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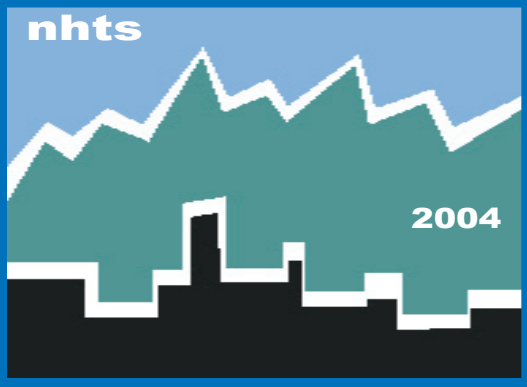
National Household Travel Survey Conference

November 1–2, 2004



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Data for Understanding Our Nation's Travel

National Household Travel Survey Conference

November 1–2, 2004
The National Academies Keck Center
Washington, D.C.

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Preface

The National Household Travel Survey (NHTS) Conference, Data for Understanding Our Nation's Travel, was designed as a forum for users of this national data set to discuss and learn about methodological issues; analysis and estimation applications; and findings related to transportation policy, planning, and modeling. It followed by 5 years its predecessor conference, Personal Travel: The Long and Short of It, which focused on the 1995 Nationwide Personal Transportation Survey and American Travel Survey. The present conference was held in Washington, D.C., on November 1–2, 2004, approximately 1 year after the release of the final data from the 2001 survey and coincided with the planning of future U.S. Department of Transportation household travel behavior surveys.

The effort to bring together a diverse set of data users was intended to develop a community of users who would better understand the utility and analytic capability of the data and subsequently provide feedback to inform the design of future national travel behavior surveys. This conference offered a unique opportunity for transportation professionals at the federal, state, and local levels, as well as for academics and other transportation researchers to

- Discuss results of NHTS-based investigations of critical areas for transportation policy,
- Learn about innovative applications of the data to understand and estimate travel behavior,
- Provide input on the design of future national household travel surveys,
- Identify emerging trends and data needs that should be reflected in future survey efforts, and
- Discover data sources that complement the NHTS data in providing a more complete picture of travel behavior in the United States.

The planning committee represented personal travel data producers, analysts, and modelers and was chaired by Johanna Zmud, Nustats Partners, LP. The 132 persons attending reflected organizational diversity. Their distribution is as follows:

Organization Type	*%*
USDOT	23
State government	6
Metropolitan planning organization or local government	11
University	18
Private company	28
Other	14

The committee convened regularly over almost a year to organize the 1½-day program, which combined

- Overviews of current and future survey plans;
- Paper sessions that reported both uses of NHTS data and methodological issues;
- Workshops, anchored by resource papers, at which key issues were explored; and

- Key observations on the conference by Joseph Schofer of Northwestern University.

This report is a collection of session summaries written by the session chairs and general speakers. Papers and presentation summaries can be found on the conference website at http://www.TRB.org/Conferences/NHTS.

The conference was organized by the Transportation Research Board. The Bureau of Transportation Statistics provided funding and support. The other conference cosponsors were the American Association of State Highway and Transportation Officials and the American Public Transportation Association.

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Role of National Household Travel Survey Within U.S. Department of Transportation

GEORGE SCHOENER
U.S. Department of Transportation

By bringing together a variety of National Household Travel Survey (NHTS) users and transportation experts, this forum provides an opportunity to discuss and learn about methodological issues, analysis and estimation applications, and findings related to transportation policy, planning, and modeling.

Participation in this discussion reaffirms the U. S. Department of Transportation's (USDOT's) commitment to pursue the NHTS. The NHTS was created to help in understanding and analyzing the travel of individuals and household units regardless of mode. For more than 30 years, the NHTS and its predecessor survey, the Nationwide Personal Transportation Survey (NPTS), have provided information to policy makers, transportation planners, and others who need comprehensive data on travelers and travel patterns in the United States.

These surveys have served USDOT and the transportation community well, providing a rich source of quantitative data to use as a framework for tracking the travel behavior of the American public over the past three decades and identifying trends.

Because the NPTS and NHTS data are available over time, they have alerted us to many trends in Americans' travel, such as the following:

- Growth of the suburbs and concomitant growth of personal travel.
- Increases in household vehicle ownership. Between 1969 and 2001, average household size shrank by 18% while vehicles per household increased by 64%. In 2001 the average household owned 1.9 vehicles, and the total number of household-based vehicles exceeded the number of drivers by 12 million.
- Mix of the household vehicle fleet and the fleet's aging, with some impacts on safety. Older drivers are driving older cars.
- Impact of the baby boomer generation on travel.
- Increases in women's travel. Between 1969 and 2001, the number of women of driving age grew by 47% while the number of women drivers grew by 113%.
- Long-distance or "stretch" commuting. About 3.3 million Americans travel 50 mi or more one way to get to work. Of the 61.6 billion commutes to and from work each year, just under one out of every 200 trips is a stretch commute.
- Growth in average trip length especially for social and recreational purposes.
- Greater mobility of specific subgroups, particularly the young, the old, and people of color.
- Changes in the mix of trip purposes, particularly the growth in nonwork travel, including the propensity to make stops on the way to work, such as stopping for coffee. The census journey-to-work data do not obtain information about regular stops en route to work. The NHTS is a unique source of this information.

Within USDOT, the NHTS provides critical data to make decisions on the department's strategic goals and to measure its progress on safety, mobility, global connectivity, environmental stewardship, security, and organizational excellence. The department needs NHTS data to understand how, why, when, for how long, and how far Americans travel so that it can identify successful policies and programs to achieve strategic goals and know how well the policies and programs are working. For example:

- The NHTS provides the Federal Highway Administration (FHWA) and the Federal Transit Administration with the data they need to prepare *Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance Report*, including data to measure the benefits of transit to the public.
- NHTS data enabled the Bureau of Transportation Statistics (BTS) to compute fatal accident rates by time of day for drivers of different ages, linking the level of risk exposure with fatal crash data to provide a better understanding of the risks.
- Because the NHTS tracks individuals throughout a sampled day, it can provide vital information on daytime populations and where people are located relative to their home, their children, and other household members. This information is critical to developing evacuation plans to respond to emergencies.
- Using NHTS data, the National Highway Traffic Safety Administration computes exposure rates to show highway accidents or fatalities by vehicle miles of travel (VMT). Exposure rates, most often computed by age, show a different picture from the distribution of travel or of fatal accidents and are an important tool in targeting safety measures, programs, and campaigns. An exposure rate by age requires a survey, such as the NHTS, that collects VMT by age group.

Because of the rising cost of conducting household travel and activity surveys, more states and regions are interested in using NHTS data as a supplement to local data. An especially productive feature of the NHTS is the add-on survey, which enables states and metropolitan planning organizations to get good local data cost-effectively. By increasing the number of sample households, trip rates and travel statistics can be reliably estimated at the local level. Four states and five planning areas purchased additional samples in the 2001 survey, adding more than 40,000 sample households to the NHTS.

The questionable status of the American Community Survey, which is supposed to replace the journey-to-work portion of the Decennial Census, highlights the importance of the NHTS and the add-on option to our state and local partners. Recognizing its importance, USDOT has started planning the next NHTS with the goal of undertaking it in 2007. It will be conducted as two separate surveys: one for daily local travel and one for long-distance travel.

Having two separate travel surveys will reduce the reporting burden on survey respondents. FHWA will conduct the daily travel survey as it did the 1995 NPTS. The goal is to collect the data in 2007–2008. BTS will conduct the long-distance survey and collect trip data from the same households over the course of an entire year.

Over the course of this conference, USDOT asks that the data users share perspectives on the strengths and weaknesses of the 2001 NHTS and ideas on how to improve the design and methods of the next household travel survey including

- Identifying and prioritizing data needs that might be met with the NHTS,

- Highlighting new innovations and technology in travel surveys,
- Understanding the special needs of state and local planners to learn how and where more support and assistance can be provided to address their data needs, and
- Examining other data sources that could be used to complement NHTS data to provide a more complete picture of travel behavior in the United States.

Planning for the Next National Household Travel Survey, Part 1
Daily Trips

SUSAN LISS
Federal Highway Administration

U.S. Department of Transportation (USDOT) has decided to collect the daily and long-trip data as two surveys. Beyond that, not many decisions have been made on the next National Household Travel Survey (NHTS): now is the time for input from this conference.

Several weeks before the conference, USDOT asked the Transportation Research Board (TRB) to set up an online forum for users to pose questions about the next NHTS on the conference web page: those were thoughtful questions. This summary incorporates the responses to the questions with USDOT plans for the next NHTS.

SURVEY METHODS AND SURVEY ADMINISTRATION

USDOT will conduct the next daily trip survey either purely as a telephone sample (random digit dialing) or possibly a dual frame sample with telephone and address components. As long as the Census Bureau holds the monopoly on the national address sample frame, no cost-effective alternatives to a telephone survey exist.

Cell Phones in Sample

Reaching people with cell phones is becoming a significant issue. USDOT will be tracking what the survey research industry does about incorporating cell phones in the sample frame. If feasible, cell phones will be included in the sample frame, but there are many issues to consider (including obtaining a valid cell phone sample frame, costs to the cell phone respondent, and privacy issues).

Response Rates

Obtaining an adequate response rate is the most significant issue for the next NHTS. The Office of Management and Budget (OMB) is issuing new, more restrictive guidelines on response rates. A federally funded survey needs OMB's clearance before being fielded. A number of unique challenges involve response rates:

- Conducting the survey by telephone;
- Conducting a 2-stage survey, with a recruitment interview, followed by interviews of the individuals in the household;
- Attempting to interview each household member; and
- Interviewing all respondents within 6 days of their assigned travel day.

It is possible that the existence of the Do Not Call List will help response rates by cutting down on the number of unsolicited telephone calls received by American households. It is hoped

that a significant improvement in projected response rates will mean continuing to collect the NHTS data.

Nonresponse Follow-Up Survey

A nonresponse follow-up survey is one of the main tools to increase response rates as well as the representativeness of the sample. Typically, nonresponse follow-up surveys are conducted after the fact, but USDOT seeks to conduct one concurrent with main data collection.

Sample Size

The national sample should have about 25,000 completed households.

Add-On Component

There should be a full and robust add-on component from states, metropolitan planning organizations (MPOs), and tribal governments.

Global Positioning System Component

Global Positioning System units should be placed in about 10% of household vehicles. This would provide accurate counts of travel time, distance, speed, and circuity, which could be used to develop correction factors for the respondents' estimates.

Survey Frequency

The survey should be conducted every 6 years and be timed to provide data the year before the surface transportation reauthorization. The next survey will be fielded in 2007.

CONTENT ISSUES

General

In general, the content of the next daily trip survey will be similar to the NPTS and NHTS series to date. Some items will be added or changed, but a series of core data will be included in a manner as comparable as possible. This has always been the tug in a data series: how much to update and change because of changing conditions and how much to keep so that trend data are based on consistent data collection.

Elderly

It may be possible to obtain more information on elderly respondents because they tend to stay on the phone longer. Adding a special module to interviews with elderly respondents should be investigated. At a minimum, the nondriving elderly should be asked whether they once drove and, if so, when they gave up driving.

Availability of Public Transit

Various issues have prevented appending data on available public transit to the current data set. If these data cannot be appended, people will be asked about available public transit in the interview. The problem is that people who do not use transit don't really know whether it is available or the distance to the nearest stop.

Odometer Readings

The plan is to continue to collect two odometer readings on each household vehicle, approximately 2 months apart, and create an annualized mileage from the readings.

Modelers' Needs

There are many more data needs than can be addressed within the context of the NHTS. One way of accomplishing this may be to hand off a sample of completed NHTS interviews to another entity that can amplify the basic information collected with the decision-making processes involved. Broadening our scope to collect data with other disciplines, such as health, employment, and housing, should be considered.

RESOURCE CONSTRAINTS

There are two main resource constraints: respondent burden and financial constraints.

Respondent Burden

How much can the typical American be asked? If the maximum has been hit, and many involved in the NHTS believe that is the case, an item must be subtracted for every item added.

Financial Constraints

Paying for the survey is a serious issue, especially at a time when survey costs are rising. There is no institutionalized funding mechanism for the NHTS; i.e., it is not a line item in the USDOT budget nor is it congressionally mandated data. There are no guarantees that this data series will continue. The series has been maintained from 1969 to the present on the sheer need for these data, but priorities could change.

USDOT ANALYSIS

The plans discussed above were, in part, generated from an informal NHTS self-assessment in which we defined strengths, weaknesses, and some items that were both a strength and weakness, as outlined below.

Both Strength and Weakness

- As a general-purpose survey, NHTS serves many masters and has a broad array of topics.
- Daily trip data series has continuity but also some comparability issues.
- Travel diary improves reporting of trips but is not an activity diary.
- Big, complex dataset makes it a rich data source but is also difficult to use correctly
- Providing many choices for certain data items adds depth but also confusion.

Strengths

- Core data are comprehensive and consistent.
- Travel diary yields trip rates that are comparable to urban travel surveys.
- Household rostering of trips helps with respondent burden and coherence of the data.
- Add-on program allows serving the needs of states and MPOs while enhancing the sample.
- Our web page, http://nhts.ornl.gov, designed and operated by Oak Ridge National Laboratory, is a comprehensive tool that allows access to the data and has greatly broadened the user community.
- Appended data provide significant items, such as miles per gallon, that respondents often do not know.
- Transferability allows all jurisdictions to obtain travel indicators modeled for their area.

Areas for Improvement

- Response rate is still a serious issue as is the underlying representativeness of the sample.
- Miles and time in travel are not directly measured; all of these data are from respondents' estimates.
- Proxy reporting yields a lower trip rate than that of respondents who are interviewed personally.
- The data program is not flexible.
- Certain events, such as transit use, do not have a robust sample.

As the NHTS and its future are discussed over the next day and a half, one question should be kept in mind: How can we move into the future while preserving our link to the past?

QUESTIONS FROM CONFERENCE REGISTRANTS

Question: What is the projected cost of the next national daily trip survey?

Answer: Approximately $12 million to $14 million. It was heartening to hear George Schoener express strong USDOT support for ensuring that the travel surveys get funded.

Question: Does the projected survey budget allow for timely turnaround of the data?

Answer: Not really. Additional funding would be needed to speed up data delivery.

Question: Will Internet data collection be used for the next survey?

Answer: There are concerns that the length of the questionnaire and amount of detail does not lend itself to an Internet questionnaire. Other than that, the Internet would be helpful in reaching some underrepresented populations, such as people in the 16-to-24 age group.

Question: Please name one specific policy decision that used NHTS data.

Answer: A decision was made to overturn the requirement that firms of 25 people or more had to have a certain percentage of their workforce commuting by carpool. NPTS data provided reasons that people could not or did not carpool, primarily that no one living near them went to the same work location. George Schoener's comment earlier about the need to collect more and better information on USDOT policy uses of NHTS data is noteworthy.

Planning for the Next National Household Travel Survey, Part 2
Long-Distance Trips

LEE GIESBRECHT
Bureau of Transportation Statistics

Transportation Research Board (TRB) set up an online forum for users to pose questions about the National Household Travel Survey (NHTS) before the conference. From a variety of questions, here are answers to a few relevant to long-distance travel data.

NHTS QUESTIONS POSED BY USERS

Question: Will we will be able to look at data for all 50 states next time?

Answer: Access to long-distance trip data for all 50 states depends on the sample design and size. The 1995 American Travel Survey (ATS) made these data possible because it was a large sample (sufficient households were selected from all 50 states) and each household was asked about long-distance trips over the course of the entire year.

Question: Can we get some information about moving (job or home) and its relationship to transportation issues? What caused the move? What changes in mode, departure time, trip distances, or travel times resulted?

Answer: The size and panel survey design of the 1995 ATS made it possible to collect sufficient numbers of trips related to moving, but these questions were not included. It may be possible to add such questions if a survey of sufficient size were to be conducted again.

ASSESSMENT OF 2001 SURVEY

As a first step in the planning process for the next NHTS long-distance survey, the Bureau of Transportation Statistics (BTS) has reviewed external assessments of the 2001 NHTS including TRB's *Special Report 277* (*1*) and a report on the travel data program produced by a consultant from Oak Ridge National Laboratory. A new BTS working group identified needs and gaps in travel data. Finally, BTS staff reviewed and responded to the external assessments. Most of this paper is devoted to addressing the challenges reported in these reviews and BTS internal assessments.

The BTS goal in planning for the next NHTS is not to plan only for the next survey but to consider how to develop a data collection program that can be sustainable, one that addresses the important challenges and maintains consistency over time. Only then will users be able to rely on it and use it to measure trends in long-distance travel.

The five biggest challenges facing this program are (*a*) adequate sample size, (*b*) nonresponse bias, (*c*) coverage bias, (*d*) underreporting of trips, and (*e*) measurement error.

Adequate Sample Size

The sample size of long trips in 2001 was only about 22,000 for trips of 100 mi or more, compared with 500,000 in the 1995 ATS. This is about 4% to 5% of the trips collected in 1995. This reduction in sample affects Interstate flows, state-level estimates, and other travel flow estimates. The 4-week reference period used in 2001 caused a problem not present in the 1995 data. Since BTS did not collect data from each household about all trips taken in 2001, it cannot be determined how many people did not take any long trips in 2001. The most recent trip data collected in 2001 should help with this question.

Also, this design coupled with the smaller sample of households led to the much smaller sample of long-distance trips. We hope to go back to interviewing households multiple times (as in the 1995 ATS) to get all long trips for the year. We recognize, however, that going back to an annual reference period doesn't necessarily mean we will have enough of a sample to support detailed analyses of areas such as household moves and the impact on transportation.

