AN INVESTIGATION OF THE PSYCHOLOGY OF GLOBAL WARMING: PERCEPTIONS, PREDICTORS OF BEHAVIOR, AND THE PERSUASIVENESS OF ECOLOGICAL FOOTPRINT CALCULATORS

By

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Abstract

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Because global warming (GW) is caused primarily by human behavior, attempts to reduce GW will benefit from an understanding of the social psychology of GW-related behavior. The present investigation consisted of three studies aimed to provide a psychological understanding of people's perceptions of GW, predictors of GW-related behavioral intention, and reactions to Ecological Footprint Calculators (EFCs). Study 1 investigated GW perceptions among 112 college students. Results showed that participants continue to equate GW with general environmental problems, although participants were more likely to recognize the importance of driving less and recycling more in mitigating GW and less likely to implicate aerosol spray cans in GW than in previous research. Additionally, a model linking GW perceptions to GW-related intention was developed which explained 50% of the variance in GW-related intention. Accurate knowledge of the behaviors that mitigate GW was the strongest predictor of GW-related intention. In Study 2 a comprehensive social psychological model of GW-related intention was created drawing on the Value-Belief-Norm Theory (VBN) and the Theory of Planned Behavior (TPB). The comprehensive model of GW-related intention, a simplified version of the model, the VBN, and a modified version of the TPB were evaluated using path analysis on data obtained

from 461 college students. Overall, results showed that personal norms, self-efficacy, response efficacy, and biospheric values were the strongest predictors of GW-related intention. The modified version of the TPB provided the best fit to the data. Study 3 investigated the effectiveness of EFCs in increasing GW-related intention. Little experimental research has been conducted on EFCs. College student participants (N = 86) were randomly assigned to complete (or not) an EFC, to receive (or not) a Behavior List outlining effective energy conserving actions, and to receive (or not) Efficacy Feedback intended to bolster feelings of efficacy. Results showed that EFCs led to lower beliefs of self-efficacy and higher surprise, but had no effect on GW-related intention even when combined with the Behavior List and/or Efficacy Feedback. Overall the studies provide a much-needed overview of the social psychology of GW-related intention. Implications for policy and suggestions for future research are discussed.

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SECTION ONE

GENERAL INTRODUCTION

Problem Overview

Global climate change[1] has become a major issue in the past year with the publication of the Intergovernmental Panel on Climate Change's Fourth Assessment Report. It is now clear that global warming (GW) is unequivocal (IPCC, 2007a). In the last century, the earth has warmed 0.76 degrees Celsius, with the rate of warming increasing within the last 50 years (IPCC, 2007a). Additionally, 11 of the last 12 years are the warmest on record since 1850 (IPCC, 2007a). Three major greenhouse gases are responsible for GW: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Since pre-industrial times, the concentrations of these greenhouse gases in the atmosphere have increased considerably and are significantly higher than they have been in the last 650,000 years according to ice core samples (IPCC, 2007a).

The increases in the atmospheric concentrations of greenhouse gases are clearly linked to anthropogenic activities (Oreskes, 2004). Most (77%) of the greenhouse gases emitted by human activities are in the form of carbon dioxide (IPCC, 2007c). Human activities such as burning of fossil fuels (for industrial power, heating and cooling of buildings, and automobiles) and deforestation (through biomass burning and removal of a carbon sink) have increased the amount of atmospheric carbon dioxide (Nickerson, 2003). Methane, although emitted at a lower concentration than carbon dioxide (approximately 16% of total greenhouse gas emissions weighted by GW potential per IPCC, 2007c), "has nearly 30 times the heat trapping capacity of CO_2" (Nickerson, 2003, p. 17). Human activities such as raising cattle as livestock and rice paddy farming have led to increases in atmospheric methane (Gardner & Stern, 2002, Table 10-4, reprinted from Stern, Young, & Druckman, 1991). Additionally, human agricultural activities

such as the application of fertilizer have increased atmospheric concentrations of nitrous oxide (Gardner & Stern, 2002, Table 10-4, reprinted from Stern et al., 1991), such that nitrous oxide accounts for approximately 6% of greenhouse gas emissions weighted by GW potential (IPCC, 2007c). Nitrous oxide has over 300 times the heat trapping capacity of CO_2 (U.S. EPA, 2009a).

Many consequences of GW are already evident. Scientists have observed that the sea level has risen 0.18 m in the last century and the rate of sea level rise is increasing (IPCC, 2007b). Rising sea levels threaten humans who reside in low-lying areas and coastlines. Additionally, the migration patterns of species are being affected as well as the timing of spring events like egg laying and leaf unfolding (IPCC, 2007b). These changes have major implications for terrestrial ecosystems. Negative impacts on marine life have also been observed (e.g., coral bleaching, pressure on shell-forming organisms, and shifts in fish and plankton concentrations) due to the increased temperature of the oceans and increased ocean acidification (IPCC, 2007b). Future climate scenarios predict exacerbation of many of these negative effects of climate change along with several new consequences such as changes in precipitation events resulting in droughts in some areas and strong precipitation events in others; shortage of fresh water in some areas; species extinctions; and increased incidence of heat-related diseases, illnesses and deaths (IPCC, 2007b).

Value of a Psychological Approach and Logic of Studies

Several aspects of the problem of GW make it a prime candidate for examination from a psychological approach. First, GW results from a very complicated scientific process, so few laypeople fully understand GW (Bostrom, Morgan, Fischhoff, & Read, 1994; Dunlap, 1998; Nisbet & Myers, 2007). As described in more detail below, many people have faulty beliefs about the causes, consequences, and solutions to GW (Read, Bostrom, Morgan, Fischhoff, & Smuts, 1994; Stamm, Clark, & Eblacas, 2000), which can lead to inappropriate GW attitudes and behaviors (Leiserowitz, 2006; O'Connor, Bord, & Fisher, 1999; O'Connor, Bord, Yarnal, & Wiefek, 2002; Stamm et al., 2000). The extent to which GW perceptions lead to GW-related behavior can be investigated from a psychological approach through the lens of existing behavior change theories that outline the mechanisms by which beliefs lead to behavior.

Second, GW can be viewed as a resource dilemma. Resource dilemmas have long been studied by psychologists because they involve a social and a temporal conflict (Dawes, 1980; Hendrickx, Poortinga, & van der Kooij, 2001; Joireman, Van Lange, & Van Vugt, 2004; Kortenkamp & Moore, 2006; Messick & Brewer, 1983). The social conflict arises because individuals must make a choice between pursuing self interest and pursing what is best for society as a whole (Messick & Brewer, 1983). The temporal dimension involves a conflict between short and long term consequences of behavior. As such, resource dilemmas have been dubbed social traps, so called because the immediate consequences of many environmental decisions are positive for the individual, but the delayed consequences of environmental decisions are negative for the collective (Platt, 1973). For example, it may be in every individual's best immediate self interest to use as much fossil fuel as desired each day to drive, cool the house, run appliances, etc. Yet if all consume fossil fuels with this mindset then the

result will be an overproduction of greenhouse gas emissions leading to GW in the future that threatens the collective. Thus individuals must decide whether to act to mitigate GW based on beliefs about the outcomes of GW and beliefs about whether others will act. From a psychological standpoint, the way that people make decisions about GW as a resource dilemma can offer interesting explanations for current behavior and can pinpoint strategies for changing behavior.

Third, it is difficult to directly observe the relationship between behaviors that release greenhouse gases and the effects of GW. Greenhouse gases are not visible so people cannot physically observe the greenhouse gas emissions from their behaviors or from their use and consumption of products whose manufacturing created greenhouse gases (Winter & Koger, 2004). Additionally, the impacts of greenhouse gases in heating the planet are geographically dispersed and temporally delayed (IPCC, 2007a). As such, behaviors performed by Americans now can have an effect on people in other countries several years from now. Because people cannot directly observe the relationship between GW behaviors and GW, people's beliefs about the consequences of their behavior on GW are likely to be based more on outside sources such as media and interpersonal communication than on direct observation. From a psychological standpoint, this underscores the potential for persuasion techniques to be used to change GW beliefs, attitudes, and behavior.

Fourth, like other environmental problems, GW has a moral dimension. The consequences of GW described above can affect the self, humankind, and plants and animals. As described in more detail below, the extent to which people value these objects can lead to beliefs about GW and feelings of moral obligation to act to reduce GW (Stern, 2000). By approaching GW from a psychological perspective, social psychological theories that elaborate on the mechanisms by

which values lead to moral norms and behavior can be applied to understanding GW-related behavior.

Overall, a psychological approach to the problem of GW can elucidate the role of beliefs, barriers, values, and persuasion in influencing GW-related behavioral intention. *GW intention* is henceforth used to refer to intention to perform behaviors that reduce greenhouse gas emissions and as a result reduce GW. To fully investigate a problem such as GW using a psychological approach, a multi-staged effort is needed. First, an understanding of people's perceptions of GW is necessary. Second, knowledge of the predictors of GW intention is needed. Third, methods to increase GW intention are needed. Following this approach, the purpose of this investigation is to determine the current state of knowledge and perception of GW among college students (Study 1), to determine the role of perceptions, among other psychological variables, in predicting GW intention (Study 2), and to determine whether Ecological Footprint calculators (EFCs) increase GW intention (Study 3).

The present set of studies has three major aims: 1) to assess the state of GW perceptions among college students at Washington State University and to compare these results with previous research; 2) to advance theory by forwarding a comprehensive model of GW intention that incorporates several existing social psychological theories; 3) to evaluate the effectiveness of a real-world tool (EFCs) at increasing GW intention and to determine whether manipulating aspects of the EFC can increase its effectiveness. Overall, the results will provide a more complete picture of people's GW perceptions, the effect of these perceptions on GW intention, and whether the EF calculator is an effective way to increase GW intention.

SECTION TWO

STUDY 1: PERCEPTIONS OF GLOBAL WARMING

Introduction

Over the past 15 years, many studies have investigated people's GW perceptions, which include beliefs that GW is occurring and is human caused, ratings of the seriousness of GW, concerns for the consequences of GW, risk evaluations of GW, and beliefs about the causes and mitigators of GW (Bostrom et al., 1994; Bord, Fisher, & O'Connor, 1998; Bord, O'Connor, & Fisher, 2000; Brechin, 2003; Dietz, Dan, & Shwom, 2007; Dunlap, 1998; Dunlap & McCright, 2008; Heath & Gifford, 2006; Kahlor, 2007; Kellstedt, Zahran, & Vedlitz, 2008; Kempton, 1991; Krosnick, Holbrook, Lowe, & Visser, 2006; Leiserowitz, 2005; Leiserowitz, 2006; Lorenzoni & Pidgeon, 2006; McDaniels, Axelrod, & Slovic, 1996; Nisbet & Myers, 2007; O'Connor et al., 1999; O'Connor et al., 2002; Read et al., 1994; Semenza, Hall, Wilson, Bontempo, Sailor, & George, 2008; Stamm et al., 2000; Viscusi & Zeckhauser, 2006; Whitmarsh, 2009a). Of particular interest for Study 1 is Read et al.'s (1994) in-depth investigation of Pittsburgh residents' mental models of GW. Although several of the studies mentioned above are more recent than Read et al. (1994), Read et al.'s methods relied heavily on open-ended questions which allowed for a more complete picture of participants' spontaneous perceptions of GW and can thus be considered to be more accurate (Whitmarsh, 2009b). For the most part, Study 1 served as a replication and extension of Read et al.'s (1994) study, albeit with a different sample. In the review that follows, previous research investigating the state of laypeople's perceptions of GW is discussed as well as research results concerning the effect of these perceptions on behavioral intention.

Belief in occurrence of GW

Several studies have investigated people's beliefs about whether GW is occurring and is caused by humans. Most research has shown that participants generally believe that GW is occurring or will occur in the future (Bostrom et al., 1994; Bord et al., 2000; Dunlap & McCright, 2008). Additionally, most people believe that GW is at least somewhat likely due to human actions (Bostrom et al., 1994; Read et al., 1994). Yet, recent research has also found that 10-18% of Americans surveyed are skeptical that GW is occurring (ABC News/Planet Green/Stanford University, 2008; CNN/Opinion Research Corporation, 2009; Dunlap & McCright, 2008; Lorenzoni, Leiserowitz, Doria, Poortinga & Pidgeon, 2006; Nisbet & Myers, 2007). The present study assessed participants' beliefs about the occurrence of GW and whether it is human caused.

Hypothesis 1: The majority of participants will believe that GW is occurring and is human caused.

Perception of GW risk

Several studies have examined the public's perception of the risk of GW. In these studies, risk has generally been defined as belief that negative consequences will occur as a result of GW. In a 1996 survey of Canadian students, climate change was ranked 12th out of 65 environmental processes in terms of overall riskiness (McDaniels et al., 1996). In a 1998 sample of U.S. residents, fewer than half of the participants rated GW as a very serious risk (Dunlap, 1998). In another study, the greenhouse effect was rated fourth in terms of riskiness among a list of environmental risks after ozone depletion, industrial emissions and sea pollution (Böhm, Stahl, Henning, & Mader, 1998 as cited in Böhm & Pfister, 2001). In a more recent survey of U.S. residents, participants judged climate change as a moderate risk (Leiserowitz, 2005). In

comparing GW to other risks, Bord et al. (2000) found that participants felt less likely they would experience negative personal and societal effects from GW than from other environmental risks like water pollution and air pollution, although a more recent 2008 national poll found that more Americans (25%) rated GW as the biggest environmental problem that the world faces at this time (down from 33% in 2007) compared to other environmental risks (ABC News/Planet Green/Stanford University). In another poll, more than half the sample (60%) of Americans did not think that GW would pose a serious threat to them or their way of life in their lifetime (Gallup, 2009). Overall, GW is not generally seen as a very serious risk, even when rated only among other environmental problems.

In terms of specific consequences should GW occur, one investigation found that American participants generally did not believe that standards of living would decrease or that starvation or food shortages would increase (Bord et al., 1998). In fact more people believed that it was likely that there would be few problems from GW than believed it was unlikely that there would be few problems from GW (Bord et al., 1998). But in another study, American participants believed that GW would result in increases in temperature, changes in precipitation patterns, and impacts on ecosystems (Bostrom et al., 1994). Additionally, most participants also cited human health effects, but these were mostly related to effects from increased UV radiation, an example of confusion between ozone depletion and GW (Bostrom et al., 1994). Sea level rise was only listed by 30% of the participants (Bostrom et al., 1994). In yet another study, American participants most frequently rated the effects of GW on survival of plants and animals, agriculture production, ocean levels and human health as very harmful (Dunlap, 1998). The present study evaluated risk perceptions in terms of perception of the likelihood of outcomes of GW and the severity of these outcomes.

Hypothesis 2: Participants will view outcomes from GW as risky (i.e., will rate them above the midpoint) and will rate effects on sea levels, plants and animals and human health as especially risky relative to the other outcomes.

Perceptions of GW causes

Several studies have assessed the public's knowledge of the activities that cause GW. In initial investigations, Bostrom et al. (1994) and Read et al. (1994) interviewed Pittsburgh residents and business people to determine their thoughts about the causes of GW and asked them to rank the causes in order of importance of contribution to the greenhouse effect. Results from these studies showed that participants' knowledge of the relative impact of the contributors was often flawed. In Read et al.'s (1994) study, participants rated clearing tropical rainforests, deforestation, and even aerosol spray cans as more important causes of GW than burning fossil fuels. Similarly, in Bostrom et al.'s (1994) study, participants ranked auto emissions, deforestation, factory pollutants, air pollution and aerosol cans as the top five most important causes, while fossil fuels and overpopulation were lower on the list.

Subsequent investigations into the public's perception of the causes of GW have also found flawed perceptions. Böhm and Mader (1998) found that the most frequently cited causes of the greenhouse effect were air pollution (28% of responses), traffic and CO_2 (16%), clearing of rain forests (13%), and responses related to ozone depletion or CFCs (10%; cited in Böhm & Pfister, 2001). In a multi-country survey, Dunlap (1998) found that participants most commonly listed pollution as a cause of GW followed by CFCs or ozone then fossil fuel use. In forced choice questions, participants correctly rated loss of rainforests, coal and oil power plants and automobile exhaust as major causes, but incorrectly rated aerosol cans (54% of US sample) as a major cause (Dunlap, 1998). Bord et al. (1998) also found misperceptions about the causes of

GW, with most participants rating pollution/emissions from business/industry and destruction of tropical forests as major causes, almost half of the participants rating people driving their cars and use of coal and oil by utilities as major causes, but only 13% rating people heating and cooling their homes as major causes. In fact, four non causes (ozone depletion, use of pesticides, use of aerosols and nuclear power generation) were all rated as more major causes than household heating and cooling, and ozone depletion was rated as a major or primary cause of GW by 65% of the participants (Bord et al., 2000). Stamm et al. (2000)'s investigation into Washingtonians' beliefs about the importance of various causes of GW (in which household energy use was not an option) found that more participants (54%) believed that deforestation was a very important cause of GW than believed that use of fossil fuels was a very important cause (51%). Additionally, use of CFCs was judged to be a very important cause of GW by more participants (44%) than industrialization (40%), overpopulation (39%), and agriculture (14%; Stamm et al., 2000). In a more recent investigation, O'Connor et al. (2002) found that almost three quarters of their American participants thought that heating and cooling their homes was not a major cause of GW and over half thought that the use of coal and oil by utilities or electric companies was not a major cause. Strikingly, 35% rated people driving cars as not a major cause (O'Connor et al., 2002). Brechin (2003), in a cross national poll conducted in 2001, found that only 15% of Americans surveyed correctly rated burning of fossil fuels as the main cause of the greenhouse effect, while just over 20% rated the depletion of the ozone layer as the main cause and almost 20% rated air pollution as the main cause.

A review of the causes of GW listed by and supplied to participants in the above studies reveals that they vary widely in terms of concreteness and specificity. Although some of the general causes of GW included in previous research are concrete and can easily be translated into

individual behaviors (e.g., automobile use and energy use in homes), others are less tangible (e.g., deforestation and pollution) and cannot easily be equated with a behavior that an individual does on a daily basis. Only one study could be located that specifically taps into participants' knowledge of the everyday behaviors that they perform that cause GW (Read et al., 1994). Results from this study showed that only six behaviors were listed in the open ended question by more than 10% of the Pittsburgh residents: driving, use of aerosol cans, air conditioning, not conserving, consuming environmentally harmful products, and generating too much waste (Read et al., 1994). Research has not investigated participants' perceptions of the relative impact of individual behaviors in causing GW.

Although the research reviewed above suggests that the misperceptions of the causes of GW evident in the early 1990s are still evident in the 21st century, additional research is needed to further evaluate this assertion. Additionally, research is needed to evaluate people's perceptions of the relative impact of various behaviors that cause GW. In line with the research reviewed above, I forward the following hypotheses.

Hypothesis 3: Participants' ratings of the impact of general causes of GW will be faulty along the following lines:

a. fossil fuel use will not be seen as the primary cause of GW.

b. deforestation will be listed as more of an important cause of GW than fossil fuel use.

c. ozone depletion and CFC use will be seen as causes to GW (i.e., rated above the midpoint).

d. air pollution will be seen as a cause of GW (i.e., rated above the midpoint).

Hypothesis 4: Participants' listings and ratings of the impact of the individual behaviors that cause GW will reveal that:

a. driving will not be rated as one of the top two causes of GW.

b. heating and cooling the house will not be rated as one of the top two causes of GW.

c. use of aerosol cans will be seen as a cause of GW (i.e., rated above the midpoint).

Perceptions of GW mitigators

In addition to investigations of perceptions of the causes of GW, several studies have assessed the public's beliefs about the effectiveness of general strategies that can mitigate GW. Read et al. (1994) found that most participants rated general strategies related to energy conservation and fossil fuel reductions as being effective. Additionally, participants believed that reductions in air pollution and CFC-related activities would slow GW (Read et al., 1994). Similarly, Bostrom et al. (1994) found that participants most frequently suggested social or political activist behaviors (57%), such as joining environmental organizations, to mitigate GW, followed by air pollution controls (51%), recycling (41%), banning aerosol products (38%) and energy conservation or efficiency (32%). Böhm and Mader's (1998) participants' most frequently-cited remedies to the greenhouse effect were reduction of traffic (20% of responses), reduction of CO_2 (15%), alternative energy sources (14%), reduction of air pollution (12%), reduction of clearing forests (8%), change of industrial society (6%), and reduction of the ozone hole, improvement of public transportation and reduction of CFC, each of which constituted 2% of all responses (cited in Böhm & Pfister, 2001). Stamm et al. (2000) found that most participants considered reducing industrial emissions of greenhouse gases (60%), planting more trees (58%), energy efficient technologies (57%), driving less (52%), and halting deforestation

(51%) as very helpful solutions to reduce GW. More participants viewed stopping aerosol use as very helpful (44%) than reducing home energy use (37%; Stamm et al., 2000).

In addition to awareness of the general strategies that can mitigate GW, information about laypeople's awareness of the individual behaviors that mitigate GW is needed to determine whether people are aware of the potential to reduce their greenhouse gas emissions through their everyday behavior. Little research has been conducted on the public's knowledge of the behaviors that they can undertake to mitigate GW or their perceptions of the relative effectiveness of these behaviors. Read et al. (1994) found that their American participants' most frequently mentioned behaviors that individuals could do to reduce GW were reducing driving, political actions, personal awareness and recycling (Read et al., 1994). Few (only 11%) proposed cutting their household energy use, which is arguably the largest impact behavior that an individual can perform (Gardner & Stern, 2008). In terms of effectiveness of various behaviors in reducing GW, a more recent survey of the UK public revealed that 40% of the respondents rated recycling as the most helpful behavior that will reduce climate change (MORI, 2007). Fewer participants rated the other behaviors as most helpful: creating less waste (22%), driving less (17%), using less electricity (16%), taking fewer foreign holidays (11%), using public transport (10%), buying locally grown food (7%), having fewer children (4%), reusing bottles/containers (4%), conserving water (4%), and buying organic produce (1%; MORI, 2007).

Findings such as these led Winter and Koger (2004) to lament that "we suffer from *knowing* about environmental problems, but not knowing what to *do* about them" (p. 88). The present study evaluated the extent to which participants were aware of the specific behaviors that mitigate GW and the relative effectiveness of these behaviors.

Hypothesis 5: Participants' ratings of the effectiveness of general strategies to mitigate GW will reveal that:

a. strategies to reduce fossil fuel burning will be rated as effective (i.e., above the midpoint).

b. strategies that reduce pollution will be seen as effective (i.e., above the midpoint).

c. CFC reduction strategies will be seen as effective (i.e., above the midpoint).

Hypothesis 6: Participants' listings and ratings of the effectiveness of the individual behaviors that mitigate GW will reveal that:

a. recycling will be frequently mentioned and will be rated as effective (i.e., above the midpoint).

b. driving less will be viewed as an effective behavior (i.e., above the midpoint).

c. reducing household energy use through heating and cooling the home will be seen as less effective (i.e., below the midpoint).

GW-mitigating behaviors

Several studies have investigated participants' intentions to undertake actions to mitigate GW. Bord et al. (1998) found that people reported being most likely to install more insulation and weatherize their homes (73% were very likely), replace older appliances (60%), and buy fuel efficient cars (62%), than to use less AC and heat (42%) and carpool and drive less (30%), while O'Connor et al. (2002) found very different results in that people were more likely to be willing to suffer discomfort (adjust thermostat on water heater and A/C) than buy green (purchase energy efficient appliances and insulation) or drive less. In a recent Gallup (2008) poll, American participants most commonly stated that they had recycled more (39%) to protect the environment, with fewer stating they had driven less (17%), bought biodegradable products (14%), or used less energy (10%) to protect the environment. Less than 10% of the participants

had driven a more fuel efficient car (9%), bought "green" products (7%), used energy saving light bulbs (7%), eaten organic foods (5%), or conserved water (5%; Gallup, 2008). Another recent survey of residents of Houston and Portland found that most participants reported changing their behavior in response to climate change (Semenza et al., 2008). In response to a closed-ended question, the most frequently adopted behavior was decreasing energy use at home, followed by reducing gasoline consumption, then "other" behaviors to which the participants provided open-ended responses. The most frequently cited behavior changed to respond to climate change in the open ended responses was recycling, followed by conserving water, purchasing a fuel-efficient car, using renewable power, not using aerosol cans, taking fewer airline flights, and altering eating habits (Semenza et al., 2008).

Recent polls of the UK public have also been conducted. One found that 85% of participants reported that they would be willing to change personal behaviors to reduce climate change (Kirby, 2004). When asked which behaviors they would be prepared to perform, most participants were willing to adopt behaviors at home such as recycling (96%), using less energy (92%), installing insulation or an energy efficient heater (92%), and purchasing energy efficient products (82%), while over half reported being prepared to perform transportation behaviors such as driving less (68%) or flying less (62%; Kirby, 2004). Another survey asked participants the number one behavior they had done to tackle climate change (MORI, 2007). Although the most common response overall was not doing anything (37%), the most common behavior endorsed was recycling (23%). Substantially fewer participants stated that they had used low energy light bulbs (5%), saved energy (3%), or saved electricity/ switched off appliances (2%). Only 1% of the sample had performed each of the following behaviors: don't use/ less use of car, switch off lights, turn down heating, install home insulation, and change car/ get fuel efficient/

smaller car (MORI, 2007). In another recent investigation of perceptions of GW behaviors in the U.K., Whitmarsh (2009a) found that when participants were asked to list behaviors that they actually perform out of concern for climate change, more respondents noted that they recycle (18%) than avoid driving (8%) or conserve energy (7%). When asked what environmental behaviors they perform regardless of the reason, most participants noted they turn off lights (96%), recycle (93.1%), and buy energy efficient light bulbs (66%; Whitmarsh's, 2009a). Less than half the participants noted they buy organic food (44%), walk/cycle to work (44%), use public transport (37%) or take part in an environmental campaign (18%; Whitmarsh, 2009a). Overall, participants across studies report being most willing to recycle, moderately unwilling to adjust the thermostat, relatively unwilling to install energy efficient appliances, and least willing to drive less to reduce GW.

Hypothesis 7: When asked the likelihood that they will perform proenvironmental behaviors, participants will be:

a. most willing to recycle.

b. moderately unwilling to adjust the thermostat.

c. unwilling to install energy efficient appliances and house upgrades.

d. most unwilling to drive less.

GW perceptions as predictors of behavior

A majority of the studies on GW perceptions are relatively atheoretical and appear to operate under the general assumption that GW perceptions are important because they shape public policy or lead to the adoption of voluntary actions by individuals (e.g., Lorenzoni, Pidgeon, & O'Connor, 2005). A common underlying theme in these studies is the premise that "one cannot predict how people will respond to an issue without knowing how they perceive it" (Fischhoff,

1985, p. 90). Despite this, in general, people's perceptions of GW have been shown to be important indicators of policy support (Krosnick et al., 2006; Leiserowitz, 2006), intention to seek out information about GW (Kahlor, 2007), intention to act to mitigate GW (O'Connor et al., 1999; O'Connor et al., 2002; Stamm et al., 2000), and prior behavior adopted to mitigate GW (Semenza et al., 2008; Whitmarsh, 2009a). Several of the studies that have investigated whether GW perceptions predict GW behavior do incorporate existing theory or propose new theories, yet no overarching theory has been forwarded across these studies to outline why GW perceptions should predict GW behavior (Kahlor, 2007; O'Connor et al., 2002; Semenza et al., 2008; Stamm et al., 2000; Whitmarsh, 2009a). Although forwarding a GW perception model of GW intention is not the main purpose of Study 1 (see Study 2), a simple model is presented from which predictions about specific GW perceptions leading to behaviors can be based. The model was developed based on previous research findings and draws on the work of Leiserowitz (2006), Kahlor (2007), Krosnick et al., (2006), O'Connor et al. (2002), Stamm et al. (2000), Whitmarsh (2009a), and Witte (1998).

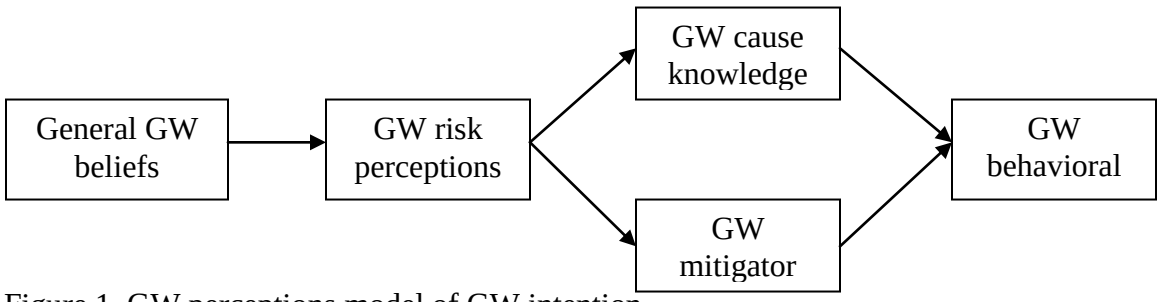

Figure 1. GW perceptions model of GW intention.

The model proposes a mediation chain where general beliefs lead to GW risk perceptions which lead to knowledge of GW causes and mitigators which lead to GW intention (Figure 1). First, general beliefs about GW such as the belief that it is occurring and is caused by humans were expected to be the most distal predictors of behavior as has been shown previous research

(Krosnick et al., 2006). Second, once a person believes that GW is occurring and is caused by humans, he/she is expected to then seek out information about the consequences of GW and as such be more likely to evaluate those consequences as risky compared to someone who does not believe that GW is occurring. Thus general GW beliefs are expected to lead to risk perceptions.

Some empirical research has investigated the effect of GW beliefs on risk perceptions and GW behavior and intention. Krosnick et al. (2006) found that stronger beliefs that GW was occurring led to increased beliefs about the seriousness of GW, which led to increased support for policies to reduce GW. Leiserowitz (2006) found that general beliefs about GW (including belief that it is occurring and is not just a natural process) predicted GW risk perceptions and preferences for national policies to mitigate GW (but not tax policies). In terms of behavioral intention, some research has shown that belief that climate change is occurring or is likely to occur predicts intention to act to reduce GW (Heath & Gifford, 2006; O'Connor et al., 1999), while other research has shown that belief that climate change is likely does not predict intention to act to reduce GW (O'Connor et al., 2002). Heath and Gifford (2006) found that belief that GW is caused by humans did not predict behavioral intention. The mixed findings concerning the relationship between GW beliefs and intention may reflect different methods to test the relationship with some studies testing the direct effect of GW beliefs on GW intention and others testing the indirect effect of GW beliefs on GW intention through intermediary variables. According to the proposed model, GW beliefs are expected lead to behavioral intention indirectly through risk perceptions.

Third, risk perceptions (perceptions of the likelihood and severity of GW-related outcomes) are hypothesized to lead to increased knowledge about the causes of and solutions to GW. One well-established fear appeal model and two recent GW models provide support for this

proposition. Witte's (1998) Extended Parallel Process Model posits that perceived threat of a stimulus determines whether action takes place to either reduce or avoid the threat. If no threat is perceived, then the individual does not take action to reduce the threat (Witte, 1998). To the extent that the perceptions of threat are balanced by perceptions of efficacy to mitigate the fear, adaptive behavior takes place (Witte, 1998). Thus, as an individual begins to view GW as a risk, he/she is expected to evaluate the extent to which taking action will reduce the threat. This evaluation requires seeking out information about the mitigators of GW and is expected to lead to more accurate knowledge of the behaviors that mitigate GW. In Kahlor's (2007) A-RISP model, risk perceptions indirectly lead to a desire to seek out more information about GW. Those who seek out more information about GW are expected to have more accurate knowledge of the causes and mitigators of GW. Similarly, according to Stamm et al.'s (2000) stage model, after people believe that GW is a problem (risk), they begin thinking about solutions to GW.

