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John D. Houston, Ph.D., Principal Investigator and Marlon G. Boarnet, Ph.D., Co-Investigator	
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16. ABSTRACT

This research helped close a crucial data gap in land use – travel behavior studies. Current estimates of land use – travel behavior relationships are based on average effects for metropolitan areas or larger geographies. That gives little insight into the effect of small-area land use policies such as targeted infill development, transit-oriented land uses near stations, or similarly localized policies. In California, Senate Bill (SB) 375 requires that metropolitan planning organizations incorporate land use – transportation planning, but existing travel diary surveys have very few observations in areas of policy interest. This research pioneered methods to obtain travel data with sufficient spatial focus to inform current debates about how land use influences vehicle miles of travel. A target of 100 to 200 travel diary surveys were obtained in small neighborhoods within the Southern California Association of Governments (SCAG) region. Approximately four neighborhoods were targeted for inclusion in this study. The methods developed in this research advanced efforts toward low-cost, rapid travel data collection that can be used in before-and-after transportation program evaluations in the future. Results expanded our understanding of the land use-travel relationships and inform policies which aim to more closely integrate transportation and land use planning and target housing and job growth into transit-oriented, mixed-use, and compact communities. Understanding how the c

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Spatially Focused Travel Survey Data Collection and Analysis: Closing Data Gaps for Climate Change Policy (Contract 65A0438)

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Task 9 (Final Report)

Prepared by

John Douglas Houston, Ph.D., Principal Investigator
Marlon G. Boarnet, Ph.D., Co-Investigator
Gavin Ferguson, Graduate Research Assistant
David Nyenhuis, Research Assistant

Prepared for

the California Department of Transportation (Caltrans)

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1.0 Overview of Study, Report, and Key Findings

This deliverable provides the results of our analysis of the Neighborhood Travel and Activity Study (NTAS) study, which collected 1-day travel diary surveys for 383 households in surveys in November/December 2012 in areas near two rail transit corridors in Los Angeles, the Red Line (subway) and Gold Line (light rail). We combined these survey results with a supplemental sample of 8,602 households in Los Angeles from the California Household Travel Survey (CHTS), which was conducted during the same time period using a similar survey protocol. The CHTS sample allowed us to increase the sample in the NTAS study area by 313 households and to compare travel patterns for the combined NTAS/CHTS sample in the study area (696 total) with those of CHTS survey households dispersed through the rest of LA County (8,289).

First, we provide an overview of the NTAS study design, sample frame, data collection, response rates and sample characteristics. Second, we report results of our factor analysis of NTAS survey results for travel-related socio-psychological factors. Third, we compare daily trip counts by mode and daily household vehicle miles traveled (VMT) for the NTAS and CHTS samples with the 2009 National Household Travel Survey (NHTS) for LA County. Fourth, we conduct a two-stage analysis of demographic, household, and near-residence built environment factors associated with household car ownership and usage.

Results suggest differences in walking, transit, and passenger vehicle travel behavior associated with residing in areas with different built environment, land use, and transit access characteristics. Based on the countywide sample, households in areas with higher employment accessibility tended to have more walking travel and lower VMT. Households within 1.5 miles of a rail transit station tended to have more transit ridership, and this relationship was strongest for households within 0.5 miles of a rail transit station. Households within 0.5 – 1.0 miles of a rail transit station tended to have more walking travel, while households with higher levels of transit service were associated with lower household VMT.

Results expand our understanding of the land use-travel relationships and inform policies which aim to more closely integrate transportation and land use planning and target housing and job growth into transit-oriented, mixed-use, and compact communities. Understanding how the characteristics of these communities influence travel behavior is particularly important given a pilot study in California suggests that areas with certain infill-related land use characteristics may be associated with lower trip generation rates than Institute of Transportation Engineers (ITE) trip generation rates.[1] The present study was not, however, designed to estimate infill or near-transit trip generation rates. Findings of the present study do reiterate the need for more localized data collection in areas targeted for infill and densification which can inform trip generation assumptions in regional transportation models. The present study was also not designed to identify transferrable parameters for transportation models.[2]

2.0 Overview of NTAS Survey Sample Frame and Data Collection

We targeted 300–600 travel diary surveys in areas near two rail transit corridors in Los Angeles, the Red Line (subway) and Gold Line (light rail). We chose these corridors based on

land use factors that have been correlated with VMT in the travel behavior literature. These factors include population density, job accessibility, concentration of neighborhood-serving businesses, distance to employment sub-centers, and distance to transit. The study areas are approximately ½ mile from center to edge, a size which corresponds to the scale of redevelopment opportunities, transit station development, and neighborhood land use planning. This scale should enable us to examine the effects of land use factors on household reductions in vehicle miles traveled (VMT) in small, SB375-relevant neighborhoods and to assess whether and to what extent impacts in these neighborhoods depart from regional average land use–travel impacts. Our study design report provides an overview of the methodology used to select these corridors.

Our final NTAS study areas include station areas along the Red and Purple subway lines and along the Gold Line. The Red/Purple Lines had about 3,751,000 annual boardings between February 2011 and February 2012, and the Gold Line had about 1,017,000 annual boardings during the same time period. These corridors have experienced substantial transit-oriented development activity in recent years. The study areas are located in High-Quality Transit Areas (HQTAs), and most of the area within the ¼- and ½-mile station buffers in these corridors is in the "very high" or "high" categories of our population density–job accessibility (PDJA) index. The corridors vary in land use patterns, transit service, roadway and traffic density, and demographic and socioeconomic characteristics, and survey results for these areas could provide insights into how land use–travel relationships vary within and across subway and light rail transit corridors.

We developed our sample frame using address information purchased in October 2012 from InfoUSA, a leading marketing firm. This address database included household socio-demographic data collected for marketing purposes, which enabled us to compare the characteristics of the overall sample frame to the characteristics of the final sample. We conducted two waves of surveys. Our Wave 1 group consisted of all households within ½ mile of stations in the Gold Line northern Los Angeles corridor, the Gold Line eastside Los Angeles corridor, the Red/Purple Line Wilshire corridor, the Red Line Hollywood corridor and the northern two stations of the Red Line Vermont corridor (Figure 2.1). The response rate to our Wave 1 recruitment mailing to about 68,000 households was low, so we conducted a second recruitment mailing to about 24,000 additional households (Table 2.1). The Wave 2 group consisted of all households within ½ mile of stations in the Gold Line western Pasadena and South Pasadena corridor, the Gold Line eastern Pasadena corridor, the San Fernando Valley corridor and the southern station of the Red Line Vermont corridor.

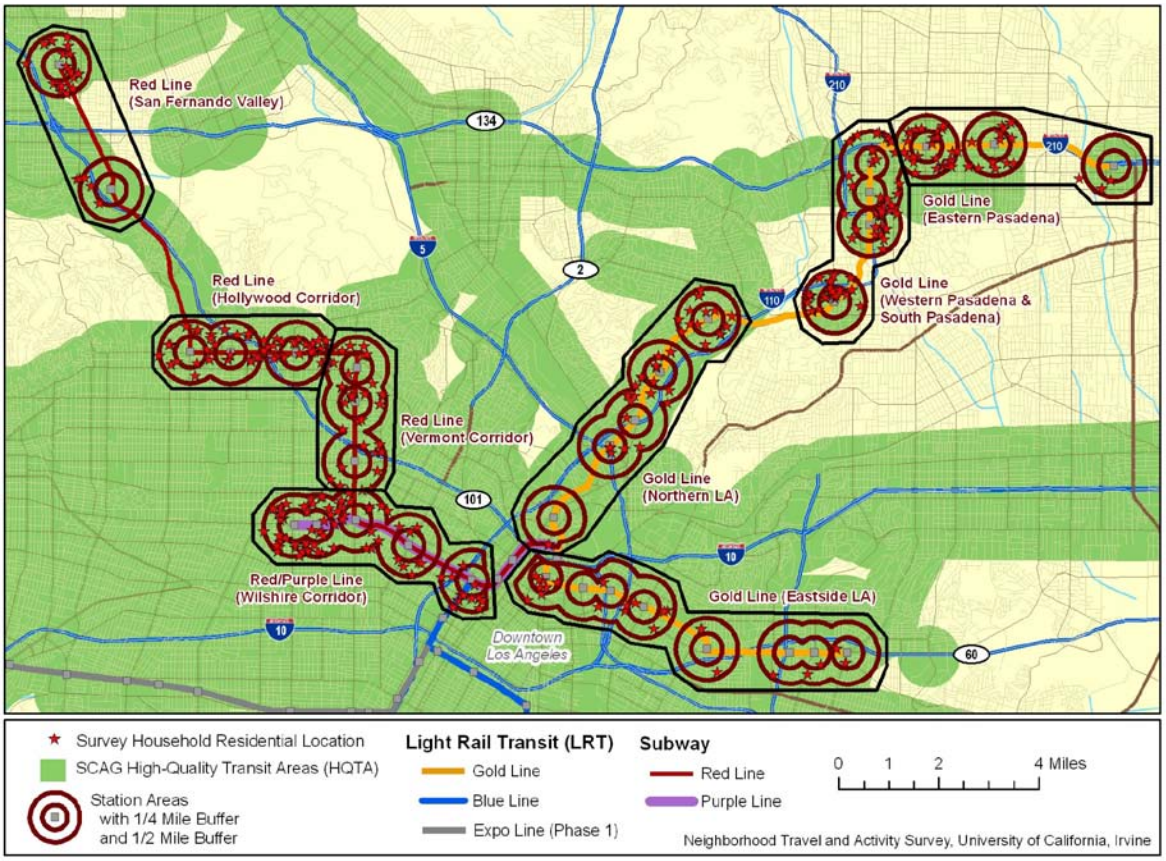

Figure 2.1 NTAS Study Areas and Location of Households Who Completed Survey (383)

Table 2.1 Overview of NTAS Data Collection Phases

Wave	Postcard Invitation		Packets Mailed		Target Survey Dates	Survey Methods
	Total	*Date*	*Total*	*Date*		
Wave 1	68,025	10/19/12	458	11/7/12	Tu/We/Th Nov 13, 14, 15	Web Hard-Copy
Wave 2	24,362	11/7/12	395	11/29/12	Tu/We/Th Dec 4, 5, 6	Hard-Copy

We mailed our initial invitation postcard offering a 1 in 10 chance of winning a $100 grocery gift card (Figure 2.2) to Wave 1 households on 10/19/12. About 458 households completed the initial screening questionnaire either online or by calling our survey team. We mailed survey packets to these households on 11/7/12. The initial screening questionnaire offered households the option of entering their responses online or returning their materials by mail. Households that had indicated they preferred to complete the survey online were mailed an instruction letter, travel diaries for all household members 16 years of age or older, and a household vehicle mileage log if they had indicated they owned one or more vehicles. In the instruction letter they were told to record their travel information on the paper travel diaries and vehicle mileage log for a specified date and afterward to go to the NTAS website to submit their travel information. When they logged in, they were asked to first complete a household

questionnaire and then to copy their travel information from their hard-copy materials to the web survey. Households that had indicated they preferred to return the survey materials by mail were mailed an instruction letter, a hard-copy version of the household questionnaire, travel diaries for all household members 16 years of age or older, a vehicle mileage log if they had indicated they owned one or more vehicles, and a return envelope with sufficient postage. About 7% of Wave 1 households were provided survey materials in Spanish per their request. The initial Wave 1 group was randomly divided into three equal-size subgroups which were instructed to report their travel for Tuesday (11/13/12), Wednesday (11/14/12), or Thursday (11/15/12).

Figure 2.2 NTAS Survey Invitation Postcards

Some households from the Wave 1 invitation who expressed interest late or who were unable to participate on the initial travel days were sent survey packets at a later date and asked to report their travel for Tuesday (12/4/12), Wednesday (12/5/12), or Thursday (12/6/12). We offered these remaining Wave 1 households an additional incentive of $15 for completing their hard-copy survey materials and returning mailing them to us by Saturday (12/8/12). In addition, we offered households who had partially completed a web survey in the earlier period an additional incentive of $25 if they mailed in their hard-copy survey. Finally, households who had provided an email address in the initial screening questionnaire received an email on the day before their travel day reminding them to record their travel information on the assigned day.

We made slight modifications to our Wave 2 procedures to try to increase the participation rate. First, we offered all Wave 2 households an additional incentive of $15 if they completed and returned their hard-copy survey materials to us on the Saturday after their assigned reporting day. Second, we asked all Wave 2 respondents to return their survey materials in hard-copy form since we suspected that some households may have found entering detailed trip data for multiple household members burdensome. Therefore, we provided a postage-paid return envelope in their travel survey packet to reduce the potential burden of entering travel survey data from hard-copy survey materials into the online survey. The initial Wave 2 group of 395 households was randomly divided into three equal-size subgroups which were instructed to report their travel for Tuesday (12/4/12), Wednesday (12/5/12), or Thursday (12/6/12). Some households from the Wave 2 invitation who expressed interest late or who were unable to participate on the initial travel days were sent survey packets at a later date and asked to report their travel for Tuesday (12/11/12), Wednesday (12/12/12), or Thursday (12/13/12). About 20 of these households completed their survey for a Tuesday, Wednesday, or Thursday in the subsequent week.

3.0 NTAS Survey Response and Sample Characteristics

Overall, about 1% of households who were mailed an invitation postcard completed a screening questionnaire, and about 45% of those households returned a completed survey (Table 3.1). This results in an overall response rate of 0.4%. We had a slightly higher response rate to our Wave 2 postcard mailing (1.2% versus 0.8%), which could have been in part because the Wave 2 study areas include more affluent areas of South Pasadena and Pasadena, which had slightly higher response rates. In addition, we had a slightly higher survey completion rate out of the households who completed the screening questionnaire in Wave 2 (55.3% versus 39.3%), which could have been in part due to the additional incentives offered. These two factors likely played a role in increasing the overall survey completion rate for all households contacted from 0.3% in Wave 1 to 0.7% in Wave 2.

