ADOPTION OF ENERGY CONSERVATION BEHAVIORS AT VARIOUS COST LEVELS

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ABSTRACT

In the United States a number of energy conservation programs have been sponsored by the public and private sectors to help people living in less than adequate housing conditions improve their energy-related behaviors. The purpose of this study is to assess the impact of the energy education program conducted by the Georgia Center for Continuing Education and the Governor's Office of Energy Resources. Between 1986 and 1990, 1,303 personal interviews were conducted by an energy counselor with selected low-income families. After recording the demographic and energy behaviors of the household, the counselor conducted an energy education program. Many of the households also received a second visit by the energy counselor in which a similar process was followed.

Members of the households were interviewed five years after their participation in the original educational program. Interviewers were obtained from Community Action and other social service agencies in the local communities. Interviewers were trained in April 1993. Data collection began as soon as the first group of interviewers were trained. The 601 reinterview surveys were completed by July 1993. The reinterview rate of 46% is high, considering the amount of time that had lapsed. During this reinterview, data were again collected on demographic characteristics, housing characteristics, heating system characteristics, participation in weatherization programs, energy changes since the first visit, factors that influence energy changes, and future plans for energy changes.

Major changes made by the households following the first counseling session were repairs to broken windows and doors, insulating water pipes, and repairing holes and cracks to the floors. In time one, 65% of the respondents reported that their homes were fully or partially insulated. This increased to 72% by time two. The probit analyses demonstrated that the energy counselor significantly influenced the closing off of rooms and closing curtains, the use of air guards, caulking, plastic over windows, repairing of windows and doors, and insulating water pipes. Most of these are relatively low-cost and low-skill activities. The receipt of energy assistance funds increased the likelihood that insulation was added to the home.

INTRODUCTION

In the United States, a number of energy conservation programs have been sponsored by both the public and private sectors to help people living in less than adequate conditions reduce their energy consumption (Walsh and Howard 1987). Brown and Rollinson (1985) suggest that lack of information inhibited elderly and low-income groups from changing their behavior. This is especially significant because the average annual energy expenditure of households in the United States in 1992 was $1,984 (Bureau of Labor Statistics 1993). Thus, it is important to determine whether information (education) will result in changes in conservation behavior.

To target future programs appropriately, it is essential to assess the impact of previous education efforts. This research measures the effects of an energy education program conducted between 1986 and 1990 by the Family and Consumer Sciences Program Unit at the Georgia Center for Continuing Education (Grogan et al. 1991). This program was sponsored by the Governor's Office of Energy Resources. To measure changes in consumer behaviors since the initial educational program, face-to-face interviews were conducted. Only by determining the long-term impacts of programs can educational providers ascertain whether they are focusing their efforts in the right direction and whether their money has been well spent.

The purpose of the program was to provide energy education and counseling to individuals on a one-to-one basis in their homes or in small group settings. Most of the clientele had limited economic resources, therefore, they were shown low-cost energy conservation techniques. The use of home visits helped overcome some of the barriers faced by clientele in coming to a meeting. For example, health and transportation problems prohibited many individuals from leaving their homes. In addition, the home visits allowed the energy counselors to observe the energy practices and conservation techniques being adopted by the clientele, as well as observe the physical condition of the residence. Fear, mistrust, and low educa-

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tional levels of the clientele were other barriers that had to be overcome.

The adoption of energy conservation measures improves the economic well-being of households and contributes to improved health, comfort, and safety. Difficult to measure but beneficial to clients are the sense of control they gain over events in their lives and an improved sense of well-being. Laquatra (1988) presented a comprehensive review of the literature on housing education and residential energy efficiency. This review serves as a resource for educators and others who are working on energy-related programs.

Because of the added cost of one-on-one energy counseling programs, it is critical for these programs to have a long-term impact on the clientele, as well as the sponsoring agency. Therefore, this research attempts to measure the changes in energy behavior over time to determine their overall impact.

