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DECREASING FUEL-OIL CONSUMPTION THROUGH FEEDBACK AND SOCIAL COMMENDATION[1]

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The energy crisis of the winter of 1973-74 led to severe shortages of fuel oil for home heating and a government request for voluntary conservation by the oil consumer. This experiment tested two methods of facilitating fuel-oil conservation. Home fuel-oil consumers were randomly assigned to one of three experimental groups: feedback of information on rate of oil use, feedback plus commendation for reduced consumption, or a no-treatment control. The consumption rate for the feedback plus commendation group was significantly lower than that of either the informational feedback group or the control group. The informational feedback group did not differ from the control group. The results suggest that feedback alone may not result in oil conservation, but that feedback combined with commendation can produce socially significant savings.

DESCRIPTORS: fuel-oil consumption, commendation, consumer behavior, feedback, recording, measurement, humans

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One aspect of the energy crisis of the winter of 1973-74 was the severe shortage of fuel oil for heating homes, especially in the Eastern United States. One official federal policy for dealing with the shortage was to request homeowners to turn down their thermostats six degrees to reduce oil consumption. This policy of requesting conservation by the consumer has been continued by the government and has been applied to all areas of energy consumption (Peterson, 1974).

However, the federal government has offered no formal plan of action, no sanctions or incentives other than price increases, to encourage conservation by the consumer. Rather, the thrust of the policy has been to inform consumers about the importance of saving energy and methods for achieving savings. This may lead to better informed consumers and to more favorable attitudes toward the conservation of energy, but is not likely in the short term to lead to effective behavior change. Research has shown that it is easier for people to hold environmentally beneficial attitudes than to behave in environmentally beneficial ways (Bickman, 1973; Swan, 1972), and this is consistent with the generally low correspondence between verbal attitude statements and overt behavior (Wicker, 1969). A study by Heberling (Note 1) of the electricity consumption of apartment dwellers indicated that the informational campaign of the federal government had no effect on the amount of electricity consumed. Further, it showed that a letter sent directly to apartment dwellers from a group advocating conservation had no effect on consumption. It is unlikely, therefore, that an informational campaign alone can successfully reduce energy consumption in the long run. What is needed is

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a program aimed at changing consumers' behavior.

Recent research has demonstrated that operant techniques can be used to modify environmentally relevant behaviors. These have included such behaviors as decreasing littering (Burgess, Clark, and Hendee, 1971; Clark, Burgess, and Hendee, 1972; Kohlenberg and Phillips, 1973), increasing litter removal (Chapman and Risley, 1974; Powers, Osborne, and Anderson, 1973), increasing bus riding (Everett, Hayward, and Meyers, 1974), and decreasing noise level in dormitories (Meyers, Note 2).

Another principle that could be applied to the reduction of fuel-oil consumption is that informational feedback facilitates behavior change (Mischel, 1968). According to this principle, a person is best able to alter his behavior when he has specific knowledge of the consequences of his behavior. Because of the way fuel oil is purchased and used, it is hard for a homeowner to know the consequences of his attempts to save fuel. Large and infrequent deliveries, variable weather conditions, automatic oil burners, and variations in the use of the home from year to year make it difficult for the consumer to monitor and evaluate the results of his conservation attempts. This difficulty is compounded by monthly billing at fluctuating prices, which makes expenditures a poor index of success or failure in any attempts to conserve fuel.

The present study examined the short-term effects of feedback and commendation on the conservation of fuel oil as a first step in the development of strategies for altering consumption patterns in the long term. It was hypothesized that providing specific information to consumers about their oil use would lead to lower oil consumption. It was further hypothesized that commending consumers who reduced their consumption, in addition to sending them informational feedback, would lead to greater conservation of fuel oil than would informational feedback alone.

METHOD

Subjects

A sample of 180 households was drawn randomly from the list of continuing accounts of a local fuel-oil distributor. Households were not included in the sample if they had been continuing customers for less than 1 yr, if they had changed address within the year, or if their oil tanks had capacities over 300 gallons, requiring only infrequent deliveries. The fuel-oil customers served by this distributor live in a university community situated in central Pennsylvania, and in nearby small towns and rural areas.