Our analysis of response rates by household and demographic characteristics is limited to the marketing information we purchased. Overall, it appears that response rates did not vary greatly by household and demographic characteristics, but households with a head of household aged 50-64, households with higher income, and households with higher technology capabilities had slightly higher response rates (Table 3.2). Relative to the sample frame, the following households were slightly overrepresented among respondents: households headed by a male, households with a head aged 50-64, higher income households, households with higher technology capabilities, and households residing in an apartment (Table 3.3).
About half (48%) of individuals in participating households were 25-44 years old, and about two fifths (38%) were 45-64 years old (Table 3.4). Three-quarters (75%) had completed an associate's degree or higher level of education. Over half (57%) of the sample self-identified as White/Caucasian, about 18% were Asian/Pacific Islander, and about 14% were Hispanic. One quarter (75%) of participants were foreign-born, and most of these participants had lived in the United States for more than 10 years. About 12% were students, and about 74% were employed either part or full time. About three quarters of survey households lived in an apartment or condominium (74%) and almost three quarters were renters (71%) (Table 3.5).

Table 3.1 Response and Completion Rates by NTAS Study Area and Survey Wave

	Total Stations	Households Contacted	Completed Screening Surveys	% of Contacts	Completed Surveys	% of Contacts	% of Screening Surveys
All Study Areas	**33**	**92,265**	**855**	**0.9%**	**383**	**0.4%**	**44.8%**
Gold Line Study Areas	**20**	36,469	399	1.1%	179	0.5%	44.9%
Pasadena (Eastern)	3	6,712	93	1.4%	48	0.7%	51.6%
Pasadena (Western) and South Pasadena	4	7,982	124	1.6%	71	0.9%	57.3%
Los Angeles (Northern)	5	9,484	105	1.1%	37	0.4%	35.2%
Los Angeles (Eastside)	8	12,291	77	0.6%	23	0.2%	29.9%
Red/Purple Line Study Areas	**13**	55,796	456	0.8%	204	0.4%	44.7%
Wilshire Corridor	5	24,905	207	0.8%	85	0.3%	41.1%
Vermont Corridor	3	11,376	84	0.7%	38	0.3%	45.2%
Hollywood Corridor	3	14,375	116	0.8%	53	0.4%	45.7%
San Fernando Valley	2	5,140	49	1.0%	28	0.5%	57.1%
Survey Wave							
Wave 1		67,905	562	0.8%	221	0.3%	39.3%
Wave 2		24,360	293	1.2%	162	0.7%	55.3%

Table 3.2 Response and Completion Rates by NTAS Household Characteristics

	Households Contacted	Completed Screening Surveys	% of Contacts	Completed Surveys	% of Contacts	% of Screening Surveys
All Study Areas	**92,265**	**855**	**0.9%**	**383**	**0.4%**	**44.8%**
Sex of Householder						
Female	40,848	367	0.9%	163	0.4%	44.4%
Male	42,529	428	1.0%	200	0.5%	46.7%
Unknown	8,888	60	0.7%	20	0.2%	33.3%
Age of Householder						
Age 18-34	20,937	217	1.0%	88	0.4%	40.6%
Age 35-49	36,876	284	0.8%	114	0.3%	40.1%
Age 50-64	22,507	254	1.1%	135	0.6%	53.2%
Age 65 plus	11,942	100	0.8%	46	0.4%	46.0%
Household Income						
Under $20,000	44,151	369	0.8%	152	0.3%	41.2%
$20,000 - $39,999	19,070	170	0.9%	76	0.4%	44.7%
$40,000 - $69,999	15,350	154	1.0%	71	0.5%	46.1%
$70,000 - $99,000	6,400	75	1.2%	46	0.7%	61.3%
$100,000 or more	7,294	87	1.2%	38	0.5%	43.7%
Technology Status						
High Tech Household	21,836	267	1.2%	127	0.6%	47.6%
Low Tech Households	70,429	588	0.8%	256	0.4%	43.5%
Residence Type						
Apartment	64,803	625	1.0%	291	0.5%	46.6%
House	27,460	230	0.8%	92	0.3%	40.0%
Units in Residential Structure						
1 unit	27,548	231	0.8%	93	0.3%	40.3%
2-9 units	16,796	144	0.9%	59	0.4%	41.0%
10-49 units	27,115	254	0.9%	126	0.5%	49.6%
50 units or more	20,806	226	1.1%	105	0.5%	46.5%
Years Residing in Residence						
1 year	21,096	190	0.9%	82	0.4%	43.2%
2-3 years	20,229	215	1.1%	86	0.4%	40.0%
4-9 years	23,460	231	1.0%	104	0.4%	45.0%
10 or more years	27,480	219	0.8%	111	0.4%	50.7%

Table 3.3 Composition of NTAS Sample Frame and Final Participants (Based on Address Data)

	Households Contacted	Completed Screening Surveys	Completed Surveys
Total	92,265	855	383
Sex of Householder			
Female	44%	43%	43%
Male	46%	50%	52%
Unknown	10%	7%	5%
Age of Householder			
Age 18-34	23%	25%	23%
Age 35-49	40%	33%	30%
Age 50-64	24%	30%	35%
Age 65 plus	13%	12%	12%
Household Income			
Under $20,000	48%	43%	40%
$20,000 - $39,999	21%	20%	20%
$40,000 - $69,999	17%	18%	19%
$70,000 - $99,000	7%	9%	12%
$100,000 or more	8%	10%	10%
Technology Status			
High Tech Household	24%	31%	33%
Residence Type			
Apartment	70%	73%	76%
House	30%	27%	24%
Units in Residential Structure			
1 unit	30%	27%	24%
2-9 units	18%	17%	15%
10-49 units	29%	30%	33%
50 units or more	23%	26%	27%
Years Residing in Residence			
1 year	23%	22%	21%
2-3 years	22%	25%	22%
4-9 years	25%	27%	27%
10 or more years	30%	26%	29%

Table 3.4 Composition of NTAS Final Survey Participants (Based on Survey Data)

Total[a]	531	100%
Gender[b]		
Female	255	48%
Male	266	50%
Age		
16 to 24 years	28	5%
25 to 34 years	159	30%
35 to 44 years	96	18%
45 to 54 years	102	19%
55 to 64 years	99	19%
65 or older	47	9%
Educational Attainment[b]		
12th grade or less	25	5%
Graduated high school or equivalent	29	5%
Some college, no degree	69	13%
Associate degree	25	5%
Bachelor's degree	208	39%
Masters degree	104	20%
Post-graduate degree	59	11%
Other	6	1%
Race/Ethnicity[b]		
Asian/Pacific Islander	95	18%
Black/African-American	23	4%
Hispanic	76	14%
Native American/Alaska Native	3	1%
Other/Multi-Racial	29	5%
White/Caucasian	303	57%
Length of Residence in the United States[b]		
Less than 5 years	10	2%
6 to 10 years	16	3%
More than 10 years	100	19%
All of his/her life	398	75%
Employment Status[b]		
Not Employed	137	26%
Employed, full time	293	55%
Employed, part time	99	19%
Student Status[b]		
Not a Student	463	87%
Student, in high school	7	1%
Student, in a college or university	49	9%
Student, in another type of school	10	2%

[a] May include participants with incomplete data who could be eliminated in the final analysis.
[b] Includes 10 or fewer participants without a response.

Table 3.5 Composition of Final NTAS Survey Households (Based on Survey Data)

Total[a]	396	100%
Housing Type[b]		
Apartment or condominium	292	74%
Detached single family house	54	14%
Duplex or triplex	25	6%
Row-house or townhouse	10	3%
Tenure Status[b]		
Own	103	26%
Rent	282	71%

[a] May include participants with incomplete data who could be eliminated in the final analysis.
[b] Includes 10 or fewer participants without a response or who indicated "other".

4.0 Factor Analysis of Socio-Psychological Questions for the NTAS Sample

4.1 Background

Travel behavior is a complex phenomenon that is affected not only by characteristics of the built environment and socio-economics but also by social and psychological factors.[3, 4] Although a few recent studies have begin to explore the role of attitudes and perceptions in travel behavior and decision making,[5-7] these underlying psychological and social decision processes that guide individual travel behavior have been largely ignored in the travel behavior literature.[8, 9] This is a shortcoming, as research has shown that individuals in homogeneous socio-economic groups may behave differently depending on their perceptions, attitudes, and preferences.[10-13]

Adequately accounting for the role of psychological factors in travel behavior could have significant implications for planners and policy makers. Clearly identifying specific attitudes, norms, and feelings of control that facilitate or hinder transit use allows the use of targeted information campaigns to address barriers to change. For instance, if travel time is a main concern of non-users, information on transit versus freeway travel times may help to change perceptions about the convenience of car use. If social support for transit use is lacking, efforts can be made to connect individuals through user groups or social media. Targeted efforts such as these could help to increase ridership in a relatively cost-effective manner compared to built environment changes or general information that does not directly address barriers to use. Appropriate targeting of messages is important. Research has shown that information campaigns with generic messages (for example about environmental benefits of transit use) may not be effective, and in some cases may lead to negative reactance against the desired change.[14]

4.2 Methods: Factor Analysis

Primary respondents in each household participating in the NTAS survey were asked to complete a questionnaire that included demographic, attitudinal, and personal safety related

questions. Survey items were adapted from questions shown to affect travel behavior and transit usage in previous similar studies.[4, 10, 15] Specifically, participants were asked questions related to the following:

- Perceived Neighborhood Amenities – Perceptions about the availability of shopping, services, restaurants, and recreation within walking distance of home.
- Transit Attitudes and Support – Attitudes toward attributes and outcomes related to the public transportation system (convenience, travel time, cost, ease of use, environmental benefits) and social norms relating to expectations/support for transit use from friends and family.
- Car Attachment – Perceived control over travel behavior and perceived travel necessities (the need for a car and activity scheduling demands), and attitudes toward privacy and crowding on public transportation versus private vehicles.

In all, the primary respondents in each household was asked to rank 13 overlapping socio-psychological statements on a 7-point Likert scale (1=strongly disagree, 2=moderately disagree, 3=slightly disagree, 4=neither agree nor disagree, 5=slightly agree, 6=moderately agree, 7=strongly agree).

The first step in analyzing participant responses to attitudinal questions is to use factor analysis to reduce the 13 questions a smaller set that can be used in regression analysis of travel outcomes. Each factor formed through this analysis is comprised of variables that are most highly correlated with each other, and least correlated with variables in other factors.

Because questionnaires that include large numbers of attitudinal variables are not often used in travel behavior research, few examples of factor analysis exist in this literature. However, factor analysis is frequently used in studies of attitude-behavior relationships, such as consumer response to new market innovations[16] and studies of how attitudes toward the environment affect behavior.[17] Examples in the travel behavior literature include Heath and Gifford (2002), who used factor analysis with a set of normative questions relating to transit use, Anable (2005), who used it as an intermediate step in segmentation study of mode-switching potential, and Hunecke et al. (2008) who used factor analysis to examine the role of attitudes, norms and beliefs on mode choice. In each case, principal component analysis with varimax rotation was used to reduce the responses to the relevant survey questions into orthogonal factors that could be treated as uncorrelated variables in subsequent analysis.

4.3 Results: Factor Analysis of Socio-Psychological Constructs

The 13 socio-psychological transit questions pertaining to the constructs in the PIA theoretical framework were subjected to exploratory factor analysis in order to reduce the large number of variables to a smaller number of underlying factors. These items were subjected to principal component analysis with varimax rotation using the statistical software SPSS 18. Based on a screen plot showing the variance explained by each factor, a three factor solution was chosen for the analysis. The resulting factors explained 49.7% of the variance in the dataset. To evaluate the internal reliability of the factors, Crohnbach's alpha was calculated for each, using the variables with the highest loadings on each factor. Table 4.1 shows the three factors extracted from the analysis, the questions asked in the original survey, and Cronbach's

alpha for each factor. The resulting three socio-psychological will be used as independent variables in regression analysis to assess their influence on travel outcomes after accounting for socio-economic and built environment variables commonly used in travel behavior research.

Table. 4.1 Factor Analysis Results

Factor	Survey Item	Factor Loading	Cronbach's α
Perceived Neighborhood Amenities	There are plenty of places to shop within walking distance of my home.	0.838	0.81
	There are good restaurants within walking distance of my home.	0.833	
	There are enough places in my neighborhood where I can go for recreation or entertainment.	0.784	
	I can get most of my personal business (like banking, laundry, etc.) done within walking distance of my home.	0.693	
Car Attachment	It is/would be difficult to get everything done without a car.	0.706	0.59
	Using the bus or train takes too long compared to going by car.	0.677	
	I feel pressed for time in my daily travels.	0.676	
	I am uncomfortable on a crowded bus or train.	0.369	
Transit Attitudes and Support	Increasing use of public transit is beneficial to the environment.	0.678	0.57
	Taking the bus or train could save me money compared to driving a car.	0.601	
	I try to minimize my impact on the environment by taking the bus or train whenever I can.	0.578	
	I don't know enough about public transit in my neighborhood to use it.	-0.499	
	My friends and family would support me if I decided to use my car less.	0.484	

5.0 Travel Outcomes: Comparisons for NTAS, NHTS (2009), and CHTS (2012) Samples

5.1 Overview

We examined whether the aggregate travel patterns of our NTAS sample were consistent with other recent travel survey studies in the NTAS study area and county. We compared our NTAS sample characteristics, daily trip counts (total and by mode), and estimated VMT with those from the 2009 National Household Travel Survey (NHTS) and the 2012 California Household Travel Survey (CHTS) (www.californiatravelsurvey.com). We used the geocoded household location data from each survey to identify subsamples of NHTS and CHTS households within the NTAS survey areas (within ½ mile of an active Red/Purple or Gold Line station at the time of the survey). Note comparisons of travel patterns exclude respondents near the Gold Line Eastside Extension for all three datasets since this segment was not in service during the NHTS 2009 survey. We also generated the same comparisons between our NTAS sample with subsamples of NHTS and CHTS households within ½ mile of an active MTA light rail or subway station at the time of the survey (Appendix B). The NTAS survey and NHTS

and CHTS comparison surveys used a similar 1-day travel diary survey protocol, and represent the largest and most recent and spatially refined travel surveys in the study area. Caution should be used when interpreting differences, however, since the samples and observed travel patterns could vary across studies due to factors such as differences in survey timing, design, recruitment procedures, and data processing.

