changes may be difficult to make since environmental problems are often experienced as remote in place and time, and as not personally relevant (Leary, Toner, & Gan, 2011). Furthermore, the benefits of behavioral changes may also be perceived as remote, and to only occur when many individuals change their behavior. Global warming and energy conservation illustrate these difficulties (Frantz & Mayer, 2009; Gifford, 2011; Heath & Gifford, 2006). People may believe that the negative consequences of global warming are uncertain, will only occur in the distant future, and will not be as relevant to the self as to others. Furthermore, while energy conservation, a primary individual behavior that can affect climate change, may have personal financial benefits, the environmental benefits will only occur as many people conserve. Thus, energy use may be a difficult behavior to change, especially in the US where energy costs are relatively low. Under the press of daily concerns that have obvious, immediate, and personal consequences, people may give little weight to energy conservation. In the present research, we examined factors that predict this presumably low priority behavior. Specifically, we examined predictors of four ways to conserve energy. Our proposed predictors were derived from Ajzen's Theory of Planned Behavior (TPB) and from problem-awareness variables that may indirectly predict energy conservation through their relationship to variables in the TPB framework (see Figures 1-4).

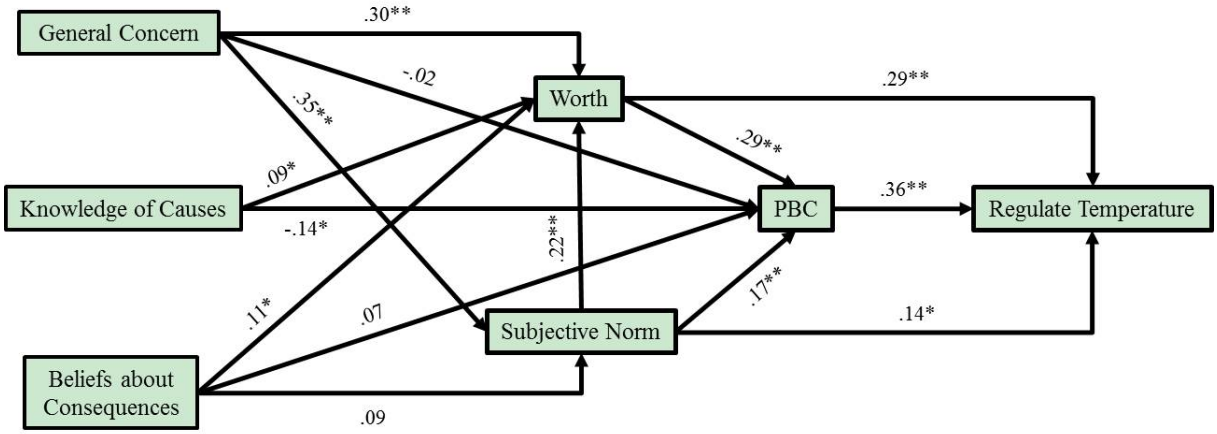

Figure 1. Path model with standardized path coefficients for variables directly and indirectly predicting temperature regulation

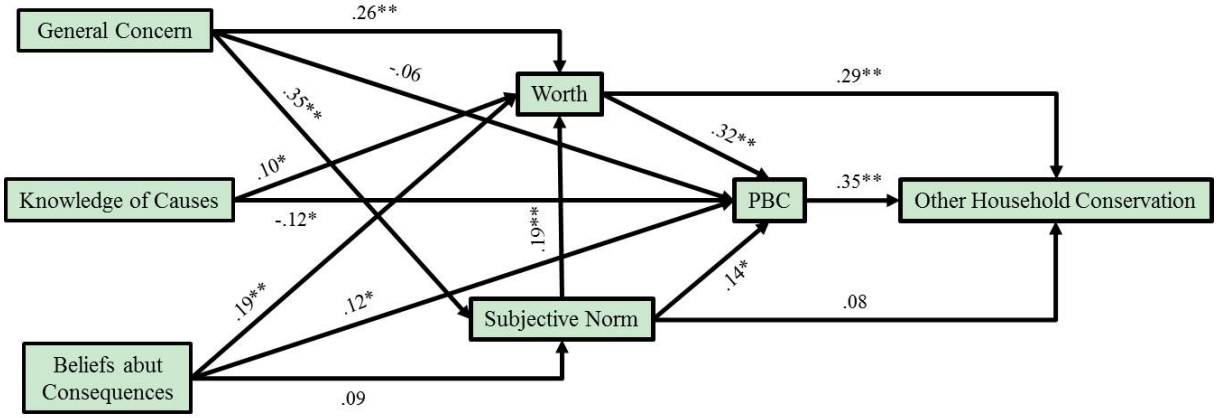

Figure 2. Path Model with standardized path coefficients for variables directly and indirectly predicting other household energy conservation

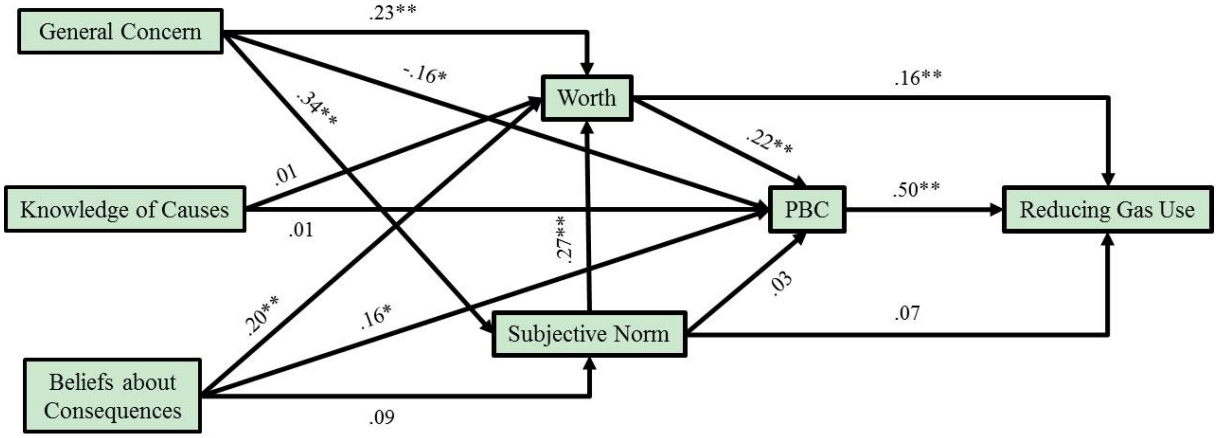

Figure 3. Path model with standardized path coefficients for variables directly and indirectly predicting reducing gas consumption

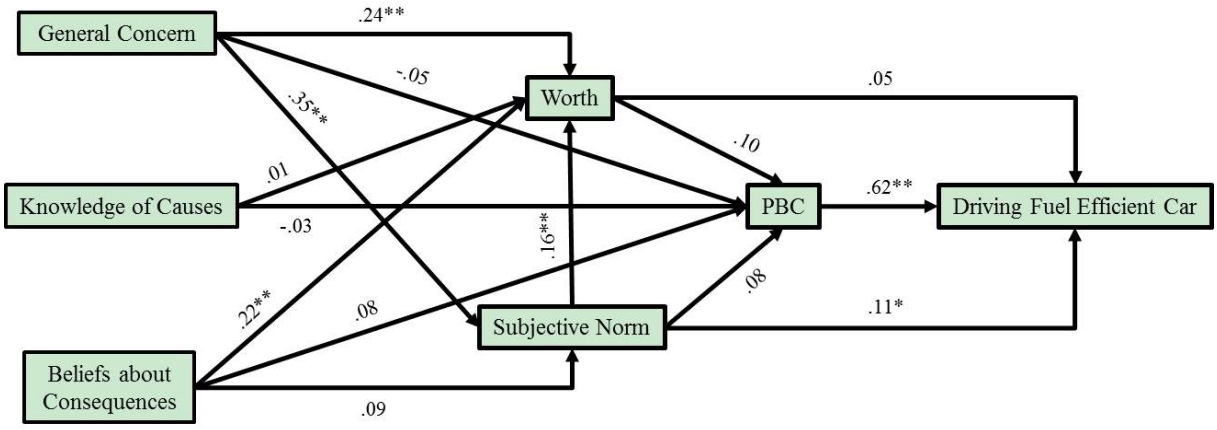

Figure 4. Path model with standardized path coefficients for variables directly and indirectly predicting driving a fuel efficient car

In the current study, we examined four distinct conservation behaviors in order to assess the generalizability of our findings to the processes underlying engagement in these behaviors rather than simply to performance of a particular behavior, as the relative strength of predictors of energy conservation may differ across behaviors. Effective interventions have been found to differ for different Environmentally Responsible Behaviors (ERB) (Osbaldiston & Schott, 2012) and some research on ERB suggests that predictors may differ depending on the degree to which the behavior is high or low in "cost" in money, effort, or time (Black, Stern, & Elsworth, 1985; Collins & Chambers, 2005; Guagnano, Stern, & Dietz, 1995; Schultz & Oskamp, 1996). The four behaviors examined in the present study were regulating household temperature, conserving household energy in other ways, reducing gas consumption by driving less, and driving a fuel-efficient car.

