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THE IMPACT OF A CONTINUING ENERGY CRISIS:

CHANGING ATTITUDES AND BEHAVIORS REGARDING THERMOSTAT SETBACK

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Abstract

A sample of Akron, Ohio SMSA households are utilized to examine thermostat setback as an energy conservation strategy. Socio-economic differences between adopting households are evaluated using discriminant analysis. The results constitute the bases on which our recommendations for future increased use of the thermostat setback strategy are made.

1. INTRODUCTION

The current United States energy situation has created the need for investigating energy supply and distribution and the interrelationships between and among energy, economy, environment, politics and international issues and options (5, 9, 10, 18, 31, 35, 39). While energy conservation is now receiving greater attention than every before, conflicting opinions on strategies for ameliorating the current shortage have hampered widespread utilization of conservation strategies. Some experts feel emphasis should be placed on increasing energy production rather than on energy conservation. This view was held by the Ford administration and therefore resulted in the de-emphasis on energy conservation. Scenarios exist which equate energy conservation with national economic disaster with concomitant drastic life-style changes and discrimination toward specific societal groups (9, 10, 18). The advantages of a well-formulated energy conservation strategy are becoming increasingly obvious. We believe that such a strategy should consider short, intermediate and long term energy supply pictures. Berg outlines these supply limitations:

> In the immediate future (1972 to 1980) the most important problem appears to be inadequate power generating capacity. In the distant future (the year 2000 and beyond) the basis problem is availability of fuel or of energy in another form, such as solar or geothermal energy. In the intermediate time range (1980 to 2000) the conservation of energy by means which do not damage the functioning of the economy could well be the most important consideration (2, p. 128).

Most experts agree that short term energy conservation can slow energy growth rates, reduce imports and thus provide the time needed for developing new types of energy sources and the technology for increasing the output from oil wells (13, 23, 44). Conservation proponents indicate that an appreciable amount of the energy consumed in America is wasted. They argue that much of this loss is salvagable. Thus waste reduction can significantly decrease United States consumption rates and may result in considerable potential dollar savings to all consuming sectors of the U.S. economy through the adoption of energy-savings techniques. Evidence indicates that such steps are being taken by the industrial, commercial and transportation sectors, while the residential sector remains relatively unaffected. The American household is a major concern to conservation enthusiasts because of its role in consumption and waste. It therefore requires increased attention in energy conservation research. This concern necessitated this study of certain aspects of household conservation attempts.

2. THE PIVOTAL ROLE OF THE AMERICAN HOUSEHOLD

Households have a major role to play in a comprehensive, energy-conservation plan. Personal consumption in various forms (transport, heating, etc.) amounts to two-thirds of the total United States energy budget (33). For example, space heating and the automobile together account for approximately twenty-four percent (24%) of the total national budget (14, 37, 39, 44). Because of the high wastage in the household sector, the energy savings that may accrue through the adoption of various energy-conserving techniques, including thermostat setback, proper insulation, caulking and weatherstripping, the use of energy efficient appliances, more careful driving and the shift to lighter-weight automobiles, may be as high as 30 percent (5, 14, 37, 44). Much of the capability for energy-conservation reduction rests with the individual consumer. Recent indications, however, are that many households are not adopting such procedures, and to date very little research has been done to analyze the households' adjustments to rising costs, their preference structures, or their adoption or rejection of specific strategies. Commenting on the present lack of such research and their future role in energy conservation, Berg noted that:

> Influence(s) including those of political and institutional character, may require examination if one is to explain why surprisingly economically attractive fuel savings measures were not adopted in the past. It may, in fact, be necessary to find an explanation in order to plan for fuel conservation efforts in the future...(3, p. 264).

The efforts of public utility companies and federal agencies to introduce energy saving innovations through energy task forces, "management committees" and publications such as "The Electric Decision-Maker" and "How to Save Energy Dollars" reflect the belief that barriers to the adoption of energy conservation procedures are largely institutional and informational.

