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# Analyzing Barriers to Energy Conservation in Residences and Offices: The Rewire Program at the University of Toronto

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Conducting a barriers analysis is an important first step when designing proenvironmental behavior change interventions. Yet, detailed information on common barriers to energy conservation campaigns remains unavailable. Using a pair of original surveys, we leverage the theory of planned behavior to report on the most important barriers for fourteen energy conservation behaviors common in university residences and offices. Our results provide key information for individuals designing community-based social marketing and other behavior change campaigns in an educational setting, particularly for energy conservation efforts. Results also provide guidance for the process of conducting effective barrier assessments.



## INTRODUCTION

Effective behavioral interventions aimed at individuals could reduce U.S. households' greenhouse gas emissions by 20%, accounting for over 7% of national emissions (Dietz, Gardner, Gilligan, Stern, & Vandenbergh, 2009). Earlier research suggests energy wasted by users throughout offices and residences could be as high as 50% of the total energy use, making it a powerful target for behavior change campaigns (Schipper, Bertlett, Hawk, & Vin, 1989). Yet, an incomplete understanding of the barriers to proenvironmental behavior change has compromised attempts to realize this potential. Since the 1970s energy crisis, numerous studies have measured the uptake of energy conservation behaviors through behavior change interventions (e.g., Abrahamse, Steg, Vlek, & Rothengatter, 2005; Dwyer, Leeming, Cobern, Porter, & Jackson, 1993; Geller, 2002; Katzev & Johnson, 1987). Their results are often sobering: Many participants do not engage in behaviors after training, many behavioral

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changes do not persist, and the broader environmental effects of these interventions remain uncertain. Despite policymakers and environmentalists' continued deployment of information campaigns, these campaigns do not always engender significant changes in behavior, even if they succeed in changing knowledge or attitudes (Costanzo, Archer, Aronson, & Pettigrew, 1986).

Part of this limited success can be explained by reliance on a misguided assumption that simply providing information can shift attitudes, and as a result, behaviors. Recent work has argued that proenvironmental attitudes are shaped by a much wider variety of factors than information alone, including, for example, direct appeals to emotion (Leiserowitz, 2006; Steg & Vlek, 2009), and the relative internalization of values and motivation (de Young, 2000; Osbaldiston & Sheldon, 2003). Psychological research has also questioned the direct link between attitudes and behavior itself. Icek Ajzen's theory of planned behavior emphasizes that attitudes alone are insufficient to generate behavioral results (Ajzen, 1991). Instead, behavioral intention is mediated by three aggregate factors: the attitude toward a behavior, subjective norms, and an individuals' perceived behavioral control. Attitudes comprise an individual's beliefs about the behavior's consequences, subjective norms comprise an individual's beliefs about how others view the behavior, and perceived control comprises an individual's beliefs about what factors support or inhibit the behavior (Ajzen, 2002; Harland, Staats, & Wilke, 1999).

Researchers have also linked the behavioral change efforts' failure to the existence of behavioral barriers (DeYoung, 1989; Gardner & Stern, 1996; McKenzie-Mohr, 2000b; Pelltier, Dion, Tuson, & Green-Demer, 1999). Barriers are the varied factors preventing people from engaging in a given proenvironmental behavior. Since they are activity-specific, barriers require analysis on a behavior-by-behavior basis (McKenzie-Mohr, Nemiroff, Beers, & Desmarais, 1995). Barriers can be internal, for example, if someone does not know how to turn on computer energy efficiency settings, or external, for example, the lack of a light switch to turn off common space lighting (Gardner & Stern 1996; McKenzie-Mohr, 2000b). In our analysis, we broaden the definition of barriers from a simple focus on internal versus external barriers by using the theory of planned behavior to create 10 different barrier subcategories (see Table 1). Although the theory of planned behavior provides a framework relating the determinants of behavioral intention with actual behavior change, a barriers analysis can help program designers understand which specific variables may prove most salient in a given context. In particular, Douglas McKenzie-Mohr advances a view that environmental behavior change campaigns should begin with a barriers analysis (McKenzie-Mohr, 2000a; Pelltier et al., 1999), and suggests that researchers publish barriers analysis results to aid future program design and implementation in comparable contexts. Such analyses help explicate which behaviors can be most easily targeted and will achieve the highest reductions (Flemming, Hilliard, & Jamieson, 2008; Gardner & Stern 1996; McKenzie-Mohr, 2000b). Without first identifying and then removing barriers to behavior change, experimenters and program administrators may ultimately find even their best-funded efforts fail to shift target behaviors.