The TPB has been found to be a useful theoretical framework for predicting behaviors related to some of these areas of ERB. The present research extends the findings of earlier TPB studies. We separately examine, in one sample, a set of behaviors that are related to each other and fall under the large umbrella of energy conservation, but are also distinct from each other. We examine whether predictive patterns are consistent across behaviors. The present research also extends prior findings of indirect relationships within the TPB as it is applied to environmental behaviors; we extend these findings to new behaviors, and test predictors of TPB constructs that have not been previously tested. Understanding the factors that predict diverse types of energy conservation, which as stated above may be low priority individual behaviors, may aid in developing appropriate policies and interventions.

1.1 Theory of Planned Behavior

The TPB (Ajzen, 1985; 1991; 2002) proposes that behavior is based on a rational decision process that is guided by a set of beliefs about the specific behavior in question. The beliefs generate three factors that determine intentions to perform a behavior: 1) attitude toward the behavior, 2) subjective norm, and 3) perceived behavioral control (PBC). Attitude toward the behavior refers to the subjective value of the perceived outcome of the behavior. It stems from beliefs about the likelihood and degree of particular outcomes, as well as from the evaluation of these outcomes.

Subjective norm refers to perceived social pressure to perform the behavior. Subjective norms arise from beliefs about the normative expectations and behaviors of others, i.e., beliefs about the degree to which important others would approve or disapprove of the behavior, and in extensions of TPB, beliefs about the degree to which important others themselves perform the behavior in question (Grube, Morgan, & McGree, 1986; Warburton & Terry, 2000). These beliefs are also thought to be a function of the motivation to comply with these social pressures and act in accordance with the referent (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975).

PBC refers to perceptions of the freedom to perform the behavior and the ease of performing the behavior. In contrast to attitude, which is based on the expected *outcome* of the behavior, PBC relates to beliefs about performing the behavior itself. PBC arises from beliefs about the presence of internal or external variables that may aid or hinder performance and the perceived power of these variables. These variables include a self-assessment of the possession of information, abilities, skills, time, and opportunity necessary for performing the behavior, as well as assessment of external aids or barriers to behavioral engagement (Ajzen, 2002).

According to the TPB, attitude, subjective norm, and PBC determine intentions to perform a behavior, and intentions are the direct antecedent of performing the behavior (Ajzen, 1988; 1991). Thus, the relationships between the antecedents of intentions and behavior will be mediated by intentions. However, some studies have found support for direct relationships between the three TPB variables and a target behavior (e.g., Ajzen & Driver, 1992; Bentler & Speckart, 1979; Katz, 2001 and see others below). Additionally, in the TPB, the relative importance of each of the three determinants in the prediction of intentions or behavior varies across behaviors and contexts (Ajzen, 1991). Finally, a variety of exogenous variables, including social and demographic variables and personality characteristics, are thought to affect behavior through their influence on the antecedents of intentions presented in the model (Ajzen & Fishbein, 1980). As will be seen below (section 1.3) these antecedents of intentions may also mediate exogenous variables that are specifically related to knowledge, beliefs, and concern about environmental problems.

1.2 TPB and Energy Conservation

The TPB and related constructs have been used in the prediction of many behaviors (e.g., Ajzen, 2001; Ajzen & Fishbein, 1980; Armitage & Conner, 2001), including a plethora of ERB (e.g., Aguilar-Luzon, Garcia-Martinez, Calvo-Salguero, & Salinas, 2012; Bamberg, 2003; Bamberg & Moser, 2007; Chao, 2012; Fielding, McDonald, & Louis, 2008; Kaiser & Gutscher, 2003). For example, in a meta-analysis of research on a wide range of ERB Bamberg & Moser (2007) tested a theoretical model that integrated TPB variables with other variables. Two TPB variables, PBC and attitude, were each independent direct predictors of intention to engage in ERB, and intention in turn predicted behavior. Further, although subjective norm was not directly related to intention, it was related to each of the other proximal variables.

Our interests in this research focus on a subset of ERB, namely behaviors that conserve energy. Two primary ways people use energy in their everyday lives are through transportation and household energy consumption. The TPB has been found to be a useful theoretical framework for predicting behaviors related to both of these areas, though there is substantially more research related to transportation than to household energy use.

1.2.1 TPB and Transportation

Transportation is energy intensive, and it is the area where perhaps the most energy can be conserved by individuals (Dietz, Gardner, Gilligan, Stern, & Vandenburgh, 2009). There are two ways to conserve energy when considering transportation behaviors. First, people can elect to drive less. Researchers have studied this behavior from two complementary perspectives: using public transportation and frequency of car use. Second, people can elect to drive a more fuel efficient vehicle. They do not drive less miles, but the miles that they do travel consume fewer gallons of gasoline. Evidence for the relationship between TPB variables and intentions to use public transportation is strong. For example, two studies looking at the intention to use, and actual use of, a bus by university students examined TPB variables and the effect of an intervention, namely pre-paid bus passes (Bamberg, Ajzen, & Schmidt, 2003; Heath & Gifford, 2002). In both studies, TPB variables significantly predicted intention, which in turn predicted bus use, both before and after the intervention, and TPB variables mediated the effects of the intervention. Similarly, in a model that included TPB variables as predictors of intention to use, and actual use of, public transportation (Bamberg, Hunecke, & Blobaum, 2007), PBC and attitude predicted intention, and intention mediated their relation with behavior.

Largely similar results have been found in studies of car use. TPB variables (especially PBC) predicted intentions to limit car use and reduce driving speed (Kaiser & Gutscher, 2003), and PBC over *reducing* car use was a strong negative predictor of actual car use (Abrahamse, Steg, Gifford, & Vlek, 2009). Similarly, a meta-analysis of 23 studies of car use (Gardner & Abraham, 2008) found that all TPB variables measured with respect to "non-car use" negatively predicted intention to drive, and, with the exception of subjective norm, also negatively predicted actual driving behavior. PBC over non-car use was the variable most strongly (negatively) related to both actual car use and intentions.

The second method of conserving fuel when driving involves using less fuel per distance travelled, or driving a more fuel-efficient vehicle. Despite the availability of many fuel-efficient cars, a lack of research leaves open the question of whether the TPB constructs predict use of fuel-efficient vehicles.

1.2.2 TPB and Household Energy Conservation

TPB has also been found to predict energy conservation intentions and behaviors in the household, though fewer studies are available in this area. Attitude and subjective norm significantly predicted intentions to engage in the general behavior "conserve energy" (Laudenslager, Holt, & Lofgren, 2004), and all TPB variables significantly predicted intention toward a specific type of energy savings, namely, use of energy-saving light bulbs (Harland,

Staats, & Wilke,1999). Finally, Abrahamse and Steg (2009) found that the TPB variables attitude and PBC predicted household energy use, and PBC also predicted indirect energy savings after an intervention. Ajzen, Joyce, Sheikh, and Cote (2011) also found a relation between TPB variables and energy conservation, though their conservation measure was a composite of household energy use, transportation, and energy-related activism.

Finally, the positive effects of experimental interventions on household energy conservation (reviewed by Abrahamse, Steg, Vlek, & Rothengatter, 2005) may in some cases be seen as supportive of the TPB model. Specifically, making a commitment to engage in a new behavior, and setting goals, may be effective because such pre-planning increases perceptions of control. Similarly, modeling energy conservation may be effective because it increases subjective norms (e.g., Aronson, 1990; Costanzo, Archer, Aronson, & Pettigrew, 1986).

1.2.3 Hypothesis 1

Taken together, the findings discussed above indicate that TPB constructs, most consistently PBC and attitude, are effective predictors of intentions to conserve energy in various ways (and in some cases are direct predictors of behavior), though the greatest body of evidence has come from studies on amount of driving, with no prior research on use of fuel efficient cars, and relatively few studies on household energy use. The reported findings are consistent with theoretical models of motivation for ERB in general (Pelletier, Dion, Tuson, & Green-Demers, 1999), and for actions to mitigate global warming specifically (Frantz & Mayer, 2009). According to these models, in order to engage in ERB, among other things, people must believe they have the ability and resources to engage in the relevant behavior, and as emphasized by Pelletier et al. (1999), the ability to sustain the effort needed for the behavior. PBC is a measure of such beliefs and thus the predictive value of PBC supports these models.

