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REDUCING RESIDENTIAL ELECTRICAL ENERGY USE: PAYMENTS, INFORMATION, AND FEEDBACK[1]

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Monetary payments, energy information, and daily feedback on consumption were employed to reduce electricity use in four units of a university student housing complex. A combined multiple-baseline and withdrawal design permitted both within- and between-unit comparisons. Payments produced immediate and substantial reductions in consumption in all units, even when the magnitude of the payments was reduced considerably. Feedback also produced reductions, but information about ways to conserve and about the cost of using various appliances did not. It was also found that, in general, payments combined with either information or feedback produced no greater effect than payments alone.

DESCRIPTORS: behavioral community psychology, electrical energy use, conservation, feedback, monetary reinforcers, information, multiple baseline, withdrawal, reactivity, university students

In the last few years, behavior analysts have generated a growing literature on the applied analysis of environmentally relevant behavior. Such activities as littering (*e.g.,* Chapman and Risley, 1974; Hayes, Johnson, and Cone, 1975), recycling (Reid, Luyben, Rawers, and Bailey, 1976), destructive walking patterns (Hayes and Cone, *in press*), and mass transportation (Everett, Hayward, and Meyers, 1974) have been studied. More recently, energy consumption has also been investigated (*cf.* Kohlenberg, Phillips, and Proctor, 1976; Palmer, Lloyd, and Lloyd, *in press;* Seaver and Patterson, 1976; Winett & Nietzel, 1975). It is generally agreed that the consumption of energy in the industrialized nations of the world has reached levels that cannot long be sustained, given our present energy resources.

The problems caused by high levels of consumption may be dealt with in two major ways: (a) new sources of energy can be developed, espçcially through new technology, and (b) consumption of energy can be altered. In the short term, the latter solution seems to be the only option. Put succinctly, the energy crisis is at least partially a behavioral problem.

With respect to electrical energy use, behavioral interventions can be aimed at two dimensions of the problem: (a) patterns of consumption, and (b) levels of consumption. The first has to do with the greater demand for electrical power at certain peak periods, usually between 8:00 to 11:00 a.m. and 5:00 to 9:00 p.m. A significant percentage of the power-generating capacity required for peak periods is idle during times of lower demand. Thus, if consumption patterns can be changed to level production requirements, smaller power plants

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could be constructed at less overall cost to the environment.

An effort to change such patterns was undertaken by Kohlenberg *et al.* (1976). The effects of payments, information, and feedback on electrical energy "peaking" of private residences were investigated in a withdrawal design with three volunteer families who had responded to a newsletter ad. Results indicated that information alone (telling families the effects of peaking on the environment and appliance wattage ratings in terms of 100-W light-bulb equivalents) produced no changes in peaking, while feedback alone (indicator light showing excess current being used) had a moderate effect. The greatest change occurred with the feedback plus payment condition (double the monetary value of their electric bill for a 100% reduction in peaking).

Studies by Winett and Nietzel (1975), Seaver and Patterson (1976), and Palmer *et al.* (*in press*), have addressed the other major dimension of the energy use problem, that of overall levels of consumption. Winett and Nietzel examined the effects of information (manual containing energy reduction suggestions), feedback (self-recording form for monitoring weekly meter readings), and payments (up to $5 per week for reductions greater than 20%) on the consumption of electricity and natural gas in private residences. In a design permitting both within- and between-group comparisons, one group of households received information and feedback and the other received weekly monetary payments as well. Both groups apparently reduced electricity and gas consumption from baseline levels. There was a between-group effect for electricity only, however, with the payment group showing a greater reduction in use. (It should be noted that payments by the experimenter were in addition to those resulting from the lower bill produced by reduced consumption. Thus, both groups were actually exposed to monetary payments of one form or another.)

Seaver and Patterson (1976) examined the separate and relative effects of feedback and feedback plus "We are saving oil" decals on use of home heating oil. Again, a combined within- and between-groups design was used with families randomly assigned to one of the above conditions or to an untreated control group. Overall analyses of variance and internal analyses showed significantly less consumption for the feedback plus decals group after intervention than for the control and feedback only groups, which were not significantly different from one another.

