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THE EFFECTS OF VIDEOTAPE MODELING AND DAILY FEEDBACK ON RESIDENTIAL ELECTRICITY CONSERVATION, HOME TEMPERATURE AND HUMIDITY, PERCEIVED COMFORT, AND CLOTHING WORN: WINTER AND SUMMER

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Two studies were conducted in all-electric townhouses and apartments in the winter (N = 83) and summer (N = 54) to ascertain how energy conservation strategies focusing on thermostat change and set-backs and other low-cost/no-cost approaches would affect overall electricity use and electricity used for heating and cooling, the home thermal environment, the perceived comfort of participants, and clothing that was worn. The studies assessed the effectiveness of videotape modeling programs that demonstrated these conservation strategies when used alone or combined with daily feedback on electricity use. In the winter, the results indicated that videotape modeling and/or feedback were effective relative to baseline and to a control group in reducing overall electricity use by about 15% and electricity used for heating by about 25%. Hygrothermographs, which accurately and continuously recorded temperature and humidity in the homes, indicated that participants were able to live with no reported loss in comfort and no change in attire at a mean temperature of about 62°F when home and about 59°F when asleep. The results were highly discrepant with prior laboratory studies indicating comfort at 75°F with the insulation value of the clothing worn by participants in this study. In the summer, a combination of strategies designed to keep a home cool with minimal or no air conditioning, in conjunction with videotape modeling and/or daily feedback, resulted in overall electricity reductions of about 15% with reductions on electricity for cooling of about 34%, but with feedback, and feedback and modeling more effective than modeling alone. Despite these electricity savings, hygrothermograph recordings indicated minimal temperature change in the homes, with no change in perceived comfort or clothing worn. The results are discussed in terms of discrepancies with laboratory studies, optimal combinations of video-media and personal contact to promote behavior change, and energy policies that may be mislabeled as sacrificial and underestimate the effectiveness of conservation strategies such as those investigated in these studies.

DESCRIPTORS: energy conservation, comfort, modeling

In the United States, heating and cooling buildings accounts for about 25% of our total energy expenditures, and about 65% of energy consumption in the residential sector (Stobaugh & Yergin, 1979). Building type and structural characteristics, interior design, type and capacity of the heating and cooling system, and appropriate building retrofits are all factors that influence the energy requirements for heating and cooling homes (U.S. Department of Housing and Urban Development, 1980). In addition, thermal parameters, particularly temperature in a home, markedly affect energy consumption. For exam-

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ple, best estimates are that a 1°F change in a thermostat setting during a 24-h period equals about a 4% to 5% change in energy use in the winter and 7% to 8% change in the summer in a residential setting (Socolow, 1978). Thus, efforts to change thermostat settings in public and private buildings and campaigns to persuade people to modify thermostat settings in their homes can potentially yield substantial energy savings.

A question that is central to efforts to modify thermostat settings is the effect such changes may have on human "comfort." Comfort can be conceptualized functionally within psychological, cognitive, behavioral, and indeed, social-cultural dimensions. For example, after an hour of being sedentary in a 55°F room, a person's skin temperature may decrease. He or she may begin to shiver, have thoughts about being cold, perhaps verbalize this state, and attempt to get warm by raising the thermostat, dressing more warmly, or increasing activity level. Further, all these events are likely to be viewed as aversive, if such thermal conditions are rarely experienced or expected in our society (Winkler & Winett, 1982). Thus, mandating or attempting to persuade people to modify thermostat settings is not likely to be successful if thermostat setting guidelines result in perceived discomfort.

Considerable research, primarily from a series of laboratory studies, has been directed to the identification of the temperature range within which most people are comfortable (ASHRAE, 1977). In these studies, groups of six to eight people have been placed in an environmental chamber for periods of 2-3 h and exposed to different levels of temperature and humidity settings not revealed to participants. Periodically, and anonymously, the participants "voted' using standard scales on their degree of perceived comfort and sensation of warm or cold (Rohles, 1981).

Using these same procedures, clothing requirements at various thermal levels have also been ascertained. Participants have worn garments having a previously verified insulation or "clo" value (Munson & Hayter, 1978). Such experiments have concluded that most people report being comfortable within a temperature range of 73°-75°F when sedentary and wearing moderate amounts of clothing (e.g., pants, shirt, shoes, socks, underwear). Considerable clothing, generally not currently worn or typically in the wardrobe of most people, is reported to be required for comfort at 65°F (Rohles, 1981).

Such studies have been the basis for standards used worldwide (ASHRAE, 1977). While they have, perhaps, identified ideal thermal and clothing requirements, in these studies, comfort is seen as a relatively fixed, static state. As noted above, comfort can also be conceptualized as a term that subsumes more specific and interrelated physiological, cognitive, behavioral, and sociocultural dimensions, each of which may be subject to modification.

Support for this more dynamic position comes from an examination of our own past history, current conditions in other Western countries, and recent behavioral, residential energy conservation studies. For example, in the United States during this century, winter temperatures in building have steadily increased, partly as a result of more efficient heating systems and the availability of cheap energy sources. Concomitantly, the insulation value of clothing worn indoors in the winter has decreased (ASHRAE, 1972). Air conditioning has only become prominently used during the last 20 years in this country, but in many quarters today is viewed as a "necessity." However, other Western countries with similar and higher standards of living use far less heating than the United States and minimal air conditioning (Stobaugh & Yergin, 1979). This comparison suggests that a high standard of living or "quality of life" is not necessarily linked to our current heating or cooling practices, or some relatively absolute comfort zone.

Behavioral studies have indirectly investigated comfort and energy consumption. For example, most behavioral studies have been short-term projects of only about 2-4 mo duration (Winett

& Neale, 1979). Not surprisingly, data from residential studies indicate that the primary conservation strategy adopted was thermostat control (Winett, Kagel, Battalio, & Winkler, 1978; Winett, Neale, & Grier, 1979), not retrofitting. One interesting outcome of these studies, however, has been the finding that reductions in energy consumption achieved during a 4-5 wk intervention period have then been maintained for periods up to several months, until the end of the heating or cooling season (Winett, Neale, & Grier, 1979; Winett, Neale, Williams, Yokley, & Kauder, 1979). In the Winett, Neale, and Grier study investigating the efficacy of different feedback strategies, participants reported a change in thermostat setting of several degrees (F), and such reports were found to be highly correlated with energy savings. One of several possible explanations for maintenance is that participants had adapted to and were now comfortable at the new thermostat settings. At a minimum, the data suggested that thermal conditions in homes could be modified easily.

There is a need for field studies to investigate in a more exact way than prior behavioral studies, and in a more externally valid way than laboratory studies, thermal conditions under which people can live. This paper reports the results of a winter and a summer study. In these studies, more precise information on temperature and humidity was obtained from hygrothermographs placed in participants' homes, while information on perceived comfort was obtained from periodic self-reports from participants. Daily written feedback on energy consumption as effectively used previously (Winett, Neale, & Grier, 1979; Winett, Neale, Williams, Yokley, & Kauder, 1979) was now used to promote conservation of home energy and to ascertain some limits on temperatures participants were able to try in their homes. Videotape programs in which actors within vignettes demonstrated conservation strategies related to heating, cooling, and thermostat control were shown to some participants. The efficacy of this strategy, based on social learning and communications principles (Bandura, 1977), when used alone or with feedback, was also investigated.

Winter conservation/comfort strategies focused on gradual (week-by-week) thermostat change when a home was occupied, thermostat set-backs to 55°-58°F when a home was unoccupied or when participants were sleeping (a recommended ASHRAE procedure; Becky & Nelson, 1981), and the wearing of warmer clothing. In the summer, conservation/comfort strategies focused on gradual (week-by-week) raising of the thermostat when home; turning air conditioning off or to 80°F when asleep or when the home was unoccupied; closing all windows, doors, and shades in the morning; using fans instead of air conditioning in the evening; and several other strategies described below.