Further, these models argue that people must believe that their efforts will be effective in reducing environmental problems (see also Huebner & Lipsey, 1981, who found that believing actions made a difference was a predictor of environmental activism). The predictive value of attitude in the above studies supports this proposal to the extent that the measures of attitude reflect people's belief that the ERB will be effective.

In the present study we hypothesize that TPB constructs will be positively related to the reported frequency of recent engagement in four distinct types of energy conservation. Although various studies have examined TPB with respect to diverse forms of energy conservation, some behaviors have been more extensively tested than others, and no prior study has separately tested TPB with respect to different types of energy conservation in one sample. The relative strength of predictors of energy conservation may differ across behaviors, and comparisons across behaviors will be most straightforward when they are examined within a single study. Our study also expands on previous research by looking at the predictive value of a measure of attitude that is more specified than the often-used ratings of whether the target behavior is "good-bad." Given Azen's (1991, 2002) conceptualization of attitude as specifically related to beliefs about the likelihood and value of outcomes related to the behavior (as opposed to beliefs about the performance of a behavior itself), and given our focus on behaviors relevant to climate change, our measure of attitude toward each behavior asked subjects specifically to assess whether the behavior is worthwhile in the effort to solve the problem of climate change. Thus our attitude measure (referred to as "worth" in regard to the findings of the present study) targeted a specific outcome expectation.

1.3 Variables That Predict TPB Constructs

TPB constructs have been found to mediate the relationship between a host of other variables and ERB (e.g., Bamberg & Moser, 2007). In Bamberg and Moser's meta-analysis of a variety of ERB, their variable "problem awareness" had multiple indirect effects via TPB variables. Bamberg and Moser (2007) did not report how problem awareness was operationalized, but all other variables, including performing the behavior, were either directly or indirectly derived from problem awareness, and the authors pointed out that the total effects of this variable (direct and indirect effects on the several variables included) were substantial. We see two factors that can comprise the broad concept of problem awareness: 1) general environmental concern; and 2) knowledge and beliefs about environmental problems. Each of these factors could potentially impact TPB constructs.

1.3.1 Environmental Concern

Evidence that responses to TPB measures are shaped by general environmental concern comes from studies showing that TPB variables mediate the relationship between environmental concern and intentions or actual behaviors. In the sphere of public transportation, environmental concern has been found to predict attitude, which in turn predicted intentions (Collins & Chambers, 2005; De Groot & Steg, 2007; Gardner & Abraham,

2010). Further, a study of using a "green electricity" brochure (Bamberg, 2003) found that environmental concern did not directly predict intention, but predicted perceptions of subjective norms and perceived control over the target behavior (i.e., individuals who were more concerned perceived fewer obstacles to completing the behavior). The TPB constructs in turn predicted intention to complete the behavior.

1.3.2 Knowledge of Environmental Problems

While environmental concern may reflect a motivational or emotional component of problem awareness, measures of problem awareness can also assess factual knowledge about environmental problems and behaviors that affect these problems. A common first assumption of policy makers and educators is that educating people about environmental problems can induce ERB. However, support for this hypothesis is inconsistent. In fact, the link between knowledge and behavior is so tenuous that it has been nicknamed "the gap" (for an overview of this research, see Kollmuss & Agyeman, 2002). Interventions to increase knowledge about environmental problems have had limited or inconsistent effects on behavior (Osbaldiston & Schott, 2012). Further, although some findings show a positive relationship between environmental knowledge and behavioral intentions (e.g., Fielding & Head, 2012; Kaiser, Wolfing, & Fuhrer, 1999; Meinhold & Malkus, 2005; Mobley, Vagias, & DeWard, 2010), other findings, in particular those that examine behaviors related to energy conservation, indicate that knowledge is a weak predictor at best, especially in comparison with TPB variables (e.g. Abrahamse et al., 2009; Nilsson & Kuller, 2000). Ajzen et al. (2011) found no relation between environmental knowledge and energy conservation intentions or behavior.

As with environmental concern, environmental knowledge may have indirect effects via relationships with TPB variables. Although Ajzen et al. (2011) found neither direct nor indirect effects of environmental knowledge, Bamberg et al. (2007) found that awareness that environmental problems are associated with cars was a predictor of attitude and PBC over use of public transportation, which in turn predicted intentions to use public transportation. One distinction between the studies by Ajzen et al. and Bamberg et al. is in the specificity of the measure of environmental knowledge. Ajzen et al. used a broad survey of environmental knowledge, whereas Bamberg et al. specifically measured awareness of problems associated with car use (the studies also differed in the specificity of the target behavior: a composite measure of multiple types of energy conservation vs. use of public transportation).

In understanding the possible indirect effects of environmental knowledge it may be important to examine specific types of knowledge. Three large surveys of knowledge of global warming suggest that this is an important avenue to pursue (Heath & Gifford, 2006; O'Connor, Bord & Fisher, 1999; O'Connor, Bord, Yarnal, & Wiefek, 2002). Researchers assessed knowledge of the causes of global warming, likelihood judgments of negative consequences of global warming, and the belief that climate change is occurring. These studies did not employ the TPB framework, but in each case at least one type of global-warming knowledge was significantly related to attitude toward mitigation behaviors and to mitigation intentions. Since these studies did not look at meditational relationships with TPB variables, an interesting question is whether knowledge and beliefs about global warming have indirect effects via constructs in the TPB framework.

1.3.3 Hypothesis 2

We have seen that environmental concern, and in some cases environmental knowledge, may be related to energy conservation via relationships with TPB variables. Such mediation is in line with the principle of compatibility, which suggests that predictor variables will be most directly related to behavior when they are assessed at the same level of specificity as the behavior in terms of specific actions, context or time frame (Ajzen & Fishbein, 1977). Thus, the relatively specific situation-level variables such as the antecedents of intentions in the TPB (attitudes, subjective norm, and perceptions of control over the target behavior) will be more direct predictors of intention and behavior than will contextual variables such as environmental concern and knowledge, which are conceptually more general.

However, these more generalized constructs may be useful in the prediction of TPB constructs (e.g., Bamberg, 2003; Hagger & Armitage, 2004), demonstrating indirect relationships between these contextual-level factors and intentions or frequency of engaging in a specific ERB. For example, perceived control is not only based on objective realities, but also on subjective assessment of those realities, and this assessment can be guided by contextual level variables. As stated above, Bamberg (2003) found that TPB variables mediated concern in the prediction of intention to engage in the target behavior, and he demonstrated that environmental concern directly predicted situation specific beliefs that govern the TPB variables. He argued that environmental concern guides the perception of a situation, such that this perception becomes congruent with the general attitude.

In the present study, we further explore indirect effects of problem awareness variables via TPB constructs.

Specifically, we hypothesize that TPB variables will mediate the relationship between environmental concern and each of our four conservation behaviors. We also look at indirect effects of a specific type of environmental knowledge: knowledge and beliefs related to global warming. Specifically, we hypothesize that TPB variables will mediate the relationship of knowledge of the causes of global warming, and beliefs about the consequences of global warming, to each of our four conservation behaviors. This is the first study that we know of that seeks to integrate TPB variables with climate change knowledge and beliefs.

1.3.4 Hypothesis 3

The previous hypothesis concerns the indirect effects of contextual variables on ERB via TPB variables. We further propose that there will be indirect relationships among TPB constructs themselves in predicting energy conservation. First, while subjective norm is not consistently found to be a direct predictor of ERB intentions when other variables are controlled, some studies have found that subjective norm predicts attitude and PBC (Bamberg & Moser, 2007; Bamberg et al., 2007). If important others support and model a behavior, this suggests they have a positive attitude toward this behavior (i.e., they value the expected outcomes of the behavior), and presumably one's own attitude is influenced by the attitude of important others. Further, if important others encourage and model a particular behavior then obstacles to that behavior may be perceived as fewer or less onerous (e.g., people may assume that if others encourage and use public transportation, then using public transportation must not be that difficult). Thus we predict that PBC and attitude will mediate the relationship between subjective norm and each of our four types of energy conservation.