In an ideal world, each behavioral change campaign should begin with a detailed study of the campaign's target population, including a careful qualitative examination of context-specific barriers to behavioral changes. In reality, many environmental conservation programs in communities do not have the resources or mandate to conduct extensive background research prior to program implementation. As a result, barriers can often go unexamined, even though a understanding behavioral barriers will allow for cost-effective deployment of limited campaign resources and can increase messages' precision and content (Albrecht, Burandt, & Schaltegger 2007; Djordjevic & Cotton, 2011). There is consequently an urgent need for case studies and information on typical barriers to energy

**Table 1**
**Barriers categorization**

| Category | Subcategory | Description | Typical Example |
|---|---|---|---|
| *Attitudes* | Discomfort | Losing something positive and/or useful (not including time); generating a negative result. | "The desk lamp often provides insufficient lighting." |
| *Attitudes* | Inconvenience | Losing time. | "It takes a long time when I'm in a hurry." |
| *Attitudes* | Laziness | Being lazy; disinclined to put in the effort. | "Laziness." |
| *Attitudes* | Forgetfulness | Being forgetful, including because the task is not perceived as important enough; not giving importance when hurried or rushed. | "They forget." |
| *Subjective norms* | Courtesy & norms | Wanting to be kind to others. | "Peers thinking that other people will use it again soon." |
| *Subjective norms* | Diffusion of responsibility | Not knowing whose responsibility a task is; being uncertain if it is allowed. | "They believe another person will do it." |
| *Subjective norms* | Safety | Concern for the safety of themselves or others. | "Safety. Residence washrooms are used 24/7." |
| *Perceived behavioral control* | Lack of knowledge | Not understanding how to do something. | "Many people wouldn't know how to activate the energy efficiency settings." |
| *Perceived behavioral control* | Futility | Not believing that the task is important or useful to do. | "It takes more energy to turn it on frequently than to leave it on for the day . . . I'm in and out a lot." |
| *Other* | Structural barriers | Physical impediments to behavior change. | "I know a lot of people have trouble reaching the on and off switch." |



conservation in specific institutional settings to inform social marketing campaign design (Takahashi, 2009). Universities have an important role to play in providing this knowledge (Taylor, Savan, & Fiddler, 2008). Energy conservation on campuses can both model strategies to a wider institutional audience and significantly contribute to reducing environmental impacts associated with energy consumption (Petersen, Shunturov, Janda, Platt, & Weinberger, 2007).

Currently, many universities are undertaking aggressive greenhouse gas emissions reductions targets to demonstrate leadership and support for policy change (American College and University's Presidents' Climate Commitment, 2007; Association for the Advancement of Sustainability in Higher Education [AASHE], 2010; Knuth, Nagle, Steuer, & Yarnal, 2007). To achieve their goals, effective campus energy conservation campaigns must shift behavior, influencing both institutional and community behaviors (Tilbury & Wortman, 2008). Such effective campaigns will depend on a better understanding of behavioral change barriers. Every site has its own unique barriers that are local and context specific, and there is no substitute for careful qualitative study of direct campaign target populations; yet, sharing results across institutions and campaigns can help focus the attention of campaign designers on key obstacles to successful behavioral change. Previous analyses have assessed barriers to sustainability in higher education at the institutional level (Dahle & Neumayer, 2001). Our work contributes to a pressing gap by reporting on the level of the individual and community.

# METHODS

The University of Toronto's Rewire project is an innovative energy conservation campaign that has grown to reach over 12,000 community members in Canada's largest university (see Chan, Dolderman, Savan, & Wakefield, 2012 and Mildenberger, Stokes, Savan, Dolderman, & Kolenda, 2012 for full program details). During the pilot phases of this program, community members in both residential and office environments were surveyed. One section of this survey provided a structured but open-ended space to assess barriers that could inhibit energy conservation behaviors, ranging from turning off common space lighting to using energy-efficiency settings on computers. This section of the survey was introduced with:

> What follows is a list of typical energy-saving behaviors that many people engage in while living in residence. Why do you think some people may not do these things? For each action, please indicate what factors you think may be preventing people from engaging in each action more often. If you cannot think of anything you may type Not Applicable or NA.