METHOD—WINTER

Setting

The winter study was conducted in Blacksburg, Virginia (site of Virginia Tech) in two all-electric townhouse complexes with townhouses randomly assigned to experimental groups across complexes. In Site 1, containing about half the homes in the project, homes were heated by a conventional, General Electric forced-air system with a 24,000 BTU capacity. The 8-yr-old townhouses used fiberglass insulation, R-13 in the walls and floors and R-19 in top ceilings. Site 2 townhouses were 6 yrs old, except for 10 units built within 2 yr of the study. The 6-yr-old townhouses were similarly insulated and heated (a Carrier system) as the homes in Site 1. The 10 newer homes had R-13 wall and floor insulation and R-30 in the attic. Eight of these homes had the same conventional heating systems as the other homes, while two homes had heat pumps. In both sites, homes had neither storm doors or windows, except for the 10 new homes in Site 2 which had specially insulated windows and doors. However, baseline energy consumption or responsiveness to procedures was not related to home site or equipment. According to Becky and Nelson (1981), set-backs are not supposed to be used in the winter with heat pumps. However, the two homes in the study with heat pumps used set-backs and as verified by hygrothermograph readings, showed electricity savings comparable to other homes.

Participants and Recruitment Procedures

All participants were recruited following the same door-to-door methods described in detail in Winett, Neale, and Grier (1979). However, the requirement of periodic form completion was probably responsible for reducing the participation rate to about 58% of potential participants. "Potential participants" was defined as a household that was not planning to move during the course of the project, including the follow-up, or where no resident was chronically ill or deemed at risk (by staff or the resident) because of any condition accompanying old age.

Participants were generally young roommates with only about 10% traditional families represented in the sample. The mean age of participants was 26.2 yr, range 18-56 yr. Participants had a mean gross household income in 1980 dollars of about $13,500, used a mean of 63 kWh of electricity per day (range = 32-124 kWh) during a 3-wk January baseline, for a mean monthly, winter electric bill (at 4¢/kWh) of about $76 (range $38-$150).

About one fourth of participant households were owner-occupied, with all other homes rented. However, all participants paid their own electricity bill, and there were no differences across measures between owners and renters.

Nonvolunteer comparison households. As in prior research (Winett, Neale, & Grier, 1979), households were available that were not willing to participate in the project, but consented to have their outdoor electricity meter read. These 30 households were used as before in the weather correction system (see below) and also as previously done to assess the effects of volunteer status on energy consumption. During the baseline, intervention, and follow-up phases of the study, *t* tests indicated no differences in electricity consumption between the respective nonvolunteer comparison group and the volunteer control group, suggesting that volunteer status alone did not affect electricity consumption.

Assignment to Group and Experimental Design

Groups consisted of a feedback and discussion tape group (N = 16 households), a group receiving information and a modeling tape (N = 16), a feedback and modeling tape group (N = 17), an information and discussion tape group (N = 14), and a control group (N = 20). A 2 × 2 between-group design with a control group was used to provide a control for weather and to assess the individual and interaction effects of feedback and modeling conditions.

After a 3-wk baseline period, households were randomly assigned to groups using a stratified random assignment procedure. In this procedure, all participant households were initially ranked on self-reported thermostat setting when they were home (see below) and then placed in a group through stratified random assignment using 2°F intervals. However, three households assigned to the information & discussion group could not attend meetings due to illness or prior commitments and were assigned to the control group. There were no differences on any measures between these three households and the rest of the control group. Table 1 summarizes the baseline consumption patterns of the groups.

Table 1

Baseline electricity consumption of the winter groups in mean kWh per day.

Group	*N*	*Mean*	*Range*	*SD*
FB & Discuss	16	58.9	33.7-105.3	16.4
Info & Model	16	62.5	31.7- 79.0	14.0
FB & Model	17	67.8	36.0-124.0	22.8
Info & Discuss	14	63.7	43.9- 81.4	13.9
Control	20	63.2	35.0-119.6	20.0
Sample	83	63.3	31.7-124.0	17.8

Methods and Procedures for Feedback and Videotape Programs

All groups attended separate meetings conducted at one of the townhouse complex sites. A mean of two back-up meetings were held for participants who could not attend the original meeting. In this way, at least one person in each household attended a meeting, and in about 90% of appropriate households, meetings were attended by two adults.

All meetings had common elements and procedures, including:

1. They were all conducted by the senior author, lasted about 45 min, discussed the rationale and objectives of the project, had an information-giving format with minimal questions and answers and minimal participant interaction.
2. All participants in meetings received lists showing the exact insulation (clo) value of different items of clothing.
3. Participants in the winter study in the feedback & discussion group, information & model group, feedback & model group, but not the information & discussion group received a thermostat change schedule. The thermostat change schedule was printed on a 3″ × 5″ card and called for a 1°F change per week (for 4 wk) in thermostat setting when participants were home and thermostat set-backs at 55°-58°F when the home was unoccupied or participants were asleep. The thermostat change schedule was tailored to each household's self-reported baseline temperature when participants were home. That is, the first thermostat setting for week 1 when home generally represented a 1°F change from baseline, and set-backs represented a 10°F change from the first home temperature or to a new low of 55°F. Participants were asked to place the thermostat change schedule card over their home thermostat. After the 4-wk period, participants were asked to maintain settings indicated for the last week. Participants were also given a duplicate card in their data-form packet at the end of intervention week 2.
4. All groups received written information indicating that the hygrothermograph in their home, with its window now uncovered (see below), could serve as a way for participants to monitor temperature and humidity in their home.

Thus, "information" for the information & model group and information & discussion group differed by one element: the information & model group received the thermostat change schedule. Meetings and procedures also differed dependent on whether participants in a group were to receive individual feedback on electricity consumption and type of videotape shown.

Individual, written, daily feedback was given for 35 days in the winter, with procedures including weather correction identical to those used previously (Winett, Neale, & Grier, 1979), but with the following differences: (a) no information was provided on predicted cost for electricity for the month; (b) in the meetings, the link between thermostat change and electricity savings was emphasized with feedback noted as a way for participants to ascertain if their thermostat changes had resulted in electricity savings; and (c) a specific reduction goal of 15% was called for in the meetings (Becker, 1978), and participants *signed* a form indicating they would try to reach that goal.

Both videotape programs were about 20 min in length. The discussion tape consisted of a staged interview program involving a male and female couple (each person about 25 yr old) being interviewed by a host in a studio. The couple was portrayed as having special interest and knowledge in energy problems. The discussion in the program followed chapter one of *Energy Future* (Strobaugh & Yergin, 1979) which provides an overview of the seriousness of the energy problem, indicates that most alternatives for new energy sources are in the future, and makes a strong case for conservation. However, at no time in the discussion were specific conservation practices and procedures for the home indicated.

The modeling tape program was videotaped in a townhouse similar to the homes of the participants and used the same actors as the discussion tape. This tape first presented a rationale for saving energy in the home through thermostat control and then through a series of seven vignettes showed common mistakes people make when lowering the thermostat (e.g., not dressing warmer, not using heavier blankets, not preparing friends or children). After each "inappropriate" vignette, there was an appropriate vignette that showed ways of coping with changes in thermostat settings, including dress, extra blankets, and how to deal with uncomfortable friends and children. Emphasis was also repeatedly placed on the importance of thermostat set-backs, and set-backs were demonstrated four times in the different vignettes. In addition, the couple made up their own thermostat change card (using the temperature changes noted above) and placed it over their thermostat. Vignettes also emphasized the positive consequences (dollars saved, better interpersonal interactions, more comfort) accruable from following the program's guidelines. At different points in the tape, summaries were provided by voice-over commentary.

Thus, the discussion and modeling tapes primarily differed in the type of information conveyed and practices demonstrated. Note also that, unlike feedback, videotape interventions were singular and not repetitious.

Dependent Measures

Electricity. During the 3-wk baseline periods and 5-wk intervention period, outdoor electricity meters were read every day at approximately the same time each day by a staff person, yielding a kWh use for each household for each day. The meter reading forms were the same as used previously (Winett, Neale, & Grier, 1979), and as before only one reliability check on 15 readings was performed, with an agreement of 100%. During follow-up periods, meters were read weekly.

Temperature and humidity. Hygrothermographs (Model 5020, Weathertronics) were used to assess temperature and humidity continually. The instrument is 12.5″ l × 11.5″ H × 6″ W and weighs approximately 10 lbs. The hygrothermograph prints temperature and humidity readings on a graph that rotates on a cylinder. The cylinder rotates via a winding mechanism that must be rewound approximately every 8 days. Prior to placement in homes, the humidity arm on the hygrothermograph was calibrated to match a humidity reader (Bacharach Instrument Company, Model 22-7059). The temperature arm was calibrated to match a Taylor thermometer (Model 6075-1) accurate to ±2°F. Once calibrated, the hygrothermograph is accurate to ±1% for both temperature and relative humidity.