Nonresponse Bias

Nonresponse bias is not unique to travel surveys. It is caused by differences between respondents and nonrespondents. Low response rates may make this problem worse.

The Office of Management and Budget (OMB) has new requirements for minimum response rates in federal surveys. These requirements apply to surveys that produce official statistics (such as the NHTS). "True" customer satisfaction surveys, such as those that query a finite list of customers (rather than the general public) about satisfaction with products, are not held to the same high standard. The requirements from OMB are stated on the basis of the expected survey response rate. Surveys with expected response rates of 80% or more need complete descriptions of how the expected response rate was determined and a detailed description of steps that will be taken to maximize the response rate. Surveys with expected response rates between 60% and 79% need a discussion of plans to evaluate nonresponse bias in addition to the above requirements.

Follow-up surveys are generally used to quantify nonresponse bias. Surveys with expected response rates of less than 60% will generally not be approved especially if the information to be collected will be "influential." However, it may be possible for agencies to justify conducting such an information collection, depending on the purpose of the study, the population being studied, past experience with response rates when studying this population, plans to evaluate nonresponse bias, and plans to use survey methods that follow best practices for achieving good response rates.

Nonresponse bias is difficult and costly to remedy. Some form of intensive nonresponse follow-up is needed to minimize nonresponse in the survey. Unless this includes personal-visit interviews with households that cannot be reached by telephone, the coverage bias present in random digit dialing (RDD) samples will be compounded with nonresponse bias. In RDD samples, addresses for about one-third of sample households may not be available. Follow-up is impossible with nonrespondents without addresses.

Selecting a random adult respondent from within each household would improve overall response rates since fewer contacts would be needed to secure an interview. A paper on selecting a single random adult respondent will be helpful, as will audience input during or after the conference on this subject, both pro and con.

Coverage Bias

Coverage bias is caused when members of the population have no chance to be in the survey. For example, if a survey of NHTS users attempted interviews only with the people in this room, those users not at the conference would have no chance to report and would not be represented in the sample.

In RDD sampling, nontelephone and mobile-phone-only households are not covered. Nontelephone households that sometimes have telephone service can be covered in RDD sampling by asking interviewed households whether they have had telephone service interruptions in the past, then weighting these households up to compensate for their reduced chance of selection. Research is under way on households with only cellular phones. Charlotte Steeh at Georgia State is doing work on conducting surveys over cellular phones. This type of survey has been done in other countries, such as Finland, where cellular phone penetration is very high and there are no fees to call recipients.

Data on the extent of undercoverage in RDD samples show that about 2.4% of households do not have a telephone (2000 census). About 6% are cellular-phone-only households (*2*). People in cellular-phone-only households tend to be younger, lower income, renters (rather than owners of their residence), and have fewer household members (*3*).

The number and proportion of cellular-phone-only households are expected to increase. A recent study by the market research firm In-Stat/MDR estimates wireless-only households growing to 30% of households in 2008. If that estimate holds, telephone polls will face enormous challenges in the near future. The tendency of cellular phones to be associated with individuals rather than households causes a problem with the unit of analysis and weights. Also, there are safety concerns with interviewing people over cellular phones. For example, there is a problem with USDOT conducting interviews with people on their cell phones while they are driving.

Coverage bias, like nonresponse bias, is difficult and costly to remedy. The National Survey of America's Families (NSAF) used a dual frame design (RDD with a small area frame component) to attempt to address the coverage bias while keeping data collection costs low. NSAF staff commented that this approach was problematic because good data were lacking for the area frame of nonphone households to be used as control totals in weighting. NSAF people contacted said that it mainly lent face validity to the study. They did not weight the area frame data separately because of the lack of good control totals. Many large federal surveys (Current Population Survey, American Community Survey, etc.) use an area-probability frame instead of RDD to address the problem of coverage bias.

Underreporting of Trips

People tend to forget some of their trips, especially non-home-based and nonwork trips (*4*). This problem is worse for proxy reports. GPS data may help in estimating this bias; however, GPS data are expensive to collect and process, and using a subsample of GPS data to make adjustments severely reduces the effective sample size of the survey.

The following key NHTS trip estimates show some differences between self and proxy reports:

Reported by	*Self*	*Proxy*
Mean Trips on Travel Day	4.50	3.70
Mean Long-Distance Trips	0.87	0.72
Mean Walks Trips in Past Week	4.20	3.10
Mean Bike Trips in Past Week	0.22	0.18
Used Transit on Travel Day	4.8%	3.8%
Used Transit Past 2 Months	17.3%	12.6%

Measurement Error

Even when people remember to report a trip, they tend to forget some trip details. For example, people are not good at remembering or estimating time spent traveling or miles traveled. Also, proxies may report trips but may not know details. As is the case above, using GPS data may help to estimate the magnitude of these errors but is costly and cannot be used to adjust estimates without severe effects on sampling error.

Kojetin and Miller (*5*) found in a study of the Consumer Expenditure Survey that parents were poor proxies for reporting children's spending behavior. Since parents report for virtually all children in the NHTS, this finding may apply to travel behavior as well.

RESOURCE LIMITATIONS

The ultimate budget for the next long-distance travel survey may support only a smaller sample, which means less accuracy (may not support travel flows) and will affect what can be done to improve data quality (increased response rates; measured or reduced nonresponse bias or both; coverage bias; underreporting of trips; and measurement error).

DATA NEEDS AND GAPS

Users of long-distance travel data may have in mind a list of challenges with priorities different from mine. For example, time and money spent traveling, data on people with special transportation needs, and more timely data may be among the top challenges on their lists.

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National Household Travel Survey Data Use
An Overview

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XIAOLI HAN
FAHIM MOHAMAD
MacroSys Research and Technology

The National Household Travel Survey (NHTS) collects information on both long-distance and local travel by the American public and plays a vital role in transportation planning and policy making at government and private-sector levels. According to the Bureau of Transportation Statistics (BTS), the NHTS is to provide data to (a) inform decisions on how to reduce congestion and improve mobility; (b) analyze travel behavior of special needs populations to help inform urban planners and policy makers how best to serve them; and (c) contribute to greater understanding of travel patterns to allow communities to plan, invest in, and operate transportation systems. (See NHTS highlights report at www.bts.gov/programs/national_household_travel_survey.)

Similarly, the Federal Highway Administration (FHWA) conducted the NHTS to provide the only authoritative source of information at the national level on the relationships between the characteristics of personal travel and the demographics of the traveler. The data are meant to provide planners and decision makers with up-to-date information to assist them in effectively improving the mobility, safety, and security of our nation's transportation systems. (For more information, see the NHTS website at http://nhts.ornl.gov.)

Casual observations of the transportation literature clearly show that the data from NHTS and its two predecessors [the Nationwide Personal Transportation Survey (NPTS) and the American Travel Survey (ATS)] have been extensively used by many users for a wide variety of purposes, far beyond transportation planning and policy making. Although it is useful to know that these data are valuable to the user community as intended, it requires a more systematic investigation to understand the diversity of this community and to gain insights for enhancing the related data collection programs. The purpose of this paper is to identify user categories and develop a comprehensive understanding of the users and their uses of the data at both a broad and microscopic level. Looking at firsthand information from a broad spectrum of NHTS data users may develop answers to the following questions:

- Have the NHTS data been used as the two sponsoring agencies envisioned?
- Who used the data?
- What were the data used for?
- What parts of the data were used?

The following data sources were used to develop the summary information presented in the next section.

- Oak Ridge Laboratory collection of citations and uses of NPTS and NHTS data;
- 1995 NPTS newswire and newspaper coverage;
- 1995 ATS newswire and newspaper coverage;
- BTS list of long-distance data users;
- List of TRB publications on NPTS, NHTS, and ATS; and
- NHTS Conference Planner: Preliminary Program.

This is not an exhaustive list of all users, uses, and citations nor an ad hoc selection to derive sought-after results. Improvements can be made by statistically sampling these applications and then developing sample statistics with clearly defined properties. This is an initial and preliminary exercise that will provide some general guidelines for similar efforts in the future.

DATA USERS AND USES

The NHTS data user community was divided into the following subcommunities: governments, universities, consultants, interest groups, and media. This is an institution-based classification. It says nothing about the ultimate purposes that the data served at a certain institution. For example, many research and analytical projects conducted by universities and consultants using the NHTS data may be designed by governments and contracted out for implementation. Since the universities and consultants directly used the NHTS data, however, these users are not classified as governments. Figures 1 and 2 show that researchers at universities constitute the largest group of users, followed by governments. Within governments, the federal government and metropolitan planning organizations (MPOs) use the data more often than state governments.

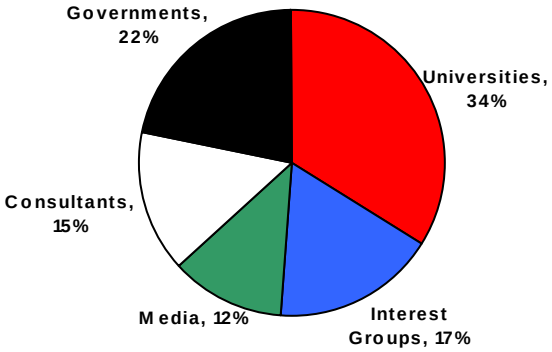

FIGURE 1 Main categories of data users.

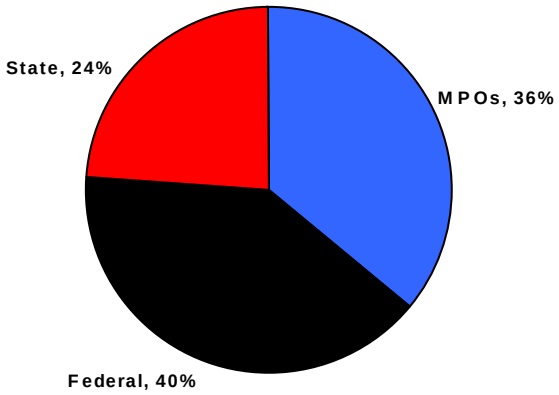

FIGURE 2 Government users.

There are not sufficient data to develop a better understanding of the differences between levels of governments in their use of the NHTS data. The more frequent use by the federal government is probably because the data are the most adequate for national-level analysis and decision making, while the use of the data more frequently by MPOs than by state governments is because the MPOs are dealing with transportation analysis and planning on a regular basis and have the most frequent needs for data.

Different users used the data for different purposes. Classifying these purposes into broad groups is again a preliminary exercise with a certain level of arbitrariness. Table 1 lists the major categories of uses and users; an X indicates that a particular user–use combination was found in the literature.

Not surprisingly, researchers at universities have used the NHTS data to conduct a wide variety of analyses. Although the information in Table 1 does not clearly indicate the intensity of the data use by a particular user or for a particular purpose, it shows that the data are widely used in terms of both user types and purposes.

The NHTS provides data on a large set of travel-related variables and characteristics. It is interesting to know what part of the data is most often used. If some parts of the dataset are used particularly often, more attention may be focused on them for future survey improvements. Or it may be helpful to find out why some parts are not used as often so that future efforts may be better targeted for the survey design. A careful review was conducted of the detailed abstracts of the papers submitted for the 2004 NHTS conference. Findings are presented in Figure 3.

These findings based on the conference program may not be representative of the larger literature because by design the program intended to cover all possible areas in which the NHTS data could have been used; therefore, the frequencies of the uses of different data types were more evenly distributed in the program than in reality. However, the figure at least shows that all parts of the NHTS data have been used. The results are probably more representative than first appears because they show that travel and related information, such as travel mode, trip purpose, and vehicle ownership, were used most often. The NHTS is after all a travel survey.

TABLE 1 Major Uses by Main Users

	Main Categories of Users								
	Federal	State	MPOs	Universities	Interest Groups	Media	Private Consulting Firms	Individual Consultants	Total
Main Categories of Use									
Air Quality Analysis	×		×	×			×	×	6
Children and Older Americans				×		×			9
Environmental Impact		×		×	×	×			6
Energy	×								5
Fatality and Injuries				×					6
Health	×			×	×	×			6
Long-Distance Travel	×			×	×			×	6
Land Use/ Socioeconomics			×	×					4
Nonmotorized Travel	×			×	×	×			8
New Urbanism							×		1
Rural TD Modeling							×		1
Race/Demography		×		×		×			5
Safety	×			×					10
Transit	×			×	×				8
Travel Behavior Analysis		×	×	×				×	7
Urban TD Modeling			×	×			×	×	8
Weekend Travel				×					8
Survey Innovations				×			×		9
Tourism Accounting and Analysis	×	×		×			×		
Total	**10**	**6**	**9**	**39**	**19**	**13**	**13**	**4**	**113**

Note: TD = travel demand.

SAMPLE USERS AND USES

This section presents a small collection of cases to show specifically how the NHTS data have been used. These cases are not presented as typical but are meant to indicate the extent of the users and uses.

Federal Government—Transportation

- House of Representatives: Committee on Science hearing on reauthorization of the transportation research, development, and education programs
- House of Representatives: hearing of Committee on Transportation and Infrastructure
- Bureau of Transportation Statistics: transportation statistics annual report (legislative mandate) using number of trips and miles of daily passenger travel; long-distance passenger travel by mode, purpose, income, gender, and age; and travel by older adults
- Office of the Secretary of Transportation: accessibility guidelines for transportation vehicles and over-the-road buses

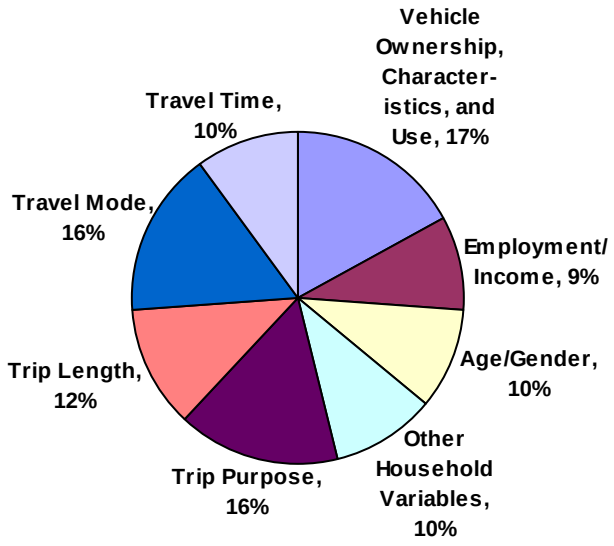

FIGURE 3 Uses by data type.

- Federal Transit Administration: strategies for improving public transportation access to large airports

Federal Government—Nontransportation

- Environmental Protection Agency: estimated greenhouse gas emissions from transportation sector
- Centers for Disease Control: conveyed the importance of nonmotorized transportation for health and active lifestyle
- National Aeronautics and Space Administration: calibrated a national transportation system decision model
- Bureau of Economic Analysis: developed travel and tourism accounts
- Department of Energy: replaced the former Residential Transportation Energy Consumption Survey

State and Local Governments

- Louisiana Department of Transportation and Development: travel demand forecasting model
- Virginia Department of Transportation: Virginia statewide multimodal transportation demand model project
- Arkansas Department of Parks and Tourism: data on visitation to Arkansas for the 2003 economic report
- Montana Department of Commerce: Montana tourism and recreation strategic plan
- City of Tucson Department of Urban Planning and Design: ATS Arizona state profile

Universities

- Department of Park, Tourism, and Recreation Resources at Michigan State University: state-level information to obtain a number of statewide parameters for a county-level tourism-spending model
- College of Business and Economics at West Virginia University: individual household data to test the hypothesis that demand for household leisure travel to South Carolina is the same for senior and nonsenior households and individual household data to compare Orlando leisure travelers with travelers to other Florida destinations

Other Users

- National Business Travel Association: data on purpose of air trips to estimate fares and taxes paid by business travelers
- The I-95 Corridor Coalition: data on purpose of trips, destination of trips, travel flow, and use of public modes by state for the analysis of passenger travel in the coalition region
- Reconnecting America: analysis of the nation's intercity travel system
- Northwest Environmental Watch Group: examination of use of air travel by persons living in different states

Special Uses

The NHTS does not only provide data to users shown above. It also helps state and local governments and organizations develop more detailed travel-related data at subnational levels. For example, the NHTS has been used as a vehicle for collecting state travel data through state and local add-ons. The 2001 NHTS has such add-ons as Kentucky, Massachusetts, Texas, Wisconsin, New York, and the Baltimore MPO. At the 2004 NHTS conference, MPO participants expressed concern that without NHTS as a survey vehicle, their organizations would not be able to conduct their own passenger travel surveys with the extensiveness of the add-ons to NHTS.

Wisconsin state and MPOs used NHTS data to complement their surveys to establish passenger travel flows from other states into Wisconsin.

Kentucky state DOT has employed Bayesian methods to use NHTS data to validate, complement, and improve the quality of its state and local travel survey data.

The NHTS has also been used as a data source for developing state and locally specific data through efforts such as data transferability. The NHTS data of a certain subcommunity are transferred to communities with similar characteristics in related areas so that more recent data are made available for analyzing these communities. Such data transfers have been conducted for states, including Indiana, Louisiana, and Missouri.

Furthermore, the NHTS has been used as a benchmark for local data collection in that estimates from smaller surveys can be compared to corresponding estimates from the NHTS as was done for the 2003 Wichita Area Economic Outlook Team's Fair Fares Resident Survey.

CONCLUSION

This short paper provides a brief summary of the findings of a literature review concerning NHTS data users and uses. Figure 4 provides a schematic summary of our findings. Although all findings are preliminary and rough, they seem to lead to the following conclusions:

- The NHTS, NPTS, and ATS provide crucial data for decision making for great public and private concerns at all levels of government.
- For travel modeling and many issues related to travel and traveling decisions, these surveys are the only data sources available.
- A wide variety of users have used the data from these surveys for purposes as envisioned by the sponsoring agencies.
- The data users and uses of these surveys extend far beyond the intended areas; this implies a great additional value of the data programs.