By posing the question in this way, we attempted to elicit responses from participants on their perceptions of barriers for themselves and others in either their residence or office environment. Each barriers question used a blank box to elicit a response; questions were open and spontaneous. This format was chosen to avoid constraining respondents' answers with preconceived ideas on what barriers were constraining behavior change. Previous reviews of the literature have found energy conservation experimental design is often focused on areas the project designers perceive to be important (Flemming et al., 2008; Gardner & Stern, 1996). An open-ended approach also avoided priming survey respondents with ideas that might later be used to individually justify behavioral nonaction. In addition to the survey, qualitative data included focus groups before and after program delivery as well as recorded observations by Rewire floor coordinators during program implementation. Both qualitative and survey-based observations of target communities are important in generating a rich understanding of behavioral barriers.

## Residence Survey

In 2005, a survey was distributed electronically as part of the Rewire program to all residents of a medium-sized undergraduate residence on the University of Toronto's St. George campus with around 400 residents. The survey was voluntary with an incentive prize draw available to those responding within a 2-week period. The survey contained a broad range of questions relating to proenvironmental behaviors with one section focused specifically on barriers.

In the residence survey, students were asked nine barriers questions focused on simple, energy conservation behaviors that could eventually be targeted by the Rewire energy conservation program. The questions were preceded by a statement asking the student to consider why some people may not engage in the behavior and respondents were asked to indicate, for each behavior, what factors were preventing people from engaging in the behavior more often. If the student couldn't think of a reason, they were instructed to enter "NA." Responses to these questions were required to complete the survey. A mandatory answer format was employed to encourage most students to take the time to think of an answer, rather than skipping to the next section. All nine behaviors were common energy conservation behaviors that could be undertaken within a residence context: turning off lights and the TV when leaving a common room; using a desk light instead of overhead lighting; turning off lights when leaving the bathroom; turning off ceiling fans when not needed; turning off printers and speakers (peripherals) when not in use; turning on computer energy efficiency settings; turning off personal TVs and stereos when not in use; unplugging the fridge when nothing is inside it; and turning off personal computers when going to class.

## Office Survey

Paper copies of the 2007 offices survey were distributed at a lunchtime talk in one of the office sites where the Rewire program was being discussed with new participants. The survey was collected at the end of the talk. The fact that the Rewire program was discussed before individuals handed in their surveys may have led to some response bias. In the future, it is advisable for surveys to be distributed and collected before any information about the program is shared. The survey itself contained barriers questions on five targeted behaviors: turning off the printer when not in use; turning off lights when leaving common spaces; turning off lights when leaving personal office spaces; using energy efficiency settings when not at your desk; and shutting down computers when leaving the office. Office employees were asked to indicate what factors they thought might prevent people from engaging in a given energy conservation behavior. If they couldn't think of a reason, they were instructed to write "NA" or simply leave the space blank. The fact that individual questions were not mandatory, because the survey was delivered on paper, led to a lower question response rate for the offices survey.

## Survey Analysis

Open-ended survey responses to the barrier question were coded into one of 10 subcategories. Given the Rewire project's use of the theory of planned behavior as an overarching theoretical framework, these subcategories were derived from attitudes, subjective norms, and perceived behavioral control (Ajzen 1988, 1991). When more than one answer was given in the response, the first discrete answer was coded. For the residence survey, results are given using the subcategories; for the offices, subcategories were aggregated and the analysis is shown using the theory of planned behavior's three categories. This difference in methodology derives from the quality and breadth of information gathered from the different survey methods.

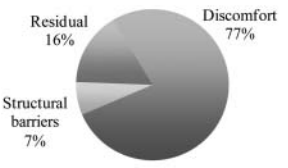
The coding itself was conducted blind, with two independent coders. Typical mismatch in coding was around 10% with a maximum of 12% (common space lighting) and a minimum of 3% (turning off computers). In these cases, a third coder adjudicated. If the adjudicator did not agree with either of the initial codes, the data point was dropped from the set. In addition, if the answer was too ambiguous or did not have enough information to code, it was removed from the dataset. In the case of the residences survey, because answers were mandatory, some of the responses were not clear; for this reason, a higher percentage of responses were discarded from the residences dataset. In the case of the offices survey, agreement amongst coders was lower; this is reflected in the results presented below.