On the first day of baseline, hygrothermographs were placed in 49 homes. In virtually every home, it was possible to place the hygrothermograph several feet from the one thermostat in each home and at tabletop height. During the baseline period, the glass window through which the graph could be seen was covered with cardboard. During the intervention and follow-up periods, the cardboard was removed. Participants were instructed not to move, open, or in any way adjust the hygrothermograph.

During data retrieval procedures (described below), hygrothermographs were checked each week, a new graph was installed, and the instrument rewound. At that time the temperature calibration was checked by a staff person against a Taylor thermometer (Model 6075-1). Approximately 830 checks were made with only five instances of recalibration noted by staff people, with a recalibration made if the hygrothermograph disagreed with the thermometer by ±2°F. Because of the expense involved in humidity calibration (the humidity reader costs about $150), humidity checks were done by visual inspection (i.e., noticeable wide variations or inexplicable trends in the humidity readings). This resulted in four instances of humidity recalibration. Thus, hygrothermographs apparently reliably assessed temperature and humidity.

Hygrothermographs were randomly assigned to about two thirds of the homes in the feedback & discussion, information & model, and feedback & model groups and to about one-half of the information & discussion and control groups. The rationale for this distribution was to put more of the hygrothermographs in homes where it was expected that thermal changes would occur. However, there was no statistical difference in baseline, intervention, or follow-up kWh use or self-reported temperature in homes with or without hygrothermographs within each group. Placement of a hygrothermograph in a home, thus, did not appear to affect the thermal environment or electricity consumption.

Table 2 shows the mean baseline temperatures in the homes during three designated times. The reason for noting these times will be discussed later.

Comfort. Perceived comfort and sensation were assessed using 9-point scales (with "comfortable" or "neutral" sensation at point 5) used in prior comfort research (Rohles, 1981). All adult participants were requested to complete three scales at three standard times in a week (Tuesday and Thursday evenings and Sunday afternoon) during baseline and intervention phases, and once per week (Sunday afternoon) during follow-up.

Clothing. The clo value of the clothing worn by adult participants was assessed by a clothing checklist to be completed at the same time and on the same schedule as the comfort scales. The checklist, different for men and women, consisted of about 30 items. During the baseline period, the clo value of each item was not indicated, whereas during the intervention and follow-up phases, the clo value was noted on all checklists except those completed by the control groups.

Each data-retrieval staff person was given a designated person in each home on whom to perform a clothing reliability check. This was done when the hygrothermograph was being checked and consisted of having the staff person check off the visible clothing items worn by the designated participant. Reliability between the data retriever's and the participant's form was later checked by a staff person. Counting all items noted by the participant, but not by the data retriever, or items noted by the data retriever, but not by the participant, as diagreements, there was a total of 1,800 items noted in which there was agreement or disagreement noted, with 1,439 items scored as agreements (80%). Note also that a participant could change apparel between completing a form and being checked by the data retriever, thus providing a source of disagreement.

Other measures. Other forms were used to assess self-reports on thermostat settings during different times in a day, where people spent time in their home, several attitudinal indices, a weekly self-report on health, ratings of the videotape programs by participants after their viewing, and follow-up evaluations by partici-

Table 2

Baseline mean winter temperatures in degrees Fahrenheit from hygrothermograph readings.

Group	*N*	*6 AM*	*Range*	*SD*	*12 noon*	*Range*	*SD*	*8 PM*	*Range*	*SD*
FB & Discuss	11	63.0	51.3-67.5	4.8	64.3	55.9-68.5	3.7	64.7	58.1-68.5	3.4
Info & Model	9	63.7	59.1-69.8	3.6	64.0	59.3-69.0	3.5	65.0	59.5-70.1	3.8
FB & Model	11	63.3	57.8-67.5	2.8	63.7	58.8-68.3	2.9	64.7	59.7-69.4	2.8
Info & Discuss	7	61.0	51.9-66.2	5.7	63.3	54.4-69.5	5.9	63.6	56.9-70.4	5.9
Control	11	64.3	57.0-72.0	4.7	65.0	58.3-73.7	4.1	66.0	60.3-70.0	3.9
Sample	49	63.1	51.3-72.0	4.2	64.2	54.4-73.7	3.9	65.0	56.9-73.0	3.8

pants of the project. Data are only reported below on the participants' videotape ratings and evaluations. The self-reports on health suggested that minor colds or illnesses requiring bedtime or a doctor's visit were not affected by the intervention.

Data Retrieval System

Data forms were distributed and retrieved following similar procedures used in other field research (Winett, Neale, & Williams, 1979). At a designated time each week (2:00-5:00 p.m. Sunday), a data retriever picked up forms, checked the hygrothermograph, performed a clothing reliability check, and left forms for the following week. One back-up day each week was used for participants not available that week in the predesignated time. Following these procedures, about 85% of forms were completed and returned. Data retrievers were given homes in different experimental groups, were uninformed about other project procedures, and limited comments and interactions with participants to the data collection activities.

RESULTS

The study assessed the effects over time of feedback, modeling, and information-discussion within a five-group design. The five groups were evaluated across three phases—baseline, intervention, and follow-up—with the following dependent measures: mean daily kWh consumption per home; interior home temperature at specified times (see below); clo value of clothing reportedly worn by each participant; and perceived comfort and sensation scores of each participant. Because the stratified random assignment procedure was imperfect, with some baseline differences existing between groups, and following Huck and McLean's (1975) suggestion for the pretest-posttest control group design, all data were analyzed using covariance analysis of variance and the Scheffe's test for post hoc comparisons between groups (Keppel, 1973). (Prior analyses using a repeated measures format (Nunnally, 1975) showed about the same outcomes as ANCOVAR.)

The covariance analysis of variance was selected as the method of analysis because it adjusts for initial differences between groups. For each measure, the dependent measure gathered during baseline was used as the covariate, thus providing a means for adjusting for between-group differences prior to intervention or follow-up phases. Separate analyses were done for the intervention and follow-up phases. With the Scheffe's test, the adjusted means from the covariance analyses for each group were used in comparisons for each phase.

Although participants were followed up for a 9-wk period after the intervention phase, follow-up data are only presented based on the three coldest weeks during that phase. This is because the mean high and low daily temperatures during the follow-up phase (56.7°F and 37.6°F) were appreciably higher than during the baseline (37.2°F and 26.1°F) and intervention phases (39.3°F and 25.3°F). Therefore, during the warmer follow-up weeks, home heating contributed minimally to overall kWh consumption, and homes were somewhat warmer, precluding a meaningful test of comfort, clothing, and temperature issues. However, during the three coldest follow-up weeks (weeks 1, 3, and 6 in follow-up), the mean high and low temperatures (49.5°F and 30.9°F) more closely approximated the baseline and intervention phases. Analyses including all follow-up kWh data showed essentially the same outcomes.

Electricity Consumption

Figure 1 shows weekly electricity data for the five groups across three phases of the study represented as percent baseline and approximate mean kWh per day per household. In addition, mean kWh and mean percent baseline for each group during each phase are also noted. The graph indicates that during baseline the groups' consumption overlapped. During the intervention phase, the groups receiving feedback and/or modeling showed about 12% less consumption than the information & discussion group and about 17% less than the control group, which slightly increased consumption during the intervention phase. During the follow-up weeks, however, only the groups that received modeling showed less consumption (by about 6%) than the information & discussion group or the control group (by about 16%).

Analyses of mean daily kWh consumption across phases of the study followed the procedures described above, but with one modification of the data. Because weather greatly affects electricity used for heating, all mean kWh scores were weather corrected prior to analysis. The weather correction factor was based for each phase on the volunteer and nonvolunteer control groups' use within a phase compared to the baseline phase. The rationale and formula for this weather correction factor and for correction for vacation days have been detailed in Winett, Neale, and Grier (1979).

A covariance analysis of variance (ANCOVAR) indicated a significant difference between groups during the intervention phase, $F(4, 77) = 13.70, p < .0001$. The Scheffe's test indicated that groups receiving feedback and/or modeling were all significantly different ($p < .01$) from the information & discussion and control groups. There were no other significant differences.

