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University of California Transportation Center  
UCTC Dissertation No. 153

**Unraveling the Complexity of Land Use and Travel Behavior  
Relationships: A Four-Part Quantitative Case Study of the South Bay  
Area of Los Angeles**

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2009

UNIVERSITY OF CALIFORNIA,  
IRVINE

Unraveling the Complexity of Land Use and Travel Behavior Relationships:  
A Four-Part Quantitative Case Study of the South Bay Area of Los Angeles

DISSERTATION

submitted in partial satisfaction of the requirements  
for the degree of

DOCTOR OF PHILOSOPHY

in Planning, Policy, and Design

by

Kenneth Joh

Dissertation Committee:  
Professor Marlon G. Boarnet (Chair)  
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2009



## **DEDICATION**

**In memory of Colin Rodríguez Griswold (1979-2005)**

*A dear friend, scholar, and a man who “left his mark”*

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## ACKNOWLEDGEMENTS

I am deeply indebted to Professor Marlon Boarnet, my dissertation chair and advisor. He is an exceptional scholar, teacher, and mentor who has provided unwavering support and encouragement throughout my graduate studies at UCI. Through countless emails, phone calls, and face-to-face meetings, he has always been there to help guide me in my journey towards academic scholarship. He has always been supportive of my endeavors, provided counseling and advice during difficult times, and has congratulated me on my achievements. I have tremendous respect for Professor Boarnet, not only professionally but personally, and I am blessed to have had him as my advisor.

I would also like to thank Professor Victoria Basolo, my committee member, for her thoughtful and detailed comments on my dissertation, as well as her advice and support throughout my academic career. I also wish to thank committee members Professor Jean-Daniel Saphores and Professor Mike McNally for their helpful advice, support, and insightful comments on my work.

I owe many thanks to the faculty and staff in the Department of Planning, Policy, and Design in the School of Social Ecology and the Institute of Transportation Studies for their assistance and support throughout my time at UCI. I would like to especially thank Janet Gallagher, Jean Martinez, and Anne Marie Defeo for their years of assistance on my behalf.

I wish to thank Professor Mai Nguyen of the University of North Carolina at Chapel Hill, for her helpful comments on my dissertation as well as her advice and

support. I would also like to thank Jung Joh and Becky Kong for their helpful assistance with copyediting and proofreading my final draft.

I wish to thank my family and friends for their support and love, including my parents and my brother and sister. They have always been supportive of my career path and have given me encouragement and motivation to pursue my goals.

Finally, I would like to thank my beautiful wife, Sung Hae. Without her love, encouragement, sense of humor, and companionship, I would not have succeeded in finishing this dissertation.

Financial support for this research was provided by research grants from various sources, including the California Department of Transportation and the University of California Transportation Center, the U.S. Department of Transportation, and the School of Social Ecology at the University of California at Irvine.

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Joh, Kenneth, Marlon G. Boarnet, and Mai Thi Nguyen. "Can Built and Social Environmental Factors Encourage Walking Among Individuals with Negative Walking Attitudes?"

Abstract accepted for presentation at the 2009 Association of Collegiate Schools of Planning Conference, Crystal City, Virginia, October 1-4, 2009.

Joh, Kenneth, Marlon G. Boarnet, and Mai Thi Nguyen. "Interactions between Race/Ethnicity and Ethnic Change on Travel Behavior: South Bay Case Study."

Abstract accepted for presentation at the 2008 Association of Collegiate Schools of Planning-Association of European Schools of Planning Joint Congress, Chicago, Illinois, July 6-11, 2008.

Joh, Kenneth, Marlon G. Boarnet, Mai Thi Nguyen, William Fulton, Wally Siembab, and Susan Weaver. "Accessibility, Travel Behavior, and New Urbanism: A Case Study of Mixed-Use Centers and Auto-Oriented Corridors in the South Bay Region."

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## **ABSTRACT OF THE DISSERTATION**

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A Four-Part Quantitative Case Study of the South Bay Area of Los Angeles

By

Kenneth Joh

Doctor of Philosophy in Planning, Policy, and Design

University of California, Irvine, 2009

Professor Marlon G. Boarnet, Chair

Characteristics of the built environment, such as the mixture of land uses, transportation infrastructure, and neighborhood design, have often been associated with reduced automobile use and increased walking and transit use. However, a significant gap remains in our understanding of travel behavior, especially with respect with social environmental and attitudinal factors influencing travel, such as crime rates and the perceptions of walking. This dissertation, comprised of four empirical essays, explores the complex relationships between the built and social environment and neighborhood travel by focusing on non-work travel for individuals sampled from eight communities in the South Bay Area of Los Angeles County.

In the first essay, I examine claims made by proponents of New Urbanism that traditional neighborhood designs promote walking and discourage driving by comparing automobile and walking trip rates for mixed-use centers and auto-oriented corridors. The results showed no discernible differences in individual driving trips between these two types of neighborhoods while more walking trips were reported in mixed-use centers. Therefore, the results both support and challenge New Urbanist claims.

The second essay examines the interactions between race/ethnicity, demographic change, and travel behavior by comparing driving and walking trips across racial and ethnic groups. The results showed that African-Americans took fewer driving trips and Asians walked less compared to non-Hispanic whites, and that Hispanics who walk are more sensitive to demographic changes in their neighborhood than other groups.

The third essay focuses on crime and perceptions of safety and how they impact walking behavior. After taking sociodemographic and built environment factors into account, violent crime rates had a strong deterrent effect on walking across race, income, and gender groups, while perceptions of neighborhood safety varied.

In the fourth essay, I focus on whether the built environment encourages walking above and beyond individuals' attitudes toward walking. By comparing individuals with positive attitudes toward walking with those with neutral or negative attitudes, the results showed that individuals with positive attitudes were more responsive to built environment characteristics than those held negative attitudes. These findings suggest differences in walking behavior are more strongly shaped by personal attitudes than the built environment.

# CHAPTER 1

## Introduction

Transportation planners, engineers, scholars, and policy makers in the United States have grappled with the problem of traffic congestion for decades. Initially, a policy of expanding highway capacity to accommodate the automobile was the preferred approach, exemplified by postwar policies such as the Interstate Highway Act and constructing highways through central urban areas. Resistance to highway construction and automobile dominance began in the 1970s and has continued to the present day, and as a result, many metropolitan regions have adopted transportation and land use policies to discourage automobile use and to encourage alternative modes of transportation such as public transit, walking, and cycling. Despite these efforts, however, many metropolitan areas that have grown rapidly in recent decades, especially in Sunbelt cities such as Las Vegas and Phoenix, have continued to embrace the auto-oriented urban form by expanding highway infrastructure and constructing vast tracts of single-family homes.

During the past two decades, an increasing number of state, metropolitan, and local governments have adopted policies to discourage automobile use and increase walking and transit use via transit-oriented developments, urban growth boundaries, and other “smart growth” programs. Portland, Oregon has often been lauded as the poster child for such efforts, but the Los Angeles region has also begun to adopt similar policies, albeit at a lesser scale. These policies include transit-oriented developments along existing light rail and subway lines such as in Hollywood and Pasadena, as well as the expansion of the Eastside extension of the Gold Line and bus-rapid transit lines in the San Fernando Valley. These policies focus on altering the built environment to



encourage a shift in travel behavior, which have been the dominant approach for Los Angeles and most cities in the United States. However, studies have shown that such efforts have not always been successful, and at worst, a gross mismanagement of taxpayer funds.

Much of the attention on the built environment in the 1990s and 2000s can be attributed to the rise of the New Urbanism movement in North America. In 1996, the Congress for the New Urbanism ratified a charter which outlines their principles for guiding metropolitan planning and development policies. A central theme of the charter is creating a built environment that encourages accessibility, social interaction and community cohesiveness, and creating a sense of place. These values have resonated with many American planners and developers and consequently, an increasing number of newly built communities in the U.S. have adopted a “neo-traditional” approach, characterized by diversity of land uses and housing types, as well as accommodating walking, transit, and cycling.

Additionally, a large body of empirical research has focused on the relationship between the built environment and travel behavior. Such studies have often relied on data obtained from national and regional travel surveys and inventories of land use and transportation infrastructure such as the number of street intersections and residential and commercial business densities. An increasing number of studies have also looked at attitudinal factors in influencing travel mode choice and location decisions. While these studies have yielded interesting and relevant results with important policy implications, other key factors that impact travel behavior, for example, social environmental factors

such as crime rates and individual attitudes toward crime and walking have received scant attention compared with the built environment.

The purpose of this dissertation is to show the multitude of factors that influence travel behavior, and to unravel some of the complexities of land use and travel behavior relationships. My dissertation relies primarily on a quasi-experimental and quantitative approach. These relationships are explored in four empirical essays of travel behavior that comprise a multifaceted case study of the South Bay Area of Los Angeles County.

In the first essay, “Accessibility, Travel Behavior, and New Urbanism: Case Study of Mixed-Use Centers and Auto-Oriented Corridors in the South Bay Area,” I examine the claims made by proponents of New Urbanism that neo-traditional developments discourage automobile use and promote walking. Through a paired case study of mixed-use and auto-oriented corridor neighborhoods, I compare driving and walking trip rates after taking selected sociodemographic and attitudinal variables into account. Among the four essays, this paper most directly addresses the question of how the built environment impacts travel behavior.

The second essay titled “Interactions between Race/Ethnicity and Ethnic Change on Driving and Walking Behavior” focuses primarily on the impact of sociodemographic factors on travel behavior. In this chapter, I examine the interactions between race/ethnicity, ethnic change, and travel behavior by comparing individual driving and walking trips for Hispanics, African-Americans, and Asians in the South Bay communities selected for this case study. This study is a departure from previous studies in race/ethnicity and travel behavior by examining not only differences in travel behavior and mode choice across racial and ethnic groups, but explores whether interactions

between an individual's ethnic status and changes in the racial/ethnic profile of his or her neighborhood of residence influence travel behavior and mode choice.

The third essay is "Crime, Perceptions of Neighborhood Safety, and the Built Environment: A Case Study of Walking Trips in the South Bay Area." This chapter investigates the question of how actual and perceived crime rates influence walking behavior across various sociodemographic groups. By incorporating sociodemographic, attitudinal, built environment, and crime variables and regressing them on two measures of walking behavior (individual walking trips and walking as a preferred mode choice), I determine which factors are significant in influencing walking behavior.

The final essay, "Can Built and Social Environmental Factors Encourage Walking Among Individuals with Negative Walking Attitudes?" investigates how well individual attitudes translate into actual travel behavior. The focus of this chapter is to determine whether the design of the built environment encourages walking above and beyond individuals' attitudes toward walking or their predisposition to walk. By stratifying the sample by attitudinal disposition ("high walk" and "low walk") and regressing individual walking trips on social environmental and built environment measures, in addition to running a series of hypotheses tests, I determine whether physical or social environments differentially affect walking trips to their neighborhood shopping center, controlling for sociodemographic characteristics.

All essays rely on a common data source, the South Bay Travel Survey, which was collected in three phases from 2005-2007. The survey yielded a rich and varied data set of 2,399 respondents from eight study areas that included a one day trip diary which asked questions about trip purpose, mode choice, and trip distance. Additionally,

perceptions and attitudes pertaining to neighborhood travel were also asked. In addition to this data set, other data such as crime and the built environment were obtained from various sources, including the U.S. Department of Justice and the Los Angeles County Assessor Office. The South Bay Travel Survey was designed and implemented by Solimar Research Group, a Los Angeles area-based consulting firm, and was funded by the South Bay Cities Council of Governments and the Southern California Association of Governments.

## **CHAPTER 2**

### **Study Areas and Survey Design**

#### **Overview of the South Bay Area**

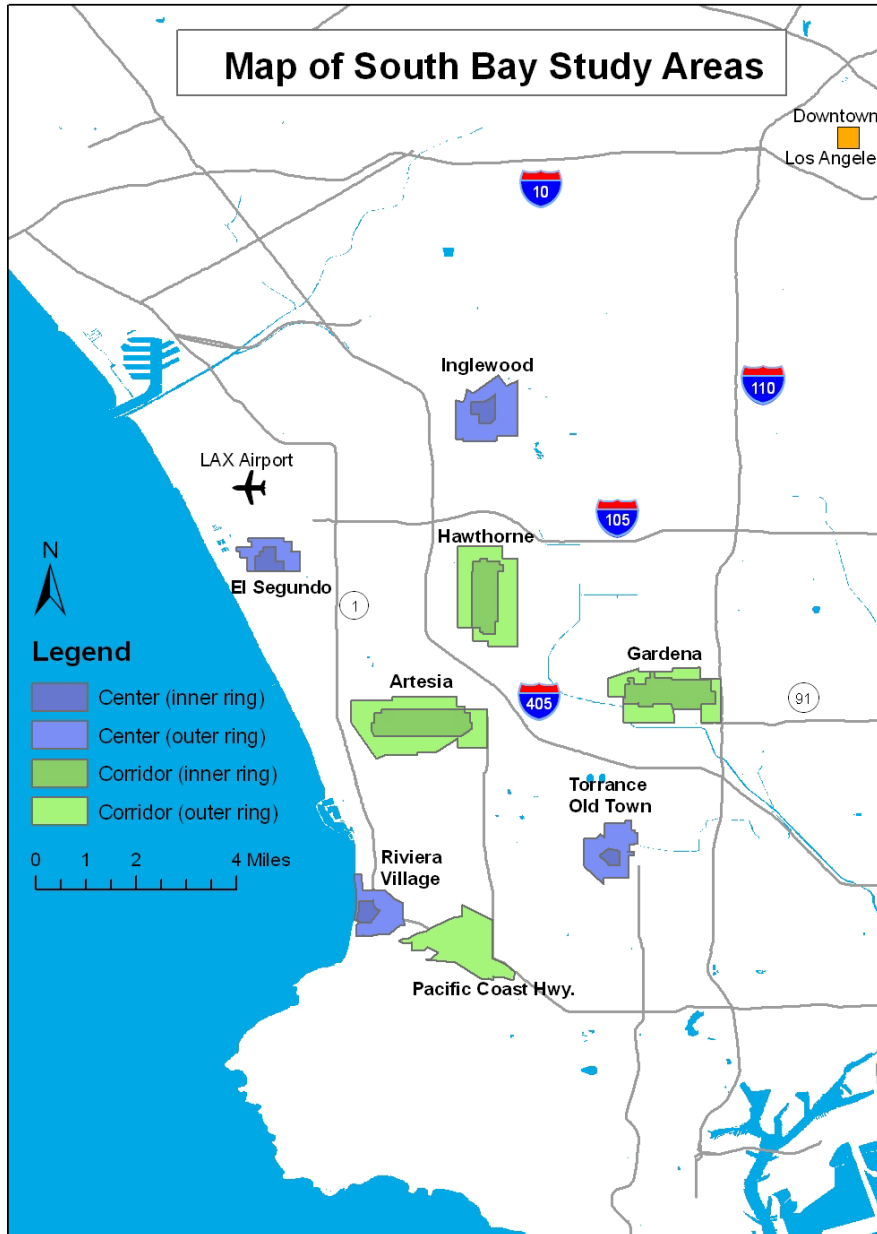
The neighborhoods analyzed for the four empirical studies in this dissertation are located in the South Bay Area of Los Angeles County. The South Bay Area occupies the southwestern portion of the Los Angeles basin, stretching from south of Los Angeles International Airport (LAX) to the Palos Verdes Peninsula, as shown in Figure 2.1. With a population of over 1 million, it is one of the most racially and ethnically diverse regions in the United States, containing fifteen incorporated cities and several unincorporated communities, including small portions of the city of Los Angeles. In the South Bay Area as a whole, there is almost an even proportion of Non-Hispanic whites, Hispanics, African-Americans, and Asians; however, the racial and ethnic makeup varies widely across the neighborhoods in the study. For example, the majority of whites and Asians are concentrated in the communities bordering the Pacific coast, while Hispanic and African-American populations tend to be concentrated further inland. The ethnic diversity of the South Bay Area allows for useful comparisons of travel behavior across various sociodemographic groups.



**Figure 2.1. South Bay Orientation Map**

The South Bay Area is also diverse in terms of land use and development patterns. It is a complex mosaic of neighborhoods which date from the prewar period to the postwar era. Large swaths of the coast are devoted to upscale single-family homes, especially towards the Palos Verdes Peninsula, while large tracts of land further inland are devoted to commercial and industrial use. Wide arterials such as Pacific Coast Highway and Hawthorne Boulevard crisscross the region, contributing to the South Bay's auto-centric orientation. Unlike some parts of Los Angeles County, the South Bay Area remains relatively underserved by transit, especially towards the south and west away from downtown Los Angeles. In response to these trends, and also due to the fact that

the entire region is virtually completely built out, much attention has been given on exploring policies to promote infill development and alleviating traffic congestion, such as the Southern California Association of Government's Compass Plan.



**Figure 2.2 Map of the South Bay Study Areas within Los Angeles County**



## **Study Areas**

Eight neighborhoods in the South Bay Area were selected as study areas, as shown in Figure 2.2. Four of these neighborhoods are classified as mixed-use neighborhoods and include: Torrance Old Town, Inglewood, Riviera Village, and El Segundo. The other four neighborhoods, Pacific Coast Highway, Hawthorne, Artesia, and Gardena, are non-mixed-use neighborhoods or what is referred to as commercial “corridor” neighborhoods. Mixed-use centers can be defined as an area that contains a diverse mix of jobs and housing, retail stores and shopping centers, and entertainment opportunities. An auto-oriented corridor is a linear area where commercial activity and retail stores are concentrated along a major arterial strip. These study areas were selected based on population density, housing density, employment density, and density of neighborhood-serving businesses (Fulton et al., 2005).

The mixed-use neighborhoods were built prior to World War II and are comprised of their historic downtown core and civic centers. The corridor neighborhoods are more typical of suburban neighborhoods built after World War II and they are concentrated along an arterial corridor. These corridors might be considered, “strip malls.” The study areas that were selected are relatively compact in size, with a radius of approximately ½ mile from the civic center or arterial. A brief description of each neighborhood is contained in Table 2.1 below.

**Table 2.1 South Bay Study Areas**

<b>Mixed-Use Neighborhoods</b>		<b>Corridor Neighborhoods</b>	
<i>Study Area</i>	<i>Description</i>	<i>Study Area</i>	<i>Description</i>
Torrance Old Town	Centered on the historic civic center in downtown Torrance (Torrance Boulevard and Van Ness Avenue)	Pacific Coast Highway (PCH)	Centered on a commercial strip along Pacific Coast Highway between Hawthorne Boulevard and Calle Mayor within City of Torrance
Inglewood	Centered on the civic center in downtown Inglewood (Manchester Boulevard and La Brea Avenue)	Hawthorne	Centered on commercial strip along Hawthorne Boulevard between Rosecrans Avenue and El Segundo Boulevard within the City of Hawthorne
Riviera Village	A seaside neighborhood in Redondo Beach (Pacific Coast Highway and Palos Verdes Boulevard)	Artesia	Centered on a commercial strip along Artesia Boulevard between Aviation Boulevard and Inglewood Avenue within city of Redondo Beach.
El Segundo	Centered on civic center in downtown El Segundo (Main Street and Grand Avenue)	Gardena	Centered on a commercial strip along Gardena Boulevard between Van Ness Avenue and Vermont Avenue within the city of Gardena

Each of the mixed-use and corridor study areas (with the exception of Pacific Coast Highway) were further divided into areas designated as “inner” and “outer.” The areas designated as “inner” comprise the inner ring of the mixed-use centers and auto-oriented corridors, while the “outer” comprise the outer ring. The inner ring is roughly a

¼ mile radius from the center, while the outer ring is about a ½ mile radius for mixed-use centers. The inner rings generally have the highest density of retail stores and the lowest density of housing units, and the outer rings generally have a lower concentration of commercial and retail activity and the highest concentration of residential units. Auto-oriented corridors are larger in area than the mixed-use centers, and the typical length of the corridor is about 1.5 miles. The boundary of the inner ring lies approximately ¼ mile from the arterial, while the outer ring boundary is about ½ mile from the arterial.

The population and land areas of the sixteen study areas vary considerably. In general, the populations and areas of the mixed-use centers are generally smaller than the auto-oriented corridors. Detailed area population, population density, and land area information for each of the study areas are listed in Table 2.2.

**Table 2.2 Population, Density, and Land Area of Study Areas**

	<i>Pop. (2000)</i>	<i>Pop. Density<sup>a</sup></i>	<i>Acres</i>
<i>Mixed-Use Centers</i>			
Torrance Inner (TOTI)	746	8776	54
Torrance Outer (TOTO)	3797	5659	429
Inglewood Inner (INGI)	287	1864	100
Inglewood Outer (INGO)	15344	13949	682
Riviera Inner (RIVI)	1139	9260	79
Riviera Outer (RIVO)	5953	10668	357
Pacific Coast Highway (PCH)	10487	8129	825
El Segundo Inner (ESI)	2238	10708	134
El Segundo Outer (ESO)	3433	9228	238
El Segundo W. (ESW)	10362	2894	3174
<i>Auto-Oriented Corridors</i>			
Hawthorne Inner (HAWI)	9042	14584	396
Hawthorne Outer (HAWO)	22392	19138	750
Artesia Inner (ARTI)	12205	20403	522
Artesia Outer (ARTO)	15757	10143	787
Gardena Inner (GARDI)	11166	14426	495
Gardena Outer (GARDO)	7911	9351	542

<sup>a</sup>Population density measured in residents per square mile for each study area  
Source: U.S. Census (2000) and Solimar Research Group (2005).

Table 2.3 shows a summary of selected demographic variables showing the number of respondents by area, gender, race/ethnicity, education, and household income. Compared to the demographic characteristics of the study areas obtained from the 2000 Census, whites, highly educated persons, and persons with higher levels of income tended to be overrepresented in the survey. This is due to the lower response rates from working class neighborhoods of color, especially Inglewood. Although this sample may not be representative of South Bay neighborhoods, the results from this study may be generalizable to New Urbanist neighborhoods, especially considering that the sociodemographic characteristics of many New Urbanist communities are similar to the South Bay sample (generally higher income and a higher proportion of whites).

**Table 2.3 Summary of Selected Demographic Variables**

	<i>Frequency</i>	<i>Percentage Share</i>
Torrance Inner (TOTI)	54	2.50
Torrance Outer (TOTO)	124	5.17
Inglewood Inner (INGI)	7	0.29
Inglewood Outer (INGO)	65	2.71
Riviera Inner (RIVI)	81	3.38
Riviera Outer (RIVO)	158	6.59
Pacific Coast Highway (PCH)	233	9.30
El Segundo Inner (ESI)	154	6.42
El Segundo Outer (ESO)	170	7.09
El Segundo W. (ESW)	274	11.42
Hawthorne Inner (HAWI)	104	4.34
Hawthorne Outer (HAWO)	174	7.25
Artesia Inner (ARTI)	243	10.13
Artesia Outer (ARTO)	283	11.80
Gardena Inner (GARDI)	138	5.75
Gardena Outer (GARDO)	147	6.13
<i>Gender</i>		
Male	1001	48.92
Female	1045	51.08
<i>Race/Ethnicity</i>		
Non-Hispanic white	1366	67.79
Hispanic	171	8.49
African-American	83	4.12
Asian	258	12.80
Other race	44	2.18
<i>Education</i>		
Did not graduate high school	30	1.46
High school graduate	144	7.03
Some college	545	26.60
Four-year college degree	628	30.65
Some graduate study	30	1.46
<i>Household Income</i>		
Less than \$15,000	64	3.23
\$15,000 - \$34,999	140	7.07
\$35,000 - \$54,999	280	14.15
\$55,000 - \$74,999	376	19.00
\$75,000 - \$99,999	387	19.56
\$100,000 and over	732	36.99

It is worth noting that the study area boundaries do not necessarily coincide with the municipal boundaries where the study areas are located. The boundaries for the study areas were derived from census block group boundaries rather than city boundaries. In addition, the study areas are also quite smaller than the cities where they are located. Two cities contain more than one study area: Artesia Blvd. and Riviera Village are both located largely within the city of Redondo Beach, and Pacific Coast Highway and Torrance Old Town are both located within the city of Torrance. Table 2.4 compares study areas as a proportion of their respective city land areas.

**Table 2.4 Study Area (SA) as a Proportion of City Land Area**

	Area	City Area	% of City Area	City Where SA Is Located
Artesia Blvd.*	2.05	6.43	31.88	Redondo Beach
El Segundo*	0.58	5.54	10.00	El Segundo
Gardena Blvd.*	1.62	5.82	27.84	Gardena
Hawthorne Blvd.*	1.79	6.06	29.54	Hawthorne
Inglewood*	1.25	9.10	13.74	Inglewood
Pacific Coast Hwy.	1.29	20.50	6.29	Torrance
Riviera Village*	0.68	6.43	10.58	Redondo Beach
Torrance Old Town*	0.76	20.50	3.71	Torrance

\* Includes both Inner and Outer areas.

### **Survey Design and Implementation**

The travel behavior data employed for this study come from responses from the South Bay Travel Survey (SBTS), which was funded by the South Bay Cities Council of Governments and the Southern California Association of Governments. The SBTS is a 155-question web-based and mail questionnaire, which was conducted in three phases,

annually, from 2005 to 2007.<sup>1</sup> Participants were asked to complete a one-day travel diary, which included questions about trip purpose, mode choice, and trip distance. In addition, questions relating to attitudes and perceptions about walking and driving, neighborhood amenities, schools, crime, and alternative travel choices were asked, as well as opinions about a range of hypothetical policy changes.

Throughout the 3-year study period, the SBTS was distributed to all 36,253 households residing within the eight study areas. One adult individual from each household was asked to complete the survey. A total of 2,399 individuals responded to the SBTS, but I include the survey results of only 2,125 respondents.<sup>2</sup> Survey response rates varied from 3.8 percent in Hawthorne to 11.9 percent in El Segundo. Since the SBTS was primary web-based<sup>3</sup> (especially in the second and third phases), response rates were lower than typical mail-based surveys.

To determine if the respondents of the survey were different from the general population in the South Bay Area, demographic characteristics of survey respondents and neighborhood residents are compared for each of the eight neighborhoods. In general, whites are overrepresented in this sample compared to the neighborhood averages.

About 66% of the survey respondents are white, while only 48.9% of residents in the

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<sup>1</sup> The Phase I survey was distributed to residents in Inglewood, Pacific Coast Highway, Riviera Village, and Torrance Old Town, and consisted of 155 survey questions. Refer to Appendix A for a copy of the Phase I survey. The South Bay Travel Survey for Phase II and Phase III was slightly modified to include 145 survey questions, which is included in Appendix B. In Phase II, the survey was distributed to residents in El Segundo and Hawthorne Boulevard corridor, and in Phase III, the survey was distributed to residents in Artesia Boulevard corridor and Gardena Boulevard corridor.

<sup>2</sup> Initially, all 2,399 respondents were included for the first study comparing mixed-use and auto-oriented corridors. However, in the interest of keeping the built environment characteristics as relatively constant as possible, the results from one anomalous section of El Segundo (El Segundo W.), which comprised of primarily industrial land, was excluded for the remaining three studies.

<sup>3</sup> A postcard with the web address for the web survey was sent to all individuals in our sample. Only individuals who contacted us and requested a paper survey were mailed one. These individuals represented less than 4% of the total number of respondents.

South Bay Area (see Table 2.5). The biggest discrepancies result from Hispanics' and African-Americans' underrepresentation in specific neighborhoods. However, the discrepancy may be due to survey respondents who chose to decline to state their race/ethnicity, which in most study areas was comparable to the gap between census and survey proportions of whites. Due to relatively low response rates and the slight underrepresentation of various racial/ethnic respondents, the results from these studies should be interpreted with caution.



**Table 2.5 Racial/Ethnic Breakdown of South Bay Study Areas**

Study Area	Total		White				Hispanic				African-American				Asian				Other/NR	
	<i>Census</i> <i>n</i>	<i>Sample</i> <i>n</i>	<i>Census</i> <i>n</i>	<i>%</i>	<i>Sample</i> <i>n</i>	<i>%</i>	<i>Census</i> <i>n</i>	<i>%</i>	<i>Sample</i> <i>n</i>	<i>%</i>	<i>Census</i> <i>n</i>	<i>%</i>	<i>Sample</i> <i>n</i>	<i>%</i>	<i>Census</i> <i>n</i>	<i>%</i>	<i>Sample</i> <i>n</i>	<i>%</i>	<i>Sample</i> <i>n</i>	<i>%</i>
Artesia*	27,962	452	19,797	70.8	325	71.9	5,581	20.0	26	5.8	1,122	4.0	4	0.9	3,006	10.8	46	10.2	51	11.3
El Segundo*	5,671	252	4,767	84.1	204	81.0	704	12.4	12	4.8	55	1.0	4	1.6	324	5.7	8	3.2	24	9.5
Gardena*	19,077	226	5,268	27.6	57	25.2	7,458	39.1	44	19.5	1,704	8.9	0	0.0	6,983	36.6	110	48.7	15	6.6
Hawthorne*	31,434	219	10,676	34.0	99	45.2	14,956	47.6	51	23.3	7,233	23.0	28	12.8	2,953	9.0	18	8.2	23	10.5
Inglewood*	15,631	63	3,031	19.4	10	15.9	6,620	42.4	8	12.7	7,939	50.8	39	61.9	238	1.5	2	3.2	4	6.4
Pacific Coast Hwy.	10,530	205	6,981	66.3	158	77.1	940	8.9	10	4.9	189	1.8	2	1.0	2,513	23.9	31	15.1	4	2.0
Riviera Village*	7,092	219	6,120	86.3	202	92.2	539	7.6	4	1.8	104	1.5	1	0.5	414	5.8	10	4.6	2	0.9
Torrance Old Town*	4,543	158	3,027	66.6	123	77.9	1,224	26.9	9	5.7	109	2.4	3	1.9	515	11.3	21	13.3	2	1.3
<b>ALL AREAS</b>	121,940	1,794	59,667	48.9	1178	65.7	38,022	31.2	164	9.1	18,455	15.1	81	4.5	16,946	13.9	246	13.7	125	7.0

Note: Census data are taken from the Year 2000 U.S. Decennial Census. Sample data are taken from the South Bay Travel Survey (2005).

\* These study areas include both Inner and Outer rings.

## CHAPTER 3

### **Accessibility, Travel Behavior, and New Urbanism: Case Study of Mixed-Use Centers and Auto-Oriented Corridors**

#### **Introduction**

Transportation planners, scholars, and policy makers now routinely grapple with questions of traffic congestion, suburban sprawl, and environmental degradation in our nation's major metropolitan areas. In response to these problems, many communities and metropolitan planning organizations (MPOs) across the country (e.g., Portland) have adopted smart growth planning strategies and New Urbanist (also referred to as Neo-traditional) design features. Proponents claim that New Urbanist communities are more effective at reducing traffic congestion and air pollution and thereby promoting healthier and more vibrant pedestrian-oriented communities vis-à-vis conventional auto-oriented suburbs (Calthorpe, 1993; Duany and Plater-Zyberk, 1991). By shaping urban design that curbs automobile use, proponents of New Urbanism believe this will also encourage more walking, biking, and transit use. Although New Urbanism has gained tremendous popularity, there is mounting evidence in the transportation and travel behavior literature that the relationship between urban design and travel behavior may be tenuous. In fact, some studies have even suggested that New Urbanist communities may actually encourage more, rather than less frequent automobile trips due to shorter trip distances and increased accessibility to local retail centers (Crane, 1996).

