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Energy-use Behavior Among College Students

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ENERGY-USE BEHAVIOR AMONG COLLEGE STUDENTS

by

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ABSTRACT

As the effects of global climate change become increasingly apparent, many concerned individuals are making efforts to reduce their greenhouse gas emissions. One simple and effective method of reducing one's personal carbon footprint is through energy conservation behavior. Studies have shown that occupant behavior can control as much as 50% of residential energy use and that energy use varies widely between residences with the same number of occupants depending on consumption behavior. In light of this, energy conservation behavior is a valuable method of reducing greenhouse gas emissions and curbing the effects of climate change. Motivating people to conserve energy could have profound positive effects on the environment. The following study applies Icek Ajzen's Theory of Planned Behavior (1991) to energy conservation behavior among college students in the state of Florida. This research tests the hypothesis that pro-environmental attitudes, influence of peers, and a high level of perceived control over behavior have a significant impact on energy conservation behavior.

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INTRODUCTION

Consensus within the scientific community regarding the causes and consequences of global climate change has continually increased in the last several decades. At the same time, greenhouse gas (GHG) emissions have continued to rise in the United States. Prompt action is necessary in order to prevent atmospheric carbon concentrations from more than doubling by 2050. Because of the substantial impact that energy-use behavior has on the total energy consumption of households, it is important to study this behavior and its potential as a tool for curbing climate change. Reducing one's energy consumption is a personal, simple, and effective way of reducing one's carbon footprint.

This thesis concerns the residential energy consumption of college students, a sector of the population often missing from research on household energy use in the United States. Today's college students are entering adulthood as we face the most dangerous environmental period in human history. Collectively their consumption behaviors and actions will shape trends in carbon output during the time when it matters most, the middle of the 21st century.

This thesis reports on survey data collected specifically from college students in the state of Florida. As a peninsular, low-lying state with a subtropical climate, Florida is susceptible to droughts, floods, sea level rise, biodiversity loss of its many endemic species, and severe weather events such as hurricanes and extreme heat—all of which are known to result from global climate change.

LITERATURE REVIEW

Significance of Energy-Use Behavior

As the problem of global climate change has become increasingly pressing, the need for solutions has increased, as well. The current concentration of carbon dioxide in the atmosphere is 390 parts per million (ppm), a climb from 290 ppm since the Industrial Revolution, resulting in a 1 degree Celsius increase in global temperature (IPCC 2007). Projections through the year 2050 vary based on the level of action taken today to curb greenhouse gas emissions. Continuing to emit carbon dioxide and other greenhouse gases at the current rate would result in approximately 750 ppm by 2050, while drastic cuts in carbon output would result in a best-case concentration of 450 ppm. This level is considered best-case not because it will avoid serious impacts of climate change, but because it is achievable. Scientific projections indicate that a level below this, though preferable, may not be possible. Pacala and Socolow (2004) envision the difference between projected concentrations of 750 ppm and 450 ppm levels as a triangle. The task of bringing carbon output from 750 ppm down to a stable 450 ppm may seem daunting, and since there is no single way to do so, the authors suggest dividing this triangle into a series of carbon reduction strategies that together realize the goal of stabilizing carbon dioxide concentrations at this best-case level of 450 ppm by the year 2050. Pacala and Socolow call these individual solution slices in the triangle "stabilization wedges." Raised automotive gasoline efficiency standards and adoption of renewable energy portfolio standards are examples of stabilization wedges.

Dietz *et al*. (2009), extend Pacala and Socolow's vision, arguing that their stabilization wedges rely too heavily on technology and industry. They propose that an entire wedge could be achieved through improved energy-use behavior in households. Dietz *et al*. (2009) report that

household energy in America accounts for 38% of the United States' carbon dioxide emissions, and 8% of global carbon dioxide emissions. The authors report that the United States could reduce its carbon output by over 7% in ten years through the use of currently-available in-home technologies and increased energy conservation behavior. Given this potential contribution to an overall reduction in energy use, it is undeniably important to explore possible avenues for encouraging and motivating energy conservation in the home.

The Theory of Planned Behavior

In his theory of planned behavior, Icek Ajzen (1991) identifies several factors that interact to predict specific, intentional human behavior. The model is recreated below:

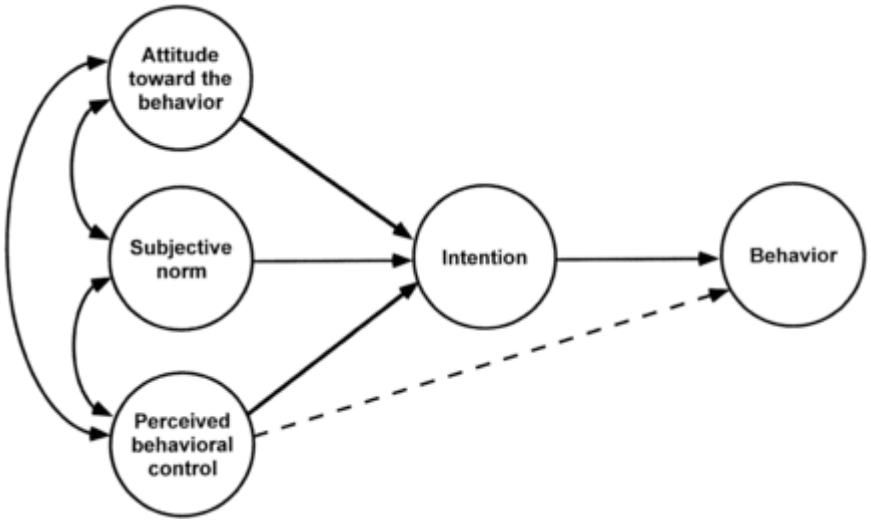

Figure 1. Ajzen's Theory of Planned Behavior (1991)

