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A PARAMETRIC ANALYSIS OF PROMPTING PROCEDURES TO ENCOURAGE ELECTRICAL ENERGY CONSERVATION

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ABSTRACT

Prompting procedures frequently have been used to promote energy conservation. Very little is known about the parametric effects of variables associated with prompts, however, as most research has compared prompt and no-prompt conditions. In this research the parametric effects of frequency of prompts were examined. Five groups of college faculty received 1, 2, 3, 4, and 7 prompts, respectively, to turn off lights after classes. The data show that groups which received two or more prompts were more responsive than the group which received one prompt, but were not different from each other. Relating to other research, these results support the view that timing of prompts is more important than frequency. Needs for future research are outlined.

Government, utilities and private interest groups rely heavily on the use of cognitive and affective appeals to encourage energy conservation. Frequently, such appeals involve providing information (e.g., "55 Save Lives") or are directed toward a sense of community spirit (e.g., "Give a Hoot, Don't Pollute").

Given the cost of such campaigns, it is necessary to determine the conditions under which such approaches are likely to be effective. With that information, it should be possible to design an optimal approach to solve a particular problem.

Cognitive and affective appeals are prompts. Prompts are antecendent stimuli designed to evoke a response in a situation in which a response otherwise is not likely to occur [1-3]. Examples of prompts include brochures, notices, stickers, flyers, billboards, radio and television "spots" and other reminders of all kinds.

Although prompts frequently are used with planned consequences, generally known as incentives, reinforcers or rewards, prompts often are used alone. In the simplest case, citizens are urged to change their lifestyle to save energy. The

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general question addressed here is under what conditions are prompts without differential consequences likely to effectively alter energy related behavior.

It is difficult to answer this question directly because in many of the studies in which prompts have been used, differential consequences (i.e., feedback, rewards or sanctions) also have been employed [4-8]. However, some research exists which indicates that prompts can be effective in reducing energy use.

In one study in a residential neighborhood, several procedures, including a prompt procedure, were used to motivate homeowners to reduce energy consumption [9]. The prompt consisted of an eight page energy conservation manual which was distributed to fifteen volunteer homeowners. The results showed that the homeowners used 8 percent less electricity after the prompt was delivered than they had used during baseline. These results indicate that the prompts had a weak effect. However, this conclusion is weakened by the fact that the homeowners were given an energy use recording form on which they could monitor their own energy use. The role of the prompt is somewhat ambiguous, therefore, because of confounding with the self-recording form.

Another study used two prompting procedures to reduce residential electricity consumption [10]. In one condition a series of typed messages which urged conservation were taped to the inside of the storm door, while in the other condition the residents received a letter from the Director of the Iowa Office of Energy. The results showed small reductions in electrical energy use with both procedures.

Other researchers have sought to reduce energy use in college settings. In a study in ten men's rooms, posters were placed adjacent to the wall switch, asking users to turn off the lights when leaving the room [11]. The results showed reductions in lighting use ranging from 46 to 63 percent of baseline rates.

Posters have been used to prompt users to turn off lights in a college classroom as well [2]. In that study Winett first obtained data in an experimental classroom when no prompts to conserve were present (baseline). Subsequently, a small sign was placed over the light switch for one week. During the following week a sticker was placed over the light switch. Finally, one and then three larger posters were placed in the room during the final two weeks of the study, respectively. The results showed virtually no reduction in lighting when the small sign and sticker were present, but a 55 percent reduction when the large posters were present.

A recent study in college classrooms also used posters to reduce lighting use. A multiple baseline design was used with two groups of classrooms [12]. The results showed decreases from 44 percent and 34 percent during baseline to 25 percent and 12 percent in the two groups respectively, after the posters were installed.

These three studies are significant because of the large reductions in lighting use which were achieved and because the use of posters is widely applicable, at least in principle. A serious disadvantage of this approach, however, is the relatively high cost and inefficiency of the strategy. The inefficiency arises from the fact that many college classrooms are unscheduled during some periods of the day, but are left with the lights burning [13, 14]. While the posters in both Winett's [2] and Zolik *et al.*'s [12] studies were directed at lighting use at the end of the day, a better procedure would be to tailor the poster to each individual room and to prompt users to turn off lights prior to any unscheduled period.