During the (cold weeks) follow-up phase, ANCOVAR indicated a significant between-groups difference, $F(4, 77) = 6.54, p < .001$, but with the Scheffe's test only finding the information & model and feedback & model groups significantly different ($p < .01$) from the control group. These data suggest a strong effect of modeling, not evident during intervention. However, a fine-grain analysis of individual household data suggested that the finding of no effects for feedback & discussion at follow-up was mainly attributable to four households in this group that performed poorly during the intervention phase (mean = 94% of baseline) and

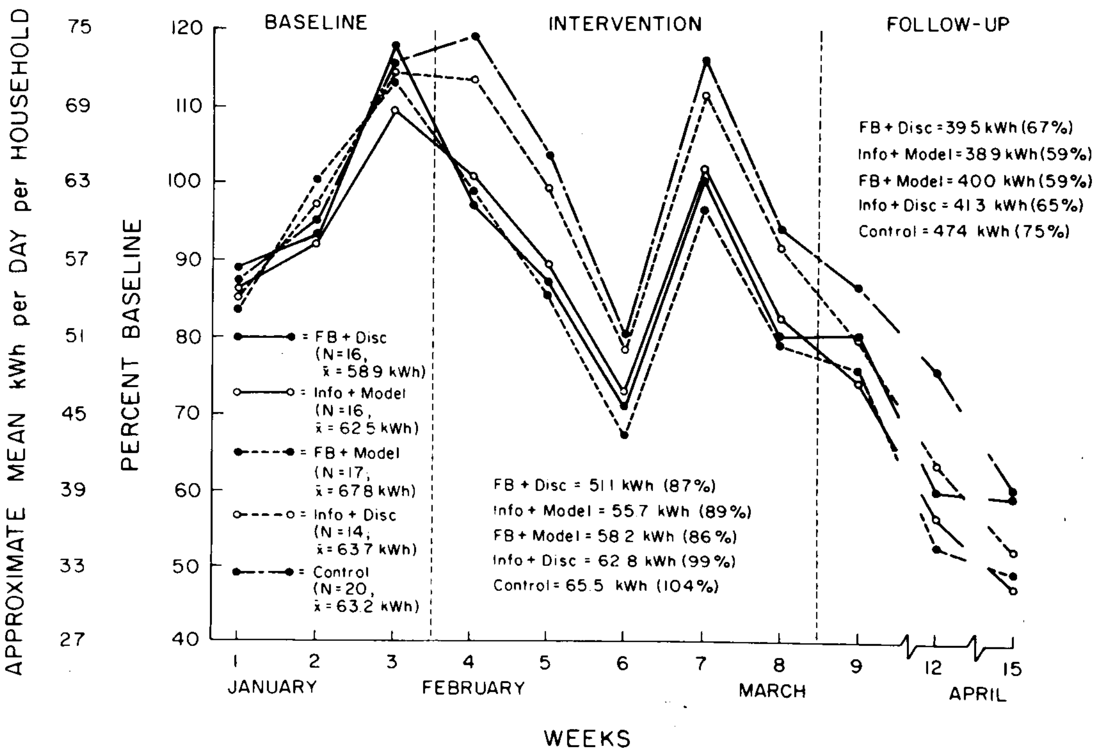

Fig. 1. Mean weekly kWh consumption across baseline, intervention, and follow-up phases of the winter study represented as percent baseline and approximate mean kWh per household per day.

extremely poorly at follow-up (mean = 86%). At follow-up, without these four households, the feedback & discussion group's data were about the same as the two modeling groups.

Since homes were all-electric, an estimate of electricity used only for heating was derived by using, as a relatively constant estimate of electricity consumed for all other uses in the home, consumption figures from late April and early May (a minimal or nonheating or air conditioning period) and subtracting this "constant" from electricity consumption during the intervention period: (January and February baseline mean daily kWh consumption) — (late April and early May mean kWh consumption) = (approximate mean kWh consumption for heating). (According to Dr. Sam Bowen of the Virginia Center for Coal and Energy Research at Virginia Tech, this estimation procedure is an accepted practice in the field. In addition, estimates of kWh consumption for nonheating and noncooling for similar-sized winter and summer residences were about the same: 28 kWh, winter, 26 kWh, summer.) Since interventions were exclusively focused on thermostat control and participants reported on follow-up evaluations only engaging in thermostat control practices, actual kWh reduced during intervention, divided by the estimate of kWh for heating, yielded: (mean baseline kWh consumption — mean intervention kWh consumption) ÷ (estimate of consumption for heating) × 100 = (estimate of percent reduced for heating). The same procedures were used to estimate reductions on heating during the follow-up period.

During the intervention period, groups receiving feedback or modeling reduced their use of electricity for heating by about 23%. The information & discussion group decreased by about 3%, whereas the control group increased electricity used for heating by about 6%. During the warmer follow-up period, the two modeling groups showed about a 74% reduction in electricity for heating, feedback & discussion reduced by about 60%, information & discussion by about 64%, compared to about 46% by the control group. Finally, there is no apparent explanation for the information & discussion group's better (though nonsignificant) performance at follow-up than during the intervention phase.

Fine-grain analyses of kWh data were also used to assess consistency of outcome by day and household. For each of the 35 days during the intervention phase, the three groups receiving either feedback or modeling showed a lower percent baseline consumption than the control group. For groups receiving feedback and/or modeling, 42 of 49 (85%) households reduced their kWh use from baseline to intervention phases by ≧6%, compared to only 5 of 34 (15%) households in the other two groups. During the warmer follow-up phase, 32 of 49 (65%) households that received feedback and/or modeling during intervention reduced kWh use by ≧35%, compared to 7 of 34 (21%) households in the other two groups.

Analyses using only households with hygrothermographs or without hygrothermographs showed essentially the same results as reported above.

Temperature and Humidity

Relative humidity data recorded from hygrothermographs showed no differences between groups or differential group change across phases. Across phases, relative humidity varied from 54.4% (baseline) to 47.8% (intervention) to 55.6% (follow-up).

Temperature data across groups and phases of the study are shown in Table 3. Although data were available for every 2-hr interval, only three times are indicated in the table: 6:00 a.m., when homes should be the coldest if set-backs were used; 12:00 noon, when a home should again show a reduced temperature if a day setback was used; and 8:00 p.m., which is a time when most people would be home and the temperature in the home would probably be the warmest. (Overall temperature data across hours substantiated the choice of these hours in the winter and hours noted below for the summer.)

Since homes were generally occupied at 8:00 p.m., and during the week participants were asked to complete comfort and clothing forms at about this time, 8:00 p.m. was used to provide an assessment of temperature, comfort, and clothing requirements. Data are not presented by week because analysis of the temperature data indicated that most participants abruptly, not gradually, changed their thermostat settings at the intervention point, i.e., did not exactly follow the thermostat schedule.

ANCOVAR and the Scheffe's test were used to analyze the data for the three times during the intervention and follow-up phases. For 6:00 a.m., a significant effect was found during intervention, $F(4, 44) = 12.82, p < .0001$, with the Scheffe's test indicating that groups receiving feedback and/or modeling ($p < .01$) were significantly different from the control group, with the feedback & model group also significantly different ($p < .05$) from the information & discussion group. A similar effect was found at follow-up, $F(4, 44) = 9.65, p < .0001$, with both feedback groups ($p < .01$) and the information & model group ($p < .05$) significantly different from the control group.

For 12:00 noon, there was a significant effect during intervention, $F(4, 44) = 6.99$, $p < .0002$, and follow-up, $F(4, 44) = 9.52$, $p < .0001$. For both phases the two feedback groups ($p < .01$) and the information & model group ($p < .10$) were significantly different from the control group.

At 8:00 p.m., significant effects were found during intervention, $F(4, 44) = 9.45$, $p < .0001$, and follow-up, $F(4, 44) = 7.53$, $p < .0001$, with groups receiving feedback and/or modeling different from the control group ($p < .01$) at intervention, but with only the two feedback groups significant ($p < .01$) from the control group at follow-up.

Despite a low mean temperature across baseline times of about 64°F, inspection of Table 3 and analyses indicated that during the intervention phase groups receiving feedback and/or modeling reduced mean 6:00 a.m. temperature by 4.5°F (63.3° to 58.8°), while the information & discussion group decreased 1.4°F and the control group increased .3°F. For 12:00 noon, the groups receiving feedback and/or modeling reduced the temperature by a mean of 3.1°F (64.0° to 60.9°), while the information & discussion group decreased .7°F and the control group increased .4°F. For 8:00 p.m., the feedback & discussion group decreased temperature by 2.1°F, the information & model group reduced by 1.8°F, and the feedback & model group decreased by 2.7°F. The information & discussion group decreased by .6°F, while the control group increased by 1.0°F.