Several researchers have examined the effect of GW risk perceptions on GW-related behavior and intention, although no research could be found that investigated the effect of GW risk perceptions on knowledge of the causes and mitigators of GW. Krosnick et al. (2006) found that increased beliefs about the seriousness of GW led to increased support for policies to reduce GW. O'Connor et al. (1999) and O'Connor et al. (2002) found that belief that climate change will have negative consequences predicted intention to act to reduce GW while Viscusi and Zeckhauser (2006) found that belief that GW would lead to increases in hurricane activity predicted willingness to pay a gas tax to mitigate GW. In sum, most researchers have found that beliefs about the risk of GW lead to increased policy support and behavioral intention. According to the model presented in this study, risk perceptions are expected to lead to

behavioral intention but this relationship is expected to be mediated by knowledge of the causes and mitigators of GW.

Finally, the model hypothesizes that people who are more accurately knowledgeable about the behaviors that they perform that cause GW and the behaviors that they could perform to mitigate GW will be more likely to intend to perform behaviors that actually mitigate GW compared to people who are not aware of the causes and mitigators of GW. In terms of general proenvironmental behavioral intention, a recent meta-analysis found that knowledge of environmental problems had the strongest total effect on intention (Bamberg & Moser, 2007). In regard to GW, some research has found that participants note lack of knowledge of how to change behavior to reduce climate change as a major barrier to GW behavior (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007; Semenza et al., 2008). Other research has investigated the effect of knowledge of GW causes on GW intention, but the measures of GW cause knowledge included items assessing knowledge of general causes (e.g., destruction of tropical forests) in addition to individual behavioral causes (e.g., people driving their cars). In general, these studies have found that knowledge of GW causes predicts GW intention (Bord et al., 2000; O'Connor et al. 1999; 2002).

Some researchers have recognized the possibility that knowledge of behaviors that mitigate GW may predict behavior, although little empirical research has been conducted to test this assertion. Kempton (1993) followed the public response to GW, and concluded that a lack of correct knowledge of the behaviors that can solve GW was a major reason for the lack of public action on the issue in the early 90s. More recently, Gardner and Stern (2008) hypothesized that mitigator knowledge is important in predicting effective action to reduce GW. Although no empirical research could be located that investigated the effect of mitigator knowledge of GW

behaviors, some research has investigated the effects of mitigator knowledge on behavioral intention in other environmental domains (Hall & Slothower, 2009; Lam, 2006). Lam (2006) found that the belief that the behavior under consideration is the most effective behavior that could be taken to conserve water significantly predicted intention to perform that behavior, and Hall and Slothower (2009) found that belief that creating a defensible space around one's home would reduce the threat of fire predicted intention to create a defensible space. These research findings suggest that mitigator knowledge likely predicts GW intention and should be investigated in future research.

As described in more detail below, a comprehensive model of GW intention that incorporates existing social psychological theories is needed and would greatly benefit this research area. Although noted, the purpose of Study 1 centered less on testing a full model of GW intention and more on providing a detailed picture of GW perceptions. See Study 2 for a more complete model of GW perceptions. The present model is useful in that it provides a theoretical framework for GW research that predicts GW intention only from GW perceptions. Based on the model and theoretical rationale given above, I forward the following additional hypotheses for Study 1.

Hypothesis 8: GW beliefs (GW is occurring and caused by humans) will predict GW intention and this relationship will be mediated by GW risk perceptions.

Hypothesis 9: GW risk perceptions will predict GW intentions and will be mediated by knowledge of the causes and mitigators of GW.

Hypothesis 10: Knowledge of the causes and mitigators of GW will predict GW intention.

Hypothesis 11: GW perceptions will be stronger predictors of GW intention than non-GW related proenvironmental behaviors.

Method

Participants

Undergraduate WSU psychology majors *(N* = 112) served as participants, 69 women and 43 men. The participants predominantly identified themselves as White, non-Latino (66.1%), with the remaining participants identifying themselves as Asian (12.5%), Latino (10.7%), African American (4.5%), and other (6.3%). The majority of the participants were between the ages of 18 and 25 (97.3%), with the sample age ranging from 18 to 52. In terms of political party affiliation, the largest segment was Democrat (42.9%), with the remainder of the sample identifying themselves as Republican (16.1%) or Independent (36.6%).

Procedure

Participants completed several surveys on the computer individually on the internet from their residences. First, participants completed several questionnaires originally asked in Read et al. (1994) or adapted from that study. In open-ended questions, participants listed all behaviors that they do that contribute to GW and the most effective behaviors that they could perform to reduce GW. After listing each behavior, participants were asked to rate the extent to which the behavior caused GW on a scale from 1 (Negligible impact) to 11 (Very major impact) or reduced GW on a scale from 1 (Extremely ineffective) to 11 (Extremely effective), respectively. Then participants completed Read et al.'s (1994) scale assessing participants' beliefs about the extent to which 14 general activities are a cause of GW on a scale from 0 (Not a cause of GW) to 7 (Very major cause of GW). Participants also completed Read et al.'s scale assessing participants' beliefs about the extent to which 21 general strategies can affect GW on a scale from -5 (Definitely will speed GW) to +5 (Definitely will slow GW).

Next participants completed measures developed by the author that assess beliefs about the extent to which specific behaviors cause and mitigate GW. Participants rated 16 behaviors on the extent to which they contribute to GW on a scale from 1 (Negligible impact) to 11 (Very major impact). The measure was developed such that some behaviors that are known not to cause GW (skiing, using aerosol cans, littering, purchasing items that are tested on animals, and riding your bike) were included because they have been identified by previous research (Read et al., 1994) as sources of potential misperceptions. Participants also rated 20 behaviors on the extent to which they are effective in reducing GW on a scale from 1 (Extremely ineffective) to 11 (Extremely effective). The measure was developed such that some proenvironmental behaviors that are known not to reduce GW (avoid using aerosol sprays, turn off the sink while brushing teeth, avoid buying products that are tested on animals, throw away garbage instead of littering, use environmentally friendly cleaning products) were included because they have been identified by previous research (Read et al., 1994) as sources of misperceptions.

Participants then completed two behavioral intention scales developed for this study. The 39-item GW Behavioral Intention Scale (GWBS) assessed participants' intention to perform several global-warming related behaviors in the coming month on a scale from 1 (Strongly unlikely) to 7 (Strongly likely). The GWBS was developed to tap dimensions of GW behaviors related to car maintenance, travel, energy use at home, electronics use, energy use related to hot water, recycling and reusing, food consumption, consumer behavior, and other (α =.94). The 6-item non-GW Proenvironmental Behavior Scale (α = .75) assessed participants' intention to perform several proenvironmental behaviors that are known not to reduce GW (such as avoid using aerosol spray cans and throw away garbage instead of littering) in the coming month on a scale from 1 (Strongly unlikely) to 7 (Strongly likely).

Then participants completed four questions (adapted from Leiserowitz, 2006) assessing their general GW beliefs about whether GW is occurring and is caused by humans ($\alpha = .65$) on a scale from 1 (Strongly Disagree) to 7 (Strongly Agree). Participants' GW risk perceptions were assessed via their ratings of the likelihood of 12 GW outcomes (outlined by the IPCC, 2007b) in the next 50 years on a scale from 1 (Extremely unlikely) to 7 (Extremely likely) and the severity of these outcomes should they occur on scales from 1 (Minor Impact) to 7 (Major Impact).

Finally, participants completed demographic questions assessing their age, year in college, sex, political party and ethnicity.

Results

General causes of global warming

Participants were asked to rate the extent to which 14 general actions were causes of GW (Table 1). In terms of the general causes of GW, participants' responses revealed relatively accurate perceptions. Fossil fuels were rated as the most major cause of GW followed closely by automobiles and overpopulation. Deforestation and clearing rainforests were also rated fairly high as were toxic wastes. The hole in the ozone layer and aerosols[2] were both rated above the midpoint of the scale and were seen as moderate causes of GW. Nuclear power was also rated above the midpoint. Finally, methane-related objects such as cows, rice, termites, and swamps were rated below the midpoint.

Table 1. Mean cause ratings for activities that cause global warming.

Causes	Mean	SD
Fossil fuels	7.98	1.85
Automobiles	7.48	2.16
Overpopulation	7.39	2.36
Deforestation	7.24	2.34
Toxic wastes	7.21	2.30
Clearing rainforest	7.18	2.21
Hole in ozone layer	6.92	2.72
Ozone in cities	6.89	2.71
Ocean dumping	6.88	2.63
Nuclear power	6.52	3.07
Aerosols	5.73	2.58
Acid raid	5.60	3.17

Table 1. (cont.)

Causes	Mean	SD
Cows, rice, termites, swamps	4.29	2.81
Space program	3.91	2.52

Note. Response scale was 0 (Not a cause of GW), 1 (A very minor cause of GW), and 10 (A very major cause of GW).

Strategies for abating GW

Participants were also asked to rate the extent to which 21 strategies would slow or speed GW (Table 2). In this study stopping the use of fossil fuels was rated as the strategy that will most definitely slow climate change, and converting to electric cars was rated as the second most effective strategy. Preventing pollution was also recognized as a GW strategy, with participants judging reducing pollution from chemical plants and meeting clean air standards as effective strategies to abate climate change. Planting trees, recycling, and reducing population growth were also rated as effective strategies. Strategies related to CFCs such as banning chlorofluorocarbons, stopping use of aerosol spray cans, and stopping the release of coolant from refrigerators and air conditioners were all rated as behaviors that would slow GW. Finally, making more clouds in the atmosphere and putting dust in the stratosphere were rated as actions that would have virtually no impact on climate change.

Table 2. Mean ratings for strategies that speed or slow global warming.

Strategies	Mean	SD
Stopping use of fossil fuels	3.51	1.87
Convert to electric cars	3.26	2.11
Stopping pollution from chemical plants	3.23	2.04
Meet clean air act standards	3.17	1.85
Planting trees	3.06	1.79

Table 2. (cont.)

Strategies	Mean	SD
Recycling most consumer goods	2.81	1.90
Reduce population growth	2.81	2.02
Using all known energy conservation measures	2.70	3.01
Ban chlorofluorocarbons	2.33	1.95
Stopping release of coolant from refrigerators and air conditioners	2.30	1.82
Switching to fluorescent or other efficient lights	2.21	1.98
Stopping use of aerosol spray cans in U.S.	1.96	1.89
High tax on all fossil fuels	1.79	2.09
Making national parks out of remaining tropical rain forests	1.77	2.58
Switching from styrofoam to paper cups	1.75	2.17
Switching from coal to natural gas	1.68	2.10
Switching from fossil fuels to nuclear power	1.04	2.48
Fertilize ocean to make algae grow faster	0.43	2.25
Stop the space program	0.37	1.71
Make more clouds high in atmosphere	0.18	1.84
Put dust in the stratosphere	-0.42	2.09

Note. Response scale was -5 (Will definitely speed GW), 0 (Will have no impact on GW), and +5 (Will definitely slow GW).

Behaviors that cause GW

The participants' free response answers to the behaviors that they perform that contribute to GW were coded such that any behavior listed by more than one participant was assigned to a category. Participants were asked to list all the behaviors that they do that contribute to GW and

were given 10 spaces to list their behaviors; few participants listed more than 7 behavioral causes of GW (Table 3).

Table 3. Percentage of participants (N =112) listing at least each number of causes.

# causes listed	% of participants
1	90.2
2	83.9
3	64.3
4	40.2
5	30.4
6	17.9
7	9.8
8	8.0
9	5.4
10	5.4

Participants' responses were coded such that each participant could only list each category once. If participants listed the same category twice (i.e., I drive a car, I drive a truck), only the first response was calculated in the totals. After removing duplicates within participants, 343 behaviors in total were listed by participants. Although the question asked for specific behaviors that cause GW, seven participants listed only very broad and general causes of GW (e.g., "climatic cycle", "CO_2", and "sun's rotation") and were deleted from this analysis. Additionally, four participants did not list any causes, resulting in a final sample size for this question of N = 101.

The participants' free response answers to the behaviors that they perform that cause GW are shown in Table 4. The left hand columns of Table 4 show the frequency and percentage of

participants who listed each category. Driving a car was by far the most frequently listed behavior. Not recycling was listed next frequently followed by using electricity, but both behaviors were listed by 65% less participants than driving a car. More than 10% of the sample listed consuming products as a behavior they perform that causes GW.

Some behaviors that are not major contributors of GW were also provided by participants. Using aerosols was listed by almost 10% of the sample and littering was listed by almost 5%. Additionally, Table 4 shows that one quarter of the participants actually listed proenvironmental behaviors as causes of GW. It is not clear whether these represent misinterpreting of the question or misunderstanding of the behavioral causes of GW. The most frequently listed proenvironmental behavior was recycling. Additionally, some behaviors that are major contributors to GW were not listed by many participants. Less than 6% of the sample recognized that their use of heat and A/C caused GW and less than 5% of the sample recognized that eating meat contributes GW.

Table 4. Percentage of participants listing each behavioral cause of global warming and impact ratings of behaviors listed in free response question.

	Participants listing behavior		Impact of behavior	
Behavior	Frequency	Percent	M	SD
Environmental inaction	8	7.92	9.00	2.20
Use heat & A/C	6	5.94	8.17	2.48
Use products that pollute	4	3.96	7.50	3.42
Produce garbage	9	8.91	7.44	2.40
Fly in airplanes	9	8.91	7.22	2.33
Consume products	11	10.89	6.91	2.30
Drive	90	89.11	6.66	2.66

Table 4. (cont.)

	Participants listing behavior		Impact of behavior	
Behavior	Frequency	Percent	M	SD
Recycle*	9	8.91	6.44	2.92
Use or waste paper	5	4.95	6.40	2.30
Use or waste energy	6	5.94	6.33	1.03
Use aerosol sprays	10	9.9	6.30	2.31
Miscellaneous behaviors	24+	23.76	6.13	3.08
Waste goods and resources	8	7.92	6.13	1.46
Do not recycle	22	21.78	6.09	2.20
Do not carpool or use bus	4	3.96	5.75	1.50
Cut down trees	3	2.97	5.67	1.53
Leave on lights	10	9.9	5.60	1.58
Buy goods from factories	9	8.91	5.33	3.54
Smoke cigarettes	9	8.91	5.22	2.44
Use or waste water	8	7.92	5.00	1.93
Buy water bottles	3	2.97	5.00	1.00
Use electricity	21	20.79	4.90	2.57
Walk*	5	4.95	4.80	3.11
Ride the bus	6	5.94	4.67	3.61
Build fires	13	12.87	4.46	2.70
Use inefficient light bulbs	4	3.96	3.75	2.22
Exist or breathe	4	3.96	3.50	3.70
Use no aerosol sprays*	2	1.98	3.50	3.54
Eat meat	5	4.95	3.00	1.87

Table 4. (cont.)

	Participants listing behavior		Impact of behavior	
Behavior	Frequency	Percent	M	SD
Litter	5	4.95	2.00	1.22

Note. Response scale for impact was 1 (Negligible impact) to 11 (Very major impact).
* proenvironmental behavior. [+]one participant did not provide an effectiveness rating.

In addition to listing all behaviors that they do that contribute to GW, participants were also asked to rate the impact of each behavior they listed in contributing to GW. The right hand columns of Table 4 show the mean and standard deviation of participants' impact ratings for each free response behavior listed.

General environmental inaction was recognized as having the greatest impact in contributing to GW. Using heat and A/C was rated second highest, with use of products that pollute rated third. Producing garbage was rated as the fourth most impactful behavior and flying in airplanes was rated fifth. The impacts of driving (a major contributor to GW) and using aerosol cans (a non-contributor to GW) on contributing to GW were both rated near the midpoint of the scale. Interestingly, recycling, compared to not recycling, was rated as having more of an impact in contributing to GW. Leaving on lights was rated as a stronger contributor than using inefficient light bulbs. Building fires was rated as a relatively minor contributor to GW and eating meat was rated near the low end of the scale.

Comparisons between the percentage of participants who listed the behavior and the impact rating of the behavior reveal that some behaviors were frequently implicated in the participants' mental models of GW but were not considered as having a relatively large impact. For example, driving was the most frequently listed behavior although it was rated slightly above the midpoint on the impact scale. Similarly, not recycling, and use of electricity were listed by over 20% of

the sample but were rated at or below the midpoint of the impact scale. On the other hand, some behaviors were only listed by a small proportion of the sample but were rated as very impactful by that subset. For example, using heat and A/C, using products that pollute, and flying in airplanes were rated as having a relatively large impact although they were not listed by many participants. Finally, some behaviors showed strong correspondence between the frequency of participants who listed the behavior and the mean rating of the behavior's impact. Use of inefficient light bulbs, eating meat and littering were ordered low on both frequency of participants listing the behavior and mean rating of impact. Conserving behavior was ordered relatively high on both frequency of listing and mean rating of the impact.

Although impact ratings of the behaviors that participants spontaneously associate (without prompting) with causing GW is important in understanding participants' mental models of GW, the impact ratings also reflect potential bias in that the responses are skewed by the subset of participants who listed the behavior. As such, after participants completed the free response question about contributors to GW, they were asked to rate the impact of 16 behaviors in contributing to GW. As described above in the method section, the behaviors were chosen to represent actual behaviors that cause GW as well as behaviors that have been commonly associated with GW in previous research. The mean ratings of each behavior's impact in contributing to GW are shown in Table 5.

The contributor rated as having the highest impact was driving a car. Participants also rated throwing away recyclable materials and flying in airplanes above the midpoint of the scale. All other behaviors were rated as having an impact on causing GW below the midpoint of the scale, although heating and cooling the house was rated as having an impact just below the midpoint of the scale. Using aerosol cans and littering, both non causes, were rated as being stronger

contributors to GW than lighting in the home. As in the free response impact rating, eating meat was rated low on the scale in terms of impact.

Mean differences between the corresponding items from the free response question and this forced choice question can be compared descriptively as the impact ratings were assigned on the same response scale for both questions. Some behaviors (e.g., driving, not recycling) were given higher ratings in the forced choice question, while other behaviors (e.g., flying in airplanes, heating and cooling the house) were given higher ratings in the free response format. Of non-causes, littering was rated higher on the forced choice question than the free response item, while using aerosol cans was rated lower on the forced choice than the free response items. Overall, no clear pattern emerged to suggest that question type (either open-ended or closed-ended) revealed more accurate perceptions.

Table 5. Mean ratings of contributor impact from closed ended questions.

Behavior	Mean	SD
Driving your car	7.79	2.25
Throwing away recyclable materials	6.83	2.57
Flying in airplanes	6.47	2.46
Heating and cooling your house	5.97	2.41
Littering	5.83	2.84
Using aerosol cans	5.75	2.57
Lighting in your house	5.51	2.48
Using paper	5.43	2.53
Heating water for the shower and laundry	5.29	2.62
Using the dishwasher	5.27	2.64
Using electronic devices	5.14	2.54

Table 5. (cont.)

Behavior	Mean	SD
Having children	4.55	2.74
Eating meat	3.83	2.52
Purchasing items that are tested on animals	3.70	2.86
Riding your bike	2.61	3.05
Skiing	2.54	2.06

Note. Response scale for impact was 1 (Negligible impact) to 11 (Very major impact).

Behaviors that reduce GW

Participants were given 10 spaces to list the most effective actions they could take to prevent GW; few participants listed more than 7 behaviors (Table 6).

Table 6. Percentage of participants (*N* =112) listing at least each number of preventive behaviors.

# behaviors listed	% of participants
1	93.8
2	88.4
3	74.1
4	51.8
5	33.0
6	16.1
7	12.5
8	8.9
9	7.1
10	6.3

The participants' free response answers about the behaviors that they could perform to prevent GW were coded such that any behavior listed by more than one participant was assigned to a category. Although it could be argued that certain categories should be combined (e.g., replace light bulbs and turn off lights; conserve electricity and adjust thermostat), an effort was made to maintain the specificity of responses as much as possible to provide an in-depth picture of the participants' specific perceptions. Participants' behaviors were coded into one of 28 categories.

Participants' responses were coded such that each participant could only be counted once per category. If participants listed the same category twice (e.g., "I don't use my car when possible" and "I carpool," both coded as drive less/use alternative transportation), only the first response was calculated in the totals. Additionally, although the question asked for specific actions that the individual could take to prevent GW, several participants listed actions that did not address the question, such as broad actions that could be only undertaken at a government-level (e.g., "higher fines for non-recycling" and "stricter policies for polluters"), or fragments or statements that could not be deciphered as individual actions (e.g., "chemicals," and "I think that well industried conturies (sic) have to invent something instead of running machine"). Fourteen responses that fell into these categories were deleted from the analysis, leaving a total of 361 behaviors. One participant was removed from the analysis because all behaviors listed failed to address individual level behaviors. Additionally, seven participants did not list any behaviors, leaving a final sample for this question of 104.

The numbers and percentages of participants who listed each category of behaviors that prevent GW are shown in the left hand columns of Table 7. Driving less or using alternate transportation besides driving was listed by more than three quarters of the participants.

Recycling was listed second most frequently, by almost half of the sample. Use of eco-friendly products was listed by almost one quarter of the participants and was listed by more participants than driving a more fuel-efficient car. Rounding out the top five, encouraging others was listed by over 18% of the sample.

Conservation behaviors were also recognized in that 13% of the sample listed conserving electricity and 11% listed conserving resources in general, although adjusting the thermostat was recognized by less than 6% of the participants. Over 10% of the sample recognized political actions as effective behaviors they could undertake. Flying less and reducing meat consumption were only listed by 2 participants. Additionally, purchasing energy-efficient appliances and installing insulation were listed by less than 2% of the sample. This most likely reflects sample characteristics, as most college students are expected to live in rental properties where they have little direct control over house upgrades.

Table 7. Percentage of participants listing each behavior that prevents global warming and effectiveness ratings of behaviors listed in free response question.

	Participants listing behavior		Effectiveness of behavior	
Behavior	Frequency	Percent	M	SD
Do not pollute	6	5.77	8.17	2.99
Alternatives to fuel/cars	5	4.81	7.80	3.11
Produce less garbage	2	1.92	7.50	2.12
Drive less; Use alternate transportation	80	76.92	7.34	2.66
Learn	6	5.77	7.33	4.27
Reduce energy	6	5.77	7.33	3.44
Fly less	2	1.92	7.00	0.00

Table 7. (cont.)

	Participants listing behavior		Effectiveness of behavior	
Behavior	Frequency	Percent	M	SD
Recycle	49	47.12	7.00	2.60
Don't litter	7	6.73	6.86	2.12
Drive fuel-efficient car	22*	21.15	6.76	2.59
Reduce fossil fuel use	3	2.88	6.67	2.08
Make fewer fires	4	3.85	6.50	1.29
Political actions	11	10.58	6.45	3.33
Use eco-friendly products	25*	24.04	6.42	2.21
Plant trees	6	5.77	6.33	1.51
Adjust thermostat	6	5.77	6.33	2.73
Miscellaneous behaviors	37	35.58	6.32	3.08
Turn off lights	7	6.73	6.14	2.34
Avoid aerosol sprays	9	8.65	6.11	2.52
Encourage others	19*	18.27	6.11	2.85
Conserve electricity	13	12.5	6.08	2.56
Replace light bulbs with efficient ones	10	9.62	5.70	2.71
Don't buy bottled water	3	2.88	5.67	0.58
Conserve	11	10.58	5.45	1.57
Insulate house	2	1.92	5.00	1.41
Reduce meat consumption	2	1.92	5.00	5.66
Stop smoking	6	5.77	4.17	2.23

Table 7. (cont.)

	Participants listing behavior		Effectiveness of behavior	
Behavior	Frequency	Percent	M	SD
Purchase energy-efficient appliances	2	1.92	3.50	0.71

Note. Response scale was 1 (Extremely ineffective) to 11 (Extremely effective).
* denotes proenvironmental behaviors that are not major mitigators of GW.

Participants were also asked to rate the effectiveness of each behavior listed in reducing GW. The right hand columns of Table 7 show the mean (and standard deviation) for each free response behavior listed. Twenty one of the twenty eight behaviors were rated above the midpoint of the scale, meaning that participants viewed these behaviors as effective in reducing GW. Considering the wording of the question, which asked participants to list behaviors that are effective in preventing GW, this is not particularly surprising. Among the participants who mentioned it, not polluting was rated as the most effective behavior to prevent GW. Undertaking behaviors to find alternatives to fuel were rated as the second most effective behavior and producing less garbage was rated third. Driving less or using alternative transportation was rated as the fourth most effective behavior and learning more about GW and reducing energy use were both rated fifth. House efficiency upgrades of insulating the house and purchasing energy-efficient appliances were rated below the midpoint of the scale. Additionally, reducing meat consumption and stopping smoking were rated below the midpoint of the scale in terms of effectiveness.

Comparisons between the percentage of participants who listed the behavior and the effectiveness rating of the behavior reveal that the behaviors were frequently implicated in the participants' mental models of GW were considered the most effective in preventing GW. For

example, driving less and recycling were both rated relatively high in both scales. Similarly, not buying bottled water, insulating the house, reducing meat consumption, and purchasing energy-efficient appliances were rated relatively low in terms of frequency mentioned and effectiveness in preventing GW.

After participants completed the free response question about behaviors that prevent GW, they were asked to rate the effectiveness of 20 behaviors in reducing GW. As described above in the method section, the behaviors were chosen to represent actual behaviors that prevent GW as well as behaviors that are commonly mistakenly associated with GW in previous research (Read et al., 1994).

Table 8 shows the mean effectiveness ratings for each of the behaviors. Throwing away garbage instead of littering, a behavior that does not mitigate GW, was seen the most effective behavior. Choosing a fuel-efficient car was rated as the second most effective behavior. Reducing driving was rated third and recycling was rated fourth. Besides throwing away garbage, three other behaviors that do not mitigate GW were rated above the midpoint of the scale: using environmentally friendly cleaning products, turning off the sink while brushing teeth, and avoiding aerosol sprays. On the other hand, some more major mitigators of GW were listed below the midpoint of the scale: adjusting thermostats and reducing meat consumption. Overall, the behaviors were rated from moderately effective to moderately ineffective as means ranged from 4.35 to 8.34 on a scale from 1 to 11.

Table 8. Mean effectiveness ratings of behaviors that reduce global warming from closed ended questions.

Behavior	Mean	SD
Throw away garbage instead of littering*	8.34	2.63
When it is time for a new car, choose a more fuel efficient vehicle	8.26	3.04
Reduce the number of miles you drive by walking, biking, etc.	8.00	2.96
Recycle paper, glass, and plastic	7.98	2.70
Only run your dishwasher when there is a full load	7.94	2.94
Turn off electronic devices when you're not using them	7.81	2.82
Use environmentally friendly cleaning products*	7.65	2.91
Turn off sink while brushing teeth*	7.09	3.24
Avoid using aerosol spray cans*	7.05	3.22
Print double-sided	6.65	3.40
Do not purchase individual size water or soda bottles, instead use a reusable container for drinks	6.59	3.33
Refuse plastic and paper bags at the grocery and use cloth bags or carry groceries by hand	6.45	3.49
Buy locally grown and produced foods	6.34	3.18
Reduce the number of miles you fly	6.33	3.42
Make sure your tire pressure is correct	6.06	3.29
Keep your water heater thermostat no higher than 120 degrees	6.04	3.07
Stop receiving junk mail	5.95	3.58
Move your thermostat down in winter and up in summer	5.95	3.13
Avoid buying products that are tested on animals*	5.58	3.50

Table 8. (cont.)

Behavior	Mean	SD
Reduce your meat consumption	4.35	2.96

Note. Response scale was 1 (Extremely ineffective) to 11 (Extremely effective).
* denotes behaviors that are not major contributors to GW.

Other GW perceptions

The majority of participants at least somewhat agreed that GW is occurring and is caused by human activities (Table 9). Participants recognized that the climate is warming and that there is scientific evidence for GW, but were more skeptical that there was scientific consensus about GW. Participants were the most skeptical that human activities are the main cause of GW, with more than 20% of the participants at least somewhat disagreeing with this statement.

Table 9. Percentage of participants who agreed and disagreed each GW belief statement.

Statement	Strongly disagree	Disagree	Somewhat disagree	Unsure	Somewhat agree	Agree	Strongly agree
The majority of scientists believe that GW is occurring	1.79	4.46	5.36	13.39	23.21	35.71	12.50
The climate system is not warming (R)	17.86	35.71	18.75	17.86	4.46	2.68	1.79
Human activities are the main cause of GW	4.46	9.82	6.25	13.39	21.43	25.89	16.07

Table 9. (cont.)

Statement	Strongly disagree	Disagree	Somewhat disagree	Unsure	Somewhat agree	Agree	Strongly agree
There is no scientific evidence that GW is occurring (R)	25.00	29.46	14.29	23.21	2.68	3.57	0.89

Note: (R) refers to items that were reverse coded in tabulation of the GW perception summary score.

Participants' GW risk perceptions were calculated by multiplying participants' ratings of the severity and likelihood of each GW-related event, with possible scores ranging from 1 to 49. Table 10 shows participants' mean risk perceptions of the GW-related outcomes. Water shortages were perceived as the largest risk followed by sea level rise and drought. Melting of glaciers and polar ice caps as well as heat-related mortalities were rated near the middle of the pack in terms of riskiness, although above the midpoint of the scale. Outcomes relating specifically to non human animals, such as migration of species and bleaching of corals, were rated relatively low in terms of riskiness (lower than the midpoint of the scale) compared to other events.

Table 10. Risk perceptions (severity x likelihood) of GW-related events.

	Total Risk Rating		Occur Rating		Severity Rating	
Events	Mean	SD	Mean	SD	Mean	SD
Water shortages	30.39	13.01	4.91	1.65	6.08	1.27
Sea level rise	28.61	12.82	5.39	1.59	5.16	1.55
More areas experiencing drought	28.28	12.17	4.78	1.50	5.81	1.34

Table 10. (cont.)

	Total Risk Rating		Occur Rating		Severity Rating	
Events	Mean	SD	Mean	SD	Mean	SD
Stronger and more frequent hurricanes	27.11	13.05	4.99	1.53	5.32	1.71
Melting of glaciers	26.99	13.60	5.26	1.77	4.99	1.62
Melting of the polar ice caps	25.65	14.27	4.63	1.88	5.38	1.62
More intense tropical cyclones	25.23	12.79	4.84	1.54	5.15	1.76
Increased heat-related mortalities	25.05	12.63	4.56	1.53	5.32	1.61
Increased number of heavy precipitation events	24.30	12.58	4.45	1.59	5.26	1.52
Earlier timing of spring events	22.25	12.73	4.49	1.61	4.75	1.62
Migration of species northward	20.88	12.67	4.61	1.58	4.32	1.69
Bleaching of corals	17.51	12.75	4.37	1.61	3.68	1.73

Note. *N*s ranged from 109 to 111.

Behavioral intention

Participants' ratings of the likelihood that they would engage in various behaviors in the next month are provided in Table 11. The behaviors were classified in two categories: GW-related behaviors and general proenvironmental behaviors not related to GW (denoted by asterisks).The highest likelihood for performing a behavior was throwing away garbage instead of littering. Other behaviors that were strongly endorsed are running the dishwasher only when the load is full, recycling, and turning off electronics. Among the lowest rated intention items were stop eating beef, write a letter to a politician, and install solar panels.

Table 11. Mean likelihood ratings of behavioral intention.