The first part of this chapter examines the link between urban design and travel behavior by comparing land use patterns and trip generation rates for non-work automobile and walking trips in sixteen mixed-use centers and auto-oriented corridors in

the South Bay Area of Los Angeles County. The mixed-use centers share similar characteristics with New Urbanist communities in terms of their orientation around a civic center, relative compactness, interconnected network of streets and pedestrian paths, and mixed land uses. The auto-oriented corridors share many qualities with conventional suburbs, characterized by wide arterials, strip mall businesses, and few amenities for pedestrians. Relying on disaggregate travel data obtained from travel diaries and surveys, regression analyses of non-work walking and automobile trip frequencies will be conducted while controlling for sociodemographic and attitudinal variables. The second part of this chapter analyzes location choice and travel behavior for the South Bay mixed-use centers and corridors by constructing an instrumental variable model; driving and walking trips are regressed on sociodemographic, attitudinal, and land use variables using two-stage least squares (2SLS) estimators. Selected instruments for the land use variables that are not directly correlated with travel behavior but hypothesized to influence location choice are used to control for endogeneity bias in ordinary least squares (OLS) regressions.

The next section will give an overview of relevant empirical studies in the transportation literature, followed by a presentation of hypotheses, methodology (case selection, descriptions of the South Bay study areas, data and variables), regression results and discussion and analysis of results for driving and walking trips, and conclude with implications for land use and travel behavior.

### *Problem Statement*

The relationship between land use and travel behavior is inherently complex and remains elusive, despite the vast literature that has emerged during the past two decades.

Transportation scholars such as Boarnet, Crane, Cervero, Handy, and others have conducted extensive empirical research on how the built environment impacts travel behavior using data from the San Francisco Bay Area, Southern California, and other metropolitan regions. Past and present studies have been able to show empirical evidence that urban design impacts travel but have been less successful at distinguishing which land use or built environment variables have the most impact on travel behavior due to methodological and data limitations. Therefore, due to the complexity of travel behavior and the difficulty of isolating individual components of the built environment, it is paramount to derive a methodological approach that controls for as many confounding variables as possible (Crane, 2000).

New Urbanist planning is based on the assumption that improved urban design would result in improved transportation benefits (e.g., better accessibility, reduced automobile dependence), a claim that has yet to be fully substantiated or invalidated in the land use and travel behavior literature. Despite the fact that numerous studies in the literature have shown that neo-traditional designs may not have as much of an impact on travel behavior as their proponents have suggested, many planners and policy makers continue to incorporate elements of neo-traditional design into their community plans due to the purported benefits.

The primary concern facing urban and transportation planners today is that land use and transportation policy making are often not based on empirical research, but are driven by external factors such as politics and finance. Based on our current understanding of the relationship between land use and travel behavior, there is not enough evidence to make informed policy decisions about land use and transportation.

Therefore, further travel behavior research employing improved methodological approaches and better data is necessary and warranted.

### *Relevance of the Study*

This study of mixed-use centers and auto-oriented corridors in the South Bay region makes a unique contribution to the diverse literature on land use and travel behavior and broaden our knowledge of the complex relationships between the built environment, travel behavior, and residential location choice. Despite the large and diverse literature that already occupies this field, important gaps in the literature remain, including the impact of residential self-selection and attitudinal factors on travel mode choices, and which built environment variables have the most impact on travel behavior. This study aims to fill these gaps by controlling for residential self-selection in the instrumental variable model and incorporating attitudinal variables in the regression analyses. The results of this study will not only contribute to empirical research in land use and travel behavior, but will aid in helping planners and policy makers make more informed transportation and land use decisions that are based on empirical evidence.

## **Literature Review**

### *Does Urban Design Influence Travel Behavior?*

The goal of planning accessible neighborhoods through urban design was brought to the forefront during the 1980s and 1990s with the rise of New Urbanism, led by Duany and Plater-Zyberk (1991) and Calthorpe (1993). New Urbanist communities are typically characterized by higher densities, mixed land uses and housing types, an interconnected

pattern of grid streets (as opposed to cul-de-sacs), and a defined civic and town center that can also serve as a hub for public transit. Proponents have argued that neo-traditional design reduces automobile dependency and use, increases walking and public transit use, and shortens trip distances and times, thereby improving accessibility for residents living in these neighborhoods (Calthorpe, 1993; Duany et al., 2000).

The assertions made by New Urbanists were heavily based on the simulation study by Kulash et al. (1990), which found that traditional neighborhoods based on a grid pattern resulted in a 57% reduction in vehicle-miles traveled (VMT) when compared to a neighborhood with a more conventional auto-oriented layout. However, the results of the study were limited by the assumption that trip frequencies were fixed regardless of prevailing land use patterns, which led some to criticize the simulation study for its simplicity. More elaborate simulation studies conducted by Stone et al. (1992) and McNally and Ryan (1993) also confirmed that gridiron street patterns reduce VMT and average trip length, albeit with far less dramatic reductions (10-15 percent). For the most part, simulation studies offer adequate explanation of how street patterns affect automobile use and travel behavior, but offer little explanation of the key behavior interactions which are fundamental in understanding the complex relationships between land use and travel behavior.

Evidence from more recent studies by Boarnet and Crane (2001) and Crane (1996) shine a critical light on claims made by proponents of New Urbanism. In general, these studies find little conclusive evidence that grid street patterns actually reduce automobile trips. Rather, residents living in traditional grid neighborhoods tend to take shorter trips due to its more compact spatial layout than those living in low-density auto-oriented

neighborhoods. But, the shorter trip distances may encourage more walking trips and *more* short-distance driving trips (Crane, 1996). Therefore, the transportation benefits of neo-traditional and transit-oriented neighborhood designs remain unclear and require further empirical research.

*Paired Case Studies: Multivariate Regression Analyses Using Aggregated Data*

Other empirical studies offer alternative explanations for differences in travel behavior between traditional transit-oriented neighborhoods and suburban auto-oriented neighborhoods. Cervero and Gorham (1995) hypothesized that transit-oriented neighborhoods would generate more walking and transit trips than auto-oriented neighborhoods. They compared work and non-work trip generation rates for seven neighborhood pairs in the San Francisco Bay Area and six in the greater Los Angeles metropolitan area by conducting regression analyses of aggregate travel data. Results from the study indicate that transit-oriented neighborhoods generate more walking and transit trips for Bay Area neighborhoods. The findings for the Los Angeles area neighborhoods were less clear. Cervero and Gorham attributed the difference in results to the unique differences in geography in the two regions. Whereas the development of the Los Angeles region is more decentralized and, thereby auto-oriented, the development of the San Francisco Bay Area is concentrated along narrow corridors making it more conducive for transit (Cervero and Gorham, 1995).

Several other studies have used a similar methodology, paired comparisons of neighborhoods or cities using aggregated data. Frank and Pivo (1994), for example, tested the impacts of land-use mix, population density, and employment density on

automobile, transit, and walking trips in the Seattle metropolitan area. Also, Newman and Kenworthy (1999) compared urban density, energy consumption, automobile, and transit use between American cities and cities in Europe and Asia. The interpretation of the findings from these studies are severely limited by the failure to adequately control for differences in the demographic characteristics of neighborhoods and to capture localized neighborhood impacts from smart growth initiatives and urban design changes using aggregate data.

For example, Newman and Kenworthy (1989, 1999) used aggregate data to compare global metropolitan densities and per capita gasoline consumption, which yielded an inverse relationship between per capita fuel consumption and metropolitan densities. Based on these figures, they concluded that higher density cities are less automobile dependent and therefore, planners should strive for higher density developments. However, a major flaw of their study is that they do not take several factors that impact automobile use into account, such as the employment rate, household size, race/ethnicity, and other sociodemographic variables (Gordon and Richardson, 1989; Gomez-Ibanez, 1991). In earlier work, Pushkarev and Zupan (1977) found a positive relationship between population density and transit use, based on aggregate data collected from 105 urbanized areas for 1960 and 1970. Although they included several variables in their analysis, including the size of the CBD, parking supply, and land mix, they also omitted several important variables that affect transit use, such as transit service quality (Taylor and Fink, 2003).



In addition, the independent variables selected in these studies are often correlated with the dependent variable, limiting the explanatory power of the independent variables in the model. Using the Pushkarev and Zupan (1977) study as an example, population density is correlated with transit use because cities with larger populations tend to have a more expansive public transit network, hence, population density is endogenous to transit use. Therefore, transit use is not directly associated with population density *per se*, but factors associated with population density such as transit service. In a similar study, Gordon et al. (1991) found that cities with higher population densities have longer automobile commutes, suggesting that low density cities promote shorter and more efficient commuting patterns. However, city size is correlated with density, so a city with high population densities (such as the New York or San Francisco metropolitan areas) tend to also be spatially large, resulting in longer automobile commutes.

*Paired Case Studies: Multivariate Regression Analyses Using Disaggregated Data*

In response to these limitations, more recent studies use disaggregated travel data, primarily from travel diaries and surveys. For example, Handy (1996) compared older traditional neighborhoods with newer auto-oriented suburbs for two pairs of cities in the San Francisco Bay Area, similar to the aforementioned Cervero and Gorham study. However, Handy measured trip frequencies for shopping and non-work trips by categorizing and indexing measures of accessibility, such as accessibility to local retail centers and shopping malls, the number of 4-way intersections and cul-de-sacs per road mile, and blocks per square mile. Handy found that traditional neighborhoods that are closer to shopping destinations generate more trips than newer auto-oriented

neighborhoods, echoing Crane's (1996) results. Cervero and Kockelman (1997) and Kockelman (1996) also used individual travel data obtained from travel diaries to examine how "the 3Ds" (density, diversity, and design) affect trip generation rates and mode choice for 50 and 1,300 selected neighborhoods in the San Francisco Bay Area, respectively. By regressing VMT and mode choice on socioeconomic variables, including population and employment densities, as well as land use mix, and street design data, a "built environment" model was constructed to predict trip generation rates. The study revealed that the 3Ds have an impact in reducing trip rates and promoting non-auto travel, although the impacts may be marginal. In addition, the 3Ds have a stronger impact on reducing non-work trips than work trips, which confirms previous studies (Crane, 1996; Handy, 1996; Boarnet and Crane, 2001).

#### *The Role of Attitudes and Self-Selection*

Although these studies and others that utilize disaggregated data (Kulkarni, 1996; Crane and Crepeau, 1996; Krizek, 2003; Handy and Clifton, 2001) are an improvement on the paired case studies approach, they still have limitations. First, they do not incorporate attitudinal factors in their statistical models. It may be the case that attitudes about travel, rather than the built environment, shape behavior. By omitting attitudinal variables, the results from these studies may be biased. Second, these studies do not control for residential self-selection bias. If residents choose to live in a particular neighborhood that suits their travel needs and preferences, this would confound the relationship between the built environment and travel behavior (Handy et al., 2005).

Kitamura et al. (1997) incorporate attitudinal variables in their study of the impacts of land use on travel behavior for five selected neighborhoods in the San

Francisco Bay Area. Employing factor analysis, they determined eight factors from 39 attitude statements relating to their lifestyle preferences. Data obtained from travel diaries for individuals living in the selected neighborhoods were first regressed on sociodemographic and land use variables. High density neighborhoods were associated with a greater proportion of non-motorized trips while greater distance from rail stations were associated with fewer rail transit trips, which is to be expected. However, when attitudinal factors were added to the regression model, these factors explained differences in travel behavior across neighborhoods better than the land use variables. Handy et al.'s (2005) study of neighborhoods in Northern California examine the problem of self-selection bias and the direction of causality (i.e., whether neighborhood design influences travel behavior or whether travel preferences influence residential location decisions). Employing multivariate regression analyses, reported vehicle miles driven (VMD) were regressed on sociodemographic characteristics, factors for perceived and preferred neighborhood characteristics, and attitudes about travel. Handy and her colleagues found that VMD per week was higher for residents of suburban neighborhoods than residents of traditional neighborhoods, which is not surprising given previous findings. However, the results of their study revealed that when attitudinal variables were added to the models predicting driving and walking behavior, these variables were statistically significant while no measures of the built environment (e.g., perceived and preferred neighborhood characteristics) were statistically significant. These results strongly suggest that self-selection may be a significant factor that affects the observed correlations between the built environment and travel behavior.

The review of the literature on urban design and travel behavior highlights two key points. First, the emphasis of travel behavior literature has shifted from studies relying on aggregate-level data to those using disaggregate-level data over the past few decades. While studies based on aggregate travel data are useful in explaining aggregate travel across neighborhoods and metropolitan regions, their level of detail is too coarse to explain travel behavior at the local neighborhood level and to capture the localized impacts of neo-traditional features such as traffic calming and mixed-use housing. Second, recent studies (Handy et al., 2005; Kitamura et al., 1997) have shown how the correlation between the built environment and travel behavior may not be as clear as previous studies have suggested due to their failure to take into consideration attitudinal factors and self-selection bias. More nuanced studies incorporating these measures show that preferential attitudes toward a particular type of neighborhood based on accessibility and urban design features play a significant role in residential location decisions.

### **Theories of Travel Behavior**

The theoretical framework that has been frequently used to explain the relationship between urban form and travel behavior is discrete choice theory, which states that the probability of an individual making a particular choice out of a set of choices is contingent upon the utility of that choice relative to the utilities of the other available choices (Ben-Akiva and Lerman, 1985). In terms of thinking about travel behavior, discrete choice theory suggests that an individual makes a logical decision on what mode of transportation to take depending on the utility of that choice relative to other modes, which can be quantified in terms of monetary cost (e.g., cost of gasoline,

transit fare, tolls) and also time cost and convenience (e.g., transit headways, number of transfers required). In terms of residential location choice, discrete choice theory can be applied in terms of an individual's decision to locate in a neighborhood based on its overall utility relative to other neighborhoods (e.g., proximity to work, parks and other amenities, median housing prices). While many researchers have pointed to this theoretical framework to model travel behavior, this model has only been applied in a limited number of ways to describe the relationship between urban form and travel behavior.

For example, proponents of neo-traditional planning have called for higher density developments to promote transit use and walking, exemplified by the recent surge of transit-oriented developments and light rail expansions in Portland, Oregon, the Bay Area, and other U.S. metropolitan areas. Newman and Kenworthy (1999) relied primarily on comparative data on population and employment densities to make their claim that cities in Europe and Asia are more transit-oriented and less automobile dependent than the U.S. However, the discrete choice model suggests that it is not density *per se* that impacts travel behavior, but rather, the set of choices related to density that influences travel behavior (Handy, 1996a). These choices may include quantifiable variables such as the number of retail stores, shops, and restaurants or variables less easily quantifiable such as the vibrancy and social network of a neighborhood.

Discrete choice theory can also be applied to the concept of accessibility in travel behavior. In the built environment and travel behavior literature, accessibility has been operationalized in terms of density (population, housing units, employees per unit, intensity of land uses), street network, and land use mix, including proximity to

nonresidential activities, distances to employment, retail, and recreational destinations, and the ease in reaching those destinations, whether by car, walking, biking, or public transit (Cervero and Kockelman, 1997; Kitamura et al., 1997, Boarnet and Sarmiento, 1998). As previous studies have suggested, differences in accessibility across neighborhoods influence mode choice, trip frequency, and residential location choice.

However, there are other factors influencing travel behavior that stretch beyond the realm of what can be explained by discrete choice theory alone. One factor that has been overlooked in the travel behavior literature has been the impact of neighborhood design and the built environment on travel behavior, in particular walking behavior (Handy, 1996a, Handy, 1996b). In travel behavior theory, travel demand is typically assumed to be a derived demand, meaning that travel is based on the need to reach destinations as efficiently as possible and not for the sake of travel itself. Although the theory of derived demand can usually be applied to driving trips, its applicability to walking trips is questionable because the motivation for taking walking trips is more complicated than what has been shown by traditional mode choice models (Handy, 1996b). The reason is that individuals often choose to walk based on the experience of walking itself and not necessarily because it is the most efficient choice. And the experience of walking is often shaped by the surrounding built and natural environment, such as ease of pedestrian crossings, street trees and landscaping, benches, and other amenities.

A hypothetical example that illustrates the complexity of walking behavior can be shown by the mode choice decision of two groups of individuals residing in two different communities, Town A and Town B. Assuming that both individuals reside an equal

distance (one-quarter to one-half mile) from their respective neighborhood centers and sociodemographic variables are controlled for, discrete choice theory would assume that the travel mode preferences of individuals residing in A or B would be similar. However, Town A has a more aesthetically pleasing environment for walking than Town B. For the group of individuals that are primarily concerned with going to the neighborhood center as efficiently as possible, the lack of pedestrian amenities may not have an impact on their decision to walk to their destination; therefore, this group would be equally likely to walk in Town A or Town B. However, for the group of individuals who are motivated to walk primarily for the pleasure of walking, they would be less likely to walk to the center in Town B than in Town A even though the distances to the center are the same since B is a less pleasant environment to walk in. Therefore, incorporating the causal factors that determine the choice to walk remains a formidable challenge in modeling travel behavior and predicting mode choice.

## **Hypotheses**

Based on the previous literature review and the discussion of New Urbanism and the impact of the built environment on travel behavior, the following hypotheses are tested:

- 1. Individuals residing in mixed-use centers will take more walking trips than residents of auto-oriented neighborhoods.*

Since higher levels of accessibility imply shorter distances to retail destinations and activities and neighborhoods with higher levels of accessibility tend to be more pedestrian-oriented, individuals residing in these communities would be inclined to take more walking trips than individuals residing in auto-oriented corridors.

*2. Residents living in mixed-use centers will not take fewer automobile trips than residents living in auto-oriented corridors.*

Although some residents may choose to walk more often to neighborhood destinations in mixed-use centers given the increased pedestrian accessibility and shorter distances, the shorter trip distances may induce more frequent trips by car, which would offset gains in walking trips. Some authors have suggested that greater induced car trip-making, due to shorter trip distances, could even increase the total number of car trips that residents make in New Urbanist neighborhoods (Crane, 1996).

I will test these hypotheses using multivariate regression analyses for the selected neighborhoods that comprise the South Bay Area of Los Angeles County. This will be discussed in more depth in the following section.



## Methodology

Eight neighborhoods (divided into sixteen study areas) that met the criteria of a mixed-use center or an auto-oriented corridor were selected for this study. The travel behavior data for this study was obtained from the South Bay Travel Survey (SBTS), which was described in detail in Chapter 2.

### *Negative Binomial Regression Analyses*

For the purposes of this study, this chapter will analyze how total trips (i.e., all modes of travel), walking trips, and driving trips will be affected by center of residence dummy variables, sociodemographic variables, and attitudinal variables using negative binomial regression analyses. Since the dependent variable is count data (number of driving and walking trips), negative binomial regressions were used (Cameron and Trivedi, 1998). The dependent variables in the regression models are the sum of all trips (*alltrip*), the number of driving trips (*drivetrip*), and walking trips (*walktrip*) made by an individual on a single day. For Models 1a, 1b, and 1c, all trips, driving trips, and walking trips will be regressed on center of residence variables for each of the sixteen study areas, such that

$$N = \beta_0 + \beta_1' C + u \quad (1)$$

where  $N$  = all trips, driving, and walking trips,  $C$  = a column vector of center of residence variables, and  $u$  = regression error term. Regression coefficients are the scalar  $\beta_0$  and the

row vector of coefficients  $\beta_1'$ . Similar notation is used for the coefficients in the models described below.

For Models 2a, 2b, and 2c, all trips, driving trips and walking trips will be regressed on center of residence variables and a vector of sociodemographic variables, such that

$$N = \beta_0 + \beta_1' C + \beta_2' S + u \quad (2)$$

where  $N$  = all trips, driving, and walking trips,  $C$  = center of residence variables,  $S$  = a column vector of sociodemographic variables, and  $u$  = regression error term.

Sociodemographic variables include the following:

- age (less than 25, 26-40, 41-65, greater than 65)
- gender
- race/ethnicity (White, Hispanic, African-American, Asian, Other Race)
- income (less than \$35k, \$35-\$55k, \$55-\$75k, \$75-100k, greater than \$100k)
- employment status
- number of children
- number of licensed drivers per household
- number of vehicles per household
- education level (less than high school, high school graduate, some college, 4-year college graduate, graduate and beyond)
- length of residence in neighborhood (less than 1 year, 1-5 years, 6-10 years, more than 10 years)

-

For Models 3a, 3b, and 3c and 4a, 4b, and 4c, all trips, driving trips and walking trips will be regressed on area variables, the above listed sociodemographic variables, and a vector of attitudinal variables, such that

$$N = \beta_0 + \beta_1' C + \beta_2' S + \beta_3' A + u \quad (3)$$

where  $N$  = all trips, driving, and walking trips,  $C$  = center of residence dummy variables,  $S$  = sociodemographic variables,  $A$  = a column vector of attitudinal variables, and  $u$  = regression error term.

For Models 3a, 3b, and 3c, the following attitudinal variables were included:

- Q10: being able to walk to nearby stores and restaurants
- Q11: being able to walk to work
- Q12: living less than a ten minute drive to work
- Q13: having good schools in the neighborhood
- Q14: neighborhood safety
- Q15: having nearby entertainment opportunities in the neighborhood
- Q16: having transportation options in the neighborhood
- Q17: living in a neighborhood with vibrant street life
- Q18: living in a neighborhood where people are friendly

The attitudinal variables (Q10 through Q18) were derived from questions where respondents were asked to rate on a 5-point ordinal scale (from “not at all important” to “very important”) how important the above factors are for them and the neighborhoods they live in.

For Models 4a, 4b, and 4c, these variables were aggregated into three variables: *prowalk* (Q10 + Q11 + Q12), *safe\_school* (Q13 + Q14), and *proneigh* (Q15 + Q16 + Q17 + Q18), which generally show:

- favorable attitudes towards walking (*prowalk*)
- favorable attitudes towards schools and safety (*safe\_school*)
- favorable attitudes towards quality of life in the neighborhood (*proneigh*)

The Hawthorne area was chosen as the control area for the regression analyses, and the center of residence dummies for Hawthorne inner and outer ring were omitted from the regressions. Therefore, the coefficients on the area dummy variables show the effects of area residence on driving and walking trips, relative to living in Hawthorne. Hawthorne was selected as a control because it is believed that the Hawthorne neighborhood shares many characteristics of an auto-oriented suburb (wide arterials, strip businesses), is socioeconomically diverse, and does not have any striking differences in geographic and sociodemographic characteristics compared with the other areas. Therefore, comparing other mixed-use areas and auto-oriented corridors with Hawthorne seemed most appropriate.

## Results

The results of the four regression models are presented in Tables 3.1 through 3.3. Torrance Inner was dropped from all of the regressions due to collinearity with sociodemographic and attitudinal variables. The regression results are summarized in the following order: all trips, driving trips, and walking trips. Only results that are statistically significant at  $p < .05$  will be discussed hereafter. Due to the low sample sizes of some of the study areas (e.g., Inglewood), the regression results pertaining to these areas should be interpreted with caution.

**Table 3.1 All Trips Per Person Per Day by Center of Residence**

	Model 1a Center dummies only		Model 2a Sociodemo.		Model 3a Sociodemo. & Q10-Q18		Model 4a Socio. & prowalk, safeschool, proneigh	
<i>Area</i>	<i>Coeff.</i>	<i>Z-score</i>	<i>Coeff.</i>	<i>Z-score</i>	<i>Coeff.</i>	<i>Z-score</i>	<i>Coeff.</i>	<i>Z-score</i>
PCH	<b>0.278</b>	<b>3.56</b>	<b>0.202</b>	<b>2.23</b>	0.162	1.76	0.171	1.85
TOTO	0.175	1.83	-0.034	-0.27	0.033	0.25	0.009	0.07
INGI	-0.603	-1.43	<b>1.427</b>	<b>2.54</b>	<b>1.545</b>	<b>2.8</b>	<b>1.454</b>	<b>2.6</b>
INGO	<b>-0.454</b>	<b>-3.22</b>	0.135	0.72	-0.003	-0.01	-0.048	-0.22
RIVI	0.140	1.24	0.182	1.48	0.209	1.64	0.211	1.65
RIVO	0.042	0.46	0.073	0.58	0.031	0.24	0.034	0.26
ESI	-0.039	-0.42	-0.048	-0.54	-0.035	-0.4	-0.036	-0.4
ESO	<b>0.180</b>	<b>2.09</b>	<b>0.160</b>	<b>1.96</b>	0.145	1.77	<b>0.167</b>	<b>2.04</b>
ESW	<b>0.274</b>	<b>3.71</b>	<b>0.152</b>	<b>2.08</b>	0.141	1.92	<b>0.149</b>	<b>2.03</b>
ARTI	0.092	1.18	-0.015	-0.21	-0.022	-0.3	-0.014	-0.18
ARTO	0.122	1.63	-0.013	-0.18	-0.029	-0.39	-0.011	-0.16
GARDI	0.009	0.09	0.095	1.02	0.082	0.89	0.086	0.93
GARDO	0.854	-0.45	-0.070	-0.8	-0.083	-0.94	-0.079	-0.89
	Pseudo R-Squared = 0.0055  N = 2399		Pseudo R-Squared = 0.0198  N = 1586		Pseudo R-Squared = 0.0246  N = 1564		Pseudo R-Squared = 0.0246  N = 1564	

Note: Coefficients shown in bold are significant at the five percent level or greater.

*Results for All Individual Trips for Mixed-Use Centers and Corridors*

For Model 1a (center of residence variables only), the negative binomial regression results show that individuals living in the PCH corridor, El Segundo Outer, and El Segundo W. take more individual trips than the Hawthorne control group (Table 3). Inglewood Outer reported fewer individual trips than Hawthorne. In Model 2a, when sociodemographic variables were added, individuals living in PCH, Inglewood Inner, El Segundo Outer, and El Segundo W. had significantly more trips per day than in Hawthorne. The inclusion of sociodemographic variables changed the significance of Inglewood Outer and Inglewood Inner. Trips in Inglewood Outer were not significantly different to trips in Hawthorne while trips in Inglewood Inner were significantly greater. When the attitudinal variables (q10-q18) were added in Model 3a, all areas that were statistically significant in Model 2a lost significance except for Inglewood Inner. Therefore, only Inglewood Inner has significantly more total trips than Hawthorne. In Model 4a (when *prowalk*, *safe\_school*, and *proneigh* variables were added), Inglewood Inner remained statistically significant and El Segundo Outer and El Segundo W. regained statistical significance.

Based on the regression results, it is unclear whether there are significant differences between mixed-use centers and auto-oriented corridors after controlling for sociodemographic and attitudinal variables.

**Table 3.2 Driving Trips Per Person Per Day by Center of Residence**

	Model 1b Center dummies only		Model 2b Sociodemo.		Model 3b Sociodemo. & Q10-Q18		Model 4b Socio. & prowalk, safeschool, proneigh	
<i>Area</i>	<i>Coeff.</i>	<i>Z-score</i>	<i>Coeff.</i>	<i>Z-score</i>	<i>Coeff.</i>	<i>Z-score</i>	<i>Coeff.</i>	<i>Z-score</i>
PCH	<b>0.533</b>	<b>6.56</b>	<b>0.492</b>	<b>5.20</b>	<b>0.443</b>	<b>4.61</b>	<b>0.451</b>	<b>4.67</b>
TOTO	<b>0.348</b>	<b>3.49</b>	<b>0.300</b>	<b>2.31</b>	<b>0.368</b>	<b>2.80</b>	<b>0.345</b>	<b>2.62</b>
INGI	-0.287	-0.68	<b>1.592</b>	<b>2.86</b>	<b>1.735</b>	<b>3.21</b>	<b>1.654</b>	<b>3.01</b>
INGO	<b>-0.319</b>	<b>-2.14</b>	0.324	1.69	0.242	1.12	0.184	0.85
RIVI	<b>0.309</b>	<b>2.62</b>	<b>0.380</b>	<b>2.92</b>	<b>0.412</b>	<b>3.07</b>	<b>0.423</b>	<b>3.16</b>
RIVO	<b>0.213</b>	<b>2.26</b>	<b>0.272</b>	<b>2.07</b>	0.264	1.93	<b>0.273</b>	<b>2.00</b>
ESI	0.008	0.08	0.033	0.34	0.051	0.52	0.056	0.58
ESO	0.103	1.10	0.096	1.06	0.085	0.92	0.111	1.20
ESW	<b>0.172</b>	<b>2.14</b>	0.099	1.22	0.099	1.21	0.114	1.39
ARTI	<b>0.326</b>	<b>4.00</b>	<b>0.252</b>	<b>3.17</b>	<b>0.243</b>	<b>3.05</b>	<b>0.255</b>	<b>3.20</b>
ARTO	<b>0.399</b>	<b>5.14</b>	<b>0.300</b>	<b>3.83</b>	<b>0.277</b>	<b>3.52</b>	<b>0.301</b>	<b>3.83</b>
GARDI	<b>0.234</b>	<b>2.39</b>	<b>0.339</b>	<b>3.49</b>	<b>0.329</b>	<b>3.41</b>	<b>0.336</b>	<b>3.46</b>
GARDO	<b>0.236</b>	<b>2.46</b>	<b>0.236</b>	<b>2.55</b>	<b>0.222</b>	<b>2.41</b>	<b>0.229</b>	<b>2.48</b>
	Pseudo R-Squared = 0.0092  N = 2399		Pseudo R-Squared = 0.0232  N = 1586		Pseudo R-Squared = 0.0285  N = 1564		Pseudo R-Squared = 0.0245  N = 1564	

Note: Coefficients shown in bold are significant at the five percent level or greater.

*Results for Individual Driving Trips for Mixed-Use Centers and Corridors*

The regression results for Model 1b show that persons living in all areas (with the exception of Inglewood Inner, El Segundo Inner, and El Segundo Outer) take more driving trips than persons living in Hawthorne (Table 3.2). Residents living in Inglewood Outer take fewer driving trips than those in Hawthorne. The highest z-scores were reported for PCH (6.56), Artesia Outer (5.14), and Artesia Inner (4.00), which are all auto-oriented corridors. When sociodemographic variables were added in Model 2b, residents in PCH, Torrance Outer, Inglewood Inner, Riviera Village Inner and Outer, Artesia Inner and Outer, and Gardena Inner and Outer take a significantly higher number

of driving trips per person per day than in the control area, Hawthorne. In addition, Inglewood Outer and El Segundo W. lost statistical significance, indicating that driving trips in these areas were not significantly different than in Hawthorne. Adding the attitudinal variables in Model 3b and Model 4b did not result in any changes from Model 2b—the areas that had higher driving trips remained statistically significant.

The results from the negative binomial regression analyses suggest that it is difficult to distinguish any significant differences in the number of individual daily driving trips between mixed-use centers and auto-oriented corridors. These findings challenge New Urbanist claims that individuals living in neo-traditional neighborhoods take fewer driving trips than individuals living in traditional auto-oriented suburbs. Compared to individuals living in the Hawthorne control area, individuals residing in 9 of the 16 study areas took significantly more driving trips when sociodemographic and attitudinal variables were controlled for. Five of these areas were auto-oriented corridors (PCH, Artesia Inner and Outer, and Gardena Inner and Outer) and four were mixed-use centers (Torrance Outer, Inglewood Inner, and Riviera Village Inner and Outer). Therefore, almost an even number of mixed-use centers and auto-oriented corridors reported higher driving trips than the control area. It is interesting to note that several mixed-use centers reported higher driving trips than Hawthorne, which is an auto-oriented corridor. The higher number of driving trips reported in the mixed-use centers suggests that Crane's (1996) assertion that neo-traditional and New Urbanist designs may not reduce automobile trips but may actually encourage more auto trips may have validity. In sum, these findings failed to reject the null hypothesis that individuals residing in



mixed-use centers do not take fewer automobile trips than individuals in auto-oriented corridors.