Second, we propose that behavior-specific attitude might have indirect effects on energy conservation via PBC. As stated above, Bamberg (2003) found that the general attitude variable, environmental concern, predicted PBC over use of a green electricity brochure, which mediated the relationship between concern and intention. We propose that behavior-specific attitude may work in the same way. Thus, we attempt to extend Bamberg's findings and proposals for general attitude to behavior-specific attitude; just as general environmental concern can guide perception of control over a target behavior as discussed above, so may attitude toward the specific behavior. For example, individuals with a positive attitude toward lowering household temperature (i.e., they value the expected outcomes) may perceive fewer obstacles to this behavior. Thus, we hypothesize that PBC will at least partially mediate the relationship between attitude and energy conservation. Although previous research has examined the indirect effect of the exogenous variable, general environmental concern, via PBC, prior research with environmental behaviors has not examined the mediation of behavior-specific attitude by PBC.

1.4 Summary of Hypotheses

Using a survey design we examined factors that predict four distinct types of energy conservation among college students. As stated above we have three sets of predictions:

Hypothesis 1: The reported frequency of recent engagement in four distinct types of energy conservation will be positively related to constructs identified by TPB.

Hypothesis 2: TPB variables will mediate the relationships between general environmental concern, knowledge of the causes of global warming, and beliefs about the consequences of global warming, and each of our four energy conservation behaviors.

Hypothesis 3: We expect mediating relationships among TPB variables: (a) PBC and attitude will mediate the relationship between subjective norm and energy conservation, and (b) PBC will mediate the relationship between attitude and energy conservation.

2. Method

We examined our hypotheses with a multi-part online survey given to college students. Initial parts of the survey measured general environmental concern, knowledge of causes of global warming, beliefs about the consequences of global warming, and subjective norms related to energy conservation. Following the assessment of these variables, perceived worth (attitude), perceived behavioral control, and self-reported frequency were each assessed with respect to four specific behaviors: (a) conserving household (or dorm room) energy via temperature regulation; (b) conserving household (or dorm room) energy in other ways (e.g., turning off lights, appliances, computers, reducing hot water usage, buying compact fluorescent bulbs); (c) reducing gas consumption by carpooling, combining trips, biking, walking or using public transportation; (d) owning or driving a fuel-efficient car. Given that many individuals in the current study are already engaging in the target behaviors, antecedent-behavior relationships (based on self-report of recent activities), rather than antecedent-intention relationships, were examined.

2.1 Participants

Participants were 405 undergraduate psychology students at a southeastern university in the United States who received course credit for completing the survey.

2.2 Measures and Procedure

2.2.1 General Environmental Concern

Five items adapted from Franzen (2003) assessed concern about environmental issues. An example item is, "*We worry too much about the future of the environment*" (reverse coded). A sixth item was added and asked specifically about global warming, "*I am worried about global warming*." Subjects rated their agreement with each item on a 6-point scale (1 = Strongly Disagree to 6 = Strongly Agree). Based on an examination of Cronbach's alpha reliability coefficient and inter-item correlations, one item was removed from this scale. A composite "concern" score was created by summing remaining items.

2.2.2 Knowledge of Causes of Global Warming

Awareness of the causes of global warming was assessed with 13 "true-false" items (11 were true). (Fourteen "causes" items were present, but one item was subsequently judged to be an invalid measure). Instructions stated: *Scientific data indicate that the earth's climate is heating up due to the build up of "green house" gasses in the atmosphere. Regardless of whether you know a lot about global warming, please indicate whether you think each of the following factors is a cause of global warming.* An example "true" item was "*Emissions from power plants using fossil fuels."* An example "false" item was "*Pesticides in the food chain."* A composite score was created by summing correct responses.

2.2.3 Beliefs about Consequences of Global Warming

Beliefs about the negative consequences of global warming were assessed with 12 items asserting consequences for the world in general (e.g., "*There will be an increase in severe droughts"*), and three items asserting personal consequences (e.g., *"Food shortages will occur in my area"*). Following O'Conner, Bord, and Fisher (1999), items were rated on a 5-point scale (1 = Very Unlikely to 5 = Very likely). A composite score was created by averaging all items.

2.2.4 Subjective Norms Related to Energy Conservation

Two items assessed whether important others would support the participant's environmentally motivated energy conservation efforts, and a third item assessed whether important others themselves engage in environmentally motivated conservation behaviors. Items were: "*In general, people who are important to me would support my efforts to conserve energy for environmental reasons," "In general, people who are important to me think I should conserve energy for environmental reasons,"* and *"In general, people who are important to me take steps to conserve energy for environmental reasons."* Subjects rated their agreement with these statements on a 6-point scale (1 = Strongly Disagree to 6 = Strongly Agree). A composite score was created by summing the three items.

2.2.5 Perceived Behavioral Control

Subjects read the following preliminary paragraph: *Several ways for people to reduce energy consumption have been recommended. Although these behaviors might be wise and important to do, we may have obstacles to carrying out the behaviors, or there may be factors that reduce the likelihood we will carry out the behaviors. For example, we may face practical obstacles to conserving energy that are related to freedom, time, money, effort required, access, or know-how."* Subjects were then told to think about the past month and to rate their freedom to carry out each behavior. Instructions stated *"Rate the degree to which you had the FREEDOM to do the behaviors mentioned. That is, rate the degree to which these behaviors were under your own control."* Following from the stem, "*My freedom to ……in the past month was:"* subjects rated each behavior on six point scale: 1 = Very Low (I had very little Control) to 6 = Very High (I had Complete Control). Finally subjects were instructed: *"The next four items concern the DIFFICULTY OR EASE of carrying out energy conservation behavior.* Following the stem, "*For me to ……. in the past month would have been:"* subjects rated each behavior on a scale ranging from 1 = Extremely Difficult to 6 = Extremely Easy). For each behavior, a Perceived Behavioral Control score was created by multiplying responses to the freedom item and ease item. We multiplied rather than added the two items because the variables of freedom and ease are probably more interactive than merely summative.

2.2.6 Worth (Attitude Toward The Behavior)

Subjects were asked to *"rate the degree to which you believe each of the following behaviors is worthwhile IN THE EFFORT TO SOLVE THE PROBLEM OF CLIMATE CHANGE."* (Capitalization was present in the actual

item). Ratings were '1' = Extremely Worthless to '6' = Extremely Worthwhile. Consistent with Ajzen's conceptualization of attitude (1991, 2002), our measure targets expectations about a specific outcome (solving climate change).

2.2.7 Frequency of Energy Conservation Behaviors

For each behavior, subjects rated (1 = Never, 6 = Very Often) the frequency with which they *"Made a deliberate attempt to…"* engage in the behavior in the past month.

3. Results

Means, standard deviations, internal consistency reliability estimates, and inter-correlations for study measures are reported in Table 1. To examine our hypotheses, structural models (see Figures 1 - 4) were tested to estimate the direct and indirect effects of the hypothesized predictor variables on each of the four behaviors using AMOS 21 (Arbuckle, 2012). The variables included in the structural models and the proposed directions of causality are based on previous research and our theorizing as presented above. To assess model fit, in addition to the chi-square statistic, we examined the comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR) fit indices. A non-significant chi-square value, a CFI value of .95 or greater, a RMSEA value of .06 or lower, and a SRMR value of .08 or lower indicate good model fit (Hu & Bentler, 1998).

Table 1. Means, standard deviations, reliabilities and correlations for study variables

	M	*SD*	1	2	3	4	5	6	7	8	9	10
1. General Concern	19.11	5.02	(.79)									
2. Causes	8.53	2.23	.32**	(.54)								
3. Consequences	3.30	.83	.58**	.37**	(.94)							
4. Subjective Norm	10.6	3.6	.40**	.17**	.30**	(.87)						
5. Worth Behavior 1	4.4	1.4	.48**	.27**	.38**	.39**						
6. Worth Behavior 2	4.7	1.3	.48**	.29**	.43**	.37**	.79**					
7. Worth Behavior 3	4.8	1.4	.46**	.21**	.42**	.42**	.63**	.71**				
8. Worth Behavior 4	4.7	1.5	.43**	.19**	.40**	.32**	.54**	.60**	78**			
9. PBC Behavior 1	16.8	11.1	.18**	-.02	.17**	.27**	.34**	.29**	25**	.15**	(.77)	
10. PBC Behavior 2	22.7	9.7	.18**	.02	.22**	.25**	.31**	.36**	34**	.23**	.63**	(.67)
11. PBC Behavior 3	15.2	10.7	.05**	.07	.17**	.11*	.12**	.16**	23**	.09	.27**	.37**
12. PBC Behavior 4	9.97	10.6	.06**	.01	.10**	.10*	.12**	.07	11*	.13*	.24**	.17**
13. Behavior 1	3.8	1.6	.35**	.13**	.23**	.35**	.47**	.36**	27**	.21**	.50**	.36**
14. Behavior 2	4.4	1.4	.30**	.11*	.28**	.27**	.36**	.44**	37**	.28**	.31**	.47**
15. Behavior 3	3.4	1.6	.22**	.05	.25**	.19**	.15**	.22**	31**	.17**	.15**	.17**
16. Behavior 4	2.5	1.6	.12*	.06	.08	.19**	.10*	.04	.09	.16**	.10	.04

Table 1. Continued

	11	12	13	14	15
1. General Concern					
2. Causes					
3. Consequences					
4. Subjective Norm					
5. Worth Behavior 1					
6. Worth Behavior 2					
7. Worth Behavior 3					
8. Worth Behavior 4					
9. PBC Behavior 1					
10. PBC Behavior 2					
11. PBC Behavior 3	(.74)				
12. PBC Behavior 4	.25**	(.78)			
13. Behavior 1	.06	.19**			
14. Behavior 2	.11*	.12*	.61**		
15. Behavior 3	.54**	.14**	.26**	.35**	
16. Behavior 4	.09	.64**	.26**	.15**	.30**

Notes. N = 405. Coefficient alphas reported on the diagonal for all composite variables.

