Part B. Information Collection by Statistical Methods:

The statistical and survey design for the 2008 National Household Travel Survey (NHTS) is based on the design utilized in the 2001 and 1995 surveys. While building upon the existing methodology to preserve trend data, several enhancements have been made to reduce respondent burden, increase response rates, improve overall data quality, and quantify bias in the resultant data. For further information about the survey design contact Heather Contrino at FHWA, 202-366-5060, heather.contrino@dot.gov.

1. Describe potential respondent universe and any sampling selection method to be used:

The NHTS is a study conducted by the U.S. Department of Transportation (DOT) Federal Highway Administration (FHWA) that obtains data on key aspects of travel by the American public. The survey is focused on the household as the basic unit of observation.

Respondent Universe

The population of inferential interest for the 2008 NHTS is defined as households living in the U.S, excluding group quarters, during the data collection period. (January 2008 – December 2008). The universe for sample selection is households within the 50 states and the District of Columbia.

A telephone number frame is utilized; hence the sampled population is restricted to households with telephones. Of primary concern is the continued increase in cell phone only households. An in-depth review of the current state of practice in administering cellular telephone samples has been conducted by the NHTS team. Several researchers within and outside the Federal research community are testing the feasibility of incorporating cellular phone numbers into telephone sample frames. Based on the existing literature in this area and consultation from survey sampling statisticians, we have determined that the inclusion of a cellular phone sample in the 2008 NHTS carries an intolerable level of risk. This risk is related to the myriad of legal, cost, safety and privacy issues. In addition, current research has shown that cell only samples experience lower response rates, up to 12 percent lower in the JPSM Practicum, have an increasing level of users under the age of 18, and are typically person-based lines[1]. Also of consideration by the NHTS team is the impact of the exclusion of cell phone only households on key survey estimates. Research conducted by the Pew Research Center found that while cellular phone only respondents are different from landline respondents in important ways, they were neither numerous enough nor different enough to produce a significant change in the overall general population survey estimates[2].

In the 2001 pretest, research was conducted using an experimental design to evaluate the costs and benefits of the use of an address frame for the NHTS. The analyses and conclusion reached from this research were that the difference in response rates (8.9% increase) from the use of an address sample was not sufficient to justify coverage issues inherent in non-Census address

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[1] Yuan, A., Allen, B., Brick, M., Dipko, S., Presser, S., Tucker, C., et al. (2005). Surveying Households on Cell Phones – Results and Lessons. JPSM Practicum, Bureau of Labor Statistics, Washington, DC.

[2] Keeter, S., Kennedy, C, and Clark, A. (2007). What's Missing from National RDD Surveys? The Impact of the Growing Cell-Only Population. Paper presented at the Annual Conference of the American Association for Public Opinion Research, Anaheim, California.

frames coupled with a threefold increase in the cost of conducting in-person interviews for a portion of the sample.

Sample Selection

The 2008 NHTS will be conducted using a random digit dialing (RDD) list-assisted design, in which sample telephone numbers are formed by appending randomly generated digits to valid telephone area codes and exchanges. Source information for constructing the sampling frame will be the list of all currently assigned NPA/NXX codes (area codes and three digit prefix codes), which is available from Bell Communication Research (BELLCORE). The NPA/NXX codes will be assigned to geographic strata based on either the county with the highest share of listings, or the county in which the rate-center-city is located. A count of the number of listed residential numbers for each block of 100 telephone numbers in the frame will be used for stratification. Unlisted telephone numbers are included in the sample frame. Cellular telephone numbers existing outside of the 100 blocks are not included in the sample frame.

The sample frame for the 2008 NHTS will be stratified by three variables: (1) the nine U.S. Census Divisions, (2) three levels of metropolitan areas size, and (3) two substrata based on the number of listed residential telephone numbers per "100 block." The metropolitan area size levels include (1) MSAs or CMSAs of 1 million or more in population, (2) MSAs with less than 1 million in population, and (3) Areas not in MSAs. The planned strata are listed in Table B-1 along with information on the stratum sizes. The sample will be selected proportional to population density.

