ACKNOWLEDGMENT

We gratefully acknowledge the support of the German Ministry of Transport, the Integrated Transport Systems of Munich and Stuttgart, and the German Automobile Association. Special thanks are also extended to Peter Jones and Martin Dix for their extensive and constructive contributions in reviewing a first draft of this paper; to Hans Fechtel, Otto Förg, and Wilfried Schwerdtfeger for their help in developing the methodological instruments described in this paper; and to Monica Gora for translating the German version of this paper into English.

REFERENCES

1. SOFOS. Sonderauswertung--KONTIV (Kontinuierliche Erhebung zum Verkehrsverhalten) 1975: Verkehrsmittelwahl, Fahrtzweckstrukturen, Besetzungszahlen, Munich 1978.
2. Vergleich der KONTIV-Ergebnisse mit anderen Untersuchungen zur Verkehrsteilnahme von älteren Menschen sowie Kindern und Jugendlichen. In Art und Häufigkeit motorisierter und nichtmotorisierter Verkehrsteilnahme, Sozialforschung Brög, Munich, 1978.
3. W. Brög and A.H. Meyburg. The Non-Response Problem in Travel Surveys: An Empirical Investigation. TRB, Transportation Research Record (forthcoming, 1980).
4. Sozialforschung Brög. From Price Elasticity to Price Sensitivity: A Reality-Oriented Model for Influencing Transportation Fees According to Demand. Presented at Conference in Public Transport Systems in Urban Areas, Göteborg, Sweden, June 1978.
5. Verkehrsmittelwahl im Berufs-und Ausbildungsverkehr. Sozialforschung Brög, Munich, 1975.
6. Fly and Ride. Sozialforschung Brög, Munich, 1979.
7. H.D. Lasswell. The Structure and Function of Community in Society. In The Communication of Ideas (L. Bryson, ed.), Institute for Religious and Social Studies, New York, 1948.
8. W. Brög and K.H. Neumann. The Interviewee as a Human Being: A Critical Contribution to the Discussion of Methods in Empirical Social Research. Presented at 44th European Society for Opinion Surveys and Market Research, Seminar on Ways and New Ways of Data Collection, Jony-en-Josas, France, Nov. 1977.
9. W. Brög, D. Heuwinkel, and K.H. Neumann. Psychological Determinants of User Behaviour. Presented at 34th Round Table on Transport Economics, Conference Europeene des Ministres des Transport, Paris, May 1976.
10. W. Brög and W. Schwerdtfeger. Considerations on the Design of Behavioural Oriented Models from the Point of View of Empirical Social Research. Presented at the World Conference on Transport Research, Rotterdam, the Netherlands, April 1977.
11. W. Brög. Behaviour as a Result of Individual Decisions in Social Situations. Presented at Research Conference on Mobility in Urban Life, Arc-et-Senans, France, Sept. 1978.
12. W. Brög. Mobility and Lifestyle--Sociological Aspects, Part II: Modal Choice. Presented at 8th International Symposium on Theory and Practice in Transport Economics, Conference Europeene des Ministres des Transport, Istanbul, Sept. 1979.
13. W. Bungard and H.E. Lück. Forschungsartefakte und nicht reaktive Messverfahren. Teubner Verlag, Stuttgart, 1974.
14. H. Benninghaus. Ergebnisse und Perspektiven der Einstellungs-Verhaltens-Forschung. Verlag Anton Hain, Meisenheim am Glan, West Germany, 1976.
15. Verbesserung der Spielmöglichkeiten von Kinder auf öffentlichen Strassen im Wohnumfeld. Socialdata, Munich, 1979.
16. P.M. Jones. "HATS": A Technique for Investigating Household Decisions. Environment and Planning A, Vol. 11, 1979, pp. 59-70.
17. P.M. Jones. Assessing Policy Impacts Using the Household Activity-Travel Simulator. Oxford University Transport Studies Unit, Oxford, WP 18, 1977.
18. Preiselastizität der Nachfrage im ÖPNV. Sozialforschung Brög, Munich, 1978.
19. Autokostenuntersuchung. Sozialforschung Brög, Munich, 1978.
20. Die Nutzung des ÖPNV bei Mehrpersonen-fahrten und die Marktchancen eines Familien-tarifs beim VVS (Verkehrs- und Tarifverbund Stuttgart). Socialdata, Munich, 1979.
21. Ermittlung der für den städtischen Personenverkehr relevanten Verhaltens-muster von Haushalten. Sozialforschung Brög, Munich, 1977.
22. Preiselastizität der Nachfrage im ÖPNV. Sozialforschung Brög, Munich, 1978.
23. W. Brög and O.G. Förg. Potential Reactions of Users of Public Transportation to Fare Increases. Presented at 59th Annual Meeting, TRB, 1980.

