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Bicycle and Pedestrian Studies Based on Data From the National Household Travel Survey

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BICYCLE AND PEDESTRIAN STUDIES BASED ON DATA FROM THE NATIONAL HOUSEHOLD TRAVEL SURVEY

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Abstract

Communities around the nation are addressing new federal regulations and an increased pressure by national and local advocacy groups to accommodate bicyclists and pedestrians in transportation projects. One of the main sources for data on travel and transportation available to industry professionals is the National Household Travel Survey (NHTS), which FHWA conducts every 5 to 7 years and which provides data sets on daily travel for all transportation modes, including information on driver characteristics, travel time, trip purpose, time of day, and day of the week a trip took place. The objective of this research is to review NHTS survey methodology and relevant literature about the use of the data for bicycle–pedestrian modeling and facility planning and to provide a synthesis of lessons learned.

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Bicycle and Pedestrian Studies Based On Data From The National Household Travel Survey

Communities around the nation are addressing new federal regulations and an increased pressure by national and local advocacy groups to accommodate bicyclists and pedestrians in transportation projects. To meet these demands, state and local transportation planning agencies must often rely on data sets derived from small samples and with little previous application to develop user characteristics and travel demand models that determine the effect an increase in bicycle and pedestrian infrastructure will have on the transportation network. One of the main sources for data on travel and transportation available to industry professionals is the National Household Travel Survey (NHTS), which FHWA conducts every 5 to 7 years and which provides data sets on daily travel for all transportation modes, including information on driver characteristics, travel time, trip purpose, time of day, and day of the week a trip took place. Agencies may also conduct travel surveys themselves; however, doing so is often infeasible because of budgetary and staffing limitations. An NHTS add-on program provides a mechanism for obtaining local data consistent with the national data set yet of sufficient detail to provide agencies the means for local-scale modeling. The objective of this research is to review NHTS survey methodology and relevant literature about the use of the data for bicycle–pedestrian modeling and facility planning. A set of lessons learned based upon this analysis is then provided.

Literature Review

Background on NHTS

The NHTS began in 2001 after the Nationwide Personal Transportation Surveys (NPTS) was combined with the American Travel Survey (ATS). The NPTS was used to obtain information regarding daily trips, while the ATS was distributed to identify information concerning long-distance trips. In 1990, the Add-on program was added to the NPTS which allowed state and local planning agencies to purchase additional survey samples, including five area specific questions, to provide a more accurate depiction of local transportation patterns and issues (Federal Highway Administration, 2010). Over the 40-year history of the NPTS and NHTS, the program has grown from the initial 15,000 households in 1969 to a total of 150,147 household samples with 26,000 from the national survey sample and the remainder of samples from 20 Add-on areas for the 2009 NHTS.

In order to conduct the NHTS a sample list was developed using a random digit dialing (RDD) telephone number system identifying landline connected households of fewer than 10 people. These numbers were then address-matched to the households and an invitation letter including a five dollar incentive was sent to targeted households in the sample. Specific travel days were assigned to each participating household for all seven days of the week, including holidays, for the period of one year. Travel data was then collected through the use of travel diaries and a Computer-Aided Telephone Interviewing (CAIT) system (Federal Highway Administration, 2011).

The data collection process for the Add-on program is identical to the national data set. This enabled the integration of the Add-on samples into the NHTS database. To account for oversampling in the Add-on areas each Add-on sample is adjusted by a weighting factor based upon state sample selection probabilities, demographics, and other adjustment factors. Any additional questions purchased as part of the Add-on program by a jurisdiction were not included in the NHTS Public Use data set (Federal Highway Administration, 2011).

NHTS Collection of Bicycle and Pedestrian Data

More specific to the topic of bicycle and pedestrian data collection, several factors from the NHTS development process were reviewed. These factors include the content of the NHTS and number of walk and bicycle trips, the data editing process, and changes to the NHTS. To help clarify the NHTS role in bicycle and pedestrian data collection, information from the 2009 NHTS Summary of Content in the 2009 NHTS User's Guide is organized and presented in Table 1 with the information directly relevant for bicycle and pedestrian travel referenced in bold (Federal Highway Administration, 2011).