The purpose of this paper is to examine the factors that influence energy conservation behavior. These behaviors were classified into three levels: no-cost behaviors that required no economic resources, minimal cost activities, and activities that ranged from moderate to high cost. Demographic and housing characteristics, as well as the influence of the energy counselor were independent variables. Only data from time two are presented because the purpose of this paper is to indicate actions taken after energy education.

METHODOLOGY

Data were collected in personal interviews with the respondents using a survey instrument developed by the Energy Education Program Office. Data were collected before and after the respondents received educational assistance on energy conservation. Data reported here were collected between April and July 1993. The development of the instrument and the data collection procedures are described in detail below.

Development of Questionnaire

The questionnaires for time one were developed by program specialists in the Energy Education Program Office of the Family and Consumer Sciences Program Unit of the Georgia Center for Continuing Education and by a director from the Georgia Office of Energy Resources (Sweaney and Meeks 1993). The original questionnaire was adapted from an instrument used to survey clients participating in "The Energy Event," a project developed by the Cooperative Extension Service at a U.S. university and a state's Corporation Commission. Over the course of the work with families in the energy education program, the questionnaire was revised to be more user friendly so that three versions of the questionnaire for time one were developed. Differences among the questionnaires were relatively minor.

The questionnaire for time two was based on a composite of the time one questionnaires. The questionnaire was further pretested in December 1992 for readability and ease of use. The final questionnaire was both shortened and the language of some of the questions was revised.

Data Collection

Interviews for time one were conducted by the energy education counselors from November 1986 until 1990. The households were visited twice during this time period. The first visit was made to introduce the energy education program and the second visit simply reinforced the information provided earlier. The counselors also collected information on demographic characteristics and energy behaviors of the households.

For time two, interviewers were obtained from Community Action and other social service agencies in the local communities. Interviewers were trained in April 1993. Data collection began as soon as the first group of interviewers were trained. The final surveys were completed in July 1993. Data were collected again on demographic characteristics, housing characteristics, heating system characteristics, participation in weatherization programs, energy changes since the first visit, factors that influence energy changes, and future plans for energy changes. A comparison was made between the two samples to determine changes in energy conservation behaviors (Meeks et al. 1994; Sweaney and Meeks 1994).

Sample

There were 1,301 completed questionnaires from time one. In time two, 858 households were contacted. Budget limitations dictated the number of households that could be contacted. From these contacts, 601 interviews were used in the analysis. Of the remaining 257 contacts, 169 households from the original sample had moved, 42 respondents were deceased, 16 did not answer after at least two attempts, 2 refused, and 28 were miscoded, with the most common problem being names missing or code numbers incorrect. The reinterview rate of 46% is high, considering the amount of time that had lapsed between the two interview periods.

Analysis

Energy conservation behaviors as reported by the respondents were classified into three levels:

1. *no cost*, which included closing rooms to reduce heating or cooling costs, closing windows to keep out cold or warm air, and closing curtains on sunny days[1];

[1]Due to the large proportion of households using space heaters as their primary heating system (57.7%), turning back the thermostat was not discussed with the clientele.

2. *minimal cost* behavior, which related primarily to reducing air infiltration and included use of air guards, caulking, use of plastic over windows, and weatherstripping; and
3. activities that ranged from *moderate to high additional costs*, which included adding insulation, repairing broken windows or doors, and insulating water pipes.

Independent variables included the following household characteristics—age, gender, marital status, race, and receipt of energy assistance funds. Housing characteristics included fuel type, housing type, and use of a space heater. The influence of the energy counselor also was included as a variable. Data on income were not collected because all of the households had to qualify for energy assistance prior to participation in the program. Thus, there would be little variation in this variable. Fewer than 10% of the households had more than three members; thus, household size was not included as a variable in the analysis.

Probit analysis was used because all the energy conservation behaviors were discrete, i.e., coded as zero or one. All data reported in this paper are from time two.