**Table 3.3 Walking Trips Per Person Per Day by Center of Residence**

	Model 1c Center dummies only		Model 2c Sociodemo.		Model 3c Sociodemo. & Q10-Q18		Model 4c Socio. & prowalk, safeschool, proneigh	
<i>Area</i>	<i>Coeff.</i>	<i>Z-score</i>	<i>Coeff.</i>	<i>Z-score</i>	<i>Coeff.</i>	<i>Z-score</i>	<i>Coeff.</i>	<i>Z-score</i>
PCH	0.645	1.82	<b>1.515</b>	<b>2.43</b>	<b>1.914</b>	<b>2.95</b>	<b>1.885</b>	<b>2.90</b>
TOTO	<b>0.985</b>	<b>2.47</b>	0.902	1.06	1.102	1.27	1.108	1.26
INGI	0.640	0.44	-11.198	0	0.398	0	0.769	0
INGO	0.021	0.03	1.948	1.41	-12.212	-0.01	-11.866	-0.01
RIVI	<b>1.626</b>	<b>3.81</b>	<b>2.906</b>	<b>4.09</b>	<b>2.347</b>	<b>3.25</b>	<b>2.826</b>	<b>3.89</b>
RIVO	<b>1.079</b>	<b>2.93</b>	<b>1.92</b>	<b>2.77</b>	1.448	1.91	<b>1.652</b>	<b>2.17</b>
ESI	0.727	1.88	<b>1.588</b>	<b>2.75</b>	<b>1.422</b>	<b>2.43</b>	<b>1.551</b>	<b>2.65</b>
ESO	0.395	1.00	<b>1.540</b>	<b>2.67</b>	<b>1.461</b>	<b>2.47</b>	<b>1.485</b>	<b>2.53</b>
ESW	0.192	0.54	<b>1.316</b>	<b>2.43</b>	<b>1.439</b>	<b>2.59</b>	<b>1.382</b>	<b>2.50</b>
ARTI	0.460	1.30	<b>1.369</b>	<b>2.52</b>	<b>1.470</b>	<b>2.63</b>	<b>1.459</b>	<b>2.62</b>
ARTO	-0.226	-0.59	0.761	1.37	0.931	1.62	0.867	1.53
GARDI	-0.549	-1.04	0.729	1.06	0.708	1.03	0.740	1.06
GARDO	<b>-1.306</b>	<b>-1.96</b>	-0.594	-0.67	-0.501	-0.56	-0.435	-0.49
	Pseudo R-Squared = 0.0293  N = 2399		Pseudo R-Squared = 0.0629  N = 1586		Pseudo R-Squared = 0.0896  N = 1564		Pseudo R-Squared = 0.0767  N = 1564	

Note: Coefficients shown in bold are significant at the five percent level or greater.

*Results for Individual Walking Trips for Mixed-Use Centers and Corridors*

The negative binomial regression results show that individuals living in Torrance Outer, Riviera Village Inner and Outer take more walking trips than in the control area, Hawthorne (see Model 1c in Table 3.3). Gardena Outer reported fewer statistically

significant walking trips than Hawthorne. The z-scores for Riviera Village Inner and Outer are the highest (3.81 and 2.93, respectively), which is to be expected given that this area has dense pedestrian and retail activity at the center. With the exception of Gardena Outer, none of the auto-oriented corridors had statistically significant coefficients. In Model 2c, when sociodemographic variables were included, Riviera Village Inner and Outer, PCH, Artesia Inner, and El Segundo Inner, Outer, and W. had significantly more walking trips per person per day than in Hawthorne. Walking trips for individuals in Torrance Outer and Gardena Outer did not remain statistically significant when sociodemographic variables were added to the regression. Adding the attitudinal variables in Model 3c and Model 4c did not result in any changes from Model 2c with the exception of Riviera Village Outer losing significance in Model 3c.

The regression analyses predicting walking trips show that the majority of mixed-use centers reported higher number of individual walking trips relative to the Hawthorne control area, thereby supporting the New Urbanist claim that neo-traditional neighborhoods promote more walking. After controlling for sociodemographic and attitudinal variables, individuals residing in seven of the study areas took a significantly higher number of walking trips than the Hawthorne control group—five were mixed-use centers (Riviera Village Inner and Outer and El Segundo Inner, Outer, and W.) and two were auto-oriented corridors (PCH and Artesia Inner). The mixed-use centers that did not report a significantly higher number of walking trips include Torrance Outer and Inglewood Inner and Outer.

Based on my knowledge of the study areas, it is not surprising that Riviera Village reported a higher number of walking trips, given that this area is very pedestrian-

oriented in design (small blocks, narrow streets) and a large number of pedestrians can be observed from the street. Downtown El Segundo is also compact and its compact grid street patterns are conducive to pedestrian activity. Among the mixed-use centers that did not report a higher number of walking trips, the following reasons may explain these results. The relatively low pedestrian activity for Torrance Outer could be explained by the fact that a significant proportion of the area is occupied by a Honda research and development plant which is surrounded by large parking lots and open space. For Inglewood, possible explanations for the low pedestrian activity include the lack of pedestrian amenities and the perception of the area as being unsafe for walking due to its high crime rate. For the auto-oriented corridors that reported a higher number of walking trips (PCH and Artesia Inner), these results were unexpected and it is unclear why these areas reported a statistically higher number of walking trips.

### **Methodology (Instrumental Variable Model)**

#### *Part Two: Using an Instrumental Variable Model for Analyzing Location Choice and Travel Behavior*

Although the models mentioned in the previous section show notable differences in walking and driving trips across mixed-use centers and corridors, it assumes that the direction of causality flows from the built environment to travel behavior. However, as previously mentioned, many studies in the travel behavior literature have not adequately controlled for residential location choice or self-selection bias (Boarnet and Sarmiento, 1998; Handy, 1996a). This problem can be illustrated in the following equation, which assumes that the number of non-work driving trips is approximately continuous

$$N = \beta_0 + \beta_1' L + \beta_2 y + \beta_3 y^2 + \beta_4' S + u \quad (1)$$

where  $L$  is the vector of land use variables,  $y$  is income,  $S$  is a vector of sociodemographic variables, and  $u$  is the regression error term.

When individuals choose residential locations based on unobserved preferences which are correlated with attitudes toward driving, for example, the variables in the  $L$  vector may be correlated with  $u$ , leading to endogeneity bias in OLS. For example, an individual who is averse to driving may choose to drive less often but also choose to live in high density, mixed-use centers where alternative transportation options are available. In such situations, the OLS estimates for the above equation will be inconsistent and biased. However, this problem can be ameliorated by the use of instrumental variables (Boarnet and Sarmiento, 1998; Boarnet and Greenwald, 2000; Greenwald and Boarnet, 2001).

The choice of instruments is critical and should be carefully selected so that they are highly correlated with urban form but not correlated with the error term. Assume that the residential location of an individual can be expressed in the following equation:

$$ResLoc = f(C_i, A_i) \quad (2)$$

where  $ResLoc$  = individual's residential location,  $C_i$  = individual sociodemographic characteristics, and  $A_i$  = characteristics of residential locations, including location-

specific amenities such as proximity to highways, recreational areas, retail stores, quality of schools, age of housing stock, and demographics of the surrounding neighborhood.

If individuals choose residential locations based on unobserved preferences that are correlated with travel mode preferences, the variables in the  $L$  vector (land use variables) may be correlated with  $u$ , the error term. Since the variables in equation (2) explain residential location choice, they are potential instruments for the  $L$  variables in equation (1).

The following land use variables and non-transportation related instruments have been selected for the instrumental variable model:

Land use variables  $L$  include:

*pop\_den* = population density of study area according to 2000 census block groups

*job\_den* = employment density of study area according to 2000 census block groups

*pct\_4way* = percentage of intersections that are four-way within study area

*int\_den* = density of intersections per square mile within study area

*pct\_park* = percent of total area that is parkland or open space within study area

Selected instruments for the land use variables include:

*pct\_hisp* = percentage of population identified as Hispanic from the 2000 census living in study area

*pct\_blak* = percentage of population identified as African-American from the 2000 census living in study area

*pct\_asn* = percentage of population identified as Asian from the 2000 census living in study area

The instrumental variable model uses a two stage least squares (2SLS) estimator to correct for endogeneity bias in OLS. In the first stage, the problematic endogenous variable (land use variables) is regressed on all exogenous and predetermined variables (selected instruments) to create new instrumental variables. In the second stage, OLS regression is computed using the newly created instrumental variables which are uncorrelated with the error term, replacing the problematic endogenous variable. Assuming that all other assumptions for OLS are met, the coefficients will be unbiased and consistent (Johnston, 1972; Wooldridge, 2003).

### **Results (Instrumental Variable Model)**

Two sets of instrumental variable (IV) regressions were computed for individual nonwork driving trips and walking trips, presented in Tables 3.4 and 3.5. Driving and walking trips were regressed on sociodemographic variables and one land use variable. Due to the small number of instruments, only one land use variable was included for each IV regression. The columns are grouped into pairs, first showing the OLS estimates and the IV estimates for the same specifications (presented below):

Columns A and B: OLS and IV regressions were computed for driving/walking trips regressed on sociodemographic variables and the land use variable *pop\_den* (population density).

Columns C and D: OLS and IV regressions were computed for driving/walking trips regressed on sociodemographic variables and the land use variable *job\_den* (job density).

Columns E and F: OLS and IV regressions were computed for driving/walking trips regressed on sociodemographic variables and the land use variable *pct\_4way* (percentage of four-way intersections).

Columns G and H: OLS and IV regressions were computed for driving/walking trips regressed on sociodemographic variables and the land use variable *int\_den* (intersection density – number of intersections divided by square mile of study area).

Columns I and J: OLS and IV regressions were computed for driving/walking trips regressed on sociodemographic variables and the land use variable *pct\_park* (percentage of parks and open space in study area).

Additionally, an overidentification test (Sargan test) was conducted for each IV regression to test the validity of the selected instruments. This tests the null hypothesis that the instruments are uncorrelated with the error term, which is required for unbiased and consistent estimates. The observed chi-square statistic and p-values are presented for IV regression.

### *Comparison of OLS and IV Regressions for Driving Trips*

For the most part, the results in Table 3.4 show little or no change in significance between the OLS and IV results. However, there are a few notable exceptions to this pattern. The regression results in Columns A and B show that the endogenous land use variable (population density) is not statistically significant in the OLS regression, but gains statistical significance in the IV regression (t-statistic: -2.25). The results in Columns C and D indicate two sociodemographic variables (household income > 100k and employment status) as significant in the OLS regression, but insignificant in the IV regression.

For the IV regressions, the overidentification tests reject the null hypothesis that the instrument set is valid for the following land use variables at the 5% critical value: population density (p-value = 0.0030), percentage of four-way intersections (p-value = 0.0004), intersection density (p-value = 0.0074), and percentage of parks and open space (p-value = 0.0003). This suggests that the instruments that were selected for these land use variables may not be the most appropriate. For the IV regression for job density, however, the results were more encouraging—the overidentification test failed to reject the null hypothesis at the 95% level of significance (p-value = 0.1431), suggesting that the selected instruments may be valid for the job density land use variable.

### *Comparison of OLS and IV Regressions for Walking Trips*

The results in Table 3.5 show a few notable changes in significance between OLS and IV regression results. In Columns A and B (population density), two sociodemographic variables (“Asian” and “Tenure”) lose significance from OLS to IV,



while one sociodemographic variable (Household income 35-55k) gains significance from OLS to IV. In Columns E and F, the land use variable (percentage of four-way intersections) is statistically significant in OLS but loses significance in the IV regression. In Columns I and J, the land use variable (percentage of parks and open space) gains statistical significance from OLS to IV.

The overidentification tests rejected the null hypothesis at the 95% level of significance for the land use variables population density (p-value = 0.0335) and job density (p-value: 0.0205), and failed to reject the null hypothesis for the land use variables percentage of four-way intersections (p-value = 0.0946), intersection density (p-value = 0.3040), and percentage park and open space (p-value = 0.3935). The selected instruments performed especially well for the intersection density and percentage of parks and open space variables, suggesting that the selected instruments were quite valid.

**Table 3.4 Comparison of Ordinary Least Squares (OLS) and Instrumental Variable Regressions for Individual Non-work Driving Trips: Census Block Group Level**

Independent Variables	Column A: Pop. Density (OLS)		Column B: Pop. Density (IV)		Column C: Job Density (OLS)		Column D: Job Density (IV)	
	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Female	0.2230	1.93	0.2160	1.86	0.2153	1.87	0.1318	0.84
Hispanic	0.2393	1.30	0.2769	1.49	0.2401	1.31	0.3217	1.31
African-American	-0.6404	-1.90	-0.5238	-1.53	-0.5997	-1.79	0.0025	0.00
Asian	0.0884	0.56	0.0574	0.36	0.0791	0.51	-0.0661	-0.31
Household income 35-55k	0.2269	0.98	0.1967	0.84	0.2558	1.11	0.4590	1.44
Household income 55-75k	0.1180	0.53	0.0799	0.36	0.1439	0.65	0.3041	1.02
Household income 75-100k	0.3961	1.75	0.3487	1.53	0.4101	1.83	0.4431	1.50
Household income >100k	<b>0.4744</b>	<b>2.21</b>	<b>0.4250</b>	<b>1.96</b>	<b>0.4471</b>	<b>2.09</b>	0.1010	0.31
Employment status	<b>0.3994</b>	<b>2.47</b>	<b>0.4226</b>	<b>2.60</b>	<b>0.3797</b>	<b>2.36</b>	0.2457	1.11
Household with children	0.1515	1.27	0.1508	1.25	0.1485	1.25	0.1196	0.76
Tenure (rent/own)	-0.2244	-1.75	-0.2373	-1.84	-0.1672	-1.30	0.3268	1.16
Population Density	-8.60e-06	-0.67	<b>-0.00005</b>	<b>-2.25</b>				
Job Density					<b>-0.657</b>	<b>-3.16</b>	<b>-0.6634</b>	<b>-2.42</b>
Constant	<b>1.8068</b>	<b>6.40</b>	<b>2.3725</b>	<b>6.34</b>	<b>2.0067</b>	<b>8.45</b>	<b>4.9466</b>	<b>0.00</b>
Number of observations		1133		1133		1133		1133
R-squared		0.0327		0.0244		0.0408		0.00
Adjusted R-squared		0.0223		0.0139		0.0305		0.00
Overidentification Test								
X <sup>2</sup> Observed				11.590				3.888
X <sup>2</sup> P-value				0.0030				0.1431

Note: Coefficients shown in bold are significant at the five percent level or greater.

**Table 3.4 (continued). Comparison of Ordinary Least Squares (OLS) and Instrumental Variable Regressions for Individual Nonwork Driving Trips: Census Block Group Level**

Independent Variables	Column E: % 4-Way Int. (OLS)		Column F: % 4-Way Int. (IV)		Column G: Int. Density (OLS)		Column H: Int. Density (IV)	
	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Female	0.2229	1.93	0.2203	1.91	<b>0.2331</b>	<b>2.02</b>	<b>0.2350</b>	<b>2.04</b>
Hispanic	0.2162	1.16	0.1927	1.02	0.2791	1.51	0.2897	1.56
African-American	<b>-0.6680</b>	<b>-1.99</b>	<b>-0.6713</b>	<b>-2.00</b>	-0.5477	-1.62	-0.5216	-1.54
Asian	0.0632	0.37	0.0131	0.07	0.1339	0.85	0.1424	0.91
Household income 35-55k	0.2301	0.99	0.2247	0.97	0.2060	0.89	0.1999	0.86
Household income 55-75k	0.1277	0.58	0.1299	0.59	0.0786	0.35	0.0680	0.31
Household income 75-100k	0.4112	1.82	0.4188	1.86	0.3459	1.53	0.3325	1.47
Household income >100k	<b>0.4986</b>	<b>2.31</b>	<b>0.5197</b>	<b>2.40</b>	0.3960	1.83	0.3763	1.73
Employment status	<b>0.3955</b>	<b>2.45</b>	<b>0.3972</b>	<b>2.46</b>	<b>0.3806</b>	<b>2.36</b>	<b>0.3776</b>	<b>2.34</b>
Household with children	0.1514	1.26	0.1508	1.26	0.1474	1.23	0.1465	1.23
Tenure (rent/own)	-0.2154	-1.67	-0.2059	-1.59	-0.2467	-1.92	<b>-0.2523</b>	<b>-1.96</b>
% 4-way Intersections Intersection Density	-0.1837	-0.47	-0.4722	-1.00	<b>0.0050</b>	<b>2.48</b>	<b>0.0061</b>	<b>2.66</b>
Constant	<b>1.7828</b>	<b>5.92</b>	<b>1.9389</b>	<b>5.82</b>	<b>0.9472</b>	<b>2.59</b>	<b>0.7845</b>	<b>1.96</b>
Number of observations		1133		1133		1133		1133
R-squared		0.0325		0.0320		0.0376		0.0373
Adjusted R-squared		0.0221		0.0216		0.0273		0.0270
Overidentification Test								
X <sup>2</sup> Observed				15.836				9.799
X <sup>2</sup> P-value				0.0004				0.0074

Note: Coefficients shown in bold are significant at the five percent level or greater.

**Table 3.4 (continued). Comparison of Ordinary Least Squares (OLS) and Instrumental Variable Regressions for Individual Nonwork Driving Trips: Census Block Group Level**

Independent Variables	Column I: % Park/Open Space (OLS)		Column J: % Park/Open Space (IV)	
	Coeff.	T-stat.	Coeff.	T-stat.
Female	0.2240	1.94	<b>0.2291</b>	<b>1.98</b>
Hispanic	0.2269	1.22	0.2729	1.43
African-American	<b>-0.6722</b>	<b>-1.99</b>	-0.6019	-1.75
Asian	0.0893	0.56	0.1537	0.91
Household income 35-55k	0.2312	1.00	0.2562	1.10
Household income 55-75k	0.1257	0.57	0.1321	0.60
Household income 75-100k	0.4055	1.80	0.4161	1.84
Household income >100k	<b>0.4865</b>	<b>2.27</b>	<b>0.4715</b>	<b>2.19</b>
Employment status	<b>0.3933</b>	<b>2.44</b>	<b>0.4049</b>	<b>2.50</b>
Household with children	0.1524	1.27	0.1451	1.21
Tenure (rent/own)	-0.2200	-1.71	-0.2364	-1.82
% Park/Open Space	-0.3427	-0.18	3.4434	0.90
Constant	<b>1.6918</b>	<b>7.69</b>	<b>1.5992</b>	<b>6.81</b>
Number of observations		1133		1133
R-squared		0.0323		0.0288
Adjusted R-squared		0.0219		0.0184
Overidentification Test				
X <sup>2</sup> Observed				15.969
X <sup>2</sup> P-value				0.0003

Note: Coefficients shown in bold are significant at the five percent level or greater.

**Table 3.5 Comparison of Ordinary Least Squares (OLS) and Instrumental Variable Regressions for Individual Non-work Walking Trips: Census Block Group Level**

Independent Variables	Column A: Pop. Density (OLS)		Column B: Pop. Density (IV)		Column C: Job Density (OLS)		Column D: Job Density (IV)	
	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Female	-0.0151	-0.62	-0.0161	-0.99	-0.0145	-0.60	-0.0158	-0.63
Hispanic	-0.0309	-0.79	-0.0257	-0.66	-0.0307	-0.79	-0.0294	-0.75
African-American	-0.0850	-1.19	-0.0687	-0.65	-0.0874	-1.23	-0.0780	-0.93
Asian	<b>-0.0690</b>	<b>-2.09</b>	-0.0733	-0.95	<b>-0.0685</b>	<b>-2.08</b>	<b>-0.0708</b>	<b>-2.04</b>
Household income 35-55k	-0.0532	-1.09	<b>-0.0574</b>	<b>-2.21</b>	-0.0558	-1.14	-0.0527	-1.03
Household income 55-75k	-0.0762	-1.63	-0.0815	-1.17	-0.0787	-1.68	-0.0762	-1.58
Household income 75-100k	-0.0027	-0.06	-0.0093	-1.73	-0.0043	-0.09	-0.0037	-0.08
Household income >100k	0.0029	0.06	-0.0040	-0.19	0.0047	0.10	-0.0007	-0.01
Employment status	0.0157	0.46	0.0189	-0.09	0.0176	0.52	0.0155	0.44
Household with children	-0.0190	-0.75	-0.0191	0.55	-0.0188	-0.74	-0.0192	-0.76
Tenure (rent/own)	<b>0.0719</b>	<b>2.65</b>	0.0700	-0.76	<b>0.0670</b>	<b>2.45</b>	0.0747	1.64
Population Density	1.06e-06	0.39	-4.43e-06	-0.99				
Job Density					0.0055	1.24	-0.0038	-0.09
Constant	0.0839	1.41	<b>0.1627</b>	<b>2.06</b>	0.0721	1.43	0.1181	0.53
Number of observations		1133		1133		1133		1133
R-squared		0.0181		0.0144		0.0193		0.0154
Adjusted R-squared		0.0076		0.0039		0.0088		0.0048
Overidentification Test								
X <sup>2</sup> Observed				6.791				7.775
X <sup>2</sup> P-value				0.0335				0.0205

Note: Coefficients shown in bold are significant at the five percent level or greater.

**Table 3.5 (continued). Comparison of Ordinary Least Squares (OLS) and Instrumental Variable Regressions for Individual Nonwork Walking Trips: Census Block Group Level**

Independent Variables	Column E: % 4-Way Int. (OLS)		Column F: % 4-Way Int. (IV)		Column G: Int. Density (OLS)		Column H: Int. Density (IV)	
	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Female	-0.0137	-0.56	-0.0138	-0.57	-0.0138	-0.57	-0.0134	-0.55
Hispanic	-0.0155	-0.39	-0.0158	-0.40	-0.0218	-0.56	-0.0191	-0.49
African-American	-0.0798	-1.13	-0.0798	-1.13	-0.0619	-0.87	-0.0552	-0.77
Asian	-0.0390	-1.09	-0.0396	-1.07	-0.0633	-1.91	-0.0611	-1.84
Household income 35-55k	-0.0507	-1.04	-0.0507	-1.04	-0.0586	-1.20	-0.0602	-1.23
Household income 55-75k	-0.0786	-1.69	-0.0786	-1.68	-0.0853	-1.82	-0.0880	-1.88
Household income 75-100k	-0.0086	-0.18	-0.0085	-0.18	-0.0142	-0.30	-0.0176	-0.37
Household income >100k	-0.0115	-0.25	-0.0112	-0.24	-0.0135	-0.30	-0.0185	-0.40
Employment status	0.0153	0.45	0.0153	0.45	0.0140	0.41	0.0132	0.39
Household with children	-0.0187	-0.74	-0.0187	-0.74	-0.0198	-0.78	-0.0200	-0.79
Tenure (rent/own)	<b>0.0657</b>	<b>2.42</b>	<b>0.0658</b>	<b>2.42</b>	<b>0.0673</b>	<b>2.48</b>	<b>0.0659</b>	<b>2.42</b>
% 4-way Intersections	<b>0.1778</b>	<b>2.17</b>	0.1741	1.76	<b>0.0009</b>	<b>1.99</b>	<b>0.0011</b>	<b>2.32</b>
Intersection Density								
Constant	0.0029	0.05	0.0049	0.07	-0.0254	-0.33	-0.0667	-0.79
Number of observations		1133		1133		1133		1133
R-squared		0.0220		0.0220		0.0214		0.0210
Adjusted R-squared		0.0116		0.0116		0.0109		0.0105
Overidentification Test								
X <sup>2</sup> Observed				4.715				2.381
X <sup>2</sup> P-value				0.0946				0.3040

Note: Coefficients shown in bold are significant at the five percent level or greater.

**Table 3.5 (continued). Comparison of Ordinary Least Squares (OLS) and Instrumental Variable Regressions for Individual Nonwork Walking Trips: Census Block Group Level**

Independent Variables	Column I: % Park/Open Space (OLS)		Column J: % Park/Open Space (IV)	
	Coeff.	T-stat.	Coeff.	T-stat.
Female	-0.0147	-0.60	-0.0127	-0.52
Hispanic	-0.0244	-0.62	-0.0064	-0.16
African-American	-0.0733	-1.03	-0.0458	-0.63
Asian	-0.0620	-1.84	-0.0369	-1.03
Household income 35-55k	-0.0510	-1.04	-0.0412	-0.83
Household income 55-75k	-0.0764	-1.64	-0.0740	-1.57
Household income 75-100k	-0.0027	-0.06	0.0015	0.03
Household income >100k	-0.0003	-0.01	-0.0062	-0.14
Employment status	0.0178	0.52	0.0223	0.65
Household with children	-0.0199	-0.79	-0.0228	-0.89
Tenure (rent/own)	<b>0.0696</b>	<b>2.56</b>	<b>0.0631</b>	<b>2.30</b>
% Park/Open Space	0.4584	1.16	<b>1.9384</b>	<b>2.40</b>
Constant	0.0879	1.90	0.0517	1.04
Number of observations		1133		1133
R-squared		0.0191		0.0068
Adjusted R-squared		0.0086		-0.0038
Overidentification Test				
X <sup>2</sup> Observed				1.865
X <sup>2</sup> P-value				0.3935

Note: Coefficients shown in bold are significant at the five percent level or greater.

### *Discussion and Analysis of Instrumental Variable Model*

The instrumental variable approach can be useful in controlling for residential location choice, with the condition that valid instruments are selected. However, finding appropriate instruments is one of the difficulties of using the IV approach. The results presented in this paper show mixed results in using the IV approach: instruments for only one out of the five land use variables were valid for driving trips, while the instruments for three out of five land use variables were valid for walking trips, which is promising. The three instruments that were chosen for the IV regression analyses presented here were selected from over a dozen instruments; the instruments that were not included in the IV regressions did not perform well in preliminary statistical tests and were therefore not considered. Despite these challenges, however, the instrumental variable approach shows much potential and improving the IV model should be a priority in future travel behavior research.

### **Conclusions**

The results from this study of South Bay neighborhoods both support and challenge New Urbanist claims. While there are no discernible differences in individual driving trips between mixed-use centers and auto-oriented corridors, there are a higher number of individual walking trips reported in mixed-use centers. These findings illustrate how the impact of urban design on walking and driving is more complex than the simple notion that New Urbanism can bring both increased walking and reduced driving. Instead, this research gives evidence that urban designs associated with more walking are not necessarily related to less driving. Future policy and research should



more carefully consider the benefits of increased pedestrian activity and how that links to New Urbanist designs, while being more cautious about whether urban design leads to reductions in non-work automobile trip generation.

Methodologically, this research brings two insights. First, the use of attitudinal variables follows other similar studies (Handy et al., 2005; Kitamura et al., 1997). This study shows that the travel behavior effect of the South Bay neighborhoods persists after controlling for both individual sociodemographic variables and the survey participants' attitudes. This provides further reason to believe that urban design has an independent effect on travel behavior. However, the question of self-selection bias requires further study. One strategy would be to use attitudinal variables, including questions about desired neighborhood type, to construct a joint model of residential location choice and travel behavior. The mathematical structure of a joint model of residential location choice and time use, which is a closely related topic, is examined in a paper by Pinjari, Bhat, and Hensher (2007). Controlling for residential selection by modeling residential location choice is a fruitful direction for future research, and the South Bay data, or similar travel survey, might support such efforts.

Second, the South Bay study applied a full travel diary survey to sixteen small neighborhoods. While there are similar travel diary studies conducted for small neighborhoods (e.g., Handy et al., 2005; Kitamura et al., 1997), this is still rare in a context where most travel diaries span metropolitan areas. This study found important insights from comparing neighborhoods chosen to represent mixed-use and auto-oriented urban designs. Going forward, technological improvements such as web-based surveys and global positioning system (GPS) travel data create the prospect that travel surveys

can be implemented with lower cost. That would make studies like the South Bay research more common, allowing comparisons of mixed-use and auto-oriented urban designs in other regions.

The evidence to date suggests that the relationship between urban design and travel behavior is complex. Most importantly, there is substantial evidence that urban design is more strongly associated with increases in walking than with reductions in driving. As a next step, a more nuanced understanding of which design features alter behaviors and which do not could improve the state of the knowledge. In addition, perhaps more multi-pronged approaches, such as neo-traditional designs and market-based approaches (e.g., charging for parking) may have a greater impact on travel behavior.

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## CHAPTER 4

### **Interactions between Race/Ethnicity and Ethnic Change on Driving and Walking Behavior**

#### **Introduction**

During the past few decades, there have been several shifts in the direction of transportation and travel behavior research focusing on different sociodemographic groups. During the 1960s and 70s, transportation scholars were primarily concerned with understanding commuting behavior (i.e., work trips) and what factors determined whether one drove or took transit to work. Some of these early studies, including Kain (1968), compared mainly differences in commuting patterns, mode choice, and commuting times between whites and minority groups (mostly African-Americans). Early travel behavior research focusing on commuting behavior for minority groups have largely relied on data obtained from national travel surveys such as the American Housing Survey and the U.S. National Household Travel Survey (Taylor and Ong, 1995; Giuliano, 2003). Based on the nature of these data, these studies, while adequate in analyzing travel behavior at the metropolitan scale, were not able to capture local or neighborhood-level factors which impact travel behavior for these groups.

To address this gap, this chapter compares individual driving and walking trips within the South Bay study areas by race and ethnicity, and analyzes the interaction between race/ethnicity ethnic change on driving and walking behavior for mixed-use centers and auto-oriented corridors in the South Bay region. The first part of this paper will examine differences in driving and walking behavior among non-Hispanic whites, Hispanics, African-Americans, and Asians. Relying on disaggregate travel data obtained



from the South Bay travel survey, individual driving trips and walking trips will be regressed on race/ethnicity variables and a vector of other sociodemographic variables. The second part of this paper will analyze the interaction effects of race/ethnicity and ethnic change for driving and walking behavior. Ethnic change is defined as the percentage change in the racial/ethnic composition of the South Bay study areas from 1990-2000. Individual driving and walking trips will be regressed on race/ethnicity variables, a vector of sociodemographic variables, a vector of ethnic change variables (percentage change for each race/ethnic group), and interaction variables (race/ethnicity variables multiplied by ethnic change variables). The results of the regression analyses would determine whether race/ethnicity is a significant factor in accounting for differences in individual driving and walking trips in the South Bay Area and whether the interaction effects of ethnic change are also significant factors for predicting individual driving and walking trips.

### **Background of the Study: Race/Ethnicity in the South Bay Region**

The South Bay region, occupying the southwestern portion of Los Angeles County, can be roughly defined as the area bounded by the Pacific Ocean on the south and west, and flanked by the I-105 and I-110 freeways in the north and east. With a population of over 1 million, it is one of the most racially and ethnically diverse regions in the United States, containing approximately a dozen incorporated cities and several unincorporated communities, including those that are part of the city of Los Angeles. In the region as a whole, there is a largely even distribution of whites, Hispanics, African-Americans, and Asians; however, the racial and ethnic makeup varies widely by

community. In general, the majority of whites and Asians are concentrated along the west and southwest near the Pacific coast, while Hispanic and African-American populations tend to be concentrated further inland towards the northeast and eastern boundaries.

The racial and ethnic makeup of the South Bay study areas also reflects the diversity of the region. Table 4.1 shows the population and proportion for whites, Hispanics, African-American, and Asians for each study area. In three of the eight study areas listed, racial/ethnic minorities comprise the majority of the area population (Gardena, Hawthorne, and Inglewood). Hispanics are the largest minority group for all but two of the areas (all except Inglewood and Pacific Coast Highway); African-Americans are the largest minority group in Inglewood and Asians comprise the largest minority group in PCH.

The South Bay region has become more ethnically and racially diverse from 1990 to 2000, primarily due to the influx of Hispanic and Asian immigrant groups during the 1990s. Table 4.2 shows the percentage change for Hispanic, African-American, and Asian populations from 1990-2000. Hispanics reported the highest percentage gains overall; the proportion of Hispanics increased for all study areas (with the exception of Torrance) with Artesia, Gardena, Hawthorne, and Inglewood having the greatest percentage increase. The proportion of African-Americans also increased slightly for all study areas, with Hawthorne experiencing the greatest percentage gain (5.73%). The Asian population reported both percentage gains and losses: the proportion of Asians residing in Artesia, Inglewood, PCH, Riviera Village, and Torrance increased while the proportion of Asians decreased in Gardena, Hawthorne, and Inglewood, which were the areas that experienced the highest gains in the Hispanic population.