Table 1
2009 NHTS Summary of Contents

For Each Household:	For Each Person:	For Each Worker:	For Each Vehicle:	Daily Travel Data:
No. people, drivers, workers, vehicles	Age/Sex/Relation to reference person	Full or part-time	Make/Model/Age (year)	Origin and Destination address (for Add-ons)
Income	Driver status	More than one job	Annual miles driven	Time trip started and ended
Housing Type	Worker status/Primary activity	Occupation (four categories)*	Commercially licensed**	Distance
Owned or rented	Internet use*	Workplace location	How long owned*	**Means of transportation:** ***Vehicle type*** • **if household vehicle, which one** • if transit, wait time • if transit, access and egress mode*
Number of cell phones*	Home deliveries from Internet shopping**	**Usual mode to work**	Odometer reading	
Number of other phones	**Travel Disability***	Drive alone or Carpool	Alternative Fuel**	
Race of reference person	**Effect of disability on mobility***	Usual distance to work	Primary Driver	
Hispanic status of reference person	Education level	Usual time to work**		
Tract and Block Group characteristics	Immigrant status*	Work from home		Interstate Use**
Internet Use & Delivery to households**	Views on transportation	Usual arrival time at work		Tolls Paid**
	Annual miles driven	Flexibility in work arrival time**		Trip Purpose
	Incidence of public transit use in past month			Detailed purpose*
	Incidence of motorcycle use in last month			Travel Party Size
	Incidence of walk and bike trips in past week			Last time of travel*
	School travel (children)**			

** added in 2001 ** added in 2009*

Each of the bicycle and pedestrian categories can be cross-referenced with the other information gathered to develop a complete picture of pedestrian and bicyclist traveler characteristics. For the 2009 NHTS a total of 100,400 walk trips and 9400 bike trips were recorded (Federal Highway Administration, 2010).

During the data editing process, most issues for bicycle and pedestrian trips involved travel time. For cases with reported travel times that overlapped, the trip was split. For example, if a bike trip was reported from 4:00 PM to 4:45 PM, and the return trip was from 4:30 PM to 5:00 PM, then the end time for the initial trip was reported as 4:30 PM with the start time of the second trip as 4:31 PM. Occasionally trip distance and travel time had to be adjusted for the difference. When a travel time was not recorded the following rules were used to estimate travel time based on mode and distance (Federal Highway Administration, 2011):

- *If the mode is bicycle (TRPTRANS = 22), for any trip distance, the average estimated speed used was 10 mph;*
- *If the mode is walk (TRPTRANS = 23), for any trip distance, the average estimated speed used was 3 mph.*

The 2009 NHTS included several changes from the 2001 NHTS. One addition was the inclusion of a Safe Routes to School section. This section focused on how children travel to school and the safety concerns of parents. The data was collected by randomly selecting one child from each household with children between the ages of 5-15 years old (Federal Highway Administration, 2011). Survey administrators asked 12 questions and received a total of 23,500 responses in relation to school travel behavior (Federal Highway Administration,

2010). A question addressing the number of adult household bikes previously included in the survey was omitted from the 2009 NHTS. (Federal Highway Administration, 2011). The reintroduction of this question may provide transportation planners with additional information to determine the effectiveness of bike share program which are becoming prevalent across the nation.

Of particular concern to transportation officials is the identification of problems intrinsic to the collection methodology of bicycle/pedestrian data. These issues often are a function of how the NHTS structures questions and instructions. One example of this indicated by Barnes et al. as cited in (Barnes, 2005) is the use of intermediate time frames in questions such as “this week” leave room for personal interpretation possibly contributing to the overestimation of national averages in bicycling frequency. Further evidence of this can be seen in the 7:1 variance of people with the response of riding in a given week to the number of people who record bike trips on their survey day.

Agrawal and Schimek as cited in (Agrawal, 2007) described the methods used to collect data on walking in the 2001 NHTS and identified issues in the methodology. Data regarding walk trips is gathered in three sections during the collection process. Trip diaries filled out by each household member included information on walk-only trips. Additional information was gathered in the trip diaries that tracked the mode of travel used by respondents to access transit. Most of the trips recorded in the transit section included walking trips which were not recorded in earlier surveys that did not include trip chaining. The final method of collection occurred during the general survey, which asked questions that

identified the respondent's attitude toward walking as a mode of transportation for both recreational and utilitarian trips.

