Oberlin

Digital Commons at Oberlin

Honors Papers | Student Work

2008

Connectedness to Nature and Electricity Consumption: An Interdisciplinary Study of Behavior and Emotional Response to Nature in the Union Street Housing Complex

Jenna Trostle
Oberlin College

Follow this and additional works at: https://digitalcommons.oberlin.edu/honors

Part of the Environmental Studies Commons

Repository Citation

Trostle, Jenna, "Connectedness to Nature and Electricity Consumption: An Interdisciplinary Study of Behavior and Emotional Response to Nature in the Union Street Housing Complex" (2008). *Honors Papers*. 443.
https://digitalcommons.oberlin.edu/honors/443

This Thesis is brought to you for free and open access by the Student Work at Digital Commons at Oberlin. It has been accepted for inclusion in Honors Papers by an authorized administrator of Digital Commons at Oberlin. For more information, please contact megan.mitchell@oberlin.edu.

Connectedness to Nature and Electricity Consumption:
An Interdisciplinary Study of Behavior and Emotional Response to Nature in
The Union Street Housing Complex

Jenna Trostle
Honors Thesis
Spring 2008

Abstract

Much research has been done surrounding conservation behaviors in the household and electricity consumption. Most research has tended to focus on attitudes about the environment and how those attitudes influence pro-environmental behavior, but the research has not usually found a strong link between the two. The Connectedness to Nature Scale was used in this study to measure emotional responses to nature, and to determine whether people who felt more connected to nature used less electricity in the household. The residents of the Union Street Housing complex at Oberlin College were chosen as the group monitored for this project, as the houses had the same baseline consumption data and the residents had no fiscal incentives to conserve electricity. I compared the emotional response to nature with attitudes about the environment and electricity consumption per house. I concluded that emotional response to nature had a correlational relationship with electricity consumption, and that attitudes about electricity consumption were very predictive of behavior, probably because the data measured attitudes about very specific behaviors. This was the first time the CNS was correlated with actual behavior. Recommendations were made for further studies that might establish a causal link between connectedness to nature and electricity consumption.

Introduction

Background

According to the Intergovernmental Panel on Climate Change, global warming is becoming a serious threat to global stability. An average temperature change of just 3 degrees Celsius could bring about the following effects, among many others: mass extinctions of plants, animals, and corals, rising water levels, increased severe weather patterns like droughts, hurricanes, and tornadoes, as well as food production problems with shifting climates and disrupted thermohaline circulation (IPCC, 2007). Most, if not all of these changes result from emissions of greenhouse gases (GHG) that are released every second by humanity's ever growing energy consumption. Carbon dioxide is the most prevalent GHG that is being released, mostly from the conversion of coal into electricity. In 2005, the United States alone used 3.816 trillion kWh of electricity (CIA World Factbook, 2005), and residential electricity use accounted for 37% of all electricity consumed in America in 2006 (Energy Information Administration report, 2006).

Ohio gets 87% of its electricity from burning coal, and Oberlin College gets a majority of its electricity from Oberlin Municipal Light and Power. Only 14.9% of the power Oberlin College purchases from OMLP is renewable; the rest comes from burning coal. Besides releasing GHG that are causing global warming, coal releases mercury and other pollution into the air when burned. The mercury eventually ends up in the bodies of animals and humans around the power plant, through the processes of bioaccumulation and biomagnification. Mercury can damage the central nervous system, endocrine system, and kidneys (EPA Mercury Study Report to Congress, 1997). The soot can combine with water and cause acid rain, which hurts forests and lakes, or wind up in peoples' lungs and cause asthma and other respiratory problems (EPA website, Effects of Acid Rain, 2007).

Conservation Motivation

Buildings are among the heaviest consumers of natural resources and account for a significant portion of the greenhouse gas emissions that affect climate change. In the U.S., buildings account for 39% of all CO2 emissions (USGBC report, 2008), and represent 70% of U.S electricity consumption (USGBC report, 2008). The largest use of electricity in the average U.S. household was for appliances (including refrigerators and lights), which consume approximately two thirds of all the electricity used in the residential sector (Energy Information Administration Report, 2001).

Take, for example, Oberlin College, where activities in buildings account for more than 90% of the greenhouse gas emissions released by the college (Heede & Swisher, 2002). The less energy we use, the less coal we have to burn, which means less pollution in our air and water. There is a fiscal incentive for conserving energy as well: in 2005, the first dorm energy competition, lasting just two weeks, saved the college over $5,000. The two-week contest resulted in an energy savings of 68,300 kWh, and averted 148,000 lbs of CO_2, 1,360 lbs of SO_2 and 520 lbs of NO_x from being released into the environment (Petersen et al, 2005). Clearly residential electricity use has a considerable impact on the environment, and must be addressed if we are to significantly ameliorate our environmental problems.