During the follow-up phase, the information & model group increased 6:00 a.m. and 12:00 noon temperatures from the intervention phase so as to approximate baseline temperatures, while the information & discussion group also increased 6:00 a.m. temperature compared to

Table 3

Group Mean Temperature (F) Across Phases of the Winter Study[a]

		Baseline			1 *Intervention*			*Follow-Up*		
Group	*N*	*6 AM*	*12 Noon*	*8 PM*	*6 AM*	*12 Noon*	*8 PM*	*6 AM*	*12 Noon*	*8 PM*
FB & Discuss	11	63.0	64.3	64.7	58.7^{d}	60.6^{d}	62.6^{d}	61.0^{d}	62.1^{d}	63.2^{d}
Info & Model	9	63.7	64.0	65.0	59.4^{d}	61.8^{b}	63.2^{d}	62.8^{c}	64.0^{d}	65.2
FB & Model	11	63.3	63.7	64.7	58.2^{d}	60.4^{d}	62.0^{d}	60.9^{d}	61.9^{d}	63.3^{d}
Info & Discuss	7	61.0	63.3	63.6	59.6	62.6	63.0	62.7	64.0	64.9
Control	11	64.3	65.0	65.4	64.6	65.4	66.4	66.0	67.0	67.8

[a] Temperature recorded from hygrothermographs.

[b] Significantly less than control group at $p < .10$ using ANCOVAR and Scheffe's test.

[c] Significantly less than control group at $p < .05$ using ANCOVAR and Scheffe's test.

[d] Significantly less than control group at $p < .01$ using ANCOVAR and Scheffe's test.

the intervention phase, but also warmer than the baseline phase. Note, however, that during the warmer follow-up phase, the mean temperatures for the two feedback groups were still lower than at baseline.

The consistency of temperature change was also examined. Of households receiving feedback and/or modeling, 25 of 31 (81%) households reduced mean 6:00 a.m. temperature during intervention compared to baseline by ≧3°F, while 0 of 18 (0%) households in the other two groups reached this criteria. For 12:00 noon, 19 of 31 (61%) feedback and/or modeling households reduced mean temperature by ≧2°F, compared to 1 of 18 (6%) households in the other groups. For 8:00 p.m., 21 of 31 (68%) feedback and/or modeling households reduced by ≧2°F, compared to 3 of 18 (17%) households in the other groups.

To verify the relationship during intervention of temperature change to kWh savings, change scores (baseline — intervention) for temperature for 6:00 a.m., 12:00 noon, and 8:00 p.m. were derived for each household and correlated with a change score for kWh consumption (intervention kWh ÷ baseline kWh). The correlation of the 6:00 a.m. temperature change score with the kWh change score was $r_{(47)} = .65$, $p < .01$; for 12:00 noon, $r_{(47)} = .60$, $p < .01$; and for 8:00 p.m., $r_{(47)} = -.48$, $p < .01$, indicating that greater temperature change (i.e., the setbacks) was associated with less electricity use. Consistent with prior research, each 1°F change per 24 h was equal to about a 4.5% change in electricity use.

Clothing

There were minimal meaningful group effects for clothing (clo value), although the feedback groups increased clo value by about 10% during the intervention phase. All groups reduced clo value during the warmer follow-up phase by about 22%. As represented by the mean clo value of .74 across the baseline and intervention phases, the typical participant wore an ensemble similar to a long-sleeve shirt, jeans, low shoes, socks, underwear, and a light sweater.

An examination of weekly clo data indicated a relationship of clo value to *outdoor* temperature across the phases of the study, $r_{(9)} = -.63$, $p < .05$. That is, more clothing was worn inside during colder days even though hygrothermograph data indicated maintenance of interior home temperature on cold days relative to warmer days. For example, clo value across groups dropped to a mean of .68 during week 3 in the intervention phase when the mean exterior temperature was 42°F. During intervention weeks 1, 3, and 4, when mean exterior temperature was 26°F, the mean clo value was .78.

Sensation and Comfort Data

Group mean sensation and comfort ratings showed weekly variations in ratings across the baseline, intervention, and follow-up phases, but there were virtually no real differences in group means. Across phases of the study, all group mean ratings for sensation were in the "slightly cool" to "neutral" range, and all group mean ratings were in the "slightly cooler than comfortable" to "comfortable" range. Only the feedback & model group showed significantly less ($p < .05$) comfort or sensation means than the control group during the intervention or follow-up phase, but this group's scores were still in the acceptable range. Further, despite a wide range of temperatures in participants' households at 6:00 a.m., 12:00 noon, and 8:00 p.m. (see Tables 2 and 3), a correlational analysis indicated no significant relationships between comfort and sensation ratings and temperature.

Videotape Ratings and Participant Evaluations

After the videotape programs were shown in meetings, participants rated the program they viewed on 7-point scales (1 = "strongly disagree," 7 = "strongly agree") across seven common items ("acting was credible"; "learned things not known before"; "tape will change attitudes"; "tape will change behavior"; "recommend tape to friend"; "enjoyed tape"; "recommend tape for other conservation programs"). Scores indicated that across items, the modeling program (mean rating = 4.7) was consistently rated as more positive by participants (N = 52) than the discussion program (mean rating = 3.4, N = 54). Postintervention phase evaluation questionnaires similar to those described in detail elsewhere (Winett, Neale, & Grier, 1979) indicated that feedback was rated by participants as "very helpful" for conservation efforts, while the modeling films were only rated as "somewhat helpful" (midrange on the scale).

The overall results for the winter indicated that feedback and/or modeling were effective in reducing electricity consumption by thermostat control, particularly through set-backs, with some evidence for maintenance of reduced consumption and interior home temperature during a warmer follow-up period. However, despite living in temperatures of 62°-63°F, with lower night and day set-backs, participants reported wearing clothing of only about .75 clo during intervention in groups receiving feedback and/or modeling, and participants reported minimal or no change in comfort under these conditions.

METHOD—SUMMER

Setting

The summer study was conducted in Salem, Virginia, a small city adjacent to Roanoke, Virginia, and 40 miles from Blacksburg, in two all-electric, centrally air-conditioned apartment complexes. At Site 1 (containing about half the units in the study), units were 6 to 11 yr old and were equipped with either Bryant, Climatrol, or Fedders 18,000 BTU central air conditioners. Apartments had R-10 fiberglass insulation in the walls and R-13 in the ceilings. Apartments at Site 2 were 6 yr old, had about the same insulation as in Site 1, and were equipped with Tappan central air conditioners with a 25,000 BTU capacity.

Participants and Recruitment Procedures

The same recruitment procedures as used in the winter were adhered to, but with only 45% of potential participants agreeing to participate. Participants represented a wide cross section of ages with a mean age of 36.4 yr, range 19 to 75 yr. Almost all households consisted of couples or families with children. Participants had a mean gross household income in 1980 dollars of about $21,500, used a mean of 48 kWh per day (range 17-119 kWh) during a 3-wk July baseline, for a mean monthly, summer electric bill (4.3¢ per kWh) of about $62 (range $22-$154). All participants were renters who paid their own electric bill.

Nonvolunteer comparison households. Fifteen households were used in the weather correction system and to assess volunteer status. No differences in electricity consumption were found at baseline, intervention, or follow-up phases of the study between the volunteer control group and nonvolunteer comparison group.

Assignment to Group and Experimental Design

The study included a feedback and modeling tape group (N = 12 households), an information and feedback group (N = 12), an information and modeling tape group (N = 11), and a control group (N = 19). A between-group design with a control group was used as in the winter, but more limited resources dictated that only certain conditions be replicated. Of particular interest were the combination of feedback and modeling as a way to assess some limits to behavior change, feedback used alone as a sort of "benchmark" for the effectiveness of different procedures, and modeling used alone to replicate winter effects.

After a 3-wk baseline period, households were randomly assigned to groups using the same stratified random assignment procedure (i.e., based on self-reported thermostat setting), but also balancing for floor where the apartment was

Table 4
Baseline electricity consumption of the summer groups in mean kWh per day.