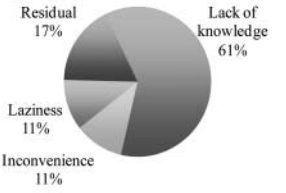
# RESULTS

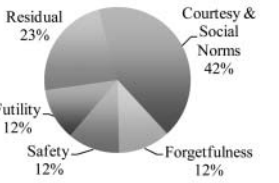
## Residence Survey

In total, 74 responses were received over the 3-week survey period: a response rate of approximately 18%. Overall, 17% of the questions were completed as "NA." For each behavior, a graph representing the breakdown of self-reported barriers is presented in Figure 1. In most cases, the top three barriers are presented, the sample size, the residual responses, and charts summarizing this information. The residual rate is defined as the remaining, valid responses that do not fall into the top three barriers categories. In some cases, responses for the third most common barriers are tied; in this case, four barriers are listed. These graphs are presented in order from most agreement to least agreement amongst respondents to give a sense of which behaviors had the greatest convergence in responses.

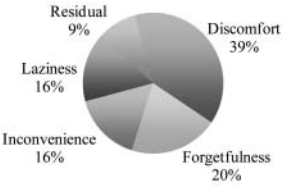
| *Behavior* | **Using desk lamp lighting** | | **Turning on computer energy efficiency settings** | | **Turning off bathroom lighting** | |
|---|---|---|---|---|---|---|
| *1st barrier* | Discomfort (*attitudes*) | 77% | Lack of knowledge (*perceived control*) | 61% | Courtesy & Social Norms (*subjective norms*) | 42% |
| *2nd barrier* | Structural barriers (*other*) | 7% | Inconvenience (*attitudes*) / Laziness (*attitudes*) | 11% | Forgetfulness (*attitudes*) / Safety (*subjective norms*) / Futility (*perceived control*) | 12% |
| *3rd barrier* | NA | | | | | |
| *Residual* | 16% | | 17% | | 23% | |
| *Sample size* | 57 | | 46 | | 52 | |

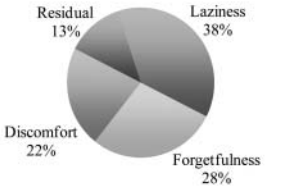


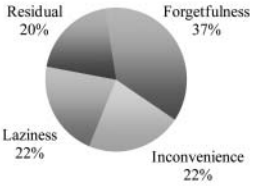



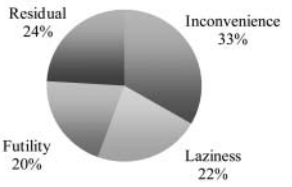

| *Behavior* | **Turning off the ceiling fan** | | **Turning off TVs, stereos, and other peripherals** | | **Turning off the printer** | |
|---|---|---|---|---|---|---|
| *1st barrier* | Discomfort (*attitudes*) | 39% | Laziness (*attitudes*) | 38% | Forgetfulness (*attitudes*) | 37% |
| *2nd barrier* | Forgetfulness (*attitudes*) | 20% | Forgetfulness (*attitudes*) | 28% | Inconvenience (*attitudes*) / Laziness (*attitudes*) | 22% |
| *3rd barrier* | Inconvenience (*attitudes*) / Laziness (*attitudes*) | 16% | Discomfort (*attitudes*) | 22% | | |
| *Residual* | 9% | | 13% | | 19.6% | |
| *Sample size* | 44 | | 32 | | 46 | |

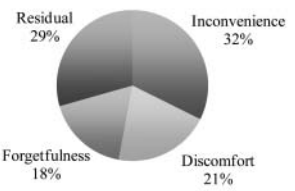



| *Behavior* | **Shutting down the computer when not in use** | | **Turning off the fridge when away for a period of time** | | **Turning off Common Room Lighting** | |
|---|---|---|---|---|---|---|
| *1st barrier* | Inconvenience (*attitudes*) | 33% | Inconvenience (*attitudes*) | 32% | Forgetfulness (*attitudes*) | 28% |
| *2nd barrier* | Laziness (*attitudes*) | 22% | Discomfort (*attitudes*) | 21% | Courtesy & Social Norms (*subjective norms*) | 22% |
| *3rd barrier* | Futility (*attitudes*) | 20% | Forgetfulness (*attitudes*) | 18% | Laziness (*attitudes*) | 18% |
| *Residual* | 24% | | 29% | | 32% | |
| *Sample size* | 54 | | 34 | | 60 | |