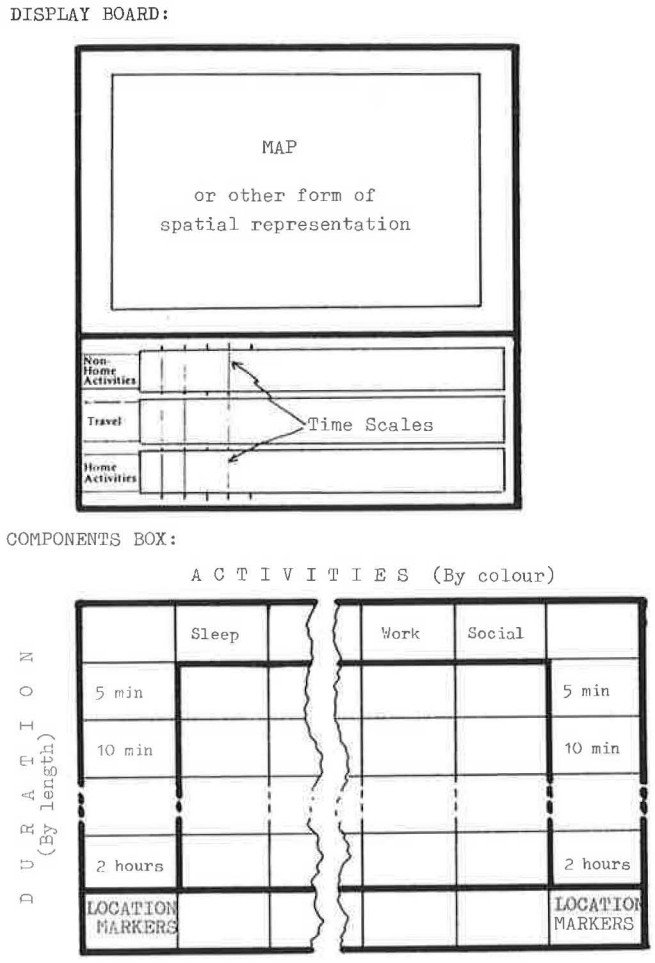
Experience with Household Activity-Travel Simulator (HATS)

PETER M. JONES

Ways in which the Household Activity-Travel Simulator (HATS) has been used in a research context to investigate aspects of household travel behavior and its more recent application as a policy tool and an educational aid are described. Use of the equipment as a laboratory simulation exercise in which students or practitioners take on the roles of household members and simulate their responses to proposed policy measures is also discussed.

The Household Activity-Travel Simulator (HATS) was developed as an exploratory research tool to investigate the role of travel in people's daily lives and the ways in which households adapt to various changes. It is an interactive

Figure 1. HATS equipment.



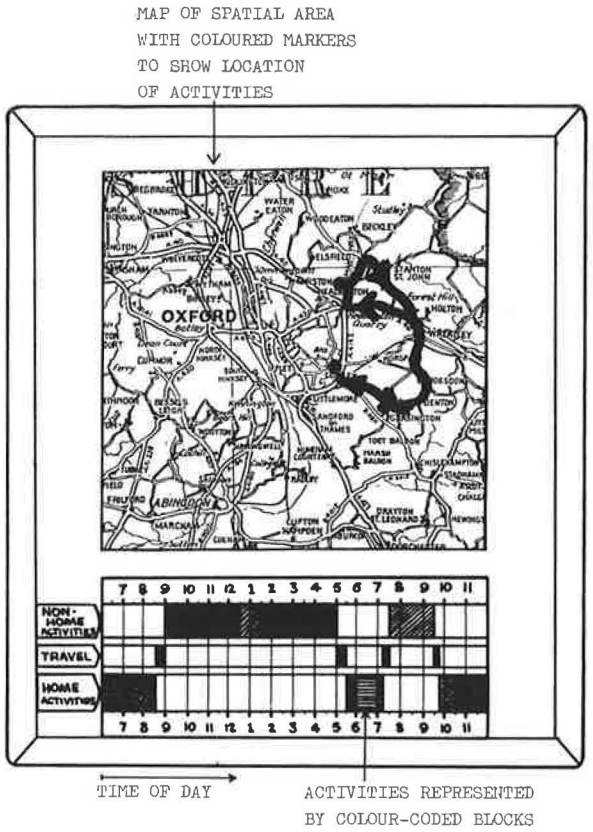
household-based survey technique that uses display equipment as part of a group in-depth interview to examine daily behavior patterns. The technique may be used to study the formation and structure of existing household activity-travel patterns and the ways in which households adapt their behavior to a range of natural changes (e.g., life-cycle transitions) or to external, policy-based measures (e.g., traffic restraint policies).