Group	*N*	*Mean*	*Range*	*SD*
FB	12	45.4	25.2- 85.4	18.7
FB & Model	12	46.3	31.1- 92.2	16.3
Model	11	47.6	17.3- 69.1	15.1
Control	19	51.4	18.4-119.1	22.0
Sample	54	48.0	17.3-119.1	17.6

located. However, eight households were either away on vacation when meetings were conducted or could not attend meetings for other reasons. These homes were placed in the control group. There were no differences on any measures between these households and households originally assigned to the control group. Table 4 summarizes the baseline consumption patterns of the groups.

Methods and Procedures for Feedback and Videotape Program

Group and back-up meetings were held at one of the apartment complexes following the same format as in the winter. Clothing lists were distributed and the use of the hygrothermograph to monitor thermal conditions was explained. Each participant home in all intervention groups received an individualized thermostat change schedule that involved a 1°F raising of the thermostat when home and generally turning the air conditioning thermostat off or to 80°F when the home was unoccupied or people were asleep at night. Participants were given a duplicate thermostat change schedule card in their dataform packet at the end of the second intervention phase week. All groups were also given detailed written information on the proper use of window fans and were also given an actual demonstration on the proper placement of two fans in an apartment.

Feedback procedures were the same as the winter, but feedback was only given for 30 days.

The 20-min summer videotape program showed participants a set of alternative practices for remaining comfortable, while reducing their use of air conditioning by following their thermostat change schedule or turning their air conditioning off. These alternative practices included the proper use of fans and natural ventilation in the evening; the use of a dehumidifier; closing all windows, doors, and drapes in the morning; shifting the time (do strenuous activities or cooking when it is cooler) and place (eat dinner on the patio) of activities; relaxing when warm; and dressing in clothing of minimal clo value. All these points (including a thermostat change schedule) were demonstrated by a male and female couple (both 35 yr old) in the program videotaped in an apartment similar to the participants' homes. However, several aspects of this program were different from the winter program, including depicting a couple making a decisive, step-by-step change from a lethargic, "high-energy life-style" to an "energy-efficient life-style." Throughout the program the couple was shown developing a plan; taking responsibility to help in the energy situation; and receiving certain benefits, including verbally expressing that they now felt they were doing something significant, saving money, and expanding their life-style. In their "prior" energy-wasteful life, the couple was shown as being highly dependent on air conditioning and usually confined during leisure time to their apartment. During their leisure time now, they were shown happily engaged in outdoor recreational activities.

Another aspect of the program was the deliberate use of the terms "energy efficiency," "energy intensive," "energy dependence," and "energy situation" a total of 19 times and the complete exclusion of the terms "energy conservation" and "energy crisis" (see below).

As in the winter tape, summaries were provided by voice-over commentary. Thus, although both winter and summer tapes demonstrated specific practices, the summer tape more clearly attempted to provide a rationale for change, emphasize efficiency, and show a couple making step-by-step changes (see Maccoby & Alexander, 1980, for the basis for this approach). The switching from inappropriate to appropriate vignettes (as in the winter) was seen as too repetitious and was not used.

Dependent Measures

The same dependent measures and data-retrieval system (with about 85% returns) used in the winter were used in the summer. As before, one reliability check on 15 electricity meter readings yielded 100% agreement. Hygrothermographs were placed in *all* homes, in the same location as the winter, with the same instructions to participants, and the same temperature and humidity checking procedures. About 550 temperature checks were performed, with four instances of recalibration. There were only three instances of humidity recalibration. Table 5 shows the mean baseline temperatures in the homes at three designated times to discussed below.

Comfort was assessed using the same scales as in the winter, with participants requested to complete the forms during baseline and intervention on Sunday, Monday, and Thursday evenings, but only on Monday evening during follow-up. Clothing worn (clo) was also assessed using the same procedures as before, but reliability checks were only performed on 10% of the homes. This yielded 91 items with an agreement or disagreement noted, and with 75 items checked as agreement (84%). The same additional measures noted before were used, with no reported effects of the procedures on health.

RESULTS

Electricity

Figure 2 shows kWh consumption represented as percent baseline and approximate kWh per house per day during the baseline, intervention, and follow-up phases. The figure also indicates mean kWh and mean percent baseline for each group during each phase. The summer follow-up phase was only 3 wk (until the end of September) because warm weather abruptly ended at that point.

The four groups showed virtually complete overlap in consumption patterns during baseline. During the intervention phase, the control group showed a slight reduction in use (2%, 1.2 kWh), the model group showed a moderate reduction (12%, 5.6 kWh), while the feedback (19%, 8.6 kWh) and the feedback & model (22%, 10.3 kWh) groups showed substantial reductions. During the follow-up phase, the control group reduced use compared to baseline by 11% and 5.6 kWh; the model group reduced by 28% and 13.4 kWh; the feedback group reduced by 29% and 13.2 kWh; and the feedback & model group reduced by 37% and 17.1 kWh.

ANCOVAR and the Scheffe's test on weather-corrected kWh scores indicated a significant effect during intervention, $F(3, 49) = 7.73$, $p < .001$, but with only the feedback and feedback & model groups significantly different ($p < .01$) from the control group. A significant effect was found during the follow-up phase, $F(3, 49) = 7.35$, $p < .001$, with the feedback ($p < .10$), model ($p < .05$), and feedback & model group ($p < .01$) significantly different from the control group.

Inspection of Figure 2 and the data suggest that the combination of feedback and modeling tended to have an additive effect during the intervention and follow-up phases, with feedback alone showing consistent, though lesser, effects and modeling alone showing weak effects during intervention, but effects comparable to feedback alone during the follow-up phase. The outcome for the model group is, however, similar to the winter results for the information & model group.

Procedures similar to the winter were used to estimate percent saved for electricity used for cooling, with early October used to obtain an estimate of kWh consumption for nonheating and noncooling. Groups receiving feedback and/or modeling made very large reductions in kWh used for cooling. For example, during the intervention phase, the feedback & model group reduced kWh used for cooling by about 49%, the feedback group reduced by about 42%, and

Table 5

Baseline mean summer temperatures in degrees Fahrenheit from hygrothermograph readings.

Group	*N*	*6 AM*	*Range*	*SD*	*4 PM*	*Range*	*SD*	*10 PM*	*Range*	*SD*
FB	12	75.5	72.1-80.3	2.4	77.2	72.1-80.4	2.8	76.5	72.3-82.3	2.6
FB & Model	12	74.6	68.2-80.1	2.8	76.9	73.3-85.1	3.1	76.4	72.1-82.2	2.7
Model	11	75.9	74.3-78.5	1.5	78.7	74.1-82.3	2.4	77.0	73.4-80.2	2.4
Control	19	74.5	71.4-81.3	2.4	77.4	71.4-86.1	3.7	76.5	71.2-83.1	3.3
Sample	54	75.1	68.2-81.3	2.2	77.6	72.1-86.1	3.1	76.6	71.2-83.1	2.7

the model group by 26%, compared to only about a 5% reduction by the control group. For the follow-up phase, very large reductions on kWh use for cooling were also evident (feedback & model = 82.2%; feedback = 65%; model = 63%; control = 24.2%).

Analyses for consistency of outcomes indicated that on 27 of 30 intervention days, groups receiving feedback and/or modeling used less electricity (percent baseline) than the control group. For groups receiving feedback and/or modeling, 28 of 35 (80%) households reduced electricity consumption by ≧15%, compared to 3 of 19 (16%) control households.

