1 Attitudinal Data

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To properly view the role of attitudinal data in urban transportation planning, we enlarged the scope of this workshop from data requirements on comfort and convenience to include more extensive uses of psychological data in models of basic travel decisions. This more general scope arose from a consensus that behavioral analysis of travel choice has a much broader potential with psychological data than merely with subjective dimensions of modal attributes.

The major research objectives that were subsequently defined focused on the determination of basic travel choice variables and their ultimate relation with design factors and behavioral groupings. Thus, the goal of this workshop was to propose stages of research in the investigation and development of a forecasting methodology that associates observed travel behavior with the attitudes of the population toward system attributes and policy variables. It was further indicated that the attitudinal models must satisfactorily relate to the real world and provide a design-directing process in contrast to the present methodology that evolved as a resource-allocation process.

Discussion and references on the foundations for psychological models, the type of data obtained, and the basic measurement techniques are given in later papers by Michaels and by Golob and Dobson and are not repeated here. The behavioral theory advanced by these authors is that travel decisions are not neatly defined by a sequential process (i.e., generation, distribution, modal choice, and route choice) but arise from a complex interaction of considerations relative to making or not making a trip and choosing the destination, mode, and route. Accordingly, any model of travel behavior should accurately model the relevant decision process. In this respect, a valid model of the decision process must (a) include the variables on which people base their decisions, (b) possibly combine sets of these variables into more basic dimensions (multivariate techniques), and (c) describe how people actually use the dimensions or variables to make travel decisions. In this sense, the experimental design must determine as well as measure the relevant variables in a decision. For example, if comparisons of temperature and seating arrangement with other attributes show them to be important, they should be included in a representation of the decision process. Also, associated measures such as ratings on 0 to 1 scales are needed to relate how individuals perceive attributes at various physical degrees. These hierarchical (among attributes) and degree measures must then be interpreted in terms of broader characteristics, such as comfort, wherein there might be direct trade-offs between temperature and space as opposed to indirect trade-offs between temperature and travel time.

If users of contemporary transportation planning models are to be able to implement research results, an evolutionary process of behavioral model development is recommended. This strategy can be initiated by improving the modal-choice methodology.

Here, the modal-choice model, which derives choice patterns on the basis of behavioral measures rather than, or in addition to, physical dimensions, should be investigated to provide a true abstract representation of travel modes to facilitate predictions of demand for new as well as existing modes. By directly or indirectly incorporating appropriate measures such as comfort, convenience, and reliability into the prediction algorithm, a significant increase in the explanation of variance over existing models will result.

BEHAVIORAL ASSUMPTIONS

Existing disaggregate modal-choice models, which are calibrated by regression, probit, or logit techniques, hypothesize that people trade off certain quantities of variables and that they maximize their satisfaction (or minimize their dissatisfaction); that is, utility theory applies. Other interpretations of the decision mechanism are possible, however. For example, one alternative viewpoint states that people rank in order the basic attributes and, if mode A is superior to mode B on the most important dimension, mode A is chosen. Another theory of travel-choice behavior hypothesizes that people do not optimize but "satisfice." That is, if both modes A and B are satisfactory on a given attribute (perform adequately relative to a minimum threshold), there is no trade-off with respect to that attribute. Consequently, each of the 3 interpretations may be correct in different circumstances. For example, in studies on the value of time, people are assumed to trade time for money in urban travel. The time factor is dominant regarding business travel and the air mode, and air conditioning is a "satisficing" attribute. The behavioral process must, therefore, be understood if any realistic model is to be consequently derived and, hence, the underlying behavioral assumptions are critical.

Furthermore, disaggregate modal-choice models, which are based on the trader hypothesis and use direct measures of time and cost, have provided a means to estimate the value of travel time, which has become an important consideration in project evaluation. This process becomes more complex when indirect psychological measures of these system attributes are used. In this case, concepts of utility theory intervene and transform attitudinal assessments into indexes of satisfaction for competing modes. These indexes or utilities are then correlated with observed choice behavior to explain fundamental decision processes. Therefore, the key element in the psychological model is the index of satisfaction, which is founded on attributes such as comfort and convenience as well as on time and cost measures. The utility transformation is derived from the explicit behavioral assumptions that underly the model, and if, for example, the trader assumption prevails, then the value of time estimates will be indicated in the intermediate utility transformation.

DATA CONSIDERATIONS

The data requirements for models based on behavioral measures to predict transport demand are potentially fewer than those for current models. This conclusion is founded on the observation that, if preferences are measured and behavioral groups established, the findings from a limited number of studies can be generalized to provide a universally applicable set of behavioral axioms regarding travel choices. It is recognized that there are many complications in reaching such a goal, particularly aggregation considerations (the definition of behavioral groups) and interarea consistencies among these classifications. However, the potential benefits from behavioral models are encouraging and, hence, problems anticipated at this early stage of investigation should not discourage future research.

