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Family Reactions to Energy Constraints

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Response to Energy and Activity Constraints on Travel (REACT), a game developed by the New York State Department of Transportation's Planning Research Unit to study how families deal with energy constraints, is described. The game, similar to those developed by Burnett, Jones, and Brög, is easily constructed at low cost. It is used to determine household reactions to a variety of policies by jointly showing activity locations, time schedules, travel adjustments, role reallocation, and family decision making. REACT was applied to data from 12 households in Albany, New York, concerning reactions to the 1979 gasoline shortage. Results indicated that two-car households would cut discretionary travel up to and beyond a 20 percent shortfall but would circumvent a no-drive-day policy by shifting travel to the other available car. One-car households, however, carpooled and shifted trip timing and destinations to adjust to both policies.

As a result of the present ongoing energy shortage, various policies to curtail automobile fuel consumption have been considered (1,2). They have been arrived at by various methods, and each implies differing levels of control of the use and allocation of fuel. Unfortunately, it is often difficult to obtain an accurate estimate of the public's likely direct and indirect responses to a particular policy. Some directives might seem to bring about the desired effect but result in severe hardship on certain individuals or families, and frequently there are responses to policies that are not in accord with the intent of those who designed them. For example, a two-car household's response to a no-drive-day energy contingency action might be to chauffeur affected family members by using the available car, thereby actually increasing vehicle miles of travel (VMT). It is, therefore, important to thoroughly investigate the possible impact of a proposed policy before implementing it. Traditional survey techniques, even trip diaries, generally overlook secondary effects such as those mentioned above.

In order to assess these less obvious effects, a survey was made that used an interactive game technique called Response to Energy and Activity Constraints on Travel (REACT). This paper describes the procedure, compares it with similar methods, and presents some preliminary results.

DEVELOPMENT OF REACT

REACT was developed as a tool to seek responses occurring as a result of a wide variety of transportation policy changes, particularly negative changes (e.g., constraints). The technique was developed from other similar procedures used at the Transport Studies Unit of Oxford University (3) and has the advantage of describing household behavior in space and time. Among its early applications was a survey

to determine the effects of changes in school hours in Oxford, England (3). In the United States, a study that dealt with travel options for senior citizens in Oklahoma City (4,5) also employed a generally similar but more structured format. Another survey (by Burnett and Ellerman, described elsewhere in this Record) that used the format was conducted in Baltimore in summer 1979. Other applications are reported (6).

Interest in the game format centers around its ability to analyze jointly activity and travel in space and time and to link household patterns as they occur in reality. The type of data obtained from a small set of interviews of this nature could then be used to create a more realistic survey instrument that would accurately analyze data in an extensive future survey. Thus REACT and games like it are not intended to be used alone but along with more conventional procedures.

GAME BOARD AND PLAYING PROCEDURES

Building on the approach described above, the Planning Research Unit of the New York State Department of Transportation constructed the game board for REACT with the assistance of the woodshop of Burnt Hills-Ballston Lake (New York) High School. In this way the cost of contruction was kept to around $20. The game in this form is practical, versatile, and easy to construct.

The main board consists of a wood plane panel that has a cork center on which any applicable map can be pinned. There are four individual playing boards, each of which has three slots, and each slot is marked with the hours of the day (see Figure 1). The three slots allow a variety of layouts. For instance, they can be used to view three different days of the week, or one base day and the reactions to two other different policies, or in-home activity, out-of-home activity, and travel separately.

Five sizes of playing pieces, which represent time spans of 5 min to 2 h (1 in = 1 h), are color-coded to correspond to 13 types of activity and travel: work, school, shop (necessities), shop (other), social and recreation, personal business, eat meal, sleep, travel by car, travel by other means, change travel means, serve passenger, and other. These components, along with colored pins, a ruler, and rubber bands used to locate trips on the map board, are the basic pieces of the game. The papers of Burnett and Jones (3-5) describe the basic game board in more detail.

The survey was taken during July 1979 in Albany, New York, and surrounding areas. Sample selection was made by means of a "friends of friends" method: Each member of the interview team asked a few of his or her friends to introduce us to a friend who would play the game. This is not a random sample, of course, but since the purpose was to see a range of responses and not to predict proportions it is an adequate method. In addition, the method is fairly easy to implement and introduces the interviewer to the household on friendly terms.