* $p < .05$, ** $p < .01$.

For each behavior, to test Hypotheses 2 and 3 (testing for indirect effects), maximum likelihood bootstrapping was used to estimate standard errors and confidence intervals (95%) for all relevant indirect, direct, and total effects (5,000 samples were drawn). However, this bootstrapping technique for estimating indirect effects is an omnibus test and, in the instances where multiple mediators were proposed, does not provide detail on which construct(s) is serving as the mediator. In these instances, in order to identify which construct(s) serve a mediational role, we conducted multiple-mediation analyses using procedures outlined by Preacher and Hayes (2008). Tables 2 and 3 present the results of the bootstrapping and multiple mediation analyses.

Table 2. Standardized indirect, direct, and total effects for general concern and beliefs about consequences (Hypothesis 2); bootstrapping used to estimate S.E. and C.I.

Behavior 1:		Predictors					
Temperature Regulation		General Concern			Beliefs about Consequences		
Outcomes	Effect	Indirect	Direct	Total	Indirect	Direct	Total
Subjective Norm	Estimate	--	.35	.35	--	.09	.09
	S.E.	--	.06	.06	--	.07	.07
	95% C.I.	--	(.24/.46)	(.24/.46)	--	(-.04/.22)	(-.04/.22)
Worth	Estimate	--	.30	.38	--	.11	.13
	S.E.	--	.05	.05	--	.06	.06
	95% C.I.	--	(.19/.41)	(.26/.48)	--	(-.01/.22)	(.00/.24)
PBC	Estimate	--	-.03	.14	--	.07	.13
	S.E.	--	.06	.06	--	.06	.06
	95% C.I.	--	(-.15/.10)	(.03/.26)	--	(-.04/.18)	(.01/.25)
Regulate Temperature	Estimate	.21	--	.21	.10	--	.10
	S.E.	.04	--	.04	.04	--	.04
	95% C.I.	(.13/.29)	--	(.13/.29)	(.02/.17)	--	(.02/.17)
Behavior 2:		Predictors					
Other Household Energy		General Concern			Beliefs about Consequences		
Outcomes	Effect	Indirect	Direct	Total	Indirect	Direct	Total
Subjective Norm	Estimate	--	.35	.35	--	.09	.09
	S.E.	--	.06	.06	--	.07	.07
	95% C.I.	--	(.24/.46)	(.24/.46)	--	(-.04/.22)	(-.04/.22)
Worth	Estimate	--	.26	.33	--	.19	.21
	S.E.	--	.06	.05	--	.06	.06
	95% C.I.	--	(.15/.37)	(.23/.43)	--	(.08/.29)	(.09/.31)
PBC	Estimate	--	-.06	.09	--	.12	.20
	S.E.	--	.06	.06	--	.06	.06
	95% C.I.	--	(-.18/.06)	(-.03/.21)	--	(.00/.23)	(.07/.32)
Other Household Energy Conservation	Estimate	.15	--	.15	.14	--	.14
	S.E.	.04	--	.04	.04	--	.04
	95% C.I.	(.08/.23)	--	(.08/.23)	(.07/.21)	--	(.07/.21)

Table 2. Continued

Behavior 3:		Predictors					
Reduce Gas Consumption		General Concern			Beliefs about Consequences		
Outcomes	Effect	Indirect	Direct	Total	Indirect	Direct	Total
Subjective Norm	Estimate	--	.35	.35	--	.09	.09
	S.E.	--	.06	.06	--	.07	.07
	95% C.I.	--	(.24/.46)	(.24/.46)	--	(-.04/.22)	(-.04/.22)
Worth	Estimate	--	.23	.33	--	.21	.23
	S.E.	--	.05	.05	--	.06	.06
	95% C.I.	--	(.12/.34)	(.22/.42)	--	(.09/.31)	(.11/.34)
PBC	Estimate	--	-.17	-.08	--	.16	.21
	S.E.	--	.07	.07	--	.07	.07
	95% C.I.	--	(-.29/-.03)	(-.21/.05)	--	(.03/.29)	(.09/.34)
Reducing Gas Use	Estimate	.04	--	.04	.15	--	.15
	S.E.	.04	--	.04	.04	--	.04
	95% C.I.	(-.04/.12)	--	(-.04/.12)	(.07/.22)	--	(.07/.22)
Behavior 4:		Predictors					
Drive Fuel Efficient Car		General Concern			Beliefs about Consequences		
Outcomes	Effect	Indirect	Direct	Total	Indirect	Direct	Total
Subjective Norm	Estimate	--	.35	.35	--	.09	.09
	S.E.	--	.06	.06	--	.07	.07
	95% C.I.	--	(.24/.46)	(.24/.46)	--	(-.04/.22)	(-.04/.22)
Worth	Estimate	--	.24	.29	--	.21	.23
	S.E.	--	.06	.06	--	.06	.06
	95% C.I.	--	(.12/.36)	(.18/.40)	--	(.11/.33)	(.12/.34)
PBC	Estimate	--	-.04	.00	--	.08	.11
	S.E.	--	.08	.07	--	.07	.07
	95% C.I.	--	(-.21/.09)	(-.14/.14)	--	(-.06/.22)	(-.03/.25)
Drive Fuel Efficient Car	Estimate	.05	--	.05	.09	--	.09
	S.E.	.05	--	.05	.05	--	.05
	95% C.I.	(-.04/.15)	--	(-.04/.15)	(.00/.19)	--	(.00/.19)

Note: Maximum likelihood bootstrapping was used with bias-corrected confidence intervals; 5,000 samples were drawn. S.E. = standard errors; C.I. = confidence intervals; PBC = perceived behavioral control. All S.E. and C.I. reported are based on the bootstrapping results.

Table 3. Multiple mediation test of indirect effects of general environmental concern and beliefs about consequences (Hypothesis 2)

Behavior 1: Temperature Regulation		
Direct Effects	General Environmental Concern	Beliefs about Consequences
Predictor → Subjective Norm	.28**	1.26**
Predictor → Worth	.14**	.66**
Predictor → PBC	.40**	2.22**
Subjective Norm → Regulate Temperature	.05*	.06**
Worth → Regulate Temperature	.27**	.31**
PBC → Regulate Temperature	.05*	.05**
Indirect Effects of Predictor on Regulate Temperature via:		
Subjective Norm	.01*	.08**
Worth	.04**	.21**
PBC	.02*	.11**
Total Indirect Effect	.07**	.40**
Total Effect of Predictor on Regulate Temperature (c)	.10**	.44**
Direct Effect of Predictor on Regulate Temperature (c')	.03*	.04
Model Summary		
$F(4, 400)$	60.45**	58.08**
R^2	.38	.37
Behavior 2: Other Household Energy Conservation		
Direct Effects	General Environmental Concern	Beliefs about Consequences
Predictor → Subjective Norm	.28**	1.26**
Predictor → Worth	.13**	.68**
Predictor → PBC	.34**	2.52**
Subjective Norm → Other Household Energy	.02	.03
Worth → Other Household Energy	.27**	.28**
PBC → Other Household Energy	.05**	.05**
Indirect Effects of Predictor on Household Energy via:		
Subjective Norm	.01	.04
Worth	.03**	.19**
PBC	.02**	.13**
Total Indirect Effect	.06**	.35**
Total Effect of Predictor on Household Energy (c)	.08**	.46**
Direct Effect of Predictor on Household Energy (c')	.02	.11
Model Summary		
$F(4, 400)$	47.06**	46.45**
R^2	.32	.32

Table 3. Continued

Behavior 3: Reduce Gas Consumption		
Direct Effects	General Environmental Concern	Beliefs about Consequences
Predictor → Subjective Norm	x	1.26**
Predictor → Worth	x	.69**
Predictor → PBC	x	2.21**
Subjective Norm → Reducing Gas	x	.02
Worth → Reducing Gas	x	.15**
PBC → Reducing Gas	x	.07**
Indirect Effects of Predictor on Reducing Gas via:		
Subjective Norm	x	.03
Worth	x	.10*
PBC	x	.16**
Total Indirect Effect	x	.29**
Total Effect of Predictor on Reducing Gas (c)	x	.47**
Direct Effect of Predictor on Reducing Gas (c')	x	.18*
Model Summary		
$F(5, 399)$	x	51.84**
R^2	x	.34

Note: Unstandardized OLS coefficients are reported based on procedures recommended by Preacher and Hayes (2008); 5,000 samples were drawn. PBC = perceived behavioral control.