5.2 Comparison of Sample Characteristics

The combined household sample size for the three surveys within ½ mile of the NTAS station areas (including the Gold Line Eastside Extension) was 677 (Table 5.1). This includes 364 NTAS households, 82 NHTS households, and 319 CHTS households. (Note, 19 of the 383 total NTAS households resided slightly farther than ½ mile of the study area stations and were therefore not included in the analysis in this section). On average, the NHTS and CHTS study area samples and the CHTS countywide sample had more household members, workers and children compared to the NTAS area sample. The NTAS sample did not, however, have a statistically significant difference than the NHTS and CHTS samples in terms of the number of household vehicles.

About 70% of NTAS households reported an annual income under $75,000 compared to 76% for CHTS households in the study area (Table 5.2). About 85% of NTAS households lived in an apartment, condo, duplex, or row-house, compared to about 77% for CHTS households in the study area, but the rental rate was similar for these two samples (73% vs. 70%). The main respondents of NTAS households had a higher rate of being White/Caucasian (64%) and having higher educational attainment (defined as having completed a Bachelor's degree or higher) (75%). In comparison, about 45% of the main respondents in CHTS households in the study reported they were White/Caucasian and 48% reported they had completed a least a Bachelor's degree.

Table 5.1 Characteristics of households within ½-mile of a study-area station (including Gold Line Eastside stations)

	N	Mean	St. Dev.	Min.	Max.	Diff. in means	S.E. of diff.	Sig.[a]
Household members								
NTAS	364	1.70	1.16	1	9	—	—	
NHTS	82	2.32	1.19	1	5	0.619	0.144	***
CHTS	319	2.15	1.36	1	8	0.453	0.097	***
CHTS, LA Co.	8219	2.58	1.43	1	8	0.880	0.063	***
Household workers								
NTAS	364	1.02	0.67	0	3	—	—	
NHTS	82	1.01	0.87	0	4	-0.007	0.102	
CHTS	319	1.12	0.76	0	4	0.103	0.055	*
CHTS, LA Co.	8219	1.26	0.88	0	6	0.240	0.036	***
Household children (under 18)								
NTAS	364	0.20	0.65	0	5	—	—	
NHTS	82	0.48	0.82	0	3	0.281	0.097	***
CHTS	319	0.41	0.88	0	5	0.216	0.060	***
CHTS, LA Co.	8219	0.50	0.95	0	6	0.309	0.036	***
Household vehicles								
NTAS	364	1.17	0.79	0	6	—	—	
NHTS	82	1.18	0.82	0	3	0.015	0.100	
CHTS	319	1.08	0.82	0	5	-0.086	0.062	
CHTS, LA Co.	8219	1.74	1.01	0	8	0.576	0.043	***

[a] Significance: * $p < .1$. ** $p < .05$. *** $p < .01$.

Table 5.2 Frequency distributions of households within ½-mile of a study-area station (including Gold Line Eastside stations)

	NTAS	(%)	NHTS	(%)	CHTS	(%)	CTHS, LA Co.	(%)
Household Income								
$0 - $34,999	115	31.94	42	53.85	126	42.71	2,057	27.88
$35,000 - $74,999	137	38.06	22	28.21	98	33.22	2,100	28.46
$75,000 - $99,999	54	15.00	5	6.41	21	7.12	1,049	14.22
$100,000+	54	15.00	9	11.54	50	16.95	2,173	29.45
Total	360	100	78	100	295	100	7,379	100
Kruskal-Wallis test: chi-squared = 11.78 with 2 d.f., p < 0.01								
Home Type								
Detached single-family home	54	14.96	20	24.39	73	22.96	5,208	64.48
Duplex, row-house, etc.	29	8.03	62	75.61	38	11.95	743	9.20
Apartment or condominium	278	77.01	0	0.00	207	65.09	2,126	26.32
Total	361	100	82	100	318	100	8,077	100
Pearson chi-squared = 257.23 with 4 d.f., p < 0.01								
Home Tenure								
Rent	262	72.58	67	81.71	222	69.81	2,648	32.29
Own	99	27.42	15	18.29	96	30.19	5,552	67.71
Total	361	100	82	100	318	100	8200	100
Pearson chi-squared = 4.63 with 2 d.f., p < 0.10								
Race/ethnicity, Main Respondent								
White/Caucasian	217	63.64	38	48.10	141	44.62	4,581	56.96
Hispanic	36	10.56	19	24.05	133	42.09	2,107	26.20
Black/African-American	16	4.69	4	5.06	17	5.38	609	7.57
Asian/Pacific Islander	51	14.96	10	12.66	22	6.96	603	7.50
Other/Multi-Racial	21	6.16	8	10.13	3	0.95	142	1.77
Total	341	100	79	100	316	100	8042	100
Pearson chi-squared = 102.10 with 8 d.f., p < 0.01								
Educational Attainment, Main Respondent								
Less than high school	9	2.65	21	28.00	46	14.51	640	7.87
Graduated high school	9	2.65	10	13.33	49	15.46	1055	12.97
Some college or Associate’s	63	18.53	18	24.00	70	22.08	2134	26.23
Bachelor's	141	41.47	17	22.67	85	26.81	2299	28.26
Graduate or Professional	115	33.82	9	12.00	66	20.82	2000	24.58
Other	3	0.88	0	0.00	1	0.32	8	0.10
Total	340	100	75	100	317	100	8136	100
Kruskal-Wallis test: chi-squared = 79.67 with 2 d.f., p < 0.01								

5.3 Comparison of Travel Patterns

Our comparisons of travel patterns excluded respondents near the Gold Line Eastside Extension for all three datasets since this segment was not in service during the NHTS 2009 survey. Although NTAS study instructions stipulated that households should complete their travel diaries on Tuesday, Wednesday or Thursday, 11 NTAS households (3%) reported their travel for other days of the week. In comparison, about 54% of CHTS households in the study area completed their travel diaries on Tuesday, Wednesday, or Thursday (Table 5.3). Compared to the CHTS sample for the NTAS study area, the NTAS sample had a lower percentage of aggregate trips for the whole sample for walking and bus modes (Table 5.4).

Table 5.3 Travel days for households within ½-mile of a study-area station (excluding Gold Line Eastside stations)

Travel Day	NTAS	(%)	NHTS	(%)	CHTS	(%)
Sunday	0	0.00	10	14.93	44	16.48
Monday	1	0.29	7	10.45	44	16.48
Tuesday	100	29.15	16	23.88	28	10.49
Wednesday	120	34.99	10	14.93	42	15.73
Thursday	112	32.65	10	14.93	45	16.85
Friday	8	2.33	11	16.42	32	11.99
Saturday	2	0.58	3	4.48	32	11.99
Total	343	100	67	100	267	100

Table 5.4 Trip frequencies by travel mode for households within ½-mile of a study-area station (excluding Gold Line Eastside stations)

Trip Mode	NTAS	(%)	NHTS	(%)	CHTS	(%)	CTHS, LA Co.	(%)
Walk	547	24.89	131	23.86	815	36.86	11,137	16.20
Bike	54	2.46	9	1.64	25	1.13	898	1.31
Private vehicle	1,239	56.37	329	59.93	1,030	46.59	52,526	76.40
Bus/Paratransit	164	7.46	64	11.66	221	10.00	2,714	3.95
Rail transit	162	7.37	4	0.73	85	3.84	580	0.84
Long-distance Rail	2	0.09	7	1.28	6	0.27	75	0.11
Other	30	1.36	5	0.91	29	1.31	825	1.20
Total	2,198	100	549	100	2,211	100	68,755	100

Although the CHTS study area sample had a higher average number of household trips compared to the NTAS sample, these samples were not significantly different in terms of the average household vehicle trips, rail transit trips and vehicle miles traveled (VMT) (Table 5.5). This pattern held for a subset of households which took at least one transit trip on the observation day (Table 5.6). For both subsets, the CHTS sample in the study area had significantly more walking and bus trips compared to the NTAS sample. Note, for the NTAS sample VMT was estimated from household vehicle odometer logs and for the CHTS sample VMT was estimated from the reported locations of trip origins and destinations.

Table 5.5 All households – Travel statistics for households within ½-mile of a study-area station

	N	Mean	St. Dev.	Min.	Max.	% > 0	Diff. in means	S.E. of diff.	Sig.[a]
Trips, any mode									
NTAS	343	6.43	4.66	0	32	96.79	—	—	
NHTS	67	8.19	6.16	1	33	100.00	1.760	0.793	**
CHTS	267	8.28	8.20	0	60	88.76	1.846	0.561	***
CHTS, LA Co.	8219	8.37	7.88	0	70	87.21	1.931	0.266	***
Walk trips									
NTAS	343	1.59	2.53	0	12	42.27	—	—	
NHTS	67	1.96	2.87	0	14	46.27	0.360	0.377	
CHTS	267	3.05	4.83	0	30	49.44	1.458	0.326	***
CHTS, LA Co.	8219	1.36	3.24	0	50	27.21	-0.240	0.141	*
Bicycle trips									
NTAS	343	0.16	0.79	0	9	5.54	—	—	
NHTS	67	0.13	0.78	0	6	4.48	-0.023	0.104	
CHTS	267	0.09	0.64	0	7	2.62	-0.064	0.058	
CHTS, LA Co.	8219	0.11	0.72	0	18	3.48	-0.048	0.043	
Vehicle trips									
NTAS	343	3.61	3.39	0	17	73.76	—	—	
NHTS	67	4.91	5.69	0	26	73.13	1.298	0.719	*
CHTS	267	3.86	5.09	0	35	62.17	0.245	0.362	
CHTS, LA Co.	8219	6.39	6.61	0	65	79.82	2.779	0.197	***
Bus/Paratransit trips									
NTAS	343	0.48	1.83	0	29	18.95	—	—	
NHTS	67	0.96	1.70	0	6	32.84	0.477	0.223	**
CHTS	267	0.83	2.33	0	18	20.97	0.350	0.173	**
CHTS, LA Co.	8219	0.33	1.43	0	24	8.61	-0.148	0.100	
Rail transit trips									
NTAS	343	0.47	1.04	0	6	20.70	—	—	
NHTS	67	0.06	0.38	0	3	2.99	-0.413	0.073	***
CHTS	267	0.32	1.38	0	18	11.61	-0.154	0.101	
CHTS, LA Co.	8219	0.07	0.59	0	20	2.49	-0.402	0.056	***
Vehicle-miles traveled									
NTAS	343	25.59	33.76	0	249.00	67.93	—	—	
NHTS	67	18.85	25.74	0	110.00	59.70	-6.744	3.635	*
CHTS	267	22.58	37.98	0	257.04	56.93	-3.008	2.954	
CHTS, LA Co.	8219	35.15	46.45	0	553.89	76.43	9.558	1.894	***

[a] Significance: * p < .1. ** p < .05. *** p < .01.

Table 5.6 Transit households – Travel statistics for households with at least on transit trip located within ½-mile of a study-area station (excluding Gold Line Eastside stations)

	N	Mean	St. Dev.	Min.	Max.	% > 0	Diff. in means	S.E. of diff.	Sig.[a]
Trips, any mode									
NTAS	102	8.50	5.61	1	32	100	—	—	
NHTS	22	10.55	8.27	2	33	100	2.045	1.848	
CHTS	72	13.89	9.59	2	53	100	5.389	1.259	***
CHTS, LA Co.	805	16.13	9.91	2	70	100	7.627	0.656	***
Walk trips									
NTAS	102	2.92	3.02	0	12	69.61	—	—	
NHTS	22	2.95	3.84	0	14	50.00	0.033	0.871	
CHTS	72	7.99	5.87	0	30	98.61	5.065	0.754	***
CHTS, LA Co.	805	7.11	5.75	0	50	96.40	4.185	0.361	***
Bicycle trips									
NTAS	102	0.15	0.71	0	5	4.90	—	—	
NHTS	22	0.05	0.21	0	1	4.55	-0.102	0.084	
CHTS	72	0.00	0.00	0	0	0.00	-0.147	0.070	**
CHTS, LA Co.	805	0.19	0.84	0	9	5.96	0.043	0.076	
Vehicle trips									
NTAS	102	1.98	3.04	0	14	44.12	—	—	
NHTS	22	4.18	7.77	0	26	45.45	2.201	1.683	
CHTS	72	1.47	2.85	0	16	34.72	-0.508	0.452	
CHTS, LA Co.	805	3.37	3.26	0	24	87.95	2.444	0.375	***
Bus/Paratransit trips									
NTAS	102	1.61	3.07	0	29	63.73	—	—	
NHTS	22	2.91	1.77	1	6	100.00	1.301	0.485	***
CHTS	72	3.07	3.66	0	18	77.78	1.462	0.528	***
CHTS, LA Co.	805	3.37	3.26	0	24	87.95	1.764	0.325	***
Rail transit trips									
NTAS	102	1.59	1.37	0	6	69.61	—	—	
NHTS	22	0.18	0.66	0	3	9.09	-1.406	0.196	***
CHTS	72	1.18	2.46	0	18	43.06	-0.408	0.320	
CHTS, LA Co.	805	0.72	1.75	0	20	25.47	-0.868	0.149	***
Vehicle-miles traveled									
NTAS	102	9.44	19.91	0	110.00	36.27	—	—	
NHTS	22	12.16	25.55	0	95.44	22.73	2.724	5.793	
CHTS	72	6.73	13.60	0	62.73	30.56	-2.701	2.541	
CHTS, LA Co.	805	19.38	33.60	0	290.36	49.81	9.942	2.300	***

[a] Significance: * $p < .1$. ** $p < .05$. *** $p < .01$.