As seen in Figure 1, one factor that influences behavior is the attitude toward the behavior, or whether a person favorably or unfavorably perceives a specific behavior. The next factor is subjective norms, or how strongly pressured a person feels he or she is to perform, or not to perform, a behavior. A third factor is perceived behavioral control, that is, how much control a person *thinks* he or she has over the behavior, including the ease of performing it, anticipated

obstacles, and confidence that a behavior will have the desired effect on an outcome. Ajzen stresses the difference between perceived behavioral control and *actual* behavioral control, which may be greater or less than perceived control. Perceived behavioral control must be an accurate reflection of actual behavioral control in order for the behavior change to be successful. Actual behavioral control is represented by the dotted line leading from perceived behavioral control to behavior in the model. These three factors interplay to influence a person's intention to perform a behavior. Using Ajzen's model as a guide, a simplified model was created for use in this experiment:

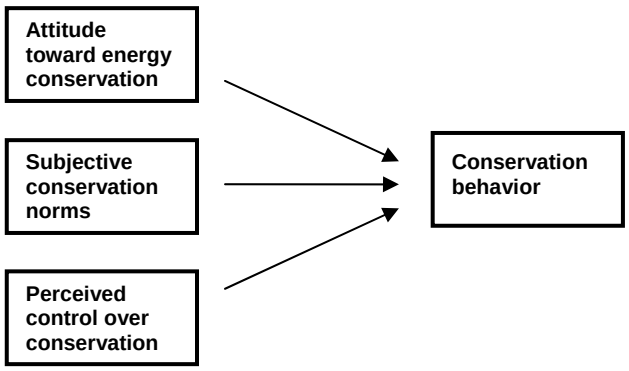

Figure 2. Applied Model of Planned Behavior

The following sections will explore and examine examples of each of these factors as they relate to residential energy use and conservation.

Attitudes and Values

The first facet of Ajzen's theory of planned behavior is the actor's attitude toward the behavior. Research has shown that the way people think about or view the world may have profound effects on their environmental attitudes. Most Americans operate under what is known as the Human Exemptionalist Paradigm (HEP), believing human beings to be the masters of the natural environment, and exempt from dealing with the consequences that may arise from

environmental limits or degradation (Dunlap and Catton 1980). Dunlap and Catton (1980) suggest that Americans will need to shift to a New Ecological Paradigm (NEP), viewing humans as members within their natural environment, rather than dominators of it, if de-carbonization is to occur. People who operate under the NEP have far more pro-environmental attitudes than their HEP counterparts.

Some values can help predict a person's attitude toward the environment, as well. For example, academic major has been shown to be a significant predictor of environmental attitudes, with environmental studies majors demonstrating significantly more positive attitudes towards the environment than economics, psychology, and sociology majors (Sherburn and Devlin 2004). The same study bolsters research regarding political ideology and environmental attitudes (Dunlap 1975), with students identifying themselves as liberal more likely to be pro-environment than students identifying themselves as conservative. In another study of university students, research concluded that a significant amount of environmental concern was present, and furthermore, that it led to an increase in environmental education and research (Fernandez-Manzanal *et al.* 2007). This study found that final-year students are more likely to take courses that relate to the environment in some way than they are earlier in their courses of study, when there is increased latitude in electives.

While both beliefs and values have been shown to play a large role in one's attitude toward the environment, research has shown a lack of a strong relationship between attitudes and real life behavior (Ajzen and Fishbein 1977). While it may seem intuitive that conservation behavior will follow from pro-environmental attitudes, this has not proven to be the case in many empirical studies. This phenomenon is referred to as the "Attitude-Behavior split" (Bell 2009). Costanzo *et al.* (1986) demonstrate that there is a lack of a direct relationship between attitudes

about conservation and real life conservation behavior. In fact, they find that "people who cite conservation as the single most important strategy for improving our energy future are no more likely than others to engage in energy-conserving behaviors" (Costanzo *et al.* 1986: 522). The authors stress that behavior change is the goal of consequence when it comes to conservation, not pro-environmental attitudes. In a way, as long as you are engaging in conservation behavior, how you feel about the environment does not necessarily matter. Pro-environmental attitudes are not enough to solve environmental problems unless students change their energy-use behavior.

Another study of energy conservation found a positive relationship between some values and such behavior; however, the relationship was weak (Neuman 1986). The study found that most of the value-behavior correlation happened for repeated conservation activity, rather than "one-shot" actions. The study ultimately concludes that values represent too small an influence on behavior to be used as an indicator of conservation behavior. On the other hand, Neuman (1986) optimistically points out that because values did not significantly impact conservation behavior, they "therefore do not constitute a significant obstacle to such efforts" (Neuman 1986: 1).

In light of these findings, why is it that attitude toward the behavior is a factor in Ajzen's theory of planned behavior? Poortinga, Steg, and Vleck (2004) stress the fact that looking at only attitudes is far too limited in scope. Attitude alone may not influence behavior, but is still important when linked with subjective norms and perceived behavioral control. Though research has shown that there is no direct link between attitudes and actual behavior, the above-mentioned studies do demonstrate a positive relationship.

Norms and Peer Influence

The next facet of Ajzen's theory is subjective norms. The research literature shows that few studies address this aspect of the theory of planned behavior; however, there are an increasing number of studies in recent years, and some research that offers valuable insight into the importance of subjective norms. Research in California found an interesting undervaluation of subjective norms (Nolan *et al*. 2008). Respondents were asked about their own energy-use behavior, the reasons for their conservation efforts, and about their perceptions of their neighbors' energy-use behavior. Respondents ranked normative beliefs as least important to them in their energy-use decisions. However, the study found that normative beliefs were in fact the strongest predictor of energy conservation of all possible options, despite residents claiming it to be unimportant to them. This research suggests not only that norms may play a powerful role in persuading people to be environmentally conscious, but also that the influence of subjective norms may be underestimated. Other researchers argue that the current approach to measuring pro-environmental behavior may focus too heavily on attitudes and not enough on other factors, including social influences.