* $p < .05$; ** $p < .01$

In sections 3.1 through 3.4 we describe in detail the results for each hypothesis for each behavior. Table 4 presents an overview of these results.

Table 4. Overview of hypotheses and results for each conservation behavior

	Temp. Reg.	Other Household Energy	Reduce Gas	Fuel Efficient Car
Hypothesis:				
H1: The four energy conservation behaviors will be positively related to:				
Subjective Norm	**s**	ns	ns	**s**
Worth	**s**	**s**	**s**	ns
PBC	**s**	**s**	**s**	**s**
H2: TPB variables will mediate the relationships between general environmental concern, and knowledge of the causes and consequences of global warming, and each of the four energy conservation behaviors:				
General Environmental Concern				
Subjective Norm	**s**	ns	ns	ns
Worth	**s**	**s**	ns	ns
PBC	**s**	**s**	ns	ns
Knowledge of Causes of Global Warming				
Subjective Norm	ns	ns	ns	ns
Worth	ns	ns	ns	ns
PBC	ns	ns	ns	ns
Beliefs about Consequences of Global Warming				
Subjective Norm	**s**	ns	ns	ns
Worth	**s**	**s**	**s**	ns
PBC	**s**	**s**	**s**	ns
H3a: PBC and Attitude will partially mediate the relationship between subjective norms and each type of energy conservation:				
Worth	**s**	**s**	**s**	ns
PBC	**s**	**s**	ns	ns
H3b: PBC will partially mediate the relationship between attitude and each energy conservation behavior:	**s**	**s**	**s**	ns

Note. s = Hypothesis supported, ns = Hypothesis not supported.

3.1 Conserving Energy via Temperature Regulation

For the first behavior (conserving energy via temperature regulation), the structural model demonstrated excellent fit [$\chi^2_{(4)} = 7.75$, $p = .10$, CFI = .99, RMSEA = .05, SRMR = .02]. Standardized path coefficients are reported in Figure 1. As predicted, the three TPB constructs were positively related to the reported frequency of this behavior, supporting Hypothesis 1.

In order to test Hypothesis 2, we examined the indirect effects of the problem awareness variables via TPB variables on conservation via temperature regulation. For this and all other behaviors, knowledge of causes had no significant indirect effects, however, both general environmental concern and beliefs about consequences had significant indirect effects on the behavior, providing initial partial support for Hypothesis 2.The results of the bootstrapping analyses are reported in Table 2. General concern demonstrated a standardized indirect effect

of .21 (p = .00), and beliefs about consequences had an indirect effect of .10 (p = .01). Thus, when general concern increases by one standard deviation, the reported frequency of conserving energy via temperature regulation increases by .21 standard deviations.

In order to identify which TPB construct(s) serve a mediational role, we conducted multiple-mediation analyses as described above. To examine the indirect effect of general concern, the behavior was regressed onto general concern, with the TPB variables entered as mediators. All three TPB variables were found to significantly mediate the relationship between general concern and energy conservation via temperature regulation. Specifically, the indirect effect through subjective norms was .01, 95% CI [.00, .03], the indirect effect via worth was .04, 95% CI [.02, .06], and the indirect effect via PBC was .02, 95% CI [.01, .04] (note that these indirect effects are unstandardized values). The same process was followed to examine the indirect effect of beliefs about consequences. All three TPB variables also significantly mediated the relationship between beliefs about consequences and energy conservation via temperature regulation. Specifically, the indirect effect via subjective norms was .08, 95% CI [.02, .15], the indirect effect via worth was .21, 95% CI [.12, 31], and the indirect effect via PBC was .11, 95% CI [.04, .20]. The results of these analyses are reported in Table 3. This provides support for Hypothesis 2 regarding an indirect effect of general environmental concern and beliefs about consequences on this behavior via the three TPB variables.

Finally, to test Hypothesis 3, potential indirect effects for subjective norms via worth and PBC, and for worth via PBC were examined using the same procedure outlined above. Subjective norms demonstrated a significant standardized indirect effect of .15 (p = .00) on conserving energy via temperature regulation. Based on the results of this omnibus test, multiple-mediation was again conducted to identify which variable(s) mediated the effect of subjective norms on the behavior. Both worth and PBC were found to significantly mediate the relationship between subjective norms and energy conservation via temperature regulation. Specifically, the unstandardized indirect effect through worth was .05, 95% CI [.03, .08], and the unstandardized indirect effect via PBC was .04, 95% CI [.03, .07]. Worth also had a significant mediated effect on the behavior (.11, p = .00). The unstandardized indirect effect through PBC was .14, 95% CI [.09, .21]. Thus, both Hypotheses 3a and 3b were supported for this behavior.

3.2 Conserving Household Energy via Other Means

For the second behavior (conserving energy via other means), the structural model again demonstrated excellent fit [$\chi^2_{(4)}$ = 4.74, p = .32, CFI = .99, RMSEA = .02, SRMR = .02]. Standardized path coefficients are reported in Figure 2. Only two of the three TPB constructs – PBC and worth – were positively related to the reported frequency of engaging in this behavior, partially supporting Hypothesis 1.

Regarding Hypothesis 2, to test for indirect effects, maximum likelihood bootstrapping was again used. The results of the bootstrapping analyses are reported in Table 2. Both general environmental concern and beliefs about consequences had significant indirect effects on the behavior. General concern demonstrated a standardized indirect effect of .15 (p = .00), and beliefs about consequences had an indirect effect of .14 (p = .00). This provides initial partial support for Hypothesis 2.

In order to identify which TPB construct(s) serve a mediational role, we again conducted multiple-mediation analyses. The results of these analyses are reported in Table 3. First, the behavior was regressed onto general concern, with the three TPB variables entered as the mediators. Worth and PBC both significantly mediated the relationship between general concern and energy conservation via other means. The indirect effect through worth was .03, 95% CI [.02, .05]. The indirect effect via PBC was .02, 95% CI [.01, .03].

To examine the indirect effect of beliefs about consequences, the behavior was regressed onto this variable with the three TPB variables entered as mediators. Both worth and PBC were again found to significantly mediate the relationship between beliefs about consequences and energy conservation via other means. Specifically, the indirect effect through worth was .19, 95% CI [.10, .30], and the indirect effect via PBC was .13, 95% CI [.06, .21]. These results provide partial support for Hypothesis 2 regarding an indirect effect of general environmental concern and beliefs about consequences on this behavior via TPB variables.

Finally, to test Hypothesis 3, potential indirect effects for subjective norms via worth and PBC, and for worth via PBC were examined. Subjective norms demonstrated a significant standardized indirect effect of .13 (p = .00) on conserving energy via other means. Both worth and PBC were found to significantly mediate this relationship. Specifically, the indirect effect through worth was .04, 95% CI [.02, .06], and the indirect effect via PBC was .03, 95% CI [.02, .05]. Worth demonstrated a significant standardized indirect effect on conserving energy via other means (.11, p = .00), and the indirect effect through PBC was .14, 95% CI [.09, .20]. Thus, again both Hypotheses 3a and 3b were supported.

3.3 Reducing Gas Consumption

For the third behavior examined (reducing gas consumption via carpooling, combining trips, biking, walking or using public transportation), the structural model demonstrated moderate fit [$\chi^2_{(4)} = 11.74$, $p = .02$, CFI = .99, RMSEA = .07, SRMR = .02]. Standardized path coefficients are reported in Figure 3. Similar to the second behavior, two of the three TPB constructs – PBC and worth – were positively related to the reported frequency of engaging in this behavior, partially supporting Hypothesis 1.