Table B-1. Estimated Strata Size and Approximate Number of Sampled Households

Stratum	Census Division	Metro Status	Number of counties	Estimated 2006 Stratum Size (Households)	Relative Stratum Size	Approximate Number of Sampled Households
1	New England Division	1	24	4,282,860	3.7%	920
2	New England Division	2	18	998,086	0.9%	210
3	New England Division	3	25	427,050	0.4%	90
4	Middle Atlantic Division	1	66	12,308,748	10.7%	2,660
5	Middle Atlantic Division	2	37	2,340,816	2.0%	500
6	Middle Atlantic Division	3	47	1,037,011	0.9%	220
7	East North Central Division	1	103	11,334,900	9.8%	2,450
8	East North Central Division	2	107	4,125,861	3.6%	890
9	East North Central Division	3	227	2,686,551	2.3%	580
10	West North Central Division	1	42	3,047,155	2.6%	660
11	West North Central Division	2	87	2,450,280	2.1%	530
12	West North Central Division	3	489	2,511,437	2.2%	540
13	South Atlantic Division	1	162	14,154,892	12.3%	3,060
14	South Atlantic Division	2	161	5,785,470	5.0%	1,250
15	South Atlantic Division	3	266	2,735,698	2.4%	590
16	East South Central Division	1	60	2,593,222	2.2%	560
17	East South Central Division	2	92	2,511,402	2.2%	540
18	East South Central Division	3	212	1,997,154	1.7%	430
19	West South Central Division	1	61	6,673,822	5.8%	1,440
20	West South Central Division	2	111	4,140,607	3.6%	890
21	West South Central Division	3	298	1,989,179	1.7%	430
22	Mountain Division	1	25	3,949,452	3.4%	850
23	Mountain Division	2	47	2,601,895	2.3%	560
24	Mountain Division	3	209	1,315,063	1.1%	280
25	Pacific Division	1	41	13,419,946	11.6%	2,900
26	Pacific Division	2	33	2,995,895	2.6%	640
27	Pacific Division	3	91	971,132	0.8%	210
			3141	115,385,585		24,880

In previous NHTS studies, the sample was allocated proportionally to the strata, with the exception that the low-density substrata (i.e. 0-24 listings per 100 blocks) were sampled at one-

fifth the rate of the higher density substrata (i.e., 25 or more listings per 100 blocks). For the 2008 NHTS, blocks with listed numbers will be sampled at a higher rate than those with few or no listed numbers.

The 2008 NHTS sample will be allocated proportionally to the geographic strata and uniformly across the 12 months of the year. The monthly samples will also be controlled by day of week; a one-seventh sub sample of household travel days will be assigned each of the seven days.

2. *Describe procedures for collecting information, including statistical methodology for stratification and sample selection, estimation procedures, degree of accuracy needed, and less than annual periodic data cycles:*

Data Collection Procedures

The 2008 NHTS is a two-stage study which includes a household interview (Stage 1) and a trip level interview (Stage 2) with all eligible household members. The study design mirrors the core methodology employed in the 2001 NHTS. Note that in 2001, the Bureau of Transportation Statistics (BTS) and Federal Highway Administration (FHWA) teamed together to collect both daily and long distance information in the study. For 2008, the NHTS will revert back to the original methodology in the sense that only daily travel information will be collected from households. Long distance data will be captured if a long distance trip occurs on the household's assigned travel day, however the concerted effort made in 2001 to collect a robust sample of long distance trips will not be included in the 2008 study.

For the 2008 NHTS, the following key procedures will be continued:

1. List assisted telephone sample,
2. Advance mailing consisting of a letter signed by the Secretary of Transportation with $5 advance incentive, and a reader-friendly brochure describing the benefits of participation,
3. Recruitment interview with one adult household member via computer assisted telephone interviewing (CATI),
4. Assignment of travel day within the recruitment interview – balanced for days of the week across a full year,
5. Mail out of diaries to households with a $2 per diary incentive,
6. Reminder and support calls to households within 2 days of their assigned travel day, and
7. Trip level interview with all members of the household age 16 and older via CATI.

Both stages (household interview and trip level interview) will be conducted using computer-assisted telephone interviewing (CATI). With CATI, the survey instrument is entered and stored within the computer. Questions and instructions are displayed for the interviewer on the computer terminal screen, and routing patterns are automatically followed by the CATI system. Programmed range checks, consistency checks, and checks for data completeness are performed on-line as the interviewer enters the respondent's answers. Corrections resulting from the edits are then entered as necessary during the interviews. Interviews are conducted in both English and Spanish.