In addition to the actual need for household conservation, we also need to understand the behavioral problems related to energy adjustments. Presently studies on this topic are few and have focused on particular aspects of the problem. For instance, "The Family Energy Project" at Michigan State University has focused, in part, on the socio-physical determinants of energy use, the relationships between lifestyles and conservation attitudes and the initial impacts of energy costs on households (22, 38, 49, 50). Generally, such studies are in the initial stages and have not dealt with specific adoption behaviors. Other behavioral studies were based on small samples and suffer from generality of scope. Such studies include that by Harvey and Ross on the implications of adjustments in the dominant travel activities of households (27), by Frazier on the influence of residential location and socio-economic variables on select attitudes and behaviors related to the energy crisis (19, 20, 21), and by various psychologists on consumer reactions to feedback and recommendation regarding electrical and fuel consumption (32, 45, 46), are examples in point. Unfortunately all these studies only hint at what individual households are either thinking or might be doing. They are of little practical value in understanding what types of conservation strategies are being adopted. One on-going research which seems to be dealing with the practical problems of conservation strategies is that by the Center for Environmental Studies at Princeton University (46). The basic thrust of the research is the use of immediate feedback to consumers about their energy consumption. The assumption is that such feedback will help the consumer develop better energy strategies (46). Indeed their results indicate that the feedback concept can lead to consumption-rate reductions. A common energy reduction strategy, they reported, is the appropriate adjustment of "automatic pilot 'thermostats'" during summer and winter. Thermostat adjustment is indeed a simple strategy that can be easily adopted by any conservation household. However, we believe that before the general implementation of such an energy-saving strategy, certain questions have to be answered: 1) who has accepted thermostat setback as an innovation? 2) what are the attributes of the adoptors? 3) what are the changing attitudes over time toward thermostat adjustment and what are the corresponding changes in attribute differences between adopters vs. non-adopters? This paper will address these questions by employing a longitudinal data set from the Akron SMSA, Ohio. Social science diffusion theory is employed to help account for adoption or rejection of energy-conservation strategies. A review of pertinent diffusion literature and discussion of the sample population follow.

3. THE RELEVANCE OF DIFFUSION THEORY

Conceptualizations of the diffusion process forwarded by social scientists of various disciplines have indicated that innovative behavior occurs in several distinct stages; 1) awareness of the innovation, 2) interest in the innovation, 3) trial, and 4) adoption or rejection (1, 6, 7, 8, 23, 25, 26, 29, 40, 41). Adoption or (rejection), the final stage in innovative behavior, depends upon a myriad of variables including an individual's personality, the character of his social group, and a need (or cognized need) for him to adopt (41). These "antecedents" determine adoption rates. In accounting for differentials in adoption rates however, the type of innovation must be considered. For ease of adoption, innovation must be such that it is not only attractive, but can be implemented into the individual's routine with little difficulty. Furthermore, the innovation must be simple. Diffusion studies indicate that there are spatial and aspatial differences between early and later adopters. Those adopting an innovation early tend to be:

1) closely associated (spatially) with other early adopters;

2) encouraged by economic factors, and

3) more likely react to oral propaganda than written (26).

Barnett asserts that the early adoption of an innovation is dependent upon:

1) prestige of the individual who is advocating adoption (rejection),

2) personality of the advocate,

3) compatability of the innovation with the potential adopter's needs and the non-possibility of substitution,

4) costs,

5) advantages and disadvantages of early adoption,

6) pleasure, and

7) penalties for non-adoption.

Later research has directly identified the socio-demographic attributes of early adoptors. As Engel et al noted, "socio-demographic variables most often associated with innovativeness are education, literacy, income and level of living" (15). With higher levels of disposable income (level of living and income variables) innovative behavior (early adoption) is more likely. Early adoption is achieved by the "best informed" population groups.

Attitudinal variables also play a role in innovative behavior. "Achievement motivation" has been identified as an indicator that an individual will adopt early and individual attitudes toward change also help determine innovation behavior. "Openmindedness" and "venturesomeness" are also characteristics of early adopters (15). These characteristics are considered below in formulating hypotheses regarding thermostat setback.