Based on the demographic changes from 1990 to 2000, several trends can be observed for Hispanics, African-Americans, and Asian populations in the South Bay study areas. The Hispanic population reported the highest percentage gains in the inland South Bay cities adjacent to South Los Angeles, which is the least affluent area in the South Bay. The proportion of Hispanics remains relatively low in PCH and Riviera Village, which are the most affluent areas in the study. The African-American population has remained relatively stable during the 1990s, concentrated primarily in working-class Inglewood and Hawthorne. The Asian population reported percentage losses in the poorer inland South Bay cities and experienced gains in the affluent coastal South Bay cities, suggesting that many Asians have migrated from working class to more affluent communities in the South Bay during the 1990s.

**Table 4.1 Racial and Ethnic Composition of South Bay Study Areas (2000 Census)**

Study Area	Total Area Pop.	White		Hispanic		African-American		Asian	
		Area Pop.	% of Total	Area Pop.	% of Total	Area Pop.	% of Total	Area Pop.	% of Total
Artesia*	27,962	19,797	70.80	<b>5,581</b>	<b>19.96</b>	1,122	4.01	3,006	10.75
El Segundo*	5,671	4,767	84.06	<b>704</b>	<b>12.41</b>	55	0.97	324	5.71
Gardena*	19,077	5,268	27.61	<b>7,458</b>	<b>39.09</b>	1,704	8.93	6,983	36.60
Hawthorne*	31,434	10,676	33.96	<b>14,956</b>	<b>47.58</b>	7,233	23.01	2,953	9.00
Inglewood*	15,631	3,031	19.40	6,620	42.40	<b>7,939</b>	<b>50.80</b>	238	1.50
PCH	10,530	6,981	66.30	940	8.93	189	1.79	<b>2,513</b>	<b>23.87</b>
Riviera Village*	7,092	6,120	86.30	<b>539</b>	<b>7.60</b>	104	1.50	414	5.80
Torrance*	4,543	3,027	66.60	<b>1,224</b>	<b>26.90</b>	109	2.40	515	11.30

Note: The study areas are identical to the mixed-use centers and auto-oriented corridors that were defined in Paper 1. The largest racial/ethnic minority for each of the study areas are in bold type.

\* These areas include both Inner and Outer rings.

**Table 4.2 Percentage Change for Hispanic, African-American, and Asian Populations from 1990 – 2000**

Study Area	Hispanic			African-American			Asian		
	% of Total Area Pop. in 2000	% of Total Area Pop. in 1990	% Change from 1990 to 2000	% of Total Area Pop. in 2000	% of Total Area Pop. in 1990	% Change from 1990 to 2000	% of Total Area Pop. in 2000	% of Total Area Pop. in 1990	% Change from 1990 to 2000
Artesia	19.96%	14.94%	<b>+5.02%</b>	4.01%	2.63%	+1.39%	10.75%	8.25%	+2.50%
El Segundo	12.29%	10.34%	+1.95%	0.97%	0.73%	+0.24%	6.41%	4.28%	+2.14%
Gardena	39.09%	28.93%	<b>+10.16%</b>	8.93%	4.94%	+3.99%	36.60%	44.81%	<b>-8.21%</b>
Hawthorne	47.58%	29.99%	<b>+17.59%</b>	23.01%	17.28%	<b>+5.73%</b>	9.39%	14.37%	-4.98%
Inglewood	44.68%	38.87%	<b>+5.81%</b>	48.80%	48.36%	+0.44%	1.35%	3.25%	-1.90%
PCH	8.84%	7.40%	+1.45%	1.64%	1.43%	+0.20%	23.08%	16.37%	<b>+6.71%</b>
Riviera Village	7.54%	6.86%	+0.67%	1.51%	1.09%	+0.42%	5.72%	4.60%	+1.11%
Torrance	25.09%	26.77%	-1.68%	2.35%	1.56%	+0.79%	10.95%	6.19%	+4.76%

Note: Percentage changes greater than 5.00% are listed in bold type.

## **Literature Review**

The complex relationship between travel behavior, the built environment, and residential location choice has been the subject of numerous studies in the transportation and travel behavior literature in recent decades. Several studies have focused on differences in travel behavior across metropolitan regions relying on aggregate data (Pushkarev and Zupan, 1977; Newman and Kenworthy, 1989) while others have specifically focused on differences in travel behavior between auto-oriented suburban neighborhoods and traditional/neo-traditional neighborhoods relying primarily on disaggregate data (Boarnet and Crane, 2001; Handy, 1996a). These studies have helped increase our understanding of the complexities of travel behavior and have not only contributed to academic scholarship, but have shaped urban planning and transportation policy.

Despite extensive research conducted on land use and travel behavior since the 1960s, relatively few studies have focused specifically on differences in travel behavior between different racial and ethnic groups. Early studies focused on differences in commuting to work behavior across racial/ethnic lines; these include Kain's (1968) study of the commuting patterns of black workers in Chicago and Detroit during the 1950s, which found that residential segregation in tandem with decentralization had created a spatial mismatch for black workers. Kain's spatial mismatch hypothesis highlighted the growing gap between whites and blacks in terms of commuting times and distances where blacks, mostly residing in the central city, had to endure long commutes to jobs that have relocated in the suburbs. Whether this spatial mismatch has persisted has been a matter of scholarly debate, however. Taylor and Ong's (1995) study comparing the

commuting trends of white and minority (black and Hispanic) workers between 1977-78 and 1985, which relied on metropolitan sample data from the American Housing Survey, found little conclusive evidence to support the spatial mismatch hypothesis. Based on multivariate regression analyses, Taylor and Ong have asserted that average commuting times for minority workers have remained stable or declined between 1977-78 and 1985, and that commuting distances for minority workers have not increased compared to whites. In contrast, other studies have shown some evidence that the spatial mismatch has persisted, especially among low-wage workers residing in central cities, who are more likely to rely on public transit and have lengthier commute times (Johnston-Anumonwo, 1995; Ong and Blumenberg, 1998).

In light of spatial mismatch concerns, transportation research in recent years has brought attention to equity concerns for low-income minority commuters, which have had a noticeable impact on metropolitan transportation policies. Several studies have addressed equity concerns specific to public transit policy (Brown, 1998; Garrett and Taylor, 1999), while others have focused on highway policy (Litman, 1996; Bullard, et al., 2004). Los Angeles was the epicenter for both equity concerns during the 1990s, which was exemplified by the 1994 MTA/L.A. Bus Rider's Union lawsuit, in which the MTA was charged with subsidizing costly rail projects while cutting back bus service (Garrett and Taylor, 1999; Brown, 1998), and the construction of the Century Freeway (I-105), which displaced hundreds of low-income minorities in South-Central Los Angeles (Van Hengel, DiMento, and Ryan, 1999).

Travel behavior research focusing on commuting behavior for minority groups have largely relied on data obtained from national travel surveys such as the American Housing Survey and the U.S. National Household Travel Survey (NHTS) for statistical analyses (Taylor and Ong, 1995; Giuliano, 2003). While national databases contain a rich array of household travel behavior data across metropolitan regions, relying on these data alone would not be able to adequately capture the localized impacts of the built environment on travel behavior, such as the construction of a new freeway or the expansion of a rail or bus transit line. For example, the NHTS asks respondents about travel-related household characteristics, characteristics of daily trip making (mode choice, purpose of trip, etc.), and characteristics of long distance travel, but does not ask about the built environment characteristics of the respondents' residence or respondents' attitudes toward travel, which has a significant impact on travel mode choice (Handy, Cao, and Mohktarian, 2005). In addition, it would be difficult for nationwide travel data to capture the differences in travel behavior for a specific metropolitan area because the questions are not region-specific, with the exception of a handful of jurisdictions that could purchase an "add-on" survey specific to their area (U.S. Department of Transportation, 2001). The overall effect of using national household travel data for comparing travel behavior across racial/ethnic groups is the tendency to generalize travel behavior characteristics for each group without taking local or regional factors into account. For instance, travel behavior and mode choice characteristics of Hispanics living in Brooklyn will most likely be different from Hispanics living in Brownsville, Texas due to the vastly different built environment characteristics of the two areas.



Some recent studies have used local and metropolitan household surveys, for example, Mauch and Taylor's (1997) analysis of commuting and household-serving travel in the San Francisco Bay Area. Mauch and Taylor used detailed trip diary data from a 1990 travel survey of Bay Area residents to examine the effects of race and ethnicity in travel behavior among men and women. They found that gender differences in commuting times also vary by race/ethnicity, although in general, the regression results for differences across genders were more robust than race or ethnicity. Nevertheless, the study is notable for analyzing the combined influences of race/ethnicity and gender and travel behavior, which has been largely ignored in the travel behavior literature.

Another area in the travel behavior literature that has been neglected historically but has attracted some attention in recent years is the travel behavior of racial/ethnic minorities compared to immigrants. Previous research has suggested that the travel patterns and mode choices of new immigrants are similar to those of racial/ethnic minorities (relying heavily on public transit) while the mode choice of older immigrants mirror those of the native-born population, which is primarily by automobile (Myers, 1996; Deakin and Ferrell, 2001; Purvis, 2003). Tal and Handy (2005) tested this hypothesis by examining travel patterns by race/ethnicity and immigrant status using NHTS data, testing for commute mode choice and other travel behavior variables such as yearly miles driven, number of weekly walk trips, and number of daily trips by all modes. They found significant differences in commute mode and yearly miles after controlling for race/ethnicity and year of immigration—recent immigrants take fewer driving trips and drive fewer miles than immigrants that have been in the U.S. longer. Recent research on immigrants and public transit ridership by Blumenberg and Evans (2006) found that

immigrants, especially recent immigrants, take significantly more transit trips than older immigrants or native-born commuters, suggesting that immigration is a significant factor for mode choice.

These studies suggest that the travel pattern of ethnic immigrants are different from older immigrants or the native-born population for the following reasons: (1) newer immigrants tend to be less affluent than older immigrants and have less disposable income to afford a car; (2) new immigrants tend to settle in the central cities of large metropolitan areas where walking and public transit are viable transportation alternatives; (3) new immigrants often face language and cultural barriers, encouraging them to rely on non-traditional transportation services such as taxis and jitney services catering to specific ethnic groups (Bartel, 1989; McGuckin and Srinivasan, 2003; Pamuk, 2004; Valenzuela et al., 2005). While these reasons are by no means exclusive, they suggest that sociodemographic characteristics, as well as cultural and attitudinal differences, play a role in explaining race/ethnicity and immigrant travel behavior.

A survey of the relevant literature examining the relationship between race/ethnicity and travel behavior has revealed that race/ethnicity and immigration influence travel behavior in complex ways. While recent literature has reflected the increased interest in race/ethnicity and travel behavior among academics, there are major gaps that have yet to be filled. One major gap is the lack of studies that analyze how demographic shifts in the ethnic and immigrant population have shaped travel behavior and whether there are significant interaction effects between ethnic change and travel behavior. With the exception of Myers's (1996) study on the effects of aging and immigration on commuting behavior which analyzed shifts in commuting patterns among

immigrants in Southern California from 1980 to 1990 and Blumenberg and Evan's (2006) study on immigration and transit use from 1980 to 2000, the travel behavior literature analyzing demographic change remains sparse. In addition, virtually no studies to date have analyzed the interaction effects between ethnic change and travel mode choice, which is a unique contribution of this study. Another gap that remains in the literature are studies comparing the differences in travel behavior across different race/ethnic groups within the same metropolitan area or region, and whether there are unique sociodemographic, attitudinal, and built environment characteristics that explain variations in travel behavior for racial/ethnic minorities across regions. Given that many regions of the U.S. have experienced dramatic sociodemographic shifts in recent years, especially in California, it would be interesting to see how these changes have impacted travel behavior.

The current study aims to fill these gaps by analyzing interactions between race/ethnicity and ethnic change for driving and walking behavior in the Greater Los Angeles metropolitan region, specifically the South Bay Area. This study would not only offer a contribution to scholarship, but also help planners and policy makers make informed policy decisions that take into account the ethnic and demographic changes that have occurred in the metropolitan region, and help fill the gaps in transit coverage and service to meet the needs of lower income ethnic minorities, recent immigrants, and other socioeconomically disadvantaged groups.

## **Theoretical Approaches for Explaining Travel Behavior**

The travel behavior literature has relied on a variety of theoretical approaches to explain differences in travel behavior and mode choice; perhaps one of the most well-known which dates from the 1960s and 1970s is discrete choice theory. McFadden (1974) is often credited for pioneering the discrete choice model, which has been applied to transportation modeling, econometrics, and other related fields. According to the discrete choice model, an individual makes a particular choice from a set of choices based on its relative utility and cost, and implies that individuals make a logical decision based on monetary cost, time cost, convenience, and other factors (Train, 1978; Ben-Akiva and Lerman, 1985). This theory has been applied often to explain travel mode choice and residential location, and continues to remain a popular methodological tool for travel demand modeling and forecasting (e.g., the four-step model).

However, more recent literature has highlighted the limitations of relying on the discrete choice and utility maximization model for explaining travel behavior (Boarnet and Crane, 2001; Handy, 1996a; Handy, Cao, and Mohktarian, 2005; Cervero, 2006). One area that has received much attention in recent literature is the impact of the built environment and urban design on travel behavior. Studies that compare traditional “old town” communities with auto-oriented suburban communities often compare built environment variables such as road and sidewalk width, streetscape and tree coverage, and other ambient factors that may influence mode choice. The research has shown that these factors are especially relevant for predicting walking behavior (Handy, 1996a; Handy, 1996b). Walking behavior is especially difficult to predict given that a variety of factors influence an individual’s decision to walk, including distance to destination,

accessibility and walkability, ambience, temperature and weather conditions, and other factors. The limitation of the discrete choice model is that discrete choice assumes that individuals would make the most efficient mode choice (usually based on distance), which may be the case for motorized trips (e.g., transit vs. driving) but most likely not the case for walking trips.

In terms of explaining differences in travel behavior across racial/ethnic groups, the focus of this paper, it would be necessary to look beyond the utility model and even the built environment and examine attitudinal and cultural factors that may influence travel behavior. While some recent studies have incorporated attitudinal variables in their statistical analyses and have attempted to assess the relative intensity of the relationship between attitudes and behavior, virtually no studies in the transportation literature have attempted to identify the causal factors that link attitudes and behavior (Kitamura, Mokhtarian, and Laidet, 1997; Handy, Cao, and Mokhtarian, 2005). This is not surprising given the difficulty of measuring attitudes, which are formed through experiences as a result of behavior and are often subject to change (Tardiff, 1997; Dobson et al., 1978; Tischer and Phillips, 1978). Additionally, very few studies, if any, have analyzed cultural factors that influence travel behavior. This would require extensive ethnographical research into value systems, morality, religion, law, and customs that may influence preferences for driving, walking, or taking public transit, which is usually beyond the scope of most empirical studies in the travel behavior literature. Understanding cultural factors would be especially relevant for studies which focus on travel behavior for immigrants; while these studies (Myers, 1996; Evans and Blumenberg, 2006) have acknowledged the role of attitudinal and cultural factors in

influencing travel behavior and mode choice among immigrant groups, like other studies in the literature, they do not delve further into the cultural norms and values which may influence individual travel decisions.

## **Hypotheses**

Based on a review of the literature and theoretical approaches explaining travel behavior, the following research questions and hypotheses are presented.

Research Question 1: *How does driving and walking behavior vary among non-Hispanic whites, African-Americans, Hispanic, and Asians, controlling for sociodemographic factors such as age, gender, and household income?*

Based on previous research which has shown lower rates of automobile ownership and travel among ethnic minorities, immigrant groups, and among low income households, I hypothesize that African-Americans and Hispanics will take significantly fewer driving trips than whites; additionally, I hypothesize that there will be no significant difference for driving trips between Asians and whites due to the higher household incomes of Asians vis-à-vis Hispanics and African-Americans. However, in terms of walking trips, I hypothesize that there will be no significant difference across racial/ethnic groups, based on previous studies (Tal and Handy, 2005).

Research Question 2: *How does driving and walking behavior vary among non-Hispanic whites, African-Americans, Hispanics, and Asians, taking into account the effects of*

*demographic and ethnic changes that have occurred in the South Bay region from 1990-2000? What are the interaction effects of race/ethnicity and ethnic change for driving and walking trips?*

Based on previous research, I hypothesize that there will be significant interaction effects of race/ethnicity and ethnic change for driving trips, while the interaction effects will be minimal for walking trips.

### **Methodology**

I will first analyze how individual walking trips and driving trips will be affected by race/ethnicity variables and sociodemographic variables. The dependent variables in the regression models are all individual driving trips and walking trips for the 16 South Bay study areas defined in Paper 1. For Model 1, driving trips and walking trips will be regressed on a vector of race/ethnicity dummy variables (white, Hispanic, African-American, and Asian) without controlling for sociodemographic variables, such that

$$N = \beta_0 + \beta_1' R + u \quad (1)$$

where  $N$  = individual driving and walking trips,  $R$  = a vector of race/ethnicity variables, and  $u$  = regression error term.

For Model 2, individual driving and walking trips will be regressed on a vector of race/ethnicity dummy variables and a vector of sociodemographic variables, such that

$$N = \beta_0 + \beta_1'R + \beta_2'S + u \quad (2)$$

where  $N$  = individual driving and walking trips,  $R$  = a vector of race/ethnicity variables,  $S$  = a vector of sociodemographic variables, and  $u$  = regression error term.

Sociodemographic variables include the following:

- gender
- household income (\$15-35k)
- household income (\$35-55k)
- household income (\$55-75k)
- household income (\$75-100k)
- household income (greater than 100k)
- employment status
- household with children
- tenure (rent/own)
- foreign born status

For the second part of the regression analysis, I will analyze the interaction effects of ethnic change on driving and walking behavior. As mentioned previously, ethnic change is defined as the percentage change in the racial/ethnic composition of South Bay mixed-use centers and auto-oriented corridors from 1990 – 2000.



For Model 3, individual driving and walking trips will be regressed on a vector of race/ethnicity dummy variables, a vector of sociodemographic variables, a vector of ethnic change variables, and race/ethnic change interaction variables, such that

$$N = \beta_0 + \beta_1'R + \beta_2'S + \beta_3'E + \beta_4'R*E + u$$

where  $N$  = individual driving and walking trips,  $R$  = a vector of race/ethnicity variables,  $S$  = a vector of sociodemographic variables,  $E$  = a vector of ethnic change variable,  $R*E$  = the interaction variable (race/ethnicity variables  $R$  multiplied by ethnic change variables  $E$ ), and  $u$  = regression error term.

## **Results**

The results for the three regression models are presented in Tables 4.3 and 4.4. Since the dependent variable is count data (number of individual driving and walking trips) and using the OLS method may result in biased and inconsistent estimates, negative binomials are used (Long, 1997; Cameron and Trivedi, 1998). I will first summarize the regression results for driving trips for Model 1 (Individual Driving Trips) and Model 2 (Individual Walking Trips).

**Table 4.3 Comparison of Individual Driving and Walking Trips Regressed on Race/Ethnicity Variables Using Negative Binomial Regressions**

Independent Variables	<i>Individual Driving Trips</i>				<i>Individual Walking Trips</i>			
	Model 1a Race Only		Model 1b Race and Sociodem.		Model 2a Race Only		Model 2b Race and Sociodem.	
	Coeff.	Z-stat.	Coeff.	Z-stat.	Coeff.	Z-stat.	Coeff.	Z-stat.
Hispanic	-0.3982	-0.56	0.1346	1.82	-0.4499	-1.72	-0.3731	-0.79
African-American	<b>-0.4408</b>	<b>-3.96</b>	<b>-0.3388</b>	<b>-2.19</b>	-0.2553	-0.55	-1.5347	-1.29
Asian	0.5619	0.96	0.1082	1.65	-0.5676	-1.86	<b>-1.0997</b>	<b>-2.14</b>
Other Race	0.2278	0.17	<b>0.2653</b>	<b>1.97</b>	-0.1622	-0.26	-0.0327	-0.04
Female			<b>0.0940</b>	<b>2.02</b>			-0.0811	-0.28
Household income 15-35k			<b>0.3788</b>	<b>2.10</b>			0.8560	0.84
Household income 35-55k			<b>0.3712</b>	<b>2.17</b>			-0.1647	-0.17
Household income 55-75k			0.3239	1.92			-0.7063	-0.70
Household income 75-100k			<b>0.4572</b>	<b>2.72</b>			0.4539	0.48
Household income >100k			<b>0.4642</b>	<b>2.80</b>			0.6364	0.67
Employment status			<b>0.1938</b>	<b>2.86</b>			0.4184	0.92
Household with children			0.0719	1.49			-0.1282	-0.42
Tenure (rent/own)			<b>-0.1030</b>	<b>-1.97</b>			<b>0.8542</b>	<b>2.64</b>
Foreign born			<b>-0.2803</b>	<b>-3.37</b>			-0.0798	-0.18
Constant	<b>0.8984</b>	<b>37.33</b>	0.2803	1.65	<b>-1.9420</b>	<b>-17.94</b>	<b>-3.2618</b>	<b>-3.23</b>
Number of observations		1794		1133		1794		1133
Pseudo R-squared		0.0025		0.0132		0.0036		0.0406

Note: Coefficients shown in bold are significant at the five percent level or greater.

**Table 4.4 Interaction between Race/Ethnicity and Ethnic Change in Population for Individual Driving and Walking Trips Using Negative Binomial Regressions**

Independent Variables	Model 3a <i>Individual Driving Trips</i>		Model 3b <i>Individual Walking Trips</i>	
	Coeff.	Z-stat.	Coeff.	Z-stat.
Hispanic	0.1626	1.32	-0.4776	-0.69
African-American	-0.0343	-0.09	2.8621	0.90
Asian	<b>0.2440</b>	<b>2.11</b>	0.0317	0.03
Female	<b>0.0968</b>	<b>2.38</b>	-0.1282	-0.64
Household income 15-35k	<b>0.3615</b>	<b>2.20</b>	0.4667	0.57
Household income 35-55k	<b>0.4803</b>	<b>3.13</b>	-0.1516	-0.19
Household income 55-75k	<b>0.5429</b>	<b>3.58</b>	-0.0482	-0.06
Household income 75-100k	<b>0.6680</b>	<b>4.42</b>	-0.0117	-0.02
Household income >100k	<b>0.6299</b>	<b>4.21</b>	0.1559	0.20
Employment status	<b>0.1441</b>	<b>2.51</b>	0.1709	0.60
Foreign born	<b>-0.1645</b>	<b>-2.55</b>	0.0498	0.15
% change in Hispanic Pop.	-0.0298	-1.95	0.0120	0.16
% change in Black Pop.	0.0693	1.45	<b>-0.4959</b>	<b>-2.04</b>
% change in Asian Pop.	0.0062	0.82	-0.0253	-0.55
Hispanic*% Change Hisp.	0.0259	0.52	<b>-0.4630</b>	<b>-2.15</b>
Hispanic*% Change Black	-0.1081	-0.74	<b>1.5593</b>	<b>2.22</b>
Hispanic*% Change Asian	-0.0223	-1.45	0.0269	0.32
Black*% Change Hisp.	-0.1890	-1.18	-1.830	-0.95
Black*% Change Black	0.7456	1.27	6.9174	0.92
Black*% Change Asian	-0.2207	-1.19	-1.8891	-0.75
Asian*% Change Hisp.	0.0447	1.09	-0.0821	-0.39
Asian*% Change Black	-0.1813	-1.41	0.0020	0.00
Asian*% Change Asian	-0.0190	-1.26	-0.0422	-0.28
Constant	0.2026	1.29	<b>-1.6238</b>	<b>-2.02</b>
Number of observations		1693		1693
Pseudo R-squared		0.0141		0.0458

Note: Coefficients shown in bold are significant at the five percent level or greater.

### *Summary of Regression Results for Driving Trips*

The regression results for Model 1a show that African-Americans take fewer driving trips on average (Z-statistic: -3.96) than whites, which remains unchanged in Model 1b (Z-statistic: -2.19). The race/ethnicity dummies for Hispanic, Asian, and “Other Race” are insignificant at the 5 percent level of significance and remain insignificant in Model 1b with the exception of “Other Race,” which is significant (Z-statistic: 1.97). This finding is not surprising given that the majority of African-Americans in the South Bay region lives in working class neighborhoods and has access to fewer automobiles. In addition, the study areas where African-Americans are concentrated (Inglewood and Hawthorne) have better public transit accessibility (e.g., MTA bus lines) than the other area which may explain why African-Americans take fewer driving trips compared to whites, Hispanics, or Asians. When sociodemographic variables were added in Model 1b, all sociodemographic variables were statistically significant except for “Household income \$55-75k” and the “Household with children” variable. The Pseudo R-squared statistic is very low for Model 1a (0.0025, which is to be expected since many variables (such as sociodemographic variables) that explain the number of driving trips was left out of the model. In Model 1b, the Pseudo R-squared increased slightly but still remain quite low (0.0132), indicating that there may be several important factors explaining driving trips that are not present in the regression models.

### *Summary of Regression Results for Walking Trips*

The regression results for Model 2a indicate that all of the race/ethnicity variables are statistically insignificant. The regression results suggest that there are no significant

differences for walking trips between Hispanics, African-Americans, Asians, and “Other Race” in comparison to whites. However, when sociodemographic variables were added in Model 2b, Asians reported fewer statistically significant walking trips compared to whites (Z-statistic: -2.14), while Hispanic, African-American, and “Other Race” remained statistically insignificant. When sociodemographic variables were added in Model 2b, all sociodemographic variables were statistically insignificant except for the tenure variable. The statistically significant findings for Asians confirm previous research, although the causal factors explaining why Asians take fewer walking trips is unknown (Tal and Handy, 2005). The Pseudo R-squared statistic is very low for Model 2a (0.0036), which is to be expected; when sociodemographic variables were added in Model 2b, the Pseudo R-squared statistic increased to 0.0406, which is a considerably higher Pseudo R-squared statistic than for driving trips. Therefore, the variables included in the regression models explained walking trips better than driving trips.

*Summary of Regression Results for Interaction between Race/Ethnicity and Ethnic Change for Driving Trips*

The regression results for Model 3a indicate a statistically significant Z-statistic for the Asian variable (Z-statistic: 2.11), while the Hispanic and African-American variables are insignificant. This indicates that Asians take more driving trips with respect to whites while Hispanics and African-Americans do not. In terms of sociodemographic variables, the following variables were statistically significant:

- female (Z-statistic: 2.38)
- Household income 15-35k (Z-statistic: 2.20)

- Household income 35-55k (Z-statistic: 3.13)
- Household income 55-75k (Z-statistic: 3.58)
- Household income 75-100k (Z-statistic: 4.42)
- Household income greater than 100k (Z-statistic: 4.21)
- Employment status (Z-statistic: 2.51)
- Foreign born status (Z-statistic: -2.55)

The regression results for the sociodemographic variables showed the expected signs, indicating that females take more driving trips than males and higher income groups drive more than the lowest income category (less than \$15,000). In terms of the female variable being positive, some studies in the travel behavior literature have shown that females take more automobile trips than men for certain types of trips, such as grocery trips and day-care trips (Mauch and Taylor, 1997). For the ethnic change variables (percentage change in population from 1990-2000 for Hispanics, African-Americans, and Asians), Hispanics are statistically significant at the 10% level (Z-statistic: -1.95) while African-Americans and Asians are insignificant. In other words, South Bay study areas that experienced an increase in the proportion of Hispanics are associated with fewer driving trips, while study areas that experienced an increase in the proportion of African-Americans and Asians were not associated with any change in driving trips. Finally, for the race/ethnicity and ethnic change interaction variables, none reported any significant interaction effects, suggesting that there are little, if any interactions between ethnicity and ethnic change.

*Summary of Regression Results for Interaction between Race/Ethnicity and Ethnic Change for Walking Trips*

The regression results for Model 3b did not indicate any statistically significant Z-statistics for any race/ethnicity variable at the 5 percent level of significance. In terms of sociodemographic variables, all were statistically insignificant. For the ethnic change variables, African-Americans are statistically significant at the 5% level (Z-statistic: -2.04), indicating that South Bay study areas that experienced an increase in the proportion of African-Americans were associated with fewer driving trips. However, the regression results suggest that there are little or no significant differences in walking trips across race/ethnic groups (perhaps with the exception of Asians for unknown reasons). In terms of interaction effects, significant interactions between race/ethnicity and ethnic change for reported for two interaction terms (Hispanic\*% Change Hispanic and Hispanic\*%Change Black).

**Conclusion**

The analyses presented here show that there are differences in driving and walking between Hispanics, African-Americans, and Asians in comparison to non-Hispanic whites in the South Bay region, controlling for sociodemographic factors. African-Americans reported fewer driving trips than whites in Model 1 (without interaction terms) while Asians reported more driving trips than whites in Model 3 (with interaction terms). This is an interesting finding since both models also control for income variables. A possible explanation for this is that African-Americans tend to be concentrated in neighborhoods with better transit accessibility (e.g., Inglewood) than

Asians. Another possible explanation may also be cultural: Asians in the South Bay prefer driving over walking or other modes of travel. While the explanation is not entirely clear from these results, it is worthy of further investigation.

The results from this study also suggests that ethnic change may also be a factor in influencing travel behavior. For walking trips, increase in the African-American population were associated with fewer walking trips, implying that demographic changes from 1990-2000 have had some influence on walking trips for areas that experienced an increase in the African-American population. Additionally, two interaction terms for Hispanics were significant. While these results are by no means conclusive and further study is necessary, the findings of this research suggest that ethnic change can have an impact on travel behavior.



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## CHAPTER 5

### **Crime, Perceptions of Safety, and the Built Environment: A Case Study of Walking Trips**

#### **Introduction**

After a steady decline in the 1990s and the early 2000s, urban crime rates have begun to creep upwards in many American cities. High crime rates and fear of crime remain facts of life in the inner cities, while crime and concerns over neighborhood safety have increasingly migrated into the suburbs and in smaller towns. Crime and fear of crime constrain the mobility of urban and suburban residents by discouraging them from partaking in outside activities such as playing in the park after dark and walking home from school or work. Crime also has a dampening effect on neighborhood revitalization efforts and discourages certain vulnerable populations from walking and taking public transportation, such as women (Loukaitou-Sideris et al., 2002).

Perceptions of crime are shaped by a combination of factors that are related to sociodemographic characteristics such as race/ethnicity, household income, and gender. In addition, the fear of crime may also be influenced by actual crime rates reported by the media as well as built environment factors such as the proximity and number of abandoned buildings, shady establishments (e.g., cheap motels and liquor stores), and the presence of graffiti (Jacobs, 1961; Newman, 1972; Wilson and Kelling, 1982; Loukaitou-Sideris, 1999; Loukaitou-Sideris, 2006). Previous researchers have found that perceptions of crime vary significantly across race/ethnicity and gender and that certain subgroups of the population are more likely to fear street crime, such as women and non-Hispanic whites (Pain, 2001; Liska et al., 1982). It is likely that these fears and

perceptions of neighborhood safety would impact one's decision to walk, drive, or take public transit.

While many researchers have studied the links between the built environment and crime and the built environment and travel behavior as independent and mutually exclusive relationships, few studies in travel behavior have explicitly taken crime and attitude towards crime into account in their analyses of travel behavior. While this is partly due to the methodological difficulties of incorporating attitudinal and sociological factors (which are more challenging to measure than built environment factors), several previous studies have often ignored these variables altogether, portraying an incomplete picture of land use and travel behavior relationships at best and a misleading one at worst. This remains a major barrier to understanding built environment and sociological factors, which are not independent but rather inextricably linked.

This case study aims to bridge this gap by exploring the nexus between neighborhood crime and perceptions of crime and safety, the built environment, and walking behavior across various sociodemographic groups in the South Bay Area of Los Angeles County, a diverse urbanized region with a population of over one million residents. This study relies on a unique and extensive dataset of 2,125 individuals sampled from eight communities, taken from the South Bay Travel Survey, a three year study which also included a detailed travel diary for each individual. Using both unstratified and stratified samples across race/ethnicity, income, and gender, this study addresses how crime and perceptions of crime impact walking travel across sociodemographic groups and also whether the built environment impacts walking behavior after controlling for sociodemographic, attitudinal, and crime factors.