Behavior	Mean	SD
Throw away garbage instead of littering*	6.25	1.12
Only run your dishwasher when there's a full load	5.76	1.45
Recycle paper, glass, and plastic	5.68	1.51
Turn off electronic devices when you're not using them	5.49	1.45
When it is time for a new car, choose a more fuel efficient vehicle	5.46	1.74
Use recycled paper products	5.42	1.36
Choose energy efficient appliances when making new purchases	5.39	1.40
Turn off the sink while brushing teeth*	5.34	1.67
Reduce the number of miles you drive by walking, biking, carpooling or taking mass transit	5.18	1.75
Keep your car tuned up	5.15	1.60
Use the energy-saving setting on your dishwasher	5.01	1.77
Buy locally grown and produced foods	4.96	1.69
Use environmentally friendly cleaning products*	4.88	1.67
Turn off car when idling longer than 30 seconds (except in traffic)	4.76	1.95
Avoid using aerosol spray cans*	4.73	1.95
Make sure your tire pressure is correct	4.68	1.77
Wash clothes in cold water only	4.63	2.02
Print double-sided	4.58	2.00
Avoid buying leather products*	4.47	1.94
Replace 3 regular incandescent light bulbs with compact fluorescent light bulbs	4.45	1.78
Keep your water heater thermostat no higher than 120 degrees	4.42	1.55

Table 11. (cont.)

Behavior	Mean	SD
Shut down your computer after using it instead of leaving it in standby mode	4.34	2.06
Avoid buying products that are tested on animals*	4.28	1.96
Reduce the number of miles you fly	4.23	1.95
Check your car's air filter each month and replace if necessary	4.20	1.82
Clean or replace dirty air conditioning filter as recommended	4.17	1.80
Avoid purchasing heavily packaged products	4.08	1.69
Use less hot water	4.06	1.82
Move your thermostat down 2° in winter and up 2° in summer	3.99	1.89
Insulate your home	3.90	1.98
Stop receiving junk mail	3.86	1.96
Do not purchase individual size water or soda bottles, instead use a reusable container for drinks	3.75	2.10
Caulk and weatherstrip your doorways and windows	3.73	1.87
Unplug electronics from the wall when you're not using them	3.69	1.92
Refuse plastic and paper bags at the grocery and use cloth bags or carry groceries by hand	3.66	2.04
Install a low-flow shower head	3.49	1.81
Use a push mower instead of a power mower	3.33	2.04
Shorten showers to 5 minutes maximum	3.27	1.91
Buy wind certificates and green tags	3.21	1.62
Use a clothesline instead of a dryer whenever possible	3.08	1.94
Reduce your meat consumption	2.99	2.07
Plant a tree	2.95	1.89

Table 11. (cont.)

Behavior	Mean	SD
Stop eating beef	2.59	2.02
Write a letter to your local politician to act to reduce global warming	2.35	1.79
Install solar panels in your home	2.22	1.74

Note. *N*s ranged from 108-112.
* denotes behaviors that were included because they are not related to GW.

Regressions predicting behavioral intention

Summary scores for the variables in Study 1 were created to allow for these variables to be included in regressions predicting behavioral intention. The behaviors listed in Table 11 (except for those denoted by an asterisk) were summed to create the GW Behavioral Intention Scale (α = .94). The six proenvironmental behaviors that are not related to GW were summed to create the non-GW Proenvironmental Behavior Scale (α = .75). Two new variables were created for the regressions: knowledge of behavioral causes and knowledge of behavioral mitigators. Following O'Connor et al.'s (1999) procedure, accurate knowledge of the behavioral causes of GW (cause knowledge) was calculated by subtracting participants' impact ratings for the non-cause items from their responses for the cause items. Accurate knowledge of the behavioral mitigators of GW (mitigator knowledge) was calculated by subtracting participants' effectiveness ratings for the non-mitigator items from their responses for the mitigator items.

Table 12 shows the intercorrelations among the scales used in this study. All variables significantly positively correlated with each other. The correlations between knowledge of the GW mitigators and knowledge of the GW causes, knowledge of the GW mitigators and GW behaviors, and risk perceptions and occurrence/human caused beliefs were all fairly strong.

Additionally, GW behavioral intention and proenvironmental behavioral intention had a high positive correlation.

Table 12. Intercorrelations among scales with means (and standard deviations) along the diagonal ($p < .001$ for all correlations except where noted).

Variables	1.	2.	3.	4.	5.	6.
1. Cause knowledge	41.54 (16.55)	.60	.49	.43	.46	.47
2. Mitigator knowledge		64.70 (24.11)	.43	.27**	.66	.56
3. Risk			298.65 (123.92)	.63	.34**	.37
4. Occur; human				5.18 (1.05)	.25*	.36
5. GW behavioral intention					157.33 (37.82)	.83
6. Non-GW PEB behavioral intention						33.39 (8.38)

Note. The sample sizes for each correlation range from 85 to 109.
**$p < .01$. *$p < .05$.

Two hierarchical multiple regressions were run, one predicting intention to adopt behaviors that reduce GW (Table 13), and one predicting other proenvironmental behaviors that are not related to GW (Table 14). For both regressions, general GW beliefs (occurring and human caused) were entered in step 1, risk perceptions were entered in step 2, and cause and mitigator knowledge were entered in step 3 according to the model presented in Figure 1.

For the regression predicting intention to adopt GW reducing behaviors, in step 1, GW beliefs were a significant predictor of GW intention and explained 5% of the variance in GW intention. When risk perceptions were added in step 2, GW beliefs were no longer significant,

but risk perceptions were a significant predictor of GW intentions, explaining 16% of the variance. When cause knowledge and mitigator knowledge were added in step 3, risk perceptions were no longer significant. Mitigator knowledge was a significant predictor, but cause knowledge was not. Overall, the final model accounted for 50% of the variance in GW behavior.

Table 13. Hierarchical regression predicting GW behavioral intention.

Predictor	Step 1	Step 2	Step 3
GW beliefs	.23*	-.05	-.02
Risk perceptions		.43**	.12
Cause knowledge			.06
Mitigator knowledge			.62***
F	4.51*	7.25**	18.70***
R^2	.05	.16	.50
ΔR^2		.10	.34

Note. Entries are standardized regression coefficients.
***$p < .001$. **$p < .01$. *$p < .05$.

For the regression predicting non-GW related proenvironmental behavioral intention, GW beliefs were added in step 1 and were a significant predictor of non-GW PEB intention, accounting for 11% of its variance. When risk perceptions were added in step 2, GW beliefs were no longer significant, although risk perceptions were significant. When cause and mitigator knowledge were added in step 3, risk perceptions were no longer significant. Both cause knowledge and mitigator knowledge were significant predictors of non-GW PEB intention. The final model accounted for 36% of the variance in non-GW PEB intention.

Table 14. Hierarchical regression predicting non-GW behavior.

Predictor	Step 1	Step 2	Step 3
GW beliefs	.33**	.14	.08
Risk perceptions		.28*	.05
Cause knowledge			.25*
Mitigator knowledge			.34**
F	11.01**	8.10**	12.25***
R^2	.11	.15	.36
ΔR^2		.04	.20

Note. Entries are standardized regression coefficients.
***$p < .001$. **$p < .01$. *$p < .05$.

As shown in the regressions, the strongest predictor of GW and general PEB behaviors was accurate knowledge of the effective responses to GW. To get a clearer idea of the relationship between mitigator knowledge and behavioral intention, individual correlations between beliefs in the GW- mitigating potential of a behavior and intention to perform that behavior were calculated (keeping in mind that the similarity of the wording of the intention and belief questions may result in somewhat inflated correlations). As can be seen in Table 15, the belief-intention correlation was strongest for refusing plastic and paper bags at the grocery store. Two of the three strongest correlations were for behaviors that will not have a large impact on reducing GW (avoid products tested on animals, and turn off sink while brushing teeth). Correlations between belief that reducing meat consumption reduces GW and intention to reduce meat consumption, between belief that a fuel efficient car will reduce GW and intention to purchase fuel-efficient car, and between belief that adjusting the thermostat will reduce GW and intention to adjust thermostat were all fairly strong. The belief-intention correlation for reducing miles driven was much lower, although still statistically significant. The belief-intention

correlation for throwing away garbage instead of littering was the lowest, likely a result of its relatively high endorsement on both scales and a slight restriction in range in that no participants rated it as a 1 on either scale.

Table 15. Correlations between belief in mitigating potential of behavior and intention to perform that behavior ($p < .001$ for all correlations except where noted).

Belief in mitigating potential-intention relationship	*r*
Refuse plastic and paper bags at the grocery and use cloth bags or carry groceries by hand	.72
Avoid buying products that are tested on animals	.70
Turn off the sink while brushing teeth	.65
Print double-sided	.64
Reduce your meat consumption	.63
Use environmentally friendly cleaning products	.61
Stop receiving junk mail	.60
When it is time for a new car, choose a more fuel efficient vehicle	.60
Only run your dishwasher when there is a full load	.59
Reduce the number of miles you fly	.58
Do not purchase individual size water or soda bottles, instead use a reusable container for drinks	.57
Move your thermostat down 2° in winter and up 2° in summer	.57
Buy locally grown and produced foods	.55
Recycle paper, glass, and plastic	.50
Keep your water heater thermostat no higher than 120 degrees	.48
Avoid using aerosol spray cans	.48
Turn off electronic devices (computer, T.V., etc.) when you're not using them	.47

Table 15. (cont.)

Belief in mitigating potential-intention relationship	*r*
Make sure your tire pressure is correct	.43
Reduce the number of miles you drive by walking, biking, carpooling or taking mass transit wherever possible	.35
Throw away garbage instead of littering	.20*

* $p < .05$.
Note. *N*s ranged from 109-112.

Discussion

Participants' responses to the questions in Study 1 provided a picture of their perceptions of the causes and mitigators of GW and how these perceptions influence behavioral intention. The discussion that follows reviews the findings in relation to the participants' perceptions of GW and several key GW-reducing behaviors and examines interesting patterns that characterize the responses. Finally, the ability of GW perceptions to predict intention to mitigate GW is discussed.

General perceptions of GW

In keeping with previous research and in support of Hypothesis 1, most participants believed that GW is occurring (Dunlap & McCright, 2008). Additionally, fewer participants in this study compared to previous national polls (9% versus 10-18% found across polls) were skeptical that GW is occurring (ABC News/Planet Green/Stanford University, 2008; CNN/Opinion Research Corporation, 2009; Dunlap & McCright, 2008; Lorenzoni et al., 2006; Nisbet & Myers, 2007), which may reflect differences in national samples and this student sample. Furthering previous research that has found that most American participants believe that GW is at least somewhat likely due to human actions (Bostrom et al., 1994; Read et al., 1994), the majority of the participants in the present study at least somewhat agreed that human activities are the *main* cause of GW. This finding is in support of Hypothesis 1 and is in line with recent surveys of the UK public that have found that almost half of those surveyed believe that human activity is the main cause of climate change (MORI, 2007).

In general, participants rated the GW outcomes as risky. All of the outcomes except increased precipitation events, earlier spring events, migration of species, and coral bleaching were rated above the midpoint of the severity x likelihood scale. The finding that events that

have a direct impact on plants' and animals' health (migration of species and coral bleaching) were rated as relatively low in riskiness is contrary to the findings of Dunlap (1998) and does not support Hypothesis 2. Participants viewed water shortages over the next 50 years as most risky compared to other GW-related events. Similar to previous research (Dunlap, 1998) and in support of Hypothesis 2, participants in this study rated the risk of sea level rise as relatively high compared to the other events. But contrary to Hypothesis 2 and previous research showing that people view effects of GW on human health as very harmful (Dunlap, 1998), in the present study, increased heat-related mortalities were rated as less risky than three quarters of the GW-related events. Overall, the results provide only limited support for Hypothesis 2; sea level rise was rated as risky but GW outcomes related to human and animal health were not rated as risky relative to the other outcomes.

Perceptions of causes and mitigators of GW

In the US, fossil fuel combustion accounts for approximately 94% of CO_2 emissions and approximately 80% of total greenhouse gas emissions (U.S. EPA, 2009a). Participants correctly recognized that fossil fuel use is the largest contributor of GW (contrary to Hypothesis 3a) and that stopping the use of fossil fuels will have the greatest potential to slow GW (supporting Hypothesis 5a). This reflects more knowledge regarding fossil fuel use and GW in this sample compared to previous research (Brechin, 2003; Dunlap, 1998). After fossil fuel use, land use changes and forestry account for the second largest source of global greenhouse gas emissions (U.S. EPA, 2009b). As has been seen in previous research (Bord et al., 1998; Dunlap, 1998), participants correctly recognized deforestation and clearing rainforests as major contributors to GW. Although in contrast to some research (e.g., Brechin, 2003; Read et al., 1994; Stamm et al., 2000) and contrary to Hypothesis 3b, deforestation was correctly rated as a lesser cause than

fossil fuel use (U.S. EPA, 2009b) in this study. Overall, it appears that participants in this study had a more knowledge of the relative contributions of fossil fuel use and deforestation on GW.

Driving is by far the largest consumer of energy, accounting for 39% of the average person's energy use (Gardner & Stern, 2008). In keeping with previous research (O'Connor et al., 2002; Read et al., 1994), the majority of participants in this study recognized the important contribution of automobiles to the GW problem, although contrary to Hypothesis 4a participants in this study rated automobiles as the most impactful behavioral cause of GW, more important than in previous investigations. In terms of general activities related to GW, automobiles were correctly recognized as being a major contributor while converting to electric cars was correctly recognized as an effective strategy for slowing GW. In terms of specific behaviors, an overwhelming majority of the participants recognized that driving causes GW (near 90%) and that reducing driving can reduce GW (near 76%). Additionally, driving was rated as one of the largest contributors to GW and driving less was rated as an effective behavior to reduce GW (supporting Hypothesis 6b). Thus, participants in this sample have a good grasp on the importance of driving in GW; they believed that driving is a major contributor of GW and that reducing driving can strongly reduce an individual's impact on GW.

Not recycling was the third most commonly listed cause of GW and was listed near the top in terms of impact in the forced choice responses. Additionally, recycling was the second most commonly listed solution to GW and was rated as an effective behavior at reducing GW (supporting Hypothesis 6a). Compared to Read et al. (1994), more than twice as many participants listed recycling as a behavior to prevent GW. Other recent studies have found similar results with participants frequently listing recycling as a very effective behavior to reduce climate change (MORI, 2007).

House space heating and air conditioning constitutes 25% of the average American's total energy use (Gardner & Stern, 2008). Previous research has found that participants underestimate the impact of heating and cooling their homes on causing GW (Bord et al., 1998; O'Connor et al., 2002). In the current study, heating and cooling the house was not listed by many participants in the free response questions, and was not rated as one of the two most impactful behaviors in causing GW in the closed ended questions (supporting Hypothesis 4b), although it was rated relatively high compared to the other behaviors. Additionally, adjusting the thermostat was rated low in terms of effectiveness in reducing GW compared to other household energy use behaviors (supporting Hypothesis 6c), such as running the dishwasher, which accounts for less than 1% of an individual's total energy use (Gardner & Stern, 2008), and turning off electronics when not in use, which accounts for approximately 3% of an individual's total energy use (Gardner & Stern, 2008). Thus, although knowledge of heating and cooling the house as a contributor to GW was higher in this sample compared to previous samples, knowledge of the mitigating potential of adjusting the thermostat remains low.

Previous research has consistently found that laypeople confuse ozone depletion with GW and believe that actions that cause and mitigate depletion of the ozone hole also relate to GW (Bord et al., 2000; Brechin, 2003; Read et al., 1994; Stamm et al., 2000; Whitmarsh, 2009b). In the present study, the hole in the ozone layer was considered to be a moderate cause of GW (supporting Hypothesis 3c) and banning CFCs and stopping the release of coolant from refrigerators and air conditioners were considered to be activities that would slow GW (supporting Hypothesis 5c), even though the production and import of CFCs has been banned in the U.S. since 1996. In terms of specific behaviors, the use of aerosol spray cans was listed by 10% of the sample as a behavior they perform that causes GW, but in the closed ended question,

use of aerosol cans was not seen as a behavioral cause of GW (contrary to Hypothesis 4c). Participants rated avoiding aerosol sprays as an effective behavior they could perform to reduce GW. Overall, the present findings reflect continued conflation of the ozone hole and climate change.

In ratings of general causes of GW, the activities of cows, rice paddies, termites and swamps were rated on average as minor causes of GW, suggesting that participants are unaware of the methane produced by these activities and/or the effect of methane on GW. Methane-producing activities are important contributors to GW, as methane is almost three times more powerful in terms of climate change potential than carbon dioxide (Nickerson, 2003). On a global level, approximately 16% of global greenhouse gas emissions come from methane-related activities (IPCC, 2007c). In terms of the specific behaviors, participants in this study rarely listed eating meat as a cause of GW and rated eating meat as having a small impact on GW in both free response and forced choice questions. Per the U.S. EPA (2009a), the largest source of methane emissions in the US comes from enteric fermentation, or emissions from ruminant animals such as cows, sheep, buffalo and goats, which account for approximately 24% of the U.S.'s total CH_4 emissions. Due to the power of methane to change the climate, some climatologists have argued for a shift in focus from CO_2 producing activities to other non-CO_2 activities such as those that emit CH_4 (Hansen, Sato, Ruedy, Lacis, & Oinas, 2000). Along these lines, environmental organizations have promoted vegetarianism as the most effective action an individual can undertake to reduce climate change in the near future (Mohr, 2005). The present sample did not recognize the effectiveness of not eating meat in reducing GW.

Almost 20% of the sample listed encouraging others to reduce climate change as an effective behavior that they could do to reduce GW. This is an interesting finding not revealed by previous

research that suggests that participants in this study realized the importance and power of interpersonal communication in reducing GW. Recent research has shown that obtaining information from family and friends about climate change leads to increased knowledge about the helpfulness of solutions such as driving less and reducing home energy use (Stamm et al., 2000). Along these lines, recent research on energy use has found that although participants often underestimate the power of social norms in dictating their behavior, energy use decreases when people are told that others are conserving energy (Nolan, Schultz, Cialdini, Goldstein, & Griskevicius, 2008). Taken together, these results show that some participants are aware of the importance of interpersonal communication in mitigating GW and point to the potential for campaigns to focus on increasing communication between friends and family on GW issues.

General trends

Participants' mental models of GW revealed their tendency to rely on a pollution model of climate change whereby activities that cause or mitigate pollution were believed to be activities that cause or mitigate GW (Kempton, 1991), supporting Hypotheses 3d and 5b. Several studies have found that air pollution is often the most frequently cited cause of GW and is often believed to be the main cause of GW (Brechin, 2003; Böhm & Mader, 1998, cited in Böhm & Pfister, 2001; Dunlap, 1998; Whitmarsh, 2009b). In support of the pollution model, participants judged reducing pollution from chemical plants and meeting clean air standards as effective strategies to abate climate change, and not polluting was rated as the most effective behavior to prevent GW among the free response items (although it was not included in the forced choice items). As noted by Kempton et al. (1991), the pollution of model of GW is problematic in that measures to reduce air pollution will not necessarily reduce GW and adoption of the air pollution model points the focus for action at cars and smokestacks at the expense of other important sources of

other greenhouse gases such as methane and nitrous oxide. As such, the pollution model would predict that the effects of household energy use, meat eating, and agricultural practices on GW would be underestimated. In the present study, this supposition was supported, with participants underestimating the effects of meat eating, agricultural practices, and to a lesser extent household energy use, on GW.

One of the major trends in Read et al.'s (1994) study was that participants viewed GW more generally as an environmental problem whereby general environmentally unfriendly behaviors contribute to it and behaviors that are good for the environment in general were judged as being good for reducing GW. The same tendency to equate environmentally unfriendly actions and GW was found in the present sample. Littering was rated relatively high in terms of impact in causing GW, while throwing away garbage instead of littering was seen as the most effective behavior to reduce GW. Using environmentally friendly cleaning products and turning off the sink when brushing teeth were also viewed as effective at reducing GW. The issue of concern here is similar to that for the conflation of air pollution and GW. To the extent that participants perform behaviors to reduce GW because of their belief in the mitigating potential of that behavior, participants may be performing behaviors that have relatively little impact in mitigating GW while neglecting more impactful behaviors (Bostrom et al., 1994). Additionally, people have been found to succumb to the single action bias, the tendency to take one action to reduce a risk but be unlikely to adopt additional behaviors to further reduce the risk (Weber, 2006). The single action bias may be especially problematic if the first behavior people adopt is actually ineffective.

As this study was a conceptual replication of Read et al. (1994), an overview of the present results in relation to their findings is warranted. Comparisons are tempered by the fact that Read

et al.'s study was conducted 15 years ago and much has changed in GW landscape since then in terms of media coverage, government agendas, and presidential administrations. Additionally, Read et al.'s sample of Pittsburgh residents and local business members differs greatly in terms of demographics from the present sample of students. Despite this, comparisons are informative and can reveal different mental models of GW between the two samples. For the most part, participants' responses revealed more accurate perceptions than those found in Read et al. (1994). Participants more readily identified the role of fossil fuels in GW and more frequently rated strategies to reduce fossil fuels as highly effective. Additionally, participants were less likely to implicate aerosol sprays in causing GW than in Read et al. (1994). The pollution model of GW and the blurring of GW with general environmental problems were evident in both studies. In terms of specific behavioral causes of GW, fewer participants in this study compared to Read et al. (1994) listed aerosol sprays and using air conditioning as behaviors that cause GW while far more participants in this study compared to Read et al. (1994) listed driving as a behavioral cause of GW. In terms of specific behaviors that prevent GW, a far greater proportion of participants in this study compared to Read et al. (1994) listed reducing driving, recycling, and purchasing or using green products as behaviors that could prevent GW, while fewer participants in this study compared to Read et al. (1994) listed political actions, personal awareness or learning, reducing aerosol use, and saving energy as behaviors that could prevent GW. Overall, participants displayed a better understanding of the behaviors that cause and mitigate GW compared to Read et al. (1994) although several misperceptions revealed by their sample were also evident in this sample.

One limitation of the present study's assessment of participants' perception of the causes and mitigators of GW was that the questions did not have an "I do not know" option. Thus the nature

of the response scale likely forced some participants to guess on some questions. Providing an "I do not know option" can be expected to more accurately reveal participants' mental models of the behaviors that cause and mitigate GW. This information may better help GW campaign designers create effective messages to counteract incorrect beliefs. As such, future research should provide such an option.

Predictors of behavior

Although it was hypothesized (Hypothesis 7a) that recycling would be the behavior that participants would be most likely to perform in the future, recycling was the 3rd most highly endorsed behavior after throwing away garbage instead of littering and using the dishwasher only on a full load. That recycling was one of the most intended behaviors fits with previous surveys of the UK public (MORI, 2007; Semenza et al., 2008; Whitmarsh, 2009a). Additionally, it was hypothesized that participants would be moderately unwilling to adjust the thermostat. Participants were, on average, unsure as to whether they would adjust the thermostat within the next month, providing little support for Hypothesis 7b. Participants were, on average, somewhat likely to reduce driving by using other modes of travel. This finding contradicts Hypothesis 7d and previous research that has consistently found a relative unwillingness to reduce driving among the American and UK public (Bord et al., 1998; Gallup, 2008; MORI, 2007; O'Connor et al., 2002; Whitmarsh, 2009a). The most likely explanation for the differences concerns the characteristics of the sample in that the WSU student sample used in this study likely has more opportunities to use alternate modes of travel due to the infrastructure that facilitates bus use in Pullman and the small size of Pullman, which enables participants to walk or bike instead of drive. The findings concerning participants' willingness to purchase energy efficient appliances and house upgrades provide mixed evidence for Hypothesis 7c. Participants were surprisingly

likely to purchase efficient appliances when making new purchases, were unsure as to whether they would install insulation, and were very unlikely to install solar panels. The wording of the questions could be responsible for the differing responses regarding efficiency upgrades. Overall, the set of questions asked participants to rate the likelihood of performing each behavior over the coming month, yet the appliances question specified that efficient appliances would be purchased when needed, while the other questions did not include this qualification. Perhaps when the participants read these questions they differentiated between installing solar panels and insulation now (within the month) and purchasing efficient appliances much later when they purchased a home. Implicit in this reasoning is the fact that participants in this sample of college students are most likely to be renters who cannot make such efficiency upgrades in their homes. Overall, the behavioral intention likelihood ratings in the present study provide an interesting insight into the participants' GW behavioral intention and a nice comparison to previous research, but the applicability of the results are tempered by the characteristics of the sample described above (renters, easy access to alternate transportation).

It was predicted that GW beliefs, GW risk perceptions and knowledge of the causes and mitigators of GW would predict GW intention according to the hypothesized model presented earlier. Hierarchical regressions showed that GW beliefs predicted GW intention and that this relationship was mediated by GW risk perceptions (supporting Hypothesis 8). Additionally, GW risk perceptions predicted GW behavioral intention after controlling for general GW beliefs and this relationship was mediated by knowledge of the causes and mitigators of GW (supporting hypothesis 9). Finally, regressions showed that, after controlling for general GW beliefs and GW risk perceptions, knowledge of GW mitigators, but not causes was a significant predictor of GW behavioral intention (partially supporting Hypothesis 10). One explanation for why cause

knowledge did not predict GW intention could be accurate knowledge of GW causes leads to abatement of these GW-causing behaviors, but not necessarily performance of GW-mitigating behaviors. Future research should evaluate this possibility.

Investigating the ability of GW perceptions to predict non-GW behavioral intention provided an interesting comparison to the GW behavior results and previous research. It was hypothesized that GW perceptions would be stronger predictors of GW intention than of non-GW PEB intention. Although risk perceptions and mitigator knowledge were stronger predictors of GW behavioral intention, GW beliefs and cause knowledge were actually stronger predictors of non-GW PEB intention (only partially supporting Hypothesis 11). Further, knowledge of the causes of GW predicted intention to perform PEBs but not GW behaviors (controlling for the other variables in the model). Thus, the results show that accurate knowledge of the causes of GW may not be a necessary precursor to effective GW behavioral intention. Similarly, Whitmarsh's (2009a) found that knowledge of certain general causes of climate change (i.e., fossil fuels) predicted transport-related behaviors, but not domestic energy conservation.

The present results suggest that knowledge of behaviors that mitigate GW may be more important than knowledge of behaviors that cause GW. No previous research could be located that assessed the effect of mitigator knowledge on GW intention, although studies in other environmental domains have found that knowledge of the effectiveness of a behavior predicts intention to perform that behavior (Hall & Slothower, 2009; Lam, 2006). In the current study, a composite measure of knowledge of the behaviors that reduce GW strongly predicted intention to adopt a composite measure of GW-mitigating behaviors. Further, this study allowed for a more in-depth evaluation of the effect of belief in the mitigating potential of individual behaviors on GW intention to perform a specific behavior. Overall, these results showed that for most

behaviors, the belief that the behavior reduced GW strongly positively correlated with intention to perform that behavior. As such, one avenue for increasing GW behaviors may be to increase beliefs that adopting GW-mitigating behaviors will decrease GW (for further recommendations, see Fisbhein & Yzer, 2003). The present findings also suggest that previous researchers' focus on cause knowledge might be better directed at mitigator knowledge. Additionally, the findings suggest that campaigns outlining things that an individual can do to stop GW may be more effective at increasing GW-related behaviors than campaigns aimed at increasing knowledge about the causes of GW, although these latter campaigns may be beneficial in increasing general PEBs. Future studies could be designed to evaluate whether manipulating GW mitigator knowledge increases actual GW behavior.

One limitation of the present study was that two of the behaviors that were included to represent non-GW related behaviors (i.e., use environmentally friendly cleaning products, and do not buy leather products) could be argued to be contributors to GW. For example, it is possible that participants interpreted environmentally friendly cleaning products as those that are locally manufactured or stored in recycled containers as opposed to products that are non-toxic as was intended by the scale. Thus it may be possible that the non-GW behavior scale at least partially assessed GW behavioral intention. Additional research should conduct pilot tests to determine participants' interpretations of these behaviors.

Conclusions

Overall, the pattern of results shows that this sample's GW perceptions are improving in some areas compared to previous research, but are still flawed. Most participants believed that GW was occurring and was human caused and viewed outcomes of GW as risky. Additionally, participants recognized the importance of driving less and recycling more but were less aware of

the effectiveness of adjusting the thermostat on reducing GW. Beyond the descriptive level, this study also provides a more complete picture of the hierarchical effect of different GW perceptions on GW intention. Overall, GW beliefs, GW risk perceptions, and cause knowledge did not predict GW behavioral intention above and beyond knowledge of the mitigating potential of behaviors. The importance of accurate knowledge of the mitigating potential of behaviors in this study paves the way for further evaluation of perceptions of these behaviors. Additionally, although the present study provides evidence that knowledge of GW mitigators is an important predictor of GW, social psychological theories have shown that beliefs are but one predictor of behavior. Other variables not included here such as values, efficacy beliefs and normative beliefs likely also predict GW behavior and will be investigated in Study 2 alongside knowledge of GW causes and belief in the mitigating potential of GW behaviors in a more complete, theoretically-driven model.

SECTION THREE

STUDY 2: PREDICTORS OF GLOBAL WARMING INTENTION

Introduction

The first study focused on identifying the misconceptions that characterize perceptions of GW and showed that these perceptions influence intention to adopt GW intention. Study 2 aimed to develop a more comprehensive model of GW intention that draws on existing social psychological models of environmental behavior. Stern's (2000) Value-Belief-Norm (VBN) theory and Fishbein and Ajzen's (1975) Theory of Reasoned Action (TRA) and its extension, Ajzen's (1991) Theory of Planned Behavior (TPB), have been applied repeatedly to predicting proenvironmental behavior (Jones, 1989-1990; Nordlund & Garvill, 2002; Schultz, 2000; Schultz & Zelezny, 1999; Steg, Dreijerink, & Abrahamse, 2005; Taylor & Todd, 1995). The VBN and the TPB frameworks are used as a basis for the model presented in this study.

The VBN (Figure 2) postulates that values are abstract guiding principles that guide more specific beliefs, which in turn guide norms (Stern, 2000). According to the VBN, a person who believes that something he/she values is at risk of harm will act to reduce the threat. Specifically, the VBN states that biospheric, egoistic and social-altruistic values influence more specific beliefs such as the New Ecological Paradigm (NEP), awareness of consequences (AC) of environmental problems on valued objects, and ascription of responsibility (AR) for causing and mitigating environmental problems. These beliefs in turn influence the personal norm of moral obligation to act pro-environmentally, which in turn influences performance of pro-environmental behaviors. Thus, the VBN is a mediation chain where each intermediary variable in the model mediates the relationship between the surrounding variables (Steg et al., 2005). The VBN has been shown to be statistically significant in predicting a wide variety of environmental

behaviors (Garling, Fujii, Garling, & Jakobsson, 2003; Nordlund & Garvill, 2002; Schultz & Zelezny, 1999; Schultz, 2000; Steg et al., 2005).

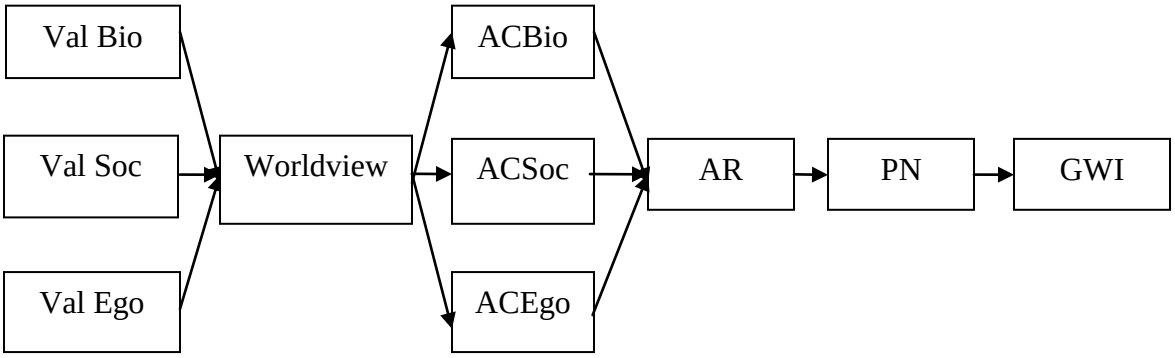

Figure 2. Depiction of the Value-Belief-Norm Theory (Stern, 2000). Note that the model does not depict paths between variables that are not adjacent although the VBN allows for partially mediated paths between nonadjacent variables. Additionally, correlations among the values and correlations among the AC scales are implicit in the model.