Palmer *et al.* (*in press*) also tried to reduce levels of consumption. Using four volunteer families in a series of withdrawal designs, they examined the effects of two types of feedback and two types of prompts. Feedback involved either (a) daily use in terms of kilowatt hours or (b) daily use plus projected monthly cost. Prompts were (a) daily requests for conservation, and (b) a personal letter from a government official urging conservation. Palmer *et al.* concluded that prompts and feedback were effective, but differential effectiveness within or between the two approaches was not established.

These four studies represent the beginning of an applied analysis of environmentally relevant energy consumption behaviors. They have addressed the two major dimensions of the energy use problem (patterns and levels of consumption) and have examined the effects of reasonable classes of independent variables.

The present study examined the effects of payments, information, and feedback on levels of electrical energy consumption. It differs from the four studies above in being the first to investigate all three variable classes separately and in various combinations. In addition, the study examined the possible reactive effects of telling subjects their consumption was being monitored and initiated preliminary parametric work concerning the magnitude of monetary payments necessary to effect stable reductions in electricity use. A design employing both multiple-baseline and withdrawal features was used.

METHOD

Subjects and Setting

The study was conducted from late January to mid-May 1975, in an 80-unit housing complex for married students at West Virginia University. Each apartment was an identical two-bedroom, unfurnished unit. Heating (both air and water) was provided by gas, so that changes in temperature were not expected to affect electricity consumption levels. The apartments were each furnished with similar electric ranges, refrigerators, and ventilation fans. Students had to be married and have children to gain access to the housing, which rented for $115 per month including all utilities. Students were put on a waiting list to get into the complex and were assigned to units as they became available (usually within several months). Thus, the assignment to units from the list was essentially random.

Unlike subjects in previous research, these did not pay their own electricity bills. When direct cash payments are offered for consumption reductions in typical residential settings, they are confounded with money saved by a reduced bill. More important, other conditions producing reductions are similarly confounded. Using nonpaying subjects eliminates this difficulty.

Because the entire complex had only one central electricity meter, separate watt-hour meters were placed on each of six different units' wiring.[3] The meters were located in the basement of two of the 10 eight-unit buildings in the complex (four units were metered in one building, two in the other). These two buildings were used because their basement fuse boxes were inaccessible to the residents. The units selected were each on the end of a row of apartments (each building had two storeys, four apartments in a row on each storey). The purpose of this procedure was to minimize communication between subjects in the study.

[3]We would like to thank the Monongahela Power Company, Fairmont Office, for providing the meters.

Data Collection

The six watt-hour meters were read once daily by one of two primary meter readers. By subtracting the previous day's reading, the kilowatt-hours (KWH) consumed could be determined. To control for the slightly varying times of the daily readings, KWH per hour (KWH/H) were used as the dependent measure. These were calculated by dividing the KWH consumed since the previous day's reading by the number of hours elapsed since that reading.

After the first few days of the study, access was also gained to the central watt-hour meter for the entire complex. This meter was read in the same way as the meters on the separate units. The data were computed in the same way except that the KWH/H figures were divided by 80 to arrive at an average unit consumption rate.

Watt-hour meters are designed to be extremely reliable and rugged. Readings are normally expected to be within three-quarters of 1% of true values for the 25-yr normal life span of the meter. The donated meters were checked for accuracy by the power company before being released to the project. On seven occasions throughout the study, the meters were independently read by a second individual. There was perfect agreement between the readings obtained by the primary and secondary readers.

Procedure

Covert baseline. Initially, meters were read for six families without their knowledge. After several days of recording, one family was dropped because of aberrantly low levels of consumption (this family was apparently seldom home), leaving five families through the rest of this phase.

Overt baseline. After 11 to 14 days of covert recording, the remaining five families were approached and asked to volunteer for "a study of energy consumption and ways to reduce it". No one asked and no one was told at this point that they had already been monitored. They were told that all future contact would be through notes in their mail box. If they asked, they were told generally that the study would involve such things as monetary payments, information, and feedback, and that the exact nature of the conditions would be described later. Four of the five families volunteered for the study. The refusing family would give no reason other than that they "didn't have the time". This particular family had shown very unusual consumption rates compared with the other four families; specifically, their recorded use of electricity was high and extremely variable.