DeYoung (1993) notes that one of the most effective coercive methods to changing environmental behavior is social pressure. Furthermore, social support is noted as one of the best positive motivators for pro-environmental behavior. Lutzenhiser (1993) suggests that perceived social disapproval (*i.e.* norms) may be a more influential variable in non-conservers than attitudes. In contrast, a very recent study also done in California found that political ideology had a significant impact on the effectiveness of subjective norms. Costa and Kahn (2010) found that Democratic households responded to information about their neighbors' energy use by reducing as much as 3%, but Republican households responded by using 1% more energy. The researchers speculate that, in addition to increasing polarization of Democrats and

Republicans on environmental issues (Dunlap and McCright 2008), there may be a defiance effect causing this negative response to norms.

On the other hand, peer influence and subjective norms has proved to be a very effective method of encouraging energy conservation behavior among college students living in on-campus dormitories. At Oberlin College, a competition was held between on-campus dormitories to see which building could reduce their energy consumption the most over the course of a two-week period. The study found that students are "highly motivated to engage in behavior that is in accord with norms and goals associated with their peer group" (Petersen 2009: 1). A dorm energy competition at Indiana University found that students were far more motivated to participate in the competition if their peers were also participating than out of concern for the environment (Pierce 2008). Interviews with students often reveal a deep concern with peer involvement in energy competitions. For example, a student at Indiana University remarked that "…if all the girls on my floor really want to win, I'd try to save energy; otherwise, I probably wouldn't do anything differently" (Pierce, 2008: 6). Whether positive or negative, these studies all indicate that subjective norms do have some influence on behavior.

Perceived Behavioral Control

The third facet of Ajzen's model is perceived behavioral control. Little research has been done specifically on the effects of perceived behavioral control on behavior, but there is still evidence in the literature that this aspect of the model is important. Some research suggests that perceived behavioral control only has an indirect influence on behavior. Rise, Thompson, and Verplanken (2003) found that perceived behavioral control only influenced recycling behavior in that it increased intentions to recycle. Another study, measuring perceived behavioral control by

asking respondents how easy they felt a pro-environmental behavior was, found that the easiest or most convenient behaviors were performed more often (Fujii 2007).

Other research has shown that behavior change is weak when there is a lack of perceived behavioral control. In another study of a dormitory energy competition, held at Tufts University, the majority of the students surveyed indicated that they believe climate change is a problem and are worried about it, but many disclosed that they have a poor understanding of how their personal energy use is related to greenhouse gas emissions and global warming. The researchers suggest that it is difficult to promote pro-environmental behavior among people who do not understand how their personal behavior can make a difference (Marcell *et al.* 2004). This is an example of Ajzen's perceived behavioral control in play. The students, having a poor understanding of how their behavior influences greenhouse gas emissions, have a low perceived behavioral control; they do not think their actions matter significantly.

Related to perceived behavioral control is the idea of feedback. In the competition at Oberlin College residents in some dormitories could log onto a competition website and view their actual energy and water usage, as weekly utility data were uploaded. In two dormitories, however, real-time feedback was made available online via automated monitoring systems. In addition, kiosks displaying the real-time updates were temporarily placed in the lobbies of these two dorms. Petersen *et al.* (2007) demonstrated the importance of feedback to motivate conservation behavior. The dorms with access to real-time feedback reduced their energy an average of 55%, compared to a 31% average reduction in the dorms receiving weekly updates. Nearly half the students indicated that they would be motivated to cut back energy use by real-time feedback, even if there were no competition being held.

This finding is supported by a review of 38 household energy studies conducted over 25 years, which also concluded that feedback on rates of consumption motivated conservation (Darby 2000). Feedback allows consumers to see a connection between their behavior and environmental and economic consequences. In each of these cases, subjects were given the opportunity to see exactly how significant their conservation behavior was, and therefore had a high perceived behavioral control.

Other Factors

The Tufts University study revealed an interesting trend regarding student attitudes toward energy conservation (Marcell *et al.* 2004). While, overall, students indicated a willingness to participate in the competition and claimed to make conscious efforts to reduce their energy consumption with lights and appliances, they did not report making similar efforts with their personal computers. Some reasons cited included the inconvenience of waiting for a computer to reboot, wanting to be connected to instant messaging or similar programs at all times, and the incorrect belief that a computer could be damaged by frequently turning it on and off. This is very important because the vast majority of college students in the United States now own their own computers, using them several hours a day. At the same time, the energy savings from shutting down computers while sleeping or while away are immense; Marcell *et al.* (2004) estimate that Tufts could save up to $90,000 and up to 590 tons of greenhouse gas emissions if all students living in Tufts dorms turned their monitors off for five hours a day for one year.

Another factor frequently cited as related to conservation behavior is economically or personally advantageous incentives. However, this poses a problem when considering the energy use habits of college students, as many students live in on-campus dormitories or student housing where utilities are included, and so do not pay, or even ever see, their own utility bills

(Pierce 2008; Petersen *et al*. 2007; Seryak 2003). This leaves students without a direct financial incentives, or awareness of their levels of consumption.

A final consideration in energy conservation behavior is gender, as females have been shown to show more concern for the environment than males. Women also indicate a willingness to participate in environmentally-friendly behavior significantly more often than men do (O'Connor *et al*. 1999). In addition, residences with single occupants consume more energy per capita than those with multiple occupants. Though the space may be larger, the lights and appliances are shared (Schipper *et al.* 1989). It is also possible that having one or more roommates may be a factor in how much energy a college student is able to conserve.

HYPOTHESES

Based on Ajzen's model, attitudes, subjective norms, and perceived behavioral control are hypothesized to have a significant effect on energy-conservation behavior when combined. Also, it is hypothesized that Environmental Studies majors will be more likely to exhibit energy conservation behaviors than Sociology or Other majors, because they are more likely to have highly pro-environmental attitudes. Finally, because women have been shown to have a higher willingness to engage in environmentally friendly behaviors, it is hypothesized that females will be more likely than males to conserve energy. The three hypotheses are listed below.

H_1: Attitudes, subjective norms, and perceived behavioral control increase energy conservation behavior.

H_2: Environmental Studies majors exhibit higher levels of energy conservation behavior than non-Environmental Studies majors.

H_3: Females exhibit higher levels of energy conservation behavior than males.