As mentioned above, the TPB and its predecessor the TRA have also been used to explain proenvironmental behavior. The TPB and TRA are based on the assumptions that behavioral intentions "follow reasonably from…beliefs about performing the behavior" and that behavioral intention leads directly to behavior (Ajzen & Fishbein, 2005, p. 193). The core of the models (Figure 3) centers on the premise that intention is predicted by attitudes, subjective norms, and perceived behavioral control (in the TPB). In the TPB and TRA, attitudes are specifically defined as positive or negative evaluations of performing the behavior and are influenced by behavioral beliefs, considerations of the advantages and disadvantages of performing the behavior, and evaluation of the behavioral beliefs (Ajzen & Fishbein, 2005). Subjective norms are defined as perceived pressures from important others to perform a behavior and are influenced by normative beliefs, considerations of whether important social groups would approve or disapprove of the performance of the behavior, and motivation to comply with these social groups (Ajzen & Fishbein, 2005). Perceived behavioral control (PBC) was the most recent

predictor added to the model and its introduction marked the evolution of the TRA to the TPB (Ajzen, 1991). PBC refers to beliefs about how easy or difficult it is to perform the behavior and is influenced by control beliefs, considerations of factors that make the behavior easier or more difficult to perform, and perceived power of the factor. PBC was added to the TRA when it became apparent that not all behaviors were under volitional control (Ajzen, 1991). Thus, regardless of attitudes and subjective norms toward the behavior, if one perceives that he/she has little control over whether or not to perform the behavior, then he/she will not likely intend to perform the behavior (Ajzen, 1991). To the extent that PBC reflects actual control over the behavior, it is expected to directly predict behavior (Ajzen, 1991). The TPB has been shown to be statistically significant in predicting a variety of environmental behaviors (Heath & Gifford, 2002; Kaiser, Hubner, & Bogner, 2005; Taylor & Todd, 1995).

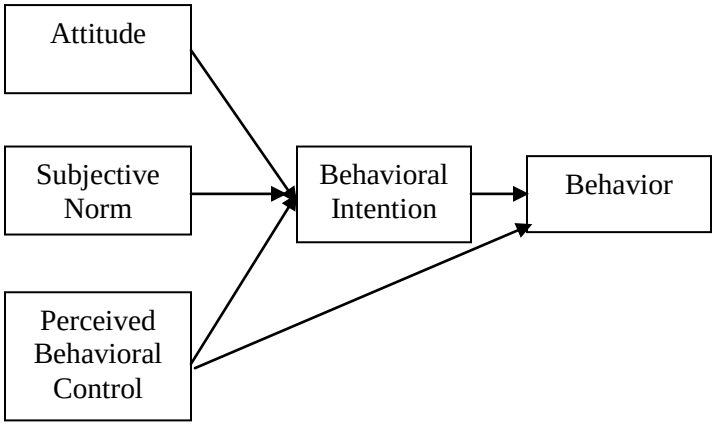

Figure 3. Depiction of the Theory of Planned Behavior (Ajzen, 1991).

This study aims to develop a model of GW behavioral intention that draws on the TPB and VBN. Bamberg and Moser (2007) noted that researchers who use the TRA/TPB view proenvironmental behavior as primarily motivated by self-interest, as the TRA/TPB is a rational choice model, while researchers who use the VBN view proenvironmental behavior as primarily motivated by altruism. But, research has shown that proenvironmental behavior (PEB) in certain

domains can be motivated by both altruism and self-interest (Bamberg & Moser, 2007; Ewing, 2001; Stern, 2000). As such, a more complete model of PEB most likely involves a hybrid of the TRA/TPB and VBN model and includes constructs from both models.

Recently, Bamberg and Moser (2007) conducted an extensive meta-analytic review of research on proenvironmental behavior conducted during the last 20 years. Drawing on the TPB and VBN as a basis for their hypothesized model, they found that PBC, attitude and moral norm, as direct predictors of behavioral intention, explained, on average, 52% of the variance in behavioral intention, with each standardized path coefficient reaching close to 0.30. Additionally, social norm and feelings of guilt were significant predictors of PBC, attitude and moral norm. Internal attribution (akin to ascription of responsibility for causing environmental problems) influenced social norms, moral norms, feelings of guilt and attitude. In total, moral norms were predicted by guilt, social norms, internal attribution, and problem awareness/ knowledge, together which explained 58% of the variance in moral norms.

In keeping with Bamberg and Moser's (2007) findings, several researchers have noted that the TPB/TRA and VBN, though significant at predicting environmental behavior, may benefit from the addition of other variables or a form of hybrid model combining certain elements of each model (Garling et al., 2003; Harland, Staats, & Wilke, 1999; Kaiser, Ranney, Hartig & Bowler, 1999; Oreg & Katz-Gerro, 2006; Oom do Valle, Rebelo, Reis, & Menezes, 2005). Taken together, the results of these studies suggest that several key variables be examined in predicting GW behavior. Below, I briefly review the theoretical rationale and research for why these key variables may be important predictors of GW behavioral intention. The variables of interest are: values, awareness of consequences, environmental concern, ascription of

responsibility, knowledge, personal norm, social norm, PBC/self-efficacy, response efficacy, collective efficacy, and collective response efficacy.

Values

Rokeach defined values as "enduring beliefs that a specific mode of conduct is personally or socially preferable to an opposite or converse mode of conduct or end-state of existence" (1968, p. 160 as cited in Dietz, Fitzgerald, & Shwom, 2005, p. 347). As such values are broad, general beliefs about desirable end states that are prioritized in terms of importance and serve as guiding principles for action (de Groot & Steg, 2008; Schwartz & Bilksy, 1987).

Research on the role of values in environmentalism grew primarily out of Stern and colleagues' (Stern, Dietz, & Kalof, 1993; Stern, Dietz, Kalof, & Guagnano, 1995) theorizing that certain value orientations should lead to feelings of moral obligation to take proenvironmental action, just as Schwartz (1977) had theorized that an altruistic value orientation could lead to feelings of moral obligation to help others. In addition to his development of the norm activation theory, Schwartz also conducted seminal research on the universalism of value orientations (Struch, Schwartz, & van der Kloot, 2002; Schwartz, 1992; Schwartz & Bilsky, 1987). Drawing on Rokeach's (1973) early work on values, Schwartz (1992) identified 10 value types: power, achievement, hedonism, stimulation, self-direction, universalism, benevolence, tradition, conformity, and security. Theoretically, these value types are organized along two major bipolar dimensions: self-enhancement vs. self-transcendence and openness to change vs. conservation/tradition (Schwartz, 1992).

The focus on values in the environmental behavior literature has primarily centered on three value orientations: egoistic orientation, biospheric orientation and social-altruistic orientation (Stern et al., 1993; 1995). People with an egoistic value act proenvironmentally in situations

where doing so maximizes benefits to the self. For example, a person with an egoistic value orientation may be inclined to carpool to work to reduce the personal health effects of pollution. People with a social-altruistic value orientation act proenvironmentally in situations where doing so maximizes benefits to humankind. For example, a social-altruistic value orientation may lead a person to carpool to work to reduce the general threat to humans of climate change. Finally, people with a biospheric value orientation act proenvironmentally in situations where doing so maximizes benefits to the biosphere (plants and animals), regardless of the effect on humans or the self. For example, a biospheric value orientation may lead a person to carpool to work to reduce the need for expanded highway lanes that would infringe upon natural habitat and harm plants and animals.

Stern et al. (1995) recognized that Schwartz's (1992) self-enhancement values (power, achievement) reflect egoism, while Schwartz's (1992) self-transcendence values (universalism and benevolence) reflect social-altruism and to a lesser extent biospherism. To more fully represent the biospheric orientation, Stern and colleagues added two biospheric items to Schwartz's Value Survey. Even with this addition, Stern et al. (1995) found that the general public did not distinguish between biospheric value orientation and social-altruistic value orientation as had been theorized by environmental researchers. In 1998, Stern, Dietz, and Guagnano created a brief version of Schwartz's Value Survey. Again, the general public did not distinguish between social-altruism and biospherism. More recently, de Groot and Steg (2008) extended Stern et al.'s (1998) brief values inventory. De Groot and Steg (2008) limited their focus to the values clusters expected to influence proenvironmental behavior, namely self-transcendence and self-enhancement values. Through a series of studies, they added one altruistic item and one egoistic item to the Scales developed by Stern et al. (1998). In general, de

Groot and Steg (2008) found that biospheric and altruistic value orientations positively correlated, but were distinct via confirmatory factor analysis. Additionally, they found discriminant validity supporting the altruistic-biospheric distinction in that altruistic values positively (and biospheric values negatively) predicted the preference to donate to humanitarian charity versus an environmental charity.

Additional research has shown that environmental values predict proenvironmental attitudes, intention and behavior. Self-transcendent values have been shown to positively correlate with concern for environmental consequences on the biosphere and negatively correlate with concern for environmental consequences on the self (Schultz, Gouveia, Cameron, Tankha, Schmuck, & Franek, 2005). Additionally, self-transcendent values have been shown to positively predict awareness of environmental problems (Nordlund & Garvill, 2002), feelings of moral obligation to reduce environmental problems (Nordlund & Garvill, 2002), support for climate change policies (Dietz et al., 2007), and intention to perform political behavior, perform consumer behavior, and willingness to sacrifice (Stern et al., 1995; 1998).

When biospheric values are investigated separately from altruistic values, biospheric values are usually found to be significant predictors of environmental attitudes, intention, and behavior, while the picture for altruistic values is less clear. Specifically, biospheric values have been shown to positively predict endorsement of the NEP Scale (de Groot & Steg, 2008; Steg et al., 2005) and willingness to accept several policy measures to reduce climate change (Nilsson, von Borgstede, & Biel, 2004). On the other hand, social-altruistic values have been found to negatively relate to NEP (de Groot & Steg, 2008 Study 1; Steg et al., 2005) and not significantly relate to NEP (de Groot & Steg, 2008 Study 2).

Egoistic values have consistently been found to negatively predict environmental attitudes, intentions, and behavior (c.f., Nilsson et al., 2004). Specifically, the egoistic value orientation has been found to negatively predict recycling attitudes (de Groot & Steg, 2008), NEP (de Groot & Steg, 2008), general awareness of consequences of environmental problems (Nordlund & Garvill, 2002), feelings of moral obligation to reduce environmental problems (Nordlund & Garvill, 2002), concern for consequences of environmental problems on the biosphere (Schultz et al., 2005), and environmental political behavioral intention (Stern et al., 1998). On the other hand, egoism has been shown to positively correlate with concern for environmental consequences on the self (Schultz et al., 2005).

The above review highlights the importance of values in predicting environmental attitudes, intention and behavior. In line with these findings, the present study will test the impact of biospheric, altruistic, and egoistic values in a model predicting GW intention.

Awareness of consequences and environmental concern

Awareness of consequences (AC), defined by Stern (2000, p. 413) is an awareness of "adverse consequences to whatever the individual values." In terms of environmental issues, "people who believe that an environmental condition has adverse consequences (AC) for things they value will be predisposed to take action" (Stern et al., 1993, p. 328). According to the VBN, people's values predispose them to seek out information about threats to valued objects (Stern et al., 1994). Thus each of the three value orientations is expected to lead to beliefs about the adverse consequences that might befall each valued object. For example, a person who values the biosphere is expected to be aware of negative consequences of environmental problems on plants and animals (biospheric AC). Similarly, a person with social-altruistic values is expected to be aware of the negative consequences of environmental problems on humans (social-altruistic AC).

Additionally, a person with egoistic values is expected to be aware of the negative consequences of environmental problems on the self (egoistic AC). The three type of awareness of consequences beliefs are not mutually exclusive as people could be simultaneously aware of the negative consequences of environmental problems on the self, others, and the biosphere. Several researchers have found support for the role of AC among VBN constructs in predicting environmental behavior and intention (Schultz et al., 2005; Stern et al., 1995; Stern, Dietz, Abel, Guagnano, & Kalof, 1999) and GW related attitudes (Steg et al., 2005).

Although Stern's VBN categorizes AC as a belief, he has used the term "concern" when describing AC (Stern, 2000, p. 413). In the social psychological literature, belief and concern are distinct concepts. Strictly speaking, a belief about a valued object is cognitive, such as knowledge about the object. On the other hand, concern connotes an affective element, such as a positive or negative evaluation of the object (Leiserowitz, 2005), and can be defined in terms of environmental concern as "the affect associated with environmental problems" (Schultz et al., 2005, p. 458). Although Stern's use of concern to describe AC beliefs may have been unintentional, it may also indicate an inclination to view environmental behavior as resulting from both cognitive and affective based attitudes. Research has found that people's attitudes toward GW are unlikely to be strictly cognitive and are laden with affect (Lorenzoni et al., 2006). Additionally, a recent study found that general concern for climate change predicted self-reported behavior change in response to climate change (Semenza et al., 2008). Along this line, Schultz (2000; 2001) developed the environmental concern (EC) scales which mirror Stern's distinction between egoistic AC (ACego), biospheric AC (ACbio) and social-altruistic AC (ACsoc), but focus on concern about (and not just awareness of) the consequences of environmental problems on each of these valued domains. Schultz and colleagues have found

that biospheric and egoistic EC are directly related to values (Schultz et al., 2005) and environmental behavior (Schultz, 2001; Schultz et al., 2005).

Environmental concern may also be seen as perceived risk. Bord et al. (1998) noted that in most surveys of GW perceptions, perceived risk is not actually assessed in terms of perceived vulnerability and perceived severity of a threat. Instead, researchers in this domain have assessed perceived threat, or "a sense that something bad will happen that could have wide-ranging, very negative impacts" as a proxy of risk (p. 79). In an attempt to reconcile the findings from the risk perception literature with VBN studies, Dietz and colleagues have equated risk perceptions and AC (Stern & Dietz, 1994; Slimak & Dietz, 2006). For example, Stern and Dietz (1994) viewed risk perceptions as "a class of beliefs about the consequences of environmental changes for valued objects" (p. 79) and noted that "perceived risks can be seen as perceived negative consequences to things people value." Following Bord et al.'s (1998) recommendations, risk perception as measured in these studies should be more clearly defined as perceptions of threat to valued objects. Additionally, EC as opposed to AC may be a better measure of perceived threat, as EC incorporates an affective dimension.

Several national and international polls have found that people's concern for GW can be characterized according to Schultz's biospheric, egoistic, and social-altruistic ECs (Bord et al., 1998; Bord et al., 2000; Dunlap, 1998; Kempton, 1993; Kirby, 2004; Leiserowitz, 2005; Stamm et al., 2000). Of these poll studies, only Bord et al. (2000) investigated the effect of GW ECs on behavioral intention and found that belief that GW was a societal threat and belief that GW was a personal threat predicted intention to adopt behaviors to reduce GW (note that they did not measure biospheric EC).

Recently Snelgar (2006) recommended using Schultz's (2000; 2001) EC scales in lieu of Stern et al.'s (1993; 1995) AC scales in VBN studies after she found the EC scales to be psychometrically superior to the AC scales. However, the belief vs. concern distinction outlined above may caution against simply supplanting AC with EC. Instead, Hansla et al. (2008) has shown that AC and EC may both play a role in the VBN. Specifically, they showed that biospheric, social-altruistic and egoistic AC partially mediated the relationship between values and biospheric, social-altruistic and egoistic EC, respectively. Although Hansla et al. (2008) did not assess the other constructs of the VBN, their findings point to the potential for future studies to investigate both EC and AC simultaneously.

In terms of TPB, at least one study has investigated the role of biospheric, social-altruistic and egoistic ECs within the TPB framework in predicting GW related behaviors. De Groot and Steg (2007) investigated intentions to use a proposed park-and-ride program. Although they hypothesized that attitudes toward the park-and-ride program would mediate the general environmental concern-intention relationship, they were unable to test for mediation using hierarchical regression because ECs did not significantly predict intention. De Groot and Steg (2007) were able to show that only ECego (not ECbio or ECsoc) predicted attitudes and attitudes in turn, along with PBC and SN, predicted intention to use the park and ride program. Additional research is needed to evaluate the role of ECs in GW behavioral intention.

Ascription of responsibility

Ascription of responsibility (AR) refers to "beliefs about responsibility for causing or ability to alleviate threats to any valued objects" (Stern et al., 1999, p. 83). According to the VBN theory, personal norms to act to mitigate environmental problems are activated when a person is aware that a valued object is threatened by environmental problems (AC) and feels responsibility

for causing or reducing the threat to the valued object (AR; Stern, 2000). As such, AC leads to AR, which leads to personal norms (Garling et al., 2003; Stern, 2000; c.f. Schultz et al., 2005 who tested the VBN as a moderation model).

Although several studies have applied the VBN to environmental behavior, only four studies could be located that included the AR construct. In these studies, AR has been operationally defined very specifically in terms of accusations that industry and government are responsible for hazardous chemical pollution because of specific actions they have taken (Stern, Dietz, & Black, 1985-86), and very generally in terms of general feelings of personal responsibility for causing GW (Steg et al., 2005) or environmental problems in one's community and worldwide (Schultz et al., 2005) and belief that every citizen must take responsibility for the environment (Garling et al., 2003). None of these operational definitions encompasses both aspects of Stern et al.'s (1999) definition of AR as responsibility for causing and/or alleviating environmental problems.

In terms of GW, AR, as it is viewed by Stern et al. (1999), appears to consist of two distinct subconstructs: belief that one's behavior causes GW, and belief that one should feel personal responsibility to act to reduce GW. As suggested by Stern and colleagues, these beliefs of responsibility are most likely positively related: as beliefs of responsibility for causing GW increase, beliefs of responsibility for acting to reduce GW increase. The separation of these constructs is essential, though, because it is quite plausible that a person could believe he/she is responsible for causing GW, but believe that another entity (e.g., government, innovative scientists, etc.) is responsible for mitigating it. Alternatively one who lives a carbon-neutral lifestyle may not feel responsibility for causing GW but may feel responsibility in acting to reduce GW. Research is needed to examine whether AR cause (belief that one is responsible for

causing GW) and AR response (belief that one is personally responsible for acting to reduce GW) are distinct constructs and to evaluate the role of each in predicting personal norms as theorized by the VBN.

Personal Norms

Personal norms are individualized feelings of moral obligation to carry out a behavior (Schwartz, 1977). In Stern's VBN, personal norms are expected to be activated when a person realizes that a valued object is threatened by environmental problems (AC) and the individual believes that he/she is responsible for lessening the environmental problems (Stern, 2000). Once personal norms are activated, they motivate the individual to take action to protect the valued object, often through proenvironmental behavior (Stern, 2000).

Within the VBN framework, personal norms have been found to predict a wide array of environmental intentions and behaviors. Specifically, personal norms have been found to predict willingness to reduce car use (Nordlund & Garvill, 2003), frequency of performance of general proenvironmental behaviors (Nordlund & Garvill, 2002), acceptability of climate change policies (Steg et al., 2005), consumer behavior (Stern et al., 1999), willingness to sacrifice (Stern et al., 1999), environmental citizenship (Stern et al., 1999), and proenvironmental behavioral intention (Garling et al., 2003).

Several researchers have suggested that personal norms should be added to the TPB (c.f. Kaiser et al., 2005). Harland et al. (1999) noted that the TPB originally consisted of both subjective and personal norms, but the personal norms component was dropped because it was so highly correlated with intention and so was thought to be a measure of intention (Ajzen & Fishbein, 1969; 1970 as cited in Harland et al., 1999). In Harland et al.'s (1999) study, personal norms added significant explanatory power above the TPB variables (attitudes, subjective norms,

and perceived behavioral control) in predicting GW-related behavioral intentions such as intention to use transport forms besides cars, use energy-saving light bulbs and reduce meat consumption. Additional variance explained by the addition of personal norms to the TPB variables ranged from 1% for transport forms besides cars to 10% for reducing meat consumption (Harland et al., 1999). Heath and Gifford (2002) also investigated the effect of personal norms among the traditional TPB variables when evaluating intentions to use the city bus after an intervention to make the bus more convenient near a Canadian university. They found that before the intervention, moral norms were important in predicting intention (but not actual bus usage), but after the intervention, when the bus system was more convenient, personal moral norms did not predict intention or actual bus usage (Heath & Gifford, 2002).

On the other hand, Kaiser et al. (2005) have argued against including personal norms as a fourth predictor of intention in the TPB when investigating conservation behavior. Kaiser et al. (2005) found that the TPB constructs alone accounted for 76% of the variance in intention. When personal norms were added as a predictor of intention, the amount of explained variance increased to 81%, but the path from subjective norms to intention was no longer significant (Kaiser et al., 2005). As the original model was satisfactory, Kaiser et al. (2005) argued against adding this path from personal norm to intention. Instead, they suggested adding personal norms as a predictor of attitude, as this path increased the variance accounted for in intention by 9%. Yet, Kaiser et al. (2005) did not specify whether personal norms mediated the subjective norm-intention relationship when personal norms were added as a fourth predictor of intention. Considering a recent meta-analysis found that moral norms mediated the relationship between social norms and intention (Bamberg & Moser, 2007), this may provide additional evidence for including moral norms as a direct predictor of intention. Additional research is needed to

evaluate the direct effect of personal norms, in addition to social norms, on GW intention and the potential for personal norms to mediate the effect of social norms on GW intention.

Social Norms

In their early work, Stern and colleagues (1994) noted that their extension of the norm activation theory leaves out social influence agents that may impact the relationship between values and beliefs and attitudes. Additionally, Schwartz (1977) noted that social norms may play a role in the norm activation theory to the extent that they are internalized as personal norms and potentially independent of personal norms. In contrast to the VBN, the TPB explicitly recognizes the role of social norms in predicting behavioral intention.

Social norms in the TPB are called subjective norms and are defined as "the perceived social pressure to perform or not to perform the behavior" (Ajzen, 1991, p. 188). Subjective norms in the TPB framework are usually operationalized by asking participants whether important others would approve or disapprove of them performing the behavior of interest and whether they are motivated to comply with these important others' beliefs. In Armitage and Conner's (2001) meta-analysis, subjective norms were the weakest predictor of behavioral intention, which they hypothesized as being partly due to the insufficiency of subjective norms to capture normative feelings resulting from personal norms and descriptive norms. Descriptive norms refer to what people do and can be defined as beliefs that others are performing the target behavior (Cialdini, Reno, & Kallgren, 1990). As such, descriptive norms, beliefs about what people typically do, differ from subjective norms, beliefs about what important others think one ought to do. Descriptive norms may prove especially useful as a measure of social norms because they reflect more subconscious motivations on behavior. Recent research has noted that, although

participants rated descriptive norms as minor influences on their behavior, descriptive norms were the greatest actual influence on energy conservation behavior (Nolan et al., 2008).

Terry, Hogg, and White (1999) investigated perceptions of group norms, particularly descriptive norms, along with TPB constructs, group identity and self-identity in predicting recycling intentions. Results showed that subjective norms were not significant predictors of behavioral intention, but group norms were significant predictors when group identity was high (Terry et al., 1999). Additionally, Heath and Gifford (2002) found that before an intervention was applied to make bus use more convenient near a Canadian university, descriptive norms predicted bus usage above and beyond the TPB constructs of attitude, subjective norm, PBC, and intention. After the intervention, descriptive norms predicted intention to use the bus system and actual bus usage (Heath & Gifford, 2002). Changes in bus use pre and post intervention resulted from changes in descriptive norms (and intention), such that increases in bus usage were driven by increases in descriptive norms of bus usage (Heath & Gifford, 2002).

Several researchers have also looked at the effect of descriptive norms in environmental field studies outside of the TPB framework. Descriptive social norms have been found to predict littering (Cialdini et al., 1990), recycling (Schultz, 1998), towel reuse in hotels (Goldstein, Cialdini, & Griskevicius, 2008) and household energy use (Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007; Nolan et al., 2008). Additionally, the importance of social norms in understanding GW behavior has recently been noted (Griskevicius, Cialdini, & Goldstein, 2008). In sum, descriptive norms are expected to play a role in predicting GW behavioral intention and are used instead of subjective norms as the measure of social norms in the present study.

Cause knowledge

Bamberg and Moser's (2007) recent meta-analysis concluded that knowledge of environmental problems, or problem awareness, was an important predictor in their environmental behavior model, albeit distal from intention. Knowledge directly predicted internal attribution, social norms, moral norms, and guilt and indirectly predicted intention. In fact, the total effect of knowledge on intention was larger than all other variables in the model (Bamberg & Moser, 2007). This finding averaged over many studies underscores the importance of knowledge of environmental problems in predicting environmental behavioral intention. Unfortunately, Bamberg and Moser (2007) did not explicitly operationally define knowledge. Considering the fact that they drew on findings from many studies, the individual definitions of the researchers on which the meta-analysis is based likely vary widely and could potentially refer to factual knowledge about the state of environmental problems, knowledge about consequences of environmental problems, or knowledge about the causes and mitigators of environmental problems.

The type of knowledge under investigation has major implications for its relationship with behavior (Kaiser, Wolfing, & Fuhrer, 1999). According to the TPB, factual knowledge about the state of environmental problems is likely a precursor to behavioral and normative beliefs, which relate to behavior only indirectly through attitudes, subjective norms and intentions (Ajzen, 1991; Ajzen & Fishbein, 2005). Thus, for knowledge about the state of environmental problems, no direct relationship with behavior would be expected. Similarly, the VBN constructs of awareness of consequences of environmental problems and beliefs about responsibility for causing or mitigating environmental problems are expected to only indirectly predict behavior through personal norms (Stern, 2000). (Note that AC refers to beliefs about consequences of

environmental problems on valued objects while cause knowledge refers to beliefs about specific behaviors that cause environmental problems.) Knowledge specific to behaviors that cause environmental problems may likely be more proximally related to behavioral intention than AC and AR. Research has shown that "knowledge about an ecological behavior (i.e., knowledge about what and how something can be done) rather than factual knowledge about the environment…is related to ecological behavior" (Kaiser, Wolfing et al., 1999, p. 4).

Several studies have assessed the relationship between knowledge of causes of GW and intention to act to mitigate GW. These studies differ from the current investigation in that they have measured knowledge of the causes of GW in terms of participants' self-reported rating of GW knowledge (Heath & Gifford, 2006) or focused on actual knowledge of general causes of GW, not individual citizens' behaviors that cause GW (Bord et al., 2000; Kaiser, Wolfing et al., 1999; O'Connor et al., 1999; O'Connor et al., 2002; Whitmarsh, 2009a). Additionally, these studies differed in the specificity of their measures of behavior. O'Connor and colleagues assessed intentions in terms of specific behaviors that people could do (e.g., "Install more insulation and weatherize homes and apartments" (Bord et al., 2000; O'Connor et al., 1999, p. 464) and "Carpool at least a couple of days each week' (O'Connor et al., 2002, p. 9)). Whitmarsh (2009a) asked open-ended questions about the actions people perform to mitigate climate change. Heath and Gifford (2006, p. 68) measured intention to act with very general items (e.g., "I plan to take some actions to stop GW") and Kaiser, Wolfing et al. (1999) measured intention strictly in terms of automobile use. Most likely due to the differing methodologies, these studies have produced differing results, with Bord et al. (2000), O'Connor et al. (1999; 2002) and Kaiser, Wolfing et al. (1999) finding that knowledge of causes of GW predicted behavioral intentions; Heath and Gifford (2006) finding that knowledge of the causes of GW did not predict

intentions; and Whitmarsh (2009a) finding that knowledge of only certain causes predicted behavior. To sort out these inconsistent findings, additional research is needed to determine the relationship between people's knowledge of the specific behaviors they perform that cause GW and their intention to perform behaviors that mitigate GW.

Investigating the role of cause knowledge in a modified VBN or TPB may prove useful. In fact, a precursor theory to the VBN (Stern and Oskamp's (1987) model of resource use) included knowledge of actions that cause environmental problems as a predictor alongside AC and AR beliefs (Stern, 1992; originally cited in Stern and Oskamp, 1987). In the VBN, AR and AC beliefs are included, yet cause knowledge has not been retained from Stern and Oskamp's model. Theoretically, cause knowledge should be closely related to AR cause, belief that one is responsible for causing environmental problems. For example, in terms of GW, in order to feel personal responsibility for causing GW, one must know that his/her personal behaviors are contributing to GW. Some research has provided support for this assertion. Kaiser, Ranney, et al. (1999) investigated the role of environmental knowledge in predicting ecological behavior within a modified TRA framework, where environmental knowledge replaced attitude, environmental values replaced subjective norms, and AR cause was added as a predictor of intention. Kaiser, Ranney et al. (1999) found that cause knowledge strongly correlated with AR cause and that both cause knowledge and AR cause (along with environmental values) significantly predicted behavioral intention (Study 1). The strong intercorrelations between the AR cause and cause knowledge variables point to the presence of mediated or indirect relationships through each other on behavioral intention (Kaiser, Ranney et al., 1999). In Study 2, the only direct predictor of intention was AR cause, but again AR cause was strongly correlated with cause knowledge and values, so indirect effects are likely (Kaiser, Ranney et al.,

1999). The inclusion of AR and the finding that AR is a likely mediator between knowledge and behavioral intention in Kaiser, Ranney et al.'s (1999) study harkens back to the VBN's mediation chain where AR mediates the relationship between beliefs and values and behavior. Kaiser, Ranney et al.'s (1999) results suggest that cause knowledge may be a significant predictor in VBN models predicting GW behavior and, as such, cause knowledge should be included in the models predicting GW behavioral intention.

Dietz et al. (2007) included self-rated level of climate change informedness in a modified VBN model predicting support for climate change policies. Results showed that amount of climate change information did not predict support for climate change policies. Yet, Dietz et al. (2007) did not assess the full VBN (i.e., they did not include AR or personal norms) and did not assess actual knowledge of climate change causes. The current study differs from that of Dietz et al. (2007) in that the dependent variable was intention to perform individual behavior, AR and personal norms were included in the model, and knowledge was assessed with actual factual knowledge, not self-reported level of knowledge.

Self-efficacy / PBC

Self-efficacy is a belief "in one's capabilities to organize and execute the courses of action required to produce given levels of attainments" (Bandura, 2000b, p. 18). According to Bandura's theory (1977), the major premise behind self-efficacy is that one who feels capable of performing a certain behavior will be more likely to expend effort to accomplish the behavior and to persist in attempting to accomplish behavior in the face of barriers. As such, people who have high efficacy beliefs are more likely to successfully accomplish that behavior.

Thus, self-efficacy is very similar to Ajzen's (1991) PBC in the TPB, defined as "perceived ease or difficulty of performing the behavior" (Ajzen, 2002, p. 665). Per Ajzen and Fishbein

(2005), "control beliefs lead to the perception that one has or does not have the capacity to carry out the behavior," and this perception is "referred to variously as self-efficacy…or perceived behavioral control" (p. 193). As a result of the lack of clarity in the definition of PBC, researchers have operationalized PBC either in terms of self-efficacy (belief that an actor can perform the behavior) or controllability (belief that performance of the behavior is up to the actor) or both (Ajzen, 2002). Reviews of the TPB literature have found that, after controlling for attitude and subjective norm, self-efficacy predicted intention and behavior, controllability predicted behavior, but not intention, and the measures that combined self-efficacy items and controllability items predicted intention but not behavior (Cheung & Chan, 2000 as cited in Ajzen, 2002). Additionally, in the few studies where self-efficacy and controllability beliefs were investigated simultaneously, self-efficacy always predicted intention and sometimes predicted behavior, while controllability did not predict intentions and only predicted behavior in one study (Ajzen, 2002). Results based on a recent meta-analysis of 185 studies employing the TPB, led Armitage and Conner (2001) to conclude that "self-efficacy should be the preferred measure of 'perceived control' within the TPB" (p. 488).