Further insights for improvements can be gained from answers to questions such as

- What are the frequently used variables?
- What useful data items are missing?
- What alternatives have been used to the entire data set and to the missing data items?

Answering these and other related questions is of great value to improving the future program design and therefore should be made an ongoing effort. Data user feedback should be collected, analyzed, and communicated to program managers and incorporated into new designs.

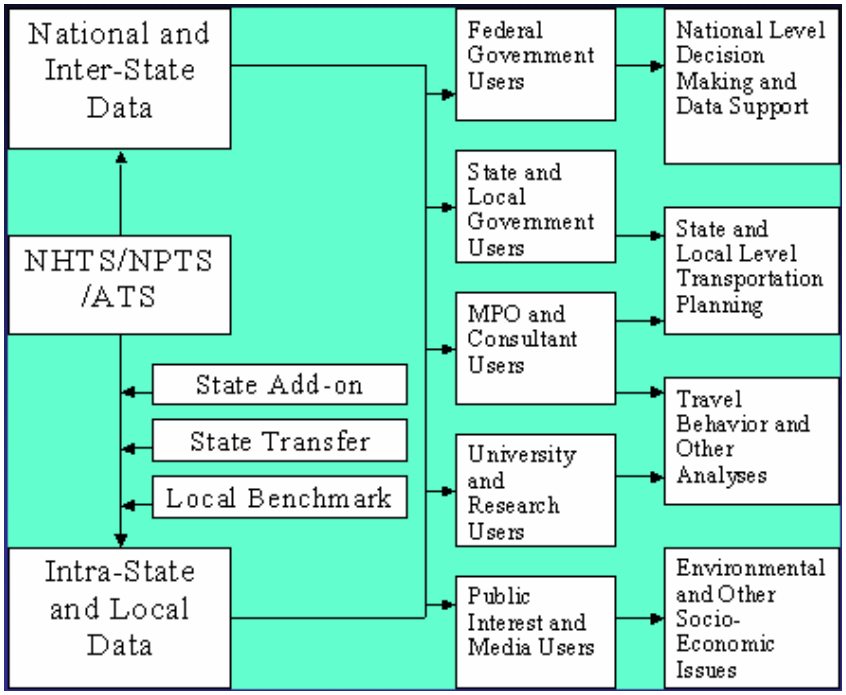

FIGURE 4 NHTS data users and uses.

PAPER SESSION SUMMARY

National Household Travel Survey Findings

STEVEN E. POLZIN
University of South Florida

This session was designed to highlight examples of the National Household Travel Survey (NHTS) applications. The nature of the analysis of NHTS data ranges from predominantly descriptive presentation of traditional analysis to more sophisticated applications involving data fusion and more elaborate manipulation and processing. Similarly, the subject areas covered a variety of applications of NHTS data.

TRAVEL CHARACTERISTICS ON WEEKENDS: IMPLICATIONS FOR PLANNING AND POLICY MAKING

Ram Pendyala and Ashish Agarwal, *University of South Florida*

Ram Pendyala presented information that contrasted the nature of weekend travel and weekend travelers with weekday conditions. It was noted that the NHTS was unique in that virtually all other travel data surveys focused on weekday travel. The context was established by noting the growth in weekend travel and that weekend travel was approaching levels of weekday travel in some time periods. Hence, weekend travel is a growing concern for professionals who plan and operate the transportation system. A variety of descriptive data was previewed and illustrated among other things that on weekends work travel's share of all travel was about one-third of the share on weekdays. Information on traveler income, age, gender, trip purpose, mode, trip length, and other items was reviewed. There appeared to be a relatively stable relationship between weekdays and weekends regarding the time spent traveling and the time spent on the activity for which one was traveling. It was also observed that weekend travel was characterized by longer trip length but shorter trip durations.

Questions resulted in discussion of several issues including the extent to which one understood how weekend travel integrated with weekday travel and whether discretionary trips were being shifted to weekend time periods. The distinct differences between Saturday and Sunday travel and the potential benefits of a multiday survey were noted.

UTILITY OF THE NHTS IN UNDERSTANDING BICYCLE AND PEDESTRIAN TRAVEL AND HOW OTHER DATA SOURCES CAN HELP

Kevin J. Krizek, *University of Minnesota,* and
Kelly J. Clifton, *University of Maryland–College Park*

Kevin Krizek's presentation provided a systematic analysis of how the current NHTS could be used in analysis of bike and pedestrian travel and what additional information or data fusion enhancements might increase its usefulness for this purpose. He particularly focused on bike travel and noted that its challenges regarding data availability were exacerbated by the relatively rare

event nature of bike travel. The presentation addressed the data challenges in studying bike travel and specifically discussed what needed to be done to enable greater use of the NHTS in analysis of travel behavior for bicyclists. Issues such as the renewed interest in nonmotorized modes as a result of health and obesity concerns, travel safety for nonmotorized modes, and the prospects for enriched data based on GPS use being integrated into travel data collection were discussed. Discerning walk trips for walk access modes and defining short walk trips were also discussed.

Subsequent questions and discussion focused on how land use and physical environment factors could be captured in or appended to NHTS data. Confidentiality issues regarding access to such data were noted.

BUILT ENVIRONMENT AND TRIP GENERATION FOR NONMOTORIZED TRAVEL

Felipe Targa and Kelly J. Clifton, *University of Maryland–College Park*

Felipe Targa discussed trip generation for nonmotorized travel. This analysis used the add-on data for Baltimore and explored nonmotorized trip generation in greater detail by using geographic coding. The NHTS data were supplemented with other data that provided information on the physical environment and demographics of the area.

Within the existing empirical studies, questions remained about the degree of trip substitution effects among different modes of travel and issues of self-selectivity (e.g., people who preferred walking and biking chose to live in built environments that facilitated that behavior as opposed to the urban environment influencing their choices). To explore in greater detail the impacts of trip generation, a Poisson regression model was considered the most appropriate methodological approach. The models were tested with numerous variables including attitude and perception variables gleaned from NHTS questions and physical characteristics of the built environment gleaned from fused data.

Discussion noted the desirability of multiday data, weather data, and more detailed and accurate data on the built environment. Discussion issues included transferability of results and precision of data.

NHTS AND TRIP CHAINING

Nancy McGuckin, *Travel Behavior Analyst*

Nancy McGuckin presented some recently completed early analysis of trip chaining travel behavior with the use of the 2001 NHTS. This presentation was based on a recent FHWA initiative to process the NHTS data into trip chains to enable more explicit study of the trip chaining phenomenon. Early results on the nature of chained trips and the increase in chaining since 1995 were presented. The concept of chaining and the subtleties of defining what constituted a chain were discussed, and the definition used in the NHTS chain development presented. Morning versus evening trip chaining, gender differences in trip chaining, and the trip length, purpose, and other characteristics of the chain were discussed.

Ms. McGuckin (a contract employee for FHWA) provided CDs of the chained trip file for additional analysis of trip chain travel behavior. Questions about issues such as the extent to which trip chains mitigate the impact of long-distance home to work commutes, the propensity to trip chain as a function of distance to work, and trip purpose mixes for trip chains were discussed.

PAPER SESSION SUMMARY

Survey Methods

ELAINE MURAKAMI
Federal Highway Administration

Of the four papers presented in this session, two were specifically about the 2001 National Household Travel Survey (NHTS); one was on address geocoding issues in a Michigan state survey; and the last was on a survey conducted in the Kansas City metropolitan region with a Global Positioning System (GPS) component:

- Improving Response Rates: Methods Employed to Promote National Household Travel Survey Participation (Mark Freeman, Janice Machado, and Susan Swain, WESTAT, Inc.);
- Nonresponse in NHTS (Gary Shapiro et al., WESTAT, Inc.);
- Improving Household Travel Survey Quality Through Time and Distance Data Checking (Laurie Wargelin et al.); and
- Results from the 2004 Kansas City GPS-Enhanced Household Travel Survey (Jean Wolf et al.).

2001 NHTS IMPROVING RESPONSE AND NONRESPONSE EVALUATION

The 2001 NHTS is a complex survey involving a presurvey letter, a telephone screener, a mailing of a diary package, an extended telephone interview to retrieve daily and long-distance travel, and two separate vehicle odometer readings.

The 2001 NHTS was a random digit dialing (RDD) multistaged survey that resulted in a 41% combined response rate. This response was an improvement over the 1995 Nationwide Personal Transportation Survey response rate of 37%. Nonetheless, new Office of Management and Budget requirements for response rates make research on nonresponse a critical element for federal surveys.

Improving Response

Many techniques to improve response rates were implemented in the 2001 NHTS, including the following:

- Advance letters with a monetary incentive ($2 or $5 depending on location) were sent to the RDD sample for which an address was identified (approximately 85% of eligible household telephone numbers).
- Small monetary incentives ($2/person) were included in the mail-out package.
- Reminder phone calls were placed.
- Spanish-language materials were available, and phone interviews could be conducted in Spanish.

- Advances in computer-assisted telephone interviewing (CATI) programming for rostering household persons and vehicles and trip rostering to reduce burden were helpful.
- Thank-you postcards were sent at completion.
- Each interviewer completed at least 24 h of training in addition to the 8 h of general training. Between 10% and 20% of interviews were silently monitored (audio and CATI screen).
- Refusal conversion resulted in more than 20% of refusals being successfully interviewed.
- Advanced call scheduling routines were planned to maximize both the initial screener (recruitment) and the extended interviews.

Unfortunately, the survey period coincided with both the terrorist attacks on the World Trade Center and the Pentagon and the anthrax mailing scare in fall 2001. The potential for nonresponse stemming from these events was managed through adjustments in calling and mailing procedures.

Nonrespondents

Because the 2001 NHTS is a multistage survey, it gives respondents more than one opportunity to drop out. For this paper, the two phases of the survey are called the (*a*) screener and (*b*) extended interview, during which the daily trips are recorded. Research was done to identify characteristics of nonresponding households and to examine whether changes in call scheduling could improve the likelihood of successful contact during both interviewing phases.

Most of the examined characteristics showed large differences between respondents and nonrespondents at the screener interview, the extended interview, and the screener and extended interviews combined.

For the screener, nonresponse is higher for telephone exchanges with higher percentages of renter-occupied housing units, a high percentage of African American and Hispanic households, and a number of other characteristics.

For the extended interview, nonresponse is higher for low-socioeconomic groups and in telephone exchanges with low-socioeconomic populations. These characteristics include low educational attainment, low percentage of college graduates, low percentage of owner-occupied housing units, low median income, high percentage of African American and Hispanic households, and households without any workers. Spanish-language households have a much lower response rate (31%) compared with English-language households (51%). People between the ages of 18 and 24 are less likely to complete the extended interview.

Weighting adjustments were made to the completed surveys, but the wide ranges in response rates have an adverse impact on the variances.

Call Scheduling

The scheduling algorithm was found to be efficient. More than half of all households were contacted on the first call, with 80% being contacted by the third attempt. Explicitly setting priorities for calling on the basis of the calling periods that have already been tried would not likely result in much gain in efficiency. Use of characteristics of the telephone exchanges in determining calling periods would also not likely improve efficiency very much.

MI TRAVEL COUNTS

MI Travel Counts is a Michigan state DOT survey with an additional sample sponsored by SEMCOG, the Detroit metropolitan planning organization. The paper describes the effort to improve the origin–destination geocoding in the survey by incorporating online time and distance checking using transportation network values for shortest path and the respondent-provided time estimation. Specifically, when respondents provide a location, the address is matched to a geographic base file. When the next destination is provided, the network distance value from the origin is combined with the respondent's answer to travel time. If the answer falls outside the range of expected values, the interviewer asks additional questions to verify the responses.

Specifically, private vehicle trips were flagged for questions when the average travel speed was less than 5 mi per hour (mph). When the trip was longer than 30 mi, it was flagged when the average travel speed was greater than 80 mph; otherwise it was flagged when the average speed was greater than 65 mph. Sometimes, the address matching routine has incorrectly matched the address to the same street address, but in another town or city. Or there may be incorrect matches to similarly named streets. Sometimes the respondent has not made an error: a time parameter outside the expected range can be explained by bad weather or a traffic incident.

Although the number of records that were improved by corrections to location were small (2.7% of the total), this quick method was straightforward and simple and should be implemented in other regional surveys.

KANSAS CITY GPS SYSTEM PROJECT

GPS samples have now been incorporated into several regional household travel-activity surveys (see Table 1). They have been limited to 1 day of GPS data collection. Although some tests of person-based GPS have been implemented, most regional surveys with a GPS component have been limited to vehicle-based projects. Conducting a vehicle-based project eliminates the problem of battery life; the car battery can easily power a GPS receiver and a personal digital assistant.

One of the most recent projects was in Kansas City, where about 10% of the full sample included a GPS component. The main goal was to use the GPS subsample to provide trip rate correction factors. Overall, 10% of trips were unreported in the self-reported diary compared with those found by the GPS. In the Laredo, Texas, project, nearly 60% of trips found by using the GPS were unreported in the self-reported diaries.

The Kansas City project included a follow-up survey to find out why people did not report trips that were identified by the GPS. Some trips that the automated trip counter included as a "separate" trip were determined not to be a separate trip. These included such vehicle movements as work-related travel by people who drive for a living (and were explicitly told not to report this in their travel diary), movements within a large parking lot (off-network travel), and traffic delays.

TABLE 1 Vehicle-Based GPS Studies Conducted to Date

Study Name	Date of Study	Total Days in Study	No. of Deployed (Households)
California Statewide HTS	Feb.–Oct. 2001	79	517
SCAG (Los Angeles) HTS	Sept.–Dec. 2001 and Jan.–March 2002	NA	820
Pittsburgh (Pa.) HTS	Sept.–Dec. 2001	38	74
Ohio Statewide HTS	2001–2002	NA	NA
Laredo (Tex.) HTS	March–May 2002	45	187
St. Louis (Mo.) HTS	Sept.–Nov. 2002	44	313
Tyler/Longview (Tex.) HTS	Sept.–Nov. 2003	61	367
Kansas City (Kans./Mo.) HTS	Feb.–April 2004	62	294

Note: HTS = household travel survey; SCAG = Southern California Association of Governments.

Some trip ends were legitimate. When respondents were asked why they did not report the stop, they typically said that they "didn't think the stop was important" or that "they forgot." Most typically the trips not reported included picking up or dropping off a passenger, getting gasoline or food, and mailing a letter. The average duration of a stop for these trips was 5.7 min.

However, trip underreporting varied by household size, number of vehicles, and number of workers; therefore, a single factor for trip-rate adjustment should not be used. Two-person, two-vehicle, two-worker households with mid-level incomes were the most likely to underreport their trips.

Underreporting of trips cannot be evaluated by itself but must be combined with analysis of impacts on trip length and total vehicle miles traveled (VMT). Typically, the missed trips have been short, and the VMT impacts are likely to be significantly smaller than the proportion of trips that are unreported. However, there may be air quality emissions impacts based on these short trips that should be analyzed.

A self-selection bias may exist for households that agree to participate in a GPS survey. Further research is recommended to compare those who agree to participate and their travel characteristics with other respondents.

DISCUSSION

Some of the questions that arose in the discussion include

- What are the characteristics of people who are early refusals? What kinds of nonresponse research can be implemented to capture this population?
- Isn't it likely that people in cell-phone-only households travel differently from others? This is a growing problem. Because cell-phone users in the United States have to pay for incoming calls, survey methodologists are having difficulty in identifying a way to reach them without a cost implication.
- Has anyone attempted differential financial incentives to entice low-responding populations to participate? In a regional survey, special outreach programs through community groups to African American and Hispanic populations may be the best way to improve response rates.

PAPER SESSION SUMMARY

State and Metropolitan Planning Organization Uses of the National Household Travel Survey

ED CHRISTOPHER
Federal Highway Administration

The National Household Travel Survey (NHTS) collects data from a nationally representative sample of households to derive statistically reliable travel estimates at the national level. Sample data in the NHTS are not adequate to provide statewide or area-specific estimates. If a state or a local jurisdiction wants to develop travel estimates for a specific area, it can purchase a contract to have additional households in its jurisdiction interviewed and included in the NHTS. The jurisdictions that purchase these additional samples are referred to as add-on areas. Examples appear in Table 1.

NHTS ADD-ON USE IN DES MOINES, IOWA, METROPOLITAN AREA

While one routinely hears from the larger metropolitan planning organizations (MPOs) with more than 1 million population, it is sometimes more instructive to learn what the smaller areas, such as the Des Moines region with a population just under 400,000, are doing. Until the Des Moines MPO staff purchased the NHTS Add-On Program for 2001, it was unable to answer some long-standing questions about regional travel and changes. Some questions were these: Are Tuesday, Wednesday, and Thursday really the "most typical" travel days? What are the vehicle occupancies for all those "other trips" that are not made for work? Is anything known about trip length? According to Tom Kane, executive director of the Des Moines MPO, "We are not very big staffwise and could not do the analysis we wanted without the NHTS."

In addition to being used to develop a regional understanding of the travel characteristics of the area's residents, the 1,200-household samples were used extensively in calibrating and validating the MPO's new travel demand model. Since the region had not had survey data of this

TABLE 1 Areas Participating in 2001 NHTS Add-On Program

Areas Participating	No. of Households
State of Wisconsin	17,000
State of New York	10,884
State of Texas	3,500
State of Hawaii	1,500
Kentucky, four-county area	1,000
Baltimore, MD	3,471
Oahu, Hi	1,500
Des Moines MPO, IA	1,200
Lancaster MPO, PA	1,000
MPO = metropolitan planning organization	

type since the 1960s, the MPO staff is now able to have the travel models more accurately reflect a true picture of travel in the Des Moines metropolitan area.