The use of the two baseline phases permitted the observation of any reactive effects of monitoring *per se.*

Payments. Monetary payments were introduced across the remaining four units in multiple-baseline fashion after eight to 13 days of the overt baseline phase. Cash payments were made at the end of one week, according to the per cent reduction in weekly electricity consumption compared to covert baseline levels. Reductions throughout the study were always calculated according to the formula: (treatment minus covert baseline)/covert baseline. Initially, a full payment or 100% schedule was implemented as follows: a 10 to 19% reduction earned $3, 20 to 29% earned $6, 30 to 39% earned $9, 40 to 49% earned $12, and a reduction of 50% or more earned $15. These levels were reduced in later phases of the study, to 83, 50, 25, or 10% of the original dollar amounts. A 50%-payment condition, for example, yielded $1.50 for a 10 to 19% reduction, $3 for a 20 to 29% reduction, and so on up to a possible $7.50 for a reduction of 50% or more.

The 100%-payment condition was withdrawn in Units 2 and 4 after one week but remained in effect in the other units to test for durability. At this point, (near the end of Week 6) the four units were divided into two sets of two units each. The effects of feedback and payments were compared in one set, information and payments were compared in the other.

Feedback. The feedback condition consisted of the daily distribution of a flier containing the following information (in dollars and cents): (a) the amount of electricity consumed the previous day, (b) the amount of electricity consumed so far for the week, (c) the amount of electricity which would be consumed for the week at that rate of consumption, and (d) the per cent above or below covert baseline levels that "c" represented. The dollars and cents values were obtained by taking the KWH/H figure for the day, multiplying it by 24 to obtain the KWH consumed for the day, and multiplying this figure by 0.06 to obtain the dollar amount.

Feedback and payments were compared in Units 3 and 4. Unit 4 received feedback for one week (following a return to baseline phase already described), then feedback plus 100% payment for a week, then feedback only for a week, and then back to baseline. In the final two weeks, two reduced-payment conditions (25% and 10%) were tried.

In Unit 3, the 100%-payment schedule was not withdrawn (the effects of payments were by then clear), but the unit went directly into a week of feedback plus 100% payment and then back to 100% payment only. During the last three weeks of the study, 83- and 50%-payment schedules were in effect for this unit.

The essential feature of the design in Units 3 and 4 is that, in one case feedback was added to a 100%-payment condition, while in the other 100% payment was added to feedback. If B = 100% payment and C = feedback, then the two sequences can be described as B, B + C, B; and C, C + B, C. This part of the design was concerned with the interaction or combination effects of the two conditions.

Information. The information condition consisted of the distribution of a 21.6 by 28 cm poster, which described ways to reduce the consumption of electricity and gave the amount of energy consumed per year (both in terms of

KWH and dollars and cents) for most common household electrical devices. This information was taken from a more extensive article by Jurgen (1974).

For Units 1 and 2, an arrangement of conditions was provided between information and payments similar to that used with feedback and payments for Units 3 and 4. Following the return to baseline, Unit 2 first received information alone, then information plus 100% payment, then back to information, and then back to baseline. The shift from information to baseline is in some sense impossible, since information as such cannot be removed. The poster was withdrawn from the unit, however.

In Unit 1, information plus 100% payment followed the 100%-payment only condition. Information was then "withdrawn" for six days of 100% payment only and then a return to baseline. After seven days of baseline, Unit 1 received seven days of 50% payment. A 25%-payment condition was then implemented in both Units 1 and 2. After nine and six days, feedback was added to the 25%-payment condition in Units 1 and 2, respectively.

Following all of the phases described, each family was given a detailed structured interview and returned to a final baseline phase. The interview consisted of questions regarding what was done to reduce consumption of electricity, what was attended to in the feedback and information conditions, and predictions as to which condition was the most successful.

In addition to the experimental units, a natural control group was provided by the data for the overall complex. To summarize, the design of the study combined multiple-baseline and withdrawal procedures (in addition to a control group) to establish the separate effects of monitoring, payments, feedback, and information. The comparative effects of the latter three conditions were established by introducing and removing an additional condition once behavior had stabilized in an existing one. A clearer understanding of the design may result from considering the results in Table 1.

RESULTS

Means and changes from covert baseline in KWH/H are presented for each unit by phase in Table 1. A graphic presentation of daily KWH/H is provided for each unit in Figures 1 and 2. It may be noted that covert baseline consumption levels are comparable between units, and reasonably stable. With the introduction of overt baseline monitoring there are accompanying decreases in consumption for all units. However, the effect is transitory. The comparability of covert and overt baseline phases is shown by the four-unit means of 0.56 and 0.53 KWH/H, respectively. Thus, knowledge that use was being monitored produced no permanent effect.