Many TPB studies have employed the self-efficacy measure of PBC to predict environmental behavioral intention. When assessed alongside attitudes and subjective norms, PBC, operationalized as self-efficacy, has been found to predict German students' intention to engage in conservation behavior (Kaiser et al., 2005); Dutch residents' intention to use a park and ride program (de Groot & Steg, 2007); Canadian students' intention to use the bus system (Heath & Gifford, 2002); and Dutch residents' intention to use unbleached paper, use alternate transport forms besides cars, use energy-saving light bulbs, and turn off the faucet while brushing teeth (Harland et al., 1999). On the other hand, some studies have found that PBC operationalized as

self-efficacy does not predict certain environmental behavioral intentions. For example, PBC did not predict Taiwanese residents' intention to install a dual-flush controller (Lam, 2006) or Dutch residents' intention to reduce meat consumption (Harland et al., 1999).

Few studies have investigated self-efficacy in the environmental domain outside of the TPB theory. In one recent exception, the effect of self-efficacy (and environmental knowledge) on proenvironmental behavior was examined among adolescents (Meinhold & Malkus, 2005). Self-efficacy (measured in both general efficacy terms and proenvironmental behavior-specific terms) was shown to be a positive predictor (along with environmental attitudes) of proenvironmental behavior. Additionally, environmental knowledge was found to be a positive predictor of proenvironmental behavior and a moderator of the attitude-proenvironmental behavior relationship. Unfortunately in Meinhold and Malkus' (2005) study, self-efficacy and environmental knowledge were not examined in the same regression equation so their joint effects on proenvironmental behavior could not be evaluated. Bandura (1982) has noted that knowledge is "necessary but insufficient for accomplished performances" (p. 122) and that self-efficacy should mediate the knowledge-behavior relationship (Bandura, 1982). Additional research is needed to test this assertion in the domain of environmental behavior.

Personal response efficacy

In addition to the role of *self-efficacy* in motivating behavior, Bandura has also identified the importance of *response efficacy* (or outcome expectancy), "a person's estimate that a given behavior will lead to certain outcomes" (Bandura, 1977, p. 193). Self-efficacy is a belief that one is capable of carrying out a behavior while response efficacy is a belief that the behavior will have the desired outcome. Bandura (1977) elaborated on the distinction between these two constructs by outlining the situation when someone believes that a behavior will lead to desired

outcomes, but is unconfident that he/she can successfully perform the behavior. Rogers' Protection Motivation Theory also makes this distinction between response efficacy and self-efficacy explicit (Rippetoe & Rogers, 1987).

Protection Motivation Theory outlines how persuasive fear appeals elicit cognitive appraisal processes that lead to maladaptive responses (such as hopelessness or avoidance) or adaptive responses (such as adoption of the behavior recommended to reduce the danger; Rippetoe & Rogers, 1987). Response efficacy (and self-efficacy) increases the perception of being able to cope with the danger, which increases the probability of adaptive responses (Rippetoe & Rogers, 1987). According to Bandura's theory, personal response efficacy is expected to lead to persistence and effort in achieving the behavior because one who believes that a behavior will have a desired outcome will work harder to achieve that behavior in the face of obstacles (Bandura, 1977). The increased persistence and effort in turn leads to greater likelihood that the behavior will actually be achieved. Although Bandura's response efficacy is a more general construct than Rogers', which focuses only on efficacy related to threats, both reflect a belief that a behavior will have the desired outcome.

Some recent research has found that response efficacy predicts environmental intention and behavior. In a study of environmental activism behavior, Lubell (2002) found that personal efficacy (operationalized as self-efficacy and personal response efficacy) predicted environmental activism and activism intention. Hall and Slothower (2009) found that response efficacy (but not self-efficacy) predicted intention to create a defensible space around one's home to protect it from wildfire, although attitude was a stronger predictor. In regard to GW, response efficacy beliefs have been shown to predict perception of personal risk of GW (Brody, Zahran, Vedlitz, & Grover, 2008). Similarly, Heath and Gifford (2006) found that response

efficacy was the strongest predictor of GW behavioral intention above belief that climate change is occurring, belief that causes are man-made, and belief that consequences are negative. Overall, these studies suggest that response efficacy is an important variable in predicting environmental behavioral intention and should be included in future models of environmental behavior.

Collective efficacy and collective response efficacy

In addition to self-efficacy, social cognitive theory also recognizes that collective efficacy may play a role in behavior (Bandura, 2000a). Bandura has defined collective efficacy as "a group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainments" (Bandura, 1997, p. 477) and as "people's shared beliefs in their collective power to produce desired results" (Bandura, 2000a, p. 75). These definitions appear to encompass both collective-level efficacy and response efficacy beliefs. The distinction made at the individual level between self-efficacy and response efficacy may be helpful at the collective level. Collective efficacy can be defined as a belief that a group is capable of accomplishing a task, and collective response efficacy can be defined as a belief that a the task will achieve a desired outcome by performing a behavior. Mirroring Bandura's (1977) distinction between self-efficacy and response efficacy, at the collective level an individual may believe that group adoption of a certain behavior will lead to a desired outcome but may believe that the group is unable to perform the behavior.

Others have similarly noted the distinction between collective efficacy and collective response efficacy (Lam, 2006; Riggs & Knight, 1994). Riggs and Knight (1994) looked at the effects of personal efficacy, personal outcome expectancy (response efficacy), collective efficacy, and collective outcome expectancy (collective response efficacy) on job satisfaction and organizational commitment. Although Riggs and Knight (1994) did not investigate

behavior, they did find support for a model of job satisfaction and organizational commitment that linked personal response efficacy and collective efficacy (but not self-efficacy or collective response efficacy) to satisfaction and commitment. Other studies investigating behavior without using the collective efficacy-response efficacy distinction have found general collective efficacy to predict group level achievement (Bandura, 1997; 2000a).

Collective efficacy is especially likely to influence behavior in interdependent situations when individuals must work together to achieve desired outcomes (Bandura, 2000a). Environmental problems, such as GW, are prime examples of such situations. In reality, the behavior of one individual (except perhaps individuals in the upper echelons of government and corporations) will not have a discernable impact on GW. Only when many people act together to reduce their personal contributions to GW can an overall reduction in GW be achieved. The public's recognition of their inability to make a difference in reducing GW alone is evident in the findings of a recent study that showed that people who consider themselves informed about GW feel less personal response efficacy than others (Kellstedt et al., 2008). This finding suggests that people have realized their inability to make a difference acting alone and suggests that research in the GW domain may benefit from focusing on collective efficacy beliefs.

Bandura (1982; 2000b) has long noted the importance of collective efficacy in solving global environmental problems. Yet few psychological studies of responses to environmental problems have included concepts related to collective efficacy. Bonniface and Henley (2008) used focus group discussions with activists (people who performed waste minimizing procedures such as recycling, reducing, and reusing) and nonactivists (people who did not perform these behaviors). Results showed that both activists and nonactivists felt low collective efficacy, but activists felt high collective response efficacy while nonactivists felt low collective response efficacy in waste

minimization behaviors. They surmised that activists believe that, although most people are not acting, if people acted together it could make a difference, while nonactivists believe that most people are not acting and even if people did act together, their actions would not make a difference.

Results from other studies investigating collective efficacy beliefs in the context of environmental behavior are less clear and may be marred by inadequate operational definitions of collective efficacy and collective response efficacy. Recently, Lam (2006) conducted two studies in Taiwan testing the effects of collective efficacy and collective response efficacy on intention to install a dual-flush toilet controller after controlling for TPB predictors of attitude, subjective norm and PBC. In Study 1, Lam (2006) found that neither collective efficacy (measured in terms of participants' perception of the number of people who would take action to save water) nor collective response efficacy (measured in terms of participants' perception that people's and government's actions would be able avoid a severe drought) predicted intention to install a dual-flush toilet controller above the TPB variables. However, Lam's replication two years later (2006, Study 2) found that collective efficacy, but not collective response efficacy, predicted intention to install the controller after controlling for TPB constructs. In another study of environmental activism behavior, Lubell (2002) found that collective response efficacy did not predict activism behavior. However, his measure of collective response efficacy consisted of one question assessing belief that people can be trusted and two questions assessing whether waterfront residents and the general public influence the water quality of the Peconic Bays System. Thus his measure was only partly reflective of collective response efficacy. Finally, Stern (2000) recognized that collective response efficacy may be an important predictor in addition to VBN constructs in predicting environmental behavior. Taken together, these studies

suggest that additional research is needed to test the role of collective response efficacy and collective efficacy in predicting intention to mitigate GW.

Social psychological model of GW behavioral intention

In light of the theoretical and empirical evidence outlined above, I propose a social psychological model of GW behavior that draws on the VBN and TPB and adds additional constructs. The model is displayed in Figure 4 and the rationale for each addition and alteration, although detailed above, is summarized below. Note that positive correlations are expected among the values scales, the AC scales, and the EC scales, although these are not depicted on the model.

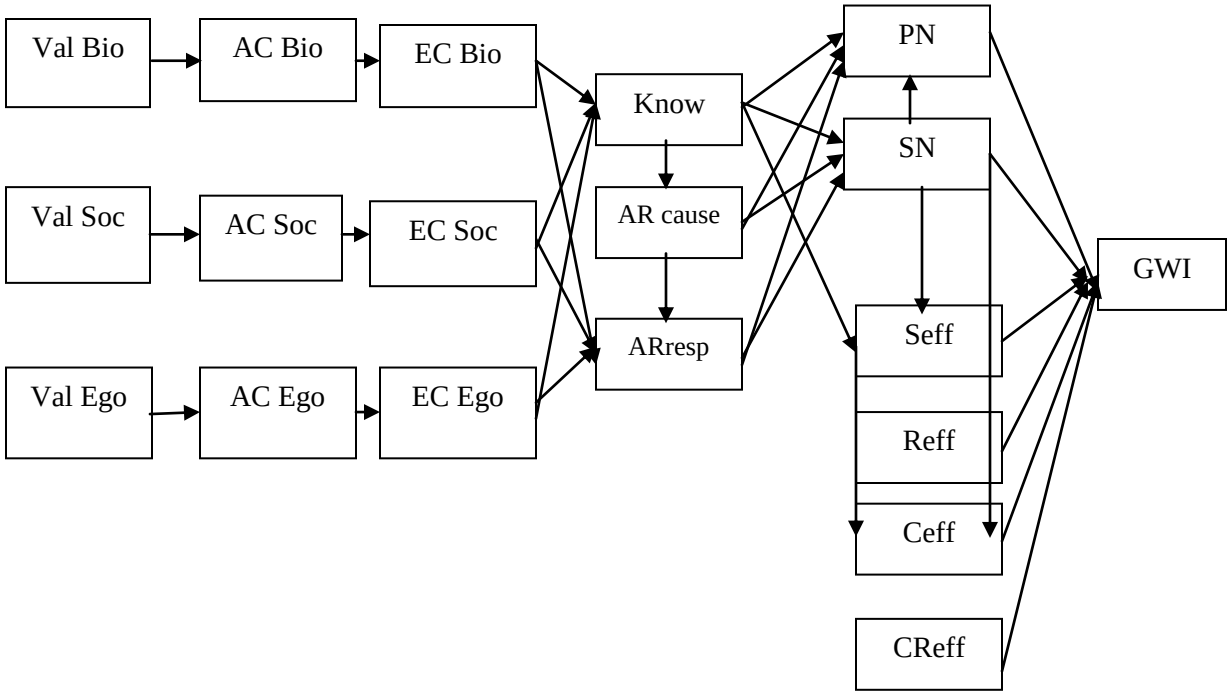

Figure 4. Social psychological model of GW behavioral intention. Note that Val = values, Bio = biospheric, Soc = social-altruistic, Ego = egoistic, AC = awareness of consequences, EC = environmental concern, Know = knowledge of GW causes, ARcause = ascription of responsibility for causing GW, ARresp = Ascription of responsibility for reducing GW, PN = personal norms, SN = social norms, Seff = self-efficacy, Reff = Response efficacy, Ceff = collective efficacy, CReff = collective response efficacy, GWI = global warming behavioral intention.

First, the model posits that environmental values lead to AC because people seek out information about potential threats to valued objects as outlined by the VBN (Stern et al., 1994). For example, people who value the biosphere are expected to seek out information about consequences of GW on the biosphere and are thus more likely to be aware of negative consequences of GW on the biosphere. Support for the direct relationship between values and AC has been found (Hansla et al., 2008; Nordlund & Garvill, 2002; Stern & Dietz, 1994).

Second, AC leads to EC such that beliefs that adverse consequences will befall valued objects leads to concern for those valued objects. For example, people who believe that GW has negative consequences for themselves are expected to be more concerned about the consequences of GW on the self. Support for the AC-EC relationship has been found by Hansla et al. (2008).

Third, environmental concern leads to knowledge of the causes of GW such that people who are concerned with effects of GW will be more likely to seek out and obtain accurate information about the causes of GW. Along these lines, Nordlund and Garvill (2003) found that EC predicted belief that traffic was a cause of environmental problems.

Fourth, I propose that AR be expanded to encompass AR cause and AR response. Current measures of AR combine these two entities (e.g., Steg et al., 2005), which is problematic because they may theoretically have different predictors and different outcomes. More accurate knowledge of the behaviors that cause GW is expected to lead to stronger beliefs that one is responsible for causing GW as realization that one is contributing daily to GW through everyday behaviors should make people more likely to believe they are responsible for causing GW. AR cause in turn predicts AR response as the more people believe they are causing GW, the more they should believe they are also responsible for acting to reduce GW. Environmental concern is

also expected to lead to ascription of responsibility to respond to GW as the more concerned people are with GW consequences, the more likely they are to believe they are responsible for responding to GW.

Fifth, personal norms and social norms are expected to be predicted by knowledge of the behavioral causes of GW, AR cause and AR response. In line with the VBN, AR cause and AR response are expected to predict personal norms, as beliefs that one is responsible for causing and reducing GW should lead to feelings of moral obligation to take action to reduce GW as has been found in previous research (Bamberg & Moser, 2007; Garling et al., 2003; Stern, 2000). Additionally, as has been found in previous research (Nordlund & Garvill, 2003), cause knowledge is expected to predict personal norm. AR cause and AR response are also expected to predict social norms (Bamberg & Moser, 2007 found this for AR cause). Finally, knowledge of the causes of GW is expected to lead to increased personal norm to take action and increased perception of social norms. Personal norms are also expected to follow from social norms as personal norms have been theorized to be internalized social norms (Schwartz, 1977). Personal norms and social norms in turn are expected to predict behavioral intention, in line with the VBN, TPB, and previous research (Bamberg & Moser, 2007; De Groot & Steg, 2007; Garling et al., 2003; Harland et al., 1999; Kaiser et al., 2005; Nordlund & Garvill, 2003).

Sixth, efficacy beliefs take a prominent role in this model. Knowledge of the causes of GW and social norms lead to self-efficacy beliefs as theorized by Bandura (1982). Belief that others are performing a behavior should lead to beliefs that one is also capable of performing the behavior. Self-efficacy in turn leads to behavioral intention as people who believe they are capable of performing a behavior are more likely to intend to perform that behavior (Cheung & Chan, 2000 as cited in Ajzen, 2002; de Groot & Steg, 2007; Harland et al., 1990; Heath &

Gifford, 2002; Kaiser et al., 2005). Self-efficacy is also expected to lead to feelings of collective efficacy, as belief that a group is capable of accomplishing a task are based on feelings that individual members of the group (i.e., the self) can accomplish the task (Bandura, 1997). Social norms are also expected to lead to collective efficacy, as beliefs that more people are performing a behavior should lead to beliefs that people can effectively perform the behavior (Bandura, 1997). Collective efficacy in turn leads to behavioral intention, as belief that the group can successfully perform the behavior should increase intention to perform the behavior as found by Lam (2006, Study 2). Response efficacy is expected to lead to behavioral intention as has been found in previous research (Heath & Gifford, 2006), such that increased beliefs that one's actions can make a difference in reducing GW should lead to increased intention to perform actions. Finally collective response efficacy is expected to lead to environmental behavior as has been found in previous research (Bonniface & Henley, 2008), such that belief that the group acting together can make a difference in reducing GW leads the individual to intend to act to reduce GW.

Study 2 used SEM to test the key aspects of the social psychological model of GW behavioral intention. Additionally, to compare the relative strength of my model with that of existing models of proenvironmental behavior, the VBN and TPB (a modified version) were also tested and comparisons were drawn between the models.

Hypothesis 12: The social psychological model of GW behavioral intention will provide a good fit to the data.

Hypothesis 13: The social psychological model of GW behavioral intention will provide a better fit to the data than the VBN and TPB.

Hypothesis 14: An exploratory factor analysis of the ascription of responsibility scale will reveal that the scale is best conceptualized as encompassing two distinct constructs: AR cause and AR response.

Method

Participants

Undergraduate WSU psychology majors *(N* = 494) served as participants. Thirty-three participants abandoned the on-line survey before the end of the survey and were omitted from further analysis. The final sample consisted of 461 participants, 287 women and 174 men. The participants predominantly identified themselves as Caucasian (80%) with the remaining participants identifying themselves as African American (3.9%), Latino (3.7%), Asian (7.2%) and other (5%). The majority of the participants were between the ages of 18 and 25 (96.1%), with the sample age ranging from 18 to 35.

Procedure

Participants completed the study on-line from their domiciles. First, participants provided demographic information. Second, participants completed a variation of Stern et al.'s (1998) Brief Values Inventory, a 9-item scale that measures values in terms of egoistic, social-altruistic, and biospheric concerns. De Groot and Steg (2008) found that the addition of two egoistic items one biospheric item and one social-altruistic item significantly improved the factor structure of the scale. As such, the revised 13-item version used by de Groot and Steg (2008) was used in the current study. The measure lists several principles and asks participants to rate the extent to which each is a guiding principle in their lives on a scale from -1 (Opposed to my values) to 7 (Of supreme importance). The internal consistency reliability of each scale was acceptable: Valbio (α = .82), Valsoc (α = .91), and Valego (α = .71).

Second, awareness of consequences and environmental concern for GW on the biosphere, humans, and the self were assessed with two scales. Participants completed Schultz's (2001) 15-item EC scales. Snelgar (2006) has shown the EC scales to have superior psychometric

properties compared to the AC scales traditionally used by Stern and colleagues (1993; 1995). In their current form, Schultz's EC scales ask participants the extent to which they are concerned about environmental problems because of their consequences on humans, the self, and the biosphere. In the current study, the term *environmental problems* was replaced with *GW* so that the EC reflected a more specific measure of environmental concern. Reliabilities for the scales were assessed: ECego (α = .92), ECsoc (α = .92), and ECbio (α = .96). Participants also completed a GW AC measure adapted from Stern et al. (1999). Six questions assessed the extent to which participants think that GW will be a serious problem for them and their family, the country, and other species of plants and animals in the next 50 years on a scale from 1 (Not a problem) to 7 (A very serious problem). Reliabilities for the scales were assessed: ACego (α = .97), ACsoc (α = .96), and ACbio (α = .98).

Fourth, participants completed measures of social norms and personal norms. The 7-item Personal Norm Scale (α = .96) was developed by the author to tap specific feelings of moral obligation to mitigate GW and was answered on a scale from 1 (Strongly disagree) to 7 (Strongly agree). The Social Norms Scale was developed by the author to tap beliefs about descriptive social norms for reducing GW and was adapted from the measure developed by Nolan et al. (2008). The 4-item Social Norms Scale (α = .87) was answered on a response scale of 1 (Very seldom) to 7 (Very often) with 0 (Do not know).

Fifth, participants completed measures of AR cause and AR response. Items were primarily devised by the author, although some were drawn from Steg et al. (2005). The AR response scale assessed the extent to which participants feel responsible for acting to reduce GW (α = .92). The AR cause scale (α = .89) assessed the extent to which participants feel responsible for causing

GW. Both AR measures are composed of 5 items and were rated on a scale from 1 (Strongly disagree) to 7 (Strongly agree).

Sixth, participants completed a 22-item measure of cause knowledge. The cause knowledge scale used in Study 1 was modified for use in this study with the revision of several items and the addition of several items in line with Gardner and Stern's (2008) list of energy use behaviors.

Seventh, participants completed measures of four different types of efficacy. For each efficacy type, the participants were asked to rate their perception of efficacy of 20 behaviors. The instructions differed among each scale: Self-Efficacy (How capable are you of performing each of the following actions?), Response Efficacy (If you performed each of the following actions, how effective would each action be in reducing GW?), Collective Efficacy (How capable are Americans as a group of performing each of the following actions?) and Collective Response Efficacy (If the majority of Americans adopted each behavior, how effective would each action be in reducing GW?). Participants provided their responses on a scale from 1 (Extremely incapable) to 11 (Extremely capable) for the Self-Efficacy ($\alpha = .92$) and Collective Efficacy Scales ($\alpha = .98$) and 1 (Extremely ineffective) to 11 (Extremely effective) for the Response Efficacy ($\alpha = .99$) and Collective Response Efficacy Scales ($\alpha = .98$).

Finally, participants completed a revised version of the GW Behavioral Intention Scale used in Study 1 to measure of intention to perform several GW behaviors ($\alpha = .95$). The scale was updated from the version used in Study 1 to account for important efficiency behaviors identified by Gardner and Stern (2008). The measure consists of 28 behaviors that participants rated in terms of frequency in performing the behavior within the next 6 months [on a scale from 1 (Almost never) to 7 (Almost always)] and 17 behaviors that participants rated in terms of

likelihood of performing the behavior in the next 6 months [on a scale from 1 (Extremely unlikely) to 7(Extremely likely)].

Results

Pearson correlations (two-tailed) among the scales were calculated and are shown in Table 16. The correlations between the value-AC variables and AC-EC variables were highest for the variables with the same focus. Specifically, Valbio most highly correlated with ACbio, Valsoc with ACsoc, and Valego with ACego. Additionally, ACbio most highly correlated with ECbio, ACsoc with ECsoc, and ACego with ECego. The correlations among the AC variables were quite high ranging from .719-.871. The correlations were later modeled in path analyses, which take care of the problem of high multicollinearity. Social Norms positively correlated with all variables except for Valego and cause knowledge, and had its highest correlation with GW intention. Personal Norms were significantly positively correlated with all variables except for Valego and were very highly correlated with AR Response. AR cause and AR response were correlated at .516. Cause knowledge was significantly positively related to all variables except for Valego, social norms, and self-efficacy and was most highly associated with AR response. The efficacy scales significantly positively correlated with each other, with the highest correlations between collective response efficacy and response efficacy and between collective response efficacy and collective efficacy. The smallest correlations among this set were between self-efficacy and collective response efficacy and self-efficacy and response efficacy. GW intention positively correlated with all variables and had the highest correlations with personal norms, response efficacy, and collective response efficacy.

Table 16. Intercorrelations among scales in Study 2 with means (and standard deviations) along the diagonal.

Variables	Valbio	Valsoc	Valego	ECbio	ECsoc	ECego	ACbio
Valbio	4.14 (1.65)	.64***	.16**	.59***	.40***	.27***	.47***
Valsoc		4.67 (1.43)	.16**	.41***	.49***	.30***	.42***
Valego			3.45 (1.23)	.05	.10*	.24***	.09*
ECbio				5.23 (1.27)	.64***	.42***	.50***
ECsoc					5.78 (1.12)	.63***	.53***
ECego						5.22 (1.27)	.32***
ACbio							5.29 (1.71)
ACsoc							
ACego							
Social Norms							
Personal Norms							
AR Cause							
AR Resp.							
Cause Knowledge							
Self-Efficacy							
Response Efficacy							
Coll. Resp. Efficacy							
Collective Efficacy							
GWB Intention							

***$p < .001$. **$p < .01$. *$p < .05$.

Note. *n*s ranged from 309 to 458. Val = Values; Bio = Biospheric, Soc = Social-altruistic; Ego = Egoistic; AC = Awareness of Consequences; EC = Environmental Concern; AR = Ascription of Responsibility; Resp. = Response; Coll. = Collective, GWB = GW Behavior.

Table 16. (cont.)

Variables	ACsoc	ACego	Social Norms	Personal Norms	AR Cause	AR Resp.	Cause Knowl.
Valbio	.43***	.41***	.21***	.50***	.21***	.46***	.25***
Valsoc	.43***	.39***	.19***	.41***	.21***	.40***	.20***
Valego	.10*	.19***	-.08	-.02	.03	-.06	-.01
ECbio	.46***	.42***	.24***	.49***	.24***	.45***	.16**
ECsoc	.56***	.47***	.19***	.42***	.26***	.42***	.22***
ECego	.40***	.52***	.17**	.35***	.24***	.33***	.16**
ACbio	.87***	.72***	.19***	.52***	.34***	.49***	.23***
ACsoc	5.18 (1.69)	.82***	.20***	.56***	.36***	.52***	.25***
ACego		4.19 (1.80)	.24***	.55***	.37***	.47***	.21***
Social Norms			3.16 (1.55)	.34***	.14**	.28***	.10
Personal Norms				4.87 (1.34)	.50***	.84***	.39***
AR Cause					4.13 (1.23)	.52***	.32***
AR Resp.						5.05 (1.22)	.43***
Cause Knowledge							15.85 (10.61)
Self-Efficacy							
Response Efficacy							
Coll. Resp. Efficacy							
Collective Efficacy							
GWB Intention							

***$p < .001$. **$p < .01$. *$p < .05$.

Note. *n*s ranged from 309 to 458. Val = Values; Bio = Biospheric, Soc = Social-altruistic; Ego = Egoistic; AC = Awareness of Consequences; EC = Environmental Concern; AR = Ascription of Responsibility; Resp. = Response; Coll. = Collective, GWB = GW Behavior.

Table 16. (cont.)

Variables	Self Efficacy	Response Efficacy	Coll. Resp. Efficacy	Collective Efficacy	GWB Intention
Valbio	.32***	.34***	.37***	.17***	.37***
Valsoc	.28***	.29***	.39***	.21***	.26***
Valego	.10*	.10*	.05	.04	-.01
ECbio	.32***	.34***	.47***	.30***	.39***
ECsoc	.29***	.38***	.51***	.32***	.31***
ECego	.30***	.40***	.45***	.32***	.30***
ACbio	.28***	.41***	.54***	.23***	.37***
ACsoc	.28***	.48***	.55***	.25***	.39***
ACego	.33***	.45***	.50***	.27***	.43***
Social Norms	.15**	.29***	.33***	.18***	.39***
Personal Norms	.32***	.48***	.53***	.24***	.50***
AR Cause	.17***	.31***	.34***	.20***	.32***
AR Resp.	.26***	.48***	.57***	.28***	.46***
Cause Knowledge	.04	.22***	.30**	.15**	.15**
Self-Efficacy	7.03 (1.95)	.38***	.36***	.41***	.44***
Response Efficacy		6.94 (2.50)	.67***	.38***	.50***
Coll. Resp. Efficacy			8.21 (2.25)	.56***	.47***
Collective Efficacy				7.66 (2.40)	.34***
GWB Intention					3.83 (.99)

***$p < .001$. **$p < .01$. *$p < .05$.

Note. *n*s ranged from 309 to 458. Val = Values; Bio = Biospheric, Soc = Social-altruistic; Ego = Egoistic; AC = Awareness of Consequences; EC = Environmental Concern; AR = Ascription of Responsibility; Resp. = Response; Coll. = Collective, GWB = GW Behavior.

Tests of my model

Complete hypothesized model

My hypothesized model was tested using path analysis with maximum likelihood estimation in MPlus. For all path analyses that follow, CFI > .95; RMSEA < .06, and SRMR < .08 are considered as cutoffs for a satisfactory global fit (Kline, 2004). As outlined in the introduction, 32 paths and 14 correlations were hypothesized. The analysis was started with a saturated model (all 190 possible paths and correlations) so that model trimming could be used to recover the hypothesized model. As expected, because the model was saturated and thus had 0 degrees of freedom, the model was a perfect fit to the data. Ninety-eight of the paths were not significant, 10 of which were hypothesized paths. The nonsignificant hypothesized paths were: social norm on cause knowledge, social norm on AR cause, self-efficacy on cause knowledge, collective efficacy on social norms, self-efficacy on social norms, cause knowledge on ECsoc, AR response on ECsoc, AR response on ECego, GW intention on collective efficacy, and GW intention on collective response efficacy.

All nonsignificant paths were dropped and the resultant model fit the data well, although the path of collective efficacy on biospheric values was not significant. This path was dropped and the final model provided an excellent fit to the data, χ^2 (99) = 157.76, p < .001; CFI = .99; RMSEA = .04 (90% CI: .02-.05); SRMR = .05; AIC = 58226.47. Although several modification indices were suggested to add paths between self-efficacy and other variables, the modifications were not accepted because the fit of the model was already satisfactory. The final model explained 37.9% of the variance in GW intention. The final model with all paths drawn is shown in Figure 5 with standardized path coefficients presented in Table 17.

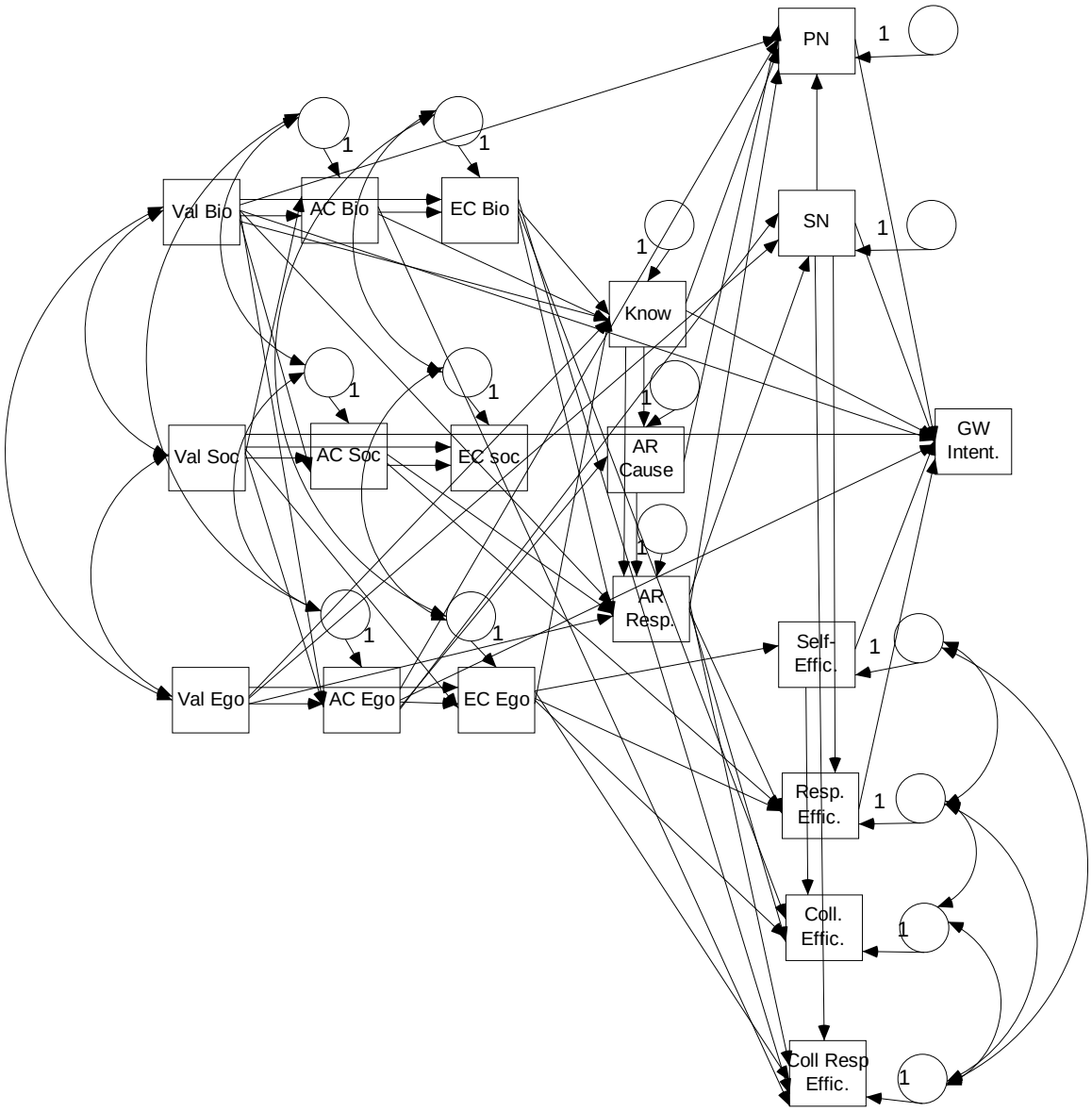

Figure 5: Path analysis results of social psychological model of GW intention. Note that Val = values, Bio = biospheric, Soc = social-altruistic, Ego = egoistic, AC = awareness of consequences, EC = environmental concern, Know = knowledge of GW causes, ARcause = ascription of responsibility for causing GW, ARresp = Ascription of responsibility for reducing GW, PN = personal norms, SN = social norms, Seff = self-efficacy, Reff = Response efficacy, Ceff = collective efficacy, CReff = collective response efficacy, GWI = global warming behavioral intention.