Each survey was performed by two interviewers, one to introduce the game to the household and the other to keep notes of the discussion and a photographic record of the game-board responses. Each interview started with the collection of some basic demographic data, such as age, sex, and automobile ownership. The household was then asked to choose one particular weekday that was reflective of an "average" day. A recent weekday was suggested, so that the respondents could remember clearly the events of the day. The interviewer would then help one household member to set up his or her day on the playing board by using the appropriate color-coded pieces. Then, by using the map board, he or she would place the pins (color-coded to identify the player) on the locations that were visited that day. Next, rubber bands were hooked around the pins to symbolize the trip route followed (using airline approximations). Other members of the household would then follow this example with any necessary assistance given by interviewers. The game board would now be set up for the base weekday. The interviewer would measure the airline distances of trips made by each player (scaled off by rubber bands) and note on each person's data sheet the length of the trip and mode of travel. Color photographs were taken of the game board to preserve a visual record of the household's activity patterns (Figure 1).

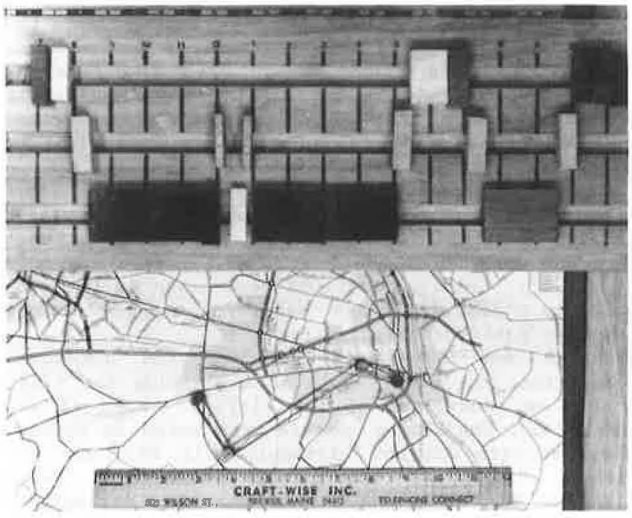
While one interviewer handled the recording activities, the other would be explaining the first policy or constraint to the players. When it was understood, the family members were asked to discuss their decision on how to comply with it. For instance, if they were required to reduce their travel distance by 20 percent (as in gasoline rationing), they would be told what 20 percent of their total vehicle travel amounted to on the base day. They would then discuss what and who would be involved in making the 20 percent savings. The interviewer would take notes on the salient points of the decision process and, if necessary, ask for any reasoning that might not have been verbalized. The household would then proceed to set up the changes on the game boards and map to serve as a visual record of the policy's effect. This visual response on the game board also aids the household in responding accurately about the exent of a policy's effect, since any changes or interactions not accounted for would show up as a conflict in the timing of their activities (i.e., two people using a car at once). A photograph would then be taken and trip changes noted on the data sheets, as before. During this process the interviewers paid special attention to respondents' reasoning processes, such as options considered but rejected, and to any difficulties encountered in adhering to policy stipulations. Probing questions would be asked when any response was not made clearly or when the full reasoning process seemed uncertain.

POLICY ANALYSIS

Many policies relating to automobile fuel consumption are being discussed by state and federal governments. However, to avoid the possibility of alienating the household members it was decided to keep the length of each interview to 2 h at most. This constrained the investigation to a few chosen topics. Some policies would not show effects unless a full week of activity could be examined, and this would again involve interviewing time constraints. So another criterion for choosing the policies was selected: whether they show results readily in the one day of activity that would be examined. Reactions to four different policies were investigated:

1. One no-drive day per week (Monday-Thursday): Each automobile would be marked with a decal or other indicator, and on one day each week it could not be driven.
2. One no-drive day per week (weekend): This policy is the same as above except that it would apply only to weekend days.
3. A 20 percent reduction in travel (weekday): As the result of a shortfall in gasoline availability, weekday travel would have to be cut by 20 percent.
4. A 20 percent reduction in travel (weekend):

Figure 1. Example of setup of the board.