## **Literature Review**

There are dozens of studies in the land use-travel behavior literature that analyze the relationship between the built environment and travel behavior (Boarnet and Crane, 2001; Cervero and Kockelman, 1997; Ewing and Cervero, 2001; Handy, 1996; Handy et al., 2005; Kitamura et al., 1997; Krizek, 2003). Influenced in part by the New Urbanism movement, several studies have focused on the relationship between urban form and walking and how land use patterns affect pedestrian behavior (Crane, 2000; Badoe and Miller, 2000; Greenwald and Boarnet, 2001; Lee and Moudon, 2006; Rodriguez and Joo, 2004). Many of these studies have relied on travel data from the U.S. Census and the National Household Travel Survey (Agrawal and Schimek, 2007) as well as metropolitan travel surveys (Cervero and Gorham, 1995; Crane and Crepeau, 1998; Handy, 1996). Recent attention has been given on studying walking behavior for different subgroups of the population, including school children, elderly, disabled persons, immigrants, and other sociodemographic groups (Boarnet et al., 2008; McMillan, 2007; Hess, 2008; Blumenberg and Evans, 2006). The link between walking and physical activity and health has also been highlighted in recent research (Boarnet et al., 2008; Frank and Engelke, 2001).

There is also a considerable body of research focusing on the effects of the built environment and crime, exemplified by both classic studies by Jane Jacobs (1961) and Oscar Newman (1972) and more contemporary studies investigating the link between urban design and crime (Loukaitou-Sideris, 2005; Loukaitou-Sideris et al., 2002; Nasar and Fisher, 1993). Jacobs's "eyes on the street" and Newman's "defensive space" are well-known and established concepts that emphasize the importance of identifying

features of the built environment that discourage delinquent and criminal activities and promoting opportunities for informal community surveillance. The fear of crime, while not synonymous with actual crime, is often influenced by certain built environment features that emphasize neglect and decay, such as a broken window (Wilson and Kelling, 1982). Numerous studies in the environmental psychology and criminology literature have highlighted the importance of perceptions and attitudes in explaining criminal and delinquent behavior, and how various sociodemographic groups perceive neighborhood safety and crime differently (Day, 1999; Kostela and Pain, 2000; Ortega and Miles, 1987; Pain, 2001). Other scholars have pointed to the importance of community structure and cohesiveness and their impacts on crime (Sampson and Groves, 1989).

Despite well-established links between the built environment and crime, previous studies in the travel behavior literature have often excluded crime and other sociological and attitudinal factors in analyses of travel behavior. There are several reasons for this: (1) the lack of a consistent theoretical framework for research on walking behavior, which needs to draw upon theories that go beyond demand theory and other economic-based theories that have dominated traditional travel behavior studies (Handy, 2005; McFadden, 1974); (2) the methodological difficulties of measuring individual attitudes about perceptions of crime and walking behavior which rely on social cognition (Loukaitou-Sideris, 2006); (3) the lack of reliable data documenting crime at the neighborhood level due to underreporting and other factors (Bureau of Justice Statistics, 2002). The lack of a uniform theoretical framework remains a significant barrier in understanding walking behavior, which is inherently complex. Since the individual decision to walk is shaped by factors that are different from motorized modes such as



accessibility, neighborhood safety, aesthetics, and even climate, it is imperative to take individual perceptions and attitudes in account in travel behavior studies (Handy, 2004; Humpel et al., 2002).

Some recent studies in the literature have highlighted the limitations of focusing solely on the built environment in understanding travel behavior, and others have suggested that focusing on the built environment alone ignores the broader picture of travel behavior, which is shaped by a myriad of sociodemographic, attitudinal, environmental, and cultural factors (Boarnet and Crane, 2001; Handy et al., 2005). For instance, Handy, Mokhtarian, and her colleagues have emphasized the importance of attitudinal factors and how an individual's attitudes influences location choice. Hence, for these individuals, it is not the characteristics of the built environment *per se* that influence travel behavior, but that the built environment attracts a subgroup of the population who are attracted to its unique characteristics. The issue of residential self-selection has often been raised to question the internal validity of built environment-travel behavior relationships (Handy et al., 2005). Without adequately accounting for self-selection bias, researchers run the risk of overstating the impacts of the built environment. Some scholars have employed various techniques in an attempt to ameliorate this problem, including instrumental variable regressions (Boarnet and Sarmiento, 1998; Boarnet and Crane, 2001) and structural equation modeling (Bagley and Mokhtarian, 2002).

However, with respect to crime and walking behavior, the issue of residential selection is not as critical since individuals typically do not choose to live in a safe neighborhood just because they prefer to walk. However, some "big picture" questions

remain: (1) Do actual crime rates or perceptions of crime influence walking behavior? (2) How do built environment factors impact walking behavior after taking crime and perceptions of crime into account? (3) How do various sociodemographic groups perceive crime differently and how do these perceptions and attitudes impact walking behavior?

In this paper, I address these questions by analyzing a uniform set of sociodemographic, attitudinal, built environment, and crime variables using both unstratified and stratified sample data to see how these factors shape walking behavior across sociodemographic groups. Furthermore, through the interpretation of the results, I seek to better understand the relationships between crime, perceptions of crime and walking, and the built environment with respect to walking behavior in the South Bay region of Los Angeles County.

## **Methodology**

The methodology and results sections of this study are organized as follows: First, I compare individual walking trip rates and crime rates for the eight neighborhoods in the South Bay Area, as described in Chapter 2. Second, I use an unstratified sample to regress walking trip rates on sociodemographic variables, while adding crime and attitudinal variables to determine the effects of crime and individual attitudes on walking behavior. Third, I stratify the sample by race, income, and gender, while adding two built environment variables to the regressions to determine any possible effects of the built environment on walking behavior with respect to crime and attitudes toward

neighborhood crime and walkability. Finally, I test for any interaction effects between crime and attitudes toward neighborhood safety.

### *Data and Variables*

To measure individual walking trip rates, two dependent variables are used: number of walking trips<sup>4</sup> and usual mode to center by walking.<sup>5</sup> While both are indicators of walking behavior, the former measures the frequency of walking trips while the latter measures preferred mode choice. I felt that comparing both of these indicators for walking behavior would lead to more robust results. Since the first variable (number of walking trips) is count data, negative binomial regressions are used (Cameron and Trivedi, 1998). Logistic regressions were used to estimate the usual mode to center by walking variable since this was a binary variable (1 = yes; 0 = no).

For independent variables, I included a vector of sociodemographic, attitudinal, crime, and built environment variables into the regressions. For the unstratified sample regressions, I included the following sociodemographic variables, shown in Table 5.1.

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<sup>4</sup> Based on the SBTS, this is the number of individual walking trips recorded by the respondent during the one-day travel diary survey.

<sup>5</sup> This was based on the respondent's assessment of their usual travel mode when going to their neighborhood center or corridor.

**Table 5.1 Sociodemographic Control Variables**

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Age less than 25 = omitted (reference) category  
Age 26 – 40, dummy = 1 or 0  
Age 41 – 65, dummy = 1 or 0  
Age > 65, dummy = 1 or 0  
Female = 1 if female  
Hispanic = 1 if Hispanic  
White = omitted (reference category)  
African-American = 1 if African-American  
Asian = 1 if Asian  
Other Race = 1 if other race  
Employed = 1 if employed; 0 = unemployed  
Household with Children = 1 if children in household; 0 = no children in household  
Foreign Born Status = 1 if foreign born; 0 = native born  
Income: dummy variables for annual household income from \$15,000 - \$35,000, \$35,000 - \$55,000, \$55,000 - \$75,000, \$75,000 - \$100,000, and > \$100,000. Less than \$15,000 is the reference category.

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Some variables within the same sociodemographic category (e.g., income) were collapsed in the stratified sample regressions to create a more parsimonious model. For example, the income variables were collapsed from four to two (less than \$75,000 and greater than \$75,000), and the age variables were collapsed into two categories instead of four (less than 40 years of age and greater than 40 years of age).

Two crime variables, violent crime and property crime, were analyzed in this case study. The crime data were obtained from the Bureau of Justice Crime Statistics (2006) and indicate violent and property crime rates for the respective cities where the study areas are located. The violent crime rate is defined as the number of violent crimes per 100,000 persons, and includes the following criminal offenses: murder, manslaughter, forcible rape, robbery, and aggravated assault. The property crime is defined as the number of violent crimes per 100,000 persons, and includes the following criminal offenses: burglary, larceny, theft, motor vehicle theft, and arson.

In addition, two attitudinal variables measure individual attitudes toward neighborhood walkability and neighborhood safety, hereafter termed *Pro-Walk Attitude*<sup>6</sup> and *Neighborhood Safety*.<sup>7</sup> The attitudinal variables were derived from questions on the travel survey where respondents were asked to rate on a 5-point ordinal scale (from “not at all important” to “very important”) how important the above factors are for them and the neighborhoods they live in. These questions were designed to gauge how much importance respondents placed on being able to walk to neighborhood businesses and how concerned they are about safety in their neighborhood.

*Walking Trip Regressions for All Respondents (Unstratified Sample)*

I present four regression models: (1) sociodemographic variables only; (2) sociodemographic and crime variables; (3) sociodemographic and attitudinal variables; (4) sociodemographic, crime, and attitudinal variables.

In the first regression model, walking trips are regressed on a vector of sociodemographic variables (including race/ethnicity dummy variables), such that

$$N = \beta_0 + \beta_1' S + u \quad (1)$$

where  $N$  = individual walking trips or usual mode to center by walking,  $S$  = a vector of sociodemographic variables, and  $u$  = regression error term.

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<sup>6</sup> This was derived from the following survey question: “Thinking about your neighborhood as a good place to live, how important is it to you that you can walk to nearby stores and restaurants?”

<sup>7</sup> This was derived from the following survey question: “Thinking about your neighborhood as a good place to live, how important is it to you that the neighborhood is safe?”

In the second regression model, two crime variables are added, violent crime and property crime, such that

$$N = \beta_0 + \beta_1'S + \beta_2'C + u \quad (2)$$

where  $N$  = individual walking trips or usual mode to center by walking,  $S$  = a vector of sociodemographic variables,  $C$  = crime variables, and  $u$  = regression error term.

In the third regression model, two attitudinal variables take the place of the crime variables, such that

$$N = \beta_0 + \beta_1'S + \beta_2'A + u \quad (3)$$

where  $N$  = individual walking trips or usual mode to center by walking,  $S$  = a vector of sociodemographic variables,  $A$  = attitudinal variables, and  $u$  = regression error term.

The fourth regression model includes both the crime and the attitudinal variables, such that

$$N = \beta_0 + \beta_1'S + \beta_2'C + \beta_3'A + u \quad (4)$$

where  $N$  = individual walking trips or usual mode to center by walking,  $S$  = a vector of other (non-race) sociodemographic variables,  $C$  = crime variables,  $A$  = attitudinal variables, and  $u$  = regression error term.

For all regressions, standard errors were clustered by study area since the crime variables take on the same value within each study area.

### *Walking Trip Regressions Stratified by Race, Income, and Gender*

I now compare how walking behavior differs across various sociodemographic populations and test for any possible effects of the built environment on walking. The following regressions are stratified by race, income, and gender. Each sociodemographic category is divided into two subgroups:

- Race: White and Non-White (including Hispanics, Asians, and African-American/Other Race<sup>8</sup>)
- Income: Low/Moderate Income (less than \$75,000) and High Income (greater than \$75,000)
- Gender: Female and Male

I include all sociodemographic variables that were included in the unstratified sample regressions while omitting the variable(s) that correspond to the stratified category (e.g., omitting the gender variable for regressions stratified by gender). I also included the collapsed income and age variables, treating young age (less than 40) and low-to-middle income (less than \$75,000) as omitted reference variables. Both attitudinal variables from the unstratified model are included in the stratified regressions. However, I only

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<sup>8</sup> Due to the low number of African-American responses, African-Americans and Other Race were treated as a single sociodemographic subgroup in the stratified sample regressions.

include violent crime for the stratified regressions based on the premise that violent crime influences walking behavior more strongly than walking behavior.

Therefore, the first regression model includes sociodemographic, attitudinal variables, and the violent crime variable, such that

$$N = \beta_0 + \beta_1'S + \beta_2'A + \beta_3'C + u \quad (5)$$

where  $N$  = individual walking trips,  $S$  = a vector of sociodemographic variables,  $A$  = attitudinal variables,  $C$  = violent crime variable, and  $u$  = regression error term.

In the second regression model, I test for the effects of the built environment by adding two built environment variables: neighborhood businesses per acre and percentage of four-way intersections. The data for these built environment variables were obtained from Los Angeles County Assessor Parcel Data, InfoUSA database, geographic information system software (ArcGIS), and satellite imagery from Google Maps. These variables are typically used in studies examining how the “3Ds” (density, diversity, design) impact travel behavior (Cervero and Kockelman, 1997; Lee and Moudon, 2006). Unlike the crime variable, which is representative of the city where the study area is located, the data from the built environment variables apply to the individual study areas themselves. The second regression model includes sociodemographic, attitudinal variables, one crime variable and two built environment variables, such that

$$N = \beta_0 + \beta_1'S + \beta_2'A + \beta_3'C + \beta_4'E + u \quad (6)$$



where  $N$  = individual walking trips,  $S$  = a vector of non-race sociodemographic variables,  $A$  = attitudinal variables,  $C$  = violent crime variable,  $E$  = built environment variables, and  $u$  = regression error term.

As in the unstratified regressions, negative binomial regressions are used for the walking trip regressions and logistic regressions are used for the usual mode to center by walking regressions. Standard errors are clustered by study area for all regressions.

In the final part of my regression analysis, I test for interaction effects between crime and attitude towards crime. This would help determine whether crime and attitude in tandem have an effect on walking behavior that is different from the main effects of each variable. As in the stratified sample regressions, the regressions for each sociodemographic category are run with and without built environment variables. However, an interaction variable, *Crime\*Neighborhood Safety*, was added to each of the regressions stratified by race, income, and gender.

## **Results**

Summaries of the overall measures of walking behavior, by study area, are presented in Table 5.2. The number of per person walking trips per day ranged from 0.083 in Inglewood to 0.276 in Riviera Village. The percentage of respondents whose usual mode to their neighborhood center was walking ranged from 8.18% in Artesia Blvd. to 53.13% in Riviera Village. With the notable exception of Inglewood, downtown core/civic center neighborhoods (Riviera Village, Torrance Old Town, El Segundo) reported a higher number of walking trips and residents in those neighborhoods chose to

walk to their neighborhood centers more than those living in corridor neighborhoods (Artesia Blvd., Gardena Blvd., Hawthorne Blvd., Pacific Coast Highway).

**Table 5.2 Walking Trip Rates by Study Area**

Study Area	Per person walking trips per day	% of respondents who usually walk to their neighborhood center	No. of survey respondents
<i>Artesia Blvd.</i>	0.087	8.18%	526
<i>El Segundo</i>	0.133	50.16%	324
<i>Gardena Blvd.</i>	0.032	8.85%	285
<i>Hawthorne Blvd.</i>	0.036	12.21%	278
<i>Inglewood</i>	0.083	30.88%	72
<i>PCH</i>	0.143	24.41%	223
<i>Riviera Village</i>	0.276	53.13%	239
<i>Torrance Old Town</i>	0.225	41.07%	178

Summaries of the overall measures of crime and fear of crime, by study area, are presented in Table 5.3. The violent crime rate per 100,000 ranged from 168 in El Segundo to 910 in Inglewood. Property crime rates per 100,000 ranged from 2,207 in Torrance Old Town to 3,864 in El Segundo. The percentage of respondents who are most concerned about neighborhood safety (chose “very important” in the 5-point ordinal scale) ranged from 67.69% in Inglewood to 96.86% in Gardena. Ironically, respondents living in the neighborhood with the highest violent crime rate (Inglewood) appeared to be less concerned about neighborhood safety than respondents in other areas, but this may be partly due to sample size error. These results show that the actual crime rate does not necessarily correlate with concern about neighborhood crime and safety.

**Table 5.3 Crime Rate/Fear of Crime\***

Study Area	Violent Crime Rate per 100,000	Property Crime Rate per 100,000	% of respondents who are most concerned about neigh. Safety	No. of survey respondents	City Where Study Area is Located
<i>Artesia Blvd.</i>	347	2314	94.21%	501	Redondo Beach
<i>El Segundo</i>	168	3864	92.43%	304	El Segundo
<i>Gardena Blvd.</i>	837	2507	96.86%	260	Gardena
<i>Hawthorne Blvd.</i>	720	2430	91.95%	261	Hawthorne
<i>Inglewood</i>	910	2533	67.69%	65	Inglewood
<i>PCH</i>	246	2207	92.79%	222	Torrance
<i>Riviera Village</i>	347	2314	78.21%	234	Redondo Beach
<i>Torrance Old Town</i>	246	2207	73.71%	175	Torrance

\* Crime rates are representative of the cities where the study areas are located

#### *Walking Trip Regressions for All Respondents (Unstratified Sample)*

The unstratified regression results, presented in Table 5.4, suggest two main findings: (1) the difference in walking trip rates and walking as preferred mode choice are largely insignificant across sociodemographic categories; (2) the addition of crime and attitudinal variables had little impact on walking behavior for all groups. This echoes previous results using this data set, which showed that adding attitudinal variables did not have a significant impact on walking trips (Joh et al., 2008). Both the negative binomial regressions for walking trips and the logistic regressions for usual mode by walking yielded similar results, although the results for the logistic regressions were more robust, indicated by the higher pseudo R-squared statistics. These results suggest that walking behavior for Hispanic, Asians, and other non-whites did not significantly differ from whites. Other sociodemographic variables (household income, gender, age, etc.) were not statistically significant for all four models (*Socio. Only*, *Socio.+Crime*, *Socio. with Attitude*, and *Socio.+Crime+Attitude*).

However, the results show that both attitudinal variables had a significant impact on walking trips. The *Pro-Walk Attitude* variable is significant and positive with and without crime in both the negative binomial and logistic regressions, suggesting that individuals who place a greater importance on being able to walk to nearby neighborhood businesses actually do walk more. The *Neighborhood Safety* variable is also statistically significant but negative for both sets of regressions. This implies that those who were more concerned about neighborhood safety and crime took fewer walking trips than those who expressed less concern about neighborhood safety.

A key finding is the negative impact of violent crime on walking trips across all sociodemographic groups. The addition of the attitudinal variables did not result in any changes in the significance of the violent crime variable. This result confirms previous research which shows how violent crime deters walking behavior (Loukaitou-Sideris, 2006). Property crime rates did not have a significant impact on walking trips, which was to be expected given that walking individuals are more typically fearful of violent crimes (such as murder and rape) than property crimes such as theft.

Overall, these results suggest that attitudes and violent crime rates have a significant impact on walking trip behavior with little variation in walking trip rates across sociodemographic populations. However, a disadvantage of using an unstratified sample is that it is difficult to distinguish how different sociodemographic groups respond to attitudes and crime rates. To adequately address this issue, I present the results from the stratified samples based on race, income, and gender in the following section.

**Table 5.4 Walking Trips Regressed on Race/Ethnicity, Sociodemographic, Attitude, and Crime**

	<i>Socio. Only</i>		<i>Socio. + Crime</i>		<i>Socio. w/ Attitude</i>		<i>Socio. + Crime w/ Att.</i>	
	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)
Independent Var.	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)
Hispanic	-0.780 (-1.38)	-0.523 (-1.72)	-0.299 (-0.47)	0.007 (0.02)	-0.812 (-1.50)	<b>-0.724</b> <b>(-2.36)</b>	-0.329 (-0.52)	-0.085 (-0.25)
African-American	<b>-1.183</b> <b>(-2.66)</b>	-0.408 (-0.92)	-0.513 (-1.00)	0.301 (0.57)	<b>-1.308</b> <b>(-2.72)</b>	-0.685 (-1.50)	-0.646 (-1.20)	0.077 (0.14)
Asian	-0.781 (-1.57)	-0.788 (-1.61)	-0.406 (-0.88)	-0.158 (-0.53)	-0.738 (-1.45)	-0.862 (-1.79)	-0.338 (-0.69)	-0.147 (-0.54)
Other Race	-0.101 (-0.17)	-0.580 (-1.05)	-0.075 (-0.12)	-0.510 (-0.99)	-0.325 (-0.54)	-0.891 (-1.35)	-0.256 (-0.40)	-0.861 (-1.32)
Female	-0.150 (-0.56)	-0.079 (-0.64)	-0.127 (-0.45)	-0.052 (-0.35)	-0.230 (-0.90)	-0.047 (-0.35)	-0.204 (-0.78)	-0.041 (-0.24)
Income \$15-35,000	1.170 (1.75)	0.685 (1.58)	1.049 (1.45)	0.686 (1.49)	1.271 (1.86)	0.686 (1.63)	1.136 (1.71)	0.700 (1.66)
Income \$35-55,000	0.266 (0.47)	0.458 (0.85)	0.092 (0.15)	0.545 (1.08)	0.422 (0.72)	0.554 (1.01)	0.223 (0.39)	0.622 (1.39)
Income \$55-75,000	0.309 (0.44)	0.498 (0.94)	0.051 (0.07)	0.428 (0.88)	0.432 (0.64)	0.536 (0.94)	0.109 (0.18)	0.413 (0.85)
Income \$75-100,000	0.350 (0.48)	0.531 (0.93)	0.064 (0.08)	0.467 (0.90)	0.490 (0.69)	0.600 (1.07)	0.174 (0.24)	0.458 (0.99)
Income > \$100,000	0.516 (0.83)	0.352 (0.52)	0.132 (0.20)	0.138 (0.25)	0.630 (0.97)	0.382 (0.54)	0.178 (0.30)	0.099 (0.18)
Employed	0.044 (0.16)	-0.027 (-0.09)	-0.021 (-0.08)	-0.030 (-0.09)	0.004 (0.01)	-0.086 (-0.28)	-0.057 (-0.20)	-0.134 (-0.42)

**Table 5.4 (continued) Walking Trips Regressed on Race/Ethnicity, Sociodemographic, Attitude, and Crime**

	<i>Socio. Only</i>		<i>Socio. + Crime</i>		<i>Socio. w/ Attitude</i>		<i>Socio. + Crime w/ Att.</i>	
	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)
Independent Var.	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)
Household w/ Children	-0.117 (-0.79)	-0.158 (-0.90)	-0.168 (-1.27)	-0.163 (-0.99)	-0.103 (-0.71)	0.201 (-1.03)	-0.143 (-1.06)	-0.197 (-1.08)
Age (26-40)	1.121 (1.23)	0.295 (1.07)	1.169 (1.27)	0.217 (0.80)	0.971 (1.01)	0.169 (0.59)	0.988 (1.00)	0.127 (0.48)
Age (41-65)	0.917 (1.03)	-0.098 (-0.38)	0.990 (1.10)	-0.139 (-0.50)	0.889 (0.95)	-0.057 (-0.20)	0.946 (0.98)	-0.060 (-0.22)
Age (> 65)	0.230 (0.21)	0.223 (0.46)	0.307 (0.28)	0.150 (0.27)	0.348 (0.31)	0.446 (0.84)	0.409 (0.35)	0.411 (0.70)
Foreign Born Status	-0.110 (-0.56)	0.128 (0.54)	-0.167 (-0.79)	0.221 (0.92)	-0.261 (-1.18)	0.039 (0.15)	-0.349 (-1.49)	0.102 (0.40)
Crime (violent)			<b>-0.002</b> <b>(-3.05)</b>	<b>-0.002</b> <b>(-2.30)</b>			<b>-0.002</b> <b>(-3.24)</b>	<b>-0.003</b> <b>(-2.57)</b>
Crime (property)			0.000 (-0.86)	0.001 (1.73)			0.000 (-1.73)	0.001 (1.48)
Pro-Walk Attitude					<b>0.492</b> <b>(3.81)</b>	<b>0.755</b> <b>(5.04)</b>	<b>0.512</b> <b>(3.84)</b>	<b>0.744</b> <b>(4.94)</b>
Neighborhood Safety					<b>-0.503</b> <b>(-1.99)</b>	<b>-0.568</b> <b>(-2.63)</b>	<b>-0.464</b> <b>(-2.09)</b>	<b>-0.623</b> <b>(-3.38)</b>
Constant	<b>-3.347</b> <b>(-3.43)</b>	-1.532 (-1.81)	-1.878 (-1.73)	-2.652 (-1.84)	<b>-2.905</b> <b>(-2.13)</b>	-1.814 (-1.29)	-1.201 (-0.90)	-2.094 (-1.04)
No. of observations	1437	1427	1437	1427	1433	1424	1433	1424
Pseudo R-squared	0.0200	0.0196	0.0319	0.1124	0.0391	0.0968	0.0521	0.1795

### *Regression Results Stratified by Race*

The results of the walking trip regressions stratified by race are shown in Table 5.5. First, I compare differences in walking behavior between white and non-white respondents for the attitudinal variables. For white respondents, both attitudinal variables were statistically significant and showed the expected signs while they were insignificant for non-white respondents. This suggests that walking trips for whites are more likely to be influenced by their attitudes toward walking and neighborhood safety than non-whites. While it is not entirely clear why non-whites are less responsive to attitudinal factors, there may be other attitudinal and cultural factors that impact walking trips for non-whites that have not been taken into account in the regression models.

Despite racial differences in the attitudinal variables, violent crime rates had a negative impact on walking behavior for both whites and non-whites. This is consistent with findings in the criminology literature where higher incidences of crime were correlated with fewer walking trips, especially at night (Koskela and Pain, 2000; Ortega and Miles, 1987). However, the significance of the *Neighborhood Safety* variable for whites suggests that whites may be more fearful of violent crime than non-whites, which is supported by some studies (Ortega and Miles, 1987).

For both groups, adding the built environment variables (neighborhood businesses per acre and percentage of four-way intersections) did not result in any changes in significance for the attitudinal variables and the crime variable. Neighborhood businesses per acre had a significant and positive effect on walking trips for whites, while they did not impact walking trips for non-whites for the negative binomial regression. The percentage of four-way intersections did not have any significant effect for both whites

and non-whites.

Overall, the regression results suggest that attitudinal factors were significant for determining walking behavior for whites and that the violent crime rate had a negative impact on walking trips, even after controlling for built environment variables.



**Table 5.5 Walking Trips Regressed on Race/Ethnicity, Sociodemographic, Attitude, and Crime Stratified by Race**

Independent Var.	<i>White Respondents</i>				<i>Non-White Respondents</i>			
	<i>Socio.+Att.+Crime</i>		<i>Socio.+Att.+Crime+BE</i>		<i>Socio.+Att.+Crime</i>		<i>Socio.+Att.+Crime+BE</i>	
	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)
	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)
Female	-0.154 (-0.73)	0.015 (0.10)	-0.145 (-0.63)	0.064 (0.41)	-0.203 (-0.41)	-0.239 (-1.37)	-0.205 (-0.41)	-0.243 (-1.38)
High Income (> \$75,000)	-0.280 (-0.91)	-0.444 (-1.74)	-0.111 (-0.43)	-0.236 (-1.18)	-0.177 (-0.39)	-0.280 (-1.00)	-0.074 (-0.16)	-0.163 (-0.51)
Employed	-0.008 (-0.04)	-0.328 (-1.24)	0.022 (0.10)	-0.243 (-0.85)	0.952 (1.52)	0.093 (0.26)	0.946 (1.52)	0.044 (0.11)
Household w/ Children	-0.106 (-0.47)	<b>-0.546</b> <b>(-2.20)</b>	-0.140 (-0.64)	<b>-0.544</b> <b>(-2.43)</b>	-0.125 (-0.38)	0.028 (0.11)	-0.140 (-0.44)	0.004 (0.02)
Foreign Born	-0.120 (-0.28)	0.007 (0.01)	-0.093 (-0.21)	-0.052 (-0.10)	-0.528 (-0.93)	-0.015 (-0.04)	-0.593 (-1.04)	0.056 (0.17)
Middle-aged/Elderly (> 40)	0.031 (0.17)	-0.080 (-0.39)	0.036 (0.19)	-0.140 (-0.72)	0.304 (0.87)	-0.037 (-0.20)	0.284 (0.78)	-0.037 (-0.19)
Pro-Walk Attitude	<b>0.609</b> <b>(5.77)</b>	<b>0.801</b> <b>(4.92)</b>	<b>0.564</b> <b>(6.51)</b>	<b>0.749</b> <b>(4.99)</b>	0.252 (1.07)	0.674 (5.02)	0.244 (1.07)	0.610 (4.53)
Neighborhood Safety	<b>-0.597</b> <b>(-2.04)</b>	<b>-0.450</b> <b>(-2.40)</b>	<b>-0.624</b> <b>(-2.08)</b>	<b>-0.411</b> <b>(-2.28)</b>	-0.481 (-1.12)	-0.514 (-1.81)	-0.496 (-1.15)	-0.473 (-1.61)
Crime (violent)	<b>-0.002</b> <b>(-2.19)</b>	<b>-0.004</b> <b>(-2.06)</b>	<b>-0.002</b> <b>(-2.21)</b>	<b>-0.003</b> <b>(-2.20)</b>	<b>-0.002</b> <b>(-2.94)</b>	<b>-0.003</b> <b>(-3.28)</b>	<b>-0.002</b> <b>(-3.01)</b>	<b>-0.003</b> <b>(-3.37)</b>
Neigh. Businesses Per Acre			<b>0.223</b> <b>(2.52)</b>	<b>0.646</b> <b>(2.52)</b>			0.245 (0.73)	<b>1.045</b> <b>(2.33)</b>
% 4-way Intersections			-0.007 (-1.19)	-0.001 (-0.90)			-0.005 (-0.75)	-0.007 (-1.30)
Constant	-0.674 (-0.43)	-0.190 (-0.20)	-0.286 (-0.18)	-0.315 (-0.38)	-0.643 (-0.36)	-0.372 (-0.19)	-0.371 (-0.20)	-0.487 (-0.26)
No. of observations	943	936	943	936	549	547	549	547
Pseudo R-squared	0.0448	0.1537	0.0512	0.2006	0.0459	0.1209	0.0470	0.1482

### *Regression Results Stratified by Income*

The regression results for walking trips stratified by income, summarized in Table 5.6, show some variation in the sociodemographic variables. For the low-middle income group, respondents who were over 40 years of age reported a higher number of walking trips; however, these respondents were not more likely to choose to walk to their neighborhood center. For the high income group, households with children were less likely to select walking as their preferred mode choice to the neighborhood center.

Comparing attitudinal differences between low income and high income respondents, the following can be observed based on regression results: (1) both attitudinal variables were insignificant for low-middle income respondents for the negative binomial regression for walking trips while *Pro-Walk Attitude* was significant and positive for the high income group; (2) both attitudinal variables were statistically significant across the board for the logistic regression for usual mode to neighborhood center. The logistic regression models were considerably more robust with respect to attitudinal variables than in the negative regression models, lending credence to the theory that attitudinal factors influence walking behavior (Handy, 1996).

As in the regressions stratified by race, violent crime remained statistically significant for both low-middle income and high income groups. Adding the built environment variables for the most part did not result in any changes in significance for sociodemographic, attitudinal and crime variable for both income groups. Density of neighborhood businesses was positively correlated with walking trips for low-middle income respondents, while they did not have any significant impact for high income respondents. One possible explanation for this is because high income individuals tend to

drive more often than lower income individuals, even for short distance trips—a fact that is well established in the travel behavior literature.