Interviewers will be trained thoroughly for the year-long national survey using a training program and manuals tested during the pretest. The training will include appropriate lectures and demonstrations, but a major portion of the training will be "hands-on" practice using the CATI system to conduct mock interviews. No interviewer will be allowed to begin work on the project until the trainers are fully satisfied with his/her performance. All interviewers will be trained in refusal avoidance and a select team of experienced interviewers will be utilized for refusal conversion. Bilingual interviews (Spanish and English) will be part of the interviewer team.

Interviewer work for the NHTS will require completion of a number of activities. The major activities will be:

- screen the sample telephone numbers to identify working residential numbers (households),
- complete an initial interview (Stage 1) with the household to recruit them for participation in the trip level portion of the study including the assignment of a travel day and rostering of household members and vehicles, and
- complete a trip level interview (Stage 2) with all eligible household members.

Supervisors and monitors will be present during all interviews to observe the interviewers at work and to assist in resolving problems that occur. Monitors will observe interviewer performance using silent monitoring equipment that allows the supervisor to listen to the interview in progress and visually monitor the CATI display. Respondents will be told that the interview may be monitored for quality control purposes. Interviewers will receive daily feedback on monitoring results. 10 percent of each interviewer's work will be monitored by supervisory staff at the data collection center.

For the telephone number screening activity, up to 12 attempts will be made to resolve the status of each number (e.g., residence, business or institution without an associated residence served by the number, or some other status such as public pay phones, computer modems, cellular phones, and similar non-residential numbers).

Once telephone number screening reveals that a household has been reached, the interviewer will determine if the screening respondent is a household member at least 18 years of age. If not, the interviewer will ask to speak to such a person or attempt to determine when an appropriate household respondent will be available for interview. Once a household member 18 years old or older is contacted, the interviewer will conduct the household-level interview beginning with the completion of the household vehicle section and continuing with a series of household-level questions. These questions are contained in four sections of the questionnaire and will be asked once for each household. The sections are:

A. Telephone Number Screening
B. Vehicle Data
C. Household and Person Level Demographics
D. Request for trip reporting participation and assignment of travel day

At the conclusion of the household-level interview, the respondent is sent a package of field materials that includes a cover letter, a reminder page for their assigned travel day, a travel dairy for each household member, and a sample completed diary. A reminder call is made to the household the evening before the household's assigned travel day. Trip level interviews (Stage 2) are started on the day following the assigned travel day. There is a seven-day window beyond travel day to collect trip information from each eligible household member. Eligible members are persons age 5 and older that is a permanent household member.

Proxies are accepted for persons under the age of 16. Proxy interviews will always be used for household members through age 15. Proxy interviews will also be used, as necessary, for household members who are 16 years of age or older under the following circumstances:

- A household member is physically or mentally unable to report trip level information,
- A household member will be unavailable during the entire trip level interview period (within 7 days of the assigned travel day), or
- A household member has not completed the trip level interview after 8 attempts (e.g., due to an unusual work schedule) and it is clear that contact cannot be made during the trip level interview period.

The trip-level sections of the questionnaire are as follows:

E. Travel to Work
F. Travel to School
G. Travel Day
H. General Travel and Vehicle Mileage
I. Internet Usage and Demographic Information

Following the trip level interview, the CATI system will advise the interviewer of the next interview step, if any, based on the household roster data. If the household respondent just interviewed is the only member of the household or the only eligible household member, no further interviewing will be required for the household. However, if trip information is needed from other household members, the interview will be instructed to either try to speak with and/or request a proxy report (for those under age 16) for remaining household members. Approximately 80 percent of trip interviews (among adults) are conducted with the respondent due to strict proxy rules.

Up to 14 call backs will be made as needed within the designated seven-day period allowed for the collection of trip information from all eligible household members. The number of callbacks has been increased to improve the number of household members that complete the trip level interview. In 2001, a maximum of 8 callbacks were made to households in Stage 2. A completed household in one is which at least 50 percent of the adults have completed the trip level interview (Stage 2).