The model was so complicated that interpretation of the pattern of relationships proved difficult. In general, as can be seen in Figure 5 and Table 17, GW behavioral intention was directly predicted by personal norms, social norms, self-efficacy, response efficacy, cause

knowledge (negatively), ACego, biospheric values, and social-altruistic values (negatively). Additionally, values, AC, and EC predicted several variables downstream in the model such that intermediary variables only partially mediated the relationships between surrounding variables. More variables than expected directly predicted the efficacy beliefs with ECego and AR response fairly consistently predicting the efficacy beliefs.

Table 17. Standardized path coefficients from the final GW intention model with correlations in italics. All paths are significant at $p < .05$.

	Path to this variable									
Path from this variable	Val soc	Val ego	AC bio	AC soc	AC ego	EC bio	EC soc	EC ego	Know	AR Cause
Valbio	*.64*	*.16*	.34	.28	.27	.46			.25	
Valsoc		*.16*	.20	.25	.21		.31	.10		
Valego					.11			.12	-.12	
ACbio				*.83*	*.65*	.29			.15	
ACsoc					*.78*		.42			
ACego								.45		.33
ECbio							*.53*	*.30*	-.18	
ECsoc								*.53*		
ECego									.15	
Know.										.20

Table 17 (cont.)

Path from this variable	Path to this variable							
	AR resp.	Social Norms	Pers. Norms	Self-Effic.	Resp. Effic.	Coll. Effic.	Coll. Resp. Efficacy	GWB Intention
Valbio	.17		.13					.15
Valsoc								-.13
Valego	-.13	-.10						
ACbio							.25	
ACsoc	.24				.19			
ACego		.15	.16					.12
ECbio	.13					.10	.10	
ECsoc								
ECego				.30	.22	.16	.21	
Know.	.24		-.10					-.14
AR Cause	.30		.10					
AR Resp.		.22	.66		.25	.12	.28	
Social Norms			.07		.12		.09	.13
Personal Norms								.27
Self-Efficacy					*.24*	.30	*.15*	.20

Table 17 (cont.)

	Path to this variable							
Path from this variable	AR resp.	Social Norms	Pers. Norms	Self-Effic.	Resp. Effic.	Coll. Effic.	Coll. Resp. Efficacy	GWB Intention
Resp. Efficacy						*.17*	*.45*	.20
Coll. Efficacy							*.41*	
Coll. Resp. Efficacy								

Note. Val = Values; Bio = Biospheric, Soc = Social-altruistic; Ego = Egoistic; AC = Awareness of Consequences; EC = Environmental Concern; AR =Ascription of Responsibility; Resp. = Response; Coll. = Collective; Effic. = Efficacy; GWB = Global Warming Behavior.

As can be seen in Table 18, biospheric values had the largest total effect on GW intention, followed by ACego , personal norms, and AR response. Self-efficacy and response efficacy, but not collective efficacy or collective response efficacy, also had significant positive total effects on GW intention. Additionally, ECbio, ECego, ACsoc, social norms, and AR cause all had positive total effects on GW intention. Cause knowledge did not have a significant total effect on GW intention.

Table 18. Standardized indirect, direct and total effects of variables on GW intention.

Variables	Direct Effect	Indirect Effect	Total Effect
Valbio	.15**	.19***	.34***
Valsoc	-.13*	.09***	-.04
Valego	-------	-------	-------

Table 18. (cont.)

Variables	Direct Effect	Indirect Effect	Total Effect
ECbio	-------	.05**	.05**
ECsoc	-------	-------	-------
ECego	-------	.09***	.09***
ACbio	-------	-------	-------
ACsoc	-------	.10***	.10***
ACego	.12*	.14***	.27***
Social Norms	.13**	.04**	.17***
Personal Norms	.27***	-------	.27***
AR Cause	-------	.11***	.11***
AR Resp.	-------	.26***	.26***
Cause Knowledge	-.14**	.06***	-.08
Self-Efficacy	.20***	-------	.20***
Response Efficacy	.20***	-------	.20***
Collective Response Efficacy	-------	-------	-------
Collective Efficacy	-------	-------	-------

***$p < .001$. **$p < .01$. *$p < .05$.

The complexity of the model did not allow for further evaluation of the pattern of relationships among the variables. As such a simplified model involving only the hypothesized direct predictors of GW intention from my model was tested. Although it is acknowledged that the simplified model does not capture the hypothesized distal predictors of behavior, focusing solely on the most proximal predictors of behavior will provide a clearer picture of the

relationships among these variables. Additional rationale for this approach is outlined in the discussion section.

Simplified model

To further examine the predictors of GW intention, the model with only the hypothesized direct predictors of GW intention was subjected to a path analysis conducted in MPlus. The model was simply the right hand portion of the hypothesized model and included personal norms, social norms, self-efficacy, response efficacy, collective efficacy, collective response efficacy, and GW intention.

The hypothesized model did not provide a good fit to the data, χ^2 (4) =137.91, $p < .001$; CFI = .79; RMSEA = .27 (90% CI: .23-.31); SRMR = .12. Three paths were not significant: GW intention on social norms, GW intention on collective efficacy, and GW intention on collective response efficacy. These paths were dropped and the model was rerun. The second model did not provide a good fit to the data, χ^2 (7) =145.01, $p < .001$; CFI = .38; RMSEA = .21 (90% CI: .18-.24); SRMR = .12. All paths were significant in the second model, but modification indices suggested adding paths of personal norms on self-efficacy, response efficacy, collective efficacy, and collective response efficacy. Paths of personal norms on the efficacy scales were added and the model was rerun. Model three provided a significantly better fit to the data than model two as the χ^2 difference test was significant at $p < .001$. Model three provided an excellent fit to the data, χ^2 (3) = 7.00, $p < .0001$; CFI = .99; RMSEA = .05 (90% CI: .00-.11); SRMR = .02; AIC = 27478.12. The final model with all significant paths drawn is shown in Figure 6. The final model accounted for 36.5% of the variance in GW intention.

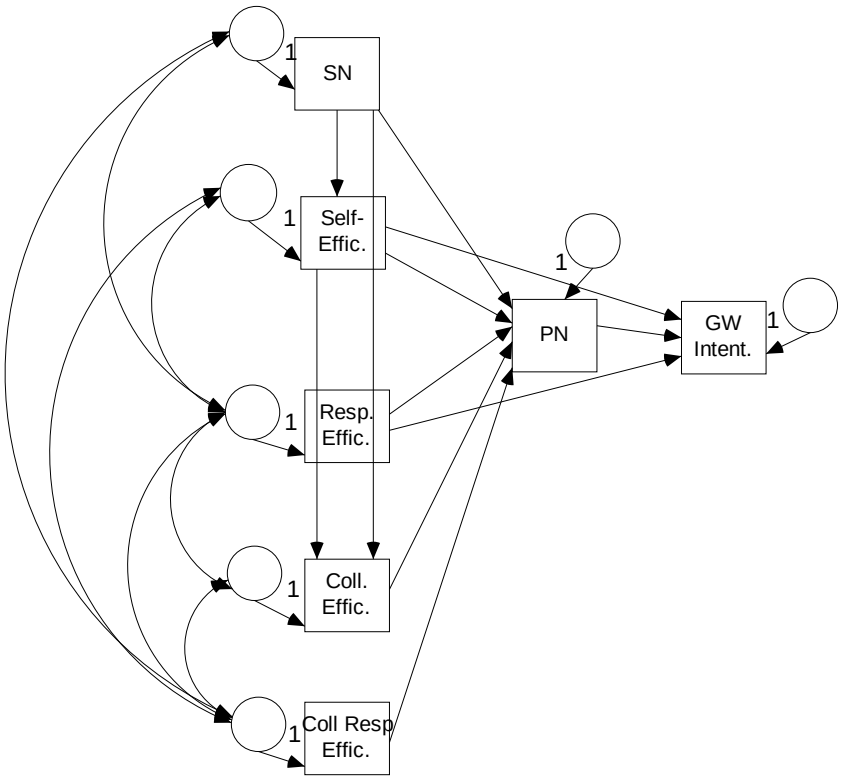

Figure 6. Path analysis results of simplified version of model of GW intention. Note that PN = personal norms, SN = social norms, Self-effic. = self-efficacy, Resp. effic. = response efficacy, Coll. Effic. = collective efficacy, Coll. Resp. Eff. = collective response efficacy, GW Intent. = global warming behavioral intention.

As shown in Table 19 and Figure 6, GW intention was directly predicted by personal norms, self-efficacy and response efficacy. Collective efficacy was predicted by social norms and self-efficacy. Self-efficacy was predicted by social norms. Personal norms were predicted by social norms, self-efficacy, response efficacy, collective efficacy, and collective response efficacy.

Table 19. Standardized direct paths of simplified GW intention model with correlations in italics.

	Path to this variable						
Path from this variable	Personal Norms	Social Norms	Self-Efficacy	Response Efficacy	Collective Efficacy	Collective Response Efficacy	GW Intention
Personal Norms							.33***
Social Norms	.14**		.16**		.14**		
Self-Efficacy	.10*				.39***		.23***
Response Efficacy	.20***	*.30****	*.34****				.22***
Collective Efficacy	-.11*			*.22****			
Collective Response Efficacy	.39***	*.32****	*.31****	*.66****	*.40****		
R^2	.35***		.02		.19***		.36***

***$p < .001$. **$p < .01$. *$p < .05$.

As can be seen in Figure 6, the final model differs most significantly from the hypothesized model in the role of personal norms. Contrary to predictions, personal norms served as a mediator between the other variables and GW intention (Table 20). Specifically, personal norms fully mediated GW behavior's relationships with social norms, collective efficacy and collective

response efficacy and partially mediated GW behavior's relationships with self-efficacy and response efficacy.

Table 20. Standardized indirect, direct and total effects of variables on GW intention.

	Indirect effects through					
Variables	Personal Norms	Self-Efficacy	Personal Norms and Collective Efficacy	Total Indirect Effect	Direct Effect	Total Effect
Personal Norms	-------	-------	-------	-------	.33***	.33***
Social Norms Scale [a]	.05**	.04**	-------	.08***	-------	.08***
Self-Efficacy	.03*	-------	-.01*	.02	.23***	.24***
Response Efficacy	.06**	-------	-------	.06**	.22***	.29***
Collective Efficacy	-.04*	-------	-------	-.04*	-------	-.04*
Collective Response Efficacy	.13***	-------	-------	.13***	-------	.13***

***$p < .001$. **$p < .01$. *$p < .05$.

[a] The indirect effects of social norms on GW intentions through personal norms and self-efficacy; and personal norms, collective efficacy and self-efficacy were not significant and were all smaller than |.006|. For ease of presentation, they are not included in the table.

EFA of AR scale

Additionally, my model proposes that AR cause is distinct from AR response. To test this assertion, the 11 item AR scale was subjected to an EFA using maximum likelihood estimation in MPlus. It was hypothesized that items relating to ascription of responsibility for reducing GW (ARRS) and items relating to ascription of responsibility for causing GW (ARCS) would load on separate factors. The 1 factor model was a poor fit, χ^2 (44) = 1286.81, $p < .001$; CFI = .68; RMSEA = .25 (90% CI: .24-.26); SRMR = .16. The 2-factor model was a significantly better fit

to the data, χ^2 (34) = 157.05, $p < .001$; CFI = .96; RMSEA = .09 (90% CI: .07-.10); SRMR = .02, as the χ^2 difference test between the 1-factor and 2-factor model was significant at $p < .001$. The 3-factor model provided the best fit to the data, χ^2 (25) = 76.57, $p < .001$; CFI = .99; RMSEA = .07 (90% CI: .05-.08); SRMR = .02, but the items did not load cleanly on the factors. As such, the 2-factor model was adopted. In the 2-factor model, all items had loadings above 0.50 on the hypothesized factors. However, two items from the ARCS scale, ARCS1 ("I am partly responsible for causing global warming") and ARCS3 ("I feel responsible for my impact on global warming") did not load cleanly on the ARCS factor as their cross loadings on the ARRS factor were above 0.30. Thus, ARCS1 and ARCS3 were removed from the analysis and the EFA was rerun.

In the second run of the EFA, the 1 factor model was a very poor fit to the data, χ^2 (27) = 938.10, $p < .001$; CFI = .70; RMSEA = .27 (90% CI: .25-.29); SRMR = .17. The 2-factor model was a significantly better fit to the data, χ^2 (19) = 76.75, $p < .001$; CFI = .98; RMSEA = .08 (90% CI: .06-.10); SRMR = .02, as the χ^2 difference test between the 1-factor and 2-factor model was significant at $p < .001$. The 3-factor model did not converge. Thus, the 2-factor model was evaluated. All items loaded cleanly on their hypothesized factors with primary loadings above 0.70 except for ARCS2 and ARRS1 which had lower loadings and all items had secondary loadings below 0.10 (Table 21). The residuals for correlations among the ARCS items were higher than the desired 0.10 suggesting that the factor did not adequately capturing some of the shared variance in the items. The two factors correlated at .42.

Table 21. Standardized loadings of AR items from EFA.

Items	Factor 1: AR cause	Factor 2: AR response
ARC2	**.69**	-.07
ARC4	**.88**	.05
ARC5	**.90**	.00
ARC6	**.73**	-.02
ARR1	.09	**.56**
ARR2	.04	**.83**
ARR3	-.03	**.94**
ARR4	-.03	**.95**
ARR5	.02	**.86**

Note. ARCS = Ascription of responsibility for causing GW, ARRS = Ascription of responsibility for responding to GW.

Value-Belief-Norm Theory Test

The VBN used in this study was slightly different from Stern's (2000) full model in that worldview was not included. To test the VBN, a path analysis with maximum likelihood estimation was run in MPlus. The hypothesized model was not a good fit to the data, χ^2 (6) =107.30, $p < .001$; CFI = .95; RMSEA = .19 (90% CI: .16-.22); SRMR = .14. When a previously established theoretical model provides a poor fit to the data, two options are available: either stop testing the model and conclude that the VBN was not a good fit to the data or make modifications to the model based on the model output and modification indices to determine what variations to the VBN would make it a good fit. The latter option was selected with the understanding that modifications to the model are purely exploratory because they are driven by statistics and not theory.

A closer inspection of the hypothesized model revealed that ten paths were not significant, most of which showed that intermediary variables fully mediated the relationship between surrounding variables. However, two hypothesized direct paths were not significant: AR on ACbio and AR on ACsoc. All nonsignificant paths were dropped from the model and the model was rerun. The second model provided a poor fit to the data, χ^2 (16) = 132.02, $p < .001$; CFI = .94; RMSEA = .13 (90% CI: .11-.15); SRMR = .15. Modification indices suggested adding back the path of AR on ACsoc. The model was rerun and the third model was not a very good fit, χ^2 (15) = 119.38, $p < .001$; CFI = .95; RMSEA = .12 (90% CI: .10-.14); SRMR = .15, although the fit improved significantly ($p < .001$) from model two based on the χ^2 difference test. Modification indices suggested adding the path of ACego on Valsoc. The model was rerun and model four fit significantly ($p < .001$) better according to the χ^2 difference test than model three, although model four was still a poor fit to the data, χ^2 (14) = 96.27, $p < .001$; CFI = .96; RMSEA = .11 (90% CI: .09-.13); SRMR = .12. Modification indices suggested adding the path of ACbio on Valsoc. Model five provided a very good fit to the data, χ^2 (13) = 39.40, $p < .001$; CFI = .99; RMSEA = .07 (90% CI: .04-.09); SRMR = .05; AIC = 22533.88, although RMSEA was higher than the cut-off of .06. Model five was a significantly ($p < .001$) better fit according to the χ^2 difference test than model four. The final model (shown in Figure 7) explained 30.3% of the variance in GW intention and 63.1% of the variance in personal norms.

In comparing the final model to the hypothesized VBN model, all direct hypothesized paths were significant except for the path of AR on ACbio. As can be seen in Figure 7 and Table 22, several paths between downstream variables were significant, suggesting that the intermediary variables did not fully mediate the relationships between surrounding variables. Biospheric values directly predicted ascription of responsibility, personal norms, and GW intention. Egoistic

values directly predicted ascription of responsibility and personal norms. Awareness of consequences for the self directly predicted personal norms and awareness of consequences for both the self and all humans directly predicted GW intention. Finally, two unexpected paths were also significant: social-altruistic values predicted awareness of consequences to the biosphere and awareness of consequences to the self.

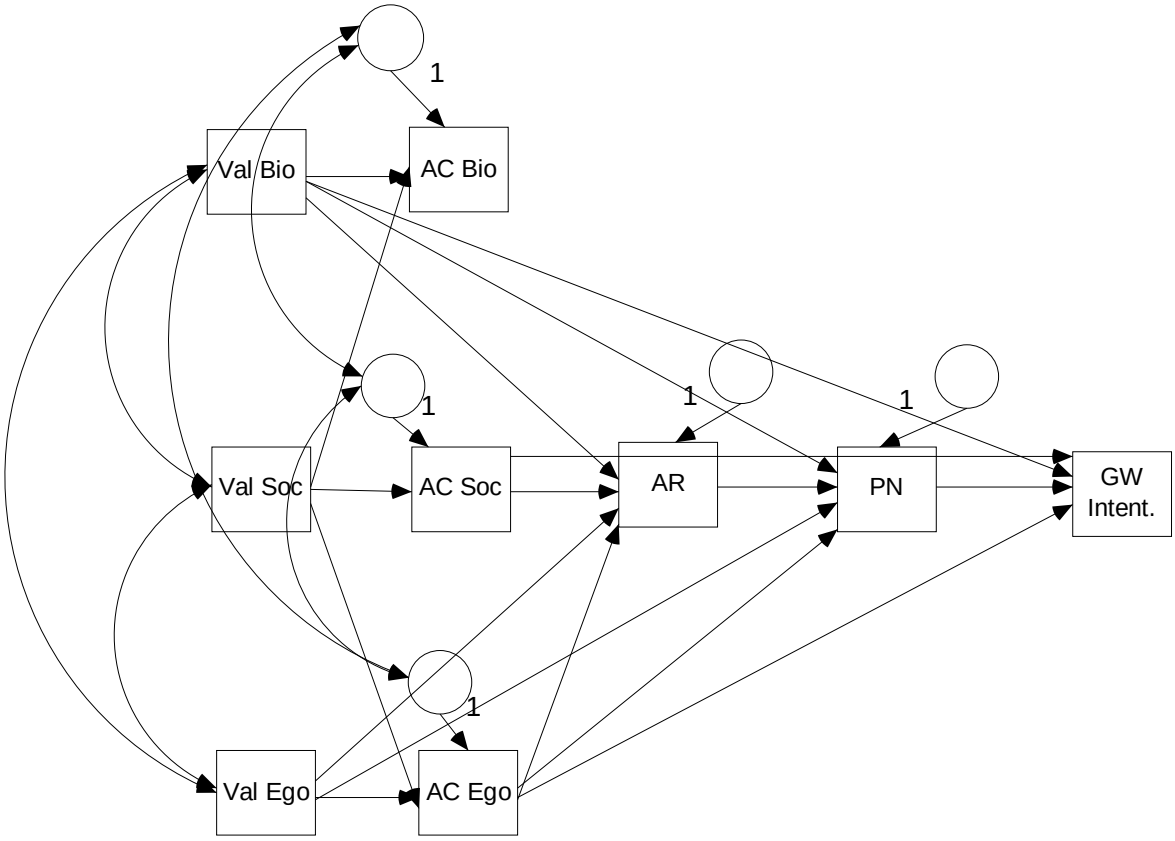

Figure 7. Path analysis results of VBN model of GW used in Study 3. Note that Val = values, Bio = biospheric, Soc = social-altruistic, Ego = egoistic, AC = awareness of consequences, AR = ascription of responsibility, PN = personal norms, GW Intent. = global warming behavioral intention.

Table 22. Standardized path coefficients from the final VBN model with correlations in italics. All paths were significant at $p < .05$.

	Path to this variable							
Path from this variable	Valsoc	Valego	ACbio	ACsoc	ACego	AR	PN	GWI
Valbio	*.64*	*.16*	.11			.19	.22	.12
Valsoc	*.16*		.35	.44	.38			
Valego					.12	-.10	-.09	
ACbio								
ACsoc			*.84*			.25		-.17
ACego			*.66*	*.77*		.21	.22	.31
AR							.57	
PN								.38
GWI								

Note. Val = values, Bio = biospheric, Soc = social-altruistic, Ego = egoistic, AC = awareness of consequences, AR = ascription of responsibility, PN = personal norms, GWI = global warming behavioral intention.

Theory of Planned Behavior Test

Because this study was not originally designed to test the TPB, the constructs of the TPB as operationally defined by Ajzen (1991) were not measured in this study. However, approximations to the constructs of the TPB were measured and as such it was possible to test a modified version of the TPB. Specifically, perceived behavioral control was measured with the self-efficacy measure (as is customary in TPB research), subjective norms were approximated with a measure of descriptive social norms, and attitude toward the behavior was approximated with a measure of beliefs about the effectiveness of performing GW-reducing behaviors (i.e.,

response efficacy). Although it is recognized that the rough approximations of the variables, particularly attitude, does not result in an exact test of the TPB, testing the TPB even with different operational definitions will serve as a useful comparison to my model. The version of the TPB evaluated in this study is shown in Figure 8.

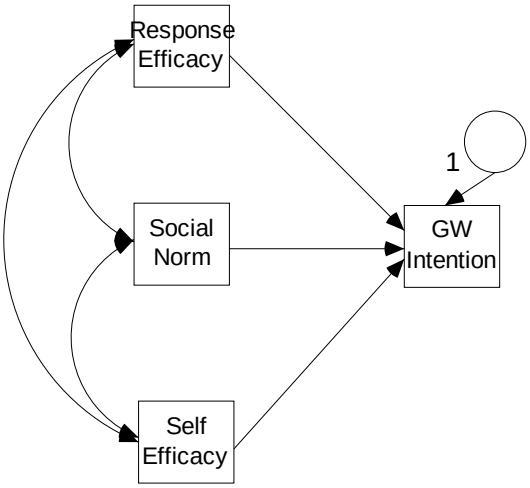

Figure 8. Model of modified TPB used in Study 3.

A path analysis with maximum likelihood estimation was run in MPlus to test the modified version of the TPB. Because the hypothesized model was saturated, the model provided a perfect fit to the data with AIC = 15459.35. As can be seen in Table 23, response efficacy had the largest effect on GW intention followed by self-efficacy and descriptive norms. The model accounted for 31.1% of the variance in GW intention.

Table 23. Standardized path coefficients from the modified TPB model with correlations in italics.

Path from this variable	Path to GW Intention	Response Efficacy	Descriptive Norm
Attitude (Response Efficacy)	.34***		
Subjective Norm (Descriptive Norms)	.15**	*.29***	
Perceived Behavioral Control (Self-Efficacy)	.26***	*.16***	*.38****

***$p < .001$. **$p < .01$. *$p < .05$.

Comparison of the three models in predicting GW intention

To determine which model was the best for predicting GW intention, comparisons were drawn between the four models: the social psychological model of GW intention, the simplified social psychological model of GW intention, the Value-Belief-Norm theory, and the Theory of Planned Behavior. As can be seen in Table 24 and described above, each model's fit to the data was acceptable according to the criteria set for the fit indices except for the RMSEA value for the Value-Belief-Norm Theory, which was higher than the desired .06. Additionally, the perfect fit of the saturated Theory of Planned Behavior makes comparisons across the models based on the fit indices of CFI, RMSEA, and SRMR difficult. AIC is used to make comparisons across non-nested models, with lower AIC values indicating a better fitting model. The lowest AIC was found for the modified Theory of Planned Behavior followed by the Value-Belief-Norm Theory and the simplified model of GW intention. The relatively high AIC value for the social psychological model of GW intention likely results from the AIC's penalty for model

complexity. In addition to a comparison of model fit, the models can also be compared based on their ability to explain variance in GW intention. The social psychological model of GW intention explained the most variance in GW intention, followed by the simplified model, the Theory of Planned Behavior, and finally the Value-Belief-Norm Theory. The amount of variance explained by the social psychological model of GW intention is likely inflated by the large number of predictors. Overall, the modified Theory of Planned Behavior and the simplified model of GW intention appear to be the two best models.

Table 24. Comparison of fit indices and GW intention R^2 for final versions of models.

Model	CFI	RMSEA	SRMR	AIC	GWI R^2
Social psychological model of GW intention	.99	.04	.05	58226.47	.379
Simplified model of GW intention	.99	.05	.02	27478.12	.365
Value-Belief-Norm Theory	.99	.07	.05	22533.88	.303
Modified Theory of Planned Behavior[a]	1.00	.00	.00	15459.35	.311

[a] This model had 0 df so the fit was perfect.

Discussion

My model

My social psychological model of GW behavioral intention was tested using model trimming procedures in path analysis. After deleting 99 nonsignificant paths (10 of which were hypothesized), the model provided an excellent global fit to the data. However, the resultant model had 91 paths and correlations and as such was extremely complicated. Because the final model based on model trimming was not the originally hypothesized model, the hypothesis that the social psychological model of GW behavior would provide a good fit to the data was not supported (contrary to Hypothesis 12).

Nevertheless, evaluation of the pattern of results obtained from the path analysis trimming method was useful for describing the relationships between the GW variables in this sample. As expected, personal norms, social norms, self-efficacy and response efficacy directly predicted GW intention, although contrary to expectations, collective efficacy and collective response efficacy did not predict GW intention. Collective efficacy and collective response efficacy were both significantly positively correlated with GW intention, but these relationships were likely due to shared correlations with other variables such as personal norms, self-efficacy and response efficacy. The relationships between the efficacy variables and GW were examined further in the simplified model of GW intention and are discussed in additional detail below.

Additionally, although not expected, GW intention was directly influenced by cause knowledge, awareness of consequences to the self, and biospheric and social-altruistic values. The finding that variables not adjacent to GW intention directly predicted GW intention is not entirely surprising given that this model is based on the VBN, which allows for downstream paths (Stern et al., 1999). However, the finding that biospheric values had the strongest total

effect on GW intention is surprising. People's value for the biosphere had more influence on behavioral intention than feelings of moral obligation to act. Based on this finding it could be argued that changing people's values so that they have stronger biospheric values would be a good strategy to increase GW intention. Unfortunately, values are considered as stable and constant throughout life (Schwartz, 1992). As an alternative to attempting to change values, de Groot and Steg (in press) have recently suggested that increasing the saliency of biospheric (and social-altruistic) values in specific situations can increase proenvironmental behavior. If this assertion is supported empirically in future research, the results of the present study suggest that it could have a meaningful effect on GW intention.

The results also revealed that the efficacy scales had more predictors than expected. Specifically, several environmental concern and awareness of consequences subscales directly predicted the efficacy scales. Little research has been conducted to examine the precursors to efficacy beliefs in the environmental domain (c.f. Kellstedt et al., 2008). Future research should be examined to develop the theoretical predictors of efficacy beliefs, especially self-efficacy and response efficacy.

In line with Hansla et al.'s (2008) finding, the present model showed that awareness of consequences partially mediated the relationship between values and environmental concerns. Consistent with Hansla et al. (2008), AC in the present study was defined as a set of cognitions, beliefs about the consequences of GW, while EC was viewed as encompassing a more evaluative component, concern about the consequences of GW. Theoretically, Hansla et al. (2008) argued that one cannot be concerned about something that one does not believe is occurring. In this study, EC was operationally defined as concern about the consequences of GW, while AC was operationally defined as belief that the consequences of GW would be a problem. Although it

could be argued that this measure of AC incorporates an evaluative component (belief that something is a problem may imply that one has evaluated it negatively), this scale based on Stern et al.'s (1999) measure was used in lieu of the traditional AC scales developed by Stern et al. (1993; 1995) because of the problems with the traditional scales described below. The results provide initial support that the AC and EC scales are distinct as intercorrelations among the corresponding subscales were not above 0.80 and the scales predicted different variables in the hypothesized model of GW intention. Additional research, such as exploratory and confirmatory factor analysis could be conducted to provide further support for this assertion. Overall, the use of different measures for AC and values and the use of path analysis versus hierarchal regressions in this study compared to Hansla et al. (2008) lends additional credence to the theory that values predispose people to become more aware of threats to valued objects and awareness of these threats leads to increased concern for environmental consequences on valued objects.

Of the AC scales, ACego had the strongest total effect on GW intention and this effect was positive. AC has been defined as awareness of adverse consequences of environmental conditions on valued objects (Stern et al., 1995). In addition to items assessing awareness of adverse consequences of environmental problems on the self, at least half of the items of the ACego scales traditionally used (Garling et al., 2003; Joireman et al., 2001; Snelgar, 2006; Stern et al, 1993; 1995) assess awareness of adverse consequences of environmental *protection* on the self (Hansla et al., 2008; Snelgar, 2006). Hansla et al. (2008) has noted this problem with the AC scales and has called for new AC measures. The AC ego scale used in this study adapted from Stern et al. (1999) asked only about the participants' belief that GW would be a problem for them and their family over the next 50 years. The present AC scales provide a nice alternative

that should be considered as potential replacements for Stern et al.'s (1993; 1995) original AC scales.

Because the full hypothesized model revealed a complicated pattern of results, the right hand portion of the model was tested separately to provide a clearer picture of the relationships between the hypothesized direct predictors of behavior. The Value-Belief-Norm theory on which this model is partly based allows for direct paths between downstream variables (Stern et al., 1999). Thus, much of the complexity of the model is as least partly predicted by theory.

Another potential explanation for the extreme complexity of my model is that the sample may have been composed of distinct subgroups for which different models of GW intention characterize the members' beliefs. Although the use of a fairly uniform student sample may appear to preclude this hypothesis, it is possible that certain demographic or other variables may shape participants such that they have different models of GW intention. Little research has suggested the need for separate models for separate groups of people or pointed to specific features of samples upon which they should be split (c.f., Bamberg, 2007). Previous research has identified political affiliation (Dietz et al., 2007; Dunlap & McCright, 2008), sex (Leiserowitz, 2005), and race (Dietz et al., 2007; Leiserowitz, 2005) as variables which are related to climate change policy support and climate change risk perceptions. But little research has investigated these variables as moderators of people's model of GW intention in the sense that members of these groups may have different structures of GW intention-related variables. For example, people who have children may be expected to place a larger emphasis on social-altruistic values, concerns and consequences than nonparents. As a result, it is plausible that parents' model of GW intention includes direct paths between GW intention and social-altruistic values, awareness of concern, and environmental concern, while nonparents' model may have only indirect paths

between these variables. Additional theoretical investigation is necessary to determine whether such moderators exist. Once identified, structural equation modeling with invariance testing can be used to empirically confirm that certain groups differ in their models of GW intention.