DATA AND METHODS

Research Design

Based on Ajzen's theory, a successful effort to change energy-conservation behavior should combine the elements of favorable attitude toward the behavior, social pressure to engage in the behavior, and a positive level of perceived behavioral control. Since it has been established that residents have considerable actual behavioral control over the energy consumption of a building, in this case, perceived behavioral control is an acceptable proxy for actual behavioral control.

As discussed earlier, pro-environmental attitudes have a weak, albeit positive, relationship with behavior change. Additionally, subjective norms are in general a good motivator for energy conservation, and perceived behavioral control, particularly through feedback, also increases energy conservation behavior. Therefore, to examine the combined effects of attitudes, subjective norms, and perceived behavioral control on energy conservation behavior, an original survey was created. The survey asked questions regarding each of the three facets of the Ajzen model, as well as questions regarding energy-use behavior, the target variable of interest.

Survey data were collected in classes as well as online using identical questions. All respondents are above the age of eighteen and currently enrolled in college. The in-person respondents consisted of students enrolled in three different undergraduate sociology courses at the University of Central Florida in the spring semester of 2010. The courses were Social Change (SYO 3400); Environmental Sociology (SYD 4510); and Birth, Death, and Population Trends (SYD 4020), the first two of which were taught by Professor Penelope Canan at the time the survey was administered. The online responses were collected via a snowball sample

obtained by posting a link to the survey on Facebook and inviting all eligible contacts to participate. Participants were encouraged to invite more respondents. The final sample size consisted of 300 college students in the state of Florida. Information about the sample population can be seen below:

Table 1. Description of Sample Population (N = 300)

VARIABLES	Number	Percentage
Age		
18-19	66	22
20-21	116	39
22-23	70	23
24-25	26	9
26 and up	22	7
Taken a course with Canan		
Yes	79	26
No	221	74
Race		
White	238	79
Hispanic	27	9
Other	35	12
Number of roommates		
None	24	8
1-2	125	42
3	112	37
4 or more	36	12
System missing	3	1
Home Type		
On-campus dormitory	57	19
Apartment	132	44
Single-family home	111	37
Gender		
Females	180	60
Males	120	40
Major		
Environmental Studies	48	16
Other	252	84

Dependent Variable

The dependent variable is reported energy-use reducing behavior. This variable is an index based on seven variables regarding personal energy use. Each question in this index was

coded on a five-point Likert scale where 1 = never, 2 = rarely, 3 = occasionally, 4 = most of the time, and 5 = always. The first of these is worded, "I leave my computer on when I am not using it." Those who do not have a computer were coded as "system missing." For this variable, the responses were re-coded in reverse where 5 = never and 1 = always. The second of these variables is worded as, "I use compact fluorescent light bulbs (CFL's) rather than incandescent ones. The third variable used for measuring behavior asks, "I turn off video game consoles when not in use." Those who do not have video game consoles were coded as "system missing." The next variable in this index is worded as, "I leave the lights on when I leave a room." This variable was also re-coded in reverse. The next variable asks, "I adjust the thermostat when I leave the house for the day." Those who do not have control over the thermostat in their home were coded as "system missing." The next variable is worded as, "I adjust the thermostat when I leave the house for an extended period of time." Those who do not have control over the thermostat in their home were coded as "system missing." The final variable is worded as, "I unplug electronic devices when not in use."

The variables were added together to create the Behavior index. By combining these seven variables as an index representing pro-energy conservation behaviors, it can be determined if the independent variables impact this index as a whole, as well as which individual variables are affected in the analysis.

Independent Variables

Gender and Major are two descriptive variables, while the other independent variables are modeled after assumptions made by the theory of planned behavior. One index of questions was created for each variable: attitudes, subjective norms, and perceived behavioral control.

Each index was created by summing the individual questions written for each of the areas of Ajzen's model.

Attitudes

The first index, Attitudes, contains five questions. Each question in this index was coded on a five-point Likert scale where 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree. The first of these is worded, "In the United States, people waste a great deal of energy." The second variable is worded as, "People should make personal efforts to conserve energy." The third variable is worded as, "Concern for the environment guides my energy use." The next variable asks, "I personally do not need to reduce my energy use," which was re-coded in reverse so that 5 = strongly disagree and 1 = strongly agree. Lastly is a variable worded as, "People have a right to use as much energy as they want." This variable was also re-coded in reverse.

Norms

The Norms index contains six questions. The first two variables in this index were coded on a five-point Likert scale where 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree. The first of these questions is worded as, "I would be more likely to conserve energy in my home if I knew that my neighbors were doing so." The second is worded as, "I rarely see advertisements that encourage energy conservation." This variable was re-coded in reverse such that 5 = strongly disagree and 1 = strongly agree.

The other four questions in this index were coded on a five-point Likert scale where 1 = never, 2 = rarely, 3 = occasionally, 4 = most of the time, and 5 = never. The first of these variables is worded as, "Most people I know turn off the lights when not in use." The next

variable is worded as, “Most people I know unplug their electronic devices when not in use.” The next variable asks, “Most people I know use compact fluorescent light bulbs (CFL’s) rather than incandescent light bulbs.” The last variable in the Norms index is worded, “Most people I know shut down their computers when not in use.”

Perceived Control

Perceived behavioral control was measured using an index of six items. Each question in this index was coded on a five-point Likert scale where 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree. The first is worded as, “I can lower my energy bill through my own actions.” The next variable in this index is worded as, “Because of other people in my home, I do not have complete control over energy decisions in my household.” This variable was re-coded in reverse so that 5 = strongly disagree and 1 = strongly agree. The next variable is worded as, “My actions have no impact on the larger community.” This variable was also re-coded in reverse. The fourth variable is worded as, “If everyone were as environmentally conscious as me, it would make a measurable difference.” The next variable is worded as, “Energy saving technologies don’t pay for themselves fast enough.” This variable was also re-coded in reverse. Finally, the last variable in this index is worded as, “There are many energy saving technologies that are affordable for my budget.”