In addition, poster board is quite expensive. If posters were used in all classrooms, and if they presented individual messages pertaining to the hours in which a particular classroom was unscheduled, they would be costly to construct, mount, update and repair.

A procedure which is less costly and therefore likely to have more practical utility was described by Luyben in two studies which led directly to the present research. The first experiment was conducted in ten classrooms selected because lights frequently were found to be left on during unscheduled class periods in baseline [13]. The intervention consisted of a letter which, sent to professors and signed by the president of the college, asked professors to turn off lights following their classes. The results showed a 39 percent increase in the number of class periods in which lights were turned off.

While the procedure used in the study cited above was effective, it still required the president's signature and individual letters, and thus was fairly costly. The second study was designed to be less expensive and to more closely approximate conditions which could be expected if the program were routinely administered.

In the second study, two groups of randomly selected subjects (*n*'s equal to 28 and 27, respectively) were used in a multiple baseline design [14]. In contrast to the previous study, the prompt consisted of a letter signed by a faculty peer rather than by the president. The first group received the letter after five weeks of baseline, while the second group was prompted three weeks later. The results showed that the overall percentages of lights turned off increased by 13 and 6 percent for the two groups, respectively, and that a 30 percent increase was obtained for the ten classrooms which had the lowest baseline rates (the "worst cases").

These studies indicate that prompts have reduced energy use. Two limitations of these studies warrant comment, however. First, in all of them the experimental conditions were implemented under the close and watchful eye of the researcher who had a vested interest in the conduct of the study. The problem is that while such a procedure is an excellent way to test an experimental variable, it may not closely resemble the real world conditions which would exist if the procedure were implemented by persons for whom this is just another task to be finished in a working day.

Second, most of the studies compared prompt to no-prompt conditions, and only one of them (Winett's classroom study) provided direct evidence of the parametric effects of variables associated with the use of the prompts. More specifically, what are the effects of color, size, design or "intensity" on the effectiveness of prompts? How often should they be presented? Is the wording of the message critical? As yet, very little of the research on the effectiveness of prompts in energy conservation has addressed these problems.

The purpose of this research was twofold. The primary goal was to assess the effects of different frequencies of prompts on energy conservation in college classrooms. Since the frequency of prompts is highly correlated with the cost of prompting procedures (particularly if the prompts are tailored to individual but changing situations such as room schedules), data of this sort are essential to provide a basis for cost/benefit analyses. It was hypothesized that subjects who received frequent reminders to turn off lights would show a greater increase in the percentage of class periods with lights turned off than those who received fewer reminders, and that the degree to which lights were turned off would correlate positively with the number of prompts received.

A second purpose of this research was to simulate as nearly as possible conditions which would exist if the prompt procedure were routinely administered by the local registrar's office. This aspect was considered vital to establish the social and programmatic validity of the findings.

METHOD

Setting and Observation Procedure

Observations of classrooms were conducted in seven academic buildings between 10 a.m. and 5 p.m. on weekdays. Starting at 5 minutes past the beginning of each class hour, observers circulated through each building on a 15 minute cycle, recording whether lights were left on or were turned off in unscheduled classrooms, and also recording if unscheduled classrooms were occupied. The specific observation periods were determined by the schedules of participating observers.

A total of 125 target observation periods were identified from the room use schedule maintained by the registrar's office. A target observation period was defined as unscheduled class periods which immediately followed a scheduled class. It was assumed that lights which were found to be on during the beginning of a target observation period had been left on by the class which had used the room during the preceding period. (This assumption was probably correct most of the time.)

Reliability

Eighteen reliability checks were made in which a second observer independently recorded the status of lights in each unscheduled room.

Percentage reliability was computed using the ratio, agreement/agreements and disagreements X 100. Perfect agreement was obtained on fifteen of the checks, with better than 90 percent agreement on the remaining checks.

Experimental Procedure

A short notice was attached to enrollment lists and, in some cases, also was mailed to professors who taught classes in the room during the period preceding a target observation period. In the note the professor was informed that the classroom was unscheduled after his class and was asked to turn off the lights following his class. The classroom(s) and time(s) for which the request was made was specifically identified.