The survey equipment and survey procedures have been fully described in previous papers (1,2). The HATS equipment consists of a set of display boards and a components box (Figure 1). Each board consists of some form of map of the local area, beneath which are three horizontal time scales for recording one person's in-home, travel, and out-of-home activities. A respondent uses color-coded blocks to construct a representation of his or her daily activity-travel pattern on the board. The blocks indicate type of activity at a particular time of day (on the appropriate time scale) and the location markers on the map indicate place. In addition, the map shows route and mode information. A completed HATS display board is illustrated in Figure 2.

Interview procedures vary in detail with the type of application, but three broad stages may be identified:

1. Representation of existing behavior on the boards and a discussion of the reasons for this

Figure 2. A completed HATS display board.



pattern (factors probed cover basic routines, the scope for day-to-day variation, constraints and interpersonal linkages, and preferences and perceptions),

2. Introduction by the interviewer of some form of natural or induced change to which the family is requested to respond, and

3. Examination by household members of the likely impact of the change on their daily lives by using the boards as a test bed for possible options, as a focus for group discussion, and perhaps also as a means of evaluating the benefits and disadvantages of the proposal.

In stage 2 a change may be introduced either because the interviewer is specifically interested in reaction to a policy measure or as a device for inducing a response so that the processes of adaptation can be studied. Analysis of responses is based on both the changes made on the boards and a taped recording of the bargaining and discussion.

The boards depict travel as part of a daily activity pattern in time and space; this helps to identify the role of travel in daily life and shows the interrelationships between travel and nontravel activities. Because the boards provide a continuous picture of behavior, they reveal logic flaws and thus make clear the direct and secondary consequences of a change in the location or timing of an activity. They show, for example, whether as a result of revised working hours a respondent is attempting to be in two places at once, is participating in two primary activities at the same time, or has unaccounted-for periods of time in his or her day. After the boards thus help to define certain objectively feasible responses to a change, the respondents can more easily agree on a preferred

behavior pattern. Such factors as interpersonal linkages and household or individual perceptions of, and preferences for, alternative courses of action can also be considered.

This paper discusses experience gained in developing and using HATS over the past four years. The technique has now been used in a variety of ways as a research, policy, or educational tool. A distinction is drawn between field applications that use sampled households and the more recent use of HATS as a laboratory simulation exercise. In the simulation, students or professionals assume the roles of members of prototypical households.

FIELD APPLICATIONS

The HATS technique was developed in 1976 as part of a project on Understanding Travel Behaviour (3) funded by the U.K. Social Science Research Council in response to a growing disenchantment in the United Kingdom with the standard aggregate, four-stage travel-demand model. The project used unconventional survey procedures to explore travel decision making. A dual quantitative-qualitative approach based on the use of activity diaries and follow-up unstructured in-depth interviews soon evolved. This method has provided many useful insights into household travel behavior that could not have been obtained by more conventional means. As the project evolved, however, it became apparent that further methodological development was necessary to enable researchers to examine the dynamics of household adaptation to change.

The diary and in-depth interview approach needed to be supplemented for three main reasons. First, it was sometimes difficult for respondents to verbalize either the formation and structure of their daily behavior or the main constraints and linkages that shaped behavior. Second, any diary framework is essentially static: It describes existing behavior patterns but does not directly provide information about the dynamics or nature of adaptation (though it can be used to describe the outcome of that process). Finally, experience showed that people found it difficult to anticipate how they would respond to a specific change: The direct effects were usually appreciated, but the secondary effects were often not apparent at first sight. What was needed was something that would enable respondents to trace through the repercussions on the household day of a change in the characteristics of one event (e.g., change in school hours).