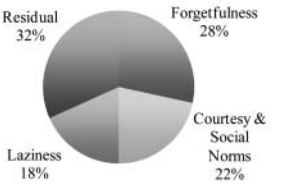




**Fig. 1.** Residences survey: Most frequent barriers reported for each behavior.

**Table 2**
**Offices survey: Barriers reported for each behavior**

| Behavior | Barriers reported | Agreement |
|---|---|---|
| Turning off lights when leaving common spaces, including the kitchen | Subjective norms | High |
| Turning off the printer when not in use | Subjective norms; Attitudes | Medium |
| Turning off lights when leaving personal office spaces | Structural barriers; Attitudes | Medium |
| Using energy-efficiency settings when not at your desk | Perceived control; Attitudes | Low |
| Shutting down computers overnight when leaving the office | Structural barriers; Perceived control; Subjective norms | Low |



Overall, we found the strongest, converging results for the behavior "using the desk light instead of overhead lighting," with 77% of respondents arguing that discomfort was a major inhibiting factor. The reason why individuals do not use energy efficiency settings had quite strong convergence, with 61% of respondents suggesting that lack of knowledge, one of the perceived control categories, was the major barrier. Overall, the fact that residuals do not tend to be higher than one-quarter demonstrates that respondents were showing significant convergence in their opinions on the relevant barriers. As Figure 1 demonstrates, respondents are quite inclined to describe barriers as relating to attitudes; of the 28 explanations highlighted in the figure, 21 of the barriers were related to attitudes. In contrast, only three of the explanations related to subjective norms and four related to perceived control.

## Offices Survey

Around 40 people worked in the Rewire offices pilot study site, with 24 individuals responding to the survey, yielding a response rate of a little over 50% for a small sample size. Results from the offices survey were much more difficult to analyze systematically owing to the lack of a large, consistent dataset. Nevertheless, results are suggestive in a number of areas. In Table 2, each behavior is shown with the class of barriers respondents suggested. Agreement refers to the level of ambiguity in the results; in cases of high agreement, respondents were clear and showed high convergence in their responses; for low agreement, respondents answers were less clear and did not show high agreement across individuals. Barriers are reported here in their overarching category, using the theory of planned behavior.

# DISCUSSION

These barriers results informed the Rewire program design. For example, in the residence survey, students responded to the behavior question "Turning off the lights when leaving the bathroom," overwhelmingly citing safety and courtesy concerns. Typical responses included "there may be someone else using the bathroom," and "people enter the bathroom too often" to turn off lights. When the Rewire program was designed, this was taken into account. We explicitly told students implementing the program within residences not to turn off bathroom lights, and to encourage other students to follow this directive. However, the program participants sometimes became quite zealous, turning off bathroom and hallway lights regardless, prompting health and safety concerns. In the 2nd year of the program, small signs were placed above bathroom and hallway lights reminding students not to turn the lights

off. As this example shows, conducting the barriers analysis before the program design was important to ensuring the program was properly managed. In addition, the barriers analysis helped to shape and focus Rewire's strategies towards promoting energy conservation. For example, in the residence survey, 49% of respondents answered either "NA" or "already do this" for the behavior "Turning off the TV or stereo when not in use." This suggests that turning off TVs and stereos may be a less successful behavior to target in an intervention than other energy conservation behaviors individuals report they are not yet engaging in. Without conducting a barriers analysis in advance, program designers would not know whether or not specific behaviors were possible in the community context or could yield significant energy conservation outcomes.

Apart from student residences, these results may prove important to those designing and implementing energy conservation programs in apartment buildings, condos, or office spaces outside of a university context. The results presented in this paper from the offices survey regarding computer energy conservation indicated that central, information technology (IT) coordination was necessary in order to change behaviors. Several individuals suggested that updates were the main problem with turning off computers overnight; if computers were turned off, employees worried about missing a software update, leading to a longer reboot in the morning or missing the updates entirely. If the IT department is able to implement "wake on LAN" or other technology that allows for a remote startup to update software overnight and indicate this change to employees, then individuals may be more likely to turn off their machines. This reality means that program designers need to work closely with IT to implement changes and then communicate these changes to employees, requesting they change their behavior. In addition, the strong results from residents that desk lighting may prove insufficient suggests a need for better energy-efficient lighting, which doesn't cause individuals to worry about straining their eyes. In both the offices and residences context, we also found that forgetfulness was an important factor blocking individuals from turning off printers and other peripheral devices. This suggests the need to activate social norms, to increase the likelihood that individuals will turn printers off. Thus, the use of public commitment alongside floor representatives, who champion these behaviors, may prove useful, consistent with earlier studies that have found social norms important in student environments (Katzev & Johnson, 1987). In addition, signage may provide an important cue, reminding individuals and acting as a normative trigger.