6.0 Results: Two-Stage Analysis of Household Vehicle Ownership and Travel (NTAS & CHTS)

6.1 Methods

Car ownership rates have been associated with near-residence land use mix, residential density, sprawl, and transit access.[18-21] Since households who prefer to own fewer cars choose (or 'self-select') to reside in denser areas with greater access to amenities and public transit, coefficient estimates of the influence of these factors on travel patterns and VMT could be biased. Previous studies have addressed this problem by first developing household vehicle choice models then using these results to develop two factors for inclusion in ordinary least squares (OLS) regression models of VMT which address endogeneity bias and selection bias.[20-23] Endogeneity bias could exist if we specify OLS models for VMT and include the number of household vehicles as an independent variable since the choice to own a vehicle could be correlated with unobserved factors (such as residential location preferences). Consistent with previous studies, we correct for endogeneity bias by replacing the household vehicle variable in the travel outcome regressions with an instrumental variable representing the predicted value of household motor vehicles (based on our vehicle choice model). Theoretically, this approach corrects for the correlation of the household vehicle variable with the error term. This approach requires that the travel outcome OLS analyses include only households with at least one vehicle, but this could introduce a selectivity bias since this approach could bias the sample towards households with greater vehicle usage. To correct for this, we generate a selection bias correction (SBC) factor from the vehicle ownership model. The SBC factor corrects for correlation between the error in the vehicle ownership equation and the error in the VMT equation.

The instrumental variable representing the expected number of household vehicles (ENV) (used to substitute for the reported number of household vehicles in travel outcome regressions) was calculated based on results of multinomial logit (MNL) regressions of vehicle ownership (Tables 6.2-6.4). The ENV calculation took the following form:

$$ENV = (0*P_0) + (1*P_1) + (2*P_2) + (3*P_{3+})$$

where P_n is the predicted probability of a household owning *n* number of vehicles.

The selectivity bias correction (SBC) factor takes the basic form of a ratio of the relevant logit choice probabilities based on results of binary logit regressions of vehicle ownership. The SBC calculation took the following form:[23]

—

where *K* is the total number of alternatives; P_k is the predicted probability of choosing *k* (the non-chosen alternatives); and P_i is the predicted probability of selecting the chosen alternative.

For OLS analysis of factors associated with continuous travel outcomes (TR) (including the number of average daily walking trips, transit trips, and VMT), we specified two types of models, one type including ENV and SBC factors as independent variables (without the number

household vehicles) and one type excluding these factors and including the number household vehicles. These models take the following form:

(1)
(2)

where *TR* is the continuous travel outcome such as household vehicle miles traveled, *x* is a vector of household and built environment characteristics, *ENV* and *SBC* are defined as above, and is the error term.

We used this same approach to generate probability models for the likelihood of a household having at least one trip by a given mode (walking, transit, vehicles). These models take the following form:

(1)
(2)

where *Y* is an indicator variable for having at least one trip by the given mode, *x* is a vector of household and built environment characteristics, and *ENV* and *SBC* are defined as above.

We developed several measures to capture near-residence built environment, land use, and transit access characteristics which could be associated with walking, transit and vehicle trips and VMT. We estimated street connectivity and "walkability" based on the number of street intersections within 0.25 miles of a household's residence based on 2010 Topologically Integrated Geographic Encoding and Referencing (TIGER) roadway data from the U.S. Census Bureau. We estimated land-use composition within 0.25 miles of a household's residence based on 2008 land-use data from the Southern California Association of Governments (SCAG). We generated transit access measures based on 2012 data obtained from SCAG representing the location of all unique bus line stops for all service providers in the study area. Near-residence transit service represents the number of unique stops for each line within 0.25 miles of a household's residence. We examined the influence of near-residence transit service by dividing households into four groups based on whether a household's nearby transit service was in the first, second, third, or fourth quartile of transit service. We also examined the influence of distance to a rail transit line (subway or LRT), and created dummy variables representing whether a household was within ½ mile distance intervals from a rail transit line.

Near-residence population density was defined as the total population per square mile in a household's census block group based on 2010 decennial census data (P.L. 94-171). We used the natural log of population density in models since it was more normally distributed than population density. We derived 2008 InfoUSA employment data for the study area from SCAG, and developed an employment access gravity estimate calculated as follows:

where:

is the number of employees at establishment , and is the distance from the centroid of block group to establishment in meters.

We created a standardized employment accessibility variable by subtracting the mean from each block group's value and dividing by the standard deviation.

The travel data are based on two travel surveys: the Neighborhood Travel and Activity Study (NTAS) study, which collected 1-day travel diaries for 383 households in November/December 2013 within 0.5 miles of stations of the Los Angeles Metro Red/Purple Line (subway) and Gold Line (light rail) and (2) the California Household Travel Survey (CHTS) which included 8,602 households in Los Angeles County. Given these surveys were conducted during the same time period using a similar travel diary protocol, we combined the NTAS sample (383) with the CHTS sample in the NTAS study area near the Red/Purple and Gold Lines (313) to create a combined NTAS/CHTS sample for the NTAS study area (696). Daily trip counts by mode were obtained for both surveys from travel diaries. For the NTAS sample, VMT was estimated from household vehicle odometer logs and for the CHTS sample VMT was estimated from the reported locations of trip origins and destinations.

6.2 Overview of Samples Use in Two-Stage Analysis

The county wide sample (8,602 households, the CHTS and NTAS samples combined) tended to have more household workers, non-workers, and vehicles than the samples in the NTAS Study area, which were within 0.5 miles of the Red Line (subway) and Gold Line (light rail) (Table 6.1). The combined NTAS/CHTS sample in the NTAS study area (696 households) differed from the county-wide sample in a few ways. The county-wide sample was much more likely to reside in a single-family residence compared to the combined NTAS/CHTS study area sample (61% vs. 18%). The combined NTAS/CHTS study area sample had a higher percentage of households with an annual income under $75,000 compared to the county-wide sample (70% vs. 51%), but the combined NTAS/CHTS study area sample also had a higher percentage of households with main respondent with an educational attainment of a Bachelor's Degree or higher (64% vs. 55%).

The combined NTAS/CHTS study area sample households tended to have less nearby residential uses (50% vs. 72%), more nearby commercial (18% vs. 9%), and greater nearby land use mix (52% vs. 20%) than the county-wide sample. As expected, households in NTAS/CHTS study area sample had higher near-residence transit access, population density and employment access compared to the county-wide sample.

Table 6.1 Descriptive Characteristics of Samples

	NTAS & CHTS Los Angeles Cnty	NTAS & CHTS NTAS Study Area	CHTS, NTAS Study Area	NTAS
Total Households	8602	696	313	383
Household Characteristics				
Household Workers (N)	1.25	1.07	1.13	1.02
Household Non-workers (N)	1.29	0.83	1.04	0.66
Household Vehicles (N)	1.72	1.13	1.09	1.17
Race, Main Respondent				
Hispanic or Latino (1/0)	0.25	0.24	0.42	0.09
Black or African-American (1/0)	0.07	0.05	0.05	0.04
Asian or Pacific Islander (1/0)	0.08	0.11	0.07	0.14
Other (1/0)	0.02	0.03	0.01	0.05
White (1/0)	0.56	0.53	0.44	0.61
Missing	0.02	0.04	0.01	0.06
Housing Type				
Single Family Residential	0.61	0.18	0.23	0.14
Multifamily Residential	0.09	0.10	0.12	0.09
Missing	0.00	0.00	-	0.01
Annual Household Income				
under $35,000	0.25	0.35	0.40	0.31
$35,000-$74,999	0.26	0.35	0.31	0.38
$75,000-$99,999	0.13	0.11	0.06	0.15
$100,000 or higher	0.26	0.15	0.15	0.14
Missing	0.10	0.04	0.08	0.01
Educational Attainment, Main Respondent				
Less than High School	0.08	0.08	0.15	0.03
High School or Equivalent	0.12	0.08	0.16	0.02
Associate's Degree	0.26	0.19	0.22	0.17
Bachelor's Degree	0.29	0.34	0.26	0.40
Graduate Degree	0.25	0.26	0.20	0.31
Missing	0.01	0.04	0.01	0.06
Near-Residence Land Use (within 1/4 mile)				
Residential (All) (%)	0.72	0.50	0.66	0.37
Commercial (All) (%)	0.09	0.18	0.18	0.19
Mixed Use (15% Res. & 15% Com.)	0.20	0.52	0.55	0.50
Near-Residence Transit Factors				
At Least 1 Stop within 1/4 mile (N)	0.78	0.97	0.96	0.98
Transit Line Stops within 1/4 mile (N)	30.83	91.45	88.92	93.51
Distance to Light Rail Station (Miles)	6.39	0.33	0.33	0.33
Near-Residence Built Environment (within 1/4 mile)				
Intersections (N)	40.53	36.60	37.16	36.15
Employment, Total (N)	815	2,485	2,307	2,631
Population Density and Employment Access Measures				
Population Density (log)	9.05	9.81	9.86	9.77
Employment Access (standardized)	0.44	1.43	1.49	1.39

6.3 Results: MNL Analysis of the Vehicle Ownership *(NTAS and CHTS samples)*

We conducted multinomial (MNL) regression analysis to assess factors associated with household car ownership for three samples: the county-wide combined NTAS/CHTS sample (8,602), the combined NTAS/CHTS sample in the NTAS study area (696), and the NTAS sample (383). These models assess the association of demographic, household, and near-residence built environment factors with household car ownership, and will provide the basis for generating ENV and SBC factors which will be used as independent variables for regression models of travel outcomes for each of these samples in the Section 6.4.

The MNL models estimated three equations: the probability that a household will own 1 vehicle versus no vehicle, the probability that a household will own 2 vehicles versus no vehicle, and the probability that a household will own 3 or more vehicles versus no vehicle. As expected, models with the county-wide sample (Table 6.2) tended to have more significant variables given its larger sample size compared to the smaller samples in the NTAS study area (Tables 6.3 and 6.4).

Having more household members was generally associated with higher vehicle ownership, but the effect was stronger for workers than non-workers, which includes children. Households residing in single family housing had a higher probability of vehicle ownership compared households in other housing types (the reference category), and households with higher levels of annual income had a higher probability of vehicle ownership compared to lower income groups (the reference category). Although racial group distinctions were largely not significant in models based on the smaller samples in the NTAS study area (Tables 6.3 and 6.4), models with the countywide sample suggest that households with a Hispanic or Black main respondent were associated with a lower probability of vehicle ownership relative to households with a White main respondent (the omitted category). Households with a main respondent with a higher level of educational attainment were generally associated with a higher probability of vehicle ownership. Greater nearby residential land uses were associated with a higher probability of vehicle ownership, and higher population density and employment access were associated with a lower probability of vehicle ownership. For the countywide sample, having more nearby transit service and living farther from a rail transit station were associated with a lower probability of vehicle ownership.

We also specified a binary logistic regression which modeled the probability that a household will own 1 or more vehicles versus no vehicle (Tables 6.5). As expected, the model with the countywide sample tended to have more significant variables compared to the smaller samples in the NTAS study area. The signs and significance of variables in the binary regression were largely consistent with the patterns in the MNL models.

Table 6.2 Multinomial Logit Model of Vehicle Ownership, LA County (CHTS & NTAS samples)

Independent Variables	1 Vehicle		2 Vehicles		3+ Vehicles	
	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
Intercept	2.92	***	0.42		-3.02	***
Household Characteristics						
Household Workers (N)	0.77	***	1.99	***	2.93	***
Household Non-workers (N)	0.15	**	0.82	***	1.10	***
Housing Type						
Single Family Residential (1/0)	0.52	***	1.41	***	2.22	***
Annual Household Income						
$35,000-$74,999 (1/0)	1.37	***	2.29	***	2.65	***
$75,000-$99,999 (1/0)	1.73	***	3.10	***	3.33	***
$100,000 or higher (1/0)	1.48	***	3.31	***	3.94	***
Race, Main Respondent						
Hispanic or Latino (1/0)	-0.31	*	-0.71	***	-0.86	***
Black or African-American (1/0)	-0.64	***	-0.88	***	-0.68	**
Asian or Pacific Islander (1/0)	0.19		0.19		0.35	
Other (1/0)	-0.53		-0.23		-0.02	
Educational Attainment, Main Respondent						
High School or Equivalent (1/0)	0.21		0.67	***	0.92	***
Associate's Degree (1/0)	0.79	***	1.32	***	1.55	***
Bachelor's Degree (1/0)	0.94	***	1.44	***	1.26	***
Graduate Degree (1/0)	1.20	***	1.59	***	1.36	***
Near-Residence Land Use (within 1/4 mile)						
Residential (All) (%)	0.80	*	0.58		1.16	*
Commercial (All) (%)	-0.09		-1.21		-1.38	
Near-Residence Built Environment (within 1/4 mile)						
Intersections (/100) (N)	0.00		0.00		0.01	*
Population Density and Employment Access Measures						
Population Density (log)	-0.31	***	-0.39	***	-0.49	***
Employment Access (standardized)	-0.37	***	-0.69	***	-0.83	***
Near-Residence Transit Factors						
Transit Line Stops within 1/4 mile (/100) (N)	-0.71	**	-0.84	**	-0.96	***
Distance to Light Rail Station (Miles)	-0.03	*	-0.05	***	-0.06	***

n = 7,545; 0 vehicles is the reference category

Significance: * p < .05. ** p < .01. *** p < .001.