In regard to Hypothesis 2, only beliefs about consequences demonstrated a significant indirect effect on the behavior (.15, $p = .00$). The results of this bootstrapping analyses are reported in Table 2.

In order to identify which TPB construct(s) serve a mediational role, we again conducted multiple-mediation analyses. The results of these analyses are reported in Table 3. The behavior was regressed onto beliefs about consequences with the three TPB variables entered as mediators. Both worth and PBC were found to significantly mediate the relationship between beliefs about consequences and reducing gas consumption. Specifically, the indirect effect through worth was .10, 95% CI [.02, .20], and the indirect effect via PBC was .16, 95% CI [.06, .27]. These results provide partial support for Hypothesis 2 regarding an indirect effect of beliefs about consequences on the behavior via two of the three TPB variables.

Finally, to test Hypothesis 3, potential indirect effects for subjective norms via worth and PBC, and for worth via PBC were examined. Subjective norms demonstrated a significant standardized indirect effect of .09 ($p = .01$) on reducing gas consumption. Only worth was found to significantly mediate this relationship. Specifically, the indirect effect through worth was .03, 95% CI [.01, .05]. Worth demonstrated a significant standardized indirect effect on reducing gas consumption (.16, $p = .00$). Further, PBC was found to significantly mediate the effect of worth on the behavior. The indirect effect through PBC was .13, 95% CI [.07, .20]. Thus, Hypothesis 3a was partially supported and Hypothesis 3b was fully supported for this behavior.

3.4 Driving a Fuel Efficient Car

For the final behavior examined (owning or driving a fuel- efficient car), the structural model demonstrated excellent fit [$\chi^2_{(4)} = 3.97$, $p = .41$, CFI = .99, RMSEA = .00, SRMR = .01]. Standardized path coefficients are reported in Figure 4. Only two of the three TPB constructs – in this case PBC and subjective norms– were positively related to the reported frequency of engaging in this behavior, partially supporting Hypothesis 1.

None of the three predictor variables (general environmental concern, knowledge of causes of global warming, or beliefs about consequences of global warming) demonstrated a significant indirect effect on the behavior. Therefore Hypothesis 2 was not supported for this behavior.

Finally, to test Hypothesis 3, potential indirect effects for subjective norms via worth and PBC, and for worth via PBC were examined, however neither variable demonstrated a significant standardized indirect effect with the behavior, therefore Hypothesis 3 was also not supported for this behavior.

4. Discussion

The present research examined factors that predict four types of energy conservation by individuals. Using a survey of college students, we tested three hypotheses derived from Ajzen's (1985) Theory of Planned Behavior (TPB), and from proposals regarding problem awareness variables that may predict TPB constructs. Our survey assessed self-reported frequency of four different types of conservation, and assessed beliefs related to the three factors that determine behavioral intentions according to Ajzen: subjective norms, attitudes toward the behavior, and perceived control over the behavior. To measure problem awareness, our survey also assessed general environmental concern, and knowledge and beliefs specifically about the causes and consequences of global warming. To our knowledge this is the first study to separately test, in one sample, TPB with respect to different types of energy conservation, and to attempt to integrate TPB variables with climate-change beliefs.

4.1 Summary of Results

4.1.1 TPB Variables Predict Energy Conservation

Consistent with our first hypothesis, path analyses including all variables measured in this study revealed that each construct identified by the TPB framework directly predicted at least some of the conservation behaviors (see Table 4). Subjective norms for energy conservation were directly related to two behaviors. Perceived worth of (attitude toward) each behavior (as measured by ratings of whether the specific behavior was worthwhile in the effort to limit climate change) was directly related to three behaviors. Perceived behavioral control was directly related to all four behaviors.

Our analyses showed that PBC was not only the sole TPB variable to directly predict all four types of energy

conservation, but that PBC was also always the strongest predictor. Our findings that PBC and worth were more likely than subjective norms to directly predict energy conservation are consistent with previous studies of the relation between TPB variables and intention toward, or performance of, environmentally responsible behaviors, including transportation behaviors (e.g. Bamberg & Moser, 2007; Bamberg et al., 2007, Gardner & Abraham, 2008). Few prior studies have examined TPB in relation to household energy conservation, but the patterns found in the current study confirm the results of Abrahamse and Steg (2009) who found that PBC and attitude predicted household energy use.

4.1.2 TPB Variables Mediate Effects of Problem Awareness

Our second hypothesis was that general environmental concern, and knowledge and beliefs specifically about global warming, are indirect predictors of energy conservation. We found partial support for this hypothesis. As shown in Table 4, TPB variables, most consistently worth and PBC, mediated the effects of concern (for two behaviors) and beliefs about consequences of global warming (for three behaviors). These results for concern support findings discussed earlier, though for a different set of target behaviors (Bamberg, 2003; Collins & Chambers, 2005; De Groot & Steg, 2007; Gardner & Abraham, 2010). The results for beliefs about global warming consequences represent the first demonstration that we know of that beliefs specifically related to global warming predict TPB variables. Interestingly we found no indirect effects for knowledge of *causes* of global warming. O'Connor et al. (2002) argue that global warming knowledge must entail perception of risk in order to affect attitudes toward mitigation behaviors. Although Sundblad, Biel, and Garling (2007) found that knowledge of both causes and consequences of global warming predicted risk judgments, conceptually, our questions about consequences (in which subjects rated the likelihood of various outcomes) are more direct assessments of risk perception than our questions about causes. The fact that the consequences (but not the causes) measure predicted both worth and PBC suggests that risk perception may be an important indirect predictor of energy conservation, and an important factor in perceptions of PBC variables regarding some of the ERB examined here.

4.1.3 Mediation among TPB Variables

Our predictions regarding mediation among TPB variables were supported for all behaviors except for driving a fuel-efficient car. Consistent with prior studies of TPB and transportation (Bamberg, Hunecke, & Blobaum, 2007), the effect of subjective norm was mediated by its relationship with worth (three behaviors) and with PBC (two behaviors). We also found that for three behaviors, the effect of worth was partially mediated by its relationship with PBC - the greater the perceived worth, the greater the perceived control. This finding represents a logical extension of Bamberg's (2003) previous findings that a general attitude variable, environmental concern, can predict PBC (over use of a green electricity brochure). We show that, for a variety of energy conservation behaviors, behavior-specific attitude (perceived worth of the target behavior) can also predict PBC.

4.1.4 Consistency across the Four Behaviors

Despite the diversity of our four behaviors, we observed several consistencies in the patterns of predictors. First, the primary predictor was always the same: All behaviors were most strongly predicted by PBC. Second, for all behaviors except owning or driving a fuel-efficient car: (a) worth was the second strongest predictor, and (b) similar patterns of indirect effects were found: beliefs about global-warming consequences were mediated by worth and PBC, social norms were mediated by worth, and worth was mediated by PBC (the indirect effects of concern were less consistent across behaviors). In contrast to these consistencies, owning or driving a fuel-efficient car was distinct in many ways. As with the other behaviors, PBC was the strongest predictor. However, worth did not significantly predict this behavior, and no indirect effects of any variables were found. This contrast with the other three behaviors will be discussed further below.

4.2 Implications

In this section we discuss the psychological and practical implications of our findings by examining the nature of the TPB constructs that were our main predictors, and considering interventions that might impact levels of TPB variables.

4.2.1 Perceived Behavioral Control

PBC is believed to be a higher order concept that consists of two distinct factors (Ajzen, 2002): beliefs about the *ease* of executing the behavior, and beliefs about the *controllability* of the behavior (is the actor free to engage in the behavior). Each of these factors is believed to reflect both internal and external obstacles or facilitators. For example, riding a bicycle to work could be difficult because of low energy (internal obstacle), or because there is an unpaved stretch of road on the route (external obstacle). Freedom to ride a bike to work could be perceived as

limited because of fear of crashing (internal obstacle that may not feel controllable), or because bicycles are not allowed on the highway (external obstacle).

Finally, perceptions of the various internal or external obstacles to carrying out a behavior could more or less be grounded in objective realities, or be subjectively biased. Thus, perceptions of whether the car traffic on a road is so heavy as to impede cycling could be the result of both the actual number of cars, and of the background of the perceiver (e.g., people from urban and rural backgrounds might differ in perceptions of the same amount of traffic). Bamberg (2003) suggests that general attitudes, such as environmental concern, play a role in the subjective assessment of control; the assessment is biased to become congruent with the general attitude.

The present findings suggest that subjective assessment of control is not only affected by general environmental concern, but even more consistently, may be affected by beliefs specifically about the consequences of global warming, and about worth (behavior-specific attitude). Subjects perceived more control over the target behavior when they had stronger beliefs about global warming consequences, and a greater belief that the behavior is worthwhile in mitigating global warming.