Temperature and Humidity

Across phases of the study, there were no significant changes in relative humidity, which was a mean of about 56% across phases of the study. Temperature data were analyzed for 6:00 a.m.,

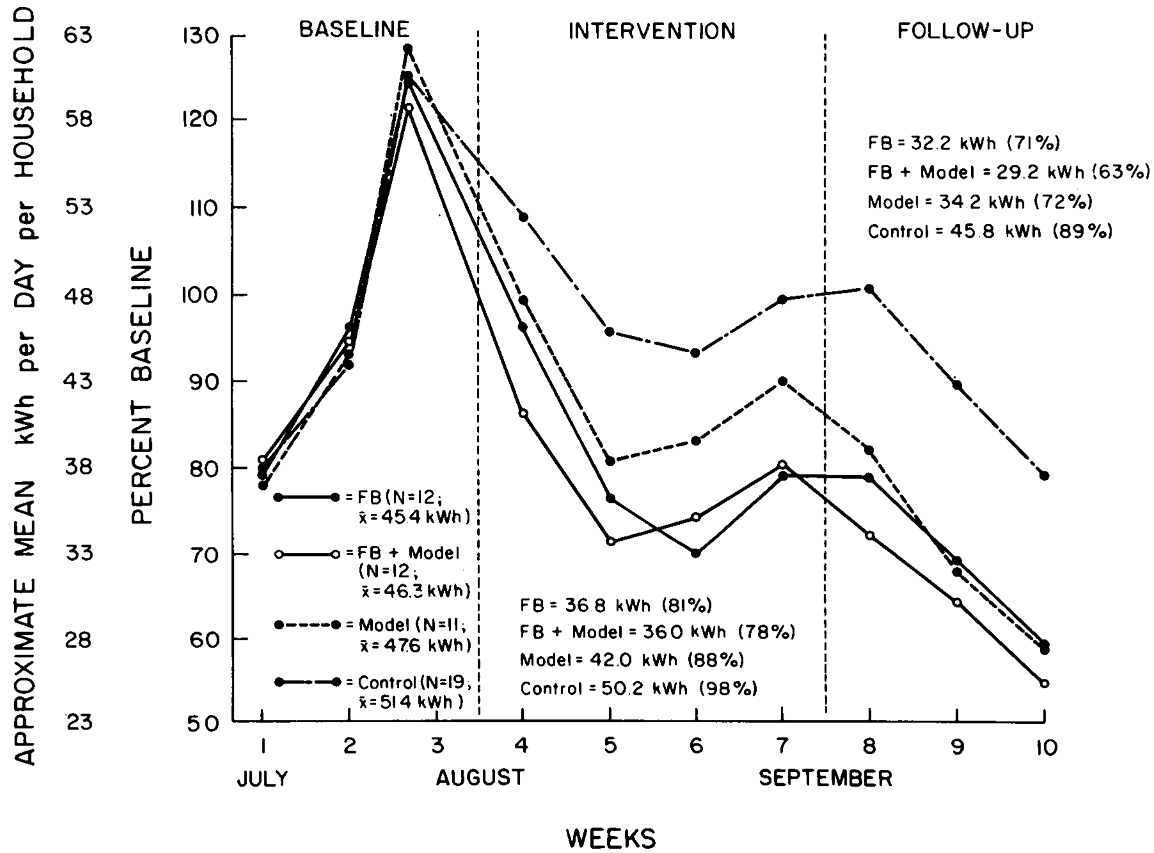

Fig. 2. Mean weekly kWh consumption across baseline, intervention, and follow-up phases of the summer study represented as percent baseline and approximate mean kWh per household per day.

4:00 p.m., and 10:00 p.m. These times were selected since 6:00 a.m. represented the coolest part of the day; 4:00 p.m., the warmest part of the day; and 10:00 p.m. was probably the coolest interior time if air conditioning was used. It was also a time when most people were home and within 1-2 h of when clothing and comfort forms were to be completed. Temperature in the home during the summer, however, can be at any time warmer or cooler depending on: structure of the home; whether or not doors, shades, and blinds are closed in the morning; use of air conditioning, fans, or natural ventilation; temperature outside; or any combination of these factors.

Although the temperature in the summer in the home is a complex result of different factors, it was important to ascertain if significant reductions on kWh and large reductions in kWh for cooling were associated with very high interior temperatures. An examination and analysis of the data indicated there was minimal change in home temperature across phases of the study. Temperatures across groups, times, and phases range from 74° to 79°F, with a mean temperature of 77°F. Only the feedback & model group showed changes from baseline of about 1.4°F during intervention at 4:00 p.m. and 10:00 p.m. and 2°F at 4:00 p.m. during the follow-up phase. These temperature changes equal about a 10% reduction in electricity (Socolow, 1978). The control group showed a cooling trend across times during the intervention and follow-up phases of about .9°F. These patterns yielded significant ANCOVARS ($p < .05$) for all three times during the intervention and follow-up phases, but with the Scheffe's test confirming that differences ($p < .05$) were only between the feedback & model and the control group. Overall however, electricity reductions were less attributable to interior temperature change than in the winter.

Clothing

Clo value remained virtually unchanged across groups and phases of the study and was a mean of .37 clo (range .19-.56). The .37 clo is equivalent to wearing light pants or shorts, a short sleeve shirt, low shoes and socks, and briefs or panties.

Sensation and Comfort

Sensation and comfort ratings also showed minimal change across groups and phases of the study with a mean across phases of 5.2 ("neutral") on sensation (range 3.0-7.1) and 5.3 ("comfortable") for comfort (range 3.1-7.0).

Videotape Ratings and Participant Evaluations

Across the same dimensions as in the winter, the videotape program was rated a mean of 5.1 (i.e., participants rated tape in positive direction). The postintervention questionnaire focused as in the winter on ratings of program components, but also on use of specific practices advocated and/or demonstrated in the videotape program or written material. Ratings were similar to the winter, with feedback rated as "very helpful" and the videotape program rated as "somewhat helpful." An examination of reports on the questionnaire indicated that participants in the intervention groups had increased practices such as turning off (or to 80°F) the air conditioning when leaving the home or sleeping; closing windows, shades, and blinds in the morning; and using fans or natural ventilation. About half the participants in the three intervention groups reportedly used fans as demonstrated; six households reported purchasing a fan during the intervention phase. No use or purchase of a dehumidifier was reported.

An analysis of the data on increases in practices with electricity consumption data was performed by totaling the number of practices participants indicated they increased and correlating this total score with the household percent baseline score for the intervention period. The result was $r_{(27)} = -.61$, $p < .001$, indicating that engagement in more practices was associated with reduced kWh consumption.

The overall results of the summer study indicated that feedback with or without modeling and to a lesser extent modeling alone, were effective in reducing overall kWh consumption and markedly successful (mean 34% and up to 43%) in reducing use of electricity for cooling. A short follow-up period indicated maintenance of kWh reductions. Temperature, clothing and comfort, and other self-report data suggested that such electricity savings were probably accruable by adoption of a combination of strategies that resulted in minimal temperature change in the home (while curtailing air conditioning use), no change in attire, and no change in perceived comfort.

DISCUSSION

The results of the winter and summer studies indicated that residential consumers can save a considerable amount of energy used for heating and cooling by thermostat control and other no-cost or low-cost procedures. In the winter, it was found that night and day set-backs and, to a lesser extent, lowering the thermostat 2°-3°F when home resulted in savings on energy used for heating by the intervention groups of a mean of about 25% compared to the control groups. Within the winter study, however, there are also important comparisons to prior work and a number of less-than-clear findings.

When participants were home, hygrothermograph readings (8:00 p.m.) in feedback and/or modeling groups indicated a mean temperature during intervention of 62.6°F, a mean clo value of about .75, yet participants reported comfort. These data are discrepant with laboratory studies (using similar-aged people) predicting comfort at 75°F with .8 clo and at least 1.6 clo needed for self-reported comfort in the laboratory at 65°F (Rohles, 1981). Thus, there is about a 12°F discrepancy between the present results and prior results!

It is not clear if this discrepancy is attributable to laboratory findings representing "ideal" thermal conditions, with the present results representing tolerable limits to comfort. It is also unclear if the experimental conditions resulted in adaptation to temperatures and/or reappraisal of the term "comfort" by participants. Then too, perhaps, lower temperatures could have been reached if participants gradually, and not abruptly, changed their thermostat settings (Rohles, 1981). Why participants did not exactly follow their schedule or adjust their clothing is also uncertain. However, even without further clarification, the results of the present study suggest that most people (nonelderly, nonsick) can probably live during the winter at temperatures lower than ASHRAE standards (ASHRAE, 1977), with minimal, if any, adjustments in wardrobes, minimal or no loss in comfort, and considerable savings in energy and money.

Besides replicating the efficacy of the modeling condition alone (albeit to a lesser extent than the winter), a number of other important results were obtained in the summer with a more diverse sample of people than in the winter study. The electricity and temperature data indicated that substantial savings (43% in the feedback & model group) on electricity used for cooling were possible with minimal change in home temperature and no loss in comfort. The self-reports from postintervention questionnaires could not be used to identify the exact or optimal combination of procedures used to achieve these results, but these data and the results of a subsequent project replicating these results (Winett & Love, Note 1) suggest that the package probably includes closing all doors, windows, shades, and blinds in the morning; using fans and natural ventilation when possible at night; and turning the air conditioning (when it is used) off or to 80°F when leaving the home for more than 2 h and when sleeping. Such strategies are particularly suitable for parts of the country where the temperature is less than a mean of about 75°F at night and not overly humid. Importantly, however, an examination of mean summer low temperatures in major American cities indicated that most areas of the country fit the 75°F or less criterion (The World Almanac, 1980). This means that if homes are air conditioned during summer nights with air conditioning thermostats set at a mean of 77°F (the mean in the present study), that many Americans are air conditioning their homes at night to a *warmer* temperature than the outside temperature!