<u>Statistical Methodology for Stratification</u>
Please see write-up included in question 1.

<u>Estimation Procedures</u>

The initial sampling weight for each telephone number will be equal to the inverse of its probability of selection. And adjustment will be made for multiplicities arising from households that may be accessed using more than one telephone number base on information collected during the interview. Household analysis weights take the form

$$W(ai) = [100\ N(a)] / [n(a)\ M(ai)]$$

Where
N (a) equals the number of eight-digit prefixes in stratum-a,
N (a) equals the number of ten-digit sample telephone numbers selected in stratum-a, and
M(ai) equals the number of telephone numbers that access household-i of stratum-a.

The sample weights for telephone numbers associated with responding households will then be adjusted for non-response. The initial sample weight will be multiplied by the ratio of the strata-specific sum of the sampling weights for responding households.

There is concern about the non-coverage of household without land lines, as well as survey non-response. Because the sampling frame for the NHTS includes only telephone household while the desired inferential population includes telephone and non-telephone households, a final adjustment to household weights will be made to attempt to compensate for the difference between telephone households and all U.S. households. This adjustment is intended to reduce the bias due the exclusion of non-telephone households from the sample.

The following non-coverage adjustments using household characteristics of both land line only households and households with land lines and cellular phones will be performed:

- that can be quantified in terms of the potential impact (using the above mentioned household characteristics of land line only and land and cell phone households) on key travel indicators,
- for which the distributions of telephone household and all U.S. households differ,
- that can be collected in the telephone interview with little non-response, and
- for which estimates for all U.S. households can be obtained from independent sources (e.g., Census (ACS) Journey to Work data).

Characteristics such as race, ethnicity, Census Division, MSA size, household size, number of household vehicles, worker status will be used in developing coverage adjustments. We will use an iterative proportional fitting algorithm to adjust all selected characteristics simultaneously until all weight sums are within a small tolerance level (e.g., 0.001 percent) of the population estimates for each characteristic simultaneously.

In 2001, non-response adjustment weights were utilized for the first time in the survey's history. In the 2001 NHTS, special care was given to non-response adjustments in the weighting of the survey data. This was done to make the weighted survey results more representative of the U.S. population. For example, these adjustments increase the weighted survey results of low-income households; thereby help compensate for the lower response rate of these households.
Replicate weights will be computed for the purpose of providing standard error estimates.

Degree of Accuracy Needed

Because the NHTS provides data on a broad spectrum of household travel characteristics, it is impossible to estimate the precision for all possible transportation parameters of interest. Table B-2 provides estimates of the expected precision for selected rate domains of interest to the primary users of the data. Note that the information presented in Table B-2 is based on the 2001 NHTS data.

Table B-2. Precision Estimates for Key Variables

Domain Description	**Relative Domain Size**	**Number of observations**	**Relative Standard Error**
Average number of daily trips made by a household	10.5 trips	248,501	+/-0.1 trips
Average annual vehicle miles of travel per household	21,566 miles	26,038	+/-201 miles
Average number of daily household shopping trips	2.3 trips	55,237	+/-0.0 trips
Percent of households that own an SUV	11.80%	6,539	+/-0.2%
Average vehicle miles of travel per day in miles for Females aged 16-20	8.2 miles	3,517	+/-0.45 miles
Number of people who do not drive a vehicle	21.25 million	4,661	+/-377 people
Average distance to work in miles	12.11 miles	31,602	+/- 0.14 miles
Average vehicle occupancy for trips of 11-15 miles	1.53 people	13,106	+/- 0.01 people
Average time spent on driving to a shop in an urban area	14.7 minutes	34,920	+/- 0.13 minutes
Average time spent driving on any trip (nationwide)	18.61 minutes	148,648	+/- 0.1 minutes
Average trip duration for motorcycle riders	33 minutes	282	+/- 7 minutes
Average daily vehicle miles driven for people not born in the United States	31.2 miles	3,592	+/- 1 mile

This table shows that very small estimates will have reasonable relative standard errors. For example, the average amount of time spent on driving to a shop in an urban area is 14.7 minutes, with a standard error of +/- 0.13 minutes. In summary, this sample design yields adequate precision for characteristics of interest in the 2008 NHTS.

