

Traveler Behavior and Values Research for Human-Centered Transportation Systems

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Understanding human behavior and human values was recognized many years ago as a key ingredient in the planning of communities. In-depth understanding of human nature is essential to the planning, design, and operational analysis of transportation systems. However, quantitative tools to understand human behavior and values have only partially been developed in the past few decades. In this area, basic and applied research has been very active, and it is only lately that we realize the benefits in practical applications. Incorporation of research findings into decision making for public policy has been slow, but it is accelerating, mainly because of recent environmental and transportation legislation and associated research investments in most of the industrialized world. A similar but much faster trend is observed in private enterprise, where market forces are imposing efficiency and customer service that requires understanding of human nature. These trends are expected to continue with increasing urgency for better decision-support tools designed around human needs and wants. In parallel, new scientific fields of research will continue to develop and strengthen, providing the milestones and support needed to understand, describe, and predict human behavior. The need for better tools provides strong support and motivation for the ideas and activities of the Committee on Traveler Behavior and Values.

The committee promotes research and disseminates research results on traveler values, attitudes, and behavior. "Traveler values and attitudes" refers to motivational, cognitive, situational, and dispositive factors determining human behavior. "Traveler behavior" refers primarily to the modeling and analysis of travel demand on the basis of theories and analytical methods from a variety of scientific fields. They include, but are not limited to, the use of time and its allocation to travel and activities, the use of time in a variety of time contexts and stages in the life of people, and the organization and use of space at any level of social organization, such as the individual, the household, the community, and other formal or informal groups. Behavioral issues are also considered in the movement of goods to the extent necessary. The committee is North America's major forum for the development, promotion, and testing of experimental or emerging interdisciplinary methods.

Given the interdisciplinary approach needed to understand human behavior, the future of the committee's work in the new millennium is inevitably one of conceptual integration. Explanations of facts from different perspectives are considered together to form a comprehensive understanding of people, their groups, and their interactions with the natural and built environment. In this way, the use of different methods to explain human behavior is more likely to give way to universally agreed upon principles. These principles in turn lead to testable hypotheses that, when probed from different perspectives, will yield

Wilson's consilience among, for example, biology, social sciences, ethics, and environmental policy (1).

Continuing along the path of behavioral travel demand models of the 1970s (2,3) and developments mainly in the social sciences, travel behavior and values are examined from both objective (observed by an analyst) and subjective (perceived by the human) perspectives (4–7). Most important in this respect is the understanding of behavior in an integrated time-space domain (8). In this undertaking, time, as conceived in everyday life, is integrated with perceptions of time and space. Research activities include theory formation, data collection, modeling, and inference [for a specific focus on panel surveys see Golob et al. (9)]. There is also a need to experiment with new analytical tools that have been under development in statistics and econometrics, psychology, and the biological sciences.

INTEGRATED TIME-SPACE TRAVEL DEMAND MODELS

Today, most people live in environments that are complex in form, function, structure, and information exchange. The built environment is the result of decisions made by individuals, households, and organizations. These decisions are made in the context of environmental constraints, and the attitudes, beliefs, and values of people and society. Individual and group decision making is multifaceted, diverse, and dynamic. As a result, the trends of man-made environments are dynamic as are the needs and concerns of the people involved, and the policy actions to consider. Consequently, processes of future development, growth, and management are dynamic and complex. Research in the longitudinal, spatial, and integrated time-space areas is offering new models of behavior that take into account social interactions and intrapersonal, interpersonal, and environmental constraints addressing the complex character of these processes.