Table 6.3 Multinomial Logit Model of Vehicle Ownership, NTAS Study Area (CHTS & NTAS)

Independent Variables	1 Vehicle		2 Vehicles		3+ Vehicles	
	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
Intercept	3.40		-2.05		-6.06	
Household Characteristics						
Household Workers (N)	0.75	**	2.11	***	2.63	***
Household Non-workers (N)	-0.14		0.68	***	1.04	***
Housing Type						
Single Family Residential (1/0)	-0.40		0.69		1.19	
Annual Household Income						
$35,000-$74,999 (1/0)	1.36	***	2.06	***	1.88	*
$75,000-$99,999 (1/0)	1.59	**	2.60	***	2.38	*
$100,000 or higher (1/0)	1.02		2.34	***	2.58	*
Race, Main Respondent						
Hispanic or Latino (1/0)	0.29		-0.21		-1.41	
Black or African-American (1/0)	-0.23		-0.47		-32.66	
Asian or Pacific Islander (1/0)	0.26		0.14		-0.40	
Other (1/0)	-1.32	*	-1.55		-0.98	
Educational Attainment, Main Respondent						
High School or Equivalent (1/0)	0.27		0.95		1.96	
Associate's Degree (1/0)	1.27	*	1.74	*	1.79	
Bachelor's Degree (1/0)	0.96		1.42		0.65	
Graduate Degree (1/0)	1.77	**	2.29	**	1.78	
Near-Residence Land Use (within 1/4 mile)						
Residential (All) (%)	0.71		-0.84		-0.53	
Commercial (All) (%)	-2.05		-3.94		-4.10	
Near-Residence Built Environment (within 1/4 mile)						
Intersections (/100) (N)	-0.01		0.00		0.00	
Population Density and Employment Access Measures						
Population Density (log)	-0.52	**	-0.42		-0.06	
Employment Access (standardized)	-0.14		-0.38		-0.35	
Near-Residence Transit Factors						
Transit Line Stops within 1/4 mile (/100) (N)	0.69		1.29		-0.27	
Distance to Light Rail Station (Miles)	1.80		3.79	**	1.54	

n = 600; 0 vehicles is the reference category

Significance: * p < .05. ** p < .01. *** p < .001.

Table 6.4 Multinomial Logit Model of Vehicle Ownership: NTAS Sample

Independent Variables	1 Vehicle		2 Vehicles		3+ Vehicles	
	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
Intercept	24.19	*	16.00		-6.75	
Household Characteristics						
Household Workers (N)	0.98	*	2.67	***	3.26	***
Household Non-workers (N)	0.37		1.93	***	3.14	***
Housing Type						
Single Family Residential (1/0)	-1.70	*	-0.35		0.86	
Annual Household Income						
$35,000-$74,999 (1/0)	2.26	***	2.80	***	1.85	
$75,000-$99,999 (1/0)	1.71	*	2.62	**	2.08	
$100,000 or higher (1/0)	2.67	*	3.60	**	1.69	
Race, Main Respondent						
Hispanic or Latino (1/0)	0.83		0.66		-3.91	
Black or African-American (1/0)	-1.26		-0.23		-42.07	
Asian or Pacific Islander (1/0)	-0.07		-0.09		0.51	
Other (1/0)	-1.38	*	-1.92		-0.93	
Educational Attainment, Main Respondent						
High School or Equivalent (1/0)	2.67		6.02	**	8.07	**
Associate's Degree (1/0)	1.41		3.83	*	3.87	
Bachelor's Degree (1/0)	0.77		3.54	*	0.75	
Graduate Degree (1/0)	1.89		5.24	**	2.54	
Near-Residence Land Use (within 1/4 mile)						
Residential (All) (%)	1.97		-2.53		-1.31	
Commercial (All) (%)	-4.45		-9.62	*	-7.14	
Near-Residence Built Environment (within 1/4 mile)						
Intersections (/100) (N)	-0.02		-0.02		0.01	
Population Density and Employment Access Measures						
Population Density (log)	-0.87	*	-0.59		1.94	
Employment Access (standardized)	0.27		-0.45		-5.87	**
Near-Residence Transit Factors						
Transit Line Stops within 1/4 mile (/100) (N)	-17.40		-16.78		-18.42	
Distance to Light Rail Station (Miles)	2.26		5.25	*	8.38	

n = 350; 0 vehicles is the reference category

Significance: * p < .05. ** p < .01. *** p < .001.

Table 6.5 Binary Logit Model of Vehicle Ownership (1 or more vehicles vs. no vehicle)

Independent Variables	Model 1 CHTS/NTAS LA County		Model 2 CHTS/NTAS NTAS Study Area		Model 3 NTAS	
	Coefficient	Sig.	Coefficien	Sig.	Coefficien	Sig.
Intercept	2.86	***	2.67		21.94	
Household Characteristics						
Household Workers (N)	1.11	***	1.08	***	1.34	**
Household Non-workers (N)	0.35	***	0.12		0.73	
Housing Type						
Single Family Residential (1/0)	0.78	***	-0.09		-1.45	*
Annual Household Income						
$35,000-$74,999 (1/0)	1.58	***	1.47	***	2.35	***
$75,000-$99,999 (1/0)	2.10	***	1.74	**	1.86	**
$100,000 or higher (1/0)	2.17	***	1.37	*	2.89	*
Race, Main Respondent						
Hispanic or Latino (1/0)	-0.42	**	0.15		0.80	
Black or African-American (1/0)	-0.69	***	-0.28		-1.21	
Asian or Pacific Islander (1/0)	0.20		0.23		-0.08	
Other (1/0)	-0.47		-1.36	*	-1.47	*
Educational Attainment, Main Respondent						
High School or Equivalent (1/0)	0.34	*	0.51		3.22	*
Associate's Degree (1/0)	0.94	***	1.44	**	1.75	
Bachelor's Degree (1/0)	1.06	***	1.12	*	1.12	
Graduate Degree (1/0)	1.30	***	1.93	***	2.28	
Near-Residence Land Use (within 1/4 mile)						
Residential (All) (%)	0.75	*	0.42		1.34	
Commercial (All) (%)	-0.30		-2.36		-5.25	
Near-Residence Built Environment (within 1/4 mile)						
Intersections (/100) (N)	0.00		0.00		-0.02	
Population Density and Employment Access Measures						
Population Density (log)	-0.32	***	-0.50	*	-0.82	*
Employment Access (standardized)	-0.44	***	-0.19		0.13	
Near-Residence Transit Factors						
Transit Line Stops within 1/4 mile (/100) (N)	-0.76	**	0.86		-15.80	***
Distance to Light Rail Station (Miles)	-0.03	**	2.07		2.41	
Pseudo R-Square	0.37		0.38		0.29	
N	7,545		635		350	

Note: 0 vehicles is the reference category

Significance: * p < .05. ** p < .01. *** p < .001.

6.4 Results: Factors Associated with Key Travel Outcomes *(NTAS and CHTS samples)*

Bivariate analyses suggest differences in travel patterns associated with residing in areas with different built environment, land use, and transit access characteristics (Table 6.6). Households in the countywide sample (CHTS/NTAS) in the highest quartile of residential land uses (i.e., households living in areas with the highest percentage of nearby residential use) had significantly lower rates of walking and transit travel and significantly higher rates of passenger vehicle travel and VMT (compared to other participating households) (Table 6.5). Inversely, households living in the highest quartile of commercial use, population density, employment access, and transit access had significantly higher rates of walking and transit travel and significantly lower rates of passenger vehicle travel and VMT. Participating households which lived within 1.5 miles of a rail station had significantly higher rates of walking and transit travel compared to other participating households, and households which lived within 2.0 miles of a rail station had significantly lower rates of passenger vehicle VMT.

We conducted multivariate analysis to better understand the relative influence of demographic, household, built environment, land use, and transit access characteristics on three categories of travel: walking travel (Tables 6.7 & 6.8), transit travel (Tables 6.9 & 6.10), and household VMT (Table 6.11). For each category, we used two modeling approaches, one including ENV and SBC factors as independent variables (without the number household vehicles) and one excluding these factors (and including the number household vehicles). The first approach (with the ENV and SBC factors generated from the vehicle choice models) assumes that the near-residence built environment, land use, and transit access characteristics influence travel outcomes by first influencing a household's choice of vehicle ownership. The second approach assumes that these near-residence characteristics influence travel outcomes more directly. As discussed below, patterns between the two approaches for each travel category are largely consistent.

Regression results for walking travel for the countywide sample (Models 1 and 4 in Tables 6.7 and 6.8) suggest that having more household members was associated with more walking travel (more walking trips and a higher probability of at least one walking trip), and that households residing in a single family residence and those with higher annual income were associated with less walking travel. Households with a main respondent who was Hispanic was associated with more walking trips; households with a main respondent with higher educational attainment was associated with fewer walking trips. In models without correction factors and including households with and without a vehicle (Table 6.8), more household vehicles were associated with less walking behavior. Although near-residence population density did not have a significant influence on walking behavior, employment accessibility was associated with more walking travel. Households in areas with the highest transit service level and those within 0.5 miles of a rail transit station had a higher probability of at least one walking trip; those with the highest transit service and those within 1.0 miles of a rail transit station were associated with more walking trips. For the combined CHTS/NTAS sample in the NTAS study area, living within 0.5 miles of a rail transit station was associated with a higher probability of at least one walking trip, but the level of overall nearby transit service was not significant. All of the socio-psychological constructs available for the mail respondents of households in the NTAS sample were significantly related to walking behavior. Participants who

strongly agreed there were plenty of amenities (shopping, restaurants, entertainment, etc.) within walking distance and those with more positive transit attitudes were associated with more walking. Those with stronger car attachment were associated with less walking.

Household with more workers and non-workers were associated with more transit travel (more transit trips and a higher probability of at least one transit trip) (Tables 6.9 and 6.10). For the countywide sample, households with a main respondent who was Hispanic or Black were associated with more transit trips; households with a main respondent with higher educational attainment were associated with fewer transit trips. In models without correction factors (Table 6.10), more household vehicles were associated with less transit ridership. Employment accessibility was associated with more transit travel for most of the models using the countywide sample. In models using the countywide sample, households within 1.5 miles of a rail transit station were more likely to make a transit trip and had more daily transit trips, and this relationship was strongest for households within 0.5 miles of a rail transit station. For the NTAS sample, households with a main respondent with more positive transit attitudes were associated with more transit ridership and those with stronger car attachment were associated with less transit ridership.

Models explained about 10-22% of the variance in VMT (Table 6.11). For the countywide sample, more household workers, higher household income, and higher educational attainment were associated with higher daily VMT. Households with a main respondent who was Hispanic were associated with more VMT (Models 1 and 2), and more household vehicles were associated with higher VMT (Model 1). Population density, employment access, and higher levels of transit service were associated with lower VMT. For the NTAS sample, households with a main respondent with stronger car attachment were associated with more VMT.

Table 6.6 Travel Outcomes by Near-Residence Built Environment Characteristics, Transit Access, and Study Sample, LA County (CHTS & NTAS)