Less Frequent than Annual Data Collection Cycles

The NHTS has been collected at approximately 5-year intervals since 1969. Fielding a survey to net 25,000 households every five years is sufficient for the Department of Transportation, States, MPOs and other users of NHTS data.

3. Describe methods to maximize response rate:

The NHTS methodology utilizes a two-stage study design. In Stage One, households are contacted via telephone to complete a brief screening and recruitment interview. The initial recruitment response rate for the survey in 2001 was 58.2 percent. Households that agreed to participate in the recruitment interview proceed to stage two, the collection of trip level data. Each recruited household is mailed a diary package which includes information about the study and a one-page trip diary to record brief information about each trip taken on a specifically designated travel day for each eligible household member. Following the household's assigned travel day, trip level interviews are completed with each eligible household member. The completion rate for this second stage is 70.8 percent; hence the composite response rate for the 2001 NHTS is 41.2 percent. Table B-3 shows weighted response rates for 2001 NHTS.

Table B-3. 2001 NHTS Response Rates

Stage One Rate	Stage Two Rate	Composite Rate
58.2%	70.8%	41.2%

The stage rates provide the response rate for only that stage of the study. Stage one is the household level recruitment interview and Stage Two is the trip level interview which is conducted with each eligible household member. The composite rate column provides the overall response rate. The overall household response rate is the product of the Stage One Rate (.582) and the Stage Two Rate (.708) for an overall household response rate of 41.2%. The CASRO method was used in the response rate calculation.

Efforts to Maximize Response Rates

The NHTS team continuously strives to maximize overall data quality, including response rates. The potential impact of non-response bias on the generalizability and representative ness of the resultant data is extremely important. Hence, the NHTS methodology, including the sample design, are continuously evaluated through in-house and survey community research in the interest of improved coverage, response rates, and overall data quality. This is based on the expectation that reduced overall burden, shorter survey, and other design factors for the proposed survey will help alleviate falling response rates for RDD type surveys. The NHTS will continue to evaluate alternatives including dual frame designs, address frames, and multi-mode data collection in planning for the 2013 study as it is always multiple improvements (as opposed to one silver bullet) that help to incrementally raise response rates and overall data quality.

Since the 2001 NHTS, several research studies have been carried out to assess and quantify non-response bias, evaluate data collection protocols, and examine frame options to feed into planning for the 2008 NHTS. These research areas are discussed in detail in section B4 of this submission. This section highlights existing and improved methods for the NHTS to increase response rates.

The following methods elements and/or improvements are included in the 2008 design in an effort to maximize response rates:

Improved Questionnaire Length and Flow - The 2008 questionnaire has been edited to filter out data that was not utilized by data users, to reduce respondent burden. A total of 18 questions have been removed from the survey instrument. In addition, sections have been slightly reworked to improve the flow of survey administration. In addition, the long-distance component has been removed from the 2008 survey instrument.

Spanish Field Materials and Interviewing – The 2008 survey will be conducted in English and Spanish, including the CATI instrument and all field materials, to help maximize participation by Hispanic households. Interviewing on the NHTS 2001 was conducted in both English and Spanish by bilingual interviewers and this practice will continue for the 2008 NHTS. An evaluation of the 2001 NHTS shows that interviewing in Spanish was an important factor in gaining the cooperation of Hispanic respondents. 6.2 percent of completed households in 2001 were Hispanic as compared to 4.5 percent in 1995.

Initial Contacts - In addition to the advance letter mailing and incentive, changes for the 2008 study include an increased number of call attempts to households and the inclusion of answering machine messages during Stage 1 of the study. In 2001, the percentage of known households to meet the maximum call attempts without an interview was 9.4 percent. An additional 2.7 percent of the entire total sample had an answering machine disposition. NHTS response rates take the hardest hit during Stage 1. In 2001, the maximum call attempts were limited to 7 for Stage 1 and 8 attempts for Stage 2. Based on in-house analyses of 2001 and 1995 data in addition to a review of methods literature[1], the maximum number of contacts made during Stage 1 has been increased to 12. The maximum number of attempts in Stage 2 has been increased to 14. While there is much debate on the optimal number of call attempts, the NHTS experience supports research evidence showing that the main non-response groups in the NHTS (low income, Hispanic, large size households) required a higher number of average calls to make contact[2].