Implementation of the 100%-payment condition resulted in immediate and generally stable reductions in electricity use, (with the possible exception of Unit 3). Overall mean KWH/H dropped to 0.36 with the initial introduction of payments. Across its several introductions throughout the study, the 100%-payment condition produced mean reductions of −33% of baseline levels (range = −26 to −46%).

Information alone had a temporary effect in Unit 2, which soon vanished. The first week of information alone yielded a mean KWH/H of 0.38 (30% below baseline), but the next introduction a week later yielded a mean KWH/H of 0.49 (9% below baseline), a figure actually higher than that produced in the subsequent return to baseline (mean KWH/H = 0.45). In neither Units 1 nor 2 was the combined effect of information plus 100% payment greater than that for 100% payment alone. In Unit 1, the combined condition had a mean KWH/H of 0.40 (26% below baseline), while the preceding and following 100%-payment conditions had mean KWH/H figures of 0.37 and 0.39 (or 31 and 28% below baseline levels, respectively). In Unit 2, information plus 100% payment yielded a mean KWH/H of 0.31 (43% below baseline), while

Table 1

Electricity use by experimental phase for all units: Means and per cent change from baseline.[a]

Unit 1

Phase	*Mean KWH/H*	*Per cent Change*
Covert Baseline (14)	0.54	
Overt Baseline (10)	0.59	+9
100% payment (15)	0.37	−31
100% payment + Information (7)	0.40	−26
100% payment (6)	0.39	−28
Overt Baseline (7)	0.55	+2
50% payment (7)	0.37	−31
25% payment (9)	0.39	−28
25% payment + Feedback (5)	0.33	−39
Overt Baseline (10)	0.58	+7

Unit 3

Phase	*Mean KWH/H*	*Per cent Change*
Covert Baseline (11)	0.68	
Overt Baseline (13)	0.66	−3
100% payment (22)	0.49	−28
100% payment + Feedback (7)	0.54	−21
100% payment (7)	0.50	−26
83% payment (14)	0.55	−19
50% payment (7)	0.46	−32
Overt Baseline (10)	0.63	−7

Unit 2

Phase	*Mean KWH/H*	*Per cent Change*
Covert Baseline (11)	0.54	
Overt Baseline (11)	0.53	−2
100% payment (7)	0.29	−46
Overt Baseline (10)	0.51	−6
Information (7)	0.38	−30
Information + 100% payment (7)	0.31	−43
Information (7)	0.49	−9
Overt Baseline (7)	0.45	−17
25% payment (6)	0.37	−31
25% payment + Feedback (8)	0.32	−41
Overt Baseline (10)	0.48	−11

Unit 4

Phase	*Mean KWH/H*	*Per cent Change*
Covert Baseline (14)	0.47	
Overt Baseline (8)	0.42	−6
100% payment (7)	0.29	−38
Overt Baseline (10)	0.51	+9
Feedback (7)	0.37	−21
Feedback + 100% payment (7)	0.31	−34
Feedback (7)	0.40	−15
Overt Baseline (7)	0.47	0
25% payment (7)	0.37	−21
10% payment (7)	0.36	−23
Overt Baseline (10)	0.49	+2

[a]Phase lengths, in number of days, are indicated in parentheses.

100% payment alone produced a mean KWH/H of 0.29 (46% below baseline).

Feedback alone produced moderate but apparently stable reductions in energy consumption in Unit 4, with mean KWH/H figures of 0.37 and 0.40 for the two weeks of this condition (21 and 15% below baseline levels, respectively). The combined effect of feedback and 100% payment was no greater than 100% payment alone. Unit 4 had a mean KWH/H of 0.31 (34% below baseline) for the combined condition, but a mean of 0.29 (38% below baseline) for the 100%-payment alone condition. Similarly, in Unit 3 the combined condition produced a KWH/H mean of 0.54 (21% below baseline), as compared with the surrounding 100%-payment condition means of 0.49 and 0.50 (28 and 26% below baseline, respectively). In Units 1 and 2, adding feedback to a 25%-payment condition had a slight effect. Consumption was reduced from a mean KWH/H in the 25%-payment condition in Unit 1 of 0.39 (28% below baseline) to 0.33 in the combined condition (39% below baseline). In Unit 2, the mean went from 0.37 (31% below baseline) to 0.32 (41% below baseline).