During initial review of this paper, an overriding question to a region such as Des Moines was whether the cost of the add-on was worth it. However, even before the review reached the paper's conclusions, the answer became a clear and unequivocal yes. The paper summarizes this point: "[T]he 1,200 surveys through the 2001 NHTS Add-on Program painted a picture of travel on the transportation system which caused the Des Moines Area MPO to be more aware of the travel patterns existing in the Planning Area."

This summary leads to the conclusion that the NHTS data helped the planning staff be smarter in its planning and the decision makers become more enlightened in their decision making. In Tom Kane's mind, the purchase of the add-on was a success and he is looking forward to participating in the purchase of another add-on with the next NHTS.

NHTS ADD-ON DATA TO ENHANCE STATE AND MPO TRANSPORTATION PLANNING: THE WISCONSIN EXPERIENCE

A paper by Kimon Proussaloglou, a consultant working on developing the statewide and various metropolitan models in Wisconsin, presented an excellent tutorial on how the Wisconsin Department of Transportation (WisDOT) used specific add-on data in the following three phases of both its statewide and local models: trip generation, trip distribution, and mode choice.

WisDOT provides direct modeling support to 9 of its 10 MPO areas. The paper takes the reader through the model components and shows where the NHTS data fit in such a way that one gains a far better understanding of the interworkings of the three components of the Wisconsin models.

A major strategy in the use of NHTS for Wisconsin was to develop both the state and the MPO models on the basis of a consistent set of household travel data. Consistency played a large role in a number of ways in Wisconsin's use of the add-on:

- Development of the zone systems and networks,
- Estimation of the different models,
- Software platform, and
- Linkages to other WisDOT data sources.

Many other states—Florida and North Carolina, for example—are working to provide some standardization to travel demand forecasting and planning processes. WisDOT, for one, has made good use of the NHTS, which can benefit from other efforts.

In developing the sample size, Wisconsin was careful to draw a sample that would provide enough observations at the MPO level for the individual MPO urban models. Doing so also provides the ability to draw some comparisons between MPOs in the state.

The paper sums up the Wisconsin experience in this way:

> The statewide and urban area samples have provided a rich source of data to observe travel patterns for Wisconsin as a whole and to measure differences and similarities across urban and rural parts of the state. Having a solid base of data for the development of various models, developing them on a consistent basis

across the urban areas and nesting the urban models with the statewide model should all go towards significantly enhancing the confidence of the various stakeholders in the models and for their use in the transportation planning process.

USE OF 2001 NHTS TO ESTIMATE AUTO AVAILABILITY: APPLICATION OF BALTIMORE REGION MODEL

A paper by Charles Baber of the Baltimore Metropolitan Council (BMC) explored using several sources of data to develop and estimate three vehicle-availability models. These three models were then compared with the 2000 Census results. The first two models used the Public Use Micro Series data, while the third used 2001 NHTS. Not quite satisfied with the model results from these two data sources, BMC staff set out to include some land use or built-environment variables that may help to explain vehicle availability.

The land use variables were derived from regional data files and included these:

- Mean entropy, a measure of zonal land use balance or the proportion of developed land uses in a given area;
- Dissimilarity, a measure of zonal land use mixing or the contrast between a land use unit and its adjacent land area;
- Opportunities, the abundance and variety of neighborhood resources that can be reached on foot: a weighted sum of the commercial, civic, cultural, educational, and recreational opportunities available within a ¼ mi of a household;
- Walkability, the relative ease with which persons can travel on foot within the immediate neighborhood of their household: an index that awards "points" to a household on the basis of the types of road intersections within a ¼-mi radius of it; and
- Total employment, a share of total employment at each destination and the travel time between the origin and the destination.

The BMC staff believes that when these land use variables are added to the models, the model that did the best job at explaining vehicle availability at a zonal level was the 2001 NHTS model with land use variables (Table 2). However, the staff did caution that this conclusion was a preliminary finding and that additional work on the model was still under way. As noted during the presentation, some variables internal to the model might be collinear; that possibility needs to be checked.

This paper made clear the need for transportation professionals to understand land use variables, for example, how to construct an entropy measure. In many respects, this paper goes beyond the world of travel variables and introduces a new world of causal variables.

TABLE 2 Baltimore City Vehicle Availability, by Percentage of Households

Source Data	None	One	Two	Three
2000 Census	35.8	39.9	19.3	5.0
2000 PUMS model	22.7	43.1	27.6	6.6
2001 NHTS model	23.1	40.8	29.0	7.1
2001 NHTS plus land use	30.0	51.1	17.3	1.6
Notes: All data are percentages. PUMS = Public Use Micro Series.				

BAYESIAN UPDATING TO ENHANCE 2001 NHTS: KENTUCKY SAMPLE DATA FOR TRAVEL DEMAND MODELING

Bing Mei, a consultant to the state of Kentucky, presented an interesting experimental investigation that was conducted with the four-county Kentucky add-on data. For the investigation, several new reaggregations of the NHTS data were derived from the total universe of records and their trip rates compared. The new clusters or reaggregations of data included the following:

- National sample: 15,443 households nationwide, excluding those in metropolitan statistical areas (MSAs) with more than 3 million people;
- East south central sample: 902 households drawn from the census division in which Kentucky is located but excluding those households from Kentucky;
- Surrounding states sample: 2,904 households from the surrounding states, excluding those households from MSAs with more than three million people;
- Similar southeast states sample: 2,781 households chosen from states with similar socioeconomic characteristics as Kentucky;
- Kentucky standard sample: 309 Kentucky households selected from the total national database; and
- Kentucky add-on sample: the 1,154 households that were purchased as the four-county add-on.

After the comparison of the trip rates by purpose for the six reconstituted samples, the authors used a statistical probability technique (Bayesian) to create a new data set drawing from the Kentucky add-on and the Kentucky standard samples. This data set was then compared with the six original data sets. Trip rates and length (in terms of time) for all seven groups were analyzed and the conclusion reached that the Bayesian process improved the estimate of the average trip length and reduced the uncertainty of the data.

This approach was interesting, but several questions remained. The first centers on the notion of the amount of reaggregation and clustering of households that can be done without violating the statistical validity of the original sample design. A far more basic question concerns identifying the variables that support these aggregation schemes and those that do not. Finally is the question of how to actually know whether the updated or enhanced data set is improved. Some would argue that, because the new data set is reconstituted from two other others, the notion of lower standard errors of the mean is more a statistical artifact of the process than a true measure.

QUALITY ASSESSMENT OF THE 2001 NEW YORK STATE NHTS ADD-ON DATA

This study, by Nathan Erlbaum, provides a detailed and rigorous assessment of the 11,000 add-on samples that the New York State DOT purchased. It does so by comparing NHTS data with other data sources reporting on vehicle miles of travel (VMT), transit ridership, employment, and vehicle availability. The paper serves as a tutorial on how to think about and work with data sets from several sources, each reporting what looks like the same thing. For example, NHTS estimates drivers, while the New York Department of Motor Vehicles considers driver's licenses.

How well do they match? Which one is “right”? Maybe they both are. This paper provides insights on how to address these questions.

Aside from providing the reader with a better understanding into a variety of data sources, this paper allows researchers to take away one singularly important point: “Perhaps noteworthy in this paper is the observation of how important a role the standard error plays and how dependent the analysis is on examining survey results within the context of the confidence interval.” This point cannot be emphasized enough, especially as researchers gain access to more and more data and learn to process it faster and faster. The technique of looking across several data sets simultaneously will now be used frequently in the future; therefore, our methods of determining which data are correct will adapt accordingly.

The paper closes with the author answering several key questions, some with more certainty than others:

- Does the survey (National Personal Transportation Survey or NHTS) estimate of vehicle travel over time adequately match observed monthly vehicle miles of travel? No.
- Can the apparent lack of change in survey estimates of residential household personal VMT for 1995 and 2001 be explained in the light of growth in the ground-count-based VMT estimates? Yes.
- Will a survey adequately reflect public transportation ridership? Yes, in certain cases.
- Is there comparability between the census and the NHTS on “Who is a worker?” Yes.
- Does the survey adequately reflect drivers and driver’s licenses? Yes and no.
- Can the census and NHTS estimates of the number of vehicles available within households in New York State be believed? Yes.

PAPER SESSION SUMMARY

Modeling and Innovative Applications

PATRICIA S. HU
Oak Ridge National Laboratory

Data from the Nationwide Personal Transportation Survey (NPTS) and the National Household Travel Survey (NHTS) have been applied to a wide spectrum of purposes, from ascertaining the causal relationships between obesity and walking and biking to determining the viability of hybrid vehicles in the late 1970s and of hydrogen fuel-cell vehicles in the early 2000s. Other applications have helped to improve vehicle and road designs, pinpoint safe school routes, formulate and evaluate transportation policies, and analyze the benefits and costs of transportation investments.

The four papers presented in the session on modeling and innovative applications reflect this diversity, in which NHTS and NPTS data are analyzed for a variety of purposes.

BAYESIAN BELIEF NETWORK

Scuderi and Clifton of the University of Maryland presented a Bayesian approach to improving, in relation to previous research, the quantitative specification of the complex relationships between land use and transportation. Specifically, the authors used the Bayesian belief network (BBN) approach to analyze complex spatial systems (e.g., the urban environment). They demonstrated that this approach did not rely on ad hoc statistical models or assumptions, was able to address the bias in neighborhood selection, and yielded more consistent results than achieved by previous research. The Baltimore NHTS add-on data were used.

To present the results, they used a graphical representation of the relationship between land use, transportation choice, and other travel determinants (e.g., age, vehicle counts, and household size). As the analysis of land use and transportation relationships moved toward coverage of larger geographic areas (e.g., from the census tract level to the zip code level), land use variables became less influential on mode choice. The authors attributed this behavior to the fact that, at coarser spatial aggregation, each spatial unit becomes more and more homogeneous compared with other polygonal areas and that there is less variation in land use across tracts. The authors concluded that (*a*) the BBN approach was able to provide, on the basis of the status of all other variables, quantitative assessments of the occurrences of specific outcomes and (*b*) it allowed for the study of complex problems—at least to the extent that the data accurately captured these problems.

In their analysis, the authors assumed each trip was unique and independent of every other. Recognizing these limitations, the authors suggested that future analysis consider trip chains and the interdependencies between sequential trips and their modal choices.

PREDICTING VEHICLE HOLDINGS AND MILES OF TRAVEL

Bhat and Sen of the University of Texas at Austin used household travel survey data to predict the vehicle holdings of households and the miles of travel by vehicle type. The goal of the study was better projection of future traffic congestion and mobile source emission levels. Prior research had primarily focused on using either regression models to project vehicle use or discrete choice models to determine household vehicle holdings. The current authors identified problems associated with previous research and developed a multiple discrete–continuous extreme value model that is able to (*a*) accommodate multiple discreteness in the use of different vehicles by members of a household, (*b*) allow diminishing marginal returns (i.e., satiation) in using a single vehicle type, and (*c*) incorporate heteroskedasticity, correlation in unobserved characteristics that might affect the utility of a vehicle, or both. Data from a sample of 3,500 households randomly selected from the 2000 San Francisco Bay Area Travel Survey (BATS) were used for this analysis. For BATS, 15,000 households were interviewed during a 2-day period. Information was collected on household vehicle ownership, vehicle make and model, number of years of vehicle possession, vehicle usage, sociodemographics, employment, and residential location.

After analysis, the researchers concluded that households were likely to own passenger cars but used non-passenger-car vehicles more than the passenger cars and that vehicle operating cost had a negative influence on vehicle ownership and usage. Specifically, increases in operating costs marginally affected the holdings of passenger cars but significantly influenced the holdings of all other vehicle types. When the operating cost increases, the ownership of SUVs and minivans dropped by the largest percentage. Someone recommended that the authors consider in their future research vehicle scrappage rates and the elasticity of consumers' decisions in altering their vehicle holdings as gasoline prices increase.

WALKING VERSUS MOTORING: THEIR RELATIVE DANGERS

Is walking truly more dangerous than motoring (i.e., riding in a moving vehicle as either a driver or a passenger), as concluded in early studies? Chu of the Center for Urban Transportation Research at the University of South Florida used an integrated, time-based comparative approach to reassess the risk associated with walking. This reassessment measured crash exposure as time spent instead of distance traveled (thus, the time-based approach), expanded the definition of crashes to include both fatal and nonfatal ones, and excluded pedestrian fatalities that occurred while the pedestrian was stationary (e.g., working on or playing in roadways or tending to a broken car). The relative risk of walking was estimated by taking into account the willingness to pay to avoid injury.

Four data sources were used: the Fatal Analysis Reporting System (FARS), the General Estimate System (GES), the 2001 NHTS, and the Federal Highway Administration's estimated unit costs of injuries by severity.

The author concluded that walking was considerably less risky than motoring if only nonfatal injuries were considered, was more risky when only fatal injuries are considered, but was somewhat less risky than or similarly risky to motoring when injuries of all severity levels were integrated. The results indicated that the average risk was about $2.00 of expected injury costs per hour of exposure for motoring but only $1.69/h for walking and suggest that motoring

on average was just as dangerous as, if not more dangerous than, walking in the United States in 2001.

Although this work was an improvement over the previous research, the author cautioned that uncertainty still existed in the estimates. He attributed it to the underreporting of injuries, the errors in estimating the number of injuries, and the inclusion of crash exposure in private roads.

MONTE CARLO SIMULATIONS OF TRAVEL CHARACTERISTICS

Many activities were under way in the late 1990s to determine the feasibility of simulating household travel data that could be used (*a*) for transportation planning in geographic areas smaller than the size that the existing survey data can statistically support and (*b*) for augmenting local-area surveys that have a sample size too small to meet transportation modeling needs. Stopher, Greaves, and Xu of the University of Sydney (Australia) showed that imitating household travel characteristics through the use of a Monte Carlo simulation produces reasonable approximations of actual travel characteristics obtained from household travel surveys. Nonetheless, this approach has some shortcomings. First, the lack of transportation system characteristics as part of the simulation procedure tends to produce little or no difference in travel patterns, regardless of changes made to the transportation system. Second, the disaggregation of the simulated data gradually reveals potential inconsistencies in the data because trips were simulated independently of each other and independent of purpose and characteristic of each trip.

To overcome these shortcomings, the authors changed the approach from a trip-based simulation to a tour-based simulation. A tour was defined as a "set of consecutive trip links that begin and end at an individual's home." In this context, two categories of tour were defined: a home-based tour and a work-based tour. From the 2001 NHTS, more than 134,000 trips were collapsed into about 47,000 tours. These tours were then classified into 12 different tour types.

Preliminary analysis of the tour-based data suggested that the NHTS data contain a sufficient number of tours to provide data for simulation. The next step is to simulate the tours.

PAPER SESSION SUMMARY

Critical Issues

FRED LAURENCE WILLIAMS
Federal Transit Administration

This session offered papers on five critical issues related to the National Household Travel Survey (NHTS) and how they should be addressed in the next NHTS. These issues included the effect the surrounding environment had on the propensity for walking; analysis of long-distance travel behavior; the consequences of aging on the travel habits of older Americans, especially as compared with older Britons; the impact that Latino immigration had and will have on travel behaviors in the United States; and the direction of growth in public transportation, both absolutely and as a percentage of all travel.

WALKING AND THE BUILT AND NATURAL ENVIRONMENT

Rob Boer, *Presenter*
Michela M. Zonta, Deborah A. Cohen, and Adrian Overton, *RAND Corporation, coauthors*

The authors linked 1995 Nationwide Personal Travel Survey (NPTS) data with other geographic data to explore correlates of walking and biking. (The final model will use 2001 NHTS data.) The linked geographic files included U.S. Census TIGER street files, InfoUSA data on the location of destinations, U.S. Historical Climatology Network data, surface elevation data, and Landsat Thematic Mapping satellite data on land uses. From these sources, a respondent's residence was rated on the Smart Scorecard for Development Projects, a location-efficiency scale published by the Congress for New Urbanism. In addition, for each respondent, a propensity score was calculated through the use of a multinomial logistic model on factors that would influence the selection of the neighborhood and the choice to walk on the NHTS travel day.

The authors examined effects on walking of the following characteristics within a 0.25-mi radius of a respondent's residence: dwelling density, population density, business diversity, business density, and combined population and business density. These results were then compared across respondents' propensity to select a walkable neighborhood and propensity to walk.

Population density and dwelling density independently influenced walking trip volumes, as did business density. The combination of population and business density further enhanced walking trips. The influence of the propensity variable on walking was most pronounced among respondents residing in neighborhoods with the highest population and business densities.

A PICTURE OF THE LONG-DISTANCE TRAVEL BEHAVIOR OF AMERICANS THROUGH ANALYSIS OF THE 2001 NATIONAL HOUSEHOLD TRAVEL SURVEY

Joy Sharp, *Presenter*
Lee Giesbrecht, and Jonaki Bose, *Bureau of Transportation Statistics, coauthors*

The authors compiled data from 45,000 long distance trips (50 mi or more) reported in the 2001 NHTS. Personal vehicles predominated over commercial air travel for all round-trip distance categories except that of 2,000 mi or more. Commercial air accounted for 75% of round trips longer than 2,000 mi and more than 40% of round trips of 1,000 to 1,999 mi.

The majority of long-distance travel was for pleasure; business travel came in second and was followed by commuting to work and personal business. The greater the trip distance was, the greater the number of nights away from home were. Long-distance trips on Thanksgiving weekend were 54% higher than the annual weekend average; the comparable spike for Christmas week was 23%.

Long-distance travel increased with education level. The personal vehicle dominated long-distance travel for all income groups, but air travel increased sharply with household incomes greater than $50,000.