The results of the simplified model underline the importance of personal norms as a direct predictor of GW intention and as a mediator of the relationship between social norms and GW intention and the efficacy scales and GW intention. The results also highlight the importance of self-efficacy and response efficacy as positive influences on GW intention. The role of self-efficacy in intention to perform environmental behavior is well-established in the environmental literature (Cheung & Chan, 2000 as cited in Ajzen, 2002; de Groot & Steg, 2007; Harland et al., 1990; Heath & Gifford, 2002; Kaiser et al., 2005). Yet, surprisingly few studies outside of the TPB context include self-efficacy in their models. Response efficacy has been investigated in even fewer studies of GW intention (c.f. Heath & Gifford, 2006), but the results of this study have shown that response efficacy is an important direct and indirect predictor of GW intention. The results suggest that self-efficacy and response efficacy should be more consistently included as predictors of GW intention.

Additionally, the results of the simplified model of GW intention showed that collective response efficacy is an indirect positive predictor of GW intention. Increased beliefs that Americans' actions can be effective in reducing GW led to increased feelings of personal moral obligation to take action to reduce GW, which in turn led to increased intent to perform GW behaviors. Collective response efficacy is seldom included in models of environmental behavior (c.f. Bonniface & Henley, 2008), but the present results suggest that future researchers should include it. On the other hand, collective efficacy was found to be a negative predictor of GW intention. Collective efficacy was influenced by perception of the descriptive norm and beliefs of

self-efficacy such that as perception that others are acting increased and perception that one could perform the necessary behaviors increased, perceptions of collective efficacy increased. But increased perceptions of collective efficacy led to decreased personal norms to take action thus leading to the indirect negative effect of collective efficacy on behavior. The negative effect of collective efficacy on personal norm may reflect a form of free riding in that when people believe that others are capable of performing the behavior, they feel less moral obligation to take action themselves. One potential solution to combat free riding is to create ways to identify each individual's contribution to GW. Recycling programs became very successful when municipalities began collecting recycling in well-marked bins placed at the curb. This process not only created clear descriptive norms for behavior but also made each individual's participation (or lack of participation) public. Similar strategies could be employed to reduce household energy use or car use. For example, utility companies could make energy meters easier to read and make energy consumption of each house available on the internet.

Finally, my model theorized that AR as it is currently defined is multidimensional. Prior researchers that have used the VBN have defined ascription of responsibility as "beliefs about responsibility for causing or ability to alleviate threats to any valued objects" (Stern et al., 1999, p. 83). This definition provides the possibility that AR is composed of two distinct subconstructs: AR for causing GW and AR for reducing GW. The exploratory factor analysis of the AR scale showed that the AR response items and AR cause items (after removing two items) loaded cleanly on their hypothesized factors. The residuals for the correlations among the AR cause items were higher than desired, suggesting that the AR cause factor does not adequately capture all of the shared variance among its items. Adding more items to this scale will likely remedy this problem. Overall, the EFA provided an initial indication that ascription of responsibility for

causing GW and ascription of responsibility for reducing GW are distinct constructs (supporting Hypothesis 14). Additional support for this assertion comes from the path analysis of the full model. Results showed that AR cause and AR response have different predictors. Additionally, AR cause and AR response predicted different outcome variables. Additional research, specifically a confirmatory factor analysis with the addition of items to the AR cause scale, is needed to further establish the discriminant validity of the two scales.

Comparison with the VBN and TPB

As a basis for comparison for my model, the VBN and a modified version of the TPB were tested in the present study. Results showed that the VBN needed three unhypothesized modifications before a good fit could be realized. Specifically, social-altruistic values predicted ACego and ACbio, and ACbio did not predict AR. One potential explanation for these results is that the AC scales used in this study differed from those commonly used in the VBN literature. The frequently used AC scales are problematic in that they have low internal consistency reliabilities (Hansla et al., 2008; Joireman, Lasane, Bennett, Richards, & Solaimani, 2001; Snelgar, 2006; Stern et al., 1993; 1995). As such, in this study, modified versions of Stern et al.'s (1999) measures of AC were used and showed acceptable levels of reliability. Future research should explore the extent to which the paths between corresponding values and ACs are a function of the measure of AC.

Additionally, the VBN test revealed that several paths between nonadjacent variables were significant. Specifically, biospheric and egoistic values and awareness of consequences for the self and all humans directly predicted variables beyond their adjacent variables. Although the VBN allows for such direct downstream effects (Stern et al., 1999), more specific theoretical rationale should be developed that identifies which direct paths should be expected. As the

theory currently stands, any direct paths between nonadjacent variables can be equally argued as being expected based on the theory and not expected based on the theory. Additional research should address this theoretical limitation.

A modified version of the Theory of Planned Behavior was also evaluated for comparison purposes with my model. Response efficacy, perceived behavioral control (operationalized as self-efficacy) and descriptive social norms each predicted GW intention. Response efficacy had the highest effect on GW intention, followed by self-efficacy and then social norms. This pattern of results with the attitude component having the strongest effect on behavioral intention followed by perceived behavioral control and norms is consistent with other tests of the TPB (Armitage & Conner, 2001). Although operationalizing the TPB constructs differently than originally envisioned is not unusual in literature applying the TPB to environmental behavior (Lam, 2006; Kaiser et al., 2005; Oreg & Katz-Gerro, 2006), future studies should use the methods advocated by Ajzen (1991). Specifically, Ajzen (1991) has recommended eliciting relevant beliefs from the sample of interest and then developing scales for each construct that assess the strength of each belief multiplied by the subjective evaluation of the belief. Research developed with this intention could provide a nice comparison between the ability of the original TPB and the models used here (the modified TPB, VBN, full model of GW intention, and simplified model of GW intention) to predict GW intention.

Overall, the four models tested in this study each provided a good fit to the data (after modifications). Based on the AIC index, the TPB and VBN provided better fits to the data than the model of GW intention and the simplified version of the model of GW intention. However, the social psychological model of GW intention and the simplified version explained more (although not much more) variance in GW intention the modified TPB than the VBN. Both of

these indices are contingent on model complexity such that increases in the number of predictors results in decreased AIC values and inflated R^2 values. Thus, clear determination about which model has the best fit is difficult. Based on the AIC values and the complexity of the model of GW intention, the model of GW intention is deemed to not be a better model than the VBN and modified TPB (contrary to Hypothesis 13). Overall, the amount of variance in GW intention explained by all models suggests that more variables are involved in predicting GW intention. These variables could include perceived convenience of performing the behavior, mitigator knowledge (as investigated in Study 1), household ownership, and income.

Conclusions

Overall the present study showed that applying social psychological models of behavior to GW intention is not straightforward. Tests of each model, except for the modified TPB, required post hoc modifications before a good fit could be seen. The modified TPB provided the best overall fit to the data compared to the other models. Across models, personal norm, response efficacy, self-efficacy, awareness of consequences to the self, and biospheric values were consistently the strongest predictors of GW intention. However, no model explained more than 38% of the variance in GW intention. The present results point to the need for additional empirical and theoretical research to further develop a concise theory of GW intention.

SECTION FOUR

STUDY 3: ECOLOGICAL FOOTPRINT CALCULATORS

Introduction

The final step in an investigation of GW behavior is to identify and improve techniques that increase behavioral intention. One of the most widely used techniques is the ecological footprint calculator. Wackernagel and Rees (1996) first proposed the concept of Ecological Footprint (EF) analysis as an accounting tool that estimates the amount of land (and water) area required to provide the resources a population consumes and to assimilate the wastes a population produces. EF analysis was originally developed as a national level tool to demonstrate that certain nations consume more resources than can be produced within their own borders.

More recently, EF analyses have been applied at the level of the individual through the distribution of EF calculators (EFCs). Such EFCs are routinely found on the websites of environmental organizations (e.g., World Wildlife Fund, Sierra Club, and The Nature Conservancy). In an EFC, a person provides information about the types of products he/she consumes and the calculator returns information to the person about the number of Earths required to support humans if all people in the world adopted that person's lifestyle. The calculators usually also provide a comparison of the person's EF in relation to the person's fair earthshare, or proportion of the Earth's land that each person should have access to if the productive lands were divided equally among all of the Earth's inhabitants (Wackernagel & Rees, 1996).

The intent of environmental organizations in using EFCs is clearly to induce attitude or behavior change among over consumers in regard to GW. Brook and Crocker (2008) note that EF proponents assume that the feedback from EFCs will motivate behavior change. As one

example, Global Footprint Network's website states that EFCs enable individuals to "take personal and collective action in support of a world where humanity lives within the Earth's bounds." Yet, very little research has been conducted to determine people's reactions to EFCs and whether EFCs are effective in changing attitudes and behaviors.

One recent investigation analyzed internet questionnaires from predominantly Italian participants to determine their perception of EFCs (Aubert, 2006). More than half of the participants did not know what EF analyses were prior to the study (Aubert, 2006). After completing an on-line EFC (the version created by Redefining Progress and Earth Day Network), participants gave their perception of the EFC via free response questions. Forty-four percent of the participants had favorable evaluations of the EFC and felt that the results were useful, valuable and surprising (Aubert, 2006). On the other hand, 34% criticized the calculator for being too vague, general, and simplistic, and for failing to provide enough information, while 16% thought the calculator was "frightening, alarming, shocking, or not very convincing" (Aubert, 2006, p. 43). Overall, Aubert (2006) reported that only 38% of her participants felt that the EFC motivated them to reduce their EF when asked immediately after completing the EFC, while 11% found it discouraging. Although purely descriptive, the negative evaluations provide much insight into the psychological reactions to EF feedback and suggest ways that the calculators can be improved.

At least one experimental study investigating behavioral reactions to EFCs has been conducted. Brook and Crocker (2008) examined whether environmental contingent self-worth (CSW) moderated the effect of EF feedback on proenvironmental behavior (operationalized as choosing to write an environment-focused letter to a politician, when given the option to write the letter on any topic). Environmental CSW is the extent to which a person bases his/her self-

esteem on being an environmentalist (Brook & Crocker, 2008). Brook and Crocker (2008) provided bogus feedback to participants that their EF quiz results showed that they had either higher (negative EF feedback) or lower EFs (positive EF feedback) than other students at their school. Their results were inconsistent between the two studies. They found no main effect of type of EF feedback on behavior in Study 2, and a marginally significant main effect in Study 1, where negative feedback resulted in lower likelihood of writing an environment-topic letter compared to positive feedback (c.f. Schultz et al. (2007) who found that, in response to descriptive normative feedback, overconsumers reduced their household energy use and underconsumers increased their household energy use). Additionally, Brook and Crocker (2008) found that negative EF feedback had no effect (Study 1) or increased proenvironmental behavior (Study 2) for participants high in environmental CSW, and had no effect (Study 2) or potentially reduced proenvironmental behavior for participants low in environmental CSW (Study 1). Thus EF feedback that is negative (much like that given to the average American) may result in effective behavior change only for a subset of the population and may even backfire for others.

Brook and Crocker's (2008) studies along with Aubert's (2006) survey provide an insightful first step into the factors impacting EFC effectiveness and point to the need for additional research in this area. First, to determine whether EFCs are effective in changing behavior, research is needed that compares behavior (or intention) between participants who complete EFCs and participants who do not. Additionally, experimental research is needed that provides participants with their actual EF calculations. Although Brook and Crocker's (2008) investigation benefitted from added control in providing bogus feedback, the EF of the majority of Americans is higher than can be sustained. As such, most Americans who complete an EFC

will have very high EFs, so Brook and Crocker's (2008) inclusion of a condition where participants get feedback that their EF is much less than others may not be realistic.

Second, additional research is needed to investigate people's emotional reactions to EFCs. The outcome of the EFC can be viewed as having the potential to elicit fear. EFCs may create fear by providing graphics on the number of Earths required to sustain the world population if each person shared the quiz-taker's lifestyle. Being presented with more than one Earth might elicit fear that we will run out of available resources if the quiz-taker continues the present course. Anecdotally, Hancock (2002) noted that people who complete EFCs experience a '"fear of footprint… [along with] sadness, powerlessness, apathy, avoidance, anxiety, shock, anger, and guilt" (p. 15). In a survey investigation, Aubert (2006) found that participants reported emotional reactions of shock, fear, and surprise to the outcomes of the EFC. Additional systematic research is needed to determine the extent to which people experience these, and other, emotions after completing EFCs and whether these emotions mediate the relationship between EFCs and behavioral intention.

A long history of research has been conducted on people's reactions to emotional persuasive appeals, with much of the research focus on fear appeals (Stiff & Mongeau, 2003). Witte's (1998) Extended Parallel Process Model (EPPM) was developed to encompass the best aspects of previous fear persuasion theories into one coherent theory that could predict apriori when fear appeals would be successful and when they would not. The EPPM posits that when confronted with a fear appeal, people first evaluate the severity of the threat and their susceptibility to the threat. If the threat is perceived to be both severe and relevant, then people evaluate the efficacy (in terms of both self-efficacy and response efficacy) of the recommended responses and weigh the efficacy appraisal against the threat appraisal (Witte, 1998). If the person's perceived

efficacy is greater than the perceived threat, then the person can be expected to take adaptive action to reduce the threat or danger via behavior change in line with recommended actions (Witte, 1998). If the person's perceived efficacy is less than the perceived threat, then the person is left with a perception that they are faced with a threat that they can do nothing about (Witte, 1998). At this point fear takes over and the person becomes motivated to reduce the fear via maladaptive means such as denial, defensive avoidance, and reactance (Witte, 1998). These responses are considered maladaptive because they do not result in behaviors to reduce the threat but instead result in behaviors to reduce the fear, leaving the threat intact.

As described above, in addition to fear, EFCs have also been reported to elicit other emotions (Aubert, 2006; Hancock, 2002). The ability of EFCs to induce guilt is especially interesting as research has shown that eliciting guilt can be effective in persuading people to change their behavior (O'Keefe, 2003). In persuasive guilt appeals, guilt is induced by pointing out a discrepancy between the target's standards and prior behavior and then providing recommendations on how to reduce the guilt (O'Keefe, 2003). A major problem with guilt appeals, though, is that explicit guilt appeals often induce other negative emotions, like anger, and as such, appeals that elicit a high amount of guilt are often not persuasive (O'Keefe, 2003). One hypothesis that has been forwarded suggests that guilt appeals may be less effective than other guilt-inducing techniques (e.g., transgression-compliance and hypocrisy paradigm), because the source of guilt in guilt appeals is often the message creator and not the self (O'Keefe, 2003; Stiff & Mongeau, 2003). As such, people may have negative reactions (e.g., anger) to guilt appeals that undermine the effectiveness of guilt appeals to change behavior (O'Keefe, 2003; Stiff & Mongeau, 2003).

To further complicate matters, research has shown that even appeals explicitly designed to elicit fear also elicit other emotions. Dillard, Plotnick, Godbold, Freimuth, and Edgar (1996) found that fear appeals elicited surprise, sadness, puzzlement, anger and happiness. Environmental risks most commonly elicit anger and helplessness, while fear and worry are much less commonly elicited and shame and guilt are very rarely elicited (Böhm, 2000, as cited in Böhm & Pfister, 2001). That environmental risks and fear appeals elicit multiple emotions is problematic because different emotions often have conflicting impacts on behavior after persuasion attempts (Dillard et al., 1996). Fear appeals that elicit self-accountability emotions (those that make people feel accountable for a situation) such as guilt and regret have been shown to lead to greater behavioral intention than fear appeals that only elicit fear or elicit low self-accountability emotions such as hope (Passyn & Sujan, 2006). Böhm (2000) theorized that fear and sadness should lead to proenvironmental beliefs that prevent or reduce environmental problems, while anger should lead to aggressive proenvironmental behaviors like boycotting. Additional research is needed to determine which emotions are aroused during EFCs and whether they have negative or positive impacts on behavioral intention.

Third, systematic evaluations are needed to determine whether manipulating certain aspects of the EFC can increase GW intention following the EFC. Lewan and Simmons (2001) noted that EFCs are "powerful and resonant means of measuring and communicating environmental impact" (p. 1), but they do not provide information on how to mitigate that environmental impact (i.e., do not bolster feelings of self-efficacy or response efficacy). This shortcoming is further reinforced with their analogy of the EF to a scale.

> The footprint has been compared to measuring one's own weight. You can find out how heavy you are, and the difference from your ideal weight, but the process of

> measuring does not tell you how to lose weight. However, you can speculate that if you do certain exercises and eliminate certain calorific foods from your diet you will shed a certain number of kilos (Lewan & Simmons, 2001, p. 1).

Similarly, 64% of Aubert's (2006) participants noted that the EFC could be improved by providing more information on how to reduce one's EF (Aubert, 2006). In other studies investigating GW intention that do not study reactions to EFCs, participants have noted a lack of knowledge of how to reduce GW as a major barrier to GW behavior (Lorenzoni et al., 2007; Semenza et al., 2008).

One way to address this barrier to GW behavior is to provide participants with a list of behaviors that they can perform to reduce their EFs immediately after they complete the EFC. According to the EPPM, fear appeals are not persuasive unless they include such efficacious behavioral recommendations (Witte, 1998). Because of the sequential appraisal process in the EPPM of threat evaluation and then efficacy evaluation, Witte (1998) suggested that the fear appeal should be given first and should be immediately followed by the recommendations to reduce the threat. Additionally, behavior lists should be ordered in terms of relative mitigating potential such that participants do not have to guess which behaviors will be most efficacious (Gardner & Stern, 2008). In the present study, participants were randomly assigned to receive (or not) a list of behaviors they can perform to reduce their EFs.

Another way to address participants' perceived barriers to GW behavior is to manipulate efficacy beliefs. Recent research has found that participants often cite low self-efficacy (Kirby, 2004; Lorenzoni et al., 2007), low response efficacy (Semenza et al., 2008) and low collective efficacy as barriers to GW behavior (Bickerstaff et al., 2004, as cited in Lorenzoni & Pidgeon, 2006; Lorenzoni et al., 2007). Additionally, feelings of response efficacy have been shown to

lead to higher perceptions of the risk of climate change (Brody et al., 2008). As such, fear appeals used in the environmental arena may benefit from bolstering beliefs of self-efficacy and response efficacy (Witte, 1998) and collective efficacy (Eagly & Kulesa, 1997).

In another line of research, systematic processing of messages asking participants to perform proenvironmental behaviors has been found to increase when participants' perceived barriers to performing the behavior are acknowledged. Werner, Stoll, Birch, and White (2002) found that university students' main perceived barrier to recycling aluminum cans was inconvenience. In signs posted on garbage bins, Werner et al. (2002) validated this perceived barrier with a message stating "It is inconvenient" along with a weak or strong persuasive message "It is the 90's" or "It is important." Signs that validated participants' perceived barrier were scrutinized more heavily such that strong validated messages (compared to weak validated messages) resulted in increased pro-recycling cognitions, increased recycling when signs were in place, and increased recycling after signs had been removed for one week (Werner et al., 2002). In a follow up study, Werner, Byerly, White, and Kieffer (2004) investigated the effect of validation and persuasive message on newspaper recycling rates. Signs that asked people to recycle but did not validate the inconvenience of recycling or provide a persuasive message that recycling is important resulted in less recycling that all other conditions. Thus validation and persuasive messages can aid in the effectiveness of proenvironmental signs or fliers.

In the domain of GW and energy use, substantial efficacy barriers exist for some behaviors (Lorenzoni et al., 2007; Semenza et al., 2008). Thus, validation in this arena should focus on acknowledging feelings of low self-efficacy, response efficacy, collective efficacy, and collective response efficacy. In the current study, participants were randomly assigned to receive

(or not) a message that validated beliefs of low efficacy and provided information to bolster these beliefs.

Study 3 investigated the ability of EFCs to increase GW behavioral intention. The study was a 2 (EFC: complete or do not complete) x 2 (behavior list: receive list or not) x 2 (efficacy information: receive information or not) between-subjects design predicting efficacy beliefs, emotions, and intention to mitigate GW. Based on the research presented above, I forwarded the following hypotheses.

Hypothesis 15: There will be a main effect of EFC on GW intention such that participants who complete the EFC will have greater GW intention than those who do not complete the EFC.

Hypothesis 16: There will be a main effect of behavior list on GW intention such that participants who receive the behavior list will have greater GW intention than those who do not receive the behavior list.

Hypothesis 17: There will be a main effect of efficacy feedback on GW intention such that participants who receive the feedback will have greater GW intention than those who do not receive the list.

Hypothesis 18: There will be an interaction between EFC and behavior list on GW intention such that the effect of EFC on GW intention will be stronger when participants receive the behavior list then when they do not.

Hypothesis 19: There will be an interaction between EFC and efficacy info on GW intention such that the effect of EFC on GW intention will be stronger when participants receive efficacy info then when they do not.

Hypothesis 20: There will be a three-way interaction between EFC, behavior list, and efficacy information such that the effect of EFC x behavior list on GW intention will be higher when participants receive efficacy information.

Hypothesis 21: Stronger efficacy beliefs will lead to increased GW intention.

Hypothesis 22: Stronger emotions (fear, guilt, surprise) will lead to increased GW intention.

Hypothesis 23: There will be a main effect of environmental concern on GW intention

Hypothesis 24: There will be an interaction between ECS and EFC feedback (number of Earth's required) on GW intention such that the relationship between EFC feedback and GW will be stronger as ECS increases.

Hypothesis 25: The EFC will lead to higher levels of fear, guilt, surprise and anger.

Hypothesis 26: The effect of EFC on emotions will be moderated by Behavior List and Efficacy Feedback such that participants who receive EFC and Behavior List or EFC and Efficacy Feedback will display less negative emotions than those who only receive the EFC.

Hypothesis 27: Receiving the Efficacy Feedback will lead to higher levels of self-efficacy, response efficacy, collective efficacy and collective response efficacy.

Hypothesis 28: Receiving the Behavior List will lead to stronger beliefs of self-efficacy, response efficacy, collective efficacy and collective response efficacy.

Hypothesis 29: There will be an interaction between EFC and Efficacy List and EFC and Behavior List such that participants who complete the EFC and receive Efficacy Feedback and/or the Behavior List will have higher efficacy scores than participants who only complete the EFC.

Method

Participants

Undergraduate WSU psychology majors served as participants. Two participants abandoned the on-line survey before the end of the survey and were omitted from further analysis. Additionally, four participants who were assigned to the Ecological Footprint Calculator did not respond to the questions asking about the feedback from the calculator and were omitted from further analysis. The final sample consisted of 86 participants, 59 women and 26 men, with one participant who did not provide an answer to the gender question. The participants predominantly identified themselves as Caucasian (66.3%), with the remaining participants identifying themselves as African American (10.5%), Latino (4.7%), Asian (14.0%) and other (2.3%). The majority of the participants were between the ages of 18-25 (81.2%), with the sample age ranging from 18 to 51.

Procedure

Participants completed the study individually, on-line at their residences. To begin, participants completed the version of Schultz's (2001) Environmental Concern Scale used by Snelgar (2006) and in Study 3. The reliability of each scale was acceptable: ECsoc ($\alpha = .91$), ECbio ($\alpha = .96$), and ECego ($\alpha = .96$). Then participants answered several questions about EFCs. Next the concept of EF was explained to each participant via a brief written description of what an EF is and what it means.

Next, half the participants were randomly assigned to complete an EFC or to not complete an EFC. The EFC that participants completed was the version found at http://www.earthday.net/footprint/flash.html. Participants were instructed to go to the website and then complete the calculator. Instructions to the participants emphasized the need for

honestly answering the questions posed by the EFC. Participants were also instructed to return to the survey materials as soon as they received the feedback from the EFC. This was intended to be sure that participants would not continue searching the website to gain more information about their EF. After completing the quiz, participants were asked the results of their EFC (how many Earth's needed, and footprint in terms of hectares).

Next, participants were randomly assigned to receive an adapted version of Gardner and Stern's (2008) list of GW-mitigating behaviors or to not receive the list. The list provided 11 personal behaviors that reduce energy in rank order in terms of energy reduction potential if performed. Additionally, participants were randomly assigned to receive (or not receive) efficacy information (a statement that read "Some of the behaviors that reduce your Ecological Footprint are difficult to perform and sometimes it doesn't seem like you can make much of a difference acting alone. But, if we ALL perform energy-reducing behaviors, TOGETHER WE CAN MAKE A REAL DIFFERENCE in reducing our Ecological Footprint and reducing global warming"). After the manipulations, participants completed the self-efficacy scale, personal response efficacy scale, collective efficacy scale and collective response efficacy scale from Study 3.

Next, all participants completed Shen and Dillard's (2007) Emotional Reaction Scales. These scales consist of items to assess surprise, disgust, fear, sadness, happiness, and anger. Additional items were added to assess guilt (guilty, blameworthy) and shame (ashamed). Participants indicated the extent to which they were currently experiencing each of these feelings on a 5-point scale from 0 (none of this feeling) to 4 (a great deal of this feeling). The ratings for the items within the subscales were averaged to create a mean emotion rating for each emotion. The internal consistency reliability was calculated for each scale (except the shame scale which only

had one item): surprise (α = .92), disgust (α = .89), fear (α = .95), sadness (α = .89), happiness (α = .86), anger (α = .94) and guilt (α = .90).

Finally, participants completed a revised version of the GW Behavioral Intention Scale used in Study 3 to measure of intention to perform several GW behaviors (α = .95). The response scale for 14 of the items corresponding to one-time behaviors (e.g., install a low-flow showerhead and stop eating beef) was altered to provide an option for participants if they had already performed the behavior and was thus on a scale with 1 (Extremely unlikely), 7 (Extremely likely) and 8 (I have already performed this behavior). During the analysis, responses of "8" were excluded from calculations of the GW intentions scale mean. All other items remained the same as in Study 2.

Results

Emotions

Correlations between the variables were calculated. The correlations involving the emotions scales are shown in Table 25. None of the emotions significantly correlated with GW behavioral intention, although the correlation with disgust was marginally significant (p = .076). The intercorrelations among the negatively valenced emotions (disgust, fear, sadness, anger, guilt and shame) were quite high (rs between .78 and .89). Considering that this amount of multicollinearity can be potentially problematic for regressions, the negatively valenced emotions were combined into one negative emotion index (α = .97) that was used in predicting GW intention in later regressions. The negative emotions index correlated positively with surprise, but did not correlate with happiness.

Table 25. Intercorrelations involving the emotion scales (N = 86) with means (and standard deviations) along the diagonal.

Variables	Disgust	Fear	Sadness	Anger	Guilt	Shame	Negative Emotions Index
Disgust	1.86 (2.52)	.88***	.85***	.78***	.86***	.89***	
Fear		1.83 (2.67)	.83***	.81***	.86***	.86***	
Sadness			2.14 (2.53)	.81***	.82***	.82***	
Anger				2.03 (2.64)	.82***	.79***	
Guilt					1.90 (2.67)	.86***	
Shame						2.27 (3.07)	
Negative Emotions Index							2.01 (2.50)

Table 25. (cont.)

Variables	Surprise	Happiness	GW Intention
Disgust	.73***	.06	.19
Fear	.67***	.03	.17
Sadness	.60***	.01	.10
Anger	.44***	-.06	.10
Guilt	.66***	.02	.17
Shame	.69***	-.04	.18
Negative Emotions Index	.68***	.00	.16
Surprise	1.57 (2.37)	.08	.16
Happiness		3.90 (2.80)	.05
GW Intention			4.00 (1.04)

***$p < .001$. **$p < .01$. *$p < .05$.

Two ANOVAs were run to evaluate the effect of the EFC, Behavior List, Efficacy Feedback and their interactions on the emotions scales. First an ANOVA was run to evaluate the effect of the manipulated variables on Happiness scores. There was no effect of the EFC, Efficacy feedback, Behavior List or their interactions on happiness.

Second, due to the correlation between Surprise and the Negative Emotions Index, the effect of the manipulated variables on these emotions scales as a set was examined. A MANOVA was run with Surprise and the Negative Emotions Index as dependent variables and EFC, Behavior List, and Efficacy Feedback and their interactions as independent variables. There was a

significant multivariate effect of EFC on the emotions scales as a set, Wilks' $\Lambda = .80$, F (2, 77) = 9.68, $p < .001$. Specifically, the effect of EFC on surprise was significant, F (1, 78) = 15.93, $p < .001$, such that participants who received the EFC were significantly more surprised ($M = 2.70$, $SD = 2.62$) than those who did not complete the calculator ($M = .90$, $SD = 1.93$). There was no significant effect of EFC on the Negative Emotions Index. In addition to the multivariate effect of EFC on the emotions scales, there was a marginally significant multivariate effect of Efficacy Feedback on the emotions scales as a set, Wilks' $\Lambda = .93$, F (2, 77) = 3.05, $p = .053$. Specifically, the effects of Efficacy Feedback on surprise, F (1, 78) = 4.08, $p = .047$, and the negative emotions index, F (1, 78) = 5.93, $p = .017$, were significant such that participants who received the Efficacy Feedback were significantly less surprised ($M = 1.41$, $SD = 2.03$) than those who did not receive the Efficacy Feedback ($M = 1.70$, $SD = 2.65$) and displayed significantly less negative emotions ($M = 1.48$, $SD = 1.97$) than those who did not receive the Efficacy Feedback ($M = 2.49$, $SD = 2.83$). Finally, there was a significant multivariate effect of EFC x Efficacy Feedback on the emotions scales as a set, Wilks' $\Lambda = .911$, F (2, 77) = 3.76, $p = .028$. Specifically, the effect of EFC x Efficacy Feedback on surprise was significant, F (1, 78) = 7.28, $p = .009$. Follow up pairwise comparisons using Tukey tests revealed that participants who received the EFC but no Efficacy Feedback ($M = 4.10$) were significantly more surprised ($p < .05$) than those who received the EFC and the Efficacy Feedback ($M = 1.66$), those who received no EFC but did receive the Efficacy Feedback ($M = 0.99$), and those who received no EFC and no Efficacy Feedback ($M = 0.64$). There were no significant effects of the Behavior List or the interactions involving the Behavior List on the Negative Emotions Index or Surprise scale.

Of particular interest in the present study are the emotions of fear and guilt, so they were analyzed both separately and as part of the Negative Emotions Index. An ANOVA was run with

EFC, Behavior List, Efficacy Feedback and their interactions as independent variables and fear as the dependent variable. The only significant effect was the main effect of Efficacy Feedback, F (1, 78) = 7.11, p = .009. Participants who received the Efficacy Feedback had significantly less fear (M = 1.21, SD = 2.18) than participants who did not receive the Efficacy Feedback (M = 2.39, SD = 2.97). A similar ANOVA was run with guilt as the dependent measure. There were no significant main effects or interaction effects on guilt, although the main effect of Efficacy Feedback on guilt approached significance, F (1, 78) = 3.33, p = .072. Participants who received the Efficacy Feedback had marginally significantly less guilt (M = 1.45, SD = 2.17) than participants who did not receive the Efficacy Feedback (M = 2.29, SD = 3.03).

Efficacy beliefs

The correlations involving the efficacy scales are shown in Table 26. Most of the correlations among the efficacy scales were significant and positive except for the correlation between self-efficacy and collective response efficacy. Each of the efficacy scales significantly positively correlated with GW intention. None of the correlations between the efficacy scales and the emotions scales were significant (not shown).

Table 26. Intercorrelations involving the efficacy scales in Study 3 (N = 86) with means (and standard deviations) along the diagonal.

Variables	GW Intention	Self-Efficacy	Response Efficacy	Collective Efficacy	Collective Response Efficacy
GW Intention		.52***	.47***	.36**	.40***
Self-efficacy		7.15 (1.86)	.33**	.51***	.17
Response Efficacy			7.95 (2.25)	.23*	.62***
Collective Efficacy				8.02 (2.12)	.29**
Collective Response Efficacy					8.82 (2.06)

***p < .001. **p < .01. *p < .05.

To further investigate the effect of the manipulated variables on the efficacy scales, a MANOVA was run with self-efficacy, response efficacy, collective efficacy and collective response efficacy as dependent variables and EFC, Behavior List, and Efficacy Feedback and their interactions as independent variables.