There are many ways to reduce electricity consumption in the household. One way is to make all domestic devices more energy efficient. This often has a great effect on electricity consumption, but it requires funds to purchase new equipment, and often the more efficient appliances are more expensive initially (although they may pay themselves back over the lifetime of the appliance in money saved from utility bills). For a low-income household, this strategy may be impractical, as many households do not have the funds to buy a new refrigerator or air conditioner or washing machine. Therefore, we must also find ways for people to participate in energy reduction that do not require spending money to save money. A method that everyone can utilize for reducing electricity consumption is to change behavioral patterns. Consumer choices can account for up to 50% of a building's electricity consumption (Schipper, 1989). Anyone, no matter what their socioeconomic status, can learn to turn off a light bulb when they leave a room, to turn off a computer when it is not in use, or to hang their clothing to dry instead of using a clothes dryer. Ideally, it is advantageous for people to change their technology as well as their choices, but either one can still have a major impact on decreasing energy consumption on its own.

We need to find what motivates people to make choices that save electricity in their homes in order to encourage positive changes in electricity use. Often, financial pressures motivate energy use. In a usual household setting, people find out how much energy they are consuming every month based on the utility bill they receive. Assuming that most people want to save money, receiving a utility bill provides a motivation for reducing a home's energy consumption. College students, on the other hand, do not have to pay utility bills when they live at the college. There is no direct financial incentive for them to conserve, since they do not get penalized for using large amounts of electricity every month. Residential Assistants at Oberlin have been told by some students that the students actually feel that the years they spend in college are the only years they get to use as much energy as they want without repercussions. Their tuition is the same whether they use a lot of electricity or a little, and so they take pleasure in being able to leave appliances and electronics running while not in use. People who leave their lights and radios on just because they can tend to continue these actions until some impetus changes their ways. This indifference not only fosters bad habits for after graduation, but also has a direct effect on how much energy the college consumes.

Past research on energy use

There have been many studies done on energy consumption in the home and effective ways of reducing consumption. Many of the studies focus on providing information feedback to help people understand when they are consuming the most energy (Allen and Janda, 2006; Brandon and Lewis, 1999; Darby, 2006), or offer incentives for a specific amount of time to help reduce their energy consumption (Kolenda and Mildenberger, 2005). Brandon and Lewis notice the possibility of a link between people who have positive environmental attitudes and less electricity consumption, and call for more research into the matter. However, little research has been done on which groups of people tend to use less electricity. Furthermore, most of these papers were conducted within housing communities with houses that were built in different time periods with varying degrees of insulation, with residents of mixed incomes and racial backgrounds, and with a variety of ages and residency. Therefore, it is harder to control for variability, and understand why a certain group uses less or more electricity than any other group.

Behavior vs. Attitude

If financial motives were the only reason people conserved electricity, then all people who paid a fixed rate for their electricity and had the same appliances would use the same amount of energy. However, this is not the case, so there must be other motivators behind peoples' behavior surrounding electricity consumption that are mental in nature. Understanding the psychological determinants of behavior can help change peoples' behavior. There is a long history of research in psychology on attitudes predicting behavior, and more recent research on conservation behavior. Attitudes are defined as psychological tendencies that are expressed by evaluating a particular entity with some degree of favor or disfavor (Eagly and Chaiken, 1993). Many researchers hypothesized that pro environmental attitudes would lead to pro environmental behavior (Holland et al., 2002; Meinhold and Malkus, 2005; Schultz and Oskamp, 1996), but the results of their research did not always back up the hypotheses.

Researchers found that there is often a small correlation between attitudes and behavior (Ajzen, 1989). This is has been particularly true when it comes to dealing with environmental issues (Ungar, 1994), for a variety of reasons. It may be that people think that their own actions do not have a large enough impact on environmental issues to make a difference, or perhaps the things people are asked to do are seen as sacrifices that would interfere with their quality of life. Whatever the reasons, it has been difficult for psychologists to find situations in which they can measure genuine consumptive or environmental behaviors, so many have constructed experiments in which the choices monitored are somewhat artificial. This means that there is a lack of good data that relates real in-home behaviors with attitudes about those behaviors. However, at least one published study did find that as the amount of effort to change a behavior to a more environmentally friendly one increases, fewer people are inclined to perform that behavior, even if they know it will help the earth and they have a positive attitude about such a behavior (Schultz and Oskamp, 1996). More than attitudes, which are cognitively based, an emotional sense of connection may better predict conservation behavior.