Controls

The first control variable is age. Responses ranged from 18 through 57 years old, with the average age being 22 years old. Race was also used as a control in this research. A large majority of the respondents, 238 out of 300, indicated their race as White. The next most common response was Hispanic, with 27 respondents. Therefore, the variable was coded such

that 1 = White, 2 = Hispanic, and 3 = Other. Subsequently, two dummy variables were created. In the first, Hispanic respondents were re-coded as 1 with White and Other as 0. In the second, Other respondents were re-coded as 1 with White and Hispanic as 0. Respondents were also asked to report their year in school. Responses ranged from 1 = freshman to 4 = senior, with an alternate open-ended category for other.

Other controls dealt with the living situation of respondents. The number of roommates was one question, coded where 0 = No roommates, 1 = 1-2 roommates, 2 = 3 roommates, and 3 = 4 or more roommates. Another question asked the type of residence, where 1 = On-campus dormitory, 2 = Apartment, and 3 = Single-family home. This variable was re-coded into two dummy variables. In the first, Apartment dwellers were coded as 1 with Dorm and Single-family home residents as 0. In the second, Single-family home dwellers were re-coded as 1 with Dorm and Apartment residents as 0.

The final control variable asks whether or not the respondent has ever taken a course with Dr. Penelope Canan, an Environmental Sociologist and Professor at the University of Central Florida. Students who have taken a course with Professor Canan are coded as 1, with those who have not as 0. Professor Canan frequently discusses carbon footprints and the importance of reducing energy consumption in her classes, so this variable was added to determine if this discussion has any effect on actual behavior.

The means and standard error for each of the dependent and independent variables can be seen in the following table. N varies for some questions because some respondents do not have computers, video game consoles, or control over the thermostat in their residences.

Table 2. Summary of Survey Items in Four Indices

VARIABLES	N	Mean	Std. error
Attitudes			
Ppl in the U.S. waste energy	300	4.49	.043
Ppl should conserve energy	300	4.49	.039
Env. concern guides my energy use	300	3.61	.060
I do not need to reduce energy use*	300	3.40	.044
Ppl have a right to unlimited energy*	300	3.69	.064
Norms			
I'd conserve if my neighbors did	300	2.86	.062
I rarely see conservation ads*	300	3.19	.064
Most ppl I know shut off lights	300	3.57	.043
Most ppl I know unplug electronics	300	2.28	.051
Most ppl I know use CFL's	300	2.80	.047
Most ppl I know turn off computers	300	2.85	.052
Perceived Control			
My actions lower my energy bill	300	4.40	.044
I don't have energy-use control*	300	2.02	.061
I don't impact the community*	300	4.12	.052
Behavior like mine makes a diff.	300	3.46	.060
Energy-saving tech. is affordable	300	3.28	.060
Energy-saving tech. don't pay off*	300	3.02	.056
Behavior			
I leave my computer on*	246	2.83	.072
I use CFL's	300	3.40	.071
I leave the lights on*	300	3.95	.054
I unplug electronics	300	2.88	.065
I shut off video game consoles	172	4.77	.073
I adjust the thermostat for the day	252	2.75	.101
I adjust the thermostat for weekends	251	3.45	.109

*Variable has been re-coded in reverse

Methods

Each question was chosen with the hopes of capturing one of the elements of Ajzen's model. However, after further consideration, some of the questions seemed potentially inappropriate as accurate measurements these elements. In the Norms index, the question "I rarely see advertisements that encourage energy conservation," was reconsidered amidst

concerns that it does not truly measure subjective norms. Such advertisements would be distributed by businesses, not peers, and the motive behind them may have less to do with conserving energy than with economics. Ultimately, this question was removed from the Norms index.

In the Perceived Control index, the question "Energy saving technologies don't pay for themselves fast enough," was removed because this question has more to do with the perceived ease or financial worth of the behavior, rather than control over the results of the behavior. The question "There are many energy saving technologies that are affordable for my budget," was reconsidered for the same reason. However, if people feel that they cannot afford to pay for energy-saving technologies, they may feel that they have no control over their energy use. Therefore, this question remained in the index.

Finally, in the Behavior index, the question "I turn off video game consoles when not in use," was reconsidered because respondent feedback indicated that this behavior is standard procedure to prevent the console from overheating, so the consoles are rarely, if ever, left on. For future research, a better question may have been "I *unplug* video game consoles when not in use," which could measure the vampire energy that consoles use when plugged in, even in the "off" position. In light of this feedback, this question was removed from the Behavior index.

To examine the indices themselves, the Cronbach's alpha for each index was determined to ascertain the strength of the fit of the questions. The Attitudes index had a Cronbach's alpha of .680, indicating an acceptable index. Norms, Perceived Control, and Behavior, however, had weak Cronbach's alpha scores, .333, .466, and .414, respectively, indicating that these indices could stand considerable improvement. Despite the weak indices, in order to test the hypothesis, a linear regression was run using nested models. This test was chosen because it allows each

index to be added in one at a time, to see if each index would remain significant in the presence of the others. The Behavior index was the dependent variable. The first model tests just the control variables against Behavior. The second model adds in the Attitudes index, followed by Norms, and finally Perceived Control.

Because the Norms, Perceived Control, and Behavior indices had weak Cronbach's alphas, an ordinal regression was estimated using each of the individual questions in the Behavior index as the dependent variables. This test was chosen because the variables use Likert scales. Attitudes remained as an independent variable because the index holds together fairly well, but instead of using Norms and Perceived Control, two questions were chosen from each index to use as independent variables. From Norms, "Most people I know turn off the lights when not in use," and, "Most people I know shut down their computers when not in use," were chosen. The former question was chosen because this is a common and intuitive behavior when one thinks of energy conservation. The latter question was chosen because the literature above indicated that shutting off computers is an often overlooked energy conservation behavior that could result in substantial energy and economic savings. From Perceived Control, "I can lower my energy bill through my own actions," and, "If everyone were as environmentally conscious as me, it would make a measurable difference," were chosen. Both of these questions were chosen because they directly ask how much control respondents feel that they have over the effects of their behavior. The former asks about one's perceived control of lowering one's energy bill through behavior, while the latter measures perceived control of positively affecting the environment through behavior.