RESULTS

Description of Sample

The majority of the sample (62.2%) were over age 65 (Table 1). Respondents were asked what factors influenced changes in energy habits. The energy counselor was perceived to influence behavior by half the respondents. The predominant heating fuel types reported were electricity (18.3%), LP gas (28.5%), natural gas (45.6%), and other (13.8%). Households were headed by females in 81.2% of this sample, in which 79.1% were single rather than married. Single represents respondents who are widowed, never married, as well as divorced and separated. These characteristics are not surprising given the elderly composition of the sample. The sample is composed of 63% white and 37% African-American respondents. Energy assistance was received by 69% of the respondents, who lived primarily in single-family detached homes. The presence of a space heater in 57.7% of the homes is related to rural location and availability of fuel.

Table 2 is a description of the number of households in the sample that adopted the energy conservation techniques suggested by the energy counselors. Given that 65% of the households had reported that their homes were fully or partially insulated in time one, the small number of households adding insulation is not surprising.

TABLE 1 **Description of the Sample**

Variable (Code)	*n*	Percent
Age		
44 and younger	83	14.2
45–54 years	64	10.9
55–64 years	74	12.7
65 and older	364	62.2
Influence of Energy Counselor		
Yes = 1	302	50.2
No = 0	299	49.8
Fuel Type[a]		
Electricity	110	18.3
LP Gas	171	28.5
Natural Gas	274	45.6
Other	83	13.8
Gender		
Male = 1	113	18.8
Female = 0	488	81.2
Marital Status		
Married = 2	125	20.9
Single = 1	473	79.1
Race		
African-Americans = 2	219	36.9
White = 1	375	63.1
Received Energy Assistance		
Yes = 1	413	68.7
No = 0	188	31.3
Multifamily = 1	140	23.4
Single-Family House = 2	460	76.6
Presence of Space Heater		
Yes = 1	347	57.7
No = 0	254	42.3

[a]Does not total 100 because respondents could have used more than one type of fuel or no fuel.

TABLE 2 **Description of Energy Behaviors**

Behavior	*n*	Percent
No-Cost Behaviors		
Closed rooms	347	57.7
Closed windows	260	43.3
Closed curtains	411	68.4
Minimal-Cost Behaviors		
Air guards	226	37.7
Caulking	196	32.6
Plastic–windows	183	30.4
Weather stripping	275	45.8
Some to High Additional-Cost Behaviors		
Added insulation	28	4.7
Repaired windows and doors	237	39.4
Insulated water pipes	131	21.8

No-Cost Behaviors

Three no-cost energy behaviors were examined: closed rooms, closed windows, and closed curtains.

TABLE 3 **Factors Influencing No-Cost Energy Behaviors**

	Closed Rooms		Closed Windows		Closed Curtains	
Variables	Estimate	SE	Estimate	SE	Estimate	SE
Age	.102	.113	.156	.117	.240[a]	.119
Energy Counselor	.234[a]	.110	−.036	.113	.053	.113
Fuel Type						
Electricity	−.089	.150	−.575[c]	.155	.019	.157
LP Gas	−.097	.129	−.259[a]	.131	.066	.132
Other Fuels	−.113	.160	.632[c]	.183	−.177	.167
Gender	−.103	.157	.075	.161	−.061	.160
Marital Status	−.118	.155	−.069	.159	.088	.157
Race	.094	.115	−.610[c]	.119	−.227	.122
Receive EAP Funds	−.022	.119	−.115	.124	−.000	.124
Single-Family House	−.050	.143	.380[b]	.145	.453[b]	.154
Space Heater	−.543[c]	.117	.205	.120	−.328[b]	.121