A comparison of long-distance travel between 1995 and 2000 is difficult because the attacks on the Pentagon and the World Trade Center on September 11, 2001, created extreme disruptions in air travel. Although the transportation system dusted itself off, improved airport security, and recovered passengers, the 2001 disruptions cascaded through the transportation system, especially for long-distance travel, and blurred straightforward interpretations of 2001 long-distance travel data.

OLDER YANKS AND OLDER BRITS: A COMPARATIVE ASSESSMENT OF THE DIFFERENCE BETWEEN DRIVERS AND NONDRIVERS

Sandi Rosenbloom, *University of Arizona, Presenter*

A comparative analysis across two industrialized countries with somewhat different land use patterns and driving habits can shed light on the implications of an aging population. On an equivalent basis, the United Kingdom has more compact development and more transit options than does the United States, although both are advanced industrialized nations.

One significant finding in the research was the importance of microlevel elements that enhance or detract from macrolevel elements that would otherwise seem advantageous for older people. For instance, intensive transit services in the United Kingdom may be a good thing at the macrolevel. But many such services suffer at the microlevel from poor vehicle maintenance, crowding, inaccessibility (the low-floor feature of a bus that is nullified by a driver's decision to stop on the crown of the road), and poor security for passengers. Breakdowns in these amenities chase off sensitive passengers and thereby deprive elderly customers of mobility.

Transit plays a more important role in British than in U.S. mobility, even for drivers. As a consequence, loss of a driver's license due to age has a much milder impact on an individual's mobility in the United Kingdom than in the United States.

Physical safety, personal security, and physical barriers are sharply accentuated concerns of the elderly in both countries. These are predominantly microlevel issues pertaining to pathways, the condition of vehicles and facilities, and hands-on management of the immediate

environment elderly passengers must navigate. U.S.-style retirement communities are attractive to elderly Brits because those communities pay close attention to the microscale of mobility issues for the elderly. Because many of these microlevel issues are idiosyncratic, having better trained, disciplined, and compensated vehicle operators may ameliorate these microlevel issues for older Yanks and Brits.

LATINO IMMIGRATION AND ITS IMPACT ON FUTURE TRAVEL BEHAVIOR

Jesse Casas and Carlos Arce, *Presenters*
Christopher Frye, *NuStats Partners, L.P., Austin, Texas, coauthor*

Through new immigration and large families, the Latino population accounts for an increasing share of the U.S. population. According to transportation surveys, Americans with Latino backgrounds exhibit important differences from the general population in such travel behaviors as vehicle ownership and vehicle occupancy. In addition, sample surveys tend to underreport Latino households by large margins, especially the households of newly arrived immigrants. As the Latino (or Hispanic) population fashions the integration of its members into the U.S. economy, its effects on transportation evolve.

In 2001, there were 9.3 million Latino households in the United States The authors divided the U.S. Latino population into three segments: (*a*) U.S. Hispanics (born in the United States), 40%; (*b*) settled Hispanics (immigrants with two-thirds of their lives in the United States), 42.4%; and (*c*) newcomer Hispanics (immigrants in the United States for less than one-third of their lives, 42.4%. This segmentation exercises discriminating power in the following analysis.

The U.S. Census undercounts Hispanic households at thrice the rate of non-Hispanic households. This miscounting declines in proportion to the household's longevity in the United States. About two-thirds of an estimated 9 million undocumented U.S. immigrants are Latino; their undocumented status contributes to the undercounts.

Latino immigrants disproportionately depend for their mobility on public transit. In regions of the United States lacking substantial transit services, this transit dependency exacerbates the isolation of Latino immigrants. However, dependency on transit lessens sharply with duration of residence in the United States so that as Latinos adopt automobile lifestyles, income replaces ethnicity in the propensity to use transit.

Latino immigration is driven in part by workforce pressures in the United States and in neighboring countries. The particular transportation needs of recent immigrants therefore play an important role at the margin of a growth economy that attracts immigrant workers. For the short and long terms, local transportation planners should pay particular attention to this segment of the population in such circumstances. Planners should be especially alert to censuses' recurring failure to count recent immigrants.

OBSERVATIONS ABOUT PUBLIC TRANSPORTATION BASED ON THE NHTS

Steven E. Polzin, *Center for Urban Transportation Research, University of South Florida, Presenter*

Successive NHTSs (before 2001, the NPTS) shed light on the evolving shape of volume-of-travel demand for public transit services.

Transit's share of travel can decline while transit posts significant ridership gains. Transit's share of journeys to work is most stable in markets in which (*a*) traffic congestion takes its greatest toll on automobile speeds, so that (*b*) commuter rail or rapid transit offers a competitive overall home-to-work travel time. Of workers who reported transit as their regular mode of travel to work in 2001–2002, 3 in 10 reported that they used another mode the previous day (most driving or carpooling) or stayed home.

A strong demand for transit services persists among disadvantaged groups such as low-income populations, the elderly, and people with disabilities. As vehicle ownership has reached more segments of the population, however, transit use has declined. Demand for the more competitive transit modes—commuter rail, rapid rail, and light rail—has grown compared with demand for transit bus services. Further, in areas with high residential and commercial densities and low automobile ownership among the middle class, transit persists as a bedrock city service.

WORKSHOP SUMMARY

Data Fusion

CATHERINE LAWSON
State University of New York, Albany

Data fusion is the process whereby two or more databases are integrated into a single source database, which is then used for statistical analysis. There are many policy, planning, and modeling issues for which National Household Transportation Survey (NHTS) data explain only part of the story, and data from other sources are necessary to complete the picture. Participants in this workshop identified opportunities for data fusion that uses NHTS data and examined the challenges and solutions for integrating one or more databases with NHTS data.

Data fusion has been used in transportation research and modeling for many years. The associated processes and procedures are often expensive and labor intensive. Today, new opportunities exist to link various data sets together by using computer technologies, including emerging web applications and advances in geographic information systems software. Web applications are useful for fusing large data sets, such as the five files that make up the NHTS data set, into one super table. This merger makes it possible to perform cross-tabulation analysis with greater ease and flexibility.

A common approach to data fusion appends data to individual sample households in the NHTS. For example, Claritas, a major marketer of consumer survey data, has developed lifestyle segments that are based on socioeconomic groups. Various characteristics, including percentage of owners and renters, percentage above or below median household income, and other important information, are fused to NHTS sample households. These fused characteristics are also being used in the transferability project, in which exact locations from the NHTS are matched to neighborhood cluster values, with each census tract being assigned to a cluster. It is basically a form of trip generation information.

NEW SOURCES OF DATA FOR FUSION EXPERIMENTS

Global Positioning Systems (GPS) are being tapped for data to be used in the fusion process. For example, to measure how much travel is occurring on certain roadways, GPS data are being postprocessed to enable researchers to generalize behaviors and attach this information to individual records in the NHTS dataset. (In the Lexington study, the GPS data were matched with functional class to examine speeds and the distribution of travel by various person characteristics and by roadway characteristics.) New research (comparing GPS data with travel diary data) examines geographical cultural differences. Researchers found that some communities are more likely to underreport trips, information that can be used to guide stratification for future surveys. In addition, understanding the amount of travel occurring on arterials or Interstates can facilitate research on emissions.

When GPS units are built into cars, it is possible to monitor the cars with these location data. These data can also be marketed to travel researchers. With wireless technologies, it might be possible to ask people just to “turn on the tap” on their vehicles; instead of having people

complete a survey, the data would transparently upload. In that case, researchers should be thinking forward and preparing to specify the type of technologies that could transmit the best data for our purposes with the least amount of respondent burden.

There are other ways to capture similar data at lower resolutions. For example, if cell phones are being used while people are driving, the data from the service towers could provide researchers vehicle locations with resolution in an area of 5 square miles. In the Netherlands, for example, people were asked to let their cell phones be used for tracking over space. The data associated with those who volunteered can be mapped.

However, with these automatic data, important information is missed: who is in the car, what the trip purpose is, and the like. And for people trying to link these data, another question becomes, What linking variable should be used? How does one link cell phone company data to other data sets? A cell phone number cannot be used as a link because that number is not in the other data set. One possibility is a mixed media survey in which old technologies and methods are handed off for new ones. In some cases, the intelligent transportation systems (ITS) data may provide sufficient needed information if they are merged with traditional surveys. For example, Canadian researchers are testing standard PDAs and GPS-enabled PDAs to track where people are going and having respondents record the information and report back. Then the researchers can ask these people to recall what they were doing at their various stops.

Another source of data for fusion can be found in administrative databases. For example, it is possible to append miles per gallon data—from the make, model, and year of vehicles—to information provided by NHTS sample households. Depending on their availability, vehicle registration data would be even more useful for air quality modeling. For example, some states require odometer readings with their vehicle registrations. Virginia, for instance, has a central database with this information, which is transferred automatically from recorders in gas stations. Pennsylvania has a safety check program. In some cases, not only are odometer readings available, but results of smog tests as well.

Data from sources such as these theoretically can be linked and would be extremely useful for air quality programs. Currently 40% of the U.S. population is included in such programs, so the impact would be significant.

Another type of administrative data contains house values, structure sizes, and structure locations, with respect to transit accessibility. Traffic counts have been linked to these parcel data sets when a portion of the network with only one exit point has been identified. This information could also be linked to some measure of household demographics for traffic generation purposes. In addition, traffic counts can be used to gather actual activities.

Metropolitan planning organizations have data resources—as do small and medium-size cities—that might be fused with surveys to increase their value. Could these data resources be used to produce another round of quick-response systems based on Census Transportation Planning Package (CTPP) and NHTS? Could researchers understand how travel correlates with land use, basically through the use of enhancement? Can a smaller survey effort be matched to the CTPP data or Public Use Micro Series data? Is there a way to get more depth and less breadth on some issues? Is it possible to leverage resources to get the needed information if the data can be pulled from other places?

Time-series data are one of the greatest assets of the NHTS series. How are a complete methodology and enough consistency maintained to enable someone to create a storyline for changes in travel patterns over time? If one uses the National Personal Travel Surveys from 1983, 1990, 1995, and 2001—even though everything is cross-sectional data—some researchers

will be able to develop a story and talk about trends and other useful findings. This is a meta-analysis problem—trying to get compare apples and apples—requiring one to go through the same processes and normalization and standardization practices with the data.

A national longitudinal survey in transportation is not necessary. However, one could use some geographic comparison techniques that include demographics. It may be possible to use credit reports, as every report has addresses and information on a person's relocations over time. In a sense, this is a longitudinal record of where people are. How long are these records kept? Is permission needed to use them? Is there a possibility of using consumer-type information, such as purchases? The LexisNexis database is used for surveys and tries to track down people who may have gone through a particular program in a 5-year period. One can actually track people by their Social Security numbers. With a longitudinal record of people, one could generate the life histories of people and combine them with NHTS for the entire United States, which would create a 20-year history that could be microsimulated.

There are gaps or holes in researchers' knowledge of people. What did they go through to get to the point indicated in the data? What did they do 10 years ago? What about important monthly surveys, such as the U.S. Commerce Department's, which generate the consumer price index and the producer price index? They are cross-sectional data, not longitudinal. The NHTS could have questions that are retrospective. This information could be generated and appended to people's records as a data-fusion exercise. What are the most relevant things from their past that determine their current travel behavior? The information could include employment, household status, and the location of these activities. Is it possible to propose having a small portion of the next NHTS survey include a panel—a group of the same respondents to return to over time?

THIRD-PARTY DATA PROVIDERS

Third-party data providers, such as Reebie in the freight world, are able to get commercial data from the private sector. In return, the data suppliers receive the benefit of aggregated data compiled from a number of companies. Some consulting firms now act as third-party providers of ITS data; their data could be useful for personal travel analysis. However, before considering third-party providers, researchers should provide some guidelines and some principles on transparency. Otherwise, researchers may not really understand the data and reach erroneous conclusions. In addition, other third-party data sources, such as consumer-market panels, could be useful. Should researchers consider such a service for travel surveys, given that they already have various other data points for people? Consumption data are being sold to corporations, but the transportation industry is not taking advantage of such opportunities, except that the industry does use these data for frame building. When building a sampling frame for surveying a region, one picks and chooses the data a private provider will supply (e.g., names, addresses, and, perhaps, from credit card information, the top 5% of consumers). (As of now, it appears that NHTS agencies are not using this type of information.)

ISSUES FACING DATA-FUSION EXPERIMENTS

Although a major concern for transportation researchers is finding data sets that can be fused to the NHTS, some overarching issues are still unresolved. For example, is there a consistent methodology for performing a fusion experiment? How can one compare short trips to short trips without knowing how they were defined in each data set? One must also try to avoid being tied to mistakes of the past, something that can happen for the sake of trying to maintain consistency. Can data be harmonized? When looking at income in three different databases, one needs to know just what "income" means: household income; combined individual incomes, including investments or not; or something else. Therefore, to merge data correctly, definitions need to be harmonized.

Data Definitions and Quality

When various databases are used, there is an additional burden for those documenting both the data and the ways in which weights were assigned or reweighting was conducted. Questions also remain about the data quality. Should one explore the possibility of assigning quality or qualifier information to each record, as is being done in archived ITS research? The archived data warn users of their quality before analysis. ITS is also producing self-describing data: every record contains metadata that "travel" with the main data.

Privacy and Stewardship

Confidentiality concerns remain an issue with all types of survey data sets. With emerging types of electronic data, it may be possible to incorporate data-encryption strategies to ensure privacy. For example, in New York State, EZ-Pass transponders were used to measure real-time delay and congestion and to detect incidents in real time. The data literally stream from the system. However, people are sensitive about having their movements traced on the system. If key variables, such as driver's licenses, automobile licenses, or vehicle identification numbers, are encrypted, data users should not be able to identify individuals or vehicles. An encryption strategy developed at the University of Washington for truck weigh-in-motion transponders uses one encryption algorithm for a given time period—for example, from 3:00 a.m. one day to 3:00 a.m. the next—and then changes the algorithm so that unauthorized decoding becomes more difficult.

Further, driver's licenses are encrypted. Why not addresses? In fact, one could encrypt them once they have been matched with other data; in that way, the fused database is produced and then, without the original exact addresses, given to users.

All these examples require stewardship—good handling procedures for security purposes. Does the encryption itself cause problems for users? Should people doing the encryption also do the fusing? Having the stewardship responsibility for both functions may become a burden for the organization holding the data if it has to respond to requests for special tabulations. Agencies holding the data can do those tabulations if they work at the lowest possible geographical level and then merge the data—and do exactly what the census does with block-level data tabulations. The data users cannot get all the data at that level, but they can get additional levels of detail at a higher level of geography.

Statistical Rigor and Validation

Probability sampling properties may or may not be changed when data are combined. Does a problem exist if the sampling frame is not perfect? Or is it good enough if many of the characteristics can be matched? If one has information from another source and uses a probability sampling procedure to confirm that they, in fact, have those same characteristics, could the probability and nonprobability samples be matched? Could small surveys be used to validate assumptions from fused data sets? How can one be certain that data from Portland is representative of Portland? How can researchers provide some level of surety that the data they give decision makers is good enough for their purposes?

Is it necessary to have a blanket database that covers the entire United States (e.g., the census or NHTS) to provide the desired breadth? If so, is the NHTS the right blanket for this purpose? Maybe the American Community Survey could include more travel information. The potential to answer research questions depends on the variables being examined—and the level of aggregation at which sufficient data are available without exposing a lot of information about individuals and their household members. More research is needed to move forward with a number of the suggested fusion practices; at the same time, more attention needs to be paid to just what researchers have created in their new supersized data sets.

WORKSHOP SUMMARY

Emerging Issues

CHANDRA BHAT
University of Texas

RAM PENDYALA
University of South Florida

NANDA SRINIVASAN
Federal Highway Administration

This report summarizes the deliberations of and conclusions from the Emerging Issues workshop. The workshop focused on identifying demographic, technological, and lifestyle changes that could potentially affect transportation policy decisions in the near future. A resource paper by Ram Pendyala and Chandra Bhat served as the starting framework for discussions at the workshop.

The workshop did not focus on detailed analytical issues related to how the National Household Transportation Survey (NHTS) data may be combined with other data sources to address relevant emerging issues, and it did not dwell on survey design–related considerations. Those aspects were discussed in other workshops held as part of the NHTS Conference.

The rest of this summary is structured in two broad sections. The first section identifies the emerging issues potentially affecting the path of transportation policy making. The second section discusses broad strategies to obtain relevant data to study, understand, and accommodate the emerging issues for transportation decision making.

EMERGING ISSUES

Safety

Safety considerations will continue to be a priority for the transportation community. While safety is not an emerging issue, the impact of September 11, 2001 (9/11), and a changing world have led to an alteration in the way individuals view safety in the context of travel choices. Specifically, 9/11 has expanded the concept of safety in travel choices to include not only safety from crime and safety from accidents but also safety from terrorist acts. Understanding safety perceptions in the context of the latter dimension is important to, among other things, identifying the most effective travel-related information dissemination strategies in the immediate aftermath of extreme events.

The current NHTS survey includes several questions related to safety perceptions in the context of accidents. For example, the NHTS asks attitudinal questions on topics such as aggressive driving, drunk driving, and accidents. It also collects information on the number and duration of trips, data that can be used to formulate time-based exposure measures to study safety from accidents. However, little data are collected on safety perceptions in the context of crime and terrorism.