The introduction of a visual display into the group in-depth interview was designed to overcome these inadequacies; it has succeeded in doing so to a surprising degree. The visual format enables respondents to readily describe and account for their patterns of travel and activities and to identify major constraints, options, and key linkages between different events and with other household members. The style and phasing of the interview lead to a realistic simulation of the dynamics of bargaining and adaptation and, in conjunction with the logic checks identified on the display boards, help respondents to identify more fully and realistically the direct and secondary impacts of changes in their daily life. This supplementary identification was apparent in the first field trial of HATS (4), in which respondents had prior knowledge of a change in school hours that was to be implemented shortly after the interviews. Most respondents had already given some thought to effects of this change, but many identified consequences during the HATS interviews that they had not thus far anticipated.

In a more general way, the display equipment provides a focus to the in-depth interview that helps to remove feelings of nervousness among participants. They become better able to discuss factors that may indirectly affect or be affected by travel but that would not normally be openly discussed in this context, for example, bathroom and breakfast arrangements. As one respondent observed, "I think it is quite useful. It does what it's designed to do. It makes people more relaxed, I think, and able to work out their bits and pieces, rather than just direct questioning."

The concepts embodied in the HATS technique appear readily intelligible to most respondents, yet the novelty of the approach is sufficient to sustain their interest through an interview lasting up to 1.5-2 h, even where there are children present. Experience has shown that HATS works particularly well with larger households that comprise both adults and children. Such families are affected by a wide range of policies because of the variations in the ages and occupations of their members, and they often adapt in complex ways because of the nature of their constraints and linkages. These groups are often difficult to study by means of more conventional interview procedures. At the other extreme, HATS has also been used successfully with single-person, retired households, although problems can arise here as a result of physical disabilities or lack of comprehension. The technique may also be less appropriate to retirees because of the lack of structure, or constraints and linkages, in a person's day.

The technique is also well liked by interviewers. Having the boards as a central focus makes it easy to visually check responses. Board use also ensures that the whole group is occupied at the same time and generates a lot of spontaneous discussion, thereby obviating the need for much detailed and repetitive probing.

RESEARCH APPLICATIONS

The Household Activity-Travel Simulator was developed to provide an exploratory research tool able to deal with three aspects of daily travel behavior--the structure of daily activity-travel patterns, the processes by which households alter established patterns of behavior, and the forms of the various outcomes of adaptation. These aspects have been investigated in a series of studies that cover school-hours changes, rural bus service cutbacks, and urban bus and rail service improvements.

The technique has been very successful as a device for examining the structure of daily behavior and in identifying formative factors. Behavior can be characterized as participation in a set of activities that satisfy physiological, sociological, and personal needs at certain locations where appropriate facilities are available. The sequence, precise timing, and location of activities depend on characteristics of the activities (e.g., frequency of the need to sleep), on availability of land use and transport facilities in space and time, and on various commitments to joint activity participation (e.g., meals) or constraints imposed by the availability of shared resources such as a car. Travel is a space-shifting activity that enables people to take part in successive primary activities at different sites.

The display boards help to identify the major activity needs and interpersonal and space-time constraints on behavior. They also vividly demonstrate the contrasts and similarities in routine activity-travel patterns between the various

life-cycle groups according to differences in car ownership, life-style, etc. The taped recording of the discussion identifies further sets of factors that influence behavior, such as differences in preferences for and perceptions of activity and travel facilities. Indeed, it might be possible to use the technique to explore perceptual time and space by getting respondents to impose their own scale on the boards. HATS brings together attitudinal and engineering approaches to the study of travel behavior by enabling options to be studied in the context of subjective and objective constraints and by making full use of both qualitative and quantitative modes of analysis.

A major advantage of the HATS technique lies in its ability to give the interview a dynamic dimension that enables the researcher to observe the simulated process of household adaptation and the resultant response patterns. It is also possible to examine the group dynamics of response and the ways in which these relate to the changing set of opportunities and constraints as alternative readjustments are considered. Study of option discussions can provide useful information about individual and household preference structures and decision rules (e.g., over priority use of the car) and about the thresholds and discontinuities in response that affect the restructuring of the activity-travel pattern.