RESULTS

Table 3 presents the results of the linear regression using Behavior as the dependent variable and gender, major, Attitudes, Norms, and Perceived Control as independent variables. Though the sample size was 300 students, respondents who indicated that they do not have a computer or do not have control over their thermostat were not included in this test because they were coded as "system missing," resulting in an N of 246.

Table 3: Nested Linear Regression of Explanatory Variables on the Behavior Index

	(1)	(2)	(3)	(4)
VARIABLES	Model 1	Model 2	Model 3	Model 4
Controls				
Age	0.05	0.07	0.08	0.07
Taken a course with Canan	1.89*	1.72*	1.67*	1.83**
Roommates	-0.19	-0.04	-0.13	-0.01
Hispanic	1.07	0.56	0.13	0.08
Other	-0.09	-0.23	-0.05	-0.03
Apartment	1.08	0.95	0.83	0.82
Single-family home	1.91*	1.65*	1.59*	1.62*
Explanatory Variables				
Female	2.06***	1.42**	1.20*	1.30*
Environmental major	1.47	0.47	0.28	-0.04
Attitudes		0.45***	0.44***	0.35***
Norms			0.36***	0.32**
Perceived Control				0.22*
Constant	16.47***	7.39**	2.65	1.23
Observations	246	246	246	246
Adjusted R-squared	0.135	0.218	0.254	0.265
F	5.263***	7.827***	8.571***	8.350***
df_m	9	10	11	12
Change in F		25.90***	12.26***	4.51*
df_change in F		1	1	1

*** p<0.001, ** p<0.01, * p<0.05

As reported in Table 3, the first model tests the control variables against Behavior. Taking a course with Professor Canan proves to have a positive and significant effect on energy conservation behavior, meaning that students who take her courses are more likely to engage in

energy conservation behavior. Also, people who live in single-family homes are more likely to conserve energy than people who live in apartments or in dorms. Gender and major are also tested in this model. Gender is also positively related, with female students being statistically significantly more likely than their male counterparts to engage in energy conservation behavior. The R-squared for this model is 0.135, which means that the control variables explain 13.5% of the variance in conservation behavior.

In the next three models, the three indices based on Ajzen's model are added in, one at a time, to determine systematically their ability to improve the model of influence in the previous step. First, Attitudes is added in. Attitude has a highly significant and positive effect on Behavior, meaning that having pro-environmental behaviors significantly increases the likelihood that a respondent will engage in energy-saving behaviors. Taking a course with Professor Canan, being female, and living in a single-family home all remain positively significant, though their effect on the dependent variable is reduced. The R-squared for this model is 0.218, which means that the control variables plus pro-environmental attitudes explain 21.8% of the variance in conservation behavior.

Next, Norms is added in, and also has a positive and significant effect on predicting energy-saving behavior. This suggests that people who believe that their peers are engaging in energy conservation behaviors are more likely to do so themselves. Taking a course with Professor Canan, being female, and living in a single-family home continue to be positively significant, with another reduction in their effect on the dependent variable. The effect of Attitudes decreases slightly, though it does remain highly significant. The R-squared for this model is 0.254, which means that the control variables, plus pro-environmental attitudes, plus

knowing others who conserve, together explain 25.4% of the variance in energy conservation behavior.

Finally, Perceived Control is added in in Model 4. Perceived control is also found to have a positive and significant effect on energy-saving behavior. This means that people who believe that they have a high level of control over the results of their actions are more likely to conserve energy. Taking a course with Professor Canan, being female, and living in a single-family home still remain positive and significant, and this time their impact on behavior increases compared to the previous model. Both Attitudes and Norms remain significant, though their impact on behavior decreases. The R-squared for this model is 0.265, which means that the control variables, pro-environmental behaviors, knowing others who conserve, and believing yourself to have a high level of control over your behavior and its outcomes, together explain 26.5% of the variance in conservation behavior.

In Table 4, the results of the ordinal regression are shown. In models 4 and 5, there are noticeably less observations than in the other models because people who responded that they do not have control over their thermostats were coded as “system missing.”

Table 4: Ordinal Regression of Explanatory Variables on Specific Behaviors

VARIABLES	(1) I leave my computer on	(2) I use CFL's	(3) I turn off lights	(4) I adjust the thermostat for a day	(5) I adjust the thermostat for longer periods	(6) I unplug electronic devices
Controls						
Age	0.01	0.04	-0.00	0.04	0.08	-0.04
Course with Canan	0.84*	-0.26	1.09**	0.66	0.17	0.60
Roommates	0.03	-0.06	0.11	-0.18	-0.09	0.09
Hispanic	-0.45	0.12	-0.10	-0.34	0.10	0.37
Other	0.18	-0.49	0.13	-0.26	-0.71	0.41
Apartment	0.57	-0.01	0.48	0.17	-0.10	0.21
Single-family home	0.81*	0.10	0.22	0.48	0.66	0.09
Explanatory var.						
Female	0.73**	0.01	0.30	0.15	0.44	0.60*
Environmental major	-0.31	0.66	-0.48	-0.23	0.05	0.41
Attitudes	0.06	0.11*	0.09	0.15**	0.10	0.15**
Norms						
Peers leave on lights	-0.16	0.21	0.37*	0.09	0.16	0.24
Peers shut off comps	0.60***	-0.12	-0.01	0.04	0.24	0.04
Perceived Control						
I can lower my bill	0.08	-0.02	0.09	-0.16	-0.03	-0.03
Behavior makes a diff.	0.14	0.46***	-0.04	0.21	0.28	0.22
cut1	2.57	2.26	0.74	2.65	3.23	2.57
cut2	4.06	3.55	1.30	3.70	4.53	4.30
cut3	5.20	4.76	3.07	4.55	5.00	5.76
cut4	7.13	6.26	5.26	5.71	5.96	7.70
Observations	294	297	297	252	251	297
chi2	60.98	49.70	32.72	38.70	42.04	66.78
df_m	14	14	14	14	14	14

*** p<0.001, ** p<0.01, * p<0.05

Some of the controls that were significant in the previous test are also significant in this test. Taking a course with Professor Canan is positively significant on "I leave my computer on even when I am not using it," and, "I leave the lights on when I leave a room," meaning that people who take classes with Penelope Canan are less likely to leave the lights on when they leave a room, and more likely to shut their computers off when they are not in use. Being female is positively significant on both "I leave my computer on even when I am not using it," and, "I unplug electronic devices when not in use," meaning that female students are more likely than

males to shut off their computers and unplug electronic devices when not in use. Living in a single-family home is also positively related and statistically significant to "I leave my computer on even when I am not using it," meaning that students who live in single-family homes are more likely to shut off their computers when not in use than students who live in on-campus dorms or apartments.