Connectedness to Nature

To measure this sense of connection, Mayer and Frantz created the Connectedness to Nature Scale (CNS, Mayer and Frantz, 2004). The CNS measures individuals' emotional feelings of connection to the natural world, instead of opinions. By measuring emotional links to nature instead of cognitively-based attitudes, the CNS bypasses the problem of asking relevant questions that relate to attitudes about specific behaviors. Most importantly, Mayer and Frantz (2004) have found that people who report that they feel more connected to nature tend to want to make decisions that help the environment. It also predicts self-reported pro-environment behavior better than environmental attitudes, which means that it may be able to predict actual environmentally friendly behavior (Mayer and Frantz, 2004). However, the Connectedness to Nature Scale has only so far been related to self-reported pro-environment behavior. Self-reported behavior and actual behavior often differ, especially if the behaviors in question are socially desirable. At this point in time, supporting pro-environmental behaviors are socially desirable, at least among college students, so it is possible that people could report engaging in more positive environmental actions than they are actually performing. Thus, self-reported data needs to be viewed with caution.

Current Research

The goal of this study was to determine whether psychological measures of the attitudes and connection with nature of students living in residential housing predict their electricity consumption. I wanted to find out whether people who feel more connected to nature use less electricity in their households than people who do not feel such a connection. In pursuit of this goal, data were collected and examined from the Spring 2007 and Fall 2007 semesters to determine whether a high score on the CNS could be used as a predictor of electricity consumption in relatively small (12 person) student houses.

It is not yet known how well the CNS predicts actual environmental behaviors. Therefore, since electricity use is environmentally important, and since consumer choices influence it, relating consumer use to connectedness to nature provides an important test for the CNS. This study builds on previous work in the following ways: for the first time, it examines the relationship between actual behavior and the CNS; it provides more information on electricity consumption behavior, and it provides good data that relates real in-home behavior with attitudes.

Methods

Background

Eleven Oberlin College-built houses on Union Street in Oberlin OH, and the residents living in them, were the subjects of this study. Union Street Housing was chosen because of the newness of the buildings, their similar layouts, and their proximity to one another, as well as the fact that they are small village houses that work much more like apartment units than residence halls. The houses were all completed in 2006, and built with four different layouts that provide approximately the same amount of space to all residents with United States Green Building Council (USBGC) Leadership in Energy and Environmental Design (LEED) criteria. Because of this, it is fair to assume that each of the houses should have similar inherent energy efficiencies and consumption.

Every house has three internal apartments that provide housing to 4 residents, for a maximum occupancy of 12 residents per house. One house, 268 Goldsmith, is handicap accessible, with a laundry machine inside that both washes and dries clothes. All other houses have a centralized laundry location in the basement of 270 Goldsmith. Houses have ceiling fans in every bedroom, living and dining room, and central heating and air conditioning by apartment. There is a centralized gas fired hot water system, and a centralized high-efficiency chiller/boiler system. However, heating and cooling has no bearing on the electricity load of the houses, and so did not influence the results of the research. Each unit has its own bathroom, kitchen, and living room/dining room, with energy efficient fluorescent lighting, low flush toilets, and low flow showerheads. The houses have R-16 insulated walls and R-38 insulated ceilings, with Low-E insulated clad wood windows with low infiltration. The kitchen use differs between residents, as most residents still eat the majority of their meals in dining halls or co-ops. Only people who are a part of BBC (Brown Bag Co-op) rely on their kitchens for the majority of their meals, because BBC works more like a grocery store than a co-op – instead of cooking for a large group of people, BBC co-opers get their food individually from a central location and then use their kitchens to make their own meals. Refrigerators, stoves, and ovens are electric and energy star compliant and identical in all units. The apartments were provided with microwaves when the houses were built, but the college has decided not to replace them when they break, so some apartments have them and others do not. Since the installed equipment is very similar in all units, differences in electricity consumption are most easily attributable to the appliances students add to the house and to the choices that students make in terms of energy use.

Participants

Residents in the houses were juniors and seniors of the college, usually ages 20-23. There was no control over who decided to live in the houses, and the housing tended to self-select towards a higher socio-economic background because it is more expensive than traditional dormitory housing (as much as $800 more than traditional housing or $2,038 more than living in a co-op per year). The residents were also predominantly White, with only four people in both studies choosing a different racial identity on the surveys. Men and women were roughly evenly distributed throughout the houses. Residents choose to live together by apartment, but not by house. Each apartment has four single bedrooms, so each resident has her own private space within the house.

Procedure

Oberlin's Campus Resource Monitoring System (CRMS, Petersen et al. 2007), developed by Oberlin students and faculty, is designed to monitor and display electricity use in Oberlin College dormitories and in the Union St. residential houses. The CRMS assesses electricity use every 20 seconds from sensing stations in each building. The data are transferred from sensors to a datalogger and then to a server computer where they are stored, processed and made available for display on a public web site. Although one of the 11 Union St. houses has electricity use monitored separately for each apartment, only total house electricity consumption data are monitored and available for each of the rest the houses. It is this total house use that was used in this study. Specifically, we averaged electricity use for each of the Union St houses for the semester and expressed it as average kilowatts per person per house. Average per capita consumption by the house in which each survey respondent lived was used in the calculations as the metric related to the psychological measure of that house. In other words, for the purpose of this study, all students occupying a given house were associated with the same rate of electricity use.