Same as above but the cut is made on a weekend day.

Policies 1 and 3 are tested first, against the base weekday chosen. The household would repeat the process for a base weekend day--either Saturday or Sunday. After setting up their game boards to represent the chosen day, new data sheets would be filled out for each household member with the details of their weekend travel. The two other policies (2 and 4) would be introduced singly and responses recorded as before. At this point, the formal game was completed, and comments were sought from the household members in order to obtain feedback on their responses to REACT as a research tool.

RESULTS

Figure 2 presents the effects of the two policies that would reduce household VMT by 20 percent. It can be seen that one-car households placed a slightly greater emphasis on weekday work travel than did multicar households in the type of travel affected. The actions taken to reach this level of conservation are similar, although one-car households did more mode switching for weekday travel than two-car households did. Trip planning is relatively less important to two-car households.

For the no-drive policies (Figure 3), the type of travel affected is almost identical. Both household types emphasize nonwork travel on both weekdays and weekends for their conservation efforts. However, the types of action used are significantly different among households. One-car families focus on mode changing under the no-drive policies, which is to be expected. The two-car households exhibited circumventing behavior; that is, they followed the rules of the policy without engaging in conservation behavior. Their primary actions dealt with using the other car to meet their travel needs, so their fuel conservation was not as great as some policymakers have expected.

The results of this survey are similar to reactions seen in previous energy shortfalls. Many of the responses to these energy-conservation actions were outlined in a study of the travel impacts of the 1973-1974 oil embargo (7) and have been observed in the 1979 crisis (8). These responses included eliminating or reducing discretionary travel, combining trips, and some carpooling. Mode switches to public transit services were infrequent and short-lived in general.

FAMILY CASE STUDY

Although the results presented in Figures 2 and 3 were generally expected, and planners may argue that these results could be obtained by other, simpler data collection methods, it must be emphasized that REACT provides a much richer data source than most other methods, for it allows respondents a much wider range of possible reactions. In order to illustrate this richness, an example of one household's reactions to the proposed policies is given.

The family consists of a father, a mother, and a preschool child. They own two cars and both adults work. For their base weekday travel, the mother drives the child to a babysitter, then drives to work, then drives home. The father uses the other car to drive to work, then picks up the child at the sitter's house on his way home. After supper, the father drives to a local gymnasium for a basketball game, while the rest of the family remains at home. This completes the picture of the base weekday travel patterns for this household.

Under the policy of a 20 percent reduction in travel for the household, discussion among the family members quickly resulted in deletion of the evening trip to the gym. This came as no surprise, since it was the only trip of a purely discretionary nature. However, the real value of the REACT game manifests itself when the second weekday policy was introduced, the restriction of not driving one of the cars on this day (no-drive day). Under this policy, the options were much less clear. Use of local transit by either worker for the work trip was rejected because of poor service--either poor scheduling or bus stops too far from the destinations. In addition, the need to bring the child to the babysitter complicated matters. A change in babysitters was discussed, but the lack of any known options resulted in disregarding that choice. The option selected consisted of the father carpooling with a co-worker for his trips to work, the babysitter's house, and home again. While this action may have solved this particular household's energy "problem", the net result would be an increase in total energy use resulting from the extra driving experienced by the co-worker (the trip to the babysitter, then to the original family's house, then back to his home). This type of response and result would not have been uncovered by using most data collection methods.

DISCUSSION

The REACT game allows the family to select any response its members feel is appropriate, travel or otherwise. Some travel problems can be solved by nontravel actions. This results in impacts on many different areas completely ignored in typical transporation study data. In addition, examination of the decision process in the selection of the household's response may suggest other policies, such as rescheduling or rerouting a bus line, that could be implemented if the demand is present.

Restrictions imposed on a person's travel will also have some effect on his or her daily activity pattern. To ascertain the degree of this effect, it is necessary to look at the household's entire travel and activity patterns. Here, many interactions are likely to be present, and any change in the daily routine of one household member could very well cause stress in the whole household. This could occur as the result of an inequitable role shift when one person is forced to take on extra duties (e.g., a wife may have to run more errands if her husband is carpooling). Of course these effects would be expected to vary within different segments

Figure 2. Results of 20 percent reduction in VMT.