Students with pro-environmental attitudes are significantly more likely to use CFL's in place of incandescent light bulbs, adjust the thermostat when leaving for the day, and unplug electronic devices when not in use. Interestingly, "Most people I know turn their lights off when they leave a room," is not significant on any behaviors except for "I turn off the lights when I leave a room," on which it is positively significant. Likewise, "Most people I know shut down their computers when not in use," is only significant on "I leave my computer on even when I am not using it." Finally, "If everyone were as environmentally conscious as me, it would make a measurable difference," has positive significance on "I use CFL's in place of incandescent light bulbs," meaning that people are more likely to use CFL's in place of incandescent light bulbs when they believe that a measurable difference would result if everyone were as environmentally conscious as the respondent.

DISCUSSION AND CONCLUSION

There are several interesting findings from the above tests. First, in Table 3, model 1, students who have taken courses with Professor Canan are somewhat more likely to conserve energy than students who have not. There is no difference in the energy conservation behavior between Environmental Studies or Other majors. This refutes the hypothesis that Environmental Studies majors are more likely to conserve energy than non-Environmental Studies majors. Also, since major does not have a significant effect on behavior, it is possible that the effect of taking a course with Professor Canan is not simply because many people who do take her courses are Environmental Studies majors. To test this idea, a linear regression was estimated without the Canan variable. In this case, majoring in Environmental Studies did prove to be significant; however, Perceived Control lost its significance. This suggests that there is some overlap between the effects of major and taking a course with Professor Canan. However, it also suggests that perceived behavioral control increases when taking a course with Professor Canan, regardless of major.

A second finding is that female college students are much more likely to engage in energy conservation behavior than males, supporting the hypothesis regarding gender, and lending support to the finding that women are more willing to participate in pro-environmental behaviors than men (O'Connor *et al.* 1999).

Third, the type of home the respondents live in has a significant effect on their behavior. Specifically, students who live in single-family homes are more likely to exhibit energy-saving behavior than students who live in on-campus dorms or apartments. This is a very interesting finding that could be explained by the fact that students who live in single-family homes almost certainly pay for their own utilities and see regular bills. As mentioned in the literature, residents

of dorms never see utility bills because electricity is included in their housing costs (Pierce 2008; Petersen *et al*. 2007; Seryak 2003). Many apartments around the UCF campus are designated student housing, and utilities are also included in the cost of rent at these establishments. Seeing your own energy bill allows you to see the energy and economic results of your behavior. Single-family home residents might therefore have higher perceived behavioral control that dorm or apartment dwellers, which could explain their increased likelihood of conserving energy.

In model 2, the index measuring pro-environmental attitude is added as an independent variable. The results show that Attitudes is highly influential on the behavior index. People who have pro-environmental attitudes are much more likely to conserve energy than people who don't. This finding is interesting because it is supported by and contrary to the literature. Costanzo *et al.* (1986) found that people who believe strongly in the importance of energy conservation are no more likely to actually conserve energy than others. On the other hand, Neuman (1986) finds a positive relationship between attitudes and behaviors, but adds that the correlation most often occurs for repetitive actions. This bodes well for this study, because the behaviors in the index are all repetitive actions, or small lifestyle changes, rather than one-shot actions.

In model 3, the subjective norms index is added as in independent variables. This also proves to have a highly significant effect on behavior. Therefore, people who think that their peers are engaging in energy-conserving behavior are more likely to do so themselves. This is supported by DeYoung (1993) and Nolan (2008), who found that subjective norms had a higher impact on environmental behavior than any other factor. In this model, the impact of attitudes decreases slightly, though its significance level remains the same, indicating that there is interaction between norms and attitudes.

In model 4, the index measuring perceived behavioral control is added in, and has a positive influence on behavior. People who believe that they have a lot of control over their actions and the results of their actions are more likely to engage in energy-conserving behaviors. This is strongly supported by other research on college students. Petersen *et al.* (2007) found that increasing perceived behavior control through feedback was a very effective method of encouraging energy conservation behavior among students. Interestingly, the impact of living in a single-family home increases somewhat once perceived control is added into the test. This makes sense considering, as previously discussed, that people who live in single-family homes are likely to have higher perceived control than residents of dorms or apartments. The effect of taking a course with Professor Canan also increases in this model, and furthermore, the significance of taking a course with her increases, as well. This may suggest that students who take her courses are afforded a better understanding of how their actions can directly affect the environment than those who do not. Also, the impact of Norms decreases slightly, and the impact of Attitudes decreases slightly more than in the previous model. This is further evidence that the indices are interacting with each other in order to explain behavior. This supports the hypothesis that these three factors have a significant effect on behavior when combined.

It is important to recall, however, that the Norms, Perceived Control, and Behavior indices were not internally strong. While the findings are interesting, they may not be wholly accurate because of the weakness of the indices. In order to get more detailed results, these weak indices were broken up for Table 4. In this table, it is shown that taking a course with Professor Canan specifically affects the likelihood of students turning off their lights when they leave a room and shutting off their computers when not in use, but not of adjusting the thermostat, using CFL's, or unplugging electronic devices. This could be because shutting off lights and

computers are very easy behaviors that intuitively suggest energy savings. Using CFL's, for example, requires an outside purchase, and many people do not realize that their electronic devices are using energy just be being plugged in, even while off. Because taking a course with Professor Canan only affects certain behaviors, and not all of them, this indicates that students are not misrepresenting their responses simply out of pressure from being in her courses.