The authors identified five issues inherent to the collection of data on walking by the NHTS. The first concern identified related the NHTS' lack of clarity to respondents on the inclusion of very short trips to the under reporting of walking trips. Two changes were made to the 2001 NHTS to reduce this error including a direction in the travel diary to include "Walks, jogs, bike rides, and short drives" and the addition to the CAIT system of the prompt "Before we continue, did {you/SUBJECT} take any other walks, bike rides, or drives on {TRIPDATE}? Please include any other trips where {you/SUBJECT} started and ended in the same place" (Agrawal, 2007). The second problem presented was the inability to clearly define the beginning and ending of a walk trip within a trip chain. A person whose trip from home to work included several stops along the route was free to interpret their walk trip as one trip with several inconsequential stops or as several smaller trips beginning a new trip after each stop. The third problem dealt with the inconsistency of recording circular trips as a trip to the furthest point of travel and a separate return trip. These trips were occasionally recorded as one long trip. A fourth point of contention was the intermingling of recreational and utilitarian trips under the same trip purpose category. The two instances acknowledged were "Go to gym/exercise/play sports" and "walk the dog/vet visits" (Agrawal, 2007). The final issue recognized the inaccuracy of respondents in estimating trip length and duration. Trip length was reported as an estimate of blocks or miles traveled. The inaccuracy of the estimated distance

was compounded by telephone interviewers following the directions “If less than 1 block or ½ mile or less enter 0” (Agrawal, 2007). Trip duration accuracy was affected by respondents rounding to the nearest 5-min time increment.

These issues and improvements in the 2001 NHTS were outlined and expanded to bicycle travel by Clifton and Krizek (Clifton, 2004). The study authors noted the addition of questions regarding the frequency of bicycle/pedestrian travel and the addition of prompts to the telephone interview as improvements over previous surveys. The increase of non-motorized travel in the sample was produced by recording the number of walk/bike trips in the week prior to the telephone interview. This relied on the person’s ability to recall the travel information and did not include information about the purpose, length or other trip attributes leading to possible inaccuracies in the data sets. Bicycle/Pedestrian trips identified as a portion of a trip chain for transit reduced the possibility of double counting such trips, but the data must be combined with other bicycle/pedestrian trips to determine total mode share and does not include trip distance. To address how subjective factors such as attitudes and lifestyles affect travel behavior the data collection process included a number of attitudinal questions. Finally, while agreeing with the previous study on the inaccuracy of estimating trip distances, the authors considered the addition of blocks as a measurement of distance as a possible improvement to estimated miles (Clifton, 2004).

Applications of NHTS to Bicycle and Pedestrian Studies

As agencies begin to assess facilities for bicycle and pedestrian use and to develop planning goals pertaining to these system users, learning from the experience of others is critical for avoiding pitfalls and capitalizing on previous successes. This section outlines trend analysis and modeling applications for bicycle/pedestrian modes, where NHTS data has been used. Lessons learned based upon the research summarized here are highlighted in the subsequent section.

Transportation planners utilize the NHTS to understand transportation trends and traveler characteristics for the various transportation modes. Litman (Litman, 2011) provided observations on short trips and non-motorized trips. Litman highlights the fact that although traditional travel surveys typically result in undercounting of bicycle/pedestrian trips, the NHTS survey is designed to illicit more detail regarding these trips through well-defined definitions of trip ends and links. While the NHTS does present more favorable results, it does not completely negate the undercounting of short trips. Results from the NHTS showed of the total number of personal trips about 10% of reported trips are a half-mile or less, about 19% are a mile or less and 41% are 3 miles or less. Of the trips of a mile or less, more than half are bicycle/pedestrian trips, with a third of trips of three miles or less belonging to the non-motorized modes of travel. The bicycle/pedestrian trips were further defined as being half recreational and half utilitarian with only 5% being attributed to commuter travel. The portion of short trips performed by drivers is often influenced by the number of stops in a trip chain, local land use

designations, population density, poverty levels, disabilities preventing driving, barriers to non-motorized travel, and the availability of public transit. An additional finding by Litman (2011) showed that bicycle/pedestrian trips provided a larger portion of total trips and travel time than travel distance because of the low average speed of travel by the modes.