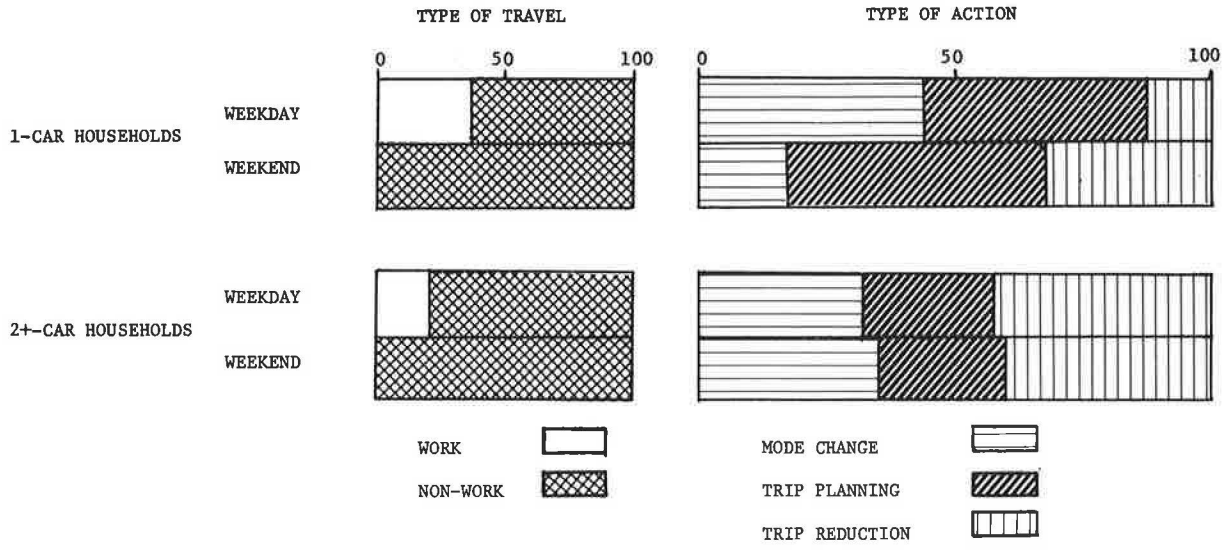
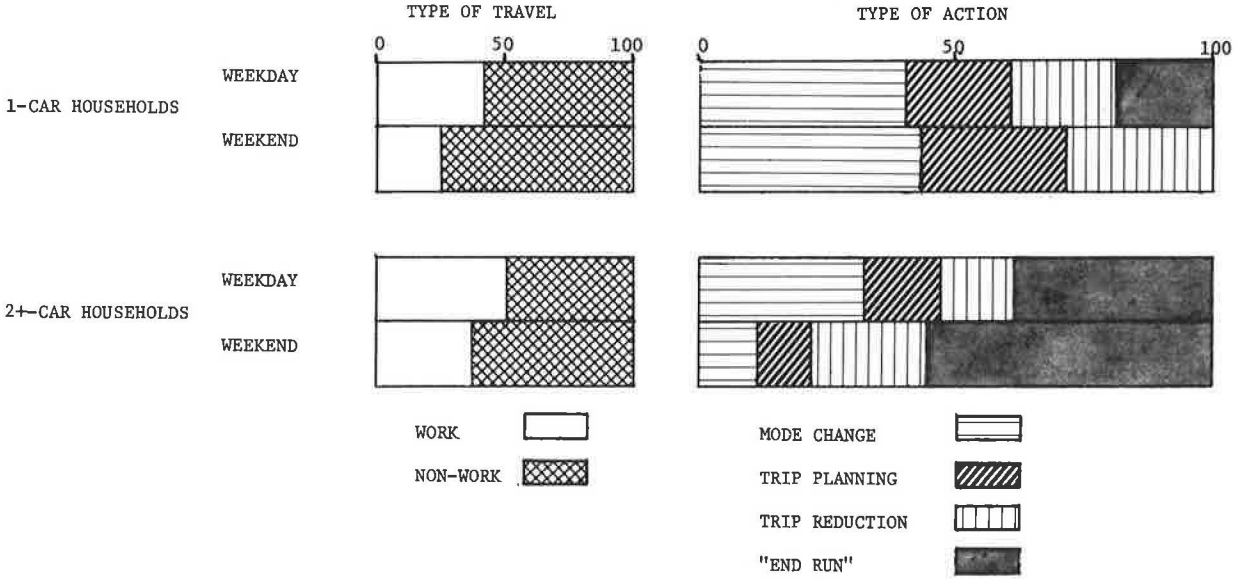


Figure 3. Results of no-drive day.



of the population since some segments exhibit a greater degree of flexibility than others.