The results for the reduced payment schedules are generally consistent with those for the 100%-payment condition. For example, while

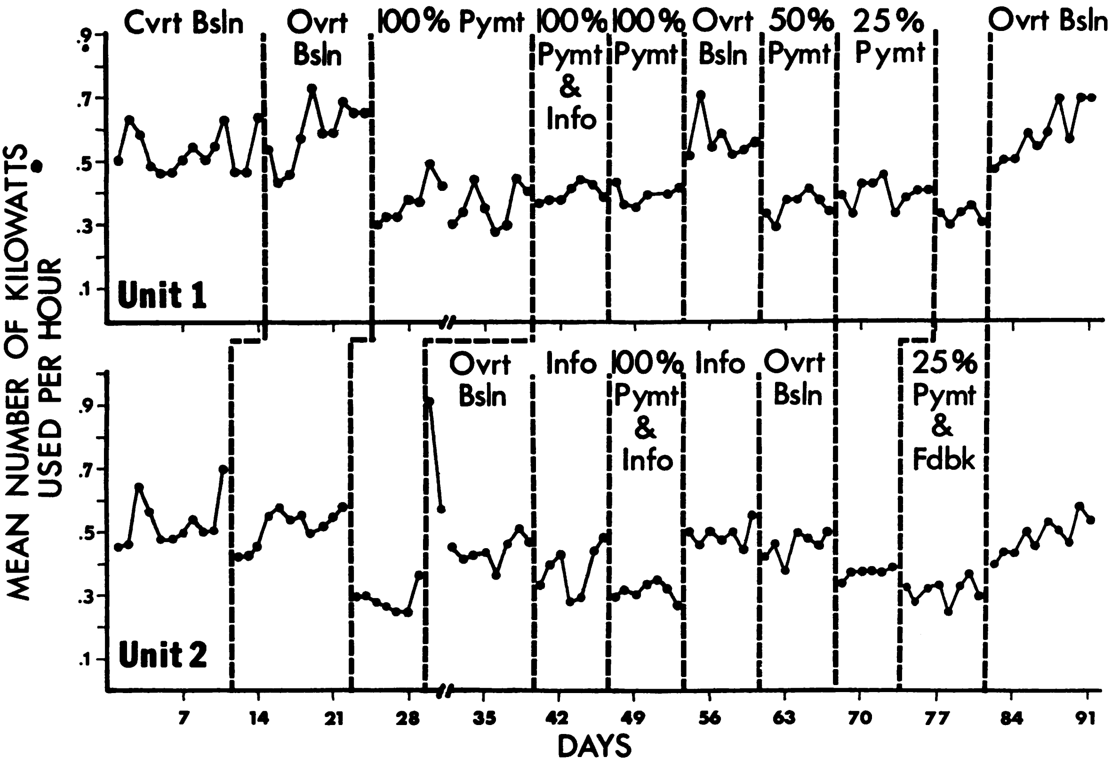

Fig. 1. KWH/H values for experimental Units 1 and 2 across the 91 days of the study. Abbreviations are: Cvrt = covert, Bsln = baseline, Ovrt = overt, Pymt = payment, Info = information, and Fdbk = feedback. The gap in the data between Days 31 and 32 was due to spring vacation at the university, during which most students left town.

the mean reduction from baseline for the 100%-payment condition was 33% (range = 26 to 46%), the mean reduction was 32% (range = 31 to 32%) for the 50%-payment condition, and 27% (range = 21 to 31%) for the 25%-payment condition. The single time a 10%-payment condition was tried, it led to a 23% reduction. Thus, while decreasing payments produced less reduction, the slope of the function is not steep, and even very minimal payments had substantial effects. The only indication that reducing payments could result in a breakdown in the effect came in Unit 3, where the transition from 100 to 83% payment generated an initial increase in consumption. After failure to obtain a payoff at the end of the first week, however, consumption returned to a low level. Subsequent lowering to 50% payment maintained the reduction. Consumption figures for Unit 3 are more variable than those for the other units, and the results are therefore difficult to interpret with certainty.