HATS makes it possible to study the explicit and implied priorities and preferences of household members by observing their choices in constrained situations. The notion of trade-offs is basic to the HATS representation of daily behavior since, with time allocation fully accounted for, more time on one activity can be gained only at the expense of less time on another. Theoretically, an examination of activity trade-offs could even reveal the relative value attached to activities at the margin--to examine the value of time, for example, in terms of its opportunity cost. What is apparent from the interviews is the extent to which people will try to maintain key elements of their activity pattern as circumstances change and the high priority attached to many forms of family activity.

All activities consume time and occur at specific places; timing is constrained by the availability of facilities, by joint commitments to other people, and (indirectly) by the need to reserve certain time slots for other activities. When a policy measure significantly affects the characteristics of travel or some other activity, it may thus be difficult for the household to make a marginal adjustment. An activity pattern is analogous in some respects to a kaleidoscope: A small adjustment has little effect, but above a certain level of stimulus a new pattern may be formed. A threshold point is reached when it is necessary to make changes to other aspects of behavior if the policy measure is to be accommodated (forced change) or taken full advantage of (permissive change). An example of the latter is the opening of the downtown section of the Washington, D.C., Metro (5). Significantly improved accessibility between the major office and shopping areas enabled substantial numbers of people to carry out, during their lunch break, shopping activities previously undertaken in the evenings or on the weekends (often at a different location). The HATS technique is an effective device for examining the operation of thresholds and the restructuring of behavior because of its display form and the dynamic, interactive nature of the interview.

Through HATS it has been possible to distinguish a number of distinct response patterns (3) on the basis of the degree of adjustment involved--in particular, whether there are any secondary effects and, if so, the extent and nature of these effects. The HATS studies suggest that people adopt a hierarchical approach to adjustment, ranging from minimum adjustment to established routines through basic locational changes at the other extreme, as the possibilities for local adaptation are exhausted. The technique demonstrates how daily stresses may arise that cannot be resolved by adjusting behavior within existing constraints. HATS thus has potential for use as a tool in residential location studies, for it can provide some insights into the relationship between transport infrastructure and land use patterns.

The work on response patterns has led to the notion of model domains (6) in which structures and assumptions of different models are fitted to the behavioral characteristics of different types of response patterns so that an appropriate model will be selected for use in a particular policy assessment study. HATS research has made it possible to identify the types of change that conventional models may be expected to handle adequately and to suggest some characteristics of new model forms that might be developed for use in higher-order domains. An activity scheduling model that uses a combination of programming techniques has recently been developed (7). Its model rules are based on the information about response patterns derived from HATS and related studies.

HATS is thus proving to be a very rich and versatile exploratory research technique for examining the travel behavior of households. It is providing insights that have a wider applicability throughout the social sciences.

POLICY APPLICATIONS

HATS was first presented publicly to an audience of engineers, planners, and consultants in summer 1976 (8) and received a mixed reception; most people were puzzled by the notion of such a technique, and some simply regarded it as a joke. Since then attitudes have changed to a remarkable degree, both with regard to HATS and toward unconventional approaches in general, and the pendulum has swung to the point where some now mistakenly see the technique as a panacea.

Once HATS had demonstrated its ability to provide useful information in a research context, the Transport Studies Unit began to be contacted by planners and engineers at local authorities and by other groups of practitioners who were interested in using HATS to formulate policy. Early interest focused on HATS as a predictive device, a replacement for or complement to conventional modeling efforts. As practitioners have gained experience in the techniques, however, they have discovered that it can be of much wider value--for example, at the stages of problem identification and policy generation.

The interest in HATS as a predictive tool arose from our concern to know whether HATS was correctly simulating household responses. Its accuracy would affect confidence in the findings of the research studies. Where possible, HATS was used in the framework of a before-and-after study, so that simulated outcomes could subsequently be compared with reported adjustments. Perceiving its potential policy application, the Transport and Road Research Laboratory commissioned consultants to carry out a small study to evaluate and test HATS predictively (9) in the context of rural bus service cutbacks. The results were tentative but quite encouraging. HATS did seem to give a good indication of probable response and provided useful information about the impacts of the proposed policy.