Often state and local agencies develop reports and presentations based on NHTS data for all modes of travel including walking and bicycling. These reports are designed to support policy makers, transportation professionals and the general public understanding of trends and issues affecting transportation. One example of this is the Trends and Conditions Report-2011 (Office of Policy Planning of the Florida Department of Transportation and the Center for Urban Transportation Research at the University of South Florida, 2011) released by the Florida Department of Transportation (FDOT). The report includes bicycle/pedestrian travel information separated by: mode share of person trips, mode share for daily travel, trip share by age, income, and gender, and trip length by age, income, and gender. This information is accompanied by narrative explaining the correlation between the data and expenditures on facility improvements and prioritization of projects. In addition to the report FDOT utilized the information in a presentation (State of Florida Department of Transportation, 2006) delivered to interested parties.

Clifton and Krizek as cited in (Clifton, 2004) identified a number of disciplines interested in the descriptive statistics provided by the NHTS in relation to bicycle/pedestrian travel. These disciplines consist of politicians, policy

advocates, the public health community, travel behavior researchers and transportation economists. A table of transportation research, planning and policy areas in the document included: overall rates of walking and cycling, investigation of the paths or routes traveled, ensuring safe and comfortable access to schools for nearby residents, understanding motivating factors and connections to the built environment, rates of bicycle/pedestrian substitution for auto travel, reducing pedestrian and bicycle crashes, creating environments that encourage and promote walking and cycling, determining what activities are likely to be accessed by cycling and walking, how non-motorized modes are used in conjunction with transit, and methods of evaluating pedestrian and cycling environments for performance and needs assessment (Clifton, 2004).

Health officials often use the NHTS to measure the activity level of an area's population. In a study by Buehler et al. as cited in (Pucher, 2011) the data from the 2001 and 2009 NHTS were compared to measure changes in active travel. Researcher began by identifying any changes in data collection methodology and the possible effects those changes would have on the study's results. Once it was determined that the differences between the collection methods would have a negligible effect, the data was analyzed on four levels: trip based, person based, daily physical activity and weekly active travel. The trip based analysis looked at the duration, distance and frequency of bicycle/pedestrian trips showing an increase in each category with the exception of bicycling duration. The person-based analysis identified the percentage of Americans participating in walking and/or cycling at any time, for a continuous 30

minutes or more, or for 30 minutes or more split into 10-min increments in a given day. Daily physical activity was measured as 30 min walking or biking per day by a percentage of the population subgroups: gender, age, education, and car ownership. Results revealed a correlation between having a university education and the lack of a personal vehicle as independent indicators of high activity levels. Additionally, males and people between the ages of 5-15 years represented a larger percentage of cyclists. Finally the weekly activity levels were measured as a comparison between the percentages of the population subgroups having either 0 or more than 5 walk trips per week. This also resulted in people with higher levels of education having a greater activity level.

Of particular concern to transportation officials is the safety of bicyclist and pedestrians. To identify areas of high risk, planners and engineers look at crash rates provided by NHTSA, the Fatality Analysis Reporting System, the Insurance Institute for Highway Safety, and various local agencies (Pedestrian and Bicycle Information Center, 2013). Table 2 is an overview of the 2013 NHTSA bicycle and pedestrian crash rates (Pedestrian and Bicycle Information Center, 2013).

Although NHTS does not directly collect crash data, it provides planners the ability to identify exposure rates by combining person miles traveled from the NHTS with recorded crash rates. The ability to determine exposure rates is important for identifying trends within each mode and provides a metric of comparison between modes. The inaccuracy inherent to bicycle and pedestrian data, because of underreporting of non-motorized trips, is further compounded by

the underreporting of crash incidents of these modes (Pedestrian and Bicycle Information Center, 2013).