As REACT looks at the activity patterns on the household level, interactions and role shifts become apparent. Because of the visual nature of the game board, the persons being surveyed can readily understand the constraints on their activity and respond more accurately. The interviewer also benefits, since he or she can interpret the full response more quickly. The response includes not only the option that was finally selected but also those considered and rejected (and the reasons for rejection). REACT will also expose any unforeseen effects that may be concealed in the enforcement of a particular policy. Many of these aspects of REACT are missing from conventional survey techniques.

Overall, then, the REACT game allows the collection of an extremely rich and varied data source. It allows a first-cut analysis of many types of policy actions and can be used to develop supporting strategies to enhance and magnify the results of the policies under investigation. The method will continue to be developed by the New York State Department of Transportation, which will report on progress periodically.

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Perceived-Difference Segmentation Model for Mass Transit Marketing

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Cluster analysis was applied to the differences automobile users perceive between the attributes of mass transit and those of automobile travel. This approach generated three stable, replicable market segments whose members exhibit sharp differences in their likelihood of switching from automobiles to mass transit. One of these segments contains a large number of individuals who have a high probability of switching; this segment was identified as a priority target segment. The cluster analysis also produced readily interpretable information that can provide transit planners with a means to develop mass transit service design and advertising strategies to effect mode switching.

Since 40 percent of U.S. oil supplies are devoted to automobile gasoline, the diversion of substantial numbers of people from private automobiles to mass transit would produce substantial energy savings. (Throughout the text, "mass transit" and "transit" will refer to public bus transportation.) For this reason, mass transit has been called on to play an expanded role in government energy policy. However, to date it has proved difficult to persuade Americans to forgo the personalized comfort and convenience of private automobiles for public transit.

It is becoming clear to transportation planners that there are no universal appeals, such as cost incentives, that successfully influence a broad range of individuals to switch to mass transit. Most attempts at converting private car drivers to mass transit (1-3) have not employed a market segmentation strategy--nor have they been particularly successful.

Transportation researchers are increasingly urging transit planners to use the segmentation approach (4-11). In general, segmentation is a method of identifying groups of consumers who have similar travel values, perceptions, and needs--and thus similar reactions toward transportation system changes. Identification of these groups (market segments) makes it possible to make more effective use of mass transit resources by tailoring transit services and promotion to the specific needs of distinct market segments.

A need has recently been identified to differentiate nonusers of mass transit in terms of their potential to switch from single-occupant automobiles to mass transit (12). In this paper a market segmentation approach will be described in which nonusers of mass transit are segmented on the basis of the differences they perceive between the attributes of mass transit and those of private automobile travel. Not only does this approach identify target market segments, but it also provides detailed diagnostic marketing information about each segment that is useful in designing mass transit service and promotion strategies to induce switching behavior.

BASES FOR MARKET SEGMENTATION

Several types of variables have been used by transportation researchers as a basis for segmenting transportation markets. Each segmentation base has its advantages. As Nicolaidis, Wachs, and Golob (8) and other researchers have noted, no one basis of segmentation is best for all purposes; the research project goal should determine selection of a segmentation base.

The most basic form of segmentation is in terms of user status (current mode choice). This segmentation base is often modified to take into account the frequency with which various transportation modes are used (7).

Sociodemographic variables such as income, age, and education have also been used as a segmentation base. Because of the relative ease with which sociodemographic information is collected, this type of segmentation was one of the earliest applied to transportation. Currently, sociodemographic segmentation is probably the most common form of market segmentation in transportation planning (8,13,14).

More sophisticated market segmentations have attempted to define homogeneous groups of individuals by basing the segmentation on some