The above discussion implies that in the initial stages of the propagation of an innovative idea, a set of variables can be identified which will significantly discriminate between the adaptors and non-adaptors. We believe that such a variable set consists of three variable groups: socio-demographic, environmental-structural and attitudinal. The demographic variables that will be used in this paper are income, age of male head of household, educational level of the male, the perceived increase in utility increases over the past year, and household size. The four environmental-structural variables are size of residential unit, age of dwelling, tenure, and the adequacy of insulation. The five attitudinal variables are attitude toward thermostat reduction, social norm, motivation, stress, and the locus of control. These calibration of these fourteen variables are described in Table 1. These same variable sets will be used to determine the differences between early adaptors, late adaptors, and non-adaptors.

A conceptualization of a problem in terms of diffusion theory is not complete unless there is a discussion of the channels of information flow and the motivation for adoption. For the thermostat setback idea discussed in this paper we believe that the initial motivation for adoption will be 'profitability'. In the late stages of the diffusion process, purely economic considerations are paralleled by the influence of the media and of friends and relatives. These are discussed in detail later.

4. THE SAMPLE POPULATION

Data were obtained through a purposive, two stage sampling procedure. In stage 1 the sample was selected from volunteers from Akron SMSA churches and civic organizations. In the second stage, a personal interview scheme to obtain adequate representation of income groupings by census tracts was devised. The survey began in February, 1976 and continued to date. Of the 312 initial sample participants only 138 households decided to participate beyond one year. A comparison of the sample population to the 1970 census, by a series of mean tests, showed that the survey population is more educated, earns slightly higher incomes and live in relatively newer homes than the 1970 population. Some of this difference is attributable to the seven year lapse in data collection.

The Akron SMSA was chosen as the study area because it offers a number of advantages. First, the ecological differentiation of its highly industrialized core approximates that of larger American cities. Second, it is typical of the Midwest climate, which is characterized by seasonal extremes of climate. Finally, and less tangible, the Akron SMSA offers the advantages of investigator familiarity with the area.

5. THE ANALYSIS

The summary information on attitude and behavioral change regarding thermostat setback in early 1976 reveals that while attitude toward reduction was generally positive, almost one third of the sample felt that reducing their thermostat settings was an unreasonable act (see Table 2). At this same time slightly more than one in three households actually performed that behavior. The relatively low adoption rate compared to the support rate gives credence to the contention that attitude is not directly linked to behavior. However, when the figures of 1976 are compared to those of 1977, there is an increase of more than 50 percent in the number who tried this strategy. Together these results suggest that there is a lag between the development of a positive attitude and the actual adoption of the innovative behavior. The results in Table 1 also suggest a change in attitude toward reducing thermostat settings. Thus in both attitudinal and behavioral terms

TABLE 1

INDEPENDENT VARIABLES FOR DISCRIMINANT ANALYSIS

Socioeconomic - Demographic Variables:

1)	Income	___less than $4000 ___$4000-7999 ___$8-11,999 ___$12-14,999 ___$15-19,999 ___$20-24,999___$25-29,999 ___$30-34,999 ___$35,000 and above
2)	Age	___under 21 yrs. ___21-30 yrs. ___31-40 yrs. ___41-50 yrs. 51-64 yrs. ___65 yrs. and over
3)	Education	___less than 6 yrs. ___6-9 yrs. ___10-12 yrs. ___high school graduate ___college
4)	Utilities Increase	___moderate ___high ___very high
5)	Household Size	Open ended question

Environmental-Structural Variables:

1)	Unit Size	Number of rooms. Open ended.
2)	Dwelling Age	___less than 5 yrs. ___5-10 yrs. ___11-20 yrs. ___21-30 yrs. ___over 30 yrs.
3)	Tenure	___less than 5 yrs. ___5-10 yrs. ___11-15 yrs. ___16-20 yrs. ___over 20 yrs.
4)	Insulation Adequacy	___very inadequate ___inadequate ___undecided ___adequate ___very adequate

Attitudinal Variables:

1) Attitude toward thermostat reduction: Is reducing your thermostat:
___unreasonable ___reasonable ___very reasonable

2) Social Norm: Do your friends/relatives feel that thermostat setback is: ___not important ___important ___very important.