It should be noted that the list of target observation periods was based solely on the registrar's room use schedule. The use of this list and the distribution of notices with the class lists was specifically designed to simulate as closely as possible a procedure which could be used by the registrar's office on a continuing basis. Since the room use schedule was used to construct the master schedule, and was continuously updated, it was assumed that this strategy would be the most practicable approach, even though it was known that some errors in identification of faculty would occur. (Some faculty change rooms without notifying the registrar's office). It was reasoned that conducting the study in this way would provide the most valid indicator of the actual effectiveness of such a prompting procedure, even though it results in some loss of experimental control.

Experimental Design

The classes which preceded the 125 target observation periods were assigned randomly without replacement to one of five groups, with the restriction that no professor teaching such a class could be represented in more than one group. The resulting *n*'s for the five groups were 25, 26, 24, 28 and 22 classes, respectively.

The groups differed in the number of prompts which were sent to the professor who taught in that room during the preceding period. The professors in each of the five groups received one, two, three, four or seven reminders at successive two week intervals throughout the semester. The first prompt was attached to the first permanent class roster. Subsequent prompts (for groups 2, 3, 4, and 7) were delivered through the campus mail except for one prompt which was attached to the mid-semester grade report.

RESULTS

The primary data of the study are the percentages of occasions when lights were turned off in target observation periods over successive weeks. Because the prompts were delivered every two weeks, the data for each group were collapsed across days and are presented as the percentages of lights turned off during successive biweekly intervals. It should be noted that these percentages are generally based on more than 200 observations during each two-week period, although fewer observations were obtained in some intervals due to holidays.

Analysis of the data showed that there were no consistent differences in the data from the groups which received two or more prompts, but that there were clear and consistent differences between the single prompt group and the multiple prompt groups. Figure 1 shows this relationship.

Because a presentation of the individual data for all groups is both confusing and uninformative, the data shown in Figure 1 have been simplified by collapsing across the multiple prompt groups and contrasting the resulting percentages with the data from the single prompt group. In Figure 1, therefore, the open circles represent the overall percentages of occasions when lights were left on in all multiple prompt groups during successive biweekly intervals, while the closed circles represent the corresponding data from the single prompt group. The bracket enclosing each open circle represents the range of the data for the four multiple prompt groups.

A breakdown of the data shown in Figure 1 is presented by groups across biweekly intervals in Table 1. The collective percentages of lights turned on for the multiple prompt group are included also.

Figure 1 shows that, beginning with the second biweekly interval and corresponding to the delivery of the second prompt, there is a clear separation in the data from the multiple prompt groups and the single prompt group. Also, inspection of the ranges within the multiple prompt data indicates that there was only one instance of overlap with the data from the single prompt group. The data in Table 1 show that the overlap is due entirely to the low performance of the four prompt group during the sixth biweekly interval.

Analysis of trends and means indicates that the multiple prompt groups showed an increasing trend in the percentages of lights turned off, eventually stabilizing at about 80 percent from an initial overall level of 68 percent. In contrast, the data from the single prompt group were quite stable around 69 percent for the first ten weeks of the study. Surprisingly, this group showed a fairly abrupt increase in the last two intervals, terminating at a high point at 76 percent.

DISCUSSION

The results show clearly that the multiple prompt procedure produced a higher percentage of lights turned off than did the single prompt procedure. Further, the higher percentage was sustained for twelve weeks. There is no basis, however, for distinguishing between the multiple prompt groups; providing two notices was equally as effective as three, four or seven. On this basis, one