On the basis of this finding, two HATS studies were carried out in conjunction with local authority staff to examine probable household response to proposals to improve urban public transport services. The first study dealt with improvements to bus services from a residential development to the center of Basildon new town, Essex (10); the second looked at proposals for rail and bus service improvements over a wider area, along a corridor from the center of Reading (11). Both studies differed from much of the previous HATS-based research work because they dealt with permissive rather than forced policy changes. This complicated the survey procedures inasmuch as it was necessary to establish the relevance of existing services to the activity patterns and life-styles of the families before considering how family members might make use of the service improvements. Useful results were obtained, but it proved impracticable to provide detailed forecasts of patronage in the second study, largely because this depended so heavily on the reliability of the new services.

In our initial contacts with practitioners in local authorities, there seemed to be a feeling that the only role that HATS--or any other applied research tool--could usefully play was to provide improved predictive models to help in the quantitative assessment of policy impacts. Early discussions about the use of HATS in one proposed study of school-hours and school bus changes, for example, were based on expectations that the technique would be used to indicate the effects that a specific school-hours proposal would have on households--until it was pointed out that, while it could do this, it could also do much more. It could, for example, by looking at the structure of household activity-travel patterns and identifying the amount of their inherent flexibility and the nature of the constraints on them, provide guidance on which form of revised hours would be most acceptable to parents and what problems changes might cause. In this way it would be possible to develop a profile of resistance to change in the timing of school hours (by type of family and amount of change) that could be used to guide the selection of an appropriate policy measure.

When carrying out HATS studies with planning agencies we encourage as much involvement of their staff as possible in the survey and analysis work in order that they may obtain optimum benefits from the exercise. Typically, we carry out a small pilot survey to demonstrate the technique's usefulness and to adjust survey and analysis procedures to local conditions. We then limit our role mainly to that of staff training and survey supervision. For many staff members it is their first introduction to more qualitative survey techniques, and for groups such as modelers it is a valuable experience for them to meet and learn about the types of families for which they plan. It is common to find that exposure to HATS changes people's awareness and helps them to adopt a broader view of their planning function. It may lead to new policy proposals, alter how data are collected and analyzed, or affect the ways in which transport and other services are marketed. In several cases HATS has been successfully demonstrated to local politicians, who generally take no interest in standard modeling exercises.

HATS is thus increasingly being viewed not simply as a technique for forecasting policy impacts but also as a device that can help with other aspects of transportation planning, such as policy generation and problem recognition. This role expansion is reflected in some of the more recent study proposals, in which it is intended to use HATS as an exploratory policy tool to investigate problems of mobility and access, etc. Experience has also shown that information gained in HATS interviews can subsequently prove of value to planning agencies in unanticipated ways. In Basildon, for example, planners were able to use information from HATS interviews to help in the design of suitable publicity material for the new bus service.

It seems likely that HATS will be of greatest value in policy terms when used in conjunction with other techniques, either in advance of or along with more conventional procedures. Because HATS interviews provide detailed high-quality data from relatively small numbers of households, a combination of HATS and other available sources (e.g., census data or transportation study data) will provide balanced information necessary for comprehensive policy assessment.

There are many occasions when it would be unnecessary or inappropriate to use an in-depth approach such as HATS--for example, when well-documented studies monitoring similar changes elsewhere exist. It is important, therefore, to see HATS as a useful addition to the existing range of analysis techniques, rather than as a panacea for solving transport problems.

The contribution of techniques like HATS to U.K. transportation planning in the 1980s is discussed in Jones (12). Specific suggestions as to the ways in which HATS can assist in policy analysis are

1. Problem identification--identification of problems faced by groups of the population;
2. Policy generation--clarification of problems to suggest ways in which they might be resolved;
3. Policy screening--provision of a means of rapidly checking the feasibility and likely range of effects of a set of policy options;
4. Policy impacts--identification of specific direct and secondary policy impacts;
5. Prepilot technique--identification of key factors (including method of presentation) to be incorporated in a structured questionnaire survey;
6. Monitoring--establishment, when used as component in a monitoring exercise, of what effects a policy is having and why;
7. Model selection--provision of a guide for the selection of a model that has an appropriate structure through knowledge of likely response patterns;
8. Forecasting--provision of approximate forecasts where household responses are likely to be very complex and not susceptible to formal modeling;
9. Evaluation--quantitative measurement of impact and qualitative information about household reaction to policy measures;
10. Policy communication--explanation (by using a case-study approach) of policy ramifications to politicians;
11. Policy interaction--illustration of the joint effects on families of policies that are being implemented independently by a number of government agencies;
12. Public participation--communication of policy options to the public with possibility of feedback; and
13. Marketing--provision of insights that may be used in a commercial marketing exercise (e.g., stressing the benefits of new transit scheme, as perceived by some families).