3) Motivational Variable: Do you think the pay-off for thermostat reduction is: ___low payoff ___medium payoff ___high payoff

4) Stress Variable: Increasing heat costs have created a major discomfort for my household. ___strongly disagree ___disagree ___undecided ___agree ___strongly agree

5) Locus of Control Variable: Rotter's measure of internal/external reward expectancy. Responses to twenty-six questions, see (16,17).

thermostat setback appears to be gaining greater appectance. Generally, these findings conform to those attitudinal changes reported by FEA:

> ...By the spring of 1975 the percentage of the population regarding energy problems as serious had risen to 79%... This reflects the lag times associated with altering public attitudes...
> ...The survey points out as one might expect, that energy conservation options that are convenient and have little cost appear to be practiced. In the spring of 1975...63% (indicated they) turned down the thermostat...(13; 546).

5.1 ROLE OF ECONOMIC FACTORS AND INFORMATION IN THE ADOPTION PROCESS

The increase in the proportion of households who turned down their thermostat is also a function of information, particularly interpersonal communication. A determination of this factor in the adoption of the thermostat lowering strategy involved asking the sample population about what influenced their decision the most. The results are reported in Table 3. In 1976, about 40 percent indicated that "increasing electric bills", "finances" or "economic considerations" caused them to reduce their thermostat settings; the "media" accounted for about 20 percent, while "friends/relatives" were noted by a meager 2.2%. percent. Indeed, economic considerations were paramount.

In 1977, the realization that the media is a source of energy conservation information is apparent. Information provided by utility companies is noted for the first time and friends/relatives is also a more important source of information. The increasing strength of the media and information from utility companies suggests strong implications for future energy conservation planning.

5.2 DIFFERENCES BETWEEN ADOPTERS AND NON-ADOPTERS IN 1976

The 130 households in the survey in 1976 were divided into adopters and non-adoptors. Using the fifteen independent variables disclosed earlier, the data were subjected to multivariate analysis of variance to determine if the two subpopulations were significantly different on these variables. The results indicate that the groups are indeed significantly different (see Table 4). The data were then analyzed by stepwise discriminant analysis in order to identify the variables which most discriminate between the two groups. The results, also summarized in Table 3 indicated that the derived single linear discriminant function consists of only five independent variables which are significant at the .05 level of confidence. This function may be expressed as:

$$Z_1 = 0.51_{inc} + 0.42_{motv} + 0.42_{loc} + 0.34_{ten} - 0.30_{insl}. \quad (1)$$

TABLE 2

ATTIDUDE AND BEHAVIORAL CHANGES REGARDING THERMOSTAT REDUCTION: 1976 - 1977 AKRON SMSA

Variable	Response		
	Unreasonable	Reasonable	Very Reasonable
Attitude toward reducing thermostat - 1976	32.6%	34.8%	32.5%
Attitude toward reducing thermostat - 1977	10.9%	37.7%	51.4%
Percent difference, 1976 - 1977	-21.7%	+ 2.9%	+18.8%
	Yes	No	
Adoption of thermostat setback - 1976	38.4%	61.6%	
Adoption of thermostat setback - 1977	89.8%	10.2%	
Percentage difference, 1976 - 1977	51.4%	51.4%	

This function is most highly weighted with income, followed by attitudinal variables, household tenure and the perceived adequacy of home insulation. Clearly the economic variable is very important to the innovation adoption procedure. People with relatively higher incomes appear to be the innovators. The poor, lacking the options open to the higher income groups, develop defeatist attitudes toward life, and therefore do not have the desire to innovate (21, 30). Other energy related studies have noted that upper and middle income families are making more energy-related adjustments than lower income groups (20, 21).