Table 2
NHTSA Bicyclist and Pedestrian Safety Facts, 2013

Crash Statistic	Pedestrian	Bicyclist
Fatalities	4,735	743
Injuries	66,000	48,000
Percentage of total fatalities	14	2
Percentage of total trips	10.9	1

NHTS also collects information on the perception of safety through attitudinal questions often included in the add-on program. These perceived factors have been used by researchers to identify bicycle and pedestrian trends. Researchers at the University of California, Berkeley, using data gathered from the 2009 California add- on program, developed a linear random-intercept model to identify traffic safety-related barriers to walking and bicycling (Schneider, Pande, & Bigham, 2011). Replying to the add-on survey were 47,559 California residents, with 29,894 reporting that they walked at least once a week and 23,104 that safety-related barriers prevented them from walking. The bicycle component did not receive the same response, with only 5,175 respondents reporting that they rode a bike once a week and 3,073 answering the question about safety-related barriers to biking. Dependent variables were identified from the responses and coded to socioeconomic, travel, land use, and roadway characteristics. Researchers then compared heat maps of crash density and the traffic safety barrier factors from the model output. The resulting analysis identified a

reasonable correlation between perceived traffic safety barriers and actual crash rates, with a stronger level of accuracy in suburban areas.

Model Development

In addition to developing information regarding trends and characteristics of bicyclists and pedestrians, transportation professionals often are interested in developing travel models related to these users. In a 2006 study, researchers from the University of Kentucky introduced a modeling approach for estimating non-motorized trips on a spatial scale smaller than city level (An, 2006). For the purpose of the study, only trips to work were considered and all bike trips and walk trips were combined due to the variance in data points between the modes. Three categories, including socioeconomic, environmental and non-motorized travel facilities, were developed by combining data sets from the 2001 NHTS (in which Kentucky participated in the Add-on program), 2000 Census Survey, the Dun & Bradstreet employment survey and a sidewalk inventory. Analyzing the data at the census block group level was considered an important factor due to the short trip distances of bike trips and walk trips. The results of a multiple linear regression analysis provided four covariates: employment density, percentage of student population, median household income, and average sidewalk length as indicators of non-motorized mode share. Based on the similarity of the model developed for this study and traditional travel demand models the possibility also exists to integrate the two methods for transportation planning purposes.

A significant influence by unobserved individual-specific factors, family and intra-household interactions, social group or peer influences, and spatial effects of

neighborhoods was identified by Bhat et al. as cited in (Ferdous, 2011) on the heterogeneity of walking and bicycling activity duration in survey data sets. In general terms, an individual's propensity to participate in walking and bicycling activities and the duration of that participation are directly related to the attitude of the person, their family and social contacts, their perception of safety and facility availability in their neighborhood. To examine these relationships a hazard-based specification was used in the development of a joint model for walking and bicycling where activity duration was the primary measure of non-motorized mode use. To reduce the computational complexity of the proposed model the researchers employed a composite marginal likelihood (CML) approach for parameter estimation. The data from the San Francisco Bay Area subsample from the 2009 NHTS was used in the application of the model. This subsample was selected to take advantage of the 2009 NHTS California Add-on data set that included detailed attitudinal information on weekly bicycling and walking activity. Additional data sources identifying built environment attributes were combined to enhance the richness of the available data sets.

The study resulted in several findings relevant to transportation modeling. Table 3 details influencing factors identified from the model application that promoted a positive or negative effect on walking and bicycling activity duration in comparison to baseline characteristics (Ferdous, 2011).

Table 3
Factors Influencing Bicycle and Walking Duration

Influencing Factors	Walking Activity	Bicycling Activity
Male		Positive
Employed full-time		Positive
Employed part-time	Positive	Positive
Couple HH	Positive	Positive
Children between 11 to 15 years in the HH		Positive
Absence of attractions and busy life style factors	Negative	Negative
Inadequate/inconvenient facilities	Negative	Negative
Perceived lack of safety	Negative	Negative

To account for the heterogeneity effects of the unobserved factors, researchers suggested the integration of land use and transportation model systems. It was also determined that walking and bicycling should be treated separately in transportation modeling due to a greater effect of unobserved factors on bicycling activity duration than walking duration (Ferdous, 2011).