Female college students are more likely than male college students to shut their computers off and unplug their electronic devices when not in use. Since previous studies have shown that women tend to have higher concern for the environment than men, they could be more likely to engage in these simple behaviors that reduce energy consumption. One possible reason for the latter result is that females could be more likely to use more small electronic devices, such as hair dryers and flat irons, than males, and therefore have more devices that can be unplugged. Another variable that significantly increases the likelihood of shutting off one's computer is living in a single-family home. This could relate back to the idea that people who live in single-family homes could be more concerned about saving money on their energy bills, and as a result, are more careful about energy conservation. Though not significant, it is also interesting to note that, in this test, Environmental Studies majors are actually less likely than non-Environmental Studies majors to engage in some energy saving behaviors, including shutting off lights and shutting down computers.

Because it is an acceptable index, based on its Cronbach's alpha, Attitudes remained an independent variable for this test. Pro-environmental attitudes were found to significantly increase the likelihood of using CFL's, turning up the thermostat when leaving for the day, and unplugging electronic devices. Interestingly, it has a positive but insignificant effect on the other behaviors, shutting off lights and computers, and turning up the thermostat when leaving for an

extended period of time, such as a weekend. This means that having pro-environmental attitudes makes a person no more likely to engage in these latter three behaviors. This could be because shutting off lights and computers are easier and more intuitive behaviors than using CFL's, turning up the thermostat when leaving for the day, and unplugging electronic devices. Additionally, turning up the thermostat when leaving for a weekend has less of an impact on daily life, and offers more obvious economic savings, than shutting off lights and computers or turning up the thermostat for just a day. It is possible that more people are willing to engage in the simple, intuitive, or clearly economically advantageous behaviors, regardless of attitude toward the environment, while an actively pro-environmental stance is needed in order to motivate a person to engage in behaviors that require more perceptible lifestyle changes. This could be an example of "virtual environmentalism" at work, or people engaging in behaviors that help the environment, but because they are easy and cost-effective, and not out of environmental concern (Bell 2009).

The two questions from the Norms index revealed very interesting results. Indicating that most people one knows shut off the lights when leaving a room made a respondent significantly more likely to report engaging in the same behavior, though it had no significant effect on any other behaviors. Similarly, indicating that most people one knows shut off their computers when not in use makes a person much more likely to indicate that he shuts off his computer when not in use, but has no effect on any other behaviors. Though not shown in this table, the same trend was found with compact fluorescent light bulbs ("Most people I know use CFL's rather than incandescent light bulbs," significant on "I use CFL's rather than incandescent light bulbs") and unplugging electronic devices ("Most people I know unplug electronic devices when not in use," significant on "I unplug electronic devices when not in use"). This suggests that people are in

fact motivated to engage in a specific behavior based on their perception of their peers' behavior. However, it is also possible that the respondents were basing their perception of their peers' behavior on their own behavior, or based on what they feel is normal, rather than the other way around. In either case, it is clear that norms play a significant role in motivating behavior.

The two questions from the Perceived Control index showed less significance, but were still interesting. People who agreed that they could lower their energy bills through their own actions were not significantly more likely to engage in any of the dependent variable behaviors than people who disagreed with this statement. The other question, "If everyone were as environmentally conscious as me, it would make a measurable difference," was only significant on one behavior, using CFL's over incandescent light bulbs, though it was highly significant. One reason for this could be that CFL's represent a fairly conspicuous form of energy conservation that requires an outside purchase. In other words, this could support the results of the norms variables, suggesting that many people already engage in simpler and more convenient behaviors, such as shutting off lights and computers, and that these behaviors are therefore not considered environmental behaviors so much as normal behaviors that everyone does, whether or not for the sake of the environment. As a result, taking the extra step to purchase CFL's could be seen as truly being environmentally conscious, because that is the primary reason to purchase them.

Though this research presents many interesting findings, there are limitations and considerable room for improvement. First, the research covers *reported* energy-use behaviors rather than *actual* behaviors. Secondly, the Norms, Perceived Control, and Behavior indices were not strong, and so the results of the Table 3 must be considered with this in mind. The final compilation of questions for each index was chosen based on theoretical contemplation and

respondent feedback, and not because removal of certain questions improved the Cronbach's alpha of any particular set of questions. For future study, it would be a good idea to include more questions so that different combinations could be tested in order to find indices with strong internal coherence, i.e., higher Cronbach's alpha scores. It would also be beneficial to choose the indices based on these scores, rather than on a non-statistical basis. In addition, the sample was selected based on availability and through snowball sampling, which introduces bias. The research would be stronger with the use of a more representative sample.

Overall, however, the study reveals some very interesting findings that contribute to the current body of literature on the subject of encouraging energy conservation. The first hypothesis is accepted, as the results showed that attitudes, norms, and perceived behavioral control all significantly influence behavior, and that none alone is enough to wholly explain behavior change. In this study, as in Ajzen's model, all three combine to explain more of the variance in behavior. The second hypothesis is rejected, as Environmental Studies majors reported being no more likely than non-Environmental Studies majors to engage in energy-saving behaviors. The third hypothesis is accepted, as female students were shown to be consistently more likely than males to conserve energy. Based on the results of this study, Ajzen's model is an effective tool for explaining energy-conservation behavior. While the literature currently focuses primarily on attitudes to explain behavior change, this study shows that subjective norms and perceived behavioral control should not be overlooked. Determining what factors encourage energy conservation will becoming increasingly important given the enormous potential that these behaviors have for reducing greenhouse gas emissions.

APPENDIX: IRB APPROVAL LETTER

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Exempt Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Lillian O'Connell**

Date: **April 05, 2010**

Dear Researcher:

On 4/5/2010, the IRB approved the following activity as human participant research that is exempt from regulation:

Type of Review:	Initial Review
Project Title:	Energy Use Attitudes and Behavior Among College Students
Investigator:	Lillian O'Connell
IRB Number:	SBE-10-06849
Funding Agency:	None

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Joseph Bielitzki, DVM, UCF IRB Chair, this letter is signed by:

Signature applied by Janice Turchin on 04/05/2010 11:12:16 AM EDT

IRB Coordinator

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