**Table 5.6 Walking Trips Regressed on Race/Ethnicity, Sociodemographic, Attitude, and Crime Stratified by Income**

Independent Var.	<i>Low-Mid. Income (less than \$75,000)</i>				<i>High Income (greater than \$75,000)</i>			
	<i>Socio.+Att.+Crime</i>		<i>Socio.+Att.+Crime+BE</i>		<i>Socio.+Att.+Crime</i>		<i>Socio.+Att.+Crime+BE</i>	
	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)
	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)
Female	-0.123 (-0.57)	-0.184 (-0.98)	-0.090 (-0.37)	-0.189 (-0.90)	-0.356 (-1.07)	0.048 (0.19)	-0.371 (-1.11)	0.134 (0.54)
Hispanic	-0.329 (-0.38)	-0.197 (-0.42)	-0.052 (-0.06)	-0.023 (-0.05)	-0.352 (-0.44)	0.287 (0.78)	-0.406 (-0.49)	0.271 (0.72)
Asian	0.216 (0.33)	-0.153 (-0.40)	0.365 (0.59)	-0.033 (-0.09)	-0.375 (-0.72)	0.006 (0.01)	-0.438 (-0.93)	-0.025 (-0.06)
African-American/Other	-0.060 (-0.11)	-0.031 (-0.06)	0.318 (0.76)	0.145 (0.28)	-0.715 (-0.76)	-0.828 (-1.34)	-0.677 (-0.72)	-0.673 (-1.24)
Employed	0.049 (0.24)	-0.255 (-0.83)	0.033 (0.14)	-0.286 (-0.88)	0.186 (0.50)	-0.386 (-1.32)	0.246 (0.69)	-0.158 (-0.49)
Household w/ Children	0.222 (0.68)	-0.090 (-0.35)	0.243 (0.73)	-0.054 (-0.21)	-0.361 (-1.71)	<b>-0.534</b> <b>(-2.64)</b>	-0.387 (-1.77)	<b>-0.524</b> <b>(-2.85)</b>
Foreign Born	-0.103 (-0.43)	-0.104 (-0.36)	-0.081 (-0.28)	-0.131 (-0.43)	-0.128 (-0.24)	0.163 (0.54)	-0.094 (-0.18)	0.291 (0.94)
Middle-aged/Elderly (> 40)	<b>0.675</b> <b>(2.07)</b>	0.156 (0.74)	<b>0.782</b> <b>(2.25)</b>	0.184 (0.89)	-0.277 (-1.14)	-0.223 (-1.72)	-0.338 (-1.31)	<b>-0.378</b> <b>(-3.62)</b>
Pro-Walk Attitude	0.315 (1.60)	<b>0.752</b> <b>(4.46)</b>	0.152 (1.04)	<b>0.706</b> <b>(4.13)</b>	<b>0.625</b> <b>(3.22)</b>	<b>0.776</b> <b>(4.81)</b>	<b>0.625</b> <b>(3.34)</b>	<b>0.692</b> <b>(4.53)</b>
Neighborhood Safety	-0.336 (-1.57)	<b>-0.504</b> <b>(-2.34)</b>	-0.285 (-1.13)	<b>-0.431</b> <b>(-2.00)</b>	0.004 (0.01)	-0.460 (-1.87)	0.028 (0.10)	<b>-0.469</b> <b>(-2.11)</b>
Crime (violent)	<b>-0.002</b> <b>(-2.35)</b>	<b>-0.003</b> <b>(-3.22)</b>	<b>-0.002</b> <b>(-2.05)</b>	<b>-0.003</b> <b>(-3.65)</b>	<b>-0.002</b> <b>(-3.70)</b>	<b>-0.005</b> <b>(-2.30)</b>	<b>-0.003</b> <b>(-3.94)</b>	<b>-0.004</b> <b>(-2.93)</b>

**Table 5.6 (continued) Walking Trips Regressed on Race/Ethnicity, Sociodemographic, Attitude, and Crime Stratified by Income**

	<i>Low-Mid. Income (less than \$75,000)</i>				<i>High Income (greater than \$75,000)</i>			
	<i>Socio.+Att.+Crime</i>		<i>Socio.+Att.+Crime+BE</i>		<i>Socio.+Att.+Crime</i>		<i>Socio.+Att.+Crime+BE</i>	
	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)
Independent Var.	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)
Neigh. Businesses Per Acre			<b>0.570</b> <b>(6.87)</b>	<b>0.605</b> <b>(3.97)</b>			-0.006 (-0.04)	0.911 (1.71)
% 4-way Intersections			-0.004 (-1.18)	-0.006 (-0.59)			-0.007 (-0.81)	-0.012 (-1.79)
Constant	-1.662 (-1.19)	-0.255 (-0.26)	-1.864 (-1.14)	-0.669 (-0.54)	<b>-3.608</b> <b>(-2.15)</b>	-0.067 (-0.04)	-3.297 (-1.69)	0.275 (0.22)
No. of observations	646	643	646	643	820	814	820	814
Pseudo R-squared	0.0424	0.1485	0.0822	0.1862	0.0516	0.1665	0.0527	0.2179

### *Regression Results Stratified by Gender*

The regression results for walking trips stratified by gender are summarized in Table 5.7. For sociodemographic variables, women with children were less likely to choose to walk to their neighborhood center while men with children took fewer walking trips. Male respondents who were over 40 were also less likely to walk or to choose walking as their preferred mode choice to their neighborhood center. For attitudinal variables, the results show that both men and women were more likely to prefer walking if they held favorable views toward walking, while women were less likely to take walking trips if they were strongly concerned about neighborhood safety. This finding partly reflects a greater concern for neighborhood safety and walking for women vis-à-vis men, which is supported by numerous studies in the sociological and criminology literature (Koskela and Pain, 2000; Ortega and Miles, 1987; Pain, 2001). As in the previous regressions stratified by race and income, the violent crime rate had a significant negative impact on walking behavior for both gender groups while the actual violent crime rate variable was not significant at the 5% level for the negative binomial regressions for females.

As in the previous regressions stratified by race and income, adding the built environment variables did not produce any changes in significance for the attitudinal and crime variables, although it resulted in some changes in significance for male respondents in two sociodemographic variables (*Employed* and *Middle-aged/Elderly* for the logistic regressions). The density of neighborhood businesses was positively correlated with walking behavior for both females and males, while the percentage of four-way intersections did not have any significant effect on walking trips.

**Table 5.7 Walking Trips Regressed on Race/Ethnicity, Sociodemographic, Attitude, and Crime Stratified by Gender**

Independent Var.	<i>Female Respondents</i>				<i>Male Respondents</i>			
	<i>Socio.+Att.+Crime</i>		<i>Socio.+Att.+Crime+BE</i>		<i>Socio.+Att.+Crime</i>		<i>Socio.+Att.+Crime+BE</i>	
	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)
	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)
Hispanic	-0.378 (-0.72)	0.422 (1.25)	-0.329 (-0.64)	0.507 (1.42)	-0.285 (-0.31)	-0.335 (-0.60)	-0.177 (-0.19)	-0.152 (-0.29)
Asian	0.152 (0.20)	-0.454 (-0.97)	0.070 (0.90)	-0.381 (-0.81)	-0.103 (-0.20)	0.142 (0.47)	-0.075 (-0.16)	0.169 (0.69)
African-American/Other	-0.486 (-1.15)	-0.605 (-1.49)	-0.242 (-0.65)	-0.491 (-1.29)	-0.858 (-0.95)	-0.083 (-0.16)	-0.768 (-0.85)	0.100 (0.20)
High Income (> \$75,000)	-0.168 (-0.53)	-0.348 (-1.17)	0.058 (0.21)	-0.092 (-0.33)	0.008 (0.03)	-0.467 (-1.94)	0.163 (0.76)	-0.299 (-1.49)
Employed	0.310 (1.30)	-0.001 (-0.00)	0.255 (1.01)	-0.085 (-0.22)	-0.161 (-0.42)	<b>-0.694</b> (-2.29)	-0.123 (-0.31)	-0.539 (-1.57)
Household w/ Children	0.448 (1.74)	<b>-0.609</b> (-2.47)	0.371 (1.35)	<b>-0.624</b> (-2.61)	<b>-0.727</b> (-2.46)	-0.047 (-0.18)	<b>-0.751</b> (-2.49)	-0.018 (-0.08)
Foreign Born	-0.992 (-1.08)	-0.065 (-0.16)	-0.869 (-0.98)	0.038 (0.10)	0.174 (0.54)	0.011 (0.04)	0.179 (0.55)	-0.009 (-0.03)
Middle-aged/Elderly (> 40)	0.771 (1.90)	0.038 (0.20)	0.789 (1.89)	0.004 (0.02)	<b>-0.452</b> (-2.51)	-0.233 (-1.65)	<b>-0.452</b> (-2.91)	<b>-0.309</b> (-3.15)
Pro-Walk Attitude	<b>0.831</b> (3.34)	<b>0.890</b> (4.15)	<b>0.737</b> (3.16)	<b>0.790</b> (4.12)	0.213 (1.66)	<b>0.699</b> (5.39)	0.163 (1.43)	<b>0.662</b> (5.02)
Neighborhood Safety	<b>-0.741</b> (-2.41)	-0.570 (-1.79)	<b>-0.718</b> (-1.99)	-0.415 (-1.37)	0.044 (0.12)	-0.484 (-1.83)	0.025 (0.07)	-0.505 (-1.94)
Crime (violent)	-0.001 (-1.76)	<b>-0.004</b> (-3.32)	-0.001 (-1.83)	<b>-0.003</b> (-3.65)	<b>-0.003</b> (-3.49)	<b>-0.003</b> (-2.79)	<b>-0.003</b> (-3.17)	<b>-0.003</b> (-3.12)

**Table 5.7 (continued) Walking Trips Regressed on Race/Ethnicity, Sociodemographic, Attitude, and Crime Stratified by Gender**

Independent Var.	<i>Female Respondents</i>				<i>Male Respondents</i>			
	<i>Socio.+Att.+Crime</i>		<i>Socio.+Att.+Crime+BE</i>		<i>Socio.+Att.+Crime</i>		<i>Socio.+Att.+Crime+BE</i>	
	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)	(no. of walk trips)	(usual mode by walking)
	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)	Coeff. (Z-Stat)
Neigh. Businesses Per Acre			<b>0.309</b> <b>(3.26)</b>	<b>0.838</b> <b>(2.97)</b>			<b>0.267</b> <b>(2.77)</b>	0.648 (1.94)
% 4-way Intersections			-0.014 (-1.71)	-0.006 (-0.67)			0.001 (0.05)	-0.012 (-1.40)
Constant	-2.459 (-1.24)	-0.326 (-0.20)	-1.722 (-0.72)	-1.020 (-0.56)	-1.417 (-0.71)	0.575 (0.38)	-1.535 (-0.71)	0.811 (0.64)
No. of observations	694	689	694	689	780	774	780	774
Pseudo R-squared	0.0830	0.1902	0.0994	0.2328	0.0453	0.1361	0.0497	0.1786



### *Testing for Interaction Effects*

In the final part of my regression analysis, I test for interaction effects between crime and attitude towards crime to see whether crime and attitude in tandem have an effect on walking behavior that is different from the main effects of each variable. As in the previous regressions, the regressions for each demographic category are run with and without built environment variables. However, an interaction variable, *Crime\*Neighborhood Safety*, was added to each of the regressions stratified by race, income, and gender.

The regression results did not show any interaction effects between crime and attitudes toward neighborhood safety and crime for all sociodemographic categories. Similar to the previous regressions stratified by race, income, and gender, adding the built environment variables did not produce any changes in significance for sociodemographic, attitudinal, and the crime variable. Therefore, there is no statistical evidence to suggest that the main effects were confounded by two-way interactions between crime and attitudes toward crime.

### **Interpretation and Conclusion**

Interpreting the results, we can see that the perception of crime and neighborhood safety varies significantly across sociodemographic groups, impacting one's decision to take a walking trip as opposed to taking other modes of travel. As expected and confirmed by previous studies in the literature, whites and females appear to be more fearful of crime than non-whites and males (Liska et al., 1982; Pain, 2001). Previous research has suggested that the fear of being victimized by violent crime is especially

acute within certain sociodemographic groups, especially among women (Braungart et al., 1980). The results show that among women, those who expressed a greater concern for neighborhood safety took fewer walking trips than men. This is not surprising given that women are more likely to avoid walking and taking public transit at night (Loukaitou-Sideris, 2006). Therefore, measures should be taken to improve public safety for women and other vulnerable groups by increasing surveillance in public areas and by incorporating crime prevention through environmental design.

The results from this study also show that while perceptions of crime vary across sociodemographic groups, actual violent crime rates discourage walking behavior regardless of race, income, or gender. This is illuminating and shows the strong deterrent effect of neighborhood crime on walking, even after controlling for built environment features (residential density and street geometry). These findings suggest that if the crime rate reaches a certain threshold, the negative effects of crime on walking trips would negate any positive impacts on walking trips from high urban densities and pedestrian-friendly design features. An interesting note is that many of the highest crime neighborhoods in the Los Angeles metropolitan area are located in older, inner-city neighborhoods that would score fairly high on a pedestrian walkability index due to high population densities and a compact grid-oriented street patterns (such as downtown Inglewood). Unfortunately, these favorable built environment features do not result in more walking trips for crime-ridden neighborhoods.

While these findings are relevant and have important implications for planning, further research is necessary to improve our understanding of the complex relationships between crime, perceptions of crime, and the built environment. One limitation of this

study was the availability of a consistent dataset of neighborhood-level crime statistics. This is mainly due to how different cities collect, report, and aggregate crime data. Since none of the cities in this study had consistent criteria for reporting neighborhood crime, I opted to use the city-wide crime statistics from the Bureau of Justice Statistics. However, while preserving consistency, some fine-grained detail on crime at the neighborhood level was inevitably lost. With improved availability of uniform crime data, this problem should be ameliorated in the future. Another limitation is that some independent variables may not be completely exogenous (e.g., attitudes about safety), which is inherent in a multiple regression approach.

However, a more difficult obstacle that remains is the issue of causality with respect to crime, perceptions of crime, and travel behavior. One main reason for this is methodological inconsistency, which has led some studies to suggest a strong link between neighborhood safety and walking while the results of other studies have been more tenuous (Loukaitou-Sideris, 2006). Another reason is differences in the subpopulations that are being studied who respond to fear and risk in public spaces differently, which are often shaped by one's identity (Day, 1999). While this research suggests a link between crime and fear of safety and walking behavior for South Bay residents, I am careful not to overstate these results since there may be other exogenous factors that influence one's attitude about neighborhood safety. The causality issue of whether attitude is influenced by behavior or vice versa needs to be further addressed in future studies.

Despite these limitations, the results of this study illustrate the following key points on crime, perceptions of neighborhood safety, and the built environment with

respect to walking behavior, which have important implications for planning and policymaking: 1) Crime and the fear of crime influences one's decision to walk and should not be ignored in studies of walking behavior; 2) Policies should focus on improving public safety in crime-prone areas via improvements in surveillance and urban design; 3) Protecting vulnerable sociodemographic groups from crime can have positive transportation impacts by promoting transit and walking. Since each metropolitan area is unique and needs to approach its crime problems differently, this remains a significant challenge. However, given that the mobility of a large segment of the population is constrained by crime and the fear of crime, it is suggested that the impacts of crime be given more consideration in future studies of travel behavior.

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## CHAPTER 6

### **Can Built and Social Environmental Factors Encourage Walking among Individuals with Negative Walking Attitudes?**

#### **Introduction**

After roughly fifty years of automobile dominance in suburban America, walking is back in style. For a multitude of reasons, an interdisciplinary group of scholars and practitioners have converged on the notion that walkable neighborhoods are once again in vogue. Architects profess the potential for urban design to create a stronger “sense of community” and a “sense of place” (Calthorpe, 1993; Duany and Plater-Zyberk, 1991). Some transportation planners attest to the reduction in automobile travel by those living in more pedestrian-oriented neighborhoods. These transportation planners claim that well-designed, compact neighborhoods can shorten the length or reduce the number of automobile trips, induce individuals to shift from automobile use to alternative forms of transportation, or encourage individuals to ditch automobiles altogether (Boarnet and Crane, 2001; Crane 1996). Public health professionals have measured the health benefits from an increase in physical activity for those living in pedestrian-oriented neighborhoods (Frank and Engelke, 2001; Saelens et al., 2003). The physical compactness of walkable neighborhood also aligns with environmentalists’ desires to reduce the impact of development on the natural environment. This convergence of support for walkable neighborhoods in the last few years has steered the direction of research away from questions about the benefits of walking towards determining which factors encourage more walking.

While there is broad ranging consensus about the positive benefits of walking, scholars are less certain about the factors that promote walking in neighborhoods. Is it

the built environment, social environment, or lifestyle attitudes that can explain why some individuals walk more than others? More vexing to scholars studying this question is the challenge of disentangling which of these factors has a greater influence on walking behavior. One of the key questions emerging from this literature is whether the design of the built environment encourages more walking above and beyond individuals' attitudes towards walking or their predisposition to walk. In other words, can physical design of neighborhoods encourage people to walk even if they hold negative attitudes towards walking?

This paper examines this question using survey information from 2,125 residents of eight neighborhoods in the South Bay Area of Los Angeles, California. I compare individuals who have positive attitudes about walking to individuals who have negative attitudes towards walking to determine whether physical or social environments differentially affect walking trips to their neighborhood shopping center, controlling for sociodemographic characteristics. While there have been quite a few studies that have examined the relationship between attitudes, physical environment, and social environment, very few studies have examined the relative importance of all three sets of factors. Moreover, Los Angeles residents are notorious for their aut centrality and, therefore, this study may provide for a more stringent test of the influence of the physical and social environments on walking behavior.

This chapter is organized as follows. First, I will give a review of the literature, focusing on how the built environment, crime and safety, and individual attitudes impact walking behavior. I will then present the methodology of my research, followed by the results.

## **Neighborhoods and Walkability: An Overview of the Literature**

Undoubtedly, the recent shift from auto-oriented to pedestrian-oriented neighborhoods can be credited to the New Urbanist (or neotraditional) design movement that emerged in the 1990s. New Urbanist designs call for more pedestrian oriented neighborhoods that include elements such as narrower streets, tree-lined sidewalks, shallow setbacks, front porches, corner grocery stores, and a town center that houses civic buildings, retail shops, and public open spaces. If designed according to the New Urbanism Charter,<sup>9</sup> these neighborhoods would encourage more walking than other suburban type of neighborhood developments.<sup>10</sup> This urban design theory sparked a host of empirical studies testing the relationship between urban form and travel behavior (Boarnet and Crane, 2001; Cervero and Kockelman, 1997; Ewing and Cervero, 2001; Handy, 1996a; Handy, 1996b; Handy et al., 2005; Kitamura et al., 1997; Krizek, 2003). In the last few years, several reviews on the topic have been published (Badoe and Miller, 2000; Crane, 2000; Ewing and Cervero, 2001; Handy, 1996a), therefore there is no need to cover travel behavior studies in general. Instead, I will review the literature on the factors influencing walking behavior.

### *Built Environment and Walking*

Influenced in part by the New Urbanism movement, several studies have focused on the relationship between urban form and walking and how land use patterns affect

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<sup>9</sup> A copy of the New Urbanism Charter is available at: [www.cnu.org/charter](http://www.cnu.org/charter).

<sup>10</sup> New Urbanist theory also posits a reduction in automobile use, but the empirical findings to support this are quite mixed depending on how automobile use is operationalized. For a complete review of studies that examine the relationship between the built environment and automobile travel, see Saelens and Handy (2008). It is beyond the scope of this study to address the empirical findings of these studies.

pedestrian behavior (Crane, 2000; Badoe and Miller, 2000; Greenwald and Boarnet, 2001; Lee and Moudon, 2006; Rodriguez and Joo, 2004). Many of these studies have relied on travel data from the U.S. Census and the National Household Travel Survey (Agrawal and Schimek, 2007) as well as metropolitan travel surveys (Cervero and Gorham, 1995; Crane and Crepeau, 1998; Handy, 1996a). Recent attention has been given on studying walking behavior for different subgroups of the population, including school children, elderly, disabled persons, immigrants, and other sociodemographic groups (Boarnet et al., 2008; McMillan, 2007; Hess, 2008; Blumenberg and Evans, 2006). The link between walking and physical activity and health has also been highlighted in recent research (Boarnet et al., 2008; Frank and Engelke, 2001).

The results from these studies have shown a fairly strong link between the built environment and walking behavior. In particular, the proximity of retail and commercial land uses has been attributed to an increased number of walking trips. Paired case studies by Handy and her colleagues (Handy, 1996b; Handy and Clifton, 2001; Handy, Clifton, and Fisher, 1998) have shown that the proximity to neighborhood businesses is a robust predictor of walking trips. Several other studies have also found that residents living in or near commercial or mixed-use areas took more frequent walking trips than those who did not (Frank and Pivo, 1994; Shriver, 1997; Krizek, 2003; Joh et al., 2008).

Several studies have also shown that street and sidewalk connectivity is correlated with walking behavior. In a study of twelve neighborhoods in the Puget Sound region, Moudon et al. (1997) found that pedestrian activity was higher in neighborhoods with direct pathways and a more complete system of pedestrian facilities (e.g., block size and sidewalk length). Other studies have shown a correlation between street geometry and

walking trips, with higher rates of walking trips reported in neighborhoods with traditional gridiron street patterns (Cervero and Duncan, 2003; Saelens et al., 2003).

The quality of the pedestrian environment, such as the presence of street lighting, benches, landscaping, trees, and other amenities, has also been cited as a factor by some as a determinant of walking behavior. However, the empirical evidence suggesting this link has been weaker than the correlation between walking and proximity to neighborhood businesses or connectivity. For instance, Handy (1996a) found that differences between traditional and modern neighborhoods in terms of walking quality did not seem to affect the choice to walk. Additionally, studies by Cervero and Kockelman (1997) and Kitamura et al. (1997) showed that walking quality was not the most robust indicator for determining walking trips and appeared to matter mainly for non-work trips rather than commute trips.

### *Crime, Safety, and Walking*

The literature on the built environment and crime is informed by two classic studies by Jane Jacobs (1961) and Oscar Newman (1972). Jacobs's ideas about "eyes on the street" and Newman's "defensive space" are well-known and established concepts that emphasize the importance of identifying features of the built environment that discourage delinquent and criminal activities and promote opportunities for informal community surveillance. More contemporary empirical studies investigating the link between urban design and crime rates have found that the built environment can both promote and mitigate crime (Block and Block, 1995; Loukaitou-Sideris et al., 2001). Researchers have also found that criminal activity tends to be concentrated in specific

nodes or “hot spots” in the city (Nasar and Fisher, 1993; Loukaitou-Sideris, 1999). For example, Loukaitou-Sideris’s study of bus stop crimes in Los Angeles found that 18% of the total crime incidents reported at bus stops occurred at only ten bus stops, mainly in the downtown area. Her study also revealed that these locations were the site for undesirable land uses (such as seedy motels, liquor stores, and check-cashing establishments) and lacked attributes associated with “defensible space” (i.e. adequate lighting and alleyways), leaving bus riders vulnerable to criminal attack and allowing criminals to easily escape. These studies suggest that the built environment can also deter crime, such as improving lighting and visibility to promote defensible space and by eliminating signs of neglect such as derelict buildings (Loukaitou-Sideris, 1999; Loukaitou-Sideris et al., 2002; Perkins et al., 1993).

Other studies relying on objective measures of crime include McDonald’s study of neighborhood crime and walking in the San Francisco Bay Area. Her results show evidence for a negative association between violent crime and amount of daily walking. Similarly, a study of transit crimes along the Green Line light rail in Los Angeles found that crime was a major deterrent for walking to nearby transit stations (Loukaitou-Sideris et al., 2002).

While these studies have used objective measures of crime, another body of work analyzes subjective measures of crime, such as fear and perceptions of neighborhood safety, on walking behavior. Fear of crime, while not synonymous with actual crime, often impacts one’s decision to walk. While fear is often influenced by certain built environment features that represent neglect and decay, such as a broken window (Wilson and Kelling, 1982), fears can also be socially produced (e.g., family upbringing, media

reports). Studies have also shown that fear and perceptions of crime vary across sociodemographic groups (Day, 1999; Kostela and Pain, 2000; Ortega and Miles, 1987; Pain, 2001). For instance, women are more likely to avoid walking at night due to concerns over personal safety (Atkins, 1989; Ross, 2000). These studies suggest that the fear of crime often deters walking behavior, especially for vulnerable groups. A 1994 survey conducted by the U.S. Department of Transportation found that the majority of respondents would walk more if safety was not an issue, and other studies have also shown that perceived safety is an important environmental quality for walking for respondents (Bauman et al., 1996; Hawthorne, 1989). Therefore, these studies suggest that perceptions or fear of crime may impact walking behavior as much as actual crime, if not more so.

### *Attitudes and Walking*

The role of individual attitudes in shaping travel behavior has often been overlooked in the travel behavior literature due to methodological difficulties in assessing personal attitudes. However, a number of recent empirical studies have begun to acknowledge this gap and have incorporated attitudinal factors in their analyses of travel behavior (Kitamura et al., 1997; Handy et al., 2005; Cao et al., 2006; Joh et al., 2008). With respect to walking behavior, some have suggested that attitudinal factors may be a stronger determinant of walking than built environment factors (Kitamura et al., 1997; Bagley and Mokhtarian, 2002). For example, Handy (1996a) found that the quality of the walking environment did not appear to affect the choice to walk, while Moudon et al. (1997) reported high walking trip rates in neighborhoods that have been rated low in



terms of pedestrian accessibility. This line of research points to the need to factor in individual attitudes in shaping decisions to walk.

Although there is a general consensus among scholars that attitudes should be measured, there are methodological challenges to doing so. The ideal research method would involve a study of individuals moving from an auto-oriented neighborhood to a pedestrian-oriented neighborhood and measure the individual's attitudes towards travel before and after the move. This methodology would address questions about causality and residential self-selection bias. As with much social science research, it is rare that an experimental design of this nature is feasible with human subjects in the real world. But, there have been several recent studies that have helped us learn more about these questions about attitudes and self-selection. Handy, Cao, and Mokhtarian's (2005) paired case study of traditional and suburban neighborhoods in Northern California revealed that differences in travel behavior across these two types of neighborhoods were largely attributable to attitudinal factors rather than built environment characteristics. Cao et al. (2006) investigated this question in their case study of pedestrian trips in Austin, Texas. They analyzed pedestrian trips (strolling trips and pedestrian shopping trips) and found that residential self-selection impacted both types of trips, but especially for pedestrian shopping trips. However, the results also showed that the built environment did have a separate effect for certain types of walking trips, which appear to suggest that the built environment still matters. Schwanen and Mokhtarian's (2005) study of mismatched urban and suburban residents in the San Francisco Bay Area further support this notion, which seemed to show that the built environment had less of an impact on urban residents (i.e., those who preferred to walk did) than for suburban residents (i.e., those who

preferred to walk often had little choice but to drive). In contrast, Chatman (2009) argues that the effects of residential self-selection does not appear to bias the effects of the built environment as much as others have suggested, and therefore should not be considered a major factor in explaining differences in travel behavior.

## **Methodology**

The primary data source for this study was from the South Bay Travel Survey, which surveyed respondents from eight neighborhoods in the South Bay Area of Los Angeles County (see Chapter 2 for more detail). Data from the SBTS was merged with other publicly available data sources. The data and data sources include: 1) crime statistics from the Bureau of Justice Statistics (2006) and 2) built environment data from GIS parcel data maps from the Los Angeles County Assessor's Office, the InfoUSA database, and satellite imagery from Google Maps.

### *Regression Models*

I employed negative binomial regression analyses to model differences in walking behavior between those who hold strongly favorable attitudes toward walking ("high walk") and those who held neutral or negative attitudes toward walking ("low walk"). Therefore, the samples were stratified across attitudinal differences toward walking: high walk and low walk attitudes. These differences were defined by a question on the travel survey which asked how important it is to be able to walk to nearby neighborhood businesses. Respondents were asked to rate on a 5-point ordinal scale, with 5 representing very important and 1 representing not at all important. Those who responded 4 or 5 on the ordinal scale ("important" and "very important") were included in the high walk

sample, while those who responded 3 (“neutral”) or lower on the scale comprised the low walk group.<sup>11</sup>

I tested six regression models to examine the relative strength of sociodemographic, social environment, built environment, and attitudinal variables on walking behavior for individuals who express high walk compared to low walk attitudes. Walking behavior, the dependent variable, is a count measure of the number of individual walking trips taken by the respondent to the neighborhood center as reported in the one-day travel diary. Since this variable is count data, negative binomial regressions are used (Cameron and Trivedi, 1998). The negative binomial regression models were constructed as nested models in which sets of variables are included additively with each subsequent model. Log likelihood tests were conducted to determine the best fitting model. Model 1 contains sociodemographic variables in addition to a control variable that measures distance to the neighborhood center. Model 2 includes sociodemographic and social environment variables along with the control variable. Finally, built environment variables are added in Model 3 (the full model).

The full model is expressed below:

$$N = \beta_0 + \beta_1' C + \beta_2' D + \beta_3' S + \beta_4' B + u \quad (4)$$

where  $N$  = number of individual walking trips,  $C$  = sociodemographic variables,  $D$  = distance to neighborhood center,  $S$  = social environment variables,  $B$  = built environment variables, and  $u$  = regression error term.

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<sup>11</sup> This response was based on the following question on the South Bay Travel Survey: “Thinking about your neighborhood as a good place to live, how important is it to you that you can walk to nearby stores and restaurants?”

For all regression models, standard errors were clustered by study area since the crime and land use variables take on the same value within each study area (see Moulton, 1990, for further discussion).

The sociodemographic variables used in these models are quite typical of those found in the travel behavior literature (Handy et al., 2006). These include respondent's racial and ethnic background, gender, age, household income, employment status, children in the household and foreign-born status. All of the sociodemographic variables are dichotomous variables. However, the age category was stratified into two groups: "not elderly" (65 years of age or younger) and "elderly" (greater than 65 years of age). Similarly, household income was also collapsed into two groups, "high income" (greater than \$75,000) and "low income" (less than \$75,000). For details about these variables and their coding, see Table 6.1.

**Table 6.1 List of Variables in Negative Binomial Models**

<b>Variable</b>	<b>Variable Coding</b>
<i><b>Dependent Variable:</b></i>	
Individual walking trips	Actual counts of walking trips taken by the respondent to the neighborhood center as reported in the one-day travel diary
<i><b>Independent Variables:</b></i>	
<i><u>Sociodemographic</u></i>	
Race/ethnicity	
Hispanic	Hispanic = 1; else = 0
Asian	Asian = 1; else = 0
African-American	African-American = 1; else = 0
Other	Other Race = 1; else = 0 <sup>12</sup>
Gender	1 = female; 0 = male
Age	1 = greater than 65 years of age; 0 = 65 or younger
Household income	1 = greater than \$75,000; 0 = less than \$75,000
Employment status	1 = employed; 0 = unemployed
Household with children	1 = at least one child in household; 0 = no children in household
Foreign-born status	1 = born outside of the U.S.; 0 = born in the U.S.
<i><u>Social Environment</u></i>	
Violent crime rate	Number of violent crimes per 100,000 persons for the city where the study area is located
Neighborhood safety attitude	1 = not at all important; 2 = rather unimportant; 3 = neutral; 4 = important; 5 = very important
<i><u>Built Environment</u></i>	
Neighborhood business concentration	The number of neighborhood businesses per acre in the study area, defined by 6-digit NAICS codes
Block size	Average block size, calculated by summing the total acres for each study area divided by the number of blocks in the study area
<i><u>Control</u></i>	
Distance to the neighborhood center	1 = resident lives in the inner ring; 0 = resident lives in the outer ring

<sup>12</sup> Non-Hispanic whites were treated as a reference category and thus omitted.

The next set of variables included in these models are social environment (SE) variables, which includes a measure of violent crime rates and a measure of individual perceptions about safety. The violent crime rate variable, taken from the Bureau of Justice Crime Statistics (2006), measures violent crime rates for the respective cities where the study areas are located and is defined as the number of violent crimes per 100,000 persons. Violent crimes constitute the following criminal offenses: murder, manslaughter, forcible rape, robbery, and aggravated assault. The perceptions about safety variable is obtained from a survey question designed to gauge how much importance respondents placed on being able to walk safely in their neighborhood.<sup>13</sup>

The models also include two variables measuring the built environment (BE), neighborhood businesses per acre and block size. The data for the neighborhood businesses per acre variable were obtained from the InfoUSA database and measure the concentration of neighborhood businesses within each study area. Neighborhood businesses were defined to be local population-serving retail and service establishments. These are categorized by 6-digit NAICS codes, listed in Appendix C. The block size variable measures the average block size for each study area, which was calculated by summing the total acres for each study area divided by number of blocks in the study area. The figures for average block sizes were derived from GIS parcel data maps from the Los Angeles County Assessor's Office and also from satellite imagery from Google Maps. These BE variables are typically used in studies examining how the "3Ds" (density, diversity, design) impact travel behavior (Cervero and Kockelman, 1997; Lee and Moudon, 2006).