Design and Procedure

The experiment used a randomized treatments-by-blocks design with three levels of the feedback treatment (no-feedback control, informational feedback, and informational feedback plus commendation). To control for differences among homes in size, insulation, use patterns, furnace efficiency, age, *etc.,* households were assigned to blocks according to their oil consumption in the January to May period the previous year. To do this, the number of gallons of oil consumed by each household in that period was divided by the number of degree-days during the period to obtain a rate expressed as gallons per degree-day.[2] Households were ranked by consumption rate and were divided into 20 blocks of nine households having similar consumption rates. Within blocks, households were assigned randomly to the three treatment conditions, three to each condition for a total of 60 households in each condition.

The study was conducted from February through May 1974, during an acute oil shortage. The federal government had requested all

[2]Cumulative degree-days are an index of the coldness of the weather during a period and are computed by subtracting the mean temperature for each day from 65 degrees and summing the difference across days. In the present study, degree-days were computed from a base of 70 degrees in keeping with the practice of the distributor.

households to turn down their thermostats six degrees, and, according to the cooperating distributor, most households were using less oil than usual at the time the study began. Two consecutive oil deliveries to each sample household were monitored, and the gallonage recorded. The first delivery was used to compute information for feedback to consumers. The second delivery was used to compute the consumption rate in the period following the experimental treatment and served as the dependent variable.

The distributor normally mails each customer a delivery ticket after each delivery stating the number of gallons delivered, the price, and the amount due. In the experimental samples, delivery tickets for each household were accompanied by specially prepared feedback slips providing additional information. A sample feedback slip is shown in Figure 1. In addition to an explanation of the consumption rate, the slip provided three kinds of information: rate of use during the current delivery period and during a similar period the previous winter, per cent increase or decrease in consumption rate, and the resulting dollar savings or loss compared to what the customer would have paid if he had continued to use oil at the previous year's rate. This information was computed from the gallonage on the delivery ticket and the cumulative degree-days since the previous delivery.

In the feedback plus commendation condition, those households that had reduced their rate of consumption compared to the previous winter received in addition to the feedback slip a white 7.5 by 7.5 cm press-on decal with the words "WE ARE SAVING OIL", printed in red block letters. The decal was accompanied by a small explanatory note. A sample decal and note are shown in Figure 2.

The no-feedback control group received only the normal delivery ticket from the distributor. Data on the fuel consumption of these households were collected during the study.

RESULTS

Of the 180 households in the original sample, 58 were lost from the study due to termination of accounts (changed distributors, died, moved out of town), change of residence, or failure to

NAME _____ DELIVERY PERIOD _____ to _____
_____ GALLONS OF FUEL OIL USED THIS PERIOD

The "RATE" below is your rate of fuel oil consumption in terms of gallons per degree-day unit. Because degree-days are a measure of how cold it has been during the delivery period, the rate indicates your average oil use, taking the weather into account. The less oil you use, the lower your rate of use will be.

RATE OF USE THIS PERIOD _____ GALLONS PER DEGREE-DAY

RATE OF USE LAST WINTER _____ GALLONS PER DEGREE-DAY

This represents a _____% increase decrease in your rate of use from last year. At the present price of fuel oil, this results in a $_____ savings loss from what you would have paid if you had continued using oil at your last year's rate.

Fig. 1. A sample feedback slip.

During the last delivery period your rate of fuel oil consumption was lower than that of last year. Because of your savings, we are enclosing this decal.

Fig. 2. A decal and explanatory note.

receive two deliveries within the period of the study. This loss of households required the combining of four pairs of adjacent blocks to eliminate empty cells from the experimental design. Complete data were obtained from 42 households in the control condition, 35 in the informational feedback condition, and 45 in the feedback plus reward condition.

Of the 60 households originally assigned to the feedback plus commendation condition, three did not receive an initial delivery during the study and were dropped. Of the remaining 57, 43 (75%) had reduced consumption compared to the previous winter and received the decal. The remaining households in this condition received feedback slips only.

The rate of fuel-oil consumption during the delivery period following feedback (or the corresponding period for the control group) was computed for each household, and mean rates were computed for each group. The mean consumption rates were for the control group, 0.146 gallons per degree-day; for the informational feedback group, 0.143; and for the feedback plus commendation group, 0.129. In response to the oil crisis, all three groups had reduced consumption from their 1973 rates, which had been respectively, 0.160, 0.173, and 0.165. To make sure that these randomly constituted groups did not differ initially, an analysis of variance was performed on the 1973 rates. The results indicated no significant differences among these rates ($F = 0.85$, $p = 0.43$).