	N	At Least 1 Walking Trip	Number of Walking Vehicle Trips	At Least 1 Transit Trip	Number of Transit Trips	At Least 1 Passenger Vehicle Trip	Number of Passenger Vehicle Trips	Household Vehicle Miles Traveled
All Survey Households	8,602	0.26	1.37	0.09	0.40	0.78	6.25	32.92
Residential Land Use (within 1/4 mile)								
Very Low (Quartile 1)	2,155	0.28	1.39	0.11 *	0.45	0.74 ***	5.40 ***	32.67
Low (Quartile 2)	2,150	0.27	1.46	0.09	0.42	0.76	5.94	30.91 *
Moderate (Quartile 3)	2,148	0.27	1.55 *	0.10	0.42	0.79	6.32	32.67
Highest (Quartile 4)	2,149	0.22 ***	1.07 ***	0.07 ***	0.30 **	0.83 ***	7.32 ***	35.43 ***
Commercial Land Use (within 1/4 mile)								
Very Low (Quartile 1)	2,159	0.18 ***	0.77 ***	0.04 ***	0.14 ***	0.85 ***	7.59 ***	42.22 ***
Low (Quartile 2)	2,146	0.23 **	1.20 *	0.07 **	0.33 *	0.81 ***	6.81 ***	34.76 *
Moderate (Quartile 3)	2,148	0.30 ***	1.72 ***	0.12 ***	0.55 ***	0.75 **	5.67 ***	28.18 ***
Highest (Quartile 4)	2,149	0.33 ***	1.78 ***	0.14 ***	0.58 ***	0.71 ***	4.91 ***	26.47 ***
Population Density (blockgroup)								
Very Low (Quartile 1)	2,154	0.18 ***	0.76 ***	0.04 ***	0.15 ***	0.83 ***	7.15 ***	42.57 ***
Low (Quartile 2)	2,147	0.20 ***	0.92 ***	0.05 ***	0.21 ***	0.84 ***	6.96 ***	36.84 ***
Moderate (Quartile 3)	2,151	0.27	1.32	0.09	0.35	0.77	6.26	30.27 **
Highest (Quartile 4)	2,150	0.39 ***	2.48 ***	0.20 ***	0.89 ***	0.68 ***	4.62 ***	21.99 ***
Employment Access								
Very Low (Quartile 1)	2,151	0.17 ***	0.73 ***	0.04 ***	0.14 ***	0.82 ***	7.19 ***	45.35 ***
Low (Quartile 2)	2,150	0.22 ***	1.05 ***	0.06 ***	0.23 ***	0.82 ***	6.91 ***	34.10
Moderate (Quartile 3)	2,151	0.26	1.27	0.09	0.38	0.79	6.19	29.75 ***
Highest (Quartile 4)	2,150	0.40 ***	2.40 ***	0.19 ***	0.85 ***	0.69 ***	4.69 ***	22.48 ***
Transit Level of Service (within 1/4 mi.)								
Very Low (Quartile 1)	2,282	0.17 ***	0.67 ***	0.03 ***	0.11 ***	0.84 ***	7.48 ***	43.58 ***
Low (Quartile 2)	2,114	0.22 ***	1.04 ***	0.06 ***	0.24 ***	0.81 ***	6.83 ***	34.51
Moderate (Quartile 3)	2,120	0.28	1.56 *	0.10	0.49 *	0.77	5.93 *	29.56 ***
Highest (Quartile 4)	2,086	0.38 ***	2.26 ***	0.18 ***	0.79 ***	0.68 ***	4.62 ***	23.06 ***
Distance to Light Rail Station								
Distance from Rail 0 - 0.5 miles	938	0.40 ***	2.34 ***	0.23 ***	0.93 ***	0.66 ***	4.15 ***	24.07 ***
Distance from Rail 0.5 – 1.0 miles	821	0.36 ***	2.22 ***	0.18 ***	0.81 ***	0.72 ***	5.27 ***	23.45 ***
Distance from Rail 1.0 – 1.5 miles	757	0.33 ***	2.00 ***	0.15 ***	0.69 ***	0.77	6.25	27.31 ***
Distance from Rail 1.5 - 2.0 miles	588	0.30	1.54	0.09	0.46	0.77	6.54	28.94 **
Distance from Rail 2.0 – 2.5 miles	522	0.25	1.22	0.07 *	0.30	0.82 *	6.13	29.91
Distance from Rail 2.5 – 3.0 miles	492	0.23	1.10 *	0.07 *	0.27 *	0.79	6.32	31.22
Distance from Rail over 3.0 miles	4,484	0.20 ***	0.93 ***	0.05 ***	0.18 ***	0.81 ***	6.83 ***	38.51 ***
Samples within NTAS Study Area								
CHTS/NTAS	696	0.41 ***	2.29 ***	0.24 ***	0.95 ***	0.67 ***	3.83 ***	24.07 ***
CHTS	313	0.47 ***	3.11 ***	0.24 ***	1.01 ***	0.62 ***	4.24 ***	23.45 ***
NTAS	383	0.37 ***	1.61	0.24 ***	0.89 ***	0.70 ***	3.50 ***	27.31 ***

Significance: * p < .05. ** p < .01. *** p < .001. Denotes the difference in means between the subgroup and all other participants is significant (unpaired t-test).

Table 6.7 Regression Results for Walking Travel (*with* ENV and SBC Factors)

Independent Variables	Model 1 Probability of At Least 1 Walking Trip		Model 2 Probability of At Least 1 Walking Trip		Model 3 Probability of At Least 1 Walking Trip		Model 4 Number of Walking Trips		Model 5 Number of Walking Trips		Model 6 Number of Walking Trips	
	CHTS/NTAS LA County		CHTS/NTAS NTAS Study Area		NTAS		CHTS/NTAS LA County		CHTS/NTAS NTAS Study Area		NTAS	
	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
Intercept	-2.64	***	-1.51		0.66		0.98	*	1.24		2.69	
Household Characteristics												
Household Workers (N)	0.24		0.65		1.57	***	0.34	*	1.01		1.48	***
Household Non-workers (N)	0.26	***	0.32		1.14	**	0.51	***	0.59	*	1.07	***
Housing Type												
Single Family Residential (1/0)	-0.48	***	-0.05		0.01		-0.68	***	-0.55		0.02	
Household Vehicle Ownership												
Household Vehicles (N)												
Expected Vehicle (N)	0.38		-0.13		-2.39	*	0.18		0.48		-1.81	*
Annual Household Income												
$35,000-$74,999 (1/0)	-0.48	***	0.11		0.60		-1.04	***	-0.26		0.43	
$75,000-$99,999 (1/0)	-0.54	**	-0.20		0.58		-1.02	***	-0.74		0.37	
$100,000 or higher (1/0)	-0.48	*	-0.36		0.35		-0.97	***	-0.69		0.53	
Race, Main Respondent												
Hispanic or Latino (1/0)	0.08		-0.18		-0.57		0.30	**	0.59		0.47	
Black or African-American (1/0)	-0.18		-0.78		-1.89		-0.06		-0.69		-1.94	*
Asian or Pacific Islander (1/0)	-0.18		-0.36		-0.44		-0.27	*	-0.34		-0.08	
Other (1/0)	-0.09		-0.19		0.22		-0.16		0.16		0.50	
Educational Attainment, Main Respondent												
High School or Equivalent (1/0)	-0.33	*	0.30		2.16		-0.71	***	0.36		1.49	
Associate's Degree (1/0)	-0.25		1.02		1.98		-0.88	***	0.22		1.20	
Bachelor's Degree (1/0)	-0.08		0.72		1.94		-0.79	***	-0.23		1.08	
Graduate Degree (1/0)	0.15		0.84		2.49	*	-0.58	**	-0.12		1.31	
Near-Residence Land Use (within 1/4 mile)												
Residential (All) (%)	0.07		0.69		1.03		0.10		0.40		1.05	
Commercial (All) (%)	0.58		2.66		0.52		0.42		1.82		-0.35	
Near-Residence Built Environment (within 1/4 mile)												
Intersections (/100) (N)	-0.09		-0.49		-0.47		-0.22		-0.65		-0.74	
Population Density and Employment Access Measures												
Population Density (log)	0.05		-0.19		-0.46		0.05		-0.24		-0.38	
Employment Access (standardized)	0.33	***	0.31		0.34		0.29	***	0.65	*	0.63	*
Near-Residence Transit Factors												
Transit Service Level												
Low Transit Service (1/0) (Quartile 2)	0.07		0.18		0.88		0.01		0.15		0.50	
Moderate Transit Service (1/0) (Quartile 3)	0.15		-0.09		0.55		0.19		-0.41		0.01	
Highest Transit Service (1/0) (Quartile 4)	0.29	**	-0.27		-0.41		0.30	**	-0.71		-0.51	
Distance to Light Rail Station												
Distance from Rail 0 - 0.25 miles (1/0)			0.58	*	0.29				0.47		-0.16	
Distance from Rail 0 - 0.5 miles (1/0)	0.25	*					0.56	***				
Distance from Rail 0.5 - 1.0 miles (1/0)	0.21						0.45	***				
Distance from Rail 1.0 - 1.5 miles (1/0)	0.15						0.28	*				
Distance from Rail 1.5 - 2.0 miles (1/0)	0.19						0.10					
Distance from Rail 2.0 - 2.5 miles (1/0)	0.09						0.03					
Flags												
NTAS Study Flag (1/0)			-0.02						-0.06			
Selection Bias Correction Factor	0.04		-0.77		0.03		1.84	***	-0.44		0.02	
Socio-Psychological Constructs												
Perceived neighborhood amenities					0.46	**					0.29	*
Perceived need for a car					-0.46	**					-0.48	**
Transit attitudes and transit social norms					0.56	***					0.58	***
Adjusted R-Square							0.14		0.11		0.19	
N	6,931		518		286		6,931		518		286	

Significance: * p < .05. ** p < .01. *** p < .001.

Table 6.8 Regression Results for Walking Travel (*without* ENV and SBC Factors)

Independent Variables	Model 1 Probability of At Least 1 Walking Trip		Model 2 Probability of At Least 1 Walking Trip		Model 3 Probability of At Least 1 Walking Trip		Model 4 Number of Walking Trips		Model 5 Number of Walking Trips		Model 6 Number of Walking Trips	
	CHTS/NTAS LA County		CHTS/NTAS NTAS Study Area		NTAS		CHTS/NTAS LA County		CHTS/NTAS NTAS Study Area		NTAS	
	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
Intercept	-1.76	***	-0.49		-0.41		1.37	***	3.42		2.25	
Household Characteristics												
Household Workers (N)	0.59	***	0.58	***	0.86	**	0.91	***	1.39	***	0.66	**
Household Non-workers (N)	0.38	***	0.38	***	0.53	**	0.77	***	1.10	***	0.62	***
Housing Type												
Single Family Residential (1/0)	-0.19	**	0.20		0.01		-0.35	***	-0.37		-0.12	
Household Vehicle Ownership												
Household Vehicles (N)	-0.57	***	-0.93	***	-0.87	**	-0.82	***	-1.61	***	-0.50	*
Expected Vehicle (N)												
Annual Household Income												
$35,000-$74,999 (1/0)	-0.39	***	-0.13		-0.19		-0.67	***	0.04		-0.48	
$75,000-$99,999 (1/0)	-0.38	***	-0.25		0.04		-0.57	***	-0.26		-0.38	
$100,000 or higher (1/0)	-0.18		-0.37		-0.46		-0.38	**	-0.10		-0.38	
Race, Main Respondent												
Hispanic or Latino (1/0)	0.08		-0.15		-0.31		0.28	**	0.41		0.82	
Black or African-American (1/0)	-0.20		-1.05	*	-1.47		-0.20		-1.66	*	-1.52	*
Asian or Pacific Islander (1/0)	-0.15		-0.31		-0.20		-0.24		-0.40		0.22	
Other (1/0)	-0.01		0.06		0.43		-0.20		0.47		0.97	
Educational Attainment, Main Respondent												
High School or Equivalent (1/0)	-0.23		0.53		0.64		-0.78	***	-0.02		0.12	
Associate's Degree (1/0)	-0.05		0.76		1.64		-0.71	***	-0.65		0.82	
Bachelor's Degree (1/0)	0.02		0.63		1.59		-0.72	***	-0.98		0.97	
Graduate Degree (1/0)	0.25		0.76		1.85		-0.52	**	-0.71		0.95	
Near-Residence Land Use (within 1/4 mile)												
Residential (All) (%)	0.14		0.03		1.34		0.33		-0.76		1.56	
Commercial (All) (%)	0.54		1.89		1.64		0.91		0.82		1.37	
Near-Residence Built Environment (within 1/4 mile)												
Intersections (/100) (N)	-0.10		-0.22		0.22		-0.32		-0.35		0.01	
Population Density and Employment Access Measures												
Population Density (log)	0.03		-0.09		-0.40		0.00		-0.08		-0.37	
Employment Access (standardized)	0.29	***	0.36	*	0.48		0.28	***	0.65	**	0.61	*
Near-Residence Transit Factors												
Transit Service Level												
Low Transit Service (1/0) (Quartile 2)	0.02		0.18		0.86	*	-0.14		-0.06		0.52	
Moderate Transit Service (1/0) (Quartile 3)	0.12		-0.08		0.65		0.07		-0.51		0.48	
Highest Transit Service (1/0) (Quartile 4)	0.30	**	-0.23		-0.10		0.27	*	-0.72		-0.13	
Distance to Light Rail Station												
Distance from Rail 0 - 0.25 miles (1/0)			0.58	**	0.27				0.54		-0.12	
Distance from Rail 0 - 0.5 miles (1/0)	0.22	*					0.46	***				
Distance from Rail 0.5 - 1.0 miles (1/0)	0.20						0.38	**				
Distance from Rail 1.0 - 1.5 miles (1/0)	0.08						0.21					
Distance from Rail 1.5 - 2.0 miles (1/0)	0.15						0.12					
Distance from Rail 2.0 - 2.5 miles (1/0)	0.00						-0.09					
Flags												
NTAS Study Flag (1/0)			-0.38						-0.75			
Selection Bias Correction Factor												
Socio-Psychological Constructs												
Perceived neighborhood amenities					0.35	*					0.31	*
Perceived need for a car					-0.39	**					-0.46	**
Transit attitudes and transit social norms					0.59	***					0.67	***
Adjusted R-Square							0.20		0.24		0.18	
N	7545		635		336		7,545		635		336	

Significance: * p < .05. ** p < .01. *** p < .001.