LABORATORY SIMULATION EXERCISE

One of the major benefits that planning agency staffs have derived from using HATS in field studies has been their broadened awareness of local issues and increased understanding of travel behavior. The

potential of HATS as an educational aid is becoming increasingly apparent (13), and an educational manual is currently in preparation to adapt HATS for use in a laboratory rather than a field setting (14).

The simplest type of educational application involves the use of the display equipment to illustrate basic concepts, such as activity sets, constraints, and linkages, and to demonstrate the role of travel in daily life. Behavior patterns characteristic of different life-cycle groups may also be represented, as may the direct and secondary impacts of policy measures on household activity-travel patterns. There are limits, however, as to how far this essentially static approach can usefully be taken. It can lead to a slightly clinical and mechanistic treatment of household adaptation, and it then becomes difficult to convey the operation of various constraints and linkages in larger households or the dynamics of bargaining. Once students have grasped basic concepts, it is useful to go one step further and get them to use the equipment and become the households they are examining. Thus, they reinforce their learning by running a gaming simulation exercise.

The laboratory simulation exercise uses a modified version of the HATS household interview procedure and the full survey equipment. Course participants play the roles of members of selected households; they learn how the household organizes its daily life and then simulate their responses to a range of policy proposals. Participants may be bona fide students, engineers and planners, local politicians, or trainee interviewers. The exercise works well when there are between 10 and 25 participants (representing two to five types of household).

Compared with the visual display exercises, the gaming simulation introduces a dynamic element that captures the process of adjustment (rather than simply noting its outcome) through group interaction, bargaining, and personal trade-offs. It also introduces other subjective factors such as perceptions, preferences, and evaluations that are not represented directly on the boards. An example of household simulation is included in Jones (13).

Given the role-playing nature of the educational exercise, there are certain types of policy measures and aspects of adaptation that can be handled more realistically than others. Confronted with an improved bus service, for example, a dogmatic participant might simply decide not to use it--and that would be the end of the exercise! For this reason, more obligatory policies to which the players have to respond in some way (e.g., change in work or school hours or elimination of a bus that they normally take) are generally introduced at first. Once participants have become familiar with their roles, however, it is possible to explore the possible ramifications of more permissive policies, such as improvements to the transit service, provision of new shopping facilities, or the introduction of a carpool. The display equipment acts like an analog computer and helps to identify feasible options, but there are certain aspects of a real family's life--such as the particular aspirations, preferences, and perceptions of its members--that cannot be replicated in this exercise. Results are thus only a guide and do not substitute for field surveys.

Despite these caveats, experience to date has been encouraging. The format of the exercise makes players relaxed and rapidly breaks down any inhibitions; they seem able to readily adapt to the roles they have been given and to simulate the decision processes of actual households with a surprising degree of realism--provided they share a common cultural background.

There are perceptible differences in the ways in which students and practitioners respond to and benefit from the gaming simulation. Students readily adapt to the exercise and easily handle it and their presentations on conventional transport modeling, etc., at the close of the exercise, although some have never before attempted to address an audience. Practitioners are generally much more skilled at lecturing but find the idea of the exercise rather strange and approach it more warily. Once involved, however, they usually make very good participants (having had more experience in some of the roles) and show more immediate benefits from the experience. Role-playing presents them with a different view of their everyday problems and many are genuinely surprised and excited by it, especially if they have already become aware of certain inadequacies in the conventional approaches.

The laboratory simulation exercise has been demonstrated at many conferences and seminars in Europe and North America and forms part of several graduate transport courses. Here it usually follows lectures on conventional modeling techniques and is used as an introduction to alternative approaches and procedures. The exercise is also a standard component of the HATS interviewer training program; it is effective in demonstrating the function of the HATS interview and makes participants aware of what it is like to be an interviewee.