The importance of motivation in the discriminant function indicates that the adopting group is distinguishable from the non-adopters because adopters believe that there will be a payoff for turning back the thermostat. Payoff may be interpreted in either economic terms, thus reinforcing the importance of the income variable, or in social terms, which would indicate a belief in the benefit of society. The second attitudinal variable, locus of control, also indicates a separation of the groups. Those that believe their actions, rather than fate or the actions of others, determine the future, are the adopting population. The relationship between attitudinal variables such

TABLE 3

INFORMATIONAL SOURCES AND FACTORS RESPONSIBLE FOR THERMOSTAT SETBACK: 1976 - 1977, AKRON SMSA

	Percent*
No Response - 1976	35.5
No Response - 1977	37.7
% Difference 1976 - 1977	0.2
Media: TV/Radio/Newspapers - 1976	22.4
Media - 1977	48.6
% Difference 1976 - 1977	26.2
Friends/Relatives - 1976	2.2
Friends/Relatives - 1977	4.3
% Difference 1976 - 1977	2.1
Open Responses:	
Economic Considerations - 1976	39.9
Economic Considerations - 1977	4.3
% Difference 1976 - 1977	35.6
Utilities Info - 1976	0.0
Utilities Info - 1977	4.3
% Difference 1976 - 1977	4.3

*Percent of total responses.

TABLE 4

MANOVA AND DISCRIMINANT ANALYSIS STATISTICS FOR TEMPERATURE SETBACK: NON-ADOPTERS VS. ADOPTERS IN 1976

Manova Statistics:	Wilk's Lamda =	0.70
	F-ratio =	1.88* for 14 and 125 degrees of freedom

Discriminant Statistics:

Variables	Standardized Coefficients for Chronicle Variable
Income	.51
Motivation	.42
Locust of Control	.42
Tenure	.34
Insulation	-.30
Canonical Correlation =	.40

*Significant at the .05 level of confidence.
N = (85 and 53 =) 138.

as these used in this study and behavior are widely discussed in the literature (16, 17).

As regards tenure, the function suggests that those who have resided in their homes for longer periods tend to have adopted thermostat setback. The negative coefficient of the perceived insulation adequacy variable suggests that adopters are those who feel that their homes are less adequately insulated. Taken together these two environmental variables indicate that longtime residents of less than adequately insulated homes have adopted thermostat setback to cut fuel costs. This adoption might also be a cheap substitute prior to the possible adopting of the more expensive process of insulating the home.

In summary, a motivated, moderately high income population that believes it controls its own future has a higher probability of adopting the thermostat setback. This population is also distinguishable from non-adopters because of its perception that insulation levels are less than adequate.

5.3 DIFFERENCES BETWEEN EARLY ADOPTERS, LATE ADOPTERS AND NON-ADOPTERS

To determine the differences between early adopters, late adopters and non-adopters, the sample was divided into those who setback their thermostat before 1977, those who did in 1977, and those who had not. For these groups, the MANOVA results indicate that they are significantly different, indicating the suitability of the data for discriminant analysis (12). It should be noted that in addition to the original fourteen independent variables, four additional variables relating to the late adopter period (1977) were used in this analysis: the attitude, the social norm, motivation and stress. These are more directly related to the stimulus condition (energy conservation through thermostat setback) and, therefore, subject to change. In fact, in section 5 we showed that attitudes toward thermostat setback did change between 1976 and 1977.

Examination of Table 5 shows that only seven of the eighteen variables are significant at the .05 level of confidence. The weights for these on the two discriminant functions are:

$$Z_1 = 0.60_{motv} + .580_{at(1977)} + 0.380_{sn(1977)} + 0.280_{ten} + 0.160_{inc} + 0.070_{loc} + 0.070_{stres(1977)}$$

and

$$Z_2 = 0.30_{motv} + 0.57_{at(1977)} + 1.160_{sn(1977)} - 0.140_{ten} + 0.210_{inc} + 0.040_{loc} + 0.490_{stres(1977)}.$$

The first discriminant function, which separates non-adopters and early adopters, is most highly weighted by motivation, followed by attitude and social norm expressed in 1977 and tenure, income, locus of control and stress experienced in 1977. These positive weightings suggest that households with longer tenure, slightly higher incomes and positive attitudinal profiles were the first to turn back the thermostat. Among the attitudinal variables, motivation and attitude in 1977 have the highest weights. Since the expressed attitude in 1976 was not significant in the earlier analysis (see section 5.2), the significance of attitude in 1977 indicates that over time an increasing gulf is developing between non-adopters and early adopters regarding their feeling and beliefs about the value of thermostat setback. The adopters are more motivated, believe they are in control of their futures, have developed a more positive attitude toward adoption by 1977, feel their friends and relatives favor adoption, are of slightly higher incomes, are feeling discomfort over the increasing cost of heating their homes and have resided in their homes for longer periods than non-adopters.