Comparing the residences and offices survey suggests that online surveys with mandatory responses are more likely to yield robust datasets for later analysis. That said, the differences in response rates and the quality of the answers may be more due to the differences in the underlying populations—students versus office employees—as opposed to the survey method. The overwhelming tendency for student respondents to attribute barriers to attitudes suggests a weakness in the survey approach to barriers analysis. As much of the literature demonstrates, attitudes are often not the actual reasons blocking individuals from engaging in proenvironmental behavior (Costanzo et al., 1986; Lehman & Geller, 2004; McKenzie-Mohr, 2000b). Instead, other factors are often at play. Indeed, this finding is quite distinct from other aspects of the Rewire survey and program results, which suggested that subjective norms played an important role in determining and changing behavior (Chan et al., 2012), in line with previous research on behaviors in student populations, including alcohol consumption (Perkins, 2002).

This result raises an intriguing tension between self-reported beliefs about important barriers and broader psychological theories about the determinants of behavioral change. Students' potential overattribution of barriers to attitudes suggests that personal beliefs about the barriers to behavioral change may themselves be an obstacle to effective energy

conservation campaigns. By misidentifying the root cause of energy behaviors, students may have a hard time changing their own activities. Further, campaign designers risk focusing their efforts too heavily on attitudinal barriers. However, carefully designed energy conservation efforts can exploit this tension. For instance, although students did not identify the lack of subjective norms around energy conservation as a major barrier to private energy behaviors, our survey also revealed that students systematically underestimated the fraction of their peer group who held proenergy conservation beliefs. The Rewire program was thus able to highlight the high existing levels of proenvironmental beliefs in the community, creating shared awareness of proenvironmental beliefs that could overcome beliefs about the attitudinal barriers to action. In contrast, offices respondents were much less likely to use terms such as "laziness" or "forgetfulness" to describe the reasons why they or their coworkers may not be engaging in a given energy conservation behavior. Office respondents generally reported fewer attitudinal barriers, instead attributing barriers to a lack of perceived control and the presence of subjective norms. This finding may point to underlying difference in how the populations perceive themselves. Again, this suggests a weakness in relying solely on self-reported surveys to determine barriers to behavior change, particularly in the case of residences. As a result, it may be important to follow up barriers surveys with focus groups or informant interviews to ground-truth responses and to integrate analysis of self-reported barriers analysis with broader psychological theories of human behavior.

Although the Rewire project did not focus its efforts on providing feedback, due to the project's core knowledge base and the limitations of university residences, this area remains promising for future research. Feedback programs that incorporate elements of the normative messaging that the Rewire project employs have had positive results, although further research is required to better understand this complex component of behavior interventions (Petersen et al., 2007; Schultz, 1998). Integrating barriers identification and analysis into feedback design could prove important to designing more effective energy conservation interventions (Abrahamse, Steg, Vlek, & Rothengatter, 2007; Flemming et al., 2008). To date, much of this research is lacking adequate experimental design (Abrahamse et al., 2005; Steg & Vlek, 2009; Takahashi, 2009). Designing effective environmental campaigns requires an understanding of both the context and actors involved and the barriers to each specific behavior. Integrating a barriers analysis and the theory of planned behavior an organizing framework may help improve design and results. Further identifying barriers will help program designers realize which behaviors they should avoid targeting because the impact is likely to be small or because of insurmountable barriers, such as health and safety concerns. We encourage further research in this direction, which can build on work that outlines the essential elements of feedback: frequency, immediacy, and relevancy (Seligman, Becker, & Darley, 1981; Shippee, 1980; Winett & Neale, 1979).