Two different collection methods were used to gather resident data for the two semesters, with varying degrees of effectiveness. Spring 2007 data were gathered from April 20th through April 30th using a paper survey, with the researcher going house-to-house handing out the surveys. Candy bars were offered to residents who completed the survey. The survey contained questions about socio-economic status, gender, race, car usage, the Connectedness with Nature Scale (CNS, Frantz and Mayer, 2004), as well as eight Community Electrical Identity oriented questions (see appendix I). The Community Electrical Identity oriented questions attempted to measure how important it was to individuals that they (and the people around them) saved electricity.

Fall 2007 data were gathered using an online survey on Surveymonkey.com. This survey contained many of the same questions, but changed the Community Electrical Identity questions to coincide with questions that had been asked during previous energy competitions (for clarity, these are called Electrical Thought throughout the results to distinguish them from the Community Electrical Identity questions from the spring, and are in appendix II), which tried to establish how connected people feel to their energy use, and added a Factual Electricity quiz that measured knowledge of energy consumption on different scales (also in appendix II) (for reliability statistics on each scale, see appendix III). Residents were rewarded with pizza if their entire apartment filled out the survey. Going door to door resulted in 73 completed surveys for spring 2007 (a 53% response rate). Internet collection resulted in 49 completed surveys for fall 2007 (a 37% response rate). At least one resident in every apartment answered the survey (12 out of the 22 houses had a response rate of 50% or better).

The survey assessments used in spring and in fall of 2007 were treated as independent samples, as the residents inside each house completely changed between the semesters. This increased the sample size, and allowed a broader range of tests to be performed. A total of 268 people were involved in the experiment (137 in Spring 2007 and 131 in Fall 2007). As the houses were all built at the same time with similar floorplans, any changes in electricity consumption were due to individual choices within the houses, and not the innate character of the houses themselves. For example, certain students chose to bring and use additional personal appliances to their houses like hair dryers and televisions, and these appliances would differ among houses.

Results

For computation and analysis, means were computed for all data based on the number of occupants in each house. Because the unit of analysis was actually individuals within the houses, rather than the houses themselves, the apartments with more responses were weighted more heavily. Weighting was used because I could more accurately measure the nature of the individuals living inside of the houses when more people had responded. The percent of women was also computed per house, in case gender composition affected electricity use. Electric Thought and Community Electrical Identity were also averaged per house based on the mean responses per person. Finally, the factual electricity questions were averaged by house as well.

Multiple regressions were used to determine the best predictors of energy consumption. I looked at the two semesters together for the variables that both data sets had in common. I then ran separate analyses for each semester to include the variables that were unique to each of the semesters surveys were conducted.

Descriptives: Table 1 presents the mean and standard deviation of all variables. Tables 2 and 3 present the bivariate correlations between variables.

Table 1

Mean and Standard Deviation of dependent variables

	Mean	Standard Deviation	N
Factual electricity questions	6.6066	.89	49
% of women	1.5447	.26	122
Electrical Thought	3.9047	.64	49
Community Electrical Identity	3.1186	.20	73
House CNS Mean	4.2455	.46	122
Kilowatt hours per occupant	.1670	.04	122
Number of respondents/ house	6.5122	2.23	122

Table 2

Correlations for Spring 07

	% of women	Kilowatts per occupant	Number of respondents/ house	House CNS mean	Community Electrical Identity
% of women	1				
Kilowatts per occupant	-.047	1			
Number of respondents/ house	.066	-.239**	1		
House CNS mean	.430**	-.217*	.007	1	
Community Electrical Identity	-.158	-.181	-.140	-.346**	1

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

N= 73

Table 3

Correlations for Fall 07

	Factual electricity questions	% of women	Electrical Thought	Kilowatts per occupant	Number of respondents	House CNS mean
Factual electricity questions	1					
% of women	-.288*	1				
Electrical Thought	.737**	-.613**	1			
Kilowatts per occupant	.004	-.047	-.499**	1		
Number of respondents	-.184	.066	-.089	-.239**	1	
House CNS mean	-.295*	.430**	-.144	-.217*	.007	1

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

N=49

Regressions:

A multiple regression was run predicting kilowatt hours per person from mean CNS, percent women, and number of respondents per house for the entire data set. The overall equation was significant, $R^2 = .108$, F (3, 122) = 4.817, $p = .003$. Controlling for gender and respondents per house, the house CNS significantly predicted kilowatt hours per person, $\beta = -.248$, t (122) = -2.590, $p = .011$. Houses with a higher mean CNS had lower electricity use. Also when Controlling for Gender and CNS, number of respondents per house significantly predicted kilowatt hours per person, $\beta = -.242$, t (122) = -2.790, $p = .006$. The more people that responded, the less electricity the house used. Controlling for CNS and number of respondents per house, the percent of women did not significantly predict kilowatt hours per person, $\beta = .076$, t (122) = .788, $p = .432$.