Diversity in Vehicle Type Holdings and Vehicle Technology

Recent studies suggest an increasing diversity of motorized vehicle type holdings by households. The 2001 NHTS data show that only about 57% of the personal-use vehicles are cars or station wagons, while 21% are vans or sports utility vehicles (SUVs) and 19% are pickup trucks. The increased holdings of vans, SUVs, and pickup trucks, in turn, has led to a surge in the vehicle miles traveled when these vehicles are used. This shift from small passenger car vehicle miles of travel (VMT) to large non–passenger car VMT has implications for roadway capacity because larger vehicles take up more room on roadways than smaller ones. The resulting reduced capacity exacerbates the problem of traffic congestion caused by increasing motorized personal vehicle use and also has safety implications. Further, U.S. Environmental Protection Agency statistics show that an average van, SUV, or pickup truck produces twice the amount of pollutants emitted by an average passenger car. Clearly, understanding vehicle type trends, as well as vehicle technology trends (availability of in-vehicle navigation systems, engine type, fuel type, etc.), will enable informed transportation design and policy decisions.

The NHTS collects information on vehicle type and make. However, these data can be supplemented by collecting (or appending) additional information relevant to each vehicle in the sample, perhaps by coordinating with car manufacturers and vehicle licensing agencies. The idea of collecting vehicle identification numbers (VINs) was discussed, as the VIN was a unique identifier of many vehicle type characteristics. However, gathering this information may be perceived by respondents as being too intrusive.

Demographic Shifts

The demographic composition of the U.S. population is changing rapidly in such characteristics as racial and ethnic distribution (more non-Caucasians, primarily through immigration), household structure (fewer and fewer nuclear family households), and age distribution (more older individuals). These changes have potentially significant implications for travel behavior. For example, non-Caucasians tend to have fewer vehicles and make fewer recreational trips but appear to make more social and visiting trips compared with Caucasians. The residential-choice determinants can also be quite different between different racial and ethnic groups. Such differences have also been observed in household structure and age. With regard to age, the travel behavior of the new elderly cohort is likely to be quite different from that of earlier elderly cohorts because the new elderly cohort is accustomed to an active and mobile lifestyle. This may be particularly the case for elderly women, who are likely to be hypermobile compared with elderly American women of past generations.

The NHTS survey collects data on ethnicity and race, household structure, and individual age. However, the sample size is not adequate to pursue an in-depth analysis of the effects on travel of changes along these dimensions. One approach to addressing this problem is to oversample specific population groups, though this may be difficult in a phone survey and may have other survey cost and sample size implications. In addition to working toward larger sample sizes for specific population groups, researchers need more detailed information on such issues as length of immigration and year when an individual stops driving or becomes relatively immobile; such valuable information would be helpful for transportation planning and policy analysis.

Transit Service Delivery Measurement

The provision of adequate public transportation service is important to the social and economic fabric and to the environmental sustainability of any metropolitan area. Public transportation not only represents a means by which people can efficiently move within a region with the least impact on the environment but also plays a critical role in providing access to activities for those without personal motor vehicles. Over the years, however, there have been an increasing reliance on the private car and a corresponding decline in the use of public transit systems for personal travel in metropolitan areas in the United States.

An important issue, then, is to acquire and examine transit service data relative to the needs of individuals. Transit service data may include spatial characteristics (stop locations and transit routes); temporal characteristics (time span of operation, frequency of service, on-time performance or reliability of service, and load-carrying capacity by time of day); and comfort, safety, and security characteristics associated with both transit stops and public transportation vehicles (presence of seating at stops, weather control at stops and on vehicles, lighting at stops, etc). Useful information from potential users of the transit system includes the locations of desired activities, desired times of day of travel, acceptable thresholds of access times to and wait times at transit stations, and demographic and socioeconomic attributes.

Transit agencies in metropolitan areas may have some needed transit service data, which can be appended appropriately to households in the NHTS data set based on residential location. The NHTS survey also collects data on the demographics and activity-travel patterns of individuals but does not collect data on customer desires or preferences about transit service. A set of attitudinal and preference questions on transit service would fill this void and contribute to informed transit policy decision making.

Overall Lifestyle Changes

The rapid innovations and advances in information and communication technologies (ICTs) since the early 1990s have had a profound impact on the behavior of businesses and individuals in today's society. Businesses are increasingly harnessing the potential of ICTs to facilitate and consummate business-to-business transactions and business-to-consumer transactions. In particular, it is fairly routine today for businesses to manage the production and distribution activities of their services and products (supply-chain management), as well as promote the purchase of their services and products (electronic-enabled commerce), through the use of the Internet. Individuals and households are also substantially more likely today than 10 years ago to use computers at home with web access, to use mobile telephony services, or both, in large part because of the increasing affordability and functionality of these technologies. Projections suggest that technology improvements will further fuel adoption and use of Internet computing and mobile communication devices by individuals and households.

The impacts of ICT adoption and use are likely to be far-reaching, with the potential to alter the lifestyles of businesses and individuals fundamentally. For example, travel may not be perceived as much of a "time sink" if a person is able to pursue a business or social conversation when traveling. Thus, drivers' tolerance for congestion may increase. Similarly, the advent of 24–7 services in many employment sectors, as well as employees' desires to balance work and family, is leading to an increasing prevalence of work arrangements that involve teleworking, flexible

schedules, and alternate work shifts. This diversification of work arrangements can also have a substantial impact on travel patterns.

The NHTS survey collects basic ICT use data, but not at a level that enables a good understanding of ICT–travel interactions. While it would perhaps be asking too much of the NHTS to collect detailed ICT use data, some additional ICT use questions that characterize the use and frequency of specific forms of ICT over a specified time may be helpful. As with ICT use data, detailed information on work arrangements is not available from the NHTS. This is an area for consideration in future surveys.

Land Use–Travel Interactions

Understanding the interactions between land use and travel is critical to designing balanced land use transportation systems. For instance, the neourbanist view is that urban design can affect travel choices by affecting perceptions of safety and security and providing nonmotorized-friendly and transit-friendly environments. Similarly, the idea of employing land use strategies to control the growing obesity epidemic in the United States is based on the notion that physical activity can be promoted through appropriate urban form design. Of course, it is possible that land use and urban form designs are not causing changes in travel patterns of individuals as much as individuals are selecting land use and urban forms on the basis of their travel or physical activity desires. This self-selection issue is important to understand to disentangle the true and the spurious causal effects of urban form on travel choices.

The NHTS collects the street addresses of participating households, although obtaining this information requires a separate confidentiality agreement. Thus, researchers can append land use data to the NHTS household sample if they have access to such data. However, a centralized effort to append land use data for each NHTS household would be valuable to researchers focusing on an understanding of land use and travel interactions. This would require close coordination with local and metropolitan planning organizations around the country.

Rural Issues

There continues to be faulty understanding of rural commutes and rural transportation needs in general. Unanswered questions include the following: How do individuals make the trade-off between a long commute and living in a rural area? What kinds of transportation services are available to the elderly?

The NHTS collects information from households all over the country, but representation of rural households is relatively small because of population concentration in urban areas.

STRATEGIES TO ADDRESS EMERGING ISSUES

The current NHTS survey is a rich source of travel data and already provides a wealth of information to help in understanding national and regional travel trends. This section identifies potential strategies to augment and leverage the existing richness of the NHTS survey and thereby addresses the already-identified emerging issues. The strategies proposed here are generic and not tied to specific emerging issues.

Identify Multidisciplinary Partnerships at Inception

Many agencies collect data that can be beneficially used along with the NHTS survey to address several emerging issues identified in the previous section. (For example, the Center for Disease Control and the National Institutes of Health collect rich data on physical activity.) However, different agencies collect their data in different formats and in different ways. These differences make appending relevant data at the back end of the NHTS data collection process rather tedious. In contrast, a concerted partnership among agencies at the front end of the process has the potential to make the fusing of data efficient. Specifically, the "hooks and dangles" for connection could be identified in advance. Then, fusion would become relatively straightforward rather than a nightmarish puzzle. In addition to making the fusion process efficient, a multidisciplinary partnership at the front end provides the benefit of each agency's expertise to ask the right kinds of questions.

Adopt a Time Use Survey Approach

Time use data on in-home and out-of-home activities (including travel and ICT use) can provide important information for addressing lifestyle issues, such as ICT–travel interactions and participation levels in physical activities. Although converting the entire NHTS to a time use format may be unnecessarily burdensome—and would lead to problems in examining travel trends across time—one possible modification is to collect time use data for a small set of NHTS sample households.

Collect Core Data and Use Rotation and Augmentation

Expanding the NHTS survey to include questions that address all emerging issues is infeasible because of survey burden issues. However, it may be possible to retain a core set of questions for all respondents and then to ask different sets of questions to different subsamples of respondents. For example, a small sample of respondents could be asked additional questions about levels of physical activity, another small sample about ICT use, and a third small sample about transit service preferences. Such a rotation scheme keeps the survey length reasonable for each individual yet still provides information that addresses several of the emerging issues identified earlier.

Another approach would be to augment the core questions in the NHTS with a set of indicative questions whose answers act as identifiers for targeting individuals or households for a follow-up survey (by NHTS or some other agency). For instance, one of the core questions in the NHTS could be, Do you have a cell phone? A positive answer to this question would make the individual a candidate for a follow-up survey with an in-depth focus on the effect of cell phone use on activity-travel characteristics.

Include a Global Positioning System Component

Using Global Positioning System (GPS) technology to collect travel data has been proven to be an efficient way to obtain detailed travel (and route choice) information. The GPS data collection approach can be supplemented by a short diary for recording the activity purpose at each stop location, as well as details of the activity pursued at that location (such as whether an activity was a joint activity or a solo activity, the people involved in the activity, etc.). Alternatively, it may be possible to impute the activity purpose for each stop by overlaying its location coordinates on a high-resolution land use geographic information system layer.

WORKSHOP SUMMARY

Travel Survey Methods

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The 2001 National Household Travel Survey (NHTS) was challenged to attain a response rate that met the requirements of the Office of Management and Budget (OMB), a level that would be more difficult to reach with the next NHTS. The purpose of this workshop was to provide ideas to support planners of the coming NHTS in accomplishing two primary goals: reducing nonresponse and constructing statistical compensations for the effects of nonresponse. Among the ways to accomplish these goals are to identify current trends in the survey industry and to become knowledgeable about new technologies and survey procedures that hold promise in improving the practices that were used for the 2001 NHTS survey.

ISSUES RELATED TO DATA COLLECTION

As part of the overview of the resource paper written for the workshop, Elaine Murakami introduced four issues related to daily travel data collections.

Nonresponse Associated with Random Digit Dialing Surveys

If a random digit dialing (RDD) option is used for the next survey, other alternatives must be considered and improvements must be made. Two such options are the dual-frame sample design, such as that employed by the National Survey of America's Families, and an intensive nonresponse follow-up survey, such as that done by the American Community Survey.

Continuous Surveys: Advantages and Disadvantages

Other countries, such as England and Australia, use continuous surveys. There are some obvious analytic and operational benefits (e.g., flattening of the budget across years and maintaining project resources); however, obtaining adequate sample sizes often involves rolling estimates over a longer time period.

Global Positioning Systems Subsamples

Benefits of a Global Positioning System (GPS) subsample might include better time, speed, route, and location information, with less burden on respondents. This type of subsample might

also open the possibility of obtaining multiple days of reporting, especially for personal vehicles. More testing would be needed to determine appropriate sample size, length of deployment, and locations of deployment (i.e., across the country or only in select areas).

Special Populations

Because of the inherent small sample size, studies of special populations of interest are often not possible. One example is transit users. Although the inclusion of the New York add-on significantly increased the number of transit users included, further assistance could potentially come through greater sponsorship in high transit areas as well as from the Federal Transit Administration.

LONG-DISTANCE TRAVEL SURVEY

Joy Sharp introduced key issues related to the design of the next long-distance travel survey, including the following.

Sample Size

Because of changes in data collection, the 2001 NHTS resulted in data on only 4% to 5% of the 1995 American Travel Survey's (ATS) comparable long-distance trips. This situation affected researchers' ability to make lower geographic state estimates (e.g., state and metropolitan areas) and all but eliminated their ability to produce interstate flows. As a result, most analyses that used the 1995 ATS data cannot be repeated by using the 2001 NHTS, and data users are often forced to continue using 1995 ATS data in current projects.

Nonresponse Bias

The 2002 NHTS achieved a response rate of 41%. Analysis following collection of the NHTS data demonstrated that potential for nonresponse bias did exist, although nonresponse adjustments were made in an attempt to correct for some of the bias. Higher response rates will be needed in the next survey to adhere to new OMB guidelines.

Coverage Bias

Inherently an RDD-only sample design excludes households without land-line telephones. According to the 2000 Census, 2% to 3% of U.S. households had no telephone service; another recent study estimated an additional 6% of households were cell phone only. Research suggests that these households differ from households with land lines (i.e., cell phone–only households tend to be younger, more urban, and more likely to rent than own a dwelling), and the number of cell phone–only households is predicted to grow in the coming years.

Underreporting of Trips

Research has indicated that respondents tend to underreport certain trips, especially discretionary ones. Underreporting is also more likely when proxy respondents report in place of the interview subject. Trip underreporting is another area that could potentially benefit from a GPS subsample—to validate trip reports, measure underreporting, and adjust for trips.

Measurement Error

In addition to omitting trips, inaccurate reporting of trip details introduces various types of measurement error. These types of error are often introduced or confounded by the reference period, recall error, and recall aids (e.g., map, diary), proxy reporting, and the like. GPS may also help in measuring and adjusting for these types of errors for longer-distance vehicle trips.

KEY DISCUSSION AREAS

Following these presentations, workshop participants defined several areas of improvement for the next series of passenger travel surveys. Descriptions of these areas and highlights of the ensuing discussion follow.

Nonresponse Bias and Follow-Up Studies

New OMB guidelines require a survey such as NHTS to achieve a response rate of at least 60%. Surveys with response rates between 60% and 80% require nonresponse follow-up (NRFU). The final NHTS response rate was 4%, however, each stage met or exceeded 60%. The response rate was 60% to 65% nationally at the household-interview level, and at the extended level it was about 70%.

One example of an NRFU is the ACS survey, in which 1 in 3 nonrespondents to the mail survey are subsampled in telephone or in-person interviews, which results in a weighted response rate of well over 90%. Future ACS plans include higher NRFUs in areas with low mail-back (MB) returns (up to 1 in 2) and lower NRFUs in areas with higher MB returns (1 in 4). While the unweighted response rate remains low, the weighted response rate (acceptable to OMB) is approximately 98%. The disadvantage of this method is its impact on survey weights and increases in variance.

Participants discussed two uses of NRFU surveys: evaluating the extent of bias and using data from the subsample to adjust the weights. NRFU surveys used for adjustment purposes typically require large subsamples of nonrespondents (one-quarter to one-third of the sample). In addition, they can produce higher variability in weights, which leads to higher variance and decreases in precision. However, if a NRFU study meant to evaluate bias does detect it, the smaller sample indicates that little can be done at that point to adjust for the bias. Participants also noted that face-to-face interviews typically resulted in better response rates but required an area probability or address frame (which typically resulted in much higher costs).

In the NHTS, nonresponse bias was probably different for the 85% of eligible households for which addresses were identified than for the 15% for which no addresses were found; those with known addresses received letters and incentives before being contacted by phone.

GPS and Cellular Technologies

The use of GPS technology has distinct advantages and drawbacks. Many participants felt that further pretesting is needed to understand the use of GPS in travel surveys better. Among the advantages noted were these:

- It is useful for detecting and adjusting for trip underreporting.
- Other applications for GPS include estimating vehicle miles traveled and air quality impact studies.
- GPS might address issues of diary fatigue for multiday travel surveys.
- For continuous surveys, less equipment is needed because it can be reused.
- Cost of the equipment is declining: one study cited costs of $250 to $300 per household to deploy the system and process the data.

Disadvantages included the following:

- Self-selection bias is possible in that those who refuse to use GPS may differ from others who agree to use it.
- GPS points must be processed into trip segments. There is a trade-off between maintaining confidentiality and providing a full travel survey data set to local add-on areas. The question becomes one of how to keep the subject providing GPS data anonymous, yet still maintain useful data and precision levels?
- Automobile manufacturers may include a black box that incorporates GPS and engine operating data. However, questions of determining who should have access to the data in the black boxes and which vehicles will be quipped with them may limit their use.
- Sampling can be an issue (e.g., rural vs. metro, distribution of national sample).
- How to deploy GPS units must be considered. In several past studies, GPS equipment was delivered in person to respondents' homes. An alternate method is to mail the units and rely on respondents to mail them back in a timely fashion. Prompt mail-back is important because researchers often need equipment for their next set of respondents. Obtaining and using work addresses for mailing out equipment, however, has helped in equipment return for at least one study. If a good plan for equipment return is not in place, equipment may be permanently lost.
- Recontacting respondents to reconcile reports with GPS data presents additional timing issues.

Other thoughts about GPS included these:

- Most GPS surveys to date have been vehicle based. An in-vehicle system is more reliable than a person-based system because a continuous power source is not a problem in a vehicle. Person-based systems rely on batteries, which are heavy and need to be recharged or replaced. However, using a person-based approach can expand mode coverage (e.g., walking, biking, and transit trips).
- A GPS signal underground, indoors, and in urban canyons is either nonexistent or problematic.
- With GPS, as with NRFU, the question of evaluation (validation) versus adjustment will affect design decisions. Adjustments can negatively affect precision of overall estimates.

- Intensive pretesting is required before implementation.
- Automated identification of trip ends is not yet standardized.
- Free or inexpensive geographic-based files for matching GPS points to the transportation network readily exists (TIGER and GDT).

Coverage and Frame

Some participants felt that "RDD is not dead." It is still an economic way to survey—so long as the questions of cell phones and nontelephone coverage (and ways to increase response) can be answered.

The workshop participants also noted other subpopulations not—or potentially not—covered under RDD designs, such as the following:

- Intermittent land-line households,
- Approximately 2.5 million older Americans traveling or living in RVs,
- Snowbirds, who do not establish a land line, in areas such as south Texas,
- Itinerant workers, and
- People with Internet phone service.