## CONCLUSION

This article shares findings from the Rewire program to help improve future program implementation at similar institutions where a poor understanding of the factors impeding behavior change reduces the success of energy conservation and other environmental programs. With many universities, corporations, and government agencies currently undertaking or planning to undertake energy conservation programs in both residence and office contexts, this knowledge may be useful for increasing other interventions' effectiveness. Our results highlight the importance that many students place on attitudinal barriers to energy conservation, from discomfort to

laziness to forgetfulness. For some behaviors, there was a high convergence on a single barrier; for others, respondents reported several disparate barriers. This finding highlights the importance of disaggregating barriers analysis to specific behaviors. For instance, there was strong convergence in identifying discomfort as the major barrier preventing the use of desk lighting; however, student respondents reported complex combinations of forgetfulness, laziness, and discomfort in describing the barriers to such tasks as turning off ceiling fans and shutting down computers when not in use. Some behaviors had clear nonattitudinal barriers. The major barriers to computer energy efficiency settings all related to lack of perceived control, while barriers to turning off bathroom lights were all linked towards subjective norms of courtesy. In office settings, self-reported barriers were more diverse, and respondents described more barriers rooted in subjective norms and lack of perceived control over the behavior.

Although it is important to note that barriers are context specific, the findings presented in this article could prove transferable to similar institutional settings, and will be of particular use in cases where funding or expertise are not available to conduct full barriers analyses. Furthermore, this research explicates an approach to conducting barriers research and analysis for a variety of settings and contexts, including those that do not explicitly target energy conservation or proenvironmental behavior. Although barriers analysis is by no means a panacea for effective energy conservation campaigns, it can help point to important and often overlooked challenges to the design of effective proenvironmental programs.

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## REFERENCES

AASHE. (2010). Association for the advancement of sustainability in higher education. Retrieved from http://www.aashe.org/

Abrahamse, W., Steg, L., Velk, C., & Rothengatter, T. (2005). Review of intervention studies aimed at household energy conservation. *Journal of Environmental Psychology, 25*, 273–291.

Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2007). The effect of tailored information, goal setting, and tailored feedback on household energy use, energy-related behaviors, and behavioral antecedents. *Journal of Environmental Psychology, 27*, 265–276.

Ajzen, I. (1988). *Attitudes, personality, and behavior*. Chicago, IL: Open University.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179–211.

Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *Journal of Applied Social Psychology, 32*, 665–683.

Albrecht, P., Burandt, S., & Schaltegger, S. (2007). Do sustainability projects stimulate organizational learning in universities? *International Journal of Sustainability in Higher Education, 8*, 403–415.

American College and University Presidents' Climate Commitment. (2007). *Presidents' climate commitment*. Retrieved from http://www.presidentsclimatecommitment.org/about/commitment.

Chan, S., Dolderman, D., Savan, B., & Wakefield, S. (2012). Practicing Sustainability in an Urban University: A case study of a behaviour based energy conservation project. *Applied Environmental Education and Communication, 11*(1), 9–17.

Costanzo, M., Archer, D., Aronson, E., & Pettigrew, T. (1986). Energy conservation behavior: The difficult path from information to action. *American Psychologist, 41*, 521–528.

Dahle, M., & Neumayer, E. (2001). Overcoming barriers to campus greening: A survey among higher educational institutions in London, UK. *International Journal of Sustainability in Higher Education, 2*, 139–160.

De Young, R. (1989). Exploring the difference between recyclers and nonrecyclers: The role of information. *Journal of Environmental Systems, 18*, 341–351.

De Young, R. (2000). Expanding and evaluating motives for environmentally responsible behavior. *Journal of Social Issues*, *56*, 509–226.

Dietz, T., Gardner, G., Gilligan, J., Stern, P., & Vandenbergh, M. (2009). Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions. *Proceedings of the National Academy of Sciences*, *106*, 18452–18456.

Djordjevic A., & Cotton, D. R. E. (2011). Communicating the sustainability message in higher education institutions. *International Journal of Sustainability in Higher Education*, *12*, 381–394.

Dwyer, L., Leeming, F., Cobern, M., Porter, B., & Jackson, J. (1993). Critical review of behavioral interventions to preserve the environment–Research since 1980. *Environment and Behavior*, *25*, 275–321.

Flemming, S. A. C., Hilliard, A., & Jamieson, G. A. (2008). The need for human factors in the sustainability domain. *Human factors and Ergonomics Society Annual Meeting Proceedings*, *53*, 748–752.

Gardner, G. T., & Stern, P. C. (1996). *Environmental problems and human behavior*. Boston, MA: Allyn and Bacon.