For one behavior, owning or driving a fuel-efficient car, PBC was not predicted by exogenous variables or by worth. We can view this inconsistent finding in the light of proposals and findings by Guagnano et al. (1995) and Black et al. (1985) who suggest that attitude variables are less likely to predict ERB when external conditions such as convenience or cost have extremely low or extremely high levels. Driving a fuel-efficient car is likely to be such a highly constrained behavior; it had the lowest PBC ratings of the four variables. Thus, this behavior is largely governed by perceived control, and perceived control over this behavior appears to be grounded in objective realities and not subjectively biased.

Perhaps our other three behaviors fall into the moderate range, being neither highly constrained nor unconstrained by external conditions. These behaviors do not necessarily require a high investment in time, energy or money, but they do require regular, sustained effort. They require continual commitment and vigilance to be effective at conserving energy. Thus, consistent with the Guagnano et al. (1995) model, these behaviors were directly predicted by worth, and PBC was more susceptible to contextual influences and the influence of worth.

4.2.2 Interventions to Increase Perceived Behavioral Control

A primary implication of our results is that researchers and policy makers should explore interventions that increase perceived behavioral control. Such interventions should (a) reduce external and internal obstacles to freedom and ease and (b) address both objective realities, and the subjective framing of these realities.

Changing objective realities related to *external* obstacles can occur through design of products and environments, for example, by making pedestrian and bicycle paths safe and high in connectivity, or by increasing the availability, affordability, and efficiency of public transportation [see Bamberg, Ajzen and Schmidt (2003) and Heath and Gifford (2002) for examples of such interventions relevant to public transportation]. Changing objective realities related to *internal* obstacles can occur by increasing skill and reducing cognitive effort required for conservation behaviors. Although most of the conservation behaviors measured here require little skill, instruction may in some cases be relevant (for example, instruction in safe cycling and road sharing). Also, cognitive effort can be reduced by interventions that reduce the need for information gathering, planning and decision-making. For example, behaviors can be translated from an abstract level of description to an operationalized level that spells out the concrete steps to be taken: People should know where and when to catch the bus, the specific procedures required to insulate, and the specific energy efficient products to buy. Goal setting and implementation intention interventions can help operationalize behaviors (Abrahamse, Steg, Vlek, & Rothengatter, 2005; Bamberg, 2002; Osbaldiston & Schott, 2012). These interventions minimize the effortful decision making and planning required to decide when, where, and how often to initiate an action (implementation intentions create an advance link between a specific behavior and a specific situation, e.g., I will take the bus to work whenever I do not have to pick up my son from school; cf. Bamberg, 2002).

Our mediation results, as discussed above, also indicate that we can increase PBC by addressing factors that influence the subjective assessment of effort and control. In particular, education about the likely consequences of global warming, and about the pay-off of a mitigation behavior, may reduce the perceived burden associated with carrying out the behavior.

4.2.3 Positive Outcome Expectancies

Our results showed that perceived worth of the target behaviors not only affected PBC, but also had a direct relationship with three of the four types of energy conservation. Recall that in the TPB, attitude follows from

beliefs that the behavior will produce certain outcomes and from the evaluation of these outcomes. As previously discussed, our attitude measure differs from many previous attitude measures that simply ask people to rate whether a target behavior is "good-bad," "pleasant-unpleasant" (e.g., Bamberg et al., 2007; Gardner & Abraham, 2010). Such measures do not target a specific expected outcome, and thus may or may not reflect expectations about environmental impact. Our attitude measure asked specifically about whether the conservation behavior was worthwhile in the effort to solve the problem of climate change. Our finding that this measure directly and indirectly predicted three types of energy conservation is consistent with proposals that in order to engage in ERB, people must believe that their efforts will be effective in reducing environmental problems (Frantz & Mayer, 2009; Pelletier et al. 1999).

Our findings also show that perceived worth is not simply a disinterested assessment of outcome likelihood or strength; rather this assessment is made in the context of knowledge, worries, and values. We found that perceived worth of energy conservation is itself predicted by general environmental concern, and by beliefs about consequences of global warming. Thus, attitude reflects both an assessment of likelihood of particular outcomes and the value of these outcomes; even if the size or chance of a positive outcome may be small, the value of this outcome may be high.

4.2.4 Interventions to Enhance Outcome Expectancies

Given our findings, researchers should pursue interventions that convince people that individual attempts to conserve energy make a difference (as proposed by Franz & Mayer, 2009; Huebner & Lipsey, 1981; Pelletier et al., 1999). Such interventions might include specific feedback about the payoff of individual conservation attempts (e.g., percent change in personal co_2 emissions), or messages about the specific payoff of aggregate conservation attempts. Further, since general environmental concern and beliefs about the specific consequences of global warming predict perceived worth of conservation efforts, educational efforts that heighten awareness of climate change consequences may be effective in increasing perceived worth.

4.3 Limitations

Future studies must address the limitations of the present research. First, studies that use objective assessments of frequency of the target behavior rather than self-report are needed. Not only are self-reports subject to such factors as response bias and socially desirable responding, individuals' beliefs regarding ERB may demonstrate a stronger relationship with self-reports than with observed behavior (Chao & Lam, 2011; Obregón-Salido & Corral-Verdugo, 1997). However, self-reports and observational data have been found to be significantly correlated for recycling and reuse (Corral-Verdugo, 1997; Gamba & Oskamp, 1994) and energy use (Chao & Lam, 2011; Warriner, McDougall, & Claxton, 1984).

A second potential limitation of our study concerns the measure of subjective norms. Unlike PBC and worth, subjective norms were not measured with separate items for each of the four types of energy conservation. Rather, subjective norms were measured with three items that asked whether important others would support and value the subject's energy conservation for environmental reasons, and whether important others model energy conservation for environmental reasons. We believed subjects would be more likely to have available norms (based on important others) for energy conservation in general than for individual behaviors. Furthermore, since these more general norms should extend to specific behaviors, it seemed unnecessary to increase the length of the survey by asking each of the three questions for each specific ERB. The consistency of our findings with prior research showing that subjective norm is a relatively weak predictor of pro-environmental behavior (e.g., Bamberg & Moser, 2007; Bamberg et al., 2007) supports the validity of our measure. Nevertheless it may be important in future research to confirm our findings using more behavior-specific measures of norms.

Most importantly, future studies using longitudinal designs and experimental manipulations are needed to confirm the causal relationships suggested by our results. As suggested above, interventions that may affect energy conservation through their effect on TPB variables should be experimentally tested, and the mediations identified in our data must be confirmed with experimental designs that isolate variables and demonstrate the direction of causality. For example, if we experimentally manipulate beliefs about the consequences of global warming, will this increase perceived control and perceived worth of conservation efforts? And if we manipulate perceived worth, will this increase perceived control?

4.4 Conclusions

In comparison to immediate and obvious daily concerns, people may give low priority to environmental problems and the behavior changes needed to address them. But threats to the environment, particularly the consequences of climate change, are indeed fundamental societal problems. It is then essential to identify the

drivers of key behaviors that can address these problems. Energy conservation is one such behavior and is important not only because most energy consumed comes from non-renewable sources, but also because energy production and consumption is a primary factor in climate change. Our findings indicate that the Theory of Planned Behavior is effective in predicting diverse types of energy conservation. These findings are consistent with theoretical models of why people do or do not take action to address environmental problems in general (Pelletier et al., 1999), and global warming specifically (Frantz & Mayer, 2009; Gifford, 2011). First, people must believe they have the ability and resources to engage in the relevant behavior. Our findings indicate that people are more likely to conserve energy in each of the ways examined, when they perceive the required behavior as easy and under personal control (i.e., PBC). Second, people must believe that their efforts will be effective in reducing environmental problems (i.e., perceived worth). Our findings indicate that people are more likely to conserve energy in three of the ways examined when they believe this conservation will help mitigate climate change. Our results strongly suggest that researchers and policy makers should pursue interventions that increase both perceived control and positive outcome expectations.

Our findings also indicate that the TPB variables can be affected by specific types of problem awareness, especially beliefs about global-warming consequences. Thus, efforts to increase the appreciation of the risks associated with climate change are worthwhile. Finally, our results indicate that TPB variables are not fully independent of one another, most importantly perceptions that the target behavior is worthwhile predicted perceived control over the behavior. Thus interventions that increase outcome expectancies are not only important because these outcome expectancies are themselves related to energy conservation, but because these expectancies may feed back onto perceived control.

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