The data for the overall complex provide a baseline-only control. These data include electricity used in the housing complex offices, laundry rooms, outdoor lighting, and so forth, and thus the average value per unit is higher than that for the actual units themselves. Further, these data also include the experimental units. However, the experimental units account for only 3% to 4% of the consumption in the complex, so their figures have minimal effect on the overall KWH/H. The average consumption per unit is remarkably consistent throughout the study (from mid-winter to mid-spring). These data reveal no systematic changes due to temperature (the average temperature increased during the study from about 30°F to

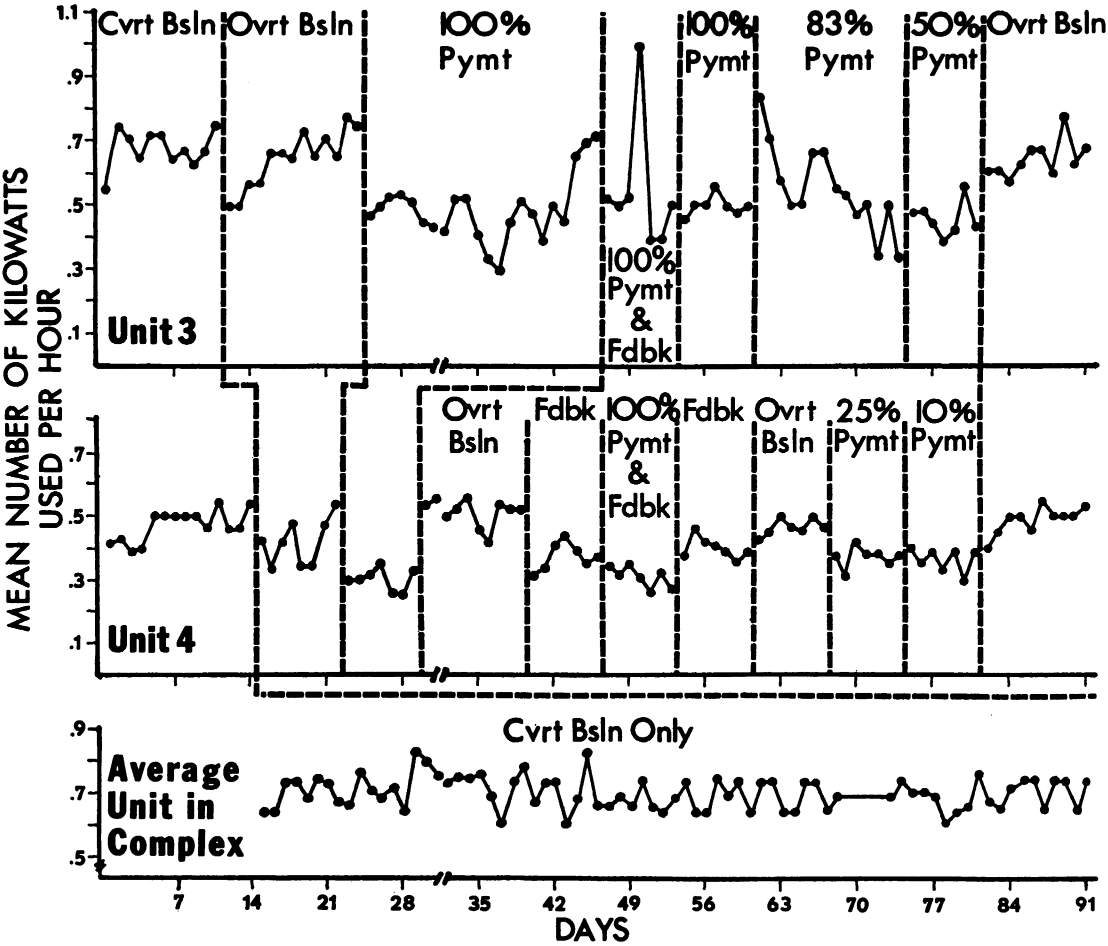

Fig. 2. KWH/H values for experimental Units 3 and 4 and for the average unit in the overall complex across the 91 days of the study. Abbreviations are: Cvrt = covert, Bsln = baseline, Ovrt = overt, Pymt = payment, Info = information, and Fdbk = feedback. The gap in the data between Days 31 and 32 was due to spring vacation at the university, during which most students left town.

about 70°F), the introduction of experimental conditions, or to extraexperimental influences that may have confounded results.