Geller, E. (2002). The challenge of increasing proenvironment behavior. In R. Bechtel & A. Churchman (Eds.), *Handbook of environmental psychology* (pp. 525–540). New York, NY: Wiley.

Harland, P., Staats, H., & Wilke, H. (1999). Explaining proenvironmental intention and behavior by personal norms and the theory of planned behavior. *Journal of Applied Social Psychology*, *29*, 2505–2528.

Katzev, R., & Johnson, T. (1987). *Promoting energy conservation: An analysis of behavioural approaches*. Boulder, CO: Westview Press.

Knuth, S., Nagle, B., Steuer, C., & Yarnal, B. (2007). Universities and climate change mitigation: Advancing grassroots climate policy in the US. *Local Environment*, *12*, 485–504.

Leiserowitz, A. (2006). Climate change risk perception and policy preferences: The role of affect, imagery, and values. *Climatic Change*, *77*, 45–72.

Lehman, P. K., & Geller, E. S. (2004). Behaviour analysis and environmental protection: Accomplishments and potential for more. *Behaviour and Social Issues*, *13*, 13–32.

McKenzie-Mohr, D. (2000a). Fostering sustainable behavior through community-based social marketing. *American Psychologist*, *55*, 531–537.

McKenzie-Mohr, D. (2000b). Promoting sustainable behaviour: An introduction to community-based social marketing. *Journal of Social Issues*, *56*, 543–554.

McKenzie-Mohr, D., Nemiroff, L. S., Beers, L., & Desmarais, S. (1995). Determinants of responsible environmental behavior. *Journal of Social Issues*, *51*, 139–156.

Mildenberger, M., Stokes, L., Savan, B., Dolderman, D., & Kolenda, B. (2012). Beyond the information campaign: Community-based energy behavioral change at the University of Toronto. *Environmental Practice*.

Osbaldiston, R., & Sheldon, K. (2003). Promoting internalized motivation for environmentally responsible behavior: A prospective study of environmental goals. *Journal of Environmental Psychology*, *23*, 349–357.

Pelltier, L., Dion, S., Tuson, K., & Green-Demer, I. (1999). Why do people fail to adopt environmental protective behaviors? Toward a taxonomy of environmental amotivation. *Journal of Applied Psychology*, *29*, 2481–2504.

Perkins, H. W. (2002). Social norms and the prevention of alcohol misuse in collegiate contexts. *Journal of Studies on Alcohol, Supplement*, *14*, 164–172.

Petersen, J. E., Shunturov, V., Janda, K., Platt, G., & Weinberger, K. (2007). Dormitory residents reduce electricity consumption when exposed to real-time visual feedback and incentives. *International Journal of Sustainability in Higher Education*, *8*, 16–33.

Schultz, W. (1999). Changing behavior with normative feedback interventions: A field experiment on curbside recycling. *Basic and Applied Social Psychology*, *21*, 25–36.

Schipper, L., Bertlett, S., Hawk, S., & Vin, E. (1989). Linking life-styles and energy use: A matter of time? *Annual Review of Energy*, *14*, 273–320.

Seligman, C., Becker, L. S., & Darley, J. M. (1981). Encouraging residential energy conservation through feedback. *Advances in Environmental Psychology*, *3*, 93–113.

Shippee, G. (1980). Energy consumption and conservation psychology: A review and conceptual analysis. *Environmental Management*, *4*, 297–314.

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*, 309–317.

Takahashi, B. (2009). Social Marketing for the Environment: An Assessment of Theory and Practice. *Applied Environmental Education and Communication*, *8*, 135–145.

Taylor, A., Savan, B., & Fiddler, J. (2008, June). *Overcoming barriers to sustainability and implementing institutional reform: A case study of the University of Toronto, Canada*. Paper presented at Responsabilite Sociale et Environnmentale, nouvelled formes organizationelles, Lyon, France. Retrieved from http://www.riodd2008.fr/Actes2/TaylorSavan.pdf

Tilbury, D., & Wortman, D. (2008). How is community education contributing to sustainability in practice? *Applied Environment Education and Communication*, *7*, 83–93.

Winett, R. A., & Neale, M. S. (1979). Psychological framework for energy conservation in buildings: Strategies outcomes, directions. *Energy and Buildings*, *2*, 101–116.