Table 6.9 Regression Results for Transit Travel (*with* ENV and SBC Factors)

Independent Variables	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	Probability of At Least 1 Bus/Train Trip		Probability of At Least 1 Bus/Train Trip		Probability of At Least 1 Bus/Train Trip		Number of Bus/Train Trips		Number of Bus/Train Trips		Number of Bus/Train Trips	
	CHTS/NTAS LA County		CHTS/NTAS NTAS Study Area		NTAS		CHTS/NTAS LA County		CHTS/NTAS NTAS Study Area		NTAS	
	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
Intercept	-3.20	***	-3.03		-6.73		0.55	**	0.51		1.58	
Household Characteristics												
Household Workers (N)	0.71	***	1.26	*	1.57	*	0.14	*	0.63	*	0.64	***
Household Non-workers (N)	0.38	***	0.66	*	0.97		0.10	***	0.33	*	0.35	*
Housing Type												
Single Family Residential (1/0)	-0.24		0.23		0.53		-0.17	**	0.00		0.22	
Household Vehicle Ownership												
Household Vehicles (N)												
Expected Vehicle (N)	-0.74		-2.68		-3.12		0.02		-0.92		-1.16	**
Annual Household Income												
$35,000-$74,999 (1/0)	-0.37		0.34		1.04		-0.31	***	-0.17		-0.05	
$75,000-$99,999 (1/0)	-0.80	**	0.04		0.74		-0.38	***	-0.38		-0.10	
$100,000 or higher (1/0)	-0.48		0.18		0.73		-0.37	***	-0.32		-0.22	
Race, Main Respondent												
Hispanic or Latino (1/0)	0.34	*	-0.05		0.99		0.12	**	0.10		0.02	
Black or African-American (1/0)	0.80	***	0.20		0.07		0.23	***	0.37		0.21	
Asian or Pacific Islander (1/0)	0.28		-0.24		0.16		-0.01		-0.16		-0.01	
Other (1/0)	-0.70		-1.35		-2.24		-0.09		-0.22		-0.22	
Educational Attainment, Main Respondent												
High School or Equivalent (1/0)	-0.47	*	-0.01		-1.93		-0.42	***	-0.16		-1.74	*
Associate's Degree (1/0)	-0.25		0.40		-0.33		-0.44	***	-0.07		-1.51	**
Bachelor's Degree (1/0)	-0.56	*	-0.31		-1.51		-0.49	***	-0.43		-1.97	***
Graduate Degree (1/0)	-0.41		-0.25		-1.18		-0.47	***	-0.48		-2.04	***
Near-Residence Land Use (within 1/4 mile)												
Residential (All) (%)	-0.20		-1.92		-2.27		0.01		-0.65		-0.88	
Commercial (All) (%)	-0.04		-2.02		-2.85		-0.02		-0.52		-0.97	
Near-Residence Built Environment (within 1/4 mile)												
Intersections (/100) (N)	-0.54	*	2.61	**	3.80	*	-0.25	***	0.69		0.67	
Population Density and Employment Access Measures												
Population Density (log)	0.08		0.30		0.76		0.02		0.09		0.22	
Employment Access (standardized)	0.15		-0.12		-1.05		0.06	*	0.10		-0.17	
Near-Residence Transit Factors												
Transit Service Level												
Low Transit Service (1/0) (Quartile 2)	0.08		-0.14		-0.24		-0.03		-0.03		-0.05	
Moderate Transit Service (1/0) (Quartile 3)	0.28		0.42		0.93		0.08		0.05		0.12	
Highest Transit Service (1/0) (Quartile 4)	0.35		0.25		1.23		0.08		-0.21		0.07	
Distance to Light Rail Station												
Distance from Rail 0 - 0.25 miles (1/0)			0.58		0.59				0.41	*	0.40	*
Distance from Rail 0 - 0.5 miles (1/0)	0.99	***					0.33	***				
Distance from Rail 0.5 - 1.0 miles (1/0)	0.74	***					0.22	***				
Distance from Rail 1.0 - 1.5 miles (1/0)	0.64	***					0.18	***				
Distance from Rail 1.5 - 2.0 miles (1/0)	0.12						0.04					
Distance from Rail 2.0 - 2.5 miles (1/0)	0.23						0.03					
Flags												
NTAS Study Flag (1/0)			0.24						0.19			
Selection Bias Correction Factor	1.33	*	2.34		1.99		0.61	***	1.41		1.63	*
Socio-Psychological Constructs												
Perceived neighborhood amenities					0.11						0.07	
Perceived need for a car					-0.86	***					-0.39	***
Transit attitudes and transit social norms					1.02	***					0.29	***
Adjusted R-Square							0.09		0.09		0.30	
N	6,931		518		286		6,931		518		286	

Significance: * p < .05. ** p < .01. *** p < .001.

Table 6.10 Regression Results for Transit Travel (*without* ENV and SBC Factors)

Independent Variables	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	Probability of At Least 1 Bus/Train Trip		Probability of At Least 1 Bus/Train Trip		Probability of At Least 1 Bus/Train Trip		Number of Bus/Train Trips		Number of Bus/Train Trips		Number of Bus/Train Trips	
	CHTS/NTAS LA County		CHTS/NTAS NTAS Study Area		NTAS		CHTS/NTAS LA County		CHTS/NTAS NTAS Study Area		NTAS	
	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
Intercept	-2.77	***	-2.59		-4.46		0.72	***	1.10		0.82	
Household Characteristics												
Household Workers (N)	0.82	***	0.64	**	1.06	**	0.34	***	0.65	***	0.60	***
Household Non-workers (N)	0.33	***	0.23	*	0.43	*	0.18	***	0.29	***	0.31	**
Housing Type												
Single Family Residential (1/0)	-0.02		0.37		0.25		-0.03		0.21		0.10	
Household Vehicle Ownership												
Household Vehicles (N)	-1.12	***	-1.53	***	-1.58	***	-0.35	***	-0.95	***	-0.69	***
Expected Vehicle (N)												
Annual Household Income												
$35,000-$74,999 (1/0)	-0.40	***	0.02		0.12		-0.28	***	-0.10		-0.07	
$75,000-$99,999 (1/0)	-0.78	***	-0.39		-0.15		-0.30	***	-0.32		-0.23	
$100,000 or higher (1/0)	-0.46	**	-0.65		-0.57		-0.24	***	-0.37		-0.48	
Race, Main Respondent												
Hispanic or Latino (1/0)	0.35	**	0.23		0.76		0.12	**	0.20		0.21	
Black or African-American (1/0)	0.57	***	-0.21		-0.20		0.22	***	-0.03		-0.22	
Asian or Pacific Islander (1/0)	0.29		0.12		0.74		0.00		-0.02		0.23	
Other (1/0)	0.11		0.13		1.11		0.00		0.37		0.80	*
Educational Attainment, Main Respondent												
High School or Equivalent (1/0)	-0.30		0.32		-1.43		-0.36	***	-0.05		-1.49	*
Associate's Degree (1/0)	0.03		-0.13		-1.29		-0.33	***	-0.39		-1.17	*
Bachelor's Degree (1/0)	-0.30		-0.40		-1.68		-0.43	***	-0.68	*	-1.40	**
Graduate Degree (1/0)	-0.21		-0.19		-1.53		-0.42	***	-0.61		-1.51	**
Near-Residence Land Use (within 1/4 mile)												
Residential (All) (%)	-0.54		-1.64		-0.66		-0.04		-1.64	*	-0.18	
Commercial (All) (%)	-0.02		-0.44		0.13		0.15		-0.83		0.10	
Near-Residence Built Environment (within 1/4 mile)												
Intersections (/100) (N)	-0.71	**	1.98	**	2.93	*	-0.33	***	0.31		0.71	
Population Density and Employment Access Measures												
Population Density (log)	0.09		0.19		0.38		0.02		0.13		0.13	
Employment Access (standardized)	0.17	*	0.13		-0.41		0.08	**	0.15		-0.12	
Near-Residence Transit Factors												
Transit Service Level												
Low Transit Service (1/0) (Quartile 2)	0.11		-0.02		-0.10		-0.09	*	-0.08		-0.03	
Moderate Transit Service (1/0) (Quartile 3)	0.31		0.20		0.57		0.04		-0.24		0.10	
Highest Transit Service (1/0) (Quartile 4)	0.43	*	0.00		0.66		0.09		-0.40		0.17	
Distance to Light Rail Station												
Distance from Rail 0 - 0.25 miles (1/0)			0.39		0.54				0.33	*	0.33	
Distance from Rail 0 - 0.5 miles (1/0)	0.76	***					0.33	***				
Distance from Rail 0.5 - 1.0 miles (1/0)	0.58	***					0.24	***				
Distance from Rail 1.0 - 1.5 miles (1/0)	0.43	**					0.14	*				
Distance from Rail 1.5 - 2.0 miles (1/0)	0.10						0.08					
Distance from Rail 2.0 - 2.5 miles (1/0)	0.00						-0.03					
Flags												
NTAS Study Flag (1/0)			0.16						-0.09			
Selection Bias Correction Factor												
Socio-Psychological Constructs												
Perceived neighborhood amenities					-0.14						0.04	
Perceived need for a car					-0.75	***					-0.39	***
Transit attitudes and transit social norms					0.82	***					0.30	***
Adjusted R-Square							0.15		0.21		0.29	
N	7545		635		336		7,545		635		336	

Significance: * p < .05. ** p < .01. *** p < .001.

Table 6.11 Regression Results for VMT (*with and without* ENV and SBC Factors)

Independent Variables	Model 1 Household VMT CHTS/NTAS LA County		Model 2 Household VMT CHTS/NTAS LA County		Model 3 Household VMT CHTS/NTAS NTAS Study Area		Model 4 Household VMT CHTS/NTAS NTAS Study Area		Model 5 Household VMT NTAS		Model 6 Household VMT NTAS	
	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
Intercept	13.85	**	4.53		-3.68		-9.56		1.25		-10.48	
Household Characteristics												
Household Workers (N)	8.94	***	8.68	***	6.30	**	8.97		7.12	*	3.59	
Household Non-workers (N)	1.84	***	1.44		0.25		0.34		0.66		-4.10	
Housing Type												
Single Family Residential (1/0)	-0.49		-1.50		5.19		7.46		2.04		-0.01	
Household Vehicle Ownership												
Household Vehicles (N)	7.11	***			14.07	***			9.01	**		
Expected Vehicle (N)			12.64	*			14.11				25.41	*
Annual Household Income												
$35,000-$74,999 (1/0)	6.97	***	7.68	***	1.88		4.73		0.96		-1.45	
$75,000-$99,999 (1/0)	7.81	***	7.91	**	6.90		9.10		9.76		6.43	
$100,000 or higher (1/0)	8.95	***	8.12	**	7.40		8.53		8.72		5.30	
Race, Main Respondent												
Hispanic or Latino (1/0)	2.60	*	2.97	*	2.86		4.72		-1.30		2.05	
Black or African-American (1/0)	1.97		1.53		1.72		0.18		7.42		16.47	
Asian or Pacific Islander (1/0)	-2.11		-2.37		-4.62		-4.95		-9.33		-9.98	
Other (1/0)	-2.95		-3.65		3.77		7.08		3.16		10.31	
Educational Attainment, Main Respondent												
High School or Equivalent (1/0)	0.60		0.74		-5.63		-6.15		-7.25		-19.57	
Associate's Degree (1/0)	5.35	**	6.39	*	2.48		5.01		2.68		-2.34	
Bachelor's Degree (1/0)	5.65	**	6.86	**	1.15		2.70		-2.23		-7.09	
Graduate Degree (1/0)	6.23	**	7.64	**	7.00		9.26		5.62		-0.52	
Near-Residence Land Use (within 1/4 mile)												
Residential (All) (%)	0.15		0.64		-7.80		-15.06		-12.76		-3.09	
Commercial (All) (%)	6.11		9.20		15.27		15.97		43.13		65.03	*
Near-Residence Built Environment (within 1/4 mile)												
Intersections (/100) (N)	-0.05		-0.11		4.57		3.95		0.47		6.16	
Population Density and Employment Access Measures												
Population Density (log)	-1.39	*	-1.50	*	0.41		0.91		0.88		0.15	
Employment Access (standardized)	-4.42	***	-4.61	***	-2.22		-2.84		-5.54		-4.12	
Near-Residence Transit Factors												
Transit Service Level												
Low Transit Service (1/0) (Quartile 2)	-3.50	**	-3.41	*	-0.43		-1.24		-0.24		-0.91	
Moderate Transit Service (1/0) (Quartile 3)	-4.57	***	-4.79	**	1.97		-0.45		1.71		2.28	
Highest Transit Service (1/0) (Quartile 4)	-4.46	**	-4.64	**	-1.09		-3.96		-4.48		-5.74	
Distance to Light Rail Station												
Distance from Rail 0 - 0.25 miles (1/0)					-9.04	**	-11.98	**	-7.49		-8.69	
Distance from Rail 0 - 0.5 miles (1/0)	3.22		3.05									
Distance from Rail 0.5 - 1.0 miles (1/0)	-0.60		-1.46									
Distance from Rail 1.0 - 1.5 miles (1/0)	-0.42		-1.07									
Distance from Rail 1.5 - 2.0 miles (1/0)	-0.62		-0.33									
Distance from Rail 2.0 - 2.5 miles (1/0)	-2.57		-3.21									
Flags												
NTAS Study Flag (1/0)					-1.65		-2.68				-18.76	
Selection Bias Correction Factor			-23.44	***			-16.16					
Socio-Psychological Constructs												
Perceived neighborhood amenities									-0.93		-1.29	
Perceived need for a car									5.35	**	5.97	**
Transit attitudes and transit social norms									-1.19		-1.17	
Adjusted R-Square	0.18		0.13		0.22		0.10		0.18		0.12	
N	7,502		6,888		634		517		336		286	

Significance: * p < .05. ** p < .01. *** p < .001.