One key element in human life is the way time is used in the pursuit of personal and societal goals. Studying the time allocation patterns and their determinants by households and household members is becoming the natural method for studying time expenditures for travel. Early in travel behavior research, it was recognized that travel is one of the means people use to participate in activities (10). As a result, travel behavior methods emerged from the proposition that travel demand is derived from the desire to participate in activities and evolved into activity-based approach, expanding the field's traditional research boundaries. In this way, researchers can understand the complex pattern of substitution between time at home and out of home, the use of stationary and mobile telecommunications technologies to complement and substitute for travel, shifts between travel for work and travel for leisure, the effects of increasing pace of life on travel, time allocation within a day and across days including weekends and its effects on predictability of travel demand, the effects of labor force composition shifts on travel, and so forth. Subsequently, this framework was expanded again to adopt a more holistic viewpoint to include the entire spectrum of time use. Some questions posed to this end are the following:

- What are the best approaches to activity and time use data collection?
- What are existing surveys telling us and what are their weaknesses?
- Are there notable trends in time use patterns by social, demographic, and geographic profiles?
- What are the relationships between time use patterns and activity engagement behavior?

- What can time use tell us about travel behavior?
- How can time use studies explain the relationship between travel and activity scheduling?
- What are the issues in building better models of time use and activity scheduling behavior?
- What are the reciprocal effects between land use–urban form and time use–activity behavior?
- What are some key constructs and frameworks for integrating time use and activity notions in travel models?
- When is time use behavior most effectively mediated by information and transportation systems?

Travel-related decision making by people and groups is also, by definition, within a spatial context. Decisions on where to locate activity centers, where to live, and how to interact with other people and groups have a strong spatial component. The committee's focus is also on fundamental research on cognitive aspects, spatial behavior, and learning concentrating on factors affecting route choice, pretrip and en route wayfinding, and behavioral responses to advanced traffic management systems and advanced traveler information systems. Route choice is examined as one dimension of network and activity analysis for location and destination choice. For example, the committee is examining behavioral models as they relate to network simulation and analytical modeling such as dynamic traffic assignment.

BEHAVIORAL ASPECTS OF GOODS MOVEMENT

Goods movement also involves judgment and decision making. The Committee on Traveler Behavior and Values is concerned with the behavioral aspects of freight transportation, addressing the following types of questions:

- How do the decisions of and the decision-making structures used by shippers, carriers, customers, and freight forwarders affect goods movement costs, volumes, and distribution patterns?
- How do freight shipper and carrier mode, route, vehicle, and contractual choices vary by type of commodity and by type of business?
- How is real-time information affecting these decisions?
- What are the perceived opportunities for intelligent transportation systems, improved intermodal transfers, and other cost-saving technologies to influence the behavior of freight shippers and carriers in the future?
- What types of empirical evidence and analytical models exist from which researchers can develop a better understanding of these and related freight mover/freight movement issues?

The objective of the committee in the new millennium is to advance the state of the art in goods movement with the same energy and enthusiasm with which it is advanced in the passenger travel demand field. Current committee activities include information gathering, and a roundtable discussion of activities and perceived research and development needs. To

this end, participants from academia, government, and the private sector are recruited to become actively involved in the committee's collaborative work with other committees.

DATA COLLECTION

All this modeling activity has created new needs for data collection. Many unanswered questions persist regarding the efficient collection of passenger and freight transportation data. There is, however, a notable trend in the research community toward more in-depth data collection, providing richer information about behavior. One such example is the interactive survey, in which a dialogue is established between the interviewer and the interviewee and a continuous acquisition of information and knowledge takes place. These new methods are not a substitute for other, more traditional methods such as the more passive multiple-day diaries in their various forms. In addition, the committee is evaluating the variety of methods used for longitudinal assessments of behavior such as panel surveys, repeated cross-sectional surveys, censuses, and so forth. Some more specific tools in this area are data collection methods that unveil the full spectrum of multiple decision making and judgment strategies and the ways in which they change under differing situations and circumstances. Methods of collecting real-world data, in-laboratory data, and combinations of the two are also considered. New technologies—such as personal digital assistants, global positioning systems, and the Internet—are considered potential tools to improve data collection.

