J. ENVIRONMENTAL SYSTEMS, Vol. 19(3) 265-273, 1989-90

PROMOTING CONSERVATION BEHAVIOR IN SHARED SPACES: THE ROLE OF ENERGY MONITORS*

RAYMOND DE YOUNG
The University of Michigan
Ann Arbor

ABSTRACT

Public university buildings are fascinating if somewhat complicated behavior settings. Designed and managed for a broad range of users, these buildings present a challenge to those trying to promote energy conservation. This is even more so when the goal is not a technology-based approach but conservation through direct involvement. This article discusses one type of participation–the use of energy monitors. Volunteer staff members were given responsibility for monitoring lighting energy usage in the public and shared spaces near their offices. They were encouraged to promote energy conservation by shutting off unneeded lights and by informally discussing their activities with other building users. This relatively simple and direct approach proved effective in reducing energy waste.

Despite the rising costs of energy, conservation in educational institutions has received little attention [1]. Those strategies that have been explored in an institutional setting generally involve technological and maintenance improvements [2, 3]. When the building users are involved it is often limited to prompting them to "be bright and turn out the light" [4, 5]. It has not been commonplace to more actively engage them in energy conservation efforts.

* This work was supported in part by a grant from the University of Michigan Energy Program (Project Number 136560).

doi: 10.2190/2N3T-WH89-B6WW-KVLH
http://baywood.com

Building managers might be wasting an opportunity. A select group of building users might be enlisted as models of energy conservation behavior. Certainly, the condition of the environment and the events occurring in it can act as a cue to appropriate behaviors [6, 7]. The state of the place one works in helps to define the norms of behavior in that place. Individuals acting as energy monitors can play a role in spreading information and defining norms. Yates and Aronson have noted the powerful influence of person-to-person diffusion of ideas [8]. Teater, in a review of Stanford University's energy management program, has called face-to-face contact, "the most important part of the program" [9]. Aronson and O'Leary report that the use of confederates as behavior models was more effective in encouraging conserving behavior than prompts were when used alone [10].

The research reported in this article explores the direct involvement of a few selected individuals, referred to as "energy monitors," in a university sponsored energy conservation project. The focus was on conserving energy used in the lighting of shared spaces in two university buildings.

METHODS

The Participants

In a survey of building users conducted some time earlier, the staff of Building 1 had indicated a greater interest in conservation behavior and a greater sense of responsibility for energy use than either the students or faculty. Given such a sense of responsibility and their more consistent presence in the building than either students or faculty, the involvement of staff members seemed most fitting.

Staff members on each floor were asked to serve as energy monitors in the portion of the building nearest their office. The individuals asked had been identified by the building manager as permanent, full-time staff members. Each staff member was individually told about the project and asked to volunteer. All those contacted volunteered, some with great enthusiasm.

The energy monitors were asked to carry out their duties as part of their normal daily routine (i.e., trips to the mailroom or restroom, trips to a copying machine center, when placing messages on faculty doors). They were fully informed about the study and the reason a participatory strategy was being tried. Their involvement was entirely voluntary with no form of external inducement used. The energy monitoring was to occur as time permitted. It was intended that the activity become part of the staff member's daily routine rather than structured as a new task. This increased the acceptability of this new role to both the monitors and their supervisors and may also contribute to the cost-effectiveness of this participatory approach.

The Settings

Building 1 – Building 1 is a structure which houses an entire school within the university. The shared spaces included stairwells, hallways, classrooms, seminar rooms, and some miscellaneous common rooms (e.g., mail room, copy room). For the purpose of this study the building was divided into four separate treatment areas and one control area. In all, fifteen classrooms and miscellaneous rooms, eleven hallways, and seven stairways were included in the study. A total of eight staff members agreed to serve as "energy monitors" with two in each of the four treatment areas.

The control area included shared hallways and stairways having the same general usage pattern as the hallways and stairways in the treatment areas. This control area did not contain other types of shared spaces such as classrooms, copy rooms, or mail rooms.

Building 2 – Building 2 included two structures linked by an enclosed pedestrian bridge making them function as one building. These are the facilities of an entire school within the university.

Six separate floors were selected as study areas, each having the same general use pattern. Three floors served as treatment areas and three as control areas. In all, twenty-four classrooms and miscellaneous rooms (e.g., mail room, copy room, lounge) and three auditoriums were included. Hallways or stairways were not used in the study. In this building the hallways and stairway lights could not be shut off by building users unless they possessed a special key. The control areas in Building 2 were virtually identical in use pattern to the treatment areas.