Regression equations were then run separately for each semester, including the variables that were unique to each data set. For the Spring 2007 semester, kW/person were predicted from the mean apartment CNS score, the community electrical identity, the number of respondents, and the percentage of women in the house. All entered variables were significant predictors (see Table 4). Most importantly, as in the larger equation, CNS was a significant predictor of kW/person. On average, house kilowatt hours decreased by .034 kW for every point that CNS increased. As people's community commitment to reducing their electricity increased, house kW/person also decreased. Also, more women in the house were associated with a decrease in kW/person, and the more people who responded to the survey were associated with a decrease in the kW/person.

Table 4
Summary of Regression Analysis for Variables Predicting Electricity Consumption During Spring 2007

Variable	B	SE B	*β*	*p*
House CNS Mean	-.034	.010	-.321	.002
Community Electrical Identity	-.090	.021	-.393	.000
Number of Respondents	-.012	.002	-.442	.000
% of women	-.045	.016	-.254	.006

Note: R^2 =.493 B is the regression coefficient, SE B is the standardized regression coefficient, *β* is the beta, and *p* is the significance level.

During the Fall Semester, we could not include all the variables in the same regression equation because there were collinearity problems. The Electrical Thought questions correlated too highly with the quiz score and gender, and shared too much variance to accurately estimate regression weights. Because this biased all the regression estimates, we ran them in two separate regressions.

For the Fall 2007 semester, kW/person were predicted from the mean apartment CNS score, the number of respondents, and the percentage of women in the house. All entered variables were significant predictors except for the factual electricity question score (see Table 5). Again, as in the larger equation, CNS was a significant predictor of kW/person. On average, apartment Kilowatt per person decreased by .023 kW/person for every point that CNS increased. Also, more women in the house were associated with an increase in kW/person, and the more people who responded to the survey were associated with a decrease in the kW/person.

However, when the Electrical Thought questions were run together with the mean CNS, the CNS was not a significant predictor of kW/person, while the Electrical Thought questions were very significant (see Table 6). None of the interactions between the factual electricity questions, the % of women or the number of respondents and the Electrical Thought questions were significant. In this equation, on average, apartment Kilowatt hours decreased by .027 kW/person for every point that the electricity questions increased.

Table 5
Regression Analysis for Variables Predicting Energy Consumption During Fall 2007, Equation 1

Variable	B	SE B	*β*	*p*
House CNS Mean	-.023	.010	-.346	.019
Factual Electricity Questions	.003	.004	-.079	.514
Number of Respondents	-.004	.001	-.307	.019
% of women	.103	.018	.809	.000

Note: R^2 =.457

Table 6
Regression Analysis for Variables Predicting Energy Consumption During Fall 2007, Equation 2

Variable	B	SE B	*β*	*p*
House CNS Mean	.002	.009	.033	.795
Electric Thought Questions	-.027	.007	-.516	.000
Number of Respondents	-.003	.002	-.235	.067

Note: R^2 =.307

Discussion

As predicted, I found that feeling a stronger connection to nature was associated with less electricity use in the home, despite the lack of manipulation or incentive for conservation. This means that one's emotional connections do seem to be able to predict behavior. This is the first time CNS has been significantly correlated with actual behavior, and that correlation opens up many new opportunities for further studies and research. I initially thought that using the CNS would be a better predictor of how behavior works than using peoples' attitudes as a basis for predicting behavior, but the study indicates that Electrical Thought questions are a better predictor of electricity consumption than CNS. It is understandable that they would be a better predictor than the CNS, since they ask questions directly about electricity use, and are not generalized questions that measure emotional responses to the environment. Interestingly, this provides a counterargument in the attitudes vs. behavior argument, because I have found a clear correlation between peoples' attitudes on electricity consumption and their behavior in the house. Perhaps electricity use is easy enough to change that attitudes tend to correlate with behavior more than if it were a harder task. A more likely explanation is that attitudes on a specific behavior can be very predictive of the behavior itself, but as the questions get more and more general, that connection is lost.

Limitations on current research

There were a number of things that could have been better controlled for in the research. For example, the number of respondents per house had a large impact on how reliable any data were from a house. If I had three responses from a house with 12 people, I got a less accurate estimate of the overall CNS of the house, because they could be the only three people in the house who cared about the environment, or the only three people in the house who enjoyed leaving their radios on 24 hours a day. Also, the people who chose to answer the survey may have had a tendency to care more about the environment, or it may be that the only people who responded to the online survey were the people who were indoors, who may have felt less connected to the environment. In either case, more people responding meant that the apartment could be predicted more accurately. The respondents per apartment needed to be in the regression equations because it explained a significant amount of the variance. However, if we had a better response rate, it may not have needed to be included.