7.0 References

1. Kimley-Horn and Associates I. Trip-Generation Rates for Urban Infill Land Uses in California Phase 1: Data Collection Methodology and Pilot Application. *Final Report to the California Department of Transportation. http://www.dot.ca.gov/newtech/researchreports/reports/2009/final_summary_report-calif._infill_trip-generation_rates_study_july_2009.pdf.* 2000.
2. National Cooperative Highway Research Program (NCHRP). Long-Distance and Rural Travel Transferable Parameters for Statewide Travel Forecasting Models. *NCHRP Report 735.* 2012.
3. Bamberg SI, Ajzen I, Schmidt P. Choice of travel mode in the theory of planned behavior: The roles of past behavior, habit, and reasoned action. *Basic and Applied Social Psychology.* 2003;25:175-188.
4. Hunecke M, Haustein S, Bohler S, Grischkat S. Attitude-Based Target Groups to Reduce the Ecological Impact of Daily Mobility Behavior. *Environment and Behavior.* 2008;42(1):3-43.
5. Arvidsson D, Kawakami N, Ohlsson H, Sundquist K. Physical activity and concordance between objective and perceived walkability. *Medicine and science in sports and exercise.* 2012;44(2):280-287.
6. Brown BB, Werner CM. Before and After a New Light Rail Stop: Resident Attitudes, Travel Behavior, and Obesity. *Journal of the American Planning Association.* 2008;75(1):5-12.
7. Joh K, Nguyen MT, Boarnet MG. Can Built and Social Environmental Factors Encourage Walking among Individuals with Negative Walking Attitudes? *Journal of Planning Education and Research.* 2012;32(2).
8. Van Acker V, Van Wee B, Witlox F. When Transport Geography Meets Social Psychology: Toward a Conceptual Model of Travel Behaviour. *Transport Reviews.* 2010;30(2):219-240.
9. Handy SL. Critical Assessment of the Literature on the Relationships among Transportation, Land Use and Physical Activity. Washington, DC: Transportation Research Board; 2005.
10. Anable J. 'Complacent Car Addicts' or 'Aspiring Environmentalists'? Identifying travel behaviour segments using attitude theory. *Transport Policy* 2005;12:65-78.
11. Cao XY, Mokhtarian PL, Handy SL. The relationship between the built environment and nonwork travel: A case study of Northern California. *Transportation Research Part A.* 2009;43(5):548-559.
12. Chatman DG. Residential choice, the built environment, and nonwork travel: evidence using new data and methods. *Environment and Planning A* 2009;41(5):1072-1089.
13. Bhat CR, Guo JY. A Comprehensive Analysis of Built Environment Characteristics on Household Residential Choice and Auto Ownership Levels. *Transportation Research Part B.* 2007;41(5):506-526.
14. Tertoolen G, Van Kreveld D, Verstraten ECH. Psychological resistance against attempts to reduce private car use. *Transportation Research A.* 1998;32:171-181.
15. Heath Y, Gifford R. Extending the Theory of Planned Behavior: Predicting the Use of Public Transportation. *Journal of Applied Social Psychology.* 2002;32(10):2154-2189.
16. Hauser J, Urban G. A Normative Methodology for Modeling Consumer Response to Innovation. *Operations Research.* 1977;25:579-619.

17. Poortinga W, Steg L, Vlek C. Values, Environmental Concern, and Environmental Behavior: A Study into Household Energy Use. *Environment & Behavior.* 2004;36:70-93.
18. Holtzclaw J, Clear R, Dittmar H, Goldstein D, Haas P. Location Efficiency: Neighborhood and Socio-Economic Characteristics Determine Auto Ownership and Use - Studies in Chicago, Los Angeles and San Francisco. *Transportation Planning and Technology.* 2002;25(1):1-27.
19. Hess DB, Ong PM. Traditional neighborhoods and automobile ownership. *Transportation Research Record.* 2002;1805:35-44.
20. Kitamura R, Akiyama T, Yamamoto T, Golob T. Accessibility in a metropolis: toward a better understanding of land use and travel. *Transportation Research Record.* 2001;1780:64-75.
21. Bento AM, Cropper ML, Mobarak AM, Vinha K. The impact of urban spatial structure on travel demand in the United States. *The Review of Economics and Statistics.* 2005;87(3):466-478.
22. Mannering F. Selectivity bias in models of discrete and continuous choice: an empirical analysis. *Transportation Research Record.* 1986;1085:58–62.
23. Zegras C. The Built Environment and Motor Vehicle Ownership and Use: Evidence from Santiago de Chile. *Urban Studies.* 2010;47(8):1793-1817.

Appendix A. Data Processing and Cleaning

Participating households returned hardcopy travel survey and diary materials in a postage-paid envelope. Survey responses were entered into the survey database by trained data entry staff, and the project manager conducted quality control to ensure that data entered into the database was consistent with the hardcopy materials submitted by households. Potential data quality concerns relating to completeness and reasonableness were reviewed by the project manager, and data quality control flags were entered into the database for use in data cleaning and generation of the final survey datasets. From the raw survey data, we constructed a household file, a person file, a trip file, and a vehicle file. At the closure of data collection we had received responses from 397 households. However, we eliminated 14 of these households because they did not report any travel data, which left 383 household records in the final dataset (Table 3.1).

Table 3.1 Record County for Final Survey Data Files

File	Records
Household	383
Person	529
Trip	2,434
Vehicles	386

Household travel surveys typically exclude data from households that do not meet a minimum threshold for the number of completed travel diaries relative to household size. For example, the 2009 NHTS excluded households in which less than 50% of adult household members completed the person interview. We did not apply such a criterion because of our low response rate, but we did record the number of unreturned travel diaries for each household in the final dataset. Table 3.2 presents a cross-tab of the number of missing travel diaries by the number expected, or the number of household members 16 years of age or older reported in the initial interest survey. Thirty-three of the 383 households were missing one travel diary, and most of these were 2-travel diary households. Just 8 households were missing 2 or 3 diaries, though naturally these occurred among the scarce larger households.

Table 3.2 Cross-tab of number of missing travel diaries by number of expected travel diaries.

HH members age 16+	Missing travel diaries				
	0	1	2	3	Total
1	226	0	—	—	226
2	100	30	0	—	130
3	8	2	5	0	15
4	6	1	0	2	9
5	1	1	0	1	3
Total	341	34	5	3	383

In summary, we performed the following checks for data quality, many of which were adapted from the 2000-2001 California Statewide Household Travel Survey.

1. Checked for missing person records. Compared the number of household members age 16 or over reported in the initial interest questionnaire to the number of received travel diaries for each household.
2. Checked for missing vehicle records. Compared the number of household vehicles reported in the initial interest questionnaire to the number of vehicles for which we received a vehicle mileage log.
3. Checked reported VMT. Flagged and set to missing VMT for each vehicle if not between 0 and 250, which eliminated two vehicles that had reported travel day mileages of 5,000 and 8,700. Checked to ensure that households with car trips had non-zero VMT.
4. Checked for potential unreported trips. Flagged persons who had no trips but did not indicate staying home all day. Flagged persons who indicated going to school or work on travel day but had no corresponding trips in the travel diary. Flagged households with positive VMT but no auto or carpool trips.
5. Checked sequence of departure and arrival times in travel diary. Flagged trips with negative travel time or activity durations. Corrected obvious AM/PM switches.
6. Checked for loop trips. Flagged trips with the same origin and destination.
7. Inspected travel diaries in which the person did not return home at the end of the day, but found nothing suspicious.

Appendix B. Supplemental Comparisons of Travel Patterns

This appendix reports the same comparisons as Section 4.0 between our NTAS sample with subsamples of NHTS and CHTS households, but it expands the NHTS and CHTS samples to include all households within ½ mile of an active MTA light rail or subway station at the time of the respective survey. That is, the NHTS and CHTS samples used in this appendix include households along the Green and Blue Lines, even though these areas were not included in the NTAS survey. This first criterion yields the largest subsample of households within easy walking distance of a rail transit station, with 1078 households, but the geographical coverage varies across the three subsamples.

Table B1 Travel days for households within ½-mile of an MTA rail transit station in operation at the time of the survey

Travel Day	NTAS	(%)	NHTS	(%)	CHTS	(%)
Sunday	0	0.00	19	13.57	91	15.91
Monday	1	0.27	16	11.43	95	16.61
Tuesday	109	29.78	23	16.43	68	11.89
Wednesday	125	34.15	28	20.00	78	13.64
Thursday	120	32.79	16	11.43	81	14.16
Friday	9	2.46	27	19.29	84	14.69
Saturday	2	0.55	11	7.86	75	13.11
Total	366	100	140	100	572	100

Table B2 Trip frequencies by travel mode for households within ½-mile of an MTA rail transit station in operation at the time of the survey

Trip Mode	NTAS	(%)	NHTS	(%)	CHTS	(%)	CTHS, LA County	(%)
Walk	590	25.37	209	19.44	1,601	32.19	11,137	16.20
Bike	57	2.45	13	1.21	65	1.31	898	1.31
Private vehicle	1,298	55.80	716	66.60	2,623	52.73	52,526	76.40
Bus/Paratransit	182	7.82	109	10.14	438	8.81	2,714	3.95
Rail transit	167	7.18	7	0.65	158	3.18	580	0.84
Long-distance Rail	2	0.09	8	0.74	11	0.22	75	0.11
Other	30	1.29	13	1.21	78	1.57	825	1.20
Total	2,326	100	1,075	100	4,974	100	68,755	100

Table B3 All households – Travel statistics of households within ½-mile of an MTA rail transit station in operation at the time of the survey.

	N	Mean	St. Dev.	Min.	Max.	% > 0	Diff. in means	S.E. of diff.	Sig.[a]
Trips, any mode									
NTAS	366	6.38	4.61	0	32	96.72	—	—	
NHTS	140	7.71	6.01	1	33	100.00	1.327	0.562	**
CHTS	572	8.70	8.33	0	60	87.76	2.316	0.423	***
CHTS, LA County	8219	8.37	7.88	0	70	87.21	1.985	0.256	***
Walk trips									
NTAS	366	1.61	2.54	0	12	42.62	—	—	
NHTS	140	1.49	2.42	0	14	39.29	-0.119	0.243	
CHTS	572	2.80	4.64	0	32	44.06	1.187	0.235	***
CHTS, LA County	8219	1.36	3.24	0	50	27.21	-0.257	0.137	*
Bicycle trips									
NTAS	366	0.16	0.77	0	9	5.74	—	—	
NHTS	140	0.09	0.59	0	6	3.57	-0.063	0.064	
CHTS	572	0.11	0.67	0	7	3.50	-0.042	0.049	
CHTS, LA County	8219	0.11	0.72	0	18	3.48	-0.046	0.041	
Vehicle trips									
NTAS	366	3.55	3.38	0	17	72.95	—	—	
NHTS	140	5.11	5.78	0	30	76.43	1.568	0.519	***
CHTS	572	4.59	5.68	0	35	67.31	1.039	0.296	***
CHTS, LA County	8219	6.39	6.61	0	65	79.82	2.844	0.191	***
Bus/Paratransit trips									
NTAS	366	0.50	1.80	0	29	19.67	—	—	
NHTS	140	0.78	1.49	0	6	28.57	0.281	0.157	*
CHTS	572	0.77	2.22	0	19	19.41	0.268	0.132	**
CHTS, LA County	8219	0.33	1.43	0	24	8.61	-0.167	0.095	*
Rail transit trips									
NTAS	366	0.46	1.02	0	6	20.22	—	—	
NHTS	140	0.05	0.32	0	3	2.86	-0.406	0.060	***
CHTS	572	0.28	1.23	0	18	8.57	-0.180	0.074	**
CHTS, LA County	8219	0.07	0.59	0	20	2.49	-0.386	0.054	***
Vehicle-miles traveled									
NTAS	366	25.42	34.10	0	249.00	67.21	—	—	
NHTS	140	20.44	28.96	0	199.44	65.00	-4.982	3.028	
CHTS	572	24.84	41.25	0	475.29	61.71	-0.582	2.480	
CHTS, LA County	8219	35.15	46.45	0	553.89	76.43	9.724	1.854	***

[a] Significance: * p < .1. ** p < .05. *** p < .01.

Table B4. Transit households – Travel statistics of households with at least one transit trip located within ½-mile of an MTA rail transit station in operation at the time of the survey.

	N	Mean	St. Dev.	Min.	Max.	% > 0	Diff. in means	S.E. of diff.	Sig.[a]
Trips, any mode									
NTAS	109	8.47	5.49	1	32	100	—	—	
NHTS	40	9.03	7.05	2	33	100	0.557	1.232	
CHTS	136	15.24	9.99	2	53	100	6.767	1.005	***
CHTS, LA County	805	16.13	9.91	2	70	100	7.659	0.631	***
Walk trips									
NTAS	109	3.03	3.04	0	12	70.64	—	—	
NHTS	40	2.30	3.13	0	14	50.00	-0.728	0.574	
CHTS	136	7.98	5.60	0	32	97.79	4.950	0.561	***
CHTS, LA County	805	7.11	5.75	0	50	96.40	4.079	0.354	***
Bicycle trips									
NTAS	109	0.14	0.69	0	5	4.59	—	—	
NHTS	40	0.13	0.46	0	2	7.50	-0.013	0.098	
CHTS	136	0.04	0.38	0	4	1.47	-0.093	0.073	
CHTS, LA County	805	0.19	0.84	0	9	5.96	0.052	0.072	
Vehicle trips									
NTAS	109	1.86	2.98	0	14	42.20	—	—	
NHTS	40	3.42	6.41	0	26	47.50	1.563	1.053	
CHTS	136	2.51	5.34	0	31	41.91	0.645	0.539	
CHTS, LA County	805	4.42	6.35	0	42	60.12	2.562	0.363	***
Bus/Paratransit trips									
NTAS	109	1.67	2.99	0	29	66.06	—	—	
NHTS	40	2.73	1.58	1	6	100	1.055	0.380	***
CHTS	136	3.22	3.59	0	19	81.62	1.551	0.420	***
CHTS, LA County	805	3.37	3.26	0	24	87.95	1.702	0.308	***
Rail transit trips									
NTAS	109	1.53	1.36	0	6	67.89	—	—	
NHTS	40	0.17	0.59	0	3	10.00	-1.357	0.160	***
CHTS	136	1.16	2.32	0	18	36.03	-0.370	0.238	
CHTS, LA County	805	0.72	1.75	0	20	25.47	-0.812	0.144	***
Vehicle-miles traveled									
NTAS	109	8.86	19.39	0	110	34.86	—	—	
NHTS	40	8.76	20.12	0	95	25.00	-0.096	3.684	
CHTS	136	9.49	19.25	0	104	33.82	0.634	2.485	
CHTS, LA County	805	19.38	33.60	0	290	49.81	10.520	2.202	***

[a] Significance: * p < .1. ** p < .05. *** p < .01.