To test the experimental hypotheses, an unweighted means analysis of variance was computed on the 1974 consumption rates. This analysis is summarized in Table 1. The effect of feedback conditions was statistically significant ($p < 0.01$). To interpret this effect, a multiple comparisons test was performed on the condition means using Tukey's WSD technique (Kirk, 1968, pp. 88-90). This test showed that the consumption rate for the feedback plus commendation group was significantly ($p < 0.01$) lower than that of either the control group or the informational feedback group. The informational feedback group did not differ from the control group. There was no significant conditions-by-blocks interaction, which indicates that the effectiveness of the feedback and commendation did not depend on the baseline consumption rates of the households.

To assess the magnitude of the obtained effect of feedback and commendation, a 95% confidence interval was computed for the difference between the rates of the control group and the feedback plus commendation group. Table 2 shows the savings in gallons and in dollars experienced by a hypothetical average household in the feedback plus commendation condition from March 1 to April 30 during this study. Savings were computed at the obtained

Table 1

Analysis of Variance of Fuel-Oil Consumption

Source	*df*	*MS*	*F*
Feedback conditions (A)	2	0.0031	6.08*
Blocks (B)	15	0.0078	15.27*
A × B	30	0.0005	0.93

*$p < 0.01$

mean difference and at the lower and upper limits of the difference. In addition, Table 2 shows the total gallons that could have been saved by a distributor with 5000 customers during these two months of the heating season. These savings were computed to show the practical significance of the obtained effect. Dollar savings per household were computed assuming fuel oil costs $0.35 per gallon. These savings, even if interpreted conservatively, are of substantial magnitude.

Table 2

Fuel-Oil Savings from March 1 to April 30

	Gallons per Household	*Savings per Household*[a]	*Gallons per Distributor*[b]
Maximum Savings[c]	52	$18.20	260,000
Observed Savings	31	$10.85	155,000
Minimum Savings[c]	10	$ 3.50	50,000

[a]Assuming fuel-oil costs $0.35 per gallon

[b]Based on a moderate size distributor serving 5000 households

[c]Based on upper and lower limits of 95% confidence interval around observed savings

DISCUSSION

The results demonstrate that the short-term fuel-oil consumption of households can be affected by an operant technique. As hypothesized, fuel-oil consumption was significantly reduced by a program of informational feedback coupled with a small decal for households that had reduced consumption. The hypothesis that informational feedback alone would reduce consumption was not supported by the data.

The decal used as a reward in this study had little practical utility for consumers, but it represented a social recognition of their efforts to save oil. The effectiveness of this decal probably depended on a pre-existing public acceptance of the desirability of conserving energy and knowledge of how to save oil. In the absence of this commendation, the informational feedback did not lead to significant oil savings.

The relationship in time between conservation behaviors and commendation was protracted. The effectiveness of this procedure depended on the subjects' perceiving the relationship between this social recognition and their conservation behaviors of up to four weeks earlier. If oil deliveries, and hence opportunities for commendation, had been more frequent, the effect of the procedure might have been even greater. In addition, the contingencies for receipt of a commending decal were not known by the subjects in advance. Their first knowledge that their consumption was being monitored was on their receipt of the feedback and decal. A stronger procedure would have been to notify each sample household of its target consumption rate and the reward contingent on achieving the target rate.

In a between-groups design such as used in this study, it is necessary to retain all subjects in their randomly assigned conditions whether or not they actually receive the experimental treatment. In this study, receiving the reward was contingent on the households already having reduced consumption. Twenty-five per cent of the households in the feedback plus commendation condition did not qualify for the decal. The effect of their being included in the analysis was probably to reduce the difference between the mean consumption rates of the feedback plus commendation group and the other two groups. This leads to a probable underestimate of treatment effects, but does not pose problems for the interpretation of the obtained effects.

While this study demonstrated the effectiveness of feedback combined with commendation for maintaining conservation behaviors over a relatively short time period, further research is needed to study the maintenance of conservation behavior over longer periods of time. Further, techniques for shaping behavior to reduce oil consumption should be examined. In light of the expected continued shortage of energy sources, results of such research can provide meaningful input to national energy policy.

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