The only statistically significant effect was the effect of EFC on the efficacy scales as a set, Wilks' Λ = .81, F (4, 75) = 4.34, p = .003. Specifically, participants who completed the EFC (M = 6.22, SD = 1.40) had significantly lower self-efficacy scores than participants who did not complete the EFC (M = 7.70, SD = 1.88), F (1, 78) = 8.109 p = .006. Additionally, participants who completed the EFC (M = 8.22, SD = 1.94) had marginally significantly higher response efficacy scores compared to those who did not complete the EFC (M = 7.78, SD = 2.42), F (1, 78) = 3.40, p = .071. No other univariate effects approached significance.

GW intention

To investigate the effect of the manipulated variables on GW intention, an ANOVA was performed with GW intention as the dependent variable and EFC, Behavior List, and Efficacy Feedback and their interactions as independent variables. None of the main effects or interactions was significant. Thus, participants who took the EFC did not differ in GW intention from those who did not take the calculator. Similarly, participants who received the Behavior List did not differ in intention from others, and participants who received the Efficacy Feedback did not differ in GW intention from others.

To examine the effect of efficacy beliefs and emotions on GW intention, a multiple regression was run with the efficacy scales and emotions scales (surprise, happiness, and the Negative Emotions Index) entered simultaneously. Although regressions with a large number of predictors relative to a small sample size can result in unstable regression weights, the hypothesized analysis was run primarily for exploratory purposes. The model significantly predicted GW intention, F (7, 78) = 8.70, $p < .001$. The only significant predictor was self-efficacy, $\beta = .42$, $p < .001$, although response efficacy, $\beta = .22$, $p = .058$ approached significance. None of the emotions scales significantly predicted GW intention. Overall, the model accounted for 43.8% of the variance in GW intention.

Results from this initial regression showed that the emotions scales were not significant predictors of GW intention. As such, a second regression predicting GW intention was run with only the efficacy scales as predictors. The purpose of this second regression was to reduce the number of predictors so that the regression weights would be more stable, thus increasing the confidence in the interpretation of the relative importance of the predictors. The pattern of results was similar to that of the regression which included the efficacy scales and the emotions scales.

The model with only the efficacy scales significantly predicted GW intention, F (4, 81) = 13.45, $p < .001$. Again, the only significant predictor was self-efficacy, $\beta = .39$, $p < .001$, although response efficacy, $\beta = .21$, $p = .068$ approached significance. Overall, the model accounted for 39.9% of the variance in GW intention.

To get a more in-depth view of the effect of the EFC on GW intention, several analyses were run on only the participants who completed the EFC. Of the 32 participants who completed the EFC, EFC feedback (number of Earths required to sustain life if all humans adopted the participants' lifestyle) ranged from 3.0 to 5.8 with a mean of 4.27 (SD = 0.76) Earths required. Thus, no participants were using resources sustainably according to the EFC feedback. Correlations between the environmental concern scales (egoistic, social-altruistic, and biospheric), number of Earths given in the EFC feedback, and GW intention were run. None of the environmental concern scales significantly correlated with the number of Earths as given in the EFC feedback. However, biospheric concern, r (29) = .33, $p = .068$ marginally significantly correlated with GW intention. To test whether environmental concern moderated the impact of EFC feedback (number of Earths required given from the EFC) on GW intention, a multiple regression was run on the participants who completed the EFC with egoistic environmental concern, biospheric environmental concern, social-altruistic environmental concern, EFC feedback, and their interactions as predictors of GW intention. The model did not significantly predict GW intention, F (7, 22) = .76, $p = .625$. As there were some concerns about low power, a simplified regression was run with only EFC feedback, biospheric concern and their interaction as predictors of GW intention. This model was not a significant predictor of GW intention, F (3, 27) = 2.45, $p = .085$.

Summary

Overall, the results reveal that completing the EFC led to lower beliefs of self-efficacy and higher feelings of response efficacy (marginally) and surprise. The Behavior List had no effect on the efficacy or emotions scales. The Efficacy Feedback led to marginally lower feelings of negative emotions, surprise and guilt, and significantly lower levels of fear, although Efficacy Feedback had no effect on efficacy beliefs. The effect of the interaction between Efficacy Feedback and EFC on Surprise was significant such that participants who received the EFC with no Efficacy Feedback were significantly more surprised than all other participants. The manipulated variables (EFC, Efficacy Feedback, and Behavior List) did not have effects on GW intention. Self-efficacy (and response efficacy to a marginal extent) predicted GW intention after controlling for the other efficacy measures and the emotions measures. Emotions did not predict GW intention after controlling for efficacy beliefs.

Discussion

EFCs and GW intention

The most significant finding of the present study was that completing the EFC (either with or without the Behavior List and Efficacy Feedback) did not lead to increased GW intention (contrary to H15, H18, H19 and H20) and actually led to lower beliefs of self-efficacy. That participants who completed the EFC felt lower senses of self-efficacy is not entirely surprising given that previous research has shown that people see low efficacy as a barrier to GW behavior (Bickerstaff et al., 2004, as cited in Lorenzoni & Pidgeon, 2006; Lorenzoni et al., 2007; Semenza et al., 2008). Nevertheless, this result is especially problematic in light of the finding that increased self-efficacy predicted greater GW intention (partially supporting H21). Thus completing the EFC led to decreased self-efficacy beliefs and decreased self-efficacy beliefs led to less GW intention. Although this paints a grim picture of EFCs, response efficacy provides some potential promise. Response efficacy increased (marginally) following the EFC, although it is not clear theoretically why this might be the case, and higher response efficacy beliefs led to (marginally) higher GW intention. Although both of these relationships did not reach conventional levels of statistical significance, this may likely result from low power. Regardless, the size of the effect of EFC on response efficacy was small such that EFCs likely do not have a large effect on response efficacy. Additional research on the EFC with more participants should be performed to examine the potential of the EFC to increase GW intention through its effect on response efficacy. More importantly, research should examine ways to increase self-efficacy following EFCs.

Although this study is the first to test whether people who take EFCs differ in terms of GW intention compared to people who do not take EFCs, some previous research has tested the

impact of EFCs on GW behavior, albeit from a different approach. Brook and Crocker (2008) had all participants take EFCs and manipulated the feedback given to them. Their results showed that the relationship between EFC feedback (EFs that were either higher than the norm or lower than the norm) and GW behavior was moderated by environmental contingent self-worth (Brook & Crocker, 2008), such that for participants high in environmental contingent self-worth, negative EF feedback increased (Study 2) or had no effect (Study 1) on GW behavior, while for participants low in environmental contingent self-worth, negative EF feedback decreased (Study 1) or had no effect (Study 2) on GW behavior. The present study took a different approach by providing participants with their actual EF results and evaluating participants' environmental concern as opposed to self-worth. Results from the present study showed that, of participants who completed the EFC, there was no effect of EFC feedback (number of Earths required), environmental concern (contrary to Hypothesis 23), or their interactions (contrary to Hypothesis 24) on GW behavior. Thus the present results suggest that participants' reactions to EFC feedback do not depend on their initial level of environmental concern or their actual EFC feedback. Again, these results should be tempered in light of the small sample size.

Behavior List and Efficacy Feedback

Previous research had found that people feel decreased efficacy (self-efficacy, response efficacy, and collective efficacy) when they think about taking action to mitigate GW (Bickerstaff et al., 2004, as cited in Lorenzoni & Pidgeon, 2006; Lorenzoni et al., 2007; Semenza et al., 2008). As such, it was expected that additions to the EFC may be needed to bolster these feelings of decreased efficacy. The Behavior List and Efficacy Feedback were incorporated into the study to serve this purpose. The Behavior List used in the study outlined 11 actions that an individual could perform to reduce energy use and the Efficacy Feedback used clinical validation

to persuade participants to increase their GW behavior while acknowledging lack of efficacy as a valid barrier to GW behavior. It was expected that both the Behavior List and the Efficacy Feedback would increase efficacy beliefs and GW intention, but the manipulations did not work. Participants who received the Behavior List did not have increased efficacy beliefs compared to those who did not receive the list (contrary to H28) and participants who received Efficacy Feedback did not differ from those who did not receive the feedback on any of the efficacy scales (contrary to H27). Additionally, neither the Behavior List nor the Efficacy Feedback interacted with EFC to effect efficacy beliefs (contrary to Hypothesis 29). Finally, neither Efficacy Feedback nor Behavior List impacted GW intention (contrary to H16 and H17).

The inability of the Efficacy Feedback and Behavior List to impact efficacy or GW intention may at first seem to suggest that they are not a necessary addition to the EFC. But caution should be taken against making this interpretation. First, the null findings may suggest that the versions of the Efficacy Feedback and Behavior List given in this study were not stimulating enough to elicit the attention required for systematic processing of the list. Because the Efficacy Feedback did show effects (on the emotions scales) in the study, this explanation applies primarily to the Behavior List. The Behavior List created for this study consisted of a list of behaviors typed in black and white with no pictures, icons, or interactive features. Future researchers may find that a Behavior List that is more engaging or shorter may prove to be more effective in future research. Second, although the Behavior List did include behaviors that participants could perform in rank order of effectiveness, additional information about the effectiveness of the behaviors was not provided. Although Gardner and Stern's (2008) list does include percentages of the amount of energy that could be saved by performing each behavior, this information was not included because it was believed that it would reduce feelings of response efficacy. For example,

according to Gardner and Stern's list, if people carpooled to work with someone else, they have the potential to save 4.2% of their personal energy use. If the Behavior List had included this information it was believed that participants would feel less response efficacy. Additional research should examine participants' perceptions of information about the amount of energy saved by their personal behaviors to determine what percentage of energy saved is required to motivate participants to adopt a behavior. Third, the Efficacy Feedback used clinical validation to acknowledge beliefs about low self and response efficacy but only provided the counterargument to bolster collective and collective response efficacy. It could be that Efficacy Feedback that includes a non-efficacy related message (e.g., "It is the right thing to do") in addition to the validation of efficacy barriers will be more effective. Future research should examine a modified version of the Efficacy Feedback in the domain of GW behavioral intention. Finally, previous research has repeatedly recommended that behavior change appeals should include information to bolster efficacious behavior beliefs (Rippetoe & Rogers, 1987; Witte, 1998). Thus presenting the EFC without such information is not recommended as it is counter to established research.

EFCs as fear appeal

Previous research has shown that EFCs elicit fear (Aubert, 2006). As such, in this study, EFCs were investigated in terms of fear appeal research, which has found that persuasive appeals that elicit fear can be effective in increasing intention if participants also have high efficacy beliefs (Witte, 1998). In the current study, there was no effect of the EFC or the interactions between EFC, Behavior List and Efficacy Feedback on fear ratings. Thus, contrary to the predictions, those who completed EFCs did not have increased fear compared to others and those

who both completed EFCs and received a Behavior List or Efficacy Feedback did not have decreased fear compared to those who only received the EFC.

Unfortunately, the measure of fear in this study so strongly correlated with the other negatively valenced emotions that a composite measure had to be constructed. Results showed that, contrary to H25 and H26, participants who received the EFC or any combination of EFC and Behavior List or Efficacy Feedback did not have more negative emotions than others who did not receive the EFC (although participants who received the EFC did show more surprise than others). Additionally, negative emotions did not significantly predict GW intention after controlling for efficacy beliefs (contrary to H22).

The relative lack of effects of EFC and the interactions between EFC and Behavior List and Efficacy Feedback on emotions may result from a methodological artifact. After participants were exposed to the IV manipulations, they completed the four efficacy scales before completing the emotions scales. Perhaps the time lapse between exposure to the manipulations and the emotions measures allowed relatively transient emotion states to subside. Thus is it possible that EFCs do elicit fear or other negative emotions and could be evaluated as fear appeals in future research. Future investigations should attempt to measure emotions immediately after completing EFCs, and receiving feedback. If emotions, such as fear or guilt, are found to be elicited from EFCs, then strategies to capitalize on the effect of these emotions, such as a commitment procedure, should be immediately implemented following completion of the EFC.

Limitations

Several limitations are evident in this study. First, the relatively small sample size may have made it difficult to detect effects of the EFC, Behavior List and Efficacy Feedback on emotions, efficacy beliefs and GW intention. It is equally likely that the effects of the manipulated

variables are too small to be important as larger effects should have been visible in this sample size. Second, although having participants complete an actual EFC that was already available on the internet added to the real world generalizability of the results, it was impossible to monitor how much time participants spent on the website of the EFC. If participants spent additional time on the EFC website browsing for additional information on the EFC, it could potentially alter the results, especially if participants who were assigned to receive on the EFC continued to browse the site for behavioral recommendations. Third, the ordering of the emotions scales after the efficacy scales, as mentioned above, may have hindered the ability to capture immediate emotional reactions to EFCs. Future research should measure emotions immediately after participants complete EFCs.

Conclusions

Overall, the present study found that EFCs were not effective at increasing GW intention even in combination with a list of behaviors to decrease energy use and/or information that validated the efficacy barriers of GW behavior. More troubling, EFCs were shown to lead to lower feelings of self-efficacy. Additionally, the results suggest that EFCs might not be able to be conceptualized as fear appeals in that they did not elicit emotions of fear or other negative emotions. The results point to the need for additional research into participants' reactions to EFCs and their effect on GW intention. Although the variables manipulated in this study did not predict GW intention, measured variables of self-efficacy and to a lesser extent response efficacy led to increased GW intention. Together, these results suggest that future research on broader samples should further attempt to increase efficacy beliefs in conjunction with EFCs.

SECTION FIVE

GENERAL DISCUSSION

Results Overview

The purpose of the present set of studies was to provide an in-depth investigation of the psychology of GW-related behavioral intentions. Specifically, the three studies set out to provide a global picture of current GW perceptions, examine the predictors of GW intention, and evaluate the extent to which EFCs increased GW intention. Taken together, the results provide interesting insight into GW perceptions and intention.

Study 1 showed that, although participants in this sample had more accurate GW perceptions compared to participants in previous research, participants' GW perceptions were still flawed. In terms of general GW beliefs and risk perceptions, most participants agreed that GW was occurring and was human caused and that GW consequences were risky. In terms of GW causes, participants recognized that fossil fuels and automobiles were major general causes and that personal behaviors such as driving and not recycling were major individual causes of GW. In terms of GW solutions, participants recognized that stopping the use of fossil fuels and converting to electric cars were important general GW solutions and that driving a more efficient car and driving less were effective personal-level GW behaviors. However, participants thought that throwing away garbage instead of littering was the most effective behavior to mitigate GW and they underestimated the ability of adjusting the thermostat to reduce GW. Additionally, participants' responses showed general flaws in their mental models of GW. Participants underestimated the role of methane-producing activities in causing and mitigating GW and displayed confusion about activities that cause and mitigate GW and activities that cause and mitigate ozone layer depletion and pollution, as has been seen in previous research (Brechin,

2003; Kempton, 1991; Read et al., 1994). In terms of GW intention, Study 1 showed that GW perceptions, in particular, GW beliefs, risk perceptions, and knowledge of GW mitigators, predicted GW intention with risk perceptions and mitigator knowledge mediating the relationships between preceding variables and GW intention. Overall, knowledge of the mitigating potential of a behavior most strongly predicted GW intention.

Study 2 tested four models of GW intention: the social psychological model of GW intention, the simplified model of GW intention, the VBN, and a modified version of the TPB. Several key findings emerged after culling the results across the models. First, none of the models (except for the TPB) was a good fit to the data without modifications. Most frequently these modifications were in the form of unhypothesized direct paths between nonadjacent variables. Second, personal norms were repeatedly found to be one of the strongest predictors of behavior. In the various models, personal norms partially mediated GW intention's relationships with biospheric values, egoistic AC, social-altruistic AC, AR cause, cause knowledge, social norms, self-efficacy and response efficacy and fully mediated GW intention's relationships with AR, egoistic values, collective efficacy and collective response efficacy. Third, self-efficacy and response efficacy were consistently found to be important direct predictors of behavior. In the simplified model, collective response efficacy was found to be an indirect positive predictor of behavior and collective efficacy was found to be a negative indirect predictor of behavior.

Study 3 showed that, contrary to expectations, completing EFCs did not lead to more fear, guilt, or intention and actually led to lower beliefs of self-efficacy. However, EFCs did lead to marginally higher beliefs of response efficacy. Additions to the EFC, i.e., the Behavior List and Efficacy Feedback, did not increase the effectiveness of the EFC to increase behavioral intention. However, Efficacy Feedback reduced fear levels and marginally reduced negative emotions,

surprise and guilt regardless of whether the EFC was taken, although the Behavior List had no effect on emotions. Contrary to expectations, negative emotions did not lead to GW intention after controlling for efficacy beliefs, but greater feelings of self-efficacy and response efficacy (marginally) predicted GW intention after controlling for the other efficacy beliefs and emotions.

Implication of results

For understanding behavioral intention

To combat GW, average citizens will have to take action to reduce their greenhouse gas emissions. Psychologists can play a role in solving GW by achieving an understanding of GW intention through systematic research investigations. The present set of studies, designed from a psychological approach, investigated the role of GW perceptions, values, norms, efficacy beliefs, and EFCs in influencing GW intention. As a result, the findings from these studies have several implications for understanding GW behavioral intention.

First, the results of Study 1 showed that GW perceptions are important predictors of GW intention. Several previous researchers had investigated GW perceptions, but an overarching theoretical model of GW perceptions has not emerged. The GW perceptions model presented in Study 1 theorized that general GW beliefs (GW is occurring and is caused by humans) lead to GW risk perceptions (perception that outcomes of GW are risky), which lead to knowledge of the causes and mitigators of GW, which in turn lead to GW intention. In general the hypothesized model with each variable mediating the relationship between the preceding variable and GW intention (except for knowledge of GW causes, which did not significantly predict GW intention above knowledge of GW mitigators) was supported by the data. The results provide a theoretical framework for future research and highlight the importance of knowledge of GW mitigators as direct predictors of behavioral intention.

Second, the results reinforce the importance of efficacy beliefs in predicting GW intention. Self-efficacy has often been included in models predicting environmental behavior and GW intention as researchers have drawn on Ajzen's (1991) Theory of Planned Behavior (de Groot & Steg, 2007; Harland et al., 1990; Heath & Gifford, 2002; Kaiser et al., 2005), which includes a

prominent role for self-efficacy (i.e., perceived behavioral control). Fewer studies have investigated the effect of response efficacy on environmental behavior (Hall & Slothower, 2009; Lubell, 2002) and GW intention (Heath & Gifford, 2006). Additionally, few researchers have included collective efficacy or collective response efficacy in their models of environmental behavior (Bonniface & Henley, 2008; Lam, 2006; Lubell, 2002) and no studies could be located that have included collective efficacy and collective response efficacy in the models of GW intention. In Study 2, self-efficacy and response efficacy were consistently shown to predict GW intention both directly and indirectly via personal norms. Additionally, Study 2 found some evidence that collective response efficacy and collective efficacy (negatively) are indirect predictors of GW intention through personal norms. In Study 3, self-efficacy significantly and response efficacy marginally significantly led to increased GW intention, while collective efficacy and collective response efficacy were not significant predictors of GW intention. In sum the findings suggest that beliefs about one's capability of performing GW behaviors, beliefs that the behaviors will reduce GW, and perhaps belief that the behaviors will be effective at reducing GW if the majority of Americans perform them led people to be more likely to adopt GW behaviors in the future.

Third, the results of Study 2 showed that applying existing social psychological models of proenvironmental behavior to predicting GW behavior only resulted in explained variances between 30 and 31%. The model developed in this study to predict GW intention did explain more variance in GW intention (38%), but the model was extremely complex. The results of Study 1 point to the potential for a hybrid model that combines the strongest social psychological predictors of GW behavior (i.e., personal norms, biospheric values, awareness of consequences on the self, and efficacy beliefs) with the strongest GW perception predictors (i.e., GW risk

perceptions and knowledge of the mitigators of GW). To better understand GW behavior, a hybrid model that focuses on the five or six most important predictors is most likely required.

For policy and global warming campaigns

GW intention, and not policy support, was the focus on the present set of studies. Yet the results have some important implications for policy makers and strategists aiming to increase GW behavior. The most direct application of the present results for GW campaigns centers on EFCs. Many organizations have EFCs on their websites under the assumption that they increase GW behavior. Because EFCs are already easily accessible on the internet, they serve as a readily available international tool that can potentially be used to increase GW behavior. Surprisingly, the EFC used in this study had no effect on intention. Additionally, the information added to the EFC to boost efficacy beliefs did not alter the effectiveness of the EFC in increasing intention. Although the EFC in this study was ineffective in this respect, additional modifications to the EFC are suggested so that GW campaigns can maximize the effectiveness of this widely used tool. If methods can be devised that mold EFCs into persuasive fear appeals, then EFC designers can draw on the breadth of research on persuasive fear appeals that already exists to elicit behavior change. One potential modification to infuse EFCs with fear-arousing stimuli is to add scary descriptive images about the personal consequences of GW after people complete the EFC. Then additional modifications to the EFC in line with Witte's (1998) Extended Parallel Process Model such as the efficacy information provided to participants in Study 3 may prove useful in improving the persuasiveness of EFCs to change intention. Care should be taken, though, to reduce feelings of anger that may be elicited in conjunction with the fear. Another option to improve EFCs is to allow participants the opportunity to make commitments to reduce their EF immediately following their EF feedback. Prior research has shown that participants who make

verbal or written commitments to act proenvironmentally actually do act more proenvironmentally later compared to those who have not made such commitments (Katzev & Wang, 1994). To increase the visibility of the commitments, EFC designers could allow participants to post their commitments on the EFC websites so that they are available for public viewing or encourage EFC takers to request paraphernalia such as bumper stickers or t-shirts from the EFC sponsoring organization as has been suggested by Bator and Cialdini (2000) in other environmental domains. Overall, countless options to improve EFCs exist. Based on the potential of EFCs to reach an international audience, strategies to improve the EFCs should be evaluated. To provide the greatest potential for success, consideration and eventual selection of strategies to improve EFCs should be chosen based on existing psychological models of persuasion.

As a set the results underscore the importance of beliefs about mitigators of GW, either in the form of accurate knowledge of GW mitigators or response efficacy, in predicting GW intention. Unfortunately, attempts to increase beliefs of response efficacy in Study 3 through the presentation of a list of behaviors one can do to reduce GW or efficacy feedback acknowledging lack of efficacy as a barrier to GW behaviors, were not effective. However, the recurrent finding in all studies that response efficacy predicted GW intention suggests that campaign designers should attempt to increase beliefs of response efficacy. Existing environmental campaigns, likely designed to increase response efficacy, often provide participants with a list of behaviors they can perform to reduce their environmental impact. Gardner and Stern (2008) have noted that the lists are often ineffective in that they frequently list too many behaviors for participants to process (sometimes up to 1001 behaviors) or list behaviors in no particular order of importance leaving people to guess which ones would be most effective. The list provided to the participants

in Study 3 included 11 behaviors rank-ordered in terms of effectiveness at reducing personal energy use, but the list was not effective at increasing response efficacy or GW intention. Behavior lists that are modified to be shorter and more vivid may prove effective to GW communicators in the future so behavior lists should not be abandoned based on the limited results of this study. However, alternatives to lists of behaviors to increase response efficacy and mitigator knowledge should be explored. One possible way to increase beliefs of response efficacy and mitigator knowledge would be to provide feedback to participants via meters on appliances and other devices that show participants the amount of energy saved or gasoline conserved with various behaviors. Feedback displaying daily energy use has repeatedly been shown to be effective in reducing household energy use (Seligman, Becker, & Darley, 1982). More sophisticated feedback has recently been developed to provide information to drivers about the amount of gasoline currently being consumed (e.g., the Prius's energy monitor display) and to homeowners about real-time energy consumption (e.g., Google's PowerMeter; http://greeninc.blogs.nytimes.com/2009/05/20/google-rolls-out-home-energy-software/). Such continuous feedback aims to educate participants about the amount of energy used by various activities so that they can change their behaviors to reduce their energy use. Information based techniques such as feedback can be effective as long as people are already motivated to conserve (Seligman et al., 1981).

The results described above highlight the finding that participants' perceptions of GW include some inaccuracies and that as accurate knowledge of GW mitigators increases, GW intention also increases. At first blush, this seems to provide evidence that a public information campaign to correct these faulty GW beliefs is all that is needed to increase GW behavior.

According to Lorenzoni and Pidgeon (2006, p. 80), previous researchers of GW perceptions have come to similar conclusions:

> Policy makers should concentrate upon reinforcing correct beliefs, rectifying those incorrect beliefs that might directly influence relevant behavior (e.g. if someone believes that undertaking actions to deal with ozone depletion also counteract the influence on the climate), while also stating the effective solutions explicitly.

However, social psychologists have long recognized that although information is necessary to change behavior, it is not sufficient (Bandura, 1982; Lorenzoni & Pidgeon, 2006). Several other psychological variables such as values, norms, and efficacy beliefs and socio-structural variables such as income, home ownership, policy, and transportation infrastructure likely influence behavior and the extent to which information influences behavior. Information provided to individuals may increase the behavior of people who have the means and desire to change their behavior but will likely be ineffective for people who lack the resources or motivation to change their behavior. Thus, campaigns that simply aim to increase information about behaviors that are effective in mitigating GW overlook potentially substantial barriers to action which may preclude increased information from leading to increased behavior. Campaign designers should conduct formative research before the campaign is launched to better understand the characteristics of the community whose behavior they wish to change (McKenzie-Mohr, 2000; Monroe, 2003; O'Keefe & Shepard, 2003). By better understanding the barriers to effective behavior (including lack of information), campaign designers are better able to craft communications that are relevant to the population of interest and address concerns about behavior change (McKenzie-Mohr, 2000).

Future research

The present results pave the way for additional investigations into GW-related behavior and raise interesting questions that can be examined in future research. First, the results of Study 1 provide promise that GW perceptions are improving compared to previous research. However, the sample of Study 1 was restricted to psychology students at a university so that a more in-depth picture of GW perceptions could be examined through open ended questions. A replication of Study 1 with a more diverse sample of Americans could help provide a better picture of current perceptions of GW.

Second, the results of Study 2 point to the need for additional theoretical and empirical research to develop a sound social psychological model of GW behavior. The initial attempt to do so in this paper drew on the VBN and TPB constructs that have been shown to predict proenvironmental behavior in previous research. Although the resultant model was a good fit to the data, it was so complicated that interpretation of the paths proved difficult. Nevertheless testing this model and the other models of GW intention was quite useful in that several variables showed themselves to be consistent predictors of GW intention across the different models tested. Personal norms, response efficacy, self-efficacy, awareness of consequences to the self, and biospheric values appear to be the strongest predictors of behavior. One option for future research is to develop a new theory that uses these five variables as a starting point for the model. Other variables such as the GW perception variables used in Study 1 should be evaluated as potential additions to the model. Additionally, demographic and socio-structural variables that are relegated to a background role in the VBN and TPB could be incorporated in the model as potential main effects or moderators.

Another avenue for future research is to develop different theories for different GW behaviors or behavior sets. GW behavior as a class of behaviors consists of behaviors that vary widely in terms of domain, difficulty, cost, and effectiveness. Although formalizing a different theory for each of these behaviors may be counterproductive, it may be useful to formulate different theories for different behavior sets. For example, although travel behavior and household energy use behavior are similar in some respects (e.g., both behaviors have monetary incentives, and both behaviors impact the environment), they are also quite different in other respects (e.g., travel behavior is public, while household energy use is not, and changes in travel behavior may require more inconvenience than changes in household energy use). Whitmarsh (2009a) has recently shown that these two behavior sets do in fact have different predictors. A more detailed theoretical rationale for why these and other behavior sets should have different predictors should be developed. Future researchers should work to develop such models.

Third, the results point to the need for additional work on EFCs. The EFC developed by Earth Day Network was used in Study 3 to evaluate the effectiveness of EFCs in increasing GW intention. Although the general premise behind EFCs is consistent across different calculators, assumptions underlying the calculations of the EFCs often differ. A recent comparison of carbon calculators found that estimates of the CO_2 emissions of certain behaviors can vary between calculators on the order of several metric tons per person per year (Padgett, Steinemann, Clarke, & Vandenbergh, 2008). Thus, although Earth Day Network's EFC gave participants certain feedback about their EFC, it is likely that other calculators may give significantly different feedback. As shown by Brook and Crocker (2008), participants' reactions to EFCs depend on their level of environmental contingent self-worth and whether the EFC feedback informs them they are above or below the norm in terms of EF. If calculations between EFCs vary enough that

participants who are above the EF norm on one EFC are below the EF norm on another EFC, participants' reactions to them may be very different. Additionally, Earth Day Network's EFC interface allows participants to personalize an avatar which then represents the quiz taker throughout the remainder of the exercise. It is possible that other EFCs that are less interactive may not be as engaging to participants. Future researchers could benefit from evaluating and comparing people's psychological reactions to the different EFCs circulating on-line to determine whether the present results are indicative of all EFCs or just that of the Earth Day Network's EFC. Finally, future researchers should investigate whether the modifications to the EFC suggested above (i.e., adding scary images of GW outcomes and incorporating a commitment technique) are effective in increasing participants' GW attitudes and/or intention.

Finally, future researchers should aim to measure GW behavior or actual energy use instead of GW intention. Azjen and Fishbein (2005) using the Theory of Reasoned Action and the Theory of Planned Behavior as a backdrop have argued that the intention-behavior correlation is generally large (c.f. Hale, Householder, & Greene, 2003). But various other factors influence the extent to which intention leads to actual behavior (e.g., perceived behavioral control; Ajzen, 1991) so measurement of actual behavior where possible is ideal. Additionally, researchers have recognized the need for investigations that focus on behaviors that are maximally impactful on the environment (Stern, 2000; Whitmarsh, 2009a). Stern (2000) has argued that efficiency upgrades (e.g., installing attic insulation and purchasing energy efficient light bulbs) are much more impactful from an environmental standpoint than curtailment behaviors (e.g., adjusting the thermostat and turning off the lights when not in use) and as such should be the focus of research investigations. In the present study, the sample consisted of students who mostly rented their homes and as such were not able to perform many of the efficiency upgrades advocated by Stern

(2000). Although research such as the present studies is needed to understand the underpinnings of non-homeowners' GW behavior, additional research will benefit by using a more diverse sample including homeowners who are better able to perform these more impactful environmental behavior. Further, if the main variable of interest is environmental impact then researchers may benefit from going a step further by measuring greenhouse gas emissions or actual energy use as opposed to behaviors that lead to these emissions or energy use. Gatersleben, Steg, and Vlek (2002) measured proenvironmental behavior with a traditional self-report measure and also developed a scale that measures a household's direct and indirect energy use in terms of giga joules per consumer behavior. Results showed that very different factors predicted the two outcomes, with attitudes primarily predicting self-reported proenvironmental behaviors and household size and income primarily predicting actual energy use (Gatersleben et al., 2002). Considering that the correlation between energy conservation behaviors and actual energy use is often quite low (Olsen, 1981), measuring actual environmental energy use or greenhouse gas use when possible may prove especially fruitful in future research.

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FOOTNOTES

1. Although climate change has become the preferred phrase among scientists, the public often uses the term global warming when referring to changes in climate that result from natural causes and human activities. As such, although climate change technically includes all changes to the climate system (including global warming) that result from changes in greenhouse gas concentrations, the terms climate change and global warming are used interchangeably in the present paper and are both meant to refer to "an average increase in the temperature of the atmosphere near the Earth's surface and in the troposphere" (US EPA, 2009c). All questions included in this study used the term global warming, as recent research has found that the laypublic more often associates global warming (versus climate change) with concern, human causes, and individual mitigating actions (Whitmarsh, 2009b).

2. The use of the word *aerosols* may be problematic as in lay parlance aerosols generally refer to aerosol spray cans, while in the scientific literature on climate, aerosols refer to particulates in the atmosphere and are known to reduce global warming. For this series of studies, aerosols are assumed to be interpreted by participants as aerosol spray cans