[a] $p < .05$
[b] $p < .01$
[c] $p < .001$

TABLE 4 **Factors Influencing Minimal-Cost Energy Behaviors**

	Air Guards		Caulking		Plastic Over Windows		Weather Stripping	
Variables	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Age	−.144	.139	.121	.130	.079	.127	−.109	.126
Energy Counselor	−1.062[c]	.136	.688[c]	.126	−.892[c]	.125	.112	.121
Fuel Type								
Electricity	.040	.184	.466[b]	.189	.147	.181	.039	.168
LP Gas	.311[a]	.159	−.070	.141	.160	.138	.264	.141
Other Fuels	.075	.197	.026	.176	.044	.168	.275	.174
Gender	−.046	.190	.153	.181	−.360[a]	.182	−.065	.171
Marital Status	−.291	.187	.018	.174	−.524[b]	.168	−.032	.168
Race	.542[c]	.144	.004	.133	.007	.129	.444[c]	.129
Receive EAP Funds	−.270	.149	.090	.135	−.105	.135	−.005	.130
Single-Family House	.214	.171	−.727[c]	.175	−.637[c]	.176	−.951[c]	.165
Space Heater	−.301[a]	.145	−.049	.133	−.554[c]	.132	.059	.129

[a] $p < .05$
[b] $p < .01$
[c] $p < .001$

There was no consistency in the independent variables that influenced the adoption of no-cost energy behaviors. Those respondents who reported making changes in their energy behavior as a result of the visits from the energy counselor were more likely to close off rooms. The use of a space heater decreased the probability of adopting no-cost energy behaviors (Table 3). Compared to natural gas, the use of other fuels increased the probability that respondents closed windows, whereas the use of electricity or LP gas as compared with natural gas decreased the probability. Whites were more likely to close windows, as were those who lived in single-family dwellings. Older respondents were more likely to close curtains, as were those in a single-family house. However, the presence of a space heater decreased the probability that the respondent closed curtains.

Minimal-Cost Behaviors

Four minimal-cost energy adaptations were investigated. These were the use of air guards, the addition of caulking, placing plastic over the windows, and weatherstripping (Table 4).

Air guards have been popular as a minimal cost energy-conserving technique. Use of air guards was not attributed to visits by the energy counselor. African-Americans were more likely to use air guards than whites. Households without a space heater and families using LP gas rather than natural gas were more likely to use air guards.

Caulking, which helps to decrease air infiltration, was found to be highly influenced by the energy counselor. More people using electricity rather than natural gas added caulking. Respondents living in multifamily

units reported that their units were more likely to be caulked than residents of single-family homes.

Another common technique used to decrease drafts at minimal costs is to place plastic over the windows. Like the equation for air guards, the energy counselors were not perceived to be influential on the decision to place plastic over the windows. More females than males reported adding plastic over the windows, as did single respondents. Residents of multifamily rather than single-family housing units were more likely to add plastic over the windows. Space heaters were significantly related to the use of plastic on windows. Homes without space heaters were more likely to have plastic over the windows.

The addition of weatherstripping was related to two independent variables—race and housing type. Respondents reporting the use of weatherstripping were more likely to be African American and to live in multifamily housing.

Some to High Additional-Cost Behaviors

Three energy conservation behaviors that had some to high additional-costs were examined. These were added insulation, repaired broken windows and doors, and insulated water pipes.

Younger households were more likely to have added insulation, as were those who received energy assistance funds (Table 5). Repairs to windows and doors were more likely to have been made in multifamily dwellings, by users of LP gas, and were not influenced by the energy counselor. Several variables influenced the insulation of water pipes, beginning with the energy counselor. Use of a fuel other than natural gas increased the probability that water pipes were insulated. Male-headed households were more likely than female-headed households to insulate water pipes. Respondents in multifamily units were more likely to report that water pipes were insulated than those living in single-family homes.

CONCLUSIONS

This study addressed populations at risk for high energy costs and poor-quality housing structures. The sample was composed of predominantly white, female-headed households over the age of 65 (interviewed in nonmetropolitan areas of Georgia). Many of the respondents were widowed and living alone. Because these respondents are not likely to participate in energy conservation programs (Meeks 1990), their inclusion in this program is extremely important. There was a lack of consistency in the roles played by the selected independent variables in the adoption of energy conservation behaviors.

Respondents lived primarily in single-family detached homes. Gmelch and Dillman (1988) found that single-family residence was related to benefits received from energy conservation. Many of the respondents in this study had a space heater, although natural gas was the fuel used by half the sample.