A total of eight staff members agreed to serve as "energy monitors" on the three treatment floors and were responsible for lights in the rooms near to their office. The treatment areas were of unequal size. The smaller area had one monitor and the two larger areas had three and four monitors, respectively.

Data Collection and Analysis

The study included an initial baseline period, before the monitors were assigned their tasks. A final baseline was not appropriate since the "treatment" in this study is the participation of selected building users, something which cannot be manipulated in a simple on/off fashion. For Building 1 the initial baseline period began in early autumn and lasted three months, into early winter. The treatment period for Building 1 lasted five months and ended in mid-spring. For Building 2 the initial baseline period began in the middle of winter and lasted four months, into late spring. The treatment period for Building 2 lasted just over three months and ended in early autumn.

The energy monitors were first contacted after the completion of the initial baseline period. As far as could be determined none of the building users were aware that an investigation was being conducted during the initial baseline

Table 1. Calculating Conservation Scores

	Status of Room Lights		
Status of Room Use	*Off*	*Half-On*	*On*
Empty	C	W	W
Study	C	C	W
Class	C	C	N

NOTE: Conservation Score = C/(C+W).

period. Care was taken to inform a minimum number of people about the study. Only the researcher, a colleague, each school's Dean, and each school's building manager were informed prior to the start of the treatment period. The Deans also agreed to conduct no other energy or resource conservation program during the term of the study.

The dependent variable, conservation, was measured by observing the status of the lighting system about once a day. For the hallways and stairwells in Building 1 this involved recording whether the lights were on, half-on (where appropriate), or off. The conservation score for a hallway was the ratio of the number of instances the lights were observed to be off to the total number of observations.

The development of the dependent variable for the rooms involved two kinds of observations. The first was a measure of how the room was being used–whether the room was empty, occupied by only a few individuals for studying, or occupied by an entire class or group. The second involved recording whether the lights were on, half-on, or off. Table 1 shows how these observations were coded.

The first step in calculating the conservation score for rooms involved discarding the combination of the room occupied by a class with the lights on. It was felt that this was an expected condition and not one likely to be altered by a behavioral strategy. The conservation score was then calculated for each room as the ratio of the number of instances of the lights being off and the number of instances of the lights being half-on with the room occupied either by a class or by people studying to the total number of instances. This is shown schematically in Table 1 with "C" representing conservation, "W" representing waste, and "N" indicating the combination not included in the calculation of the conservation score.

Using this scheme, conservation scores were calculated for each site (i.e., rooms, hallways, stairways) for both the baseline (pretest) period and treatment (posttest) period. The data were then analyzed using the one-way repeated measures test. The analysis took into account the fact that the control area in

Building 1 was comprised entirely of hallways and stairways by analyzing the treatment area data for Building 1 separately for rooms and halls (i.e., hallways and stairways).

RESULTS AND DISCUSSION

The data and results of the statistical tests are presented in Table 2. The results show a substantial and significant increase in lighting conservation in all room treatment areas from the initial baseline to the treatment periods for both buildings. In contrast there were very minor and nonsignificant changes in the control areas of both buildings. This suggests that the energy monitors were effective in conserving lighting energy in both buildings.

While the trend for the hallway and stairway treatment areas in Building 1 was generally in the direction of increased conservation, the change was small and nonsignificant. In part, these findings can be explained by the structural nature of hallways in Building 1. With only a single exception, hallways in Building 1 are without windows to the outside.

Not surprisingly, the data indicated that in most instances the lights in the hallways were always left on. This can be understood from a safety and security point of view. With the lights off these hallways are very dark and foreboding. People may prefer to have the hallways well lit rather than to fumble around for light switches every time one enters a new corridor. And, in fact, staff members did mention their desire for the hallway lights to always be on.

The single hallway with windows faces an interior courtyard. As a result it was not uncommon for this hallway to be very bright with natural lighting. This hallway also had a slight increase of 4.2 points in the conservation score from the baseline to the treatment period. This change might have been greater except that the most active energy monitor in this area, the most energetic of the participants, was gone during a part of the treatment period.

Table 2. Conservation Scores by Building

Location	*Baseline*	*Treatment*	*Repeated Measures Statistic*		
Building 1:					
Treatment Rooms (N=15)	55.2	80.0	df=1,14	F=23.32	p<.0001
Treatment Halls (N=11)	48.0	53.2			n.s.
Control Areas (N=7)	25.8	28.8			n.s.
Building 2:					
Treatment Areas (N=16)	45.1	65.8	df=1,15	F=14.80	p<.002
Control Areas (N=8)	62.0	58.5			n.s.