Participants discussed the importance of identifying the characteristics of those with cell phones and evaluating the associated bias. They cited national studies outside transportation that show characteristics of cell phone–only persons. However, participants brought up concerns about disparate differences in cell phone users in different geographic areas.

Research on cell phone surveys are not far advanced. Issues were also raised about differences between cell phone numbers and place of residence.

Additional research is still needed. One participant suggested using motor vehicle administration inserts to collect data in hard-to-enumerate areas and then evaluating those data to understand characteristics of cell phone users better. Biases might also exist here because the subsample of cell phone users for this group might look different from cell phone users without driver's licenses or state identification cards. Still, this potential research topic might help in understanding hard-to-reach populations.

Special Populations

Even though the NHTS is nationally representative, sample size is still relatively small for special populations and rarer events.

Many participants talked about the need for oversampling specific subgroups (e.g., low-income and transit areas). Oversampling alone is often not cost effective; oversampling with screening can sometimes provide more benefit.

Oversampling was discussed in terms of RDD designs—not simple using block-level data—and in terms of some information being inaccurate or unreliable.

Participants mentioned differences between onboard transit ridership numbers and estimates of transit trips from NHTS and the role of sample sizes in those differences. Other methodological issues were also addressed as potential causes of differences.

Often these special populations are relatively rare and collecting greater information requires additional questions or increased sample sizes. Nonfederal participants discussed their role in partnering with the Department of Transportation and sponsoring such efforts.

Sample Design and Sample Size

Despite high costs, there is a strong need for increased sample size, especially in terms of long-distance data. States are very interested in state-to-state estimates, and intrastate flow data are in high demand. Additional funding support would be needed to increase sample size substantially to support this level of detail. However, participants discussed other potential sponsors (e.g., AASHTO and state tourism agencies). One participant, who mentioned that the Behavioral Risk Factor Surveillance System faced similar issues, now has state sponsorship. Research on this survey could be reviewed to look for applicability to NHTS issues.

Participants also expressed concerns about losses in trend data and comparisons caused by changing the design yet again.

One participant asked about the possibility of a panel survey. Within person/household measures are not as important as reliable time series data.

Participants noted that because of cost concerns and because infinite possible uses of data exist, key survey objectives have to be identified and guide survey design and implementation.

Advantages of continuous survey designs were also discussed and included the following:

- Surveys are always vulnerable to special events (e.g., September 11, 2001); therefore, continuous surveys might be better for measuring, evaluating, and understanding the impact of those events.
- Resource needs and work levels would be distributed better over the years.
- Improvements can be made along the way.

Among the mentioned disadvantages was that continuous surveys would be more problematic for state and local add-on areas because smaller areas would not have enough of a sample while rapid changes in fast-growing areas have to be measured (e.g., current transit ridership). In addition, modelers in local areas need a sufficient sample size for a given point in time, and they would get fewer cases from the national sample for a particular point in time; larger confidence intervals would result. The discussion also considered whether some kind of hybrid would work.

Miscellaneous

Consideration needs to be given to how add-ons would obtain daily and long-distance data now that the data are to be collected through two different surveys.

Participants cited the rising costs of such a survey as a big problem and said that future cost increases would lead to decreased participation by add-on jurisdictions.

Participants also mentioned ensuring consistency in variables structure across the survey.

COMMON THEMES

Throughout the workshop discussion, the following common themes arose.

Need for Clear Survey Objectives

The information needs of the NHTS are almost infinite. There is a need to identify primary objectives and design methods to support those objectives.

Change Requires Trade-Offs

Any design changes made to the next series of passenger travel surveys require the evaluation of trade-offs (e.g., cost and resources, data quality, timeliness, data access and confidentiality, and the like).

Dialogue with Data Users Should Be Full and Frequent

Changes most beneficial to users can be implemented only if the dialogue continues. Uses are many, but users are often holed up with their own research, so we need to encourage these lively and broad exchanges to help improve the NHTS.

WORKSHOP SUMMARY

Data Needs for Innovative Modeling

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Traditional modeling and simulation in research and practice have already moved to encompass a wide variety of dimensions of trip makers' everyday life. Key aspects of this move include behavioral dynamics of life cycle stage transitions, repetition and cycles in time allocation and travel over weeklong periods, day-to-day variation in activity participation and travel, considerable attention to duration of activities and travel as well as departure time choice, and tour and trip chain considerations and associated decision making. As a result, many policies can now be analyzed through use of a new generation of models. A new need, however, arises for models that incorporate how people perceive space and time and how the use of imperfect information impacts travel choices. New models are also needed to (*a*) assess the affects of new technologies, (*b*) evaluate information systems for travelers, (*c*) assess processing and financing scenarios, and (*d*) analyze combinations of transportation management strategies. All this means an increasingly pressing need for new models that surpass current options. Existing data collection efforts are no longer sufficient to estimate these models, which require more and different data.

OUTCOME MODELS AND PROCESS MODELS

One important issue explained in detail in the workshop the resource paper (available at the conference website, www.TRB.org/Conferences/NHTS) and discussed extensively in this workshop is the difference between outcome models and process models. Outcome models include the striking majority of current practice and do not allow one to understand the path people take in selecting options. Process models, however, can shed light on the ways people go about identifying and selecting options. Conceptual models of how decisions are made and the process followed in doing so require data collection methods that are far different from traditional approaches. Moving along that direction, however, does exclude the parallel need for the more traditional outcome-based data collection and modeling. In fact, one possible method for satisfying both needs is to create a systematic structured survey that obtains both quantitative and qualitative data, information on decision outcomes and processes, and objective and subjective choice factors. A discussion-based assessment in the workshop led many to conclude that this was more feasible now than it may have been because of recent advances in survey technologies.

PROBLEMS OF RESPONDENT BURDEN AND SURVEY DESIGN

Many felt that in an expanded National Household Travel Survey (NHTS) particular attention should be paid to the increased respondent burden associated with other than just the additional questions and issues related to in-home activity reporting. Fears of nonresponse and selectivity bias motivated a movement toward solutions that combined the strengths of smaller targeted surveys yielding more in-depth information. If a smaller add-on survey is preferred to expanding the entire NHTS by increasing the number of questions, bias may be introduced from a smaller potential sample; for this reason, it is necessary to look at ways of reducing the burden on the respondents to provide this information. In fact, one way of accomplishing this task may be to distribute new questions among different segments of the respondent population, and shifting more of the burden to interviewers and analysts rather than keeping it on the respondents; however, this method still has a cost associated with it.

Accomplishing these objectives requires linking NHTS with other data sources that will include new add-ons and complements to NHTS. These additional data sources will include longitudinal survey components, census-based surveys such as the American Community Survey (ACS), data on attitudes and opinions, the American Time Use survey, and a variety of in-depth decision process data. Figure 1 illustrates this idea of using NHTS as the core information at the center with all other surveys linked conceptually and "statistically" to NHTS. For example, it is possible to identify a battery of questions repeated in all related surveys for use as anchors in "synthetic" population generation exercises. In using alternate survey designs in this way, an NHTS can be envisioned as a conglomerate of satellite survey designs that allows breadth and depth of the targeted information. The core component would need to be a modified and enriched NHTS that enables satellite surveys to procure more in-depth knowledge about spatial aspects of travel behavior, behavioral processes, and longer-term decisions and triggers of change. Alternate design advantages and disadvantages, target elimination of duplication, and waste of resources would need to be considered, but, as expected, this enriched NHTS would also require additional institutional and overhead burden. However, this linking of NHTS with other data sources may be a feasible method for using data from the in-depth surveys and other national surveys to expand the NHTS responses; some ways to accomplish this are synthetic data generation and data fusion, as discussed in the workshop on data fusion.

Figure 1 and the workshop discussion outlined a few proposals for additional data sources, including the recently published American Time Use Survey by the Bureau of Labor Statistics (http://www.bls.gov/news.release/atus.toc.htm) and the use of local focus groups. The best approach for modeling might be to combine the top-down approach of using the survey data, such as those from NHTS, to develop aggregate validated models with more of a bottom-up approach, a more disaggregate approach focused on individual decision processes. The outcome data in NHTS may be a good source of validation summaries.

Survey data expansion methods become important in applying blended data sources to represent the universe. This is a particularly thorny question when one considers that it is not always possible to quantify and control for all biases present in the individual surveys. Understanding biases is particularly difficult because there are few proxies for travel behavior; therefore, it is necessary to make better use of pilot tests and in-person follow-ups to understand these biases better.

Related issues are day-to-day variability of travel behavior and the more recent challenges to the "representative" day. Multiday surveys are the preferred data collection method: all activity-based

models that exist in the United States today are based on multiday surveys. Because of privacy concerns and the increasingly accumulating experience of dealing with the problems of biases and self-selection, many participants felt that attention should be paid to these issues when NHTS considered expanding to a multiday diary or using a multiday satellite survey to make inferences about the larger NHTS sample and the nation as a whole.

A design of NHTS that supports Figure 1 also requires consideration of necessary sample sizes and requirements about accuracy and precision of the new pieces of information. This consideration raises many questions about subsamples and their relationships to the entire NHTS survey population. If NHTS moved toward a different design, a variety of useful guidelines and requirements for linked surveys would be needed. A related issue is the definition of the most appropriate domain for individual household and activity surveys designed and executed by other

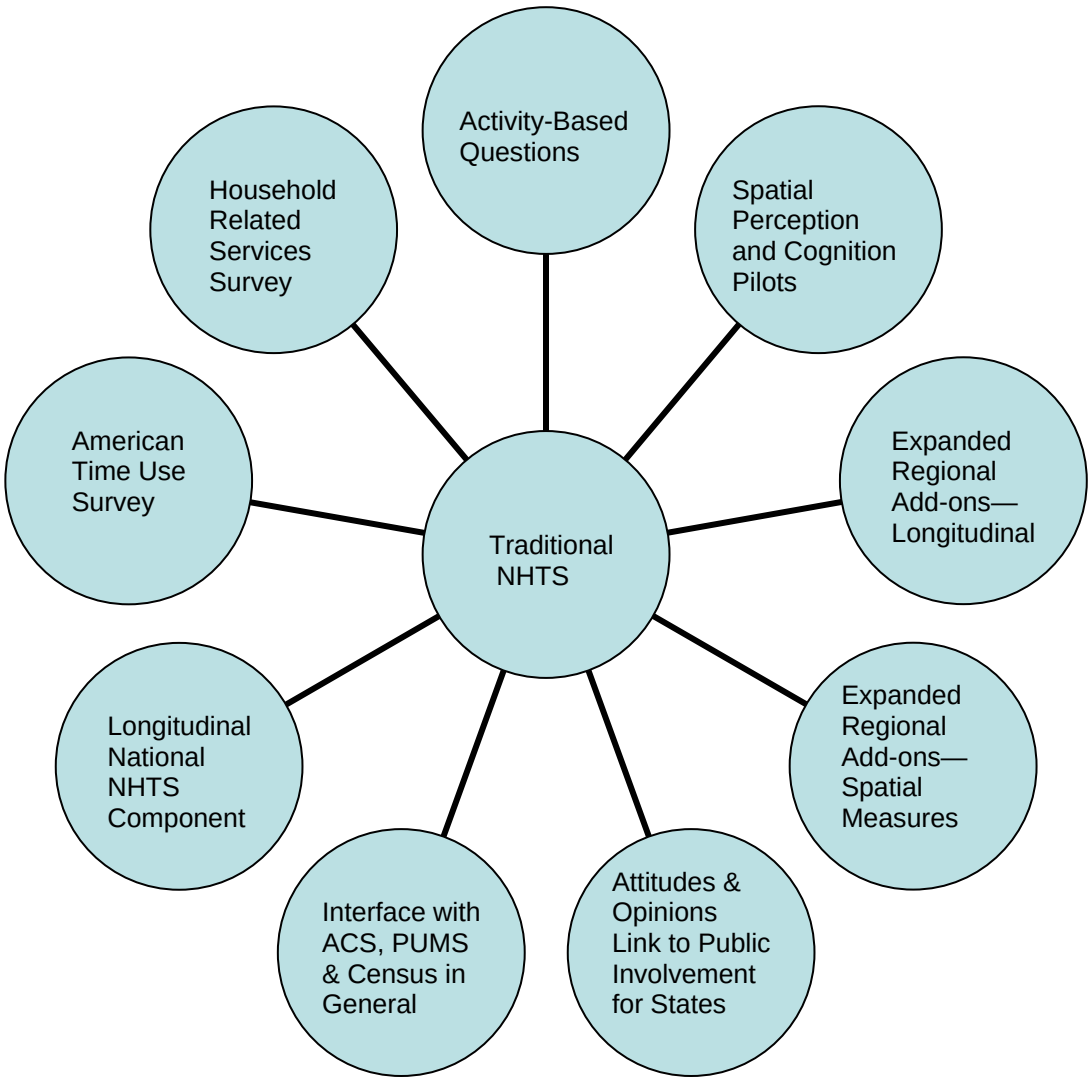

FIGURE 1 NHTS as a core survey and its satellite surveys. (PUMS = Public Use Micro Series)

agencies (today and in the future) and the separation from as well as the relationship to the national level by NHTS.

A large sector of data needs not addressed by the workshop resource paper relates to information on freight and deliveries, both to households and to businesses, and the fact that such data do not come from a household-based survey, even though they are important components of travel. An entirely different data source may be needed to link with NHTS because a large part of freight traffic is generated and motivated by households yet it is still not surveyed or measured (e.g., mail and related deliveries at home, maintenance and other contracted services at homes). Figure 1 includes one example (household-related services survey); however, many other movements are still neglected and may require other types of national data collection efforts.

CONCLUSION

In closing this workshop, the participants addressed the very important issue of using innovation to modify conventions and traditions. Changing NHTS and complementing it with the rich data sources outlined above require more than just a report from this workshop. For example, more information is needed by agencies that are trying to make decisions on whether to move to these more advanced modeling techniques, comparing the advantages, the costs, and the risks of these approaches with those of conventional approaches. In addition, the risks associated with continuing to use conventional approaches, obsolescence of some data collection items, and the increasing inability to analyze transport phenomena correctly need to be considered. This assessment is beyond the staff involved with NHTS. However, in one way or another, if the transportation research community expects these models to be successful, it needs to understand how NHTS might be combined with other data sources to provide the necessary elements for the innovation in modeling and simulation to take place.

Key Observations from the Conference

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Northwestern University

This conference has made it clear that a great diversity of travel analyses, trend spotting, model building, and forecasting is being produced with data from the National Household Travel Survey (NHTS) and its predecessors. It has been an excellent opportunity for Bureau of Transportation Statistics (BTS) and FHWA to hear from their NHTS customer base and to use what they learn to prepare for the future. Indeed, that is the primary reason for this conference.

Examples of data mining—detailed analyses that exploit the core data in NHTS (e.g., trip chaining); data manipulation to extract important patterns and trends; and data merging, through which NHTS data are linked to other data sources to derive new knowledge—have been presented. Conference participants have shown the results of their explorations into this rich data set; they have presented descriptive analyses of trends and behaviors of special populations; and they have shown ways to estimate cutting-edge activity models by using NHTS data.

The breadth of work under way using NHTS begs the question: Is it the best source of data for such analyses, or is it the only source? The answer, it appears, is a little bit of both. It is indeed the only multiyear data stream that provides a comprehensive view of household travel in the United States. While it is significantly limited, creative researchers and planners have been able to extract new and valuable insights from it. That such useful results can be derived from NHTS at once points out the importance of this data set and the critical need to continue and improve it.

Although the conference presentations have been dominated by modelers, it is useful to recognize that decisions can be and are influenced by descriptive studies and trend analyses as well as by modeling and forecasting. There is richness in this data set that leads to many uses.

One of the lessons to learn from this collection of NHTS applications is that making a decent data set readily—and freely—available brings a lot of analysts together, even without an infusion of incremental dollars to support specific studies. Of course, additional money is essential to produce targeted results, but much energy and effort have gone into analysis of NHTS even in the absence of a formal, funded program to distill its essential contents. Indeed, most users of NHTS data did not come to this conference; those who attended were really only a small proportion of the NHTS user community.

Good data bring out the modelers as well. A vast amount of intellectual progress has been made in travel-behavior modeling over the past decade. Directions are changing; disaggregate behavioral modeling no longer needs to be explained and defended; and models have become more sophisticated and detailed: activity-based, tour-based, dynamic models are evolving rapidly. The models grow in complexity as people begin to understand and reflect on the complexity of individual and household travel decisions. More complex models demand ever-more-complex data; many requests to expand and refocus the descendants of NHTS have been heard.

Some of these data enhancements are achievable, and many probably are not. While support for basic research is important, NHTS is a public, national, and general data source, and it cannot support all needs of the more advanced models being developed. It is useful to maintain some perspective on model building, at least model building that depends on NHTS.

Specifically, planners and researchers need to respond to the base: decision makers and decision making. Foremost, NHTS must support a variety of decisions about transportation policies and investments, at the national level as well as in the states and cities. While forecasts based on models support (or are supposed to support) decisions, the requirements for decision support are different from the requirements for research (*1*). In some cases, decisions can be usefully guided by descriptions of the current state of travel or by observations of trends rather than by forecasts. When the progeny of NHTS is being defined, fundamental research and model building must be balanced against more general analyses and trend spotting that may be especially useful for decision support. Model building alone should not be the core focus of NHTS.

Specifically, Figure 1 suggests numerous ways to use data from sources like NHTS to guide decision making. Analysis of data helps identify relationships (e.g., the effect of household size and age on task sharing and travel), and the fundamental understanding of processes that is contained in those relationships can provide a basis for advising decision makers. A history of evidence indicates that for decision makers the views of modelers—shaped by a total and extended immersion in data and model building—can often be more useful than complex technical analyses in supporting action decisions. Of course, relationships and understanding can sometimes lead to formal models that may be used to produce if–then forecasts: if you build it, they will, or will not, ride. But the alternate paths between data and decisions need to be considered in planning the next NHTS.