It may also be possible in the winter to use similar substitutions of low-energy-use appliances for high-energy-use appliances while maintaining reasonable temperatures and comfort. For example, consumers can use spot heaters in a room they are occupying, while turning down the main home thermostat to 55°F (Portable Electric Heaters, 1980; Rohles, 1981). The energy savings, comfort, and convenience of this strategy is being investigated in subsequent research (Winett, Note 2).

In both studies, the information and model conditions contained a number of expectancy, personal contact, and informational variables which undoubtedly contributed to the efficacy of modeling. However, interestingly, as a package the information and modeling tape condition closely followed a successful diffusion of innovation strategy called the "media-forum" (Rogers & Shoemaker, 1971). In the media-forum, groups of people are brought together, receive information, watch a special TV program on the designated innovation, and then discuss the information, the innovation, and how they plan to implement the innovation. Thus, the media-forum combines media and personal contact elements. An axiom in the dissemination and diffusion literature is that for most people, personal contact from an expert or peers is necessary to promote behavior change (Rogers & Shoemaker, 1971). That is, media alone are not effective in producing behavior change. This widely held conclusion has recently been challenged by Maccoby and Alexander (1980) who claimed media, when carefully prepared and marketed, can influence relatively simple behaviors where outcomes are nonaversive. What seems needed at this point are studies to investigate optimal and cost-effective combinations of media, personal contact and social support in promotion of mass, aggregate individual change (McAlister, Puska, Koskela, Pallonen, & Maccoby, 1980).

Although feedback showed a predictable outcome in both the winter and summer, feedback was only used in the present studies to test limits of change and as a benchmark condition. For example, in the summer, modeling and feedback showed some additive effects (significantly different from modeling alone). Because of its reliability, the use of feedback remains intriguing, and attempts have been made to make feedback more practical through less frequent administration (Hayes & Cone, 1981), teaching consumers to self-monitor energy use and provide themselves with feedback (Winett, Neale, & Grier, 1979), and by delivering feedback through mechanical means (McClelland & Cook, 1980). However, each one of these approaches has limitations in terms of cost, administration, or persuading consumers to buy devices. Media approaches, even if less efficacious then feedback, could have more widespread applicability because of the potential for reaching large audiences of consumers. Perhaps, however, the most exciting possibility is using media such as TV frequently to feed back to communities the results of their conservation efforts, an approach that has already been demonstrated (Rothstein, 1980).

Behaviorists can profit from research in communications concerning how media can be effectively developed and used to set an agenda, provide information, and influence attitudes. For example, in the summer, one seemingly effective tactic was to depict the disadvantages of a typical, "high-energy" American life-style (e.g., large energy bills, confinement to air conditioned settings) and the advantages of an "energy-efficient" life-style. Because the word conservation apparently has some negative connotations for the American public (Winett & Geller, 1981), "conservation" was replaced by the term "efficiency." The overused term "energy crisis" was also not used, but the terms "energy dependence" and "energy situation" were used instead. The depiction of the disadvantages of present conditions, advantages of the position advocated, the careful use of terms and other tactics (for example, repetition and review in the tapes) has some basis in the communications literature (Maccoby & Alexander, 1980), as well as in recent research on how subtle changes in perceptions influence decisions (Tversky & Kahneman, 1981).

Likewise, communications efforts may profit from the careful attention to behavioral modeling and operant principles such as used in the videotape program. This discussion suggests that the integration of behavioral and communications strategies should present many fertile areas for investigation (Ester & Winett, 1982).

Several points derived from the data of the studies are also important from the perspective of energy policy. Clearly, there is little doubt that behavioral procedures can be used to promote short-term changes in energy-related practices (Winett & Neals, 1979). The follow-up data in these and other studies (Winett, Neale, & Grier, 1979; Winett, Neale, Williams, Yokley, & Kauder, 1979) also indicate maintenance of effect through a heating or cooling season. Of longer-term maintenance and generalization to other conservation practices in the home and to other energy-related behaviors (transportation, water use, recycling), apparently nothing has been reported. Given the inconclusive nature of maintenance research in behavioral work and only recent, careful documentation of diverse positive and negative "side effects" of behavioral interventions (Wilson & O'Leary, 1980), the present shortcomings of the state of the art in behavioral energy research are not surprising. In addition, as in the present studies, behavioral energy research has had a rather one-dimensional approach. Rarely, for example, have behavioral procedures been used to promote retrofitting of residences, and minimal work has been directed to other sectors (industry, government, transportation; Cone & Hayes, 1980; Geller, Winett, & Everett, 1982). To work more viably with other professionals in the energy field, we need not only to understand their concepts and approaches, but also to present evidence that under some conditions our strategies can be helpful in developing programs that promote diverse and long-term changes in energy-related practices (Geller et al., 1982).

The data from the present study also have implications for other aspects of energy policy. A recent meta-analysis of behavioral residential energy conservation studies indicated that economic factors, cost of energy, and "budget share" (income expended for energy) were highly predictive of consumer responsiveness to monetary rebate and feedback interventions (Winkler & Winett, 1982). This finding is supportive of reliance on marketplace policies to promote conservation. Relative to studies included in the meta-analysis, the budget share of participants in the winter was high, resulting in the prediction of high responsiveness such as found in the winter. However, the budget share for participants in the summer was low, yet substantial energy savings were found. It may be that the careful presentation of persuasive material (e.g., the modeling program) that, in particular, offers consumers information on how to maintain comfort by *substituting* low-energy-consuming appliances (e.g., fans, spot heaters) for high-energy-use appliances can be effective in promoting conservation even without very high prices. It has been argued that, at a minimum, marketplace approaches need to be supplemented with effective information technologies (Rapping, 1981; Ross, 1979; Winett & Kagel, Note 3), a position consistent with recent criticism of "economic man," a paradigm based solely on utility maximization (Simon, 1979).

Other policy issues have been raised by Stern and Gardner (1981) who classified the strategies used in the present studies as "curtailment" approaches, as opposed to "efficiency" strategies. Attempts to have people drive less (Hake & Foxx, 1978) would be another example of a curtailment strategy, whereas the development and marketing of fuel-efficient cars is an efficiency strategy. Curtailment strategies may be difficult to promote because they usually involve maintenance of repetitive behaviors (reinforce less driving), while efficiency strategies are "one shot" (buy a fuel-efficient car). In addition, some curtailment strategies may involve discomfort or inconvenience (riding municipal transportation) and have often been associated with words such as "sacrifice," poor economic times, and a lower quality of life (Winett & Geller, 1981). Finally, Stern and Gardner indicated that curtailment strategies such as thermostat set-backs actually save only minimal energy.

It is our contention that the categories of curtailment and efficiency are not dichotomous categories or approaches. For example, thermostat set-backs represent an *efficient* use of a heating system (Becky & Nelson, 1981). To develop and use a passive solar home requires one-shot purchases *plus* daily attention to repetitive behaviors. To promote only a replacement strategy (fuel-efficient cars) means that large energy savings will only be accruable in the future (when the current fleet is replaced) and that concomitant problems of that particular energy-consumption system remain unabated (air pollution, traffic jams, long commutes, massive allotment of land for roads). Quite obviously, what is needed are combinations of curtailment and efficiency strategies (drive less and buy and energy-efficient cars).

The data from the present studies also indicate that there may be *no* sacrifice involved in adopting many simple conservation strategies. For example, in the winter, even with lowered thermostat settings, participants reported comfort. In the summer, combining a few strategies actually resulted in minimal changes in interior home temperature and no effects on perceived comfort. These simple strategies resulted in savings on electricity used for heating and cooling that were far beyond the estimates presented in Stern and Gardner (1981).

One important task is to argue persuasively that the association of conservation with sacrifice and poor economic circumstances is generally without a firm basis (Stobaugh & Yergin, 1979). National goals should not just focus on increased production to fuel our energy-inefficient practices and systems, but rather behavioral and physical analyses of energy-related practices and systems are needed to ascertain how maximal energy can be saved while preserving, if not in fact improving, our quality of life (Ross & Williams, 1981).

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