Increased Trip Level Retrieval Period – Maintaining overall data quality is an important part of the NHTS data program. The 2001 survey had a 6 day window from the assigned travel day in which trip information could be collected from eligible household members. An analysis of 1995 and 2001 data reveal that there are sufficient gains in participation of harder to reach households (Asian, Hispanic, low income, and larger size households) to warrant an increase in the trip retrieval window from 6 to 7 days. In this analysis, overall gains in household completion as well as gains in household completion by key non-response groups (Asians, Hispanics, larger households) were compared to the quality of key travel characteristics (including household trip rates, person trip rates, mode distribution, and trip distance). In addition, from a recall perspective a one week time period is easier for respondents to relate to in comparison to the

[1] Srinath, K.P., Battaglia, M., Cardoni, J., Crawford, C, and Snyder, R. (2001). Balancing Cost and Mean Squared Error in RDD Telephone Surveys: The National Immunization Survey. Proceedings of the Annual Meeting of the American Statistical Association, Washington, DC.
[2] Triplett, T. (2002). 2002 NSAF Non-response Analysis. Prepared by the Urban Institute, Washington, DC.

previous 6-day window.

Refusal Conversion –The NHTS uses a team comprised of interviewer staff members who have demonstrated exceptional skills in achieving high cooperation rates. Whenever a respondent initially refused to complete an interview, the interviewer completed a separate CATI data collection module to record any information known about the household and the respondent's reason(s) for refusing to participate. This effort will be continued in 2008.

Incentives – The NHTS includes a pre-incentive at both stages of the study design. A $5 incentive is included in the advance letter to each household prior to the household level recruitment interview. In addition, a $2 per diary incentive is included with the field materials mailing in advance of the trip level interview (Stage 2). During the last survey administration, incentive levels were tested using an experimental design. No incentive, a $10 advance incentive, and a $5 advance incentive were tested.

Improved Field Materials Design – Survey mail out materials were fully tested in 2001 and have been prepared to be clear, colorful, and easy to understand. The materials include a first-class pre-contact letter with stamp and a monetary incentive, a priority mail envelope with the travel diaries, and a second incentive. Focus group testing of field materials was conducted in 2001 in an effort to improve participation levels and data quality.

Reminder Calls – Each household receives a reminder call on the day before their assigned travel day. The call was designed to find out if the household had received its diary package, answer questions, and remind household members to record their travel in the diary the following day.

4. Describe tests of procedures or methods:

Tests of procedures and methods are an ongoing component of the NHTS Program. As a national study with nearly 40 years of transportation data, the NHTS Program is continuously examining methods to improve the overall quality and utility of the data. Of particular focus are tests of methods and procedures that (1) improve response rates and (2) improve the accuracy of trip data.

The two stage study design was introduced in the 1995 NHTS to improve the validity and reliability of key travel data produced by the study. Prior to 1995, a pure recall method was used for the collection of trip information. The two stage study design used in conjunction with a travel diary (memory jogger) produced significant improvements in trip data accuracy, however produced a negative impact on overall response rates. A full experimental design was developed and implemented in the early 1990's to test and compare gains in data accuracy with regards to increases in non-response bias.

Response Rates

Several studies have been conducted throughout the history of the NHTS to evaluate methods and procedures that improve response rates. The focus is not only on continuously improving overall response rates, which are negatively impacted by the two stage study design, but also on response rates by particular harder to reach groups. For the NHTS, the harder to reach

populations include larger households (5+ household members) and low income households. In addition to non-response research and adjustments, the NHTS data is validated with outside sources (e.g., Census Journey to Work data and FHWA Highway Performance Measurement System data) and through extensive trend analyses. The NHTS data goes back to 1969 so it is fairly easy to detect inconsistencies in key transportation indicators.

Previous Research Related to Non-Response and Coverage Issues
Even with improved materials, and a higher response rate in 2001 than 1995, non-response in the 2008 NHTS is a concern due to the potential bias it may introduce. The following sections describe the non-response research completed to date.