There is no evidence of important order effects. The mean KWH/H figures for the covert and last overt baseline periods averaged across the four experimental units were 0.56 and 0.55, respectively. If all the overt baseline phases in the four units are compared to the covert baseline, the differences range from +9% to −17% of baseline with a mean difference of only −3% of baseline figures for the first phase. Likewise, experimental conditions have strikingly similar effects, even when implemented more than once in a unit and with other conditions interposed.

The total cost of the payment program was $130.10. Counting all conditions in which payments were involved, a total of some 2600 KWH were saved in the four units compared to baseline consumption levels. At 6¢ per KWH, this amounts to a savings of $156. At a more conservative figure of 3¢ per KWH, the savings would be $78. It should also be noted that these figures include the 100% payments, which may have been much more than needed to effect change.

To assess possible demand characteristics, the families were asked to guess which treatment had been most effective in the study. They answered, in Units 1 through 4, respectively: payments, information, payments, and feedback. The subject families had no contact with the experimenter during the study, except in the form of written notes placed in the mailbox of the participants to introduce a new condition and make monetary payments. It seems unlikely that demand characteristics or social variables associated with the experimenter affected the results.

DISCUSSION

The large reductions in consumption of electrical energy found in this study are encouraging. Even a small reduction, if spread over many households, could have an important impact on the nation's energy resources.

The most effective of the three procedures was paying for reductions. Kohlenberg *et al.* (1976) had shown experimenter payments to be effective in altering patterns of electricity use. However, their payment may have been in addition to the savings resulting from lower bills, and payments were introduced concurrently with several other variables, including information about the effects of previous conditions, exhortations to make special efforts to reduce, and instructions in how to read recording charts in their homes. Winett and Nietzel (1975) had also apparently shown experimenter payments to reduce levels of consumption, but their payment was again in addition to savings from lower bills. Moreover, temperature effects made interpretation of their results difficult. The present data establish unequivocally the independent effectiveness of payments for reductions. In addition, the relative superiority of such a procedure over feedback and information has been demonstrated.

The results of the payment conditions will not necessarily apply to typical residential situations in which bills are paid by the user or to institutions in which electricity is used for heating and air conditioning. Moreover, the amounts paid may not be sufficient to affect the use of subjects more affluent than students. However, any payments would be in addition to savings on bills, and might be sufficient to produce reductions in more typical residential situations.

To be sure, costs are involved in the payment condition over and above the actual payments themselves. Before its application, the total cost of frequent meter readings, reversed billing procedures, and other components of the condition would have to be weighed against savings from reduced KWH, reduced capital costs for generating capacity, and from lower fuel bills to run existing generators. Moreover, present results suggest that considerably less than the full payment schedule may be just as effective.

It should be noted that contingencies controlling power companies are not likely to promote extraordinary efforts to reduce the consumption of energy. This may be one reason why power companies have concentrated on highly visible, but apparently ineffective, educational campaigns. Manipulations in rate structures or billing procedures designed to reduce energy consumption will probably have to come either through dictate by the public utility commissions or through more radical measures, such as the socialization of energy production. Unfortunately, the present environment generally limits extensive behaviorally oriented experimental programs in energy conservation if major cooperation from power companies is required (Winett, 1976). Therefore, programs are likely to be implemented without adequate experimental examination, if they are implemented at all.

Of the other two procedures, feedback appears more promising for future research than does information. The latter had only a temporary effect in the present study, no greater than the reactive effect of telling subjects that their use was being monitored. Curiously, information in the form of massive educational campaigns seems to be the main strategy adopted by governmental agencies and power companies to control the consumption of energy. Perhaps the money spent on such campaigns could be better spent in developing and implementing rebate or feedback systems.

Feedback could by maximized by an on-line, in-house meter similar to that used by Kohlenberg *et al.* (1976). It would seem feasible to build a meter to report continuously the amount of energy (in dollars and cents) consumed for the day and the month to date, project a total monthly bill at current rates of consumption, and turn on an indicator when certain consumption levels were exceeded. Many consumers would probably purchase such a meter as an add-on device if power companies did not furnish them.