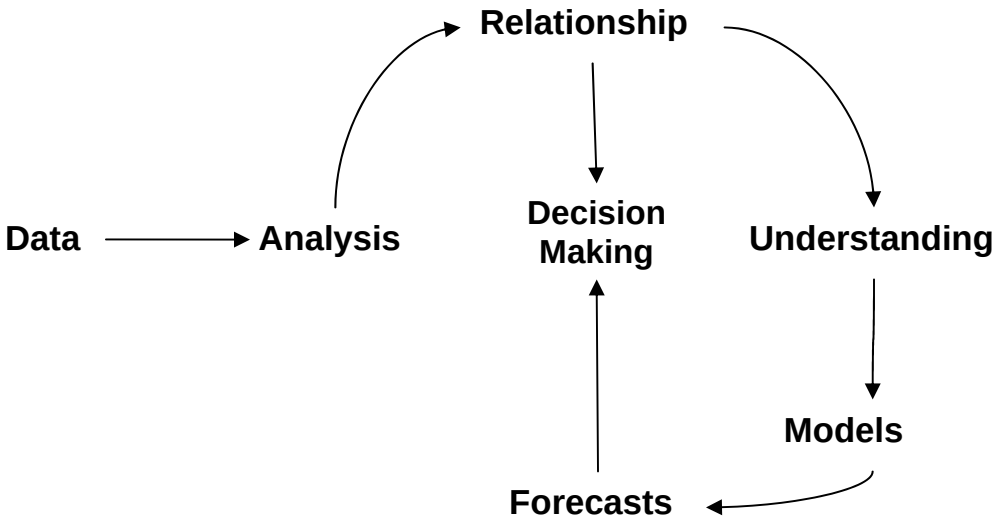

FIGURE 1 Data and decision making.

Discussions in the conference workshops were intense, diverse, and rich. Among the general observations are these:

- Using NHTS and its predecessors, many researchers are exploring trends in travel and demographic measures. Thus, it is important to continue this data series on a regular basis and to maintain a reasonable degree of consistency in the content.
- To maintain the data series, reliable funding is needed. It is especially important for BTS and FHWA to establish and maintain a dialogue with the NHTS user community. This conference is a part of that dialogue, but the interaction should continue periodically so that BTS can track and respond to evolving user needs.

Among the most evident user concerns are these:

- The problem of nonresponse must be addressed and resolved. The current response rate is below that necessary to assure statistical reliability of the data, and without intervention, future response rates are likely to be even lower. There is a need to know who do not respond and why they do not participate. Then tactics must be uncovered to bring these people into the database.
- More and more people are relying totally on wireless telephones. It is fast becoming necessary to identify effective ways to survey cell phone users. This may mean making arrangements with wireless carriers for the survey contractor to pay for the cost of the calls. Even then, strategies will be needed to extract detailed travel diaries from people who may be on the go, away from their home base.
- The fidelity of survey data must be ensured through validation studies and cognitive testing of instruments. Improved, more reliable methods for gathering proxy data from young and absent household members may be necessary.
- Global Positioning Systems (GPSs) and other technologies can be useful for survey verification. It is likely that specialized GPS tracking studies will be most useful over time as a way to improve diaries and telephone surveys by helping respondents to recall and report all trips rather than as routine checking procedures.

Users want to ask more questions on future versions of NHTS, including tour details and attitude information. The list of questions for both research and planning will continue to evolve and grow. The challenge will be to assemble these questions into one or more survey instruments that present an acceptable level of respondent burden.

Meeting the growing demands placed on NHTS requires innovation: new strategies that will provide the required and desired data without overwhelming the respondents, which means designing a survey mechanism that is practical. Among the innovations demonstrated, suggested, and implied by the conference discussions are these:

- A single survey is not likely to be able to carry all questions requested by the NHTS user community, almost certainly not with an acceptable respondent burden. Therefore, a series or family of surveys may be more effective, with a set of common core questions, to which is appended a series of rotating, specialized questions to form focused surveys (*2*).

- These focused surveys may be national or geographically targeted, single events or periodic. The specialized surveys could be driven by the needs of, and partially supported by, different collaborators or user groups.
- It might be more efficient to gather data on a continuing basis, like the U.S. Census American Community Survey. This could permit more efficient use of resources, the development and maintenance of technical skills, and a more uniform flow of expenditures.
- The family of surveys could include a national panel survey to capture behavior dynamics.
- Highly detailed, focused surveys of household activity patterns might be used to prepare a behavior bank that classifies typical activity patterns by household demographics. These behavior prototypes could then be used in emerging models to simulate household activity patterns in new or specific settings, as a function of known demographics (e.g., from census or local surveys). Such behavior banks could reduce or even eliminate the need for extensive local data collection efforts to support activity-based travel forecasting models.
- Future surveys may migrate to the World Wide Web as the market penetration of the Internet expands across the United States. This migration will allow users to complete surveys over multiple sessions and introduce location coding supported by geographical information systems and real-time consistency checking.
- Analysis and modeling would be facilitated by adding available contextual data to NHTS travel data. Specifically, adding measures of access to transit services, highway interchanges, and facilities for nonmotorized travel by merging local planning and mapping data would support more comprehensive behavioral modeling. Care must be taken to ensure confidentiality of individual responses as location detail is added.

Conference participants demonstrated many innovative NHTS applications and suggested many ways to enrich the survey to provide still more useful data. Care should be taken to avoid design by committee, which could lead to loading so many questions on NHTS rounds that the program dies of obesity.

There was no discussion at the conference of items that might be left out of surveys; yet it is clear that compromises must be made. The most extensive enhancements to NHTS may still occur through data fusion: merging NHTS data with data from other sources to add value and power to analyses. And the multisurvey, core-component approach may lead to NHTS follow-on designs that meet a broader set of user needs.

The breadth of applications of NHTS data—as well as the even larger set of ideas about future contents of NHTS—leads to the question of what data is really needed. Clearly, data needs are in the eye of the analyst, and different analysts need different data. While it is essential for BTS and FHWA to work closely with its customers, the aggregate demands on future versions of NHTS will certainly exceed any reasonable limits on available resources and respondent burden. Hard decisions must be made in the form of trade-offs among candidate questions and choices about what to include and what to leave out.

It is important that BTS build a coalition with its constituency, not only to follow the guidelines for a federal statistical agency but also to assure that there is a community of support for its flagship surveys (*3*). This conference is an element of the BTS user outreach program, and those connections should be cultivated. Still, the soldiers cannot run the army, and BTS (and FHWA) will need to make the critical choices about NHTS. Such decisions

cannot be made in a vacuum—they must be based on a clear understanding of the implications for the user community and the uses of this important data set.

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2. *Special Report 277: Measuring Personal Travel and Goods Movement: A Review of the Bureau of Transportation Statistics' Surveys.* TRB, National Research Council, Washington, D.C., 2003.
3. Martin, M. E., M. L. Straf, and C. F. Citro (eds.). *Principles and Practices for a Federal Statistical Agency*, 2nd ed. Committee on National Statistics, National Research Council, Washington, D.C., 2001.

APPENDIX A

List of Abbreviations and Acronyms

Abbreviation or Acronym	*Term*
ACS	American Community Survey
ATS	American Travel Survey
BATS	Bay Area Transportation Survey
BRC	Baltimore Metropolitan Council
BTS	Bureau of Transportation Statistics
CATI	Computer-assisted telephone interviewing
CTPP	Census Transportation Planning Package
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GPS	Global Positioning System
HTS	Household Travel Survey
MPO	Metropolitan Planning Organization
MSA	Metropolitan statistical area
NHTS	National Household Travel Survey
NPTS	Nationwide Personal Transportation Survey
NRFU	Nonresponse follow-up
NSAF	National Survey of America's Families
OMB	Office of Management and Budget
PUMS	Public Use Micro Series
RDD	Random digit dialing
USDOT	U.S. Department of Transportation
VMT	Vehicle miles of travel
WisDOT	Wisconsin Department of Transportation

APPENDIX B

Data for Understanding Our Nation's Travel

National Household Travel Survey Conference

Sessions and Events

SUNDAY, OCTOBER 31

NHTS Users Orientation: Overview and Refresher for New and Existing Users
4 p.m.–6 p.m. *(optional)*

This 2-hour orientation for new or ongoing users of the National Household Travel Survey (NHTS) is open at no charge to all conference registrants. Participants will have the opportunity to gain background knowledge about the survey and learn how to access and use data from the survey. The focus of the orientation is to give new and beginning users (or those who have used it in the past but may need a refresher) the foundation that they need to better understand this national passenger travel data source and how they might apply it to their needs. It will help to provide a foundation for the conference sessions and discussions during the next 2 days.

Topics to be covered will include

- History of the NHTS,
- Data collection methodology,
- File structure and basic content of files,
- Data limitations,
- Common analysis and examples of analysis, and
- Analysis tools and supporting documentation.

MONDAY, NOVEMBER 1

Opening Session
9:30 a.m.–11:30 a.m.
Johanna P. Zmud, *NuStats Partners, LP, presiding*

- Role of National Household Travel Survey Within U.S. Department of Transportation: George Schoener, *Deputy Assistant Secretary for Transportation Policy*
- Planning for the Next National Household Travel Survey: Susan Liss, Federal Highway Administration, and Lee Giesbrecht, *Bureau of Transportation Statistics*
- National Household Travel Survey Data Use: An Overview: Vincent Fang, Bingsong Fang, Charlie (Xiaoli) Han, and Fahim Mohamed, *Macrosys Research & Technology*

NHTS Findings Paper Session
12:30 p.m.–2:30 p.m.
Steven E. Polzin, *University of South Florida, presiding*

- Travel Characteristics on Weekends: Implications for Planning and Policy Making: Ram Pendyala and Ashish Agarwal, *University of South Florida*
- Utility of the NHTS in Understanding Bicycle and Pedestrian Travel and How Other Data Sources Can Help: Kevin J. Krizek, *University of Minnesota,* and Kelly J. Clifton, *University of Maryland–College Park*
- Built Environment and Trip Generation for Nonmotorized Travel: Felipe Targa and Kelly J. Clifton, *University of Maryland–College Park*
- NHTS and Trip Chaining: Nancy McGuckin, *Travel Behavior Analyst*

Survey Methods/Next NHTS Paper Session
12:30 p.m.–2:30 p.m.
Elaine Murakami, *Federal Highway Administration, presiding*

- Nonresponse in NHTS: Gary Shapiro, David Cantor, Li Wan Chen, Mark Freedman, and G. Hussain Choudhry, *WESTAT, Inc.*
- Results from the 2004 Kansas City GPS-Enhanced Household Travel Survey: Jean Wolf, *GeoStats,* Stacey G. Bricka, *NuStats Partners, LP,* and Todd Ashby, *Mid-America Regional Council*
- Improving Household Travel Survey Quality Through Time and Distance Data Checking: Laurie Wargelin, *MORPACE International,* Rick Donnelly, *PB Consult, Inc.*, Karen Faussett, *Michigan Department of Transportation,* and Lidia P. Kostyniuk, *University of Michigan*
- Improving Response Rates: Methods Employed to Promote National Household Travel Survey Participation: Mark Freedman, Janice Machado, and Susan Swain, *WESTAT, Inc.*

Modeling and Innovative Applications Paper Session
12:30 p.m.–2:30 p.m.
Patricia S. Hu, *Oak Ridge National Laboratory, presiding*

- Household Vehicle Type Holdings and Usage: An Application of the Multiple Discrete-Continuous Extreme Value: Chandra Bhat and Sudeshna Sen, *University of Texas*
- Using Nationwide Household Travel Data for Simulating Metropolitan Area Household Travel Data: Min Xu, Peter R. Stopher, and Stephen Greaves, *University of Sydney, Australia*
- Bayesian Approaches to Learning from Data: The Interaction Between Land Use and Transportation: Marco Scuderi and Kelly J. Clifton, *University of Maryland–College Park*
- A Time-Based, Comparative, and Integrated Approach to Measuring the Injury Risk of Walking: Xuehao Chu, *University of South Florida*

Critical Issues Paper Session
3 p.m.–5 p.m.
Fred Laurence Williams, *Federal Transit Administration, presiding*

- Walking and the Built and Natural Environment: Rob Boer, Michela M. Zonta, Deborah A. Cohen, and Adrian Overton, *RAND Corporation*
- A Picture of the Long Distance Travel Behavior of Americans Through Analysis of the 2001 National Household Travel Survey: Joy Sharp, Lee Giesbrecht, and Jonaki Bose, *Bureau of Transportation Statistics*
- Older Yanks and Older Brits: A Comparative Assessment of the Difference Between Drivers and Nondrivers: Sandra Rosenbloom, *University of Arizona*
- Latino Immigration and Its Impact on Future Travel Behavior: Jesse Casas, Carlos Arce, and Christopher Frye, *NuStats Partners, LP*
- Observations About Public Transportation Based on the NHTS: Fred Laurence Williams, *Federal Transit Administration,* and Steven E. Polzin, *University of South Florida*

State and Metropolitan Planning Organization Uses of the NHTS Paper Session
3 p.m.–5 p.m.
Ed Christopher, *Federal Highway Administration, presiding*

- Using Bayesian Updating to Enhance 2001 NHTS Kentucky Sample Data for Travel Demand Modeling: Bing Mei, *Wilbur Smith Associates,* and Niels Robert Bostrom, *Kentucky Transportation Cabinet*
- National Household Travel Survey Add-On Use in the Des Moines, Iowa, Metropolitan Area: Thomas J. Kane, *Des Moines Area Metropolitan Planning Organization*
- A Quality Assessment of the 2001 New York State NHTS Add-On Data: Nathan S. Erlbaum, *New York State Department of Transportation*
- Baltimore Region Model Application Auto Availability Estimation Using 2001 National Household Travel Survey: Charles Baber, *Baltimore Metropolitan Council*
- Enhancing State and MPO Transportation Planning Using National Household Travel Survey Add-On Data: The Wisconsin Experience: Bruce Aunet and David Cipra, *Wisconsin Department of Transportation,* and Kimon Proussaloglou, *Cambridge Systematics, Inc.*

Data Fusion Workshop
3 p.m.–5 p.m.
Catherine T. Lawson, *State University of New York–Albany, presiding*

Data fusion is the process whereby two or more databases are integrated into a single source database, which is then used for statistical analysis. There are many policy, planning, and modeling issues for which NHTS data explain only part of the story, and data from other sources are necessary to complete the picture. Participants in this workshop will identify opportunities for data fusion using NHTS data as well as examine the challenges and solutions for integrating one or more databases with NHTS data.

- Data Fusion Resource Paper: Mohan Venigalla, *George Mason University*

TUESDAY, NOVEMBER 2

Emerging Issues Workshop
8 a.m.–10 a.m.
Chandra R. Bhat, *University of Texas–Austin, presiding*

Demographic, economic, and technological changes affect the path of transportation policy making and the data needed to support it. Participants in this workshop will identify emerging trends, evaluate the capability of current NHTS data to understand them, and propose changes to NHTS content to better investigate emerging issues.

- Emerging Issues Resource Paper: Ram Pendyala, *University of South Florida*, and Chandra Bhat, *University of Texas–Austin*

Travel Survey Methods Workshop
8 a.m.–10 a.m.
Nancy McGuckin, *Travel Behavior Analyst, presiding*

The 2001 NHTS was challenged to attain a response rate that met Office of Management and Budget requirements. The challenge will be even greater in the next NHTS. This workshop will operate as a "think tank" to provide guidance and support to planners of the next NHTS to reduce nonresponse and construct statistical compensations for its effects by identifying current trends in the survey industry, new technologies, and survey procedures that promise to improve 2001 practice.

- Survey Methods and Technologies Resource Paper: Elaine Murakami, *Federal Highway Administration,* and Joy Sharp and Jonaki Bose, *Bureau of Transportation Statistics*

Data Needs for Innovative Modeling Workshop
8 a.m.–10 a.m.
Tom Rossi, *Cambridge Systematics, Inc., presiding*

New travel modeling procedures are being designed to meet today's special needs of state departments of transportation and metropolitan planning organizations. These needs include more accurate and more sensitive travel forecasts for transportation planning and air quality analysis. Survey data provide information necessary to monitor the transportation system. The data also help in estimating and validating new models and applying them to understand current characteristics and to establish a basis for comparison with forecasted future conditions. Participants in this workshop will explore the questions: Do new models require new data? If so, what types of data? How does NHTS data fit into this new reality?

- Data Needs for Innovative Modeling Resource Paper: Konstadinos G. Goulias, *University of California–Santa Barbara,* Peter S. Vovsha, *PB Consult, Inc.,* Mark Bradley, *Bradley Research & Consulting,* and Val Noronha, *University of California–Santa Barbara*

Reports from Workshops
10:30 a.m.–11:30 a.m.
Johanna P. Zmud, *NuStats Partners, LP, presiding*

- Data Fusion Workshop Report: Catherine T. Lawson, *State University of New York–Albany*
- Data Needs for Innovative Modeling Workshop Report: Tom Rossi, *Cambridge Systematics, Inc.*
- Emerging Issues Workshop Report: Chandra Bhat, *University of Texas–Austin*
- Travel Survey Methods Workshop Report: Nancy McGuckin, *Travel Behavior Analyst*

Meeting Future Needs—Conference Wrap Up
11:30 a.m.–Noon
Johanna P. Zmud, *NuStats Partners, LP, presiding*

- Key Observations from the Conference: Joseph L. Schofer, *Northwestern University*

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