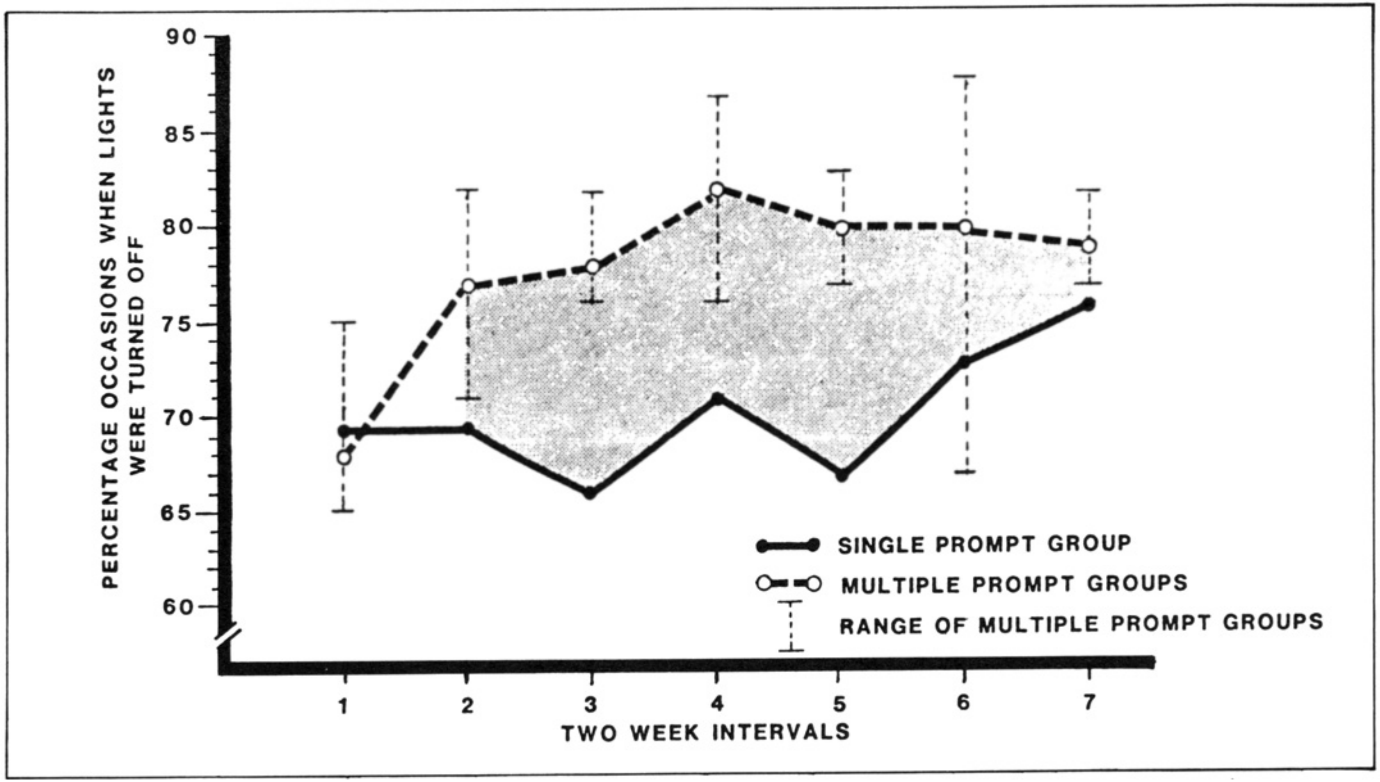

Figure 1. The percentages of occasions when lights were turned off are shown for the single prompt group and the combined multiple prompt groups across successive two week intervals. The brackets indicate the range of the data for the multiple prompt groups during each interval.

Table 1. The Percentages of Occasions when Lights were Turned Off by Group across Biweekly Intervals during the Semester

	Biweekly Intervals						
Group	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1	69 (68)	69 (77)	66 (78)	71 (82)	67 (80)	73 (80)	76 (79)[a]
2	68	80	78	87	77	88	82
3	75	76	82	76	80	89	81
4	65	71	76	75	83	67	78
7	67	82	77	85	79	75	77

[a]The numbers in parentheses are the collective percentages of occasions when lights were turned off across groups 2, 3, 4, and 7 across successive two week intervals.

might recommend that two prompts be used in a campus-wide program to encourage energy conservation in classrooms. However, a comparison of the data from this study and from the preceding study [13] leads to some interesting problems, undermining such a recommendation.