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<sup>13</sup> This response was based on the following question on the South Bay Travel Survey: "*Thinking about your neighborhood as a good place to live, how important is it to you that the neighborhood is safe?*"

In addition to these sociodemographic variables, I also include a variable that measures distance from the neighborhood center, defined as “inner” and “outer,” to control for the possibility that proximity will encourage more walking. The inner ring comprises the area closest to the center (approximately ¼ mile radius) while the outer ring comprises the area beyond the ¼ mile radius, roughly between ¼ and ½ mile from the center. The exact boundaries for the inner and outer rings were based on 2000 Census block group boundaries.

## **Results**

### *Summary of Overall Walking Trips by Study Area*

Summaries of the overall measures of walking behavior, by study area, are presented in Table 6.2. The number of per person walking trips per day ranged from a low of 0.083 in Inglewood to 0.276 in Riviera Village. The percentage of respondents whose usual mode to their neighborhood center was walking ranged from 8.18% in Artesia Boulevard to 53.13% in Riviera Village. On average, mixed-use center neighborhoods reported a higher number of daily individual walking trips (0.191 walking trips) than corridor neighborhoods (0.073 walking trips). Additionally, 47.32% of respondents from center neighborhoods reported that they typically walk to the neighborhood center while only 24.41% of respondents living in corridor neighborhoods usually walk to the neighborhood center. These findings appear to support New Urbanist assertions that people tend to walk more in traditional mixed-use neighborhoods (Handy, 1996a; Crane, 1996).

**Table 6.2 Walking Trip Rates by Study Area**

Study Area	Per person walking trips per day	% of respondents who usually walk to neighborhood center	No. of responses
<i>Mixed-Use Neighborhoods</i>			
El Segundo	0.133	50.16%	324
Inglewood	0.083	30.88%	72
Riviera Village	0.276	53.13%	239
Torrance Old Town	0.225	41.07%	178
All Mixed-Use	0.191	47.32%	813
<i>Corridor Neighborhoods</i>			
Artesia Blvd.	0.087	8.18%	526
Gardena Blvd.	0.032	8.85%	285
Hawthorne Blvd.	0.036	12.21%	278
Pacific Coast Highway	0.143	24.41%	223
All Corridor	0.073	11.97%	1312
ALL STUDY AREAS	0.119	25.49%	2125

*Summary of High Walk and Low Walk Groups*

Among those who responded to the question about attitudes towards walking, 1,401 respondents (69.39 percent) were categorized as “high walk,” 618 respondents (30.61 percent) were categorized as “low walk” according to how respondents answered the attitudinal question about walking. The distribution of high walk and low walk respondents by study area is shown in Table 6.3.



**Table 6.3 High Walk and Low Walk Respondents by Study Area**

Study Area	High Walk (N)	% High Walk	Low Walk (N)	% Low Walk
<i>Mixed-Use Neighborhoods</i>				
El Segundo	240	78.95%	64	21.05%
Inglewood	43	68.25%	20	31.75%
Riviera Village	208	88.51%	27	11.49%
Torrance Old Town	116	66.67%	58	33.33%
All Mixed-Use	607	78.22%	169	21.78%
<i>Corridor Neighborhoods</i>				
Artesia Blvd.	327	65.27%	174	34.73%
Gardena Blvd.	178	68.46%	82	31.54%
Hawthorne Blvd.	183	69.85%	79	30.15%
Pacific Coast Highway	106	48.18%	114	51.82%
All Corridor	794	63.88%	449	36.12%
ALL STUDY AREAS	1401	69.39%	618	30.61%

Across the four mixed-use neighborhoods, Riviera Village had the highest percentage of high walk residents (88.51%) while Torrance Old Town had the lowest (66.67%). Therefore, all mixed-use neighborhoods had a higher share of high walk residents than low walk residents. On average, three out of every four residents living in mixed-use centers held favorable attitudes toward walking.

Overall, corridor neighborhoods also had a larger proportion of high walk residents than low walk residents, with the notable exception of Pacific Coast Highway, which had a slightly higher share of low walk residents. However, the proportion of low walk residents was higher on average for corridor neighborhoods than mixed-use neighborhoods (36.12% low walk in corridor neighborhoods versus 21.78% low walk in mixed-use neighborhoods). Approximately one-third of corridor residents held neutral or negative attitudes towards walking. Pacific Coast Highway had the highest percentage of

low walk respondents (51.82%) while Hawthorne Boulevard had the lowest share of non pro-walk residents (30.15%).

### *Descriptive Statistics*

Descriptive statistics for sociodemographic, social environment, built environment, and distance variables are presented in Table 6.4, stratified by high walk and low walk respondents. T-tests were conducted for each variable to determine whether differences in characteristics between high walk and low walk were statistically significant.

**Table 6.4 Descriptive Statistics for Sociodemographic, Social Environment, and Built Environment Variables**

<i>Variable</i>	<b>High Walk Attitudes</b>			<b>Low Walk Attitudes</b>			<b>Mean Differences</b>
	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>t-stat</i>
All Respondents	1401	69.39%	N/A	618	30.61%	N/A	18.90
White	799	68.23%	N/A	372	31.77%	N/A	18.94
Hispanic	130	80.25%	N/A	32	19.75%	N/A	13.63
Asian	165	67.35%	N/A	80	32.65%	N/A	8.17
African-American	60	76.92%	N/A	18	23.08%	N/A	7.93
Other Race	30	76.92%	N/A	9	23.08%	N/A	5.57
Female	632	69.15%	N/A	282	30.85%	N/A	17.71
High Income (> \$75,000)	931	71.23%	N/A	376	28.77%	N/A	23.97
Employed	1165	71.96%	N/A	454	28.04%	N/A	27.81
Household with Children	409	73.17%	N/A	150	26.83%	N/A	17.47
Age greater than 65	124	55.61%	N/A	99	44.39%	N/A	2.38
Foreign-Born	184	74.80%	N/A	62	25.20%	N/A	12.64
Violent Crime	1401	428.59	242.69	618	431.27	243.01	-0.23
Neighborhood Safety	1396	4.89	0.40	616	4.75	0.72	5.22
Neigh. Businesses per acre	1401	0.62	0.83	618	0.38	0.46	6.93
Average Block Size	1401	6.04	1.63	618	6.07	1.52	-0.44
Inner Ring resident	578	78.85%	N/A	155	21.15%	N/A	27.04
Center resident	607	78.22%	N/A	169	21.78%	N/A	26.92
Walking Trips	1401	0.16	0.57	618	0.04	.27	5.07
Vehicles per Licensed Driver	1238	1.05	0.37	547	1.08	0.52	-1.02

Statistically significant differences between high walk and low walk respondents can be observed for all sociodemographic variables. Comparing high walk and low walk attitudes across racial and ethnic groups, Hispanics reported the highest share of high walk respondents (80.25%), followed by African-Americans and “other race” (76.92%), whites (68.23%) and Asians (67.35%). Other sociodemographic categories (e.g., gender, household income, employment status, households with children, age, and foreign-born status) reported similar shares of high walk versus low walk respondents (69-75% high walk, 25-31% low walk), with the exception of elderly (greater than 65 years of age) respondents, which had a considerably lower share of individuals with high walk attitudes (55.61%). However, the difference between high walk and low walk attitudes for this group was statistically significant (t-statistic: 2.38).

For social environment variables, there were no significant differences between individuals with high walk and low walk attitudes with respect to violent crime. In other words, individuals with high walk attitudes did not live in neighborhoods that were necessarily safer (i.e., lower violent crime rate) than those with low walk attitudes. However, differences across high and low walk individuals with respect to neighborhood safety attitude were statistically significant, with high walk individuals showing a greater concern for neighborhood safety (t-statistic: 5.22)

In terms of the built environment variables, the results show significant differences for high and low walk individuals with respect to neighborhood business concentration while insignificant for average block size. Individuals with high walk attitudes tended to live in neighborhoods with higher concentrations of neighborhood businesses than those with low walk attitudes. However, block size did not appear to

correlate much with attitudes toward walking. Both residents living in the inner ring closer to the neighborhood center as well as those living in mixed-use centers had significantly higher proportion of high walk individuals than low walk individuals, with roughly every three out of four inner ring and mixed-use center residents having favorable attitudes toward walking.

In addition to the variables included in these regression models, I also compared individual walking trip rates between high walk and low walk individuals. As expected, individuals with high walk attitudes took more than twice as many walking trips than individuals with low walk attitudes. However, one could argue that high walk attitudes could be proxying for low-income status, since low-income status is often correlated with less driving. To ensure that this was not the case, I also tested for means difference on vehicles per licensed driver between high walk and low walk individuals. The results show that there were no significant differences in vehicle ownership rates between high walk and low walk individuals, suggesting that high walk is not proxying for limited car availability.

### *Regression Results*

To determine the relative effects of sociodemographic, social environment, and built environment variables, six negative binomial regressions are analyzed. The results for individuals with high walk attitudes are presented in Model 1-3 in Table 6.5. Several sociodemographic variables are significant predictors of rates of walking. As shown in Model 1, African-Americans, Asians and households with children are significant predictors of fewer walking trips. When social environment variables (violent crime rate

and attitudes toward neighborhood safety) were added in Model 2, the violent crime rate variable was significant and negative, while the household with children variable remained significant. African-American and Asian were no longer significant in Model 2 when social environment variables are introduced. When built environment variables (neighborhood businesses per acre and average block size) were included in Model 3, violent crime rate lost statistical significance while households with children remained significant. Additionally, the concentration of neighborhood businesses was correlated with an increased number of walking trips. Other sociodemographic variables as well as the distance variable were not significant factors for determining walking trips.

These results show the following key findings about individuals with high walk attitudes in the South Bay study areas: 1) social environmental factors such as violent crime rate and attitude toward neighborhood safety do not appear to have a significant impact on walking behavior once built environmental factors are taken into account; 2) having nearby destinations to walk to (i.e., businesses) increases the propensity to walk; 3) distance to the neighborhood center does not impact one's decision to walk.

For the low walk regression models (refer to Table 6.6), there are many more factors that predict number of walking trips. First, in all three models (Models 4-6), African-Americans, "other race" individuals, and females took fewer walking trips. Thus, among individuals who do not have a strong affinity towards walking, sociodemographic characteristics matter in who walks more. Second, high-income individuals took fewer walking trips with the addition of the social environment variables and the built environment variables in the second and third models, respectively. Third, both indicators of the social environment (violent crime rate and attitudes toward

neighborhood safety) were significant and negative in Model 5, suggesting that low walk individuals were strongly deterred from walking by crime rates and fear of safety. Both of these variables remained significant after adding built environment variables to the regressions in Model 6. For the built environment variables, the concentration of neighborhood businesses did not appear to impact walking trips. However, larger block sizes were correlated with more walking trips, which was an unexpected finding. Additionally, low walk residents living closer to the neighborhood center did appear to take more walking trips than those living in the outer ring. In sum, low walk individuals were more sensitive to crime and safety and less sensitive to built environment variables such as concentration of neighborhood businesses and average block sizes.

**Table 6.5 High Walk Regression Results**

Independent Var.	<i>Model 1: Sociodemographics</i>		<i>Model 2: Sociodemographics + SE</i>		<i>Model 3: Sociodemographics + SE + BE</i>	
	Coeff.	Z-Stat.	Coeff.	Z-Stat.	Coeff.	Z-Stat.
Hispanic	-0.859	(-1.46)	-0.434	(-0.68)	-0.349	(-0.55)
African-American	<b>-1.111</b>	<b>(-2.24)</b>	-0.610	(-1.07)	-0.641	(-1.19)
Asian	<b>-0.937</b>	<b>(-2.58)</b>	-0.594	(-1.58)	-0.563	(-1.47)
Other Race	-0.023	(-0.04)	-0.101	(-0.16)	-0.007	(-0.01)
Female	-0.043	(-0.15)	0.000	(0.00)	-0.074	(-0.24)
High Income (> \$75,000)	0.009	(0.03)	-0.130	(-0.40)	-0.175	(-0.58)
Employed	0.030	(0.10)	-0.025	(-0.08)	0.004	(0.01)
Household w/ Children	<b>-0.363</b>	<b>(-2.13)</b>	<b>-0.365</b>	<b>(-2.10)</b>	<b>-0.425</b>	<b>(-2.66)</b>
Age (> 65)	-0.805	(-1.37)	-0.769	(-1.27)	-1.004	(-1.65)
Foreign Born Status	-0.041	(-0.14)	-0.063	(-0.22)	-0.060	(-0.20)
Distance (Inner)	0.277	(0.91)	0.277	(-0.91)	-0.122	(-0.47)
Violent Crime Rate			<b>-0.002</b>	<b>(-2.43)</b>	-0.002	(-1.93)
Neighborhood Safety			-0.155	(-0.52)	-0.143	(-0.52)
Businesses Per Acre					<b>0.442</b>	<b>(5.09)</b>
Average Block Size					0.032	(0.23)
Constant	-1.782	(-3.75)	-0.288	(-0.19)	-0.615	(-0.42)
No. of observations	1008		1006		1006	
Pseudo R-squared	0.0206		0.0306		0.0407	



**Table 6.6 Low Walk Regression Results**

Independent Var.	<i>Model 4: Sociodemographics</i>		<i>Model 5: Sociodemographics + SE</i>		<i>Model 6: Sociodemographics + SE + BE</i>	
	Coeff.	Z-Stat.	Coeff.	Z-Stat.	Coeff.	Z-Stat.
Hispanic	-0.526	(-0.52)	0.443	(0.32)	0.886	(0.57)
African-American	<b>-12.576</b>	<b>(-15.98)</b>	<b>-19.046</b>	<b>(-21.06)</b>	<b>-15.990</b>	<b>(-20.98)</b>
Asian	0.012	(0.01)	0.566	(0.56)	0.966	(1.05)
Other Race	<b>-13.617</b>	<b>(-22.12)</b>	<b>-20.897</b>	<b>(-22.95)</b>	<b>-18.416</b>	<b>(-23.08)</b>
Female	<b>-1.661</b>	<b>(-3.33)</b>	<b>-1.945</b>	<b>(-3.20)</b>	<b>-2.117</b>	<b>(-3.77)</b>
High Income (>\$75,000)	-0.970	(-1.73)	<b>-0.708</b>	<b>(-2.12)</b>	<b>-1.225</b>	<b>(-2.92)</b>
Employed	-0.561	(-0.99)	-0.735	(-1.73)	-0.688	(-1.88)
Household w/ Children	<b>0.864</b>	<b>(2.38)</b>	0.421	(1.29)	0.531	(1.25)
Age (> 65)	-0.894	(-1.10)	-0.525	(-0.65)	-0.246	(-0.30)
Foreign Born Status	-0.170	(-0.77)	-0.157	(-1.13)	<b>-0.467</b>	<b>(-3.21)</b>
Distance (Inner)	0.194	(0.37)	0.489	(1.28)	<b>2.157</b>	<b>(3.59)</b>
Violent Crime Rate			<b>-0.003</b>	<b>(-2.34)</b>	<b>-0.006</b>	<b>(-7.13)</b>
Neighborhood Safety			<b>-0.635</b>	<b>(-2.19)</b>	<b>-0.827</b>	<b>(-2.46)</b>
Businesses Per Acre					-4.708	(-1.92)
Average Block Size					<b>0.426</b>	<b>(2.62)</b>
Constant	-1.623	(-2.90)	2.449	(1.91)	3.119	(1.82)
No. of observations	427		427		427	
Pseudo R-squared	0.0535		0.0847		0.1099	

## Discussion

The results from the negative binomial regressions reveal two main differences between high walk and low walk individuals. First, individuals with a strong affinity towards walking are less sensitive to crime and neighborhood safety issues than individuals who hold less favorable attitudes towards walking. This is an illuminating finding because it reveals that fear of crime differs not only across sociodemographic groups, but is largely dependent on walking attitudes. While previous studies have found that certain sociodemographic groups such as whites and females are more fearful of crime than non-whites and males (Liska et al., 1982; Pain, 2001), differences in attitudes toward walking *within* these groups have usually not been taken into account in these studies. These differences across race and gender are clearly shown in these regression results which suggest that “other race” individuals and females who did not favor walking took fewer walking trips while members of those groups who favored walking did not take fewer walking trips. While these results reflect the results of previous studies which have suggested that the fear of being victimized by violent crime is especially acute among women (Braungart et al., 1980) and that women are more likely to avoid walking at night (Loukaitou-Sideris, 2006), these results show that not all women are equally fearful of walking, an important point that has often been overlooked in the literature.

Second, individuals who place a higher importance on walking are more likely to walk when there are destinations such as retail businesses in the neighborhood, while destinations matter less for those who feel that walking is less important. This suggests that not all residents would equally take advantage of increased shopping and service

opportunities by adding more retail stores and businesses. While this finding may appear intuitive, this reflects an important insight from attitude theory which states that behavioral intention is a reliable predictor of travel behavior (Fishbein and Ajzen, 1975; Gärling et al., 1998). To state it more simply, those who intend to walk are more likely to walk to destinations than those who do not intend to walk to these destinations. While promoting the development of neighborhood retail stores is a strategy frequently employed by urban planners to encourage more walking, these results suggest that such strategies may not be successful for those who do not prefer to walk. Furthermore, providing more local shopping opportunities may not be a fruitful strategy for discouraging automobile use and promoting walking (Handy and Clifton, 2001).

Based on these results, it can be inferred that attitudinal difference is a significant determinant for walking trips. However, what are some of the explanatory factors which account for differences in attitudes toward walking? While a detailed analysis on the specificity of attitudinal predictors is beyond the scope of this paper, I offer the following explanations. One possible reason explaining these attitudinal differences is that once people have formed positive attitudes toward walking, these individuals are more likely to follow through on their intention to walk, especially if there are destinations to walk to. Intention strength has been cited as an important factor that increases the likelihood that one would implement their intention (Fishbein and Ajzen, 1975; Sheppard et al., 1998). For instance, if individuals intend to adopt a positive attitude toward walking to nearby destinations, they are more likely to walk as opposed to driving. Furthermore, such individuals are more likely to walk to such places on a habitual basis. For individuals who preferred walking in this sample, the only significant barrier to walking was having

children, which understandably makes walking more burdensome and time-consuming, thus, it is not surprising that these individuals walked less. Another possible reason is that those who do not have a positive attitude towards walking are more likely to be deterred by social and environmental factors that impede walking, such as crime and perceptions of safety in their neighborhood. Based on the results of my study, violent crime rates and safety concerns decrease the rates of walking for low walk individuals while increases in average block size is surprisingly associated with increasing rates of walking. There are also substantial sociodemographic variations in rates of walking among individuals who do not have positive walking attitudes.

What these overall findings suggest is that encouraging individuals who do not have strong walking tendencies may be difficult. From the South Bay data, it is unclear whether those who hold negative views toward walking are those who have had unpleasant experiences walking in the past or those who do not enjoy walking to places in general, but it is evident that attitude towards walking is an important factor in influencing one's decision to walk (Handy, et al., 2005; Kitamura, et al., 1997). Therefore, altering people's attitudes may be the most effective way to encourage walking behavior, but it may also be the most difficult approach.

## **Conclusion**

Recent trends such as the threat of climate change and rising obesity rates have led to the convergence of support for walkable neighborhoods and promoting more walking. However, urban planners and designers have largely focused on modifying the built environment to promote more walking. These results suggest that walking behavior is heavily influenced by individual attitudes, and therefore policies that aim to encourage

walking by constructing or “retrofitting” neighborhoods to be more pedestrian friendly may be an insufficient approach. This is an important finding that deserves more attention in the planning literature.

The findings from this research also suggest that the goals of promoting more walkable neighborhoods and promoting more walking behavior are not synonymous. Planners and designers have given far more attention to the former while not adequately addressing the latter. While these results support previous studies that more compact, mixed-use neighborhoods generate more walking trips, the majority of residents living in these neighborhoods (at least in the South Bay Area) choose not to walk. Part of the reason is that individuals who do not have a positive attitude toward walking are less likely to walk than those who prefer to walk. These results also show that even among “high walk” and “low walk” individuals, there are significant differences in what factors will encourage and discourage walking. For those who like to walk, having nearby destinations to walk to (e.g., neighborhood businesses) is important. Crime and the fear of crime appear to be major deterrents of walking for individuals who are not predisposed to walk.

While this study clearly shows differences in walking behavior across and within sociodemographic groups based on attitudinal disposition, the question of what factors shape attitudes about walking is an important question that merits further research. Can attitudes be shaped simply through increased education about walking? Or are attitudes about walking primarily shaped through past experiences related to walking? While various attitudinal theories have been proposed by scholars in an attempt to explain travel behavior, our understanding of the role of attitudes on travel, especially with respect to

walking, remains limited. Therefore, the direction of future research should focus on measuring how individual attitudes are shaped—for instance, what factors lead to one adopting a pro-walk or anti-walk attitude—as well as how these attitudes translate into actual travel behavior.

Finally, in terms of policy recommendations, I suggest that planners and policy makers should not only focus on promoting more walkable neighborhoods, but encourage individuals to adopt a more positive attitude about walking by educating people about the environmental and health benefits of walking. This is especially important for those living in communities that are not accustomed to walking, which includes large swaths of suburban America such as the South Bay Area of Los Angeles. For individuals with less positive attitudes about walking, perhaps we need to start earlier and help shape positive attitudes towards walking and discourage driving so that they will adopt a habit of walking to nearby destinations. While policies that aim to alter individual attitudes may be challenging, similar campaigns, such as discouraging smoking, have proven to be effective. Therefore, adopting such an approach may be cheaper and more effective than reshaping the built environment to encourage more walking.

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## **CHAPTER 7**

### **Conclusions**

The findings from these empirical essays illustrate that travel behavior relationships are complicated and that other sociological and attitudinal factors are often overshadowed by the built environment in existing travel behavior literature. In these essays, I rely on a theoretical framework that extends beyond traditional travel demand models such as derived demand and discrete choice to theories relevant to psychology and criminology, such as social disorganization theory and cognitive dissonance. This multidisciplinary approach to analyzing travel behavior is a unique contribution of this research.

In Chapter 3, the results show more compelling evidence that mixed-use neighborhoods promote walking trips rather than reducing automobile trips. It does not appear from this research that there are any significant differences in driving trips between mixed-use neighborhoods and corridors, even after controlling for sociodemographic and attitudinal factors. Therefore, this suggests that it may be more difficult to discourage individuals from driving, perhaps even more so than encouraging individuals to walk.

The results from Chapter 4 shows that travel behavior varies across racial and ethnic groups, and that demographic change may shift travel patterns. Given the influx of immigrant groups and shifting demographic patterns in the Los Angeles metropolitan area, it is illuminating to see how these changes translate into differences in walking and driving trips. However, the research shows that while there are some interaction effects

between race and ethnic change, further research is needed to determine the factors causing the interactions.

In Chapter 5, there is strong empirical evidence to suggest that violent crime rates have a deterrent effect on walking behavior across sociodemographic categories. However, the perception of crime and neighborhood safety varies significantly across these groups, with certain groups reporting greater fear for safety, such as women. While these findings are significant, the limitations of the crime data should be noted.

Finally in Chapter 6, it is evident that individual attitudes toward walking have a significant effect on walking behavior that goes above and beyond the impacts of the built environment. This suggests that attitudinal disposition is a key component of travel behavior, which has often been overlooked in similar studies. However, further research needs to be conducted to see what factors shape individual attitudes and how well these attitudes translate into actual travel behavior.

In terms of policy implications, it is imperative that planners and policy makers consider factors beyond the built environment. While the built environment is by no means insignificant for shaping travel behavior, this research has shown that the social environment is equally important, if not more so. Attitudes and perceptions about neighborhoods and transportation modes are often not considered in making policy decisions related to transportation. While part of the reason is the difficulty in measuring individual attitudes compared with built environment attributes, the findings from this research highlights the importance of taking these factors into account. Therefore, it is important to take these factors into consideration to make more informed and better planning and policy decisions that would help improve the quality of life for residents



not only in the South Bay Area of Los Angeles, but in other regions and metropolitan areas as well.

## Appendix A

### South Bay Travel Survey (Phase I)

#### South Bay Travel Study

Thank you for participating in our survey. By providing some detailed information about your travel patterns in and around your area, you can provide your city with more information that will help in future efforts to deal with parking, traffic, and neighborhood issues. Your answers to these questions will be treated as strictly confidential. No one will know how you answered, and the results will only be reported in aggregated form that will not reveal the information about any individual. This study is funded by the South Bay Cities Council of Governments and the Southern California Association of Governments with the cooperation of cities of Inglewood, Redondo Beach and Torrance.

1. You have been invited to participate in this survey because you live in one of four neighborhoods in the South Bay area of Los Angeles County. When answering questions in this section of the survey, think about your neighborhoods, the area within a 10 minute walk from your home. In the questions below, we will call the area within a ten minute walk from your home your “NEIGHBORHOOD CENTER.” REMEMBER: Your answers in SECTION 1 should only apply to your neighborhood center -- the neighborhood within a 10 minute walk from your home. SECTION ONE: How many times in a typical week do you go to your neighborhood center to eat a meal?
2. How many times in a typical week do you go to your neighborhood center to shop for groceries?
3. How many times in a typical week do you go to your neighborhood center to do personal shopping (buy clothes, gas, etc.)?
4. How many times in a typical week do you go to your neighborhood center for entertainment or recreation?
5. How many times in a typical week do you go to your neighborhood center to take someone to or pick someone up from school or to attend school yourself?
6. How many times in a typical week do you go to your neighborhood center for medical or dental services?
7. How many times in a typical week do you go to your neighborhood center with no specific destination in mind, just to walk around?
8. When you go to your neighborhood center, how do you usually get there?

- 1) Car
  - 2) Bus
  - 3) Walking
  - 4) Bicycling
  - 5) Other
9. Think about all the trips you take in a typical week. About what percentage of all of your trips during a typical week are trips to your neighborhood center?
- 1) None
  - 2) Less than 20 percent
  - 3) Between 20 and 29 percent
  - 4) Between 30 and 39 percent
  - 5) Between 40 and 49 percent
  - 6) Between 50 and 59 percent
  - 7) Between 60 and 69 percent
  - 8) Between 70 and 79 percent
  - 9) Between 80 and 90 percent
  - 10) More than 90 percent
10. Thinking about your neighborhood as a good place to live, how important is it to you that you can walk to nearby stores and restaurants?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
11. Thinking about your neighborhood as a good place to live, how important is it to you that you can walk to work?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
12. Thinking about your neighborhood as a good place to live, how important is it to you that you live less than a ten minute drive from your work?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important

13. Thinking about your neighborhood as a good place to live, how important is it to you that the schools are good?
  - 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
  
14. Thinking about your neighborhood as a good place to live, how important is it to you that the neighborhood is safe?
  - 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
  
15. Thinking about your neighborhood as a good place to live, how important is it to you that there are entertainment opportunities nearby?
  - 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
  
16. Thinking about your neighborhood as a good place to live, how important is it to you that there are many different transportation options (car, bus, walking, other) to take you where you want to go?
  - 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
  
17. Thinking about your neighborhood as a good place to live, how important is it to you that your neighborhood has a vibrant street life?
  - 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important

18. Thinking about your neighborhood as a good place to live, how important is it to you that the people in your neighborhood are friendly?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
19. SECTION TWO: On a typical workday, how do you travel to work? (Check only the one that accounts for most of your trips.)
- 1) Car
  - 2) Bus
  - 3) Walking
  - 4) Bicycling
  - 5) Employee vanpool
  - 6) Other
  - 7) I work at home
  - 8) I am not employed
20. If you drive to work, where do you park your car while at work?
- 1) On the street
  - 2) Parking lot or parking garage at my workplace
  - 3) Parking lot or parking garage not at my workplace, but nearby
  - 4) Other
  - 5) I do not drive to work
21. If you drive to work, how much do you pay to park at work?
- 1) Nothing (I park for free at work)
  - 2) Less than \$1 per day (less than \$22 per month)
  - 3) Between \$1 and \$2 per day (between \$22 and \$44 per month)
  - 4) Between \$2 and \$3 per day (between \$44 and \$66 per month)
  - 5) More than \$3 per day (more than \$66 per month)
22. On a typical workday, do you carpool to work with other people?
- 1) Yes
  - 2) No
23. If you work outside your home, how far is your workplace from your home?
- 1) My workplace is within a ten minute walk from my home
  - 2) My workplace is further than a ten minute walk from my home

24. Do you do paid work at home either regularly or occasionally?
- 1) Yes
  - 2) No
25. If you work at home, during a typical work week, on how many days do you work at home?
- 1) 1 day
  - 2) 2 days
  - 3) 3 days
  - 4) 4 days
  - 5) 5 days
26. If you work at home, typically how much of the day do you work at home?
- 1) All of the day
  - 2) Part of the day
27. **SECTION THREE: This is your ONE DAY TRAVEL DIARY. This question is the first in a series that will document the trips you made yesterday. So please think about the trips you made yesterday. Start with the first trip and answer the questions below about that trip, and continue with all other trips that you made yesterday (up to ten trips). --- Some things to remember about your travel diary: EVERY TIME YOU TRAVEL FROM PLACE TO PLACE IS ANOTHER NEW TRIP. For example: You drive from your home to work. On the way to work you first drop off your child at day care (trip 1), then stop at a drive-through restaurant to buy breakfast (trip 2), then drive from the restaurant to your work (trip 3). PLEASE LIST EACH OF THOSE TRIPS AS A SEPARATE TRIP --- Your Travel Diary begins with this question. Please choose only ONE day. YESTERDAY WAS WHICH DAY OF THE WEEK?**
- 1) Monday
  - 2) Tuesday
  - 3) Wednesday
  - 4) Thursday
  - 5) Friday
  - 6) Saturday
  - 7) Sunday
28. For me, yesterday was:
- 1) A work day
  - 2) Not a work day
  - 3) I don't have a full-time or part-time job

29. IF YOU MADE NO trips outside your home yesterday, check the “NO TRIPS” box below and go to QUESTION 92, which is the first question in Section 4.
- 1) I made AT LEAST ONE TRIP
  - 2) I made NO TRIPS
30. IF YOU MADE AT LEAST ONE TRIP OUTSIDE YOUR HOME YESTERDAY, please continue with this question. TRIP 1: When I started this trip, I was at:
- 1) Home
  - 2) Work
  - 3) School
  - 4) Other
31. Continuing to think about this first trip, indicate the approximate time this trip began (Please be sure to include a.m. or p.m. as part of the time. For example 8 a.m.)
32. Continuing to think about this first trip, indicate the approximate time this trip ended (Again, be sure to include a.m. or p.m. in your answer. Example: 8:30 a.m.)
33. Continuing to think about your first trip, how did you travel? (CHOOSE ONLY ONE, PLEASE)
- 1) Personal vehicle, single occupant
  - 2) Personal vehicle, multiple occupants
  - 3) Vanpool
  - 4) Bus (not a school bus)
  - 5) School bus
  - 6) Walk
  - 7) Bicycle
  - 8) Motorcycle/Moped
  - 9) Taxi
  - 10) Other
34. Continuing to think about your first trip, what was the purpose of this trip? CHOOSE ONLY ONE of the following options.
- 1) Go to work or work related trips (including business meetings, buying business supplies, or similar trips)
  - 2) Return home (return home from any trip)
  - 3) School
  - 4) Eat a meal
  - 5) Go grocery shopping

- 6) Do other personal shopping or personal services (buy clothes, personal items, do banking, legal or insurance services, laundry, barber or hair salon, or similar)
  - 7) Drop off or pick up passengers (such as friends, family, carpool partners)
  - 8) Entertainment or recreation
  - 9) Other purpose not listed above
35. Continuing to think about your first trip, how far did you travel? (PLEASE CHOOSE ONLY ONE)
- 1) Less than  $\frac{1}{4}$  mile (for most people, this is less than a 5 minute walk)
  - 2) Between  $\frac{1}{4}$  and  $\frac{1}{2}$  mile (for most people, this is a 5 to 10 minute walk)
  - 3) Between  $\frac{1}{2}$  mile and 1 mile (for most people, this is a 10 to 20 minute walk)
  - 4) Between 1 mile and 2 miles
  - 5) Between 2 miles and 5 miles
  - 6) More than 5 miles
36. Was this your last trip of the day? If you answer YES to this question, PLEASE SCROLL to SECTION FOUR and continue with QUESTION 92. If you made MORE TRIPS yesterday, answer "NO" below and continue with the next question, Question 37.
- 1) YES, this was my last trip of the day.
  - 2) NO, this was not my last trip.
37. TRIP 2: Thinking about your SECOND trip, indicate the approximate time this trip began (Please be sure to include a.m. or p.m. as part of the time. For example 8 a.m.)
38. Continuing to think about your SECOND trip, indicate the approximate time this trip ended (Again, be sure to include a.m. or p.m. in your answer. Example: 8:30 a.m.)
39. Continuing to think about your SECOND trip, how did you travel? (CHOOSE ONLY ONE, PLEASE)
- 1) Personal vehicle, single occupant
  - 2) Personal vehicle, multiple occupants
  - 3) Vanpool
  - 4) Bus (not a school bus)
  - 5) School bus
  - 6) Walk
  - 7) Bicycle
  - 8) Motorcycle/Moped
  - 9) Taxi
  - 10) Other



40. Continuing to think about your SECOND trip, what was the purpose of this trip? Choose ONLY ONE of the following options.
- 1) Go to work or work related trips (including business meetings, buying business supplies, or similar trips)
  - 2) Return home (return home from any trip)
  - 3) School
  - 4) Eat a meal
  - 5) Go grocery shopping
  - 6) Do other personal shopping or personal services (buy clothes, personal items, do banking, legal or insurance services, laundry, barber or hair salon, or similar)
  - 7) Drop off or pick up passengers (such as friends, family, carpool partners)
  - 8) Entertainment or recreation
  - 9) Other purpose not listed above
41. Continuing to think about your SECOND trip, how far did you travel? (PLEASE CHOOSE ONLY ONE)
- 1) Less than  $\frac{1}{4}$  mile (for most people, this is less than a 5 minute walk)
  - 2) Between  $\frac{1}{4}$  and  $\frac{1}{2}$  mile (for most people, this is a 5 to 10 minute walk)
  - 3) Between  $\frac{1}{2}$  mile and 1 mile (for most people, this is a 10 to 20 minute walk)
  - 4) Between 1 mile and 2 miles
  - 5) Between 2 miles and 5 miles
  - 6) More than 5 miles
42. Was this your last trip of the day? If you answer YES to this question, PLEASE SCROLL to SECTION FOUR and continue with QUESTION 92. If you made MORE TRIPS yesterday, answer "NO" and continue with the next question, Question 43.
- 1) YES, this was my last trip of the day.
  - 2) NO, this was not my last trip.
43. TRIP 3: Thinking about your THIRD trip, indicate the approximate time this trip began (Please be sure to include a.m. or p.m. as part of the time. For example 8 a.m.)
44. Continuing to think about your THIRD trip, indicate the approximate time this trip ended (Again, be sure to include a.m. or p.m. in your answer. Example: 8:30 a.m.)
45. Continuing to think about your THIRD trip, how did you travel? (CHOOSE ONLY ONE, PLEASE)

- 1) Personal vehicle, single occupant
- 2) Personal vehicle, multiple occupants
- 3) Vanpool
- 4) Bus (not a school bus)
- 5) School bus
- 6) Walk
- 7) Bicycle
- 8) Motorcycle/Moped
- 9) Taxi
- 10) Other

46. Continuing to think about your THIRD trip, what was the purpose of this trip? Choose ONLY ONE of the following options.