The ultimate objective of theory building, data collection, understanding, and modeling is the creation of decision-support tools that can be used to describe a population and its behavior, predict its behavior under varying scenarios of policy and market actions, and prescribe specific actions in policy making. All three types of tools are in the target domain of the committee, and they all share one important characteristic—they are human-centered decision-support tools.

DESIGN OF HUMAN-CENTERED DECISION-SUPPORT TOOLS

Regional travel demand forecasting tools and statewide long-range transportation planning systems have been the decision-support tools targeted by traveler behavior research for many years. Travel behavior models have been used for urban and intercity travel studies aiding decision making. Limitations of these tools, such as lack of behavioral realism and inability to address new policy issues, created a need for better decision-support systems. The need for more realistic and flexible tools will continue well into the next century. For example, demographic and economic simulation is needed to depict future scenarios of urban evolution and to capture urban dynamics. In addition, flexible model systems are needed to study the effect of policies that cannot be tested in the real world. For example, incorporation of notions from supply chain management into goods movement and truck travel forecasting is needed to reflect the interacting behavior of producers, shippers, carriers, receivers, goods retailers, and consumers. Analytical systems that are based on spatio-temporal models of behavior using geographic information systems, among other tools, may lead to much better decision making than we see today. To do this, however, we need to design new approaches for long-range planning that integrate human behavior and values with engineering analysis for priority-setting in program development and project selection. This will lead to decision-making support models that incorporate knowledge management and information use by state agencies to select major project initiatives

affecting specific regions, corridors, or an entire state. Further, these tools will be more informed and tailored to the public needs and designed around strategic and business plans by agencies and firms. These tools are being developed today and will continue to be developed in the new millennium using stochastic simulation, computational process models, and intelligent agent technologies. Examples have appeared in the past few years, and they are expected to emerge in a richer multitude of designs and forms in the next 10 to 20 years.

Private enterprises are also in need of tools that address passenger travel and goods movement in parallel. Many examples of intricate relationships between passenger travel and goods travel emerge from electronic commerce. For example, strategies of “household replenishment” aim at an extension of vendor-managed inventory to the household level, which grocery stores may restock household pantries on a just-in-time basis. In a less sophisticated form, households engage in other purchasing behavior using telecommunications. Such emerging systems have the potential to reduce shopping trips to grocery stores, which could increase the time available to households to pursue other activities. The strategies may also increase the number of truck trips made in delivery. Such changes in trip-making behavior could also significantly affect land use and transportation systems. Technologies for implementation that will collect real-time data on the need for goods from homes are being tested. For example, groceries can be sensed using mechanical and chemical devices built into grocery storage facilities at home, and existing telecommunications networks and the Internet can be used to transfer the data without human intervention. Such a scenario has unknown implications for both passenger travel and goods movement. For example, grocery stores, as we know them today, may shift into warehouses aided by fleets of vehicles for deliveries. In addition, time savings for people may lead to even more travel to leisure destinations at even less predictable times than is the case today. This example illustrates the type of scenarios we will need to consider in future private and public decision-making actions. It also indicates the behavioral issues that need to be considered by a private enterprise in its planning and operations. The associated behavioral models and the decision-support tools we need to study the costs and benefits of these strategies do not exist.

The Committee on Traveler Behavior and Values promotes investigation and integration of developments in the area of judgment, choice, and learning from disciplines such as economics, system dynamics, behavioral geography, psychology, artificial intelligence, and artificial life. The committee is solidly positioned, not only because it aims at the theoretical integration and use of principles for research, but also because of its academic focus. Addressing the issues of future systems as described above also requires a new breed of professionals with expertise in business management, business logistics, traveler behavior, transportation legislation, and so forth. For this, training is provided to the future transportation professionals in many universities and laboratories represented on the committee. These trends in transportation problems and future analytical needs are examined and incorporated into curricula to train new generations of analysts. In the new millennium, with the design of new transportation systems and the study of new issues, we will also see new transportation courses closing the gap among different disciplines.

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