CONCLUSION

Work is continuing on the development of HATS through the improvement of equipment and survey procedures, the preparation of manuals for educational and other purposes, and the encouragement of a range of well-documented applications.

HATS is now being considered for a growing range of applications in transportation and land use planning. Most work has so far been carried out in the United Kingdom, but discussions are being held with organizations in the United States, Australia, Germany, Norway, Sweden, and South Africa. Studies of the following are now in progress or under discussion:

1. Impact of a new rapid transit system,
2. Optimum scheduling of low-frequency bus and rail services,
3. Design and monitoring of a new paratransit plan,
4. Mobility of residents in a new city,
5. Difficulties in access to a new regional hospital,
6. Options for school-hours changes in an urban area,
7. Policies to stagger work hours in an urban area,
8. Factors affecting residential relocation,
9. Life-style and activity pattern characteristics of different household groups,
10. Identification of household response patterns, and
11. Design of improved data collection procedures.

The technique is but one example of a range of new survey and analysis procedures that are making a growing contribution to transport research and application and may lead to changing attitudes in transportation planning (12).

ACKNOWLEDGMENT

The development of the HATS technique was undertaken as part of a U.K. Social Science Research Council project on Understanding Travel Behaviour. Subsequent applications have been funded by the Basildon Development Corporation, the Rees Jeffreys Road Fund, and the Transport and Road Research Laboratory. Much of the work described here was carried out with the assistance of Martin Dix and the encouragement of Ian Heggie, director of the Transport Studies Unit. The HATS equipment is covered by a U.K. manufacturing patent held by the National Research Development Corporation.

REFERENCES

1. P.M. Jones. HATS: A Technique for Investigating Household Decisions. Environment and Planning A, Vol. 11, No. 1, 1979, pp. 59-70.
2. P.M. Jones. Methodology for Assessing Transportation Policy Impacts. TRB, Transportation Research Record 723, 1979, pp. 52-58.
3. P.M. Jones, M.C. Dix, M.I. Clarke, and I.G. Heggie. Understanding Travel Behaviour: Final Report to Social Science Research Council. Transport Studies Unit, Oxford Univ., April 1980.
4. P.M. Jones. School-Hour Revisions in West Oxfordshire: An Exploratory Study Using HATS. Transport Studies Unit, Oxford Univ., Publ. 068/PR, June 1978.
5. News Section. Transportation, Vol. 7, No. 2, June 1978, pp. 247-248.
6. I.G. Heggie and P.M. Jones. Defining Domains for Models of Travel Demand. Transportation, Vol. 7, No. 2, June 1978, pp. 119-135.
7. M.I. Clarke. The Formulation and Initial Development of an Activity-Based Model of Household Travel Behaviour. Transport Studies Unit, Oxford Univ., Working Paper 116, March 1980.
8. P.M. Jones. An Investigation of Households' Response to Car Restraint and Other Policy Measures. Proc., Seminar N, Planning and Transport Research and Computation, Inc., Annual Meeting, Warwick, England, July 1976, pp. 330-343.
9. Martin and Voorhees Associates. Reductions in Rural Bus Services: An Independent Assessment of the HATS Technique. Transport Studies Unit, Oxford Univ., Publ. 072/PR, June 1978.
10. C. Brown and P. Mawson. Improvements to Bus Services in Basildon: Applicability of HATS to Local Urban Planning. Transport Studies Unit, Oxford Univ. (forthcoming).
11. P.M. Jones and M.C. Dix. Household Travel in the Woodley-Earley Area: Report of a Pilot Study Using HATS. Transport Studies Unit, Oxford Univ., Publ. 071/PR, Nov. 1978.
12. P.M. Jones. Land Use and Transport Planning: A Time of Transition. The Planner (Journal of the Royal Town Planning Institute), Vol. 66, No. 2, March 1980, pp. 37-39.
13. P.M. Jones. The Use of HATS in Transport Education. Presented at 6th World Conference on Transport Research, London, April 1980.
14. P.M. Jones. HATS Educational Manual. Transport Studies Unit, Oxford Univ. (forthcoming).

Family Reactions to Energy Constraints

SUSAN P. PHIFER, ALFRED J. NEVEU, AND DAVID T. HARTGEN

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