Specific data must be based on the particular choice process being analyzed and, accordingly, measure certain individual needs. In transportation planning the basic phenomena that must be measured include frequency of activity (trip generation), preference structures of destinations (trip distribution), satisfaction with modes of travel (modal split), and a preference structure for routes of travel (route assignment). Analy-

sis of these processes requires that a single survey provide attitudinal or preference data, socioeconomic information, and travel-choice behavior. Surveys should be longitudinal in nature to reflect changes in travel behavior relative to system changes and individual attitudes. With respect to complete data needs, the proposal by the U.S. Department of Transportation to collect a disaggregated data set was welcomed by workshop members. It was further recommended that a central data library be established to relieve researchers of the data collection problem. Several small survey projects that relate choice situations would be more expeditious to behavioral model development than large areawide surveys. This conclusion reflects the need for a survey design more detailed than past designs because, even though the transportation planner lacks a controlled environment, he or she must be careful to derive demand hypotheses from individuals who do have alternative choices available.

Techniques are well established for the collection of travel data and relevant socioeconomic information on trip-makers and will not be discussed here. Rather, the collection methodology exclusive to psychological data is addressed.

METHODOLOGY

Primary psychological information is gathered via scaling procedures that include the following: paired comparisons, rating scales, ranking data, and binary data. These techniques differ in degree of cost and sensitivity of measurement and should be tested and compared in problem applications to arrive at a consensus on techniques for specific applications (i.e., modal satisfaction versus preference structures of destinations). The questionnaire must provide reliable information on travel needs (preferences or how attitudes ideally relate to individuals) and satisfaction with given options (perceptions). Because the task of questionnaire design is extremely demanding in content and detail, experts should be consulted. In this respect, a handbook to assist planners in questionnaire design should ultimately be developed.

The psychological measures found should then be subjected to diagnostic analysis, i.e., hypothesis formulation and citation of groups that exhibit similar choice behavior, and eventually incorporated into the development of predictive models. The data are first scaled via univariate or multivariate techniques (see Golob and Dobson paper in this Special Report), and then individuals are aggregated into behavioral groups. At this point, no prior assumptions should be made to relate behavior to socioeconomic groups because it is a fundamental goal of this approach to seek classes on the basis of behavior and then relate them to demographic groups. The scaled data are combined to produce utilities or measures of satisfaction that must be related by some mathematical structure to observed choice (a behavioral prediction model).

The resulting model must be thoroughly examined regarding its capacity for realistically handling the following major methodological requirements:

1. Specifications of class boundaries for homogeneous groups;
2. Validation from longitudinal data to show sensitivity to changes over time; and
3. Sensitivity of behavior to changes in transport systems, technology, and controls.

The findings should also be tested and validated in case studies, particularly with respect to before and after data from controlled demonstration projects.

RECOMMENDED RESEARCH

The aforementioned study design is recommended for application to travel-choice modeling in an incremental fashion. The workshop recommends that initial, or short-term, research should be concerned with the incorporation of psychological dimensions of level of service into the modal-choice model to make it more complete than the existing models. The goal is to determine the important behavioral factors underlying mode choice and the establishment of a mathematical formulation for the model. Here

psychological data would be transformed to indicate modal satisfaction, which in turn would be used to indicate mode choice. At this initial stage of study the relations between behavioral sets and the traditional classifications employed in transportation planning should be investigated. Finally, the linkage between perceived attributes with manipulatable operational variables and design factors should be made.

In the intermediate state, the psychological model should be applied to the activity site selection and route-choice decisions. In the former case, a cognitive space for travel will be rendered. Various travel spaces, such as the preference structure by activity type (trip purpose) and geographic location, and activity spaces by travel mode can be investigated.

A behavioral route-choice model should be designed to diagnose particular elements relative to the route-choice decision so that an association is provided between the traveler and his or her environment. Such an association is not incorporated into conventional diversion approaches based solely on travel time and distance.

In the long-term phase of investigation into a true behavioral modeling system, the trip generation stage should be broadened to show sensitivity to activity importance and, consequently, need to travel. Such a methodology should be designed to show the relative effects on total travel demand that result from innovative social-technological schemes such as shopping via cable TV, working at home, and reducing the workweek.

Finally, if the above research provides successful models, the sequential decision models should be interrelated to define a realistic behavioral structure of the elements involved in travel decisions. Thus, the end product may be a completely new planning process with true behavioral foundations.

The research has been recommended in the described incremental fashion to integrate the results into the conventional planning process and, consequently, to slowly introduce the practitioner to the new models. The workshop concurs that the research must be useful and yet basic to achieving the broad goal of an improved planning methodology.