In 2000, the Bureau of Transportation Statistics funded the Transportation Research Board (a unit of the National Academy of Sciences) to pull together an independent committee of persons with expertise in survey methodology, sampling, and transportation research and applications to discuss issues related to household travel surveys in a complete and thorough overview of the 2001 NHTS methods and procedures. (http://onlinepubs.trb.org/onlinepubs/reports/nhts.pdf and http://onlinepubs.trb.org/onlinepubs/sr/sr277.pdf)

In spring of 2001, the second committee meeting was held which focused on the issue of non-response. Several proposals for non-response research followed. In addition, FHWA also solicited proposals from their data collection contractors and other transportation/survey organizations to propose research related to analyzing the potential impact of non-response bias. Proposals from the roundtable and general solicitation were subsequently used to formulate a plan for analyzing the generalizability of the 2001 survey results.

The primary focus of this research was to determine the impact of non-coverage or non-response, whether bias in the major measures of the survey can be seen, and how we can adjust for any bias we do detect.

Three areas of research were explored by Westat, the contractor for the 2001 NHTS, in an attempt to assess where bias might be introduced by examining non-response at various stages of the survey process. The final reports were delivered to OMB in 2004. In general, the potential for non-response bias was examined:

- By using exchange level data at the county level and comparing completed NHTS households with general characteristics of households in the same exchanges.
- By using vendor-provided data at the individual household level. This data is questionable in terms of the completeness and applicability to non-response assessment.
- By comparing the households that completed the entire survey to the households for which only a recruitment survey was completed.

This research indicates that several characteristics potentially related to travel propensity and other transportation characteristics are different for respondents and non-respondents. For example:

- Households that are in large MSA's, especially MSA's with high transit, were

more likely to be non-respondents.
- Households in areas with a high proportion of Hispanics or Blacks were more likely to be non-respondents.
- Households that rent, had a low ratio of vehicles to adults, had no retired persons, had no children, and did not have an address that could be matched to the sampled telephone number were more likely to be non-respondents.

The reports do not attempt to quantify the bias for key NHTS travel estimates since no direct measures of travel exist for non-respondents. The weighting adjustments implemented to try to reduce the non-response bias are effective to the extent that trip propensity and other travel characteristics are related to the household-level and person-level characteristics used in the non-response weighting adjustment cells.

In addition, FHWA funded case-study research on the potential sources and impacts of non-response in household travel surveys being conducted across the country (http://www.fhwa.dot.gov/ohim/nonrespond.pdf). Three household travel surveys, conducted for Atlanta, the state of Ohio, and Maricopa County (Phoenix), were examined to develop an analysis of non-response patterns, their possible impact on travel data, and potential steps to reduce non-response. The recommendations included the following suggestions to reduce non-response or to reduce the impact of non-response:

- Over-sampling specific groups,
- Different strategies at the first and second stage of data collection,
- Differentiated approach to specific demographic groups (including number and type of contacts),
- Multiple data collection methods, and
- Use of post-stratification adjustment weights.

DOT, with AASHTO and APTA as co-sponsors, sponsored a conference conducted by the Transportation Research Board in January 2005 that focused on "Data for Understanding our Nation's Travel." One tract of the conference was devoted to survey methodology and non-response issues. (http://nhts.ornl.gov/2001/pub/ec071.pdf). Research papers presented at the tract[1]:

- Analyzed non respondents at any stage of survey to respondents at all stages, separately comparing recruitment stage and retrieval stages.
- Examined ways to improve response rate using a combination of improved survey contact procedures, materials and incentives, a well designed CATI questionnaire, highly trained and well-monitored interviewers, attention to survey sample management, and constant close attention to survey progress.

Most recently, FHWA funded a non-response follow-up survey over the summer of 2005 as part

[1] Mark Freedman, Janice Machado, Susan Swain, 2004, "Improving Response Rates: Methods Employed to Promote National Household Travel Survey Participation." http://www.trb.org/conferences/nhts/Freedman.pdf and
David Cantor, Gary Shapiro, Li Wan Chen, G. Hussain Choudhry, Mark Freedman, 2004, "Non-response In The National Household Transportation Survey." http://www.trb.org/conferences/nhts/Shapiro.pdf

of the pretest of the Portland, Oregon household travel survey (http://www.nustats.com/nonresp%20report%20final.pdf). The purpose of this Follow-Up Study was to focus on COSMOS pilot sample that resulted in refusals to participate (i.e., refusers) as well as sample that was not reached (i.e., non-contacts) to inform important questions about non-response in household travel surveys. Two research questions in particular formed the core of the analyses:

1. Will special follow-up efforts with non-respondents in household travel survey improve sample representative ness? What is the return on investment (ROI)?
2. Do non-respondents in household travel surveys travel more than respondents? Does greater mobility lead to non-response in household travel surveys?