I had smaller response rate 2nd semester. This showed me that door-to-door is a better way of collecting these data, because it was harder for people to refuse the person at their door than to not go on a website. Perhaps if the incentive to complete the online survey had been large enough, I would have gotten a higher response rate, but considering that many more residents filled out surveys for a candy bar (and some even turned down the candy) than for a pizza party, the incentive would probably have to be pretty large. The smaller number of respondents probably impacted the results, because the spring semester had less variance than the fall semester (The standard error for CNS in Spring 07 was .049, and Fall 07 was .070). Therefore, results were more reliable for the Spring semester than the Fall.

I did not control for the amount of people in Brown Bag Co-op, so there could have been apartments that used a lot more energy just because they were not on a normal dining plan (the stoves in the apartments use well over 700 kW of power when all four burners and the oven are in use). Furthermore, it would be difficult to find out how many people in each house were in Brown Bag Co-op, since not everyone answered the survey and the school does not disclose the dining choices of individuals due to FERPA (the Family Educational Rights and Privacy Act). Additionally, there was no way to differentiate between the inherent consumptive behavior of the occupants (how energy use might differ if all appliances were identical among all the houses) and the consumption from the houses resulting from choices students made in appliances they brought to their apartments.

Further research also needs to be conducted on gender and electricity consumption. My study found significant results for females using less electricity and males using less electricity during different semesters, so the overall result for gender predicting electricity consumption was inconclusive and not significant. Perhaps more research will find that one gender or the other naturally tends to use less electricity than the other, or feels more connected to nature.

Future directions

That an emotional response to nature would be able to predict electricity consumption has some exciting potential applications. However, because the results I found are only correlational, not causal, it is possible that there would be no difference in electricity consumption if people felt more connected to nature. Perhaps price of energy is a greater factor in electricity consumption than CNS, and these college students would behave very differently if they had to pay for their energy, regardless of how connected they felt to nature. Future research will have to determine whether this relationship is causal, perhaps by manipulating peoples' connections to nature and measuring whether the consumption changes. If it is causal, this suggests some rather simple interventions, because it is relatively easy to increase peoples' connectedness with nature (Kellert & Wilson, 1993, Mayer et al., 2006). Something as simple as being in a natural setting for 15 minutes daily, or having a photograph of a nature setting, can increase ones feeling of connection to nature. This may be easier than educating people about environmental problems and solutions, and it also spans socioeconomic backgrounds—anyone can go outside for 15 minutes a day (one hopes), or keep a plant on one's desk.

Also, this study has collected data that will be used by other studies to measure ways to reduce electricity with students. Studies are currently underway to figure out whether people who are connected to nature do better in a manipulation where people are asked to reduce their consumption for two weeks in an "energy competition", versus people who do not feel so connected to nature (see appendix IV). These people will be challenged to reduce their electricity for a set period of time, and will be given real-time feedback on their electricity consumption. Research will also be done on whether or not people who feel more connected to nature use feedback to reduce their electricity consumption (without incentives) more than people who do not feel so connected, and also to assess how experiencing feedback on resource use affects people's connectedness with nature.

To control global warming, we must be able to change our habits on a personal level. Though there is a movement towards building "green", or building structures that have little or low environmental impact, there are millions of existing buildings that do not help us conserve energy at all. Therefore, we must be able to increase peoples' awareness of how their consumption impacts the larger picture of climate change. If one of the benefits of emotionally connecting to nature is that people naturally use less electricity, this gives researchers hope of reaching a large portion of the population that may not respond to other encouragements (such as the people who feel that climate change is a myth), and we may be able to curb our global effects in time to prevent catastrophic, world changing events.

References

Ajzen, I. 1989. "Attitude Structure and Behavior" in A. Pratkanis, S. Breckler, and A. Greenwald (Eds.), Attitude Structure and Function, Lawrence Erlbaum Associates, Hillsdale, NJ.

Allen, D. and K. B. Janda. (2006) "The Effects of Household Characteristics and Energy Use Consciousness on the Effectiveness of Real-Time Energy Use Feedback: A Pilot Study." In *Proceedings of the American Council for an Energy-Efficient Economy 2006 Summer Study*. 7.

Brandon, G., & A. Lewis. (1999). "Reducing household energy consumption: A qualitative and quantitative field study." *Journal of Environmental Psychology*, *19*, 75-85.

Central Intelligence Agency: The World Factbook. Refer to the report online at https://www.cia.gov/library/publications/the-world-factbook/geos/us.html#Econ (retrieved 3/18/08)

Darby, S. 2000. "Making it obvious: designing feedback into energy consumption." *Proceedings of the 2nd International Conference on Energy Efficiency in Household Appliances and Lighting*. Italian Association of Energy Economists/ EC-SAVE programme.

Darby, S. 2006. "The Effectiveness of Feedback on Energy Consumption: A Review for DEFRA of the Literature on Metering, Billing, and Direct Displays." For The Environmental Change Institute, University of Oxford

Duval, T. S., V. H Duval, & R. Neely. (1979). "Self focus, felt responsibility, and helping behavior." *Journal of Personality and Social Psychology*, 37, 1769-1778.