Taken together, the findings from the Building 1 hallway data suggest that conservation may be difficult to promote in the interior of buildings where natural lighting is unavailable. Structural changes would seem to be particularly appropriate for such settings: installing lower wattage lights (especially if the bulb installed is of the new higher lumen-output type), removing every other light fixture, and/or employing some form of automatic switching system.

The energy monitors in Building 1 reported discussing their activities with other staff members, students, and faculty. One group went as far as to post an article explaining why it is cost-effective to turn flourescent lights off even if you are leaving the room for only a couple of minutes. They said they did this in order to debunk the common myth that it is better to leave such lights on because of "start-up" and bulb-replacement costs.

Included in Building 2 were three auditoriums: one in a treatment area and two in a control area. Auditoriums present a particular challenge for energy conservation. They rarely have windows to the outside to allow natural lighting. And they often have several exits which makes it hard for users to know if they are the last to leave and should therefore turn off the lights.

Furthermore, it was sometimes difficult to determine from the hallway whether these auditoriums were occupied making it more difficult to monitor these shared spaces. It was also observed that light switches in auditoriums are often in out-of-the-way locations. All in all, auditoriums represent a distinctly different type of shared space than classrooms, mail rooms, or hallways. It turned out that the participatory approach to energy conservation was not effective for auditoriums. The data indicate a *reduction* in the conservation score for the auditoriums from the baseline to the treatment period. This was true for both the auditorium in the treatment area (a drop of twenty-one points) and the two in the control area (a nonsignificant drop of five points).

Limitations

Empirical studies are rarely free of limitations. The data reported here may have been affected by any number of systematic factors. While difficult to assess, several factors are worth noting to guide future research.

The first of these is the possibility that unmeasured factors had an effect on the dependent variable. For instance, daily cloud cover and other weather factors might have an effect on people's use of artificial lights, especially in spaces that are well lit by natural sun light. If weather conditions could be factored into the analysis it would become important to attend to the orientation of the shared spaces. For instance, some rooms in Building 1 face south toward the sun. Furthermore, most readings were taken near noon and during the afternoon. Thus, on certain days, west and south facing rooms might have received large amounts of natural sun light, being well lit and thus better candidates for conser-

conservation. While on these same days, north and east facing rooms might have greater need for artificial lighting.

A second factor that could effect the conservation scores are seasonal change that took place during the research. The data collection period for Building 1 extended from early autumn through mid-spring. For Building 2 data were collected from mid-winter through early autumn. Season weather patterns (e.g., overcast winters, clear and sunny summers) might have an effect on people's use of artificial lights similar to that mentioned above for daily patterns.

Another potentially relevant seasonal effect comes from the different patterns of use during each school term. Some classes begin with a lecture format but end with a greater emphasis on student projects (i.e., less class time, or a "study" pattern much more conducive to having the light half-on). Several rooms in Building 1 were particularly affected by such changes and tended to get heavy use toward the end of terms when students held numerous small group planning and working sessions.

The final limitation involves the selection of energy monitors. Once selected, no measurement of their individual performance was made. Although all energy monitors were active it was previously noted that one participant was particularly energetic. This suggests the possibility that not all of the monitors were equally effective. Furthermore, the importance of the conservation task may not have been successfully communicated to each energy monitor.

These limitations cannot be ruled out as affecting the data. They were, however, planned for in the research design and efforts were made to reduce their possible impact. This was accomplished, for instance, by the inclusion of control areas and the use of multiple rooms located throughout each building.

CONCLUSION

The pattern of results is not only interesting but, in large measure, also encouraging. The findings suggest that a participatory approach to conservation is a viable option in institutional settings. In particular, energy monitors are an appropriate means of promoting conservation in public, intermittently used space where wasteful behavior can be easily spotted and influenced by any building user.

And yet, many institutional conservation programs continue to be characterized by the limited role offered individual building users. Sometimes building users are asked to approve of a selected solution but rarely is there a chance for their early involvement in the decision making process or an opportunity for them to take direct action to conserve. The reasons offered for this state of affairs are many. Direct involvement is often perceived as difficult to initiate, expensive to manage, or ineffective at best.

As a strategy which goes against the conventional wisdom, it is necessary to explore why this form of involvement was found to be successful. A theoretical examination of the psychological implications of participation suggests that individual commitment is an essential component of resource conservation [11, 12]. Past research has documented the fact that individuals derive a great deal of intrinsic satisfaction from both conservation and direct participation [13, 14]. And, in fact, several energy monitors in Building 1 indicated they enjoyed doing something to change wasteful practices.