It should be noted that the present study examined feedback and information independent of any monetary payments in the form of reduced electrical bills. It may be that providing typical residential users with information and feedback on ways to save themselves (as opposed to the university) money would result in greater changes than were produced here.

The method of selecting subjects in the present study highlights some interesting issues in the energy control literature. Ethically, the optimal solicitation procedures might request volunteers as in Kohlenberg *et al.* and Winett and Nietzel (1975). However, both internal and external validity will suffer to the extent that volunteers somehow differ from nonvolunteers. Concerning internal validity, volunteers are likely to be more conservation oriented already, and hence contribute to Type II errors. The single refusing subject in the present study supports such an assumption, in that the electricity use for that unit was higher and more variable than that of consenting subjects. Participant data were very comparable to the 80-unit average, providing evidence for the external validity of the present study. But to the extent that there are other relevant differences between volunteers and nonvolunteers, external as well as internal validity will suffer. Research is needed on the extent of such differences before widespread dissemination of experimentally validated procedures can be successful.

The monitoring of use does not appear to produce long-term effects by itself. The initial reactivity of monitoring should be considered in designing and interpreting the data of subsequent studies, however. The surreptitious monitoring of subjects before approaching them is ethically discomfiting and generally to be avoided. However, each of the families in the present study was told of the covert monitoring and the need for it in the postexperiment interview, and none objected to its collection or use.

Subject families described a variety of ways in which they attempted to reduce energy use, including the following: used only one TV set, turned down refrigerator within safe limits, turned out lights, used battery-operated radio, left burned-out light bulbs in multiple-bulb fixtures, did not use ventilation fans as often, opened refrigerator door less frequently, used single lamp for reading rather than overhead multiple-bulb room light, had children stay in living room to study and left bedroom dark, ironed clothes in larger batches, and cooked big roasts less often. Thus, the large reductions achieved by the present subjects probably required changing many of their typical behaviors, since consumption could not be reduced by simply turning down the thermostat or showering less often.

The experimental analysis of energy consumption is a difficult but important area. In contrast to some other environmentally relevant behaviors such as littering, the behavior of energy consumption may require many studies before it is fully analyzed. This is so because there is a multiplicity of behaviors involved and a large number of settings, populations, and forms of energy to be analyzed. It seems unlikely that a few very general procedures will emerge. Rather, many different strategies may need to be developed to solve this critical problem.

REFERENCES

Chapman, C. and Risley, T. R. Anti-litter procedures in an urban high-density area. *Journal of Applied Behavior Analysis*, 1974, **7**, 377-384.

Everett, P., Haywood S., and Meyers, A. The effects of a token reinforcement procedure on bus ridership. *Journal of Applied Behavior Analysis*, 1974, **7**, 1-10.

Hayes, S. C. and Cone, J. D. Decelerating environmentally destructive lawn-walking behavior. *Environment and Behavior*, (*in press*).

Hayes, S. C., Johnson, V. S., and Cone, J. D. The marked item technique: a practical procedure for litter control. *Journal of Applied Behavior Analysis*, 1975, **8**, 381-386.

Jurgen, R. F. Energy conservation: What to tell your neighbors. *IEEE Spectrum*, 1974, June, 61-65.

Kohlenberg, R., Phillips, T., and Proctor, W. A behavioral analysis of peaking in residential electrical energy consumption. *Journal of Applied Behavior Analysis*, 1976, **9**, 13-18.

Palmer, M. H., Lloyd, M. E., and Lloyd, K. E. An experimental analysis of electricity conservation procedures. *Journal of Applied Behavior Analysis*, (*in press*).

Reid, D. H., Luyben, P. L., Rawers, R. J., and Bailey, J. S. The effects of prompting and proximity of containers on newspaper recycling behavior. *Environment and Behavior*, 1976, **8**, 471-482.

Seaver, W. B. and Patterson, A. H. Decreasing fuel oil consumption through feedback and social commendation. *Journal of Applied Behavior Analysis*, 1976, **9**, 147-152.

Winett, R. A. Efforts to disseminate a behavioral approach to energy conservation. *Professional Psychology*, 1976, **7**, 222-228.

Winett, R. A. and Nietzel, M. T. Behavioral ecology: Contingency management of consumer energy use. *American Journal of Community Psychology*, 1975, **3**, 123-133.

Received 10 July 1975.
(*Final acceptance 18 November 1976.*)