Barnes and Krizek as cited in (Barnes, 2005) estimated the current level of bicycling demand in an area based on an observed correlation of bicycle commuters in the census journey to work data to total bicycle trips. While the method presented in the paper does not allow prediction of future bicycle demand it does provide a baseline that recognizes the variability of bicycling rates in different areas. To show the relationship between commuters and total bike trips, the researchers determined the frequency of bicycle travel related to the proportion of the adult population riding a bicycle by accessing the probability an

adult would ride a bike any given day over the length of one year from responses to the NHTS. This provided the results that about one percent ride in a given day, five percent in a week, sixteen percent in a month, twenty-nine percent in the summer, and forty percent in a year. From this frequency distribution it was determined that the most active five percent of cyclists generate half of all bike trips. In addition, following assumptions related to the average speed of bicyclists based on their frequency and length of travel, the NHTS trip duration and trip length show that one quarter of all bicyclists (people riding more than 60 min a day) ride two thirds of the total miles. Since this small portion of bicyclists make up the majority of all bike trips and most of these frequent riders are commuters it was determined that commuting by bike can be used as the main indication of total bicycle travel.

In order to test the methodology researchers identified 15 Metropolitan Statistical Areas (MSAs) and 34 states for which both Census Transportation Planning Product (CTPP) commute to work shares and NHTS daily bicyclist counts were available (Barnes, 2005). To account for the small sample sizes in specific geographic areas and the low bike mode share heuristic measures were used to determine the accuracy of predictions. Given the predicted adult bike mode share, the NHTS sample size for each MSA and state, and assuming a binomial function, a ninety-five percent confidence interval was calculated. A total of 14 of the 15 MSAs and 30 of the 34 states fell within the ninety-five percent confidence interval of their predicted values.

Also addressed was the limited utility of traditional travel demand models for bicycling, where several factors were noted (Barnes, 2005). First is the conflict between how a facility is defined in the survey and how bicyclists perceive the facility based on their skill as a rider and if they use the facility for utilitarian or recreational purposes. Second is the effect of unobservable variables such as attitudinal, historical, and policy factors. The third problem identified is the large range for sampling error caused by the low number of bicyclists. The final problem addresses the issue of facilities built for political purposes that are often built in anticipation of use rather than in response to it. A solution suggested to address these issues is to study the same geographical area facilities' change over time.

Building on previous research on the link between land use and transportation Kuzmak et al. as cited in (Kuzmuak, 2006) combined information on the number, character, and desirability of key activities located within walking distance of a household in a new measure named the walk opportunities index. The development of the new approach was facilitated by inputting the 2001 NHTS Add-on program for the Baltimore region which collected information from 3,500 households, the 2001 parcel level land use-land cover data, 2000 census information, and a 2001 master employer file (MEF) which included the size, location, and standard industrial classification (SIC) description for each business in the region, into geographic information system (GIS) software. The GIS software allowed the different spatial levels represented in the data to be analyzed by placing individual households, the regional transportation network, and jurisdictional and TAZ boundaries in overlapping layers.

To measure walkability for each household an additional layer representing the geometric road network was added. The authors determined the density of four-way intersections within a defined area had positive effect on walkability while the presence of major roadways, cul-du-sacs, and three-way intersections discouraged pedestrians. These factors were weighted and a walkability index was calculated within a 0.25-mi radius of each household. To further develop this concept the household sample was overlain by the MEF layer allowing the researchers to ascertain the characteristics of businesses and thus walking opportunities within each household's 0.25-mi radius. To rank the desirability of each business as a walking destination four criteria were analyzed: 'subsistence, reflecting importance of the activity to everyday life; convenience, reflecting the desirability of having the activity close at hand, perhaps because of frequent visits; entertainment, reflecting how the activity contributes to enjoyment or quality of life; and ambience, reflecting how an activity by its presence adds to the fullness, character and variety of a place' (Kuzmuak, 2006). These scores were further adjusted based on the size of the establishment to account for the size displacement of a larger business and the likelihood a larger establishment would offer more variety and utility. From this scoring system the walk opportunities index was calculated using the predetermined walkability index to define the actual walking path and distance within the GIS program between each household and the available opportunities. The authors concluded the walkability opportunity index could replace the Pedestrian Environment Factor (PEF)

approach, which has greater resource needs and relies on the subjectivity of the transportation planners (Kuzmuak, 2006).