Eagly, A. & S.Chaiken. (1993). The Psychology of Attitudes. Harcourt Brace Jovanovich College Publishers: Fort Worth, TX

Energy Information Administration Report. Refer to the report online at http://www.eia.doe.gov/emeu/recs/recs2001/enduse2001/enduse2001.html (retrieved 3/20/08)

Energy Information Administration Electricity Infocard, 2006. Refer to the report online http://www.eia.doe.gov/bookshelf/brochures/electricityinfocard/elecinfocard2006/elecinfocard.html (retrieved 3/22/08)

Environmental Protection Agency. Mercury Study Report to Congress: Volume 5—Health Effects of Mercury and Mercury Compound. Refer to the report online at http://www.epa.gov/ttn/oarpg/t3/reports/volume5.pdf (retrieved 3/21/08)

Environmental Protection Agency. Effects of Acid Rain. Refer to the report online at http://www.epa.gov/acidrain/effects/index.html (retrieved 3/20/08)

Frantz, C. M., & F. S. Mayer, C. Norton, & M. Rock. (in press). "There is no "I" in nature: The influence of self awareness on connectedness to nature." *Journal of Environmental Psychology*.

Heede, R. & J. Swisher. 2002. Oberlin: Climate neutral by 2020. Rocky Mountain Institute: Snowmass, CO.

Holland, R.W., B.Verplanken, & A. van Knippenberg. (2002). "On the nature of attitude-behavior relations: The strong guide, the weak follow." *European Journal of Social Psychology*, 32, 869-876.

IPCC (2001, 2007). Refer to Intergovernmental Panel on Climate Change online at http://ipcc-wg1.ucar.edu/wg1/wg1_home.html (retrieved 9/19/07).

Kellert, S. R. & E. O, Wilson. (Eds.) (1993). The biophilia hypothesis. Island Press.

Kolenda, B & M. Mildenberger. (2005). "Trinity College Energy Use Behavior Pilot Study Final Report: The Effectiveness of Feedback- and Incentive-based Energy Use Mitigation Strategies."

Latane, B. & J. M. Darley. (1968). "Group inhibition of bystander intervention in emergencies." *Journal of Personality and Social Psychology*, 10, 215-221.

Latane, B. & J. M. Darley. (1970). The unresponsive bystander: Why doesn't he help? New York: Appleton-Century Crofts.

Mayer, F. S., & C. M. Frantz. (2004). "The Connectedness to Nature Scale: A measure of individuals' feeling in community with nature." *Journal of Environmental Psychology, 24,* 504-515.

Meinhold, J. L., & A. J. Malkus. (2005). "Adolescent Environmental Behaviors: Can Knowledge, Attitudes, and Self-Efficacy Make a Difference?" *Environment and Behavio*r. 37, 511-532

Petersen, J.E., V. Shunturov, K. Janda, G. Platt, K. Weinberger, & M. E. Murray, Oberlin College. (2005). Does Providing Dormitory Residents with Feedback on Energy and Water Use Lead to Reduced Consumption?" In *"Extending Connections," Proceedings of the 6th Greening the Campus Conference, Sept. 15-17 2005.*

Petersen, J.E., V. Shunturov, K. Janda, G. Platt, & K. Weinberger. (2007). "Dormitory Residents Reduce Electricity Consumption When Exposed to Real-Time Visual Feedback and Incentives." In *International Journal of Sustainability in Higher Education.* 8(1), 16-33

Petersen, J.E., M. Murray, G. Platt, & V. Shunturov. (2007). "Using Buildings to Teach Environmental Stewardship: Realtime Display of Environmental Performance as a Mechanism for Educating, Motivating and Empowering the Student Body." *Proceedings, Greening The Campus VI*, Ball State University, Muncie, Indiana September 6-8.

Schipper, L. (1989), "Linking Lifestyle and Energy Used: a Matter of Time?" *Annual Review of Energy*, 14, 273-320.

Schultz, W.P., & S. Oskamp. (1996) "Effort as a moderator of the attitude-behavior relationship: General environmental concern and recycling." *Social Psychology Quarterly*. 59(4), 375-383

Ungar, S. (1994) "Apples and oranges: Probing the attitude-behavior relationship for the environment." *Canadian Review of Sociology and Anthropology*. 31(3), 288-304

USGBC (United States Green Building Council) Report. Green Building Facts: Green Building by the numbers. Refer to the report online at http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1718 (retrieved 4/22/2008).