- 1) Go to work or work related trips (including business meetings, buying business supplies, or similar trips)
- 2) Return home (return home from any trip)
- 3) School
- 4) Eat a meal
- 5) Go grocery shopping
- 6) Do other personal shopping or personal services (buy clothes, personal items, do banking, legal or insurance services, laundry, barber or hair salon, or similar)
- 7) Drop off or pick up passengers (such as friends, family, carpool partners)
- 8) Entertainment or recreation
- 9) Other purpose not listed above

47. Continuing to think about your THIRD trip, how far did you travel? (PLEASE CHOOSE ONLY ONE)

- 1) Less than  $\frac{1}{4}$  mile (for most people, this is less than a 5 minute walk)
- 2) Between  $\frac{1}{4}$  and  $\frac{1}{2}$  mile (for most people, this is a 5 to 10 minute walk)
- 3) Between  $\frac{1}{2}$  mile and 1 mile (for most people, this is a 10 to 20 minute walk)
- 4) Between 1 mile and 2 miles
- 5) Between 2 miles and 5 miles
- 6) More than 5 miles

48. Was this your last trip of the day? If you answer YES to this question, PLEASE SCROLL to SECTION FOUR and continue with QUESTION 92. If you made MORE TRIPS yesterday, answer "NO" and continue with the next question, Question 49.

- 1) YES, this was my last trip of the day.
- 2) NO, this was not my last trip.

49. TRIP 4: Thinking about your FOURTH trip, indicate the approximate time this trip began (Please be sure to include a.m. or p.m. as part of the time. For example 8 a.m.)
50. Continuing to think about your FOURTH trip, indicate the approximate time this trip ended (Again, be sure to include a.m. or p.m. in your answer. Example: 8:30 a.m.)
51. Continuing to think about your FOURTH trip, how did you travel? (CHOOSE ONLY ONE, PLEASE)
- 1) Personal vehicle, single occupant
  - 2) Personal vehicle, multiple occupants
  - 3) Vanpool
  - 4) Bus (not a school bus)
  - 5) School bus
  - 6) Walk
  - 7) Bicycle
  - 8) Motorcycle/Moped
  - 9) Taxi
  - 10) Other
52. Continuing to think about your FOURTH trip, what was the purpose of this trip? Choose ONLY ONE of the following options.
- 1) Go to work or work related trips (including business meetings, buying business supplies, or similar trips)
  - 2) Return home (return home from any trip)
  - 3) School
  - 4) Eat a meal
  - 5) Go grocery shopping
  - 6) Do other personal shopping or personal services (buy clothes, personal items, do banking, legal or insurance services, laundry, barber or hair salon, or similar)
  - 7) Drop off or pick up passengers (such as friends, family, carpool partners)
  - 8) Entertainment or recreation
  - 9) Other purpose not listed above
53. Continuing to think about your FOURTH trip, how far did you travel? (PLEASE CHOOSE ONLY ONE)
- 1) Less than  $\frac{1}{4}$  mile (for most people, this is less than a 5 minute walk)
  - 2) Between  $\frac{1}{4}$  and  $\frac{1}{2}$  mile (for most people, this is a 5 to 10 minute walk)
  - 3) Between  $\frac{1}{2}$  mile and 1 mile (for most people, this is a 10 to 20 minute walk)
  - 4) Between 1 mile and 2 miles
  - 5) Between 2 miles and 5 miles

- 6) More than 5 miles
54. Was this your last trip of the day? If you answer YES to this question, PLEASE SCROLL to SECTION FOUR and continue with QUESTION 92. If you made MORE TRIPS yesterday, answer "NO" and continue with the next question, Question 55.
- 1) YES, this was my last trip of the day.
  - 2) NO, this was not my last trip.
55. TRIP 5: Thinking about your FIFTH trip, indicate the approximate time this trip began (Please be sure to include a.m. or p.m. as part of the time. For example 8 a.m.)
56. Continuing to think about your FIFTH trip, indicate the approximate time this trip ended (Again, be sure to include a.m. or p.m. in your answer. Example: 8:30 a.m.)
57. Continuing to think about your FIFTH trip, how did you travel? (CHOOSE ONLY ONE, PLEASE)
- 1) Personal vehicle, single occupant
  - 2) Personal vehicle, multiple occupants
  - 3) Vanpool
  - 4) Bus (not a school bus)
  - 5) School bus
  - 6) Walk
  - 7) Bicycle
  - 8) Motorcycle/Moped
  - 9) Taxi
  - 10) Other
58. Continuing to think about your FIFTH trip, what was the purpose of this trip? Choose ONLY ONE of the following options.
- 1) Go to work or work related trips (including business meeting, buying business supplies, or similar trips)
  - 2) Return home (return home from any trip)
  - 3) School
  - 4) Eat a meal
  - 5) Go grocery shopping
  - 6) Do other personal shopping or personal services (buy clothes, personal items, do banking, legal or insurance services, laundry, barber or hair salon, or similar)
  - 7) Drop off or pick up passengers (such as friends, family, carpool partners)
  - 8) Entertainment or recreation
  - 9) Other purpose not listed above

59. Continuing to think about your FIFTH trip, how far did you travel? (PLEASE CHOOSE ONLY ONE)
- 1) Less than ¼ mile (for most people, this is less than a 5 minute walk)
  - 2) Between ¼ and ½ mile (for most people, this is a 5 to 10 minute walk)
  - 3) Between ½ mile and 1 mile (for most people, this is a 10 to 20 minute walk)
  - 4) Between 1 mile and 2 miles
  - 5) Between 2 miles and 5 miles
  - 6) More than 5 miles
60. Was this your last trip of the day? If you answer YES to this question, PLEASE SCROLL to SECTION FOUR and continue with QUESTION 92. If you made MORE TRIPS yesterday, answer “NO” and continue with the next question, Question 61.
- 1) YES, this was my last trip of the day.
  - 2) NO, this was not my last trip.
61. TRIP 6: Thinking about your SIXTH trip, indicate the approximate time this trip began (Please be sure to include a.m. or p.m. as part of the time. For example 8 a.m.)
62. Continuing to think about your SIXTH trip, indicate the approximate time this trip ended (Again, be sure to include a.m. or p.m. in your answer. Example: 8:30 a.m.)
63. Continuing to think about your SIXTH trip, how did you travel? (CHOOSE ONLY ONE, PLEASE)
- 1) Personal vehicle, single occupant
  - 2) Personal vehicle, multiple occupants
  - 3) Vanpool
  - 4) Bus (not a school bus)
  - 5) School bus
  - 6) Walk
  - 7) Bicycle
  - 8) Motorcycle/Moped
  - 9) Taxi
  - 10) Other
64. Continuing to think about your SIXTH trip, what was the purpose of this trip? Choose ONLY ONE of the following options.
- 1) Go to work or work related trips (including business meetings, buying business supplies, or similar trips)
  - 2) Return home (return home from any trip)

- 3) School
  - 4) Eat a meal
  - 5) Go grocery shopping
  - 6) Do other personal shopping or personal services (buy clothes, personal items, do banking, legal or insurance services, laundry, barber or hair salon, or similar)
  - 7) Drop off or pick up passengers (such as friends, family, carpool partners)
  - 8) Entertainment or recreation
  - 9) Other purpose not listed above
65. Continuing to think about your SIXTH trip, how far did you travel? (PLEASE CHOOSE ONLY ONE)
- 1) Less than  $\frac{1}{4}$  mile (for most people, this is less than a 5 minute walk)
  - 2) Between  $\frac{1}{4}$  and  $\frac{1}{2}$  mile (for most people, this is a 5 to 10 minute walk)
  - 3) Between  $\frac{1}{2}$  mile and 1 mile (for most people, this is a 10 to 20 minute walk)
  - 4) Between 1 mile and 2 miles
  - 5) Between 2 miles and 5 miles
  - 6) More than 5 miles
66. Was this your last trip of the day? If you answer YES to this question, PLEASE SCROLL to SECTION FOUR and continue with QUESTION 92. If you made MORE TRIPS yesterday, answer "NO" and continue with the next question, Question 67.
- 1) YES, this was my last trip of the day.
  - 2) NO, this was not my last trip.
67. TRIP 7: Thinking about your SEVENTH trip, indicate the approximate time this trip began (Please be sure to include a.m. or p.m. as part of the time. For example 8 a.m.)
68. Continuing to think about your SEVENTH trip, indicate the approximate time this trip ended (Again, be sure to include a.m. or p.m. in your answer. Example: 8:30 a.m.)
69. Continuing to think about your SEVENTH trip, how did you travel? (CHOOSE ONLY ONE, PLEASE)
- 1) Personal vehicle, single occupant
  - 2) Personal vehicle, multiple occupants
  - 3) Vanpool
  - 4) Bus (not a school bus)
  - 5) School bus
  - 6) Walk
  - 7) Bicycle
  - 8) Motorcycle/Moped

- 9) Taxi
  - 10) Other
70. Continuing to think about your SEVENTH trip, what was the purpose of this trip? Choose ONLY ONE of the following options.
- 1) Go to work or work related trips (including business meetings, buying business supplies, or similar trips)
  - 2) Return home (return home from any trip)
  - 3) School
  - 4) Eat a meal
  - 5) Go grocery shopping
  - 6) Do other personal shopping or personal services (buy clothes, personal items, do banking, legal or insurance services, laundry, barber or hair salon, or similar)
  - 7) Drop off or pick up passengers (such as friends, family, carpool partners)
  - 8) Entertainment or recreation
  - 9) Other purpose not listed above
71. Continuing to think about your SEVENTH trip, how far did you travel? (PLEASE CHOOSE ONLY ONE)
- 1) Less than ¼ mile (for most people, this is a 5 minute walk)
  - 2) Between ¼ and ½ mile (for most people, this is a 5 to 10 minute walk)
  - 3) Between ½ mile and 1 mile (for most people, this is a 10 to 20 minute walk)
  - 4) Between 1 mile and 2 miles
  - 5) Between 2 miles and 5 miles
  - 6) More than 5 miles
72. Was this your last trip of the day? If you answer YES to this question, PLEASE SCROLL to SECTION FOUR and continue with QUESTION 92. If you made MORE TRIPS yesterday, answer “NO” and continue with the next question, Question 73.
- 1) YES, this was my last trip of the day.
  - 2) NO, this was not my last trip.
73. TRIP 8: Thinking about your EIGHTH trip, indicate the approximate time this trip began (Please be sure to include a.m. or p.m. as part of the time. For example 8 a.m.)
74. Continuing to think about your EIGHTH trip, indicate the approximate time this trip ended (Again, be sure to include a.m. or p.m. in your answer. Example: 8:30 a.m.)

75. Continuing to think about your EIGHTH trip, how did you travel? (CHOOSE ONLY ONE, PLEASE)
- 1) Personal vehicle, single occupant
  - 2) Personal vehicle, multiple occupants
  - 3) Vanpool
  - 4) Bus (not a school bus)
  - 5) School bus
  - 6) Walk
  - 7) Bicycle
  - 8) Motorcycle/Moped
  - 9) Taxi
  - 10) Other
76. Continuing to think about your EIGHTH trip, what was the purpose of this trip? Choose ONLY ONE of the following options.
- 1) Go to work or work related trips (including business meetings, buying business supplies, or similar trips)
  - 2) Return home (return home from any trip)
  - 3) School
  - 4) Eat a meal
  - 5) Go grocery shopping
  - 6) Do other personal shopping or personal services (buy clothes, personal items, do banking, legal or insurance services, laundry, barber or hair salon, or similar)
  - 7) Drop off or pick up passengers (such as friends, family, carpool partners)
  - 8) Entertainment or recreation
  - 9) Other purpose not listed above
77. Continuing to think about your EIGHTH trip, how far did you travel? (PLEASE CHOOSE ONLY ONE)
- 1) Less than  $\frac{1}{4}$  mile (for most people, this is less than a 5 minute walk)
  - 2) Between  $\frac{1}{4}$  and  $\frac{1}{2}$  mile (for most people, this is a 5 to 10 minute walk)
  - 3) Between  $\frac{1}{2}$  mile and 1 mile (for most people, this is a 10 to 20 minute walk)
  - 4) Between 1 mile and 2 miles
  - 5) Between 2 miles and 5 miles
  - 6) More than 5 miles
78. Was this your last trip of the day? If you answer YES to this question, PLEASE SCROLL to SECTION FOUR and continue with QUESTION 92. If you made MORE TRIPS yesterday, answer "NO" and continue with the next question, Question 79.
- 1) YES, this was my last trip of the day.
  - 2) NO, this was not my last trip.



79. TRIP 9: Thinking about your NINTH trip, indicate the approximate time this trip began (Please be sure to include a.m. or p.m. as part of the time. For example 8 a.m.)
80. Continuing to think about your NINTH trip, indicate the approximate time this trip ended (Again, be sure to include a.m. or p.m. in your answer. Example: 8:30 a.m.)
81. Continuing to think about your NINTH trip, how did you travel? (CHOOSE ONLY ONE, PLEASE)
- 1) Personal vehicle, single occupant
  - 2) Personal vehicle, multiple occupants
  - 3) Vanpool
  - 4) Bus (not a school bus)
  - 5) School bus
  - 6) Walk
  - 7) Bicycle
  - 8) Motorcycle/Moped
  - 9) Taxi
  - 10) Other
82. Continuing to think about your NINTH trip, what was the purpose of this trip? Choose ONLY ONE of the following options.
- 1) Go to work or work related trips (including business meetings, buying business supplies, or similar trips)
  - 2) Return home (return home from any trip)
  - 3) School
  - 4) Eat a meal
  - 5) Go grocery shopping
  - 6) Do other personal shopping or personal services (buy clothes, personal items, do banking, legal or insurance services, laundry, barber or hair salon, or similar)
  - 7) Drop off or pick up passengers (such as friends, family, carpool partners)
  - 8) Entertainment or recreation
  - 9) Other purpose not listed above
83. Continuing to think about your NINTH trip, how far did you travel? (PLEASE CHOOSE ONLY ONE)
- 1) Less than  $\frac{1}{4}$  mile (for most people, this is less than a 5 minute walk)
  - 2) Between  $\frac{1}{4}$  and  $\frac{1}{2}$  mile (for most people, this is a 5 to 10 minute walk)
  - 3) Between  $\frac{1}{2}$  mile and 1 mile (for most people, this is a 10 to 20 minute walk)
  - 4) Between 1 mile and 2 miles

- 5) Between 2 miles and 5 miles
  - 6) More than 5 miles
84. Was this your last trip of the day? If you answer YES to this question, PLEASE SCROLL to SECTION FOUR and continue with QUESTION 92. If you made MORE TRIPS yesterday, answer "NO" and continue with the next question, Question 85.
- 1) YES, this was my last trip of the day.
  - 2) NO, this was not my last trip.
85. TRIP 10: Thinking about your TENTH trip, indicate the approximate time this trip began (Please be sure to include a.m. or p.m. as part of the time. For example 8 a.m.)
86. Continuing to think about your TENTH trip, indicate the approximate time this trip ended (Again, be sure to include a.m. or p.m. in your answer. Example: 8:30 a.m.)
87. Continuing to think about your TENTH trip, how did you travel? (CHOOSE ONLY ONE, PLEASE)
- 1) Personal vehicle, single occupant
  - 2) Personal vehicle, multiple occupants
  - 3) Vanpool
  - 4) Bus (not a school bus)
  - 5) School bus
  - 6) Walk
  - 7) Bicycle
  - 8) Motorcycle/Moped
  - 9) Taxi
  - 10) Other
88. Continuing to think about your TENTH trip, what was the purpose of this trip? Choose ONLY ONE of the following options.
- 1) Go to work or work related trips (including business meetings, buying business supplies, or similar trips)
  - 2) Return home (return home from any trip)
  - 3) School
  - 4) Eat a meal
  - 5) Go grocery shopping
  - 6) Do other personal shopping or personal services (buy clothes, personal items, do banking, legal or insurance services, laundry, barber or hair salon, or similar)
  - 7) Drop off or pick up passengers (such as friends, family, carpool partners)

- 8) Entertainment or recreation
  - 9) Other purpose not listed above
89. Continuing to think about your TENTH trip, how far did you travel? (PLEASE CHOOSE ONLY ONE)
- 1) Less than  $\frac{1}{4}$  mile (for most people, this is less than a 5 minute walk)
  - 2) Between  $\frac{1}{4}$  and  $\frac{1}{2}$  mile (for most people, this is a 5 to 10 minute walk)
  - 3) Between  $\frac{1}{2}$  mile and 1 mile (for most people, this is a 10 to 20 minute walk)
  - 4) Between 1 mile and 2 miles
  - 5) Between 2 miles and 5 miles
  - 6) More than 5 miles
90. Was this your last trip of the day? If you answer YES to this question, PLEASE SCROLL to SECTION FOUR and continue with QUESTION 92. If you made MORE TRIPS yesterday, answer "NO" and continue with the next question, Question 91.
- 1) YES, this was my last trip of the day.
  - 2) NO, this was not my last trip.
91. Do you take more than TEN trips yesterday?
- 1) Yes, I took more than ten trips
  - 2) No, I didn't take any more trips
92. SECTION FOUR: RESUME ANSWERING QUESTIONS HERE --- In this section you will summarize your travel during a typical week. Think about all your travel in a typical week. You will be asked about the trips you make for various purposes. For each type of trip, you will be asked how many trips you take, what mode of transportation you usually use, and how far you usually go. For this question, please think of all the trips you take in a typical week that relate to SCHOOL (whether going to or from school yourself or taking or picking up someone else. How many trips do you make during the typical week for this purpose?
- 1) None
  - 2) 1 trip
  - 3) 2 trips
  - 4) 3 trips
  - 5) 4 trips
  - 6) 5 trips
  - 7) 6 trips
  - 8) 7 trips
  - 9) 8 trips
  - 10) More than 8 trips

93. Continuing to think about trips related to SCHOOL in a typical week, what mode of transportation do you usually use? (PLEASE CHOOSE ONLY ONE)
- 1) Car
  - 2) School bus
  - 3) Bus or other transit
  - 4) Walk
  - 5) Bicycle
  - 6) Other
94. Continuing to think about trips related to SCHOOL in a typical week, what is the most common distance for this type of trip?
- 1) Less than  $\frac{1}{4}$  mile
  - 2) Between  $\frac{1}{4}$  and  $\frac{1}{2}$  mile
  - 3) Between  $\frac{1}{2}$  and 1 mile
  - 4) Between 1 and 2 miles
  - 5) More than 2 miles
95. For the next 3 questions, please think of all the trips you take in a typical week to go EAT A MEAL. How many trips do you make during a typical week for this purpose?
- 1) None
  - 2) 1 trip
  - 3) 2 trips
  - 4) 3 trips
  - 5) 4 trips
  - 6) 5 trips
  - 7) 6 trips
  - 8) 7 trips
  - 9) 8 trips
  - 10) More than 8 trips
96. Continuing to think about trips taken to EAT MEALS in a typical week, what mode of transportation do you usually use? (PLEASE CHOOSE ONLY ONE)
- 1) Car
  - 2) School bus
  - 3) Bus or other transit
  - 4) Walk
  - 5) Bicycle
  - 6) Other

97. Continuing to think about trips made to EAT MEALS in a typical week, what is the most common distance for this type of trip?
- 1) Less than  $\frac{1}{4}$  mile
  - 2) Between  $\frac{1}{4}$  and  $\frac{1}{2}$  mile
  - 3) Between  $\frac{1}{2}$  and 1 mile
  - 4) Between 1 and 2 miles
  - 5) More than 2 miles
98. For the next 3 questions, please think of all the trips you take in a typical week to BUY GROCERIES. How many trips do you made during the typical week for this purpose?
- 1) None
  - 2) 1 trip
  - 3) 2 trips
  - 4) 3 trips
  - 5) 4 trips
  - 6) 5 trips
  - 7) 6 trips
  - 8) 7 trips
  - 9) 8 trips
  - 10) More than 8 trips
99. Continuing to think about trips taken to BUY GROCERIES in a typical week, what mode of transportation do you usually use? (PLEASE CHOOSE ONLY ONE)
- 1) Car
  - 2) School bus
  - 3) Bus or other transit
  - 4) Walk
  - 5) Bicycle
  - 6) Other
100. Continuing to think about trips made to BUY GROCERIES in a typical week, what is the most common distance for this type of trip?
- 1) Less than  $\frac{1}{4}$  mile
  - 2) Between  $\frac{1}{4}$  and  $\frac{1}{2}$  mile
  - 3) Between  $\frac{1}{2}$  and 1 mile
  - 4) Between 1 and 2 miles
  - 5) More than 2 miles

101. For the next 3 questions, please think of all the trips you take in a typical week to do PERSONAL SHOPPING (buy clothes, gas, or similar things). How many trips do you make during a typical week for this purpose?
- 1) None
  - 2) 1 trip
  - 3) 2 trips
  - 4) 3 trips
  - 5) 4 trips
  - 6) 5 trips
  - 7) 6 trips
  - 8) 7 trips
  - 9) 8 trips
  - 10) More than 8 trips
102. Continuing to think about trips taken to PERSONAL SHOPPING in a typical week, what mode of transportation do you usually use? (PLEASE CHOOSE ONLY ONE)
- 1) Car
  - 2) School bus
  - 3) Bus or other transit
  - 4) Walk
  - 5) Bicycle
  - 6) Other
103. Continuing to think about trips made to PERSONAL SHOPPING in a typical week, what is the most common distance for this type of trip?
- 1) Less than  $\frac{1}{4}$  mile
  - 2) Between  $\frac{1}{4}$  and  $\frac{1}{2}$  mile
  - 3) Between  $\frac{1}{2}$  and 1 mile
  - 4) Between 1 and 2 miles
  - 5) More than 2 miles
104. For the next 3 questions, please think of all the trips you take in a typical week to PERSONAL SERVICES (such as banking, laundry, legal, government, insurance and similar services). How many trips do you made during the typical week for this purpose?
- 1) None
  - 2) 1 trip
  - 3) 2 trips
  - 4) 3 trips
  - 5) 4 trips
  - 6) 5 trips

- 7) 6 trips
  - 8) 7 trips
  - 9) 8 trips
  - 10) More than 8 trips
105. Continuing to think about trips taken to use PERSONAL SERVICES in a typical week, what mode of transportation do you usually use? (PLEASE CHOOSE ONLY ONE)
- 1) Car
  - 2) School bus
  - 3) Bus or other transit
  - 4) Walk
  - 5) Bicycle
  - 6) Other
106. Continuing to think about trips made to use PERSONAL SERVICES in a typical week, what is the most common distance for this type of trip?
- 1) Less than  $\frac{1}{4}$  mile
  - 2) Between  $\frac{1}{4}$  and  $\frac{1}{2}$  mile
  - 3) Between  $\frac{1}{2}$  and 1 mile
  - 4) Between 1 and 2 miles
  - 5) More than 2 miles
107. For the next 3 questions, please think of all the trips you take in a typical week to ENTERTAINMENT OR RECREATION destinations. How many trips do you made during the typical week to these places?
- 1) None
  - 2) 1 trip
  - 3) 2 trips
  - 4) 3 trips
  - 5) 4 trips
  - 6) 5 trips
  - 7) 6 trips
  - 8) 7 trips
  - 9) 8 trips
  - 10) More than 8 trips
108. Continuing to think about trips taken to ENTERTAINMENT OR RECREATION destinations in a typical week, what mode of transportation do you usually use? (PLEASE CHOOSE ONLY ONE)
- 1) Car
  - 2) School bus

- 3) Bus or other transit
  - 4) Walk
  - 5) Bicycle
  - 6) Other
109. Continuing to think about trips made to ENTERTAINMENT OR RECREATION destinations in a typical week, what is the most common distance for this type of trip?
- 1) Less than ¼ mile
  - 2) Between ¼ and ½ mile
  - 3) Between ½ and 1 mile
  - 4) Between 1 and 2 miles
  - 5) More than 2 miles
110. For the next 3 questions, please think of all the trips you take in a typical week to attend COMMUNITY, RELIGIOUS, VOLUNTEER OR POLITICAL MEETINGS OR EVENTS. How many trips do you make during the typical week for these purposes?
- 1) None
  - 2) 1 trip
  - 3) 2 trips
  - 4) 3 trips
  - 5) 4 trips
  - 6) 5 trips
  - 7) 6 trips
  - 8) 7 trips
  - 9) 8 trips
  - 10) More than 8 trips
111. Continuing to think about trips taken to attend COMMUNITY, RELIGIOUS, VOLUNTEER OR POLITICAL MEETINGS OR EVENTS in a typical week, what mode of transportation do you usually use? (PLEASE CHOOSE ONLY ONE)
- 1) Car
  - 2) School bus
  - 3) Bus or other transit
  - 4) Walk
  - 5) Bicycle
  - 6) Other
112. Continuing to think about trips made to attend COMMUNITY, RELIGIOUS, VOLUNTEER OR POLITICAL MEETINGS OR EVENTS in a typical week, what is the most common distance for this type of trip?



- 1) Less than ¼ mile
- 2) Between ¼ and ½ mile
- 3) Between ½ and 1 mile
- 4) Between 1 and 2 miles
- 5) More than 2 miles

113. SECTION FIVE: Thanks for continuing – we know this is lengthy, but you are almost done. There are only two brief sections left. REMEMBER: Your answers will help us learn ways to improve your neighborhood --- This group of questions ask if there are any changes you would like to make in your travel patterns and how important each of these types of changes are to you. --- How important is it to you to be able to REDUCE the number of CAR TRIPS you have to make to go to WORK?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neither important nor unimportant
- 4) Important
- 5) Very important

114. How important is it to you to be able to REDUCE the number of CAR TRIPS you have to make for WORK RELATED TRIPS (buy materials, attend meetings, etc.)?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neither important nor unimportant
- 4) Important
- 5) Very important

115. How important is it to you to be able to REDUCE the number of CAR TRIPS you have to make to EAT MEALS?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neither important nor unimportant
- 4) Important
- 5) Very important

116. How important is it to you to be able to REDUCE the number of CAR TRIPS you have to make to SHOP FOR GROCERIES?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neither important nor unimportant
- 4) Important

- 5) Very important
117. How important is it to you to be able to REDUCE the number of CAR TRIPS you have to make to do OTHER SHOPPING (buy clothes or other items)?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
118. How important is it to you to be able to REDUCE the number of CAR TRIPS you have to make to use PERSONAL SERVICES (such as banking, laundry and such)?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
119. How important is it to you to be able to REDUCE the number of CAR TRIPS you have to make to drop off or pick up family members or friends from SCHOOL or DAY CARE?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
120. How important is it to you to be able to REDUCE the number of CAR TRIPS you have to make to ATTEND SCHOOL yourself?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
121. How important is it to you to be able to REDUCE the number of CAR TRIPS you have to make to go to ENTERTAINMENT OR RECREATION venues?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important

- 5) Very important
122. How important is it to you to be able to REDUCE the number of CAR TRIPS you have to make to go to MEDICAL OR DENTAL offices?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
123. This group of questions asks if certain changes in your neighborhood would encourage you to take more walking or bicycling trips. Think about the importance each of these changes would have on your decision to walk or bike more. --REMEMBER: Your answers should only apply to the neighborhood within a 10 minute walk from your home. --- How important would having a SHUTTLE BUS SERVICE in your neighborhood be in your decision to walk or bike more?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
124. How important would having BUS TRANSIT SERVICE in your neighborhood be in your decision to walk or bike more?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
125. How important would INCREASED FREQUENCY of EXISTING SHUTTLE BUS SERVICE in your neighborhood be in your decision to walk or bike more?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
126. How important would INCREASED FREQUENCY of EXISTING BUS TRANSIT SERVICE in your neighborhood be in your decision to walk or bike more?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neither important nor unimportant
- 4) Important
- 5) Very important

127. How important would an INCREASED NUMBER OF PLACES THE BUS WOULD TAKE YOU IN YOUR NEIGHBORHOOD be in your decision to walk or bike more?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neither important nor unimportant
- 4) Important
- 5) Very important