The second linear discriminant function distinguishes early adopters from late adopters. It is most highly weighted by the perceived social norm in 1977, followed by attitude in 1977, perceived stress-discomfort, motivation, income, tenure and locus of control. The very high positive weighting for social norm in 1977 (compared to 1976) suggests that adopters in 1977 were more affected by the value that friends/relatives placed on energy conservation than those who adopted the innovation in 1976. In addition to the values of friends and relatives, the importance of information in 1977 underscores the importance of communication in the later stages of the diffusion of an innovation. It is also interesting to note that later adopters are less motivated than early adopters (negative weightings) but are experiencing a greater perceived discomfort due to heating bills (stress 0.49). In comparison with the early adopters they have slightly higher incomes and shorter tenure.

A comparison of the results of the discriminant analysis in sections 5.2 and 5.3 reveal certain interesting trends:

i. The role of communication increases as the diffusion of the innovation continues. This implies that any national conservation strategy that is designed to encourage voluntary conservation must have a well executed information-dissemination plan.

ii. Those expressing a favorable attitude toward thermostat setback increased between 1976 and 1977. This indicates that as attitude toward the innovation changes positively, the number of adopters increases.

TABLE 5

MANOVA AND DISCRIMINANT ANALYSIS STATISTICS FOR TEMPERATURE SETBACK: NON-ADOPTERS, TIME 1976 ADOPTERS, AND TIME 1977 ADOPTERS

Manova Statistics: Wilk's Lambda = 0.62
F-ratio = 1.92* for 17, 120 degrees of freedom

Discriminant Statistics:

F - Matrix with 7, 129 degrees of freedom for Inter-group differences.

	Groups	
	Early Adopters	Late Adopters
Late Adopters	2.58*	
Non-Adopters	2.61*	2.34*

*Significant at the .05 level of confidence.
N = 14, 48 and 76.

6. SUMMARY AND CONCLUSIONS

This exercise has yielded several ideas concerning the future of thermostat setback as a strategy for energy conservation policy. Attitudes toward reducing thermostat settings have become positive and adoption of the strategy has increased. It should be noted, however, that while most households have setback their thermostats, the actual temperature reductions are generally modest and well below the seven-degree level set as a national goal. The adopting populations were characterized as middle and upper-middle income households, motivated by various factors. It is clear that after the initial economic shock in the early time period, the media, friends and relatives, and utility companies have aided in changing public attitudes and are assisting in the adoption of thermostat setback.

Based on the findings in this paper, we suggest that to facilitate further adoption, a combination of incentives and/or disincentives be developed by the Federal Government. Such programs could include additional peak-pricing adjustments, subsidies for installation of automatic setback thermostats and new adjustments through new billing procedures. For example bi-weekly or monthly billings showing the consumer the amounts of fuel or electricity consumed with comparable figures for the previous month and year would be initiated. Based on geographic location, the consumer could be told about the loss or gain in energy conservation for the reporting period. A tax credit could be established as an incentive for saving energy.

With the increasing realization that the media are an important source of information, it would be wise to increase advertisements, emphasizing not only the important role of thermostat setback to energy conservation but also potential savings to the consumer. Additionally, it must stress the importance of the seven-degree goal in thermostat setback. Such an advertisement must also aim at convincing the public that such reduction does not cause medical problems.

Related to media advertising we suggest that because social norms emerged as significant in our analysis and the friends/relatives variable gained strength as an information source, a special effort be made to encourage civic organizations to disseminate thermostat setback information. Groups such as the League of Women Voters have become involved in energy conservation policy and could provide an excellent outlet for such information.

Our final suggestion is that lower income households should receive separate and detailed research attention in the future. It is possible that special programs would have to be developed to assist and encourage their conservation behavior. A necessary first step is a detailed survey of their needs, attitudes and behaviors. They deserve immediate attention.

We further emphasize the need for continuing projects that will enhance the ongoing efforts of households now practicing thermostat setback. Such research will contribute to current efforts and develop new methods to conserve home energy use.

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