One observation is that the unprompted baseline rates of the two groups in the previous study were 67 and 70 percent, respectively, while in the present study the first data points for the combined multiple prompts and single prompt groups (when all groups had received just one notice) were 68 and 69 percent, respectively. These sets of data are virtually identical, even though the groups in this study had been prompted while the groups in the previous study had not. A second observation is that the multiple prompt group in this study showed a mean increase to 80 percent after the second and subsequent prompts were added, whereas the first group in the previous study achieved the same level after it had received a single prompt five weeks into the semester (or about three weeks later than in the present study). In this comparison the levels achieved were identical, even though the numbers of prompts given were different.

A probable explanation for these findings is that the initial notices in the present study were functionally neutral stimuli; i.e., this phase was comparable to baseline in the previous study. This would account for the equivalent initial rates in the two studies. In the multiple prompt groups of the present study, furthermore, it seems likely that the second prompt was the functional stimulus and was equivalent to the single prompt given to the first group in the previous study; that is, the prompts which were delivered two or five weeks into the semester were the functional stimuli in the two studies.

A reasonable conclusion is that only one prompt is necessary but that the timing of the prompt is important. Prompts delivered early in the semester appear to be ineffective, probably due to the large number of notices, announcements, etc. which are distributed at that time. In contrast, those delivered after two or three weeks appear to be effective. This conclusion appears to disconfirm a hypothesis offered in the previous study in which it was suggested that prompts delivered at the beginning of the semester would be more effective than prompts delivered later. Further it is likely, for reasons given in the previous paper, that there comes a point after which prompts are ineffective as well. The optimal schedule has yet to be determined.

The optimal procedure has not yet been established either. In both studies the maximum mean percentage of lights turned out was surprisingly constant at 80 percent. Part of the reason for this less than perfect percentage is that misidentifications of professors occurred (e.g., some professors did not teach in the rooms and/or at the times indicated in the room use schedule). Consequently, while the intent was to simulate normal implementation practices, it is important to find ways to improve these procedures to minimize misidentification errors as much as possible and thus to maximize the efficiency of the procedures.

Before concluding, two anomalies in the present data should be mentioned. It is observed that while the range in the multiple prompt groups is fairly compact and consistent for intervals 2, 3, 4, 5, and 7 there is a very large spread during the sixth two week interval. Inspection of the data from individual groups shows that two groups achieved their lowest levels at this time. No explanation is offered for these differences.

More puzzling is the abrupt increase in the data from the single prompt group during the last two intervals. Two explanations are suggested. One is that the effect may be due to shorter daylight hours during the last four weeks of the semester. The contrast between the darkness outside and the lighted interiors may have made the fact that lights were left on more noticeable. Another explanation may be that a greater proportion of rooms were occupied by students studying for exams. Because it seems likely that individuals or small groups would be more likely to turn off lights than individuals in large groups (due to the phenomenon of diffusion of responsibility suggested by Darley and Latane [15], this effect could be due to increased use of the rooms by individuals and resultant increases in the proportion of lights turned off. No clear explanations for this anomaly has been found, however.

In conclusion, the data from this study and Luyben's earlier research, taken together, provide no evidence that the frequency of prompts is an important variable in energy conservation research [13]. Here, there was no difference whether professors received two, three, four or seven reminders. Although multiple reminders were more effective than a single prompt in this study, they were not more effective than the single reminder used in the previous study [14]. The difference is in the *timing* of the prompt. In this study the prompt was given very early in the semester and had to compete with many other stimuli. The initial prompt in the previous study, and the second prompt in this study, were both delivered later in the semester when there were fewer competing demands. It thus appears that *timing* is more important than *frequency* in prompting energy conservation.

The generality of this statement is not known at the present time, in the absence of other parametric data on the effects of frequency of prompting. However, it should be noted that the prompts used in this study were remote (i.e., displaced in both time and location) from the target response. It may be that timing is particularly critical under these conditions.

This research represents one of very few studies to examine the parametric effects of variables associated with prompt procedures. Most research has compared prompt and non-prompt conditions. Future research should examine other variables concerning prompts, including size, color duration, intensity, and context. With information of this kind, we may learn to maximize the efficiency of prompting procedures and avoid costly and ineffective blind alleys in our efforts to reduce energy use.

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