Participation allows individuals to interact directly with the environment, enhances their understanding of that environment and their role in it, and increases their feelings of responsibility about the functioning of that environment [15]. Participation can provide the necessary elements to allow people to develop a sense of territoriality over places where they work and study [16]. It seemed clear from conversations with the energy monitors that they had developed a sense of territoriality and were eager to share conservation ideas or changes they had noticed. Several monitors inquired as to what would be appropriate behavior if, while walking through another monitor's territory, they found a light on. To know what to do to save energy and to care enough to act are a result of promoting a sense of "energy territoriality."

Territory, even in the conceptual sense of the word, involves ownership. If there are too many owners then the sense of territory may become diluted. To involve everyone, at the same time and in the same way, may be to truly "involve" no one. Thus, in an institutional setting, the involvement of a few selected individuals may be preferred over involving all building users.

Thus, while direct participation is typically counted as a cost, there is strong theoretical support for considering it a benefit. We live in a society where the sense of not being needed–of being surplus–is widespread. Surely participation is to be preferred to further alienation.

ACKNOWLEDGMENT

I am indebted to Rachel Kaplan for assistance throughout this project.

REFERENCES

1. R. Widmar, D. Simmons, R. Kaplan, and R. DeYoung, *Behavioral Approaches to Energy Conservation in Organizations: A Selected Review of the Literautre*, Council of Planning Librarians, Chicago, Number 142, 1984.
2. American Council on Education, *Energy Conservation Idea Handbook*, 1980.
3. R. N. Helms, *Illumination Engineering for Energy Efficient Luminous Environments*, Prentice-Hall, Englewood Cliffs, New Jersey, 1980.

4. P. A. Luyben, A Parametric Analysis of Prompting Procedures to Encourage Electrical Energy Conservation, *Journal of Environmental Systems, 12*, pp. 329-339, 1982-83.
5. E. S. Zolik, L. A. Jason, D. Nair, and M. Peterson, Conservation of Electricity on a College Campus, *Journal of Environmental Systems, 12*, pp. 225-228, 1982-83.
6. P. S. Stern and E. Aronson (eds.), *Energy Use: The Human Dimension*, Freeman, New York, 1984.
7. P. Ester and R. A. Winett, Toward More Effective Antecedent Strategies for Environmental Programs, *Journal of Environmental Systems, 11*, pp. 201-211, 1981-82.
8. S. M. Yates and E. Aronson, A Social Psychological Perspective on Energy Conservation in Residential Buildings, *American Psychologist, 38*, pp. 435-444, 1983.
9. N. R. Teater, Stanford University: Building Energy Managers Program–Report and Recommendations, unpublished manuscript, Energy Program Office, Stanford University, Stanford, California, 1983.
10. E. Aronson and M. O'Leary, The Relative Effectiveness of Models and Prompts on Energy Conservation: A Field Experiment in a Shower Room, *Journal of Environmental Systems, 12*, pp. 219-224, 1983.
11. R. D. Katzev, The Impact of Commitment in Promoting Consumer Energy Conservation, in Consumer Behavior and Energy Policy: An International Perspective, E. Monnier, G. Gaskell, P. Ester, B. Joerges, B. Lapillonne, C. Midden, and L. Puiseux (eds.), Praeger, New York, 1986.
12. R. D. Katzev and T. Johnson, *Promoting Energy Conservation: An Analysis of Behavioral Research*, Westview Press, Boulder, Colorado, 1987.
13. R. DeYoung, Some Psychological Aspects of Recycling: The Structure of Conservation Satisfactions, *Environment and Behavior, 18*, pp. 435-449, 1986.
14. _____, Encouraging Environmentally Appropriate Behavior: The Role of Intrinsic Motivation, *Journal of Environmental Systems, 15*, pp. 281-292, 1985-86.
15. S. Kaplan and R. Kaplan, *Cognition and Environment: Functioning in an Uncertain World*, Praeger, New York, 1982.
16. R. R. Gatts, R. G. Massey, and J. C. Robertson, *Energy Conservation Program Guide for Industry and Commerce*, U. S. Department of Commerce, Washington, D.C., 1974 (with supplement, 1975).

Direct reprint requests to:

Raymond DeYoung
The University of Michigan
School of Natural Resources
430 East University Avenue
Ann Arbor, MI 48109-1115