Discussion

Transportation planning agencies use data from the NHTS to analyze transportation trends and to develop travel demand models. An important factor in the development of these tools is an understanding of the methodology behind the data collection and the possibility of inaccuracies in the reporting of travel information. Based on the literature review presented in this paper the following observations were ascertained as influential to planning and modeling for bicycle/pedestrian travel:

The lack of well-defined guidelines for what constitutes a bicycle/pedestrian trip and the inaccuracy involved in estimating the trip length and duration promote an inherent variability to the NHTS data sets which is compounded by the small sample size.

The NHTS often requires supplemental data from the Add-on program or other sources to produce accurate modeling results. This is highlighted in a response by Nancy McGuckin (McGuckin, 2010) of the FHWA to a question regarding using the 2009 NHTS to estimate rare modes, “The NHTS 2009 has a small sample of households to represent major travel characteristics for each State (the minimum sample was 250 households per state). Unless the State purchased a significant add-on sample, detail for rare modes (such as bicycle, transit, long distance, etc.) will be very limited. The first step when looking for shares or conducting trends analysis is to look at the un-weighted frequencies for your unit of analysis at different geographic levels. For example, the State of Alabama has only 17 bicycle trips reported (out of 3019 total trips), and even the

East South Central Census Division has only 86 reported bicycle trips (none of the states in that division purchased an add-on). Clearly that number of sampled bicycle trips is too small for any significant estimates for the State or Census Division."

Land use, urban design, socioeconomic factors and population density are often indicators of bicycle/pedestrian travel. The use of GIS as a tool to analyze this information and overlay it with NHTS data enhances the capability of transportation professionals to accurately assess current bicycle/pedestrian trips and predict future travel demand.

Inclusion of unobserved factors including attitudinal behavior, family and social influences, historical context and the perception of safety and facility quality are important to understand bicycle/pedestrian travel for a geographical area. Agencies choosing to participate in the NHTS Add-on program should consider addressing local concerns related to these items through the additional questions that can be added to the survey through the program.

To adapt the bicycle/pedestrian information gathered from the NHTS, smaller spatial level analysis should be conducted to provide a more accurate representation of these modes of travel due to the high proportion of short distance trips.

The development of transportation plans including bicycle/pedestrian modes requires a greater level of resource commitment from a planning agency. The addition of attitudinal behavior questions to the NHTS and new techniques,

such as the walk opportunities index may provide transportation planners a better grasp on bicycle/pedestrian issues.

Conclusions

As the national pressure builds for the accommodation of bicycle/pedestrian facilities in transportation networks, transportation planning agencies are trying to identify issues with and applications for currently available data, as well as avenues for obtaining additional data. While it is difficult to develop predictive models from available data, current mode share baselines can be set to determine the impact of facility improvements and policy changes. Attitudinal behavior, perception of facilities and safety, socioeconomic factors, community and family influences, land use, population density and urban design characteristics often influence bicycle and pedestrian mode share and require additional data sources and analysis techniques. The NHTS add-on program provides one means for obtaining such data that may be more cost effective for planning agencies than undertaking an independent survey.

Organizations interested in developing and implementing their own transportation survey may have interest in several studies that were conducted to look at bicycle and pedestrian data collection methodology and the development of travel demand models including bicycle and pedestrian components on the state and local level. Available through the Transportation Research Board (TRB) is a case study analysis of 29 U.S. communities' bicycle and pedestrian data collection methods (Schneider, 2005). An extensive table in the document provides information on each community under the following categories:

Community Name, Agency Type, Use of Data, Years Data Collected and Key Aspects of Data Collection. Also included are categorical reviews of each data collection method and the identification of best practices and limitations for community based data collection. In addition, the Pedestrian and Bicycling Survey (PABS) is now available as a supplementary resource for collecting data on non-motorized travel (Forsyth, 2010).

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