Appendix I—*General Questions, CNS, and Community Electrical Identity Questions*

OCMR#: ___________

Apartment #: _________________________

Race: ___________

Gender:____________

I consider my socioeconomic status to be :

lower class _____

lower middle class _____

middle class _____

upper middle class _____

upper class _____

1	2	3	4	5	6	7
Strongly Disagree			Neutral			Strongly Agree

____ 1. I often feel a sense of oneness with the natural world around me.

____ 2. I think of the natural world as a community to which I belong.

____ 3. I recognize and appreciate the intelligence of other living organisms.

____ 4. I often feel disconnected from nature.

____ 5. When I think of my life, I imagine myself to be part of a larger cyclical process of living.

____6. I often feel a kinship with animals and plants.

____ 7. I feel as though I belong to the Earth as equally as it belongs to me.

____8. I have a deep understanding of how my actions affect the natural world.

____9. I often feel part of the web of life.

____10. I feel that all inhabitants of Earth, human and non-human, share a common "life force."

____11. Like a tree can be part of a forest, I feel embedded within the broader natural world.

____12. When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature.

____13. I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.

____14. My personal welfare is independent of the welfare of the natural world.

1	2	3	4	5	6	7
Strongly Agree			Neutral			Strongly Disagree

____1. I try not to waste electricity

____2. I feel like I can control how much electricity I use.

____3. I can think of several things I could do to reduce how much electricity my apartment uses.

____4. My goal is to limit the amount of electricity I use.

____5. My friends would all agree that it's important to try to save energy

____6. I don't really care if I wind up wasting a little electricity

____7. In my family of origin, it's considered important to turn off the lights

____8. I don't really know how we could use less electricity.

Appendix II— *Electrical Thought and Factual Electricity Questions*

Please indicate how true each statement is of you, using the scale provided. Answer truthfully; don't worry about what you think you are "supposed" to answer.

1	2	3	4	5	6	7
Not at all true of me						Very true of me

1. I often think about electricity consumption when I turn a light or appliance on or off
2. I know how the electricity I use was generated.
3. I consciously make decisions to minimize my electricity use.
4. I consciously make decisions to minimize other people's electricity use.
5. When I think about electricity, I think about the environmental implications of its use.
6. I have discussed electricity use in my apartment with other people.
7. I understand the environmental effect that different kinds of fuel sources have
8. I understand the environmental effect of my own electricity consumption here at Oberlin.

About what percentage of the electricity in the U.S. as a whole do you believe is generated through each of the following mechanisms:

	0-5%	5-20%	20-50%	50-100%
Burning coal?				
Burning oil and natural gas?				
Nuclear power?				
Hydroelectric?				
Solar and wind?				

About what percentage of the electricity used by residents of the city of Oberlin do you believe is generated through each of the following mechanisms:

	0-5%	5-20%	20-50%	50-100%
Burning coal?				
Burning oil and natural gas?				
Nuclear power?				
Hydroelectric?				
Solar and wind?				

About what percentage of the electricity used at Oberlin College do you believe is generated through each of the following mechanisms:

	0-5%	5-20%	20-50%	50-100%
Burning coal?				
Burning oil and natural gas?				
Nuclear power?				
Hydroelectric?				
Solar and wind?				

Appendix III—*Reliability Statistics*

	α	N of items
CNS	.868	14
Community Electrical Identity	.722	8
Electrical Thought	.861	8

Appendix IV

Much more data was collected during the duration of the honors project than was reported on in this study. During Fall 2007 and Spring 2007, no feedback was provided to the residents of the Union Street complex or knowledge given to them that their energy use was being monitored. This allowed me to get baseline data that I used in Spring 2008 when I conducted an energy competition between a subset of the housing units. The competition lasted for two weeks, from March 4th through March 18th. On March 1st, all residents of Union Street received a flyer on their door directing them to the Oberlin College dorm energy site, and were told that it provided real time feedback on their electricity consumption and could help them save energy. Half of the units were assigned to the energy competition, and were sent an e-mail on March 4th that gave them information that led them to the website that provided real time feedback on their energy consumption, as well as their ranking in the competition. The other half only got an e-mail on March 4th with information that led them to a website that provided real time feedback on their energy consumption. The prize for winning the competition was twenty dollars to each resident of the winning house. The people who were in the competition also received follow up information during the middle of the competition via e-mail on March 10th emphasizing that the competition was still going on, congratulating the current winning house, and encouraging that the contest could still be won by anyone. The winning house was the house that reduced its electricity by the greatest percent relative to the residents' energy consumption throughout the fall semester. No debriefing was utilized, because there was no deception, and cash awards were made to the residents of the winning house.

However, on April 6th, I discovered that the energy website that people had been looking at was inaccurately displaying the data. For the purposes of this honors project, the data were not used, because the results were inconclusive due to the error. Other researchers, however, will do further studies utilizing this data in the future.

Acknowledgments:

I'd like to thank Colin Sallee for helping me both understand SPSS and interpret my data, Cindy Frantz for advising me and being so patient with my revisions, John Petersen for helping me obtain the energy data and for being my advisor, Steve Mayer and Tom Newlin for their input into my honors project, and all of my family and friends for supporting me.