The study found that focused follow-up interviews (even in-home interview attempts) did not improve the sample in terms of capturing young adults and low-income households. Secondly, the study found that COSMOS pilot study participants (not non-respondents) had higher trip rates. All other trip characteristics between the two groups were comparable.

Current Research Related to Coverage and Non-Response Issues

The NHTS project team continues to evaluate the research conducted previously for the NHTS, current research on non-response issues, and the recommendations from the first series of TRB roundtable meetings that addressed future enumerations of the survey. These include the following topics:

- Use of Multiple Data Collection Modes
- Implementation of a Dual Frame Design
- Feasibility of Selecting a Sample of Household Members
- Inclusion of Technological Devices For Direct Measurement
- Imputation of Missing Persons Within Households
- Extension or Reassignment of Travel Day

Data Collection Protocols

Within the NHTS methodology are several protocols which have been added throughout the years in the interest of improved data quality. Several new protocols were implemented in the most recent 2001 NHTS and have been evaluated in terms of quality and cost trade-offs. For example, while some protocols may improve trip rate reporting, they have the potential for reducing response rates.

Key protocols that have been evaluated include the following:

Two Stage Study Design – The two stage study design was introduced in the 1995 NHTS to improve the validity and reliability of key travel data produced by the study. Prior to 1995, a pure recall method was used for the collection of trip information. The two stage study design used in conjunction with a travel diary (memory jogger) produced significant improvements in trip data accuracy, however produced a negative impact on overall response rates. A full experimental design was developed and implemented in the early 1990's to test and compare gains in data accuracy with regards to increases in non-response bias.

Proxy Rules – Currently the NHTS accepts proxies for children under 16 and for household members where trip information is not obtained within the three days following the assigned travel day. We evaluated the effect of collection from proxies by comparing their data to the data from respondents by age category. Other effects of using proxies include decreased number of usable households when proxies are dropped, compared to the overall quality of data obtained from proxies, described in terms of trip rates, and interaction with other responding members within the household.

Retrieval Period – The 2001 NHTS survey design required that trip data be collected from all household members within 6 days of the assigned travel day. In-house analysis of 1995 and 2001 data on person miles, vehicle miles, person trips and vehicle trips reported within 1 day of the travel day, 2 days, 3 days, etc up to 10 days shows a measurable drop in reporting after 7 days. For the 2008 NHTS the collection window will be 7 days.

Trip Data for Children – The 2001 NHTS collected trip information for children under the age of 5 for the first time in the study's history. An evaluation of information gains by the inclusion of this age group was conducted using 1995 and 2001 NHTS data. The results show that less than .5 percent of all trips are made by children under five in the absence of another household member. Hence, trips for young children are adequately captured through household member trip level interviewing. Trip level interviewing is not required for children under five years of age.

Field Materials – The field materials were tested using qualitative methods as part of the 2001 study design. The advance letter, diary letter, study brochure, and travel diary were tested.

The focus group liked the advance letter, on DOT letterhead and signed by the Secretary of Transportation. They preferred no salutation to maybe the wrong or misspelled name. The diary letter will have a personal salutation from the contact name.

The focus group loved the brochure, which is colorful, simple to read, and short. The focus groups liked the simple one-page travel diary, when compared to a booklet or other format. It was difficult for the group to understand what we meant by a 'trip', which led us to put the graphic example on the back of the travel diary and improve our explanation in the interview. The focus group did not understand one of our purposes 'Change means' which refers to changing the mode of transport. We re-formatted the purposes, and elicited the change means data by asking whether the respondent used transit for any trip. We changed the format of the series of questions detailing access to egress to transit. People had a difficult time reporting accurate distances, but could report time pretty well. As a result, we focused more on getting good estimates of time.

5. *Provide name and telephone number of individuals who were consulted on statistical aspects of the project and who will actually collect and/or analyze the information:*

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