Respondents who attributed the changes in energy behavior to a visit by the energy counselor were more likely to close off rooms, caulk, and insulate water pipes. Use of air guards and plastic over the windows, as well as repair of windows and doors, were not attributed to visits by the energy counselor. Most of these are relatively low-cost and low-skill activities that easily can be demonstrated in person by an energy counselor. The receipt of energy assistance funds increased the likelihood that insulation was added to the home.

TABLE 5 **Factors Influencing Energy Conservation Behaviors with Additional Cost**

	Added Insulation		Repaired Windows/Doors		Insulated Water Pipes	
Variables	Estimate	SE	Estimate	SE	Estimate	SE
Age	−.550[a]	.251	−.219	.141	.034	.137
Energy Counselor	.292	.229	−1.203[c]	.138	.350[b]	.133
Fuel Type						
Electricity	−.123	.315	.107	.195	−.530[b]	.193
LP Gas	−.044	.250	.351[a]	.155	−.392[b]	.141
Other Fuels	.329	.393	−.145	.189	−.472[b]	.168
Gender	−.182	.308	−.123	.196	.501[b]	.184
Marital Status	−.387	.285	−.184	.188	.248	.183
Race	−.354	.226	.132	.143	.077	.139
Receive EAP Funds	.584[b]	.221	−.048	.148	.142	.139
Single-Family House	−.046	.286	−.824[b]	.184	−1.426[c]	.268
Space Heater	−.175	.246	−.177	.144	.256	.142

[a] $p < .05$
[b] $p < .01$
[c] $p < .001$

Age only influenced the addition of insulation, and then it was younger households who added insulation. Adding insulation to a home often takes more physical and economic resources than other energy-conserving techniques. Given that many of the respondents in this study were elderly women living alone, one can speculate that adding insulation would not be an easy task. Thus, programs that provide both labor and financial support would be of assistance.

Race was a significant factor in several equations. Whites were more likely to close windows, while African-Americans were more likely to use air guards and add weatherstripping.

More females than males reported adding plastic over the windows, as did single respondents. Male-headed households were more likely than female-headed households to insulate water pipes. These results would seem consistent with the level of skills to be expected from this sample.

Housing characteristics also had a role in energy conservation behaviors adopted. In each equation natural gas was the omitted variable. Thus, the results must be in comparison with natural gas. Respondents in houses heated with electricity reported that they were less likely to close windows or insulate the water pipes but were more likely to caulk. Respondents in houses heated with LP gas as compared with natural gas were also less likely to have repaired windows and doors. Households using other fuels were more likely to close windows but were less likely to insulate water pipes. This could be the result of the perception of warmth associated with the different types of heat. Natural gas and LP gas are often perceived as warmer, more moist heat sources than electric heat. Given the differences in fuel costs, it would be expected that households in housing units with more expensive fuels would adopt more energy-conserving techniques. No control in the study accounted for education or programs that may have been taking place simultaneously by the utility companies.

Respondents who lived in single-family homes were more likely to close windows and curtains but less likely to caulk, add plastic over the windows, add weatherstripping, repair windows or doors, or insulate water pipes. It was expected that single-family residents would be more active in undertaking energy conservation activities but perhaps landlords are more conscious of the need to conserve energy and did some of the work for the respondents in the survey.

More than half the respondents in the sample had a space heater, many of which were unvented. The presence of a space heater decreased the probability that respondents closed rooms or curtains or added air guards or plastic over the windows. The difficulty of regulating the temperature with a space heater may reduce the need for such conservation measures.

It is critical that at-risk populations receive support to improve the energy use of their dwellings. Hitschler (1993) reported that the largest expenditure for elderly Americans in both 1980 and 1990 was for housing, with utilities consuming 30% of the housing budget. Changing energy consumption behavior is one way to reduce household utility expenditures. This study illustrates the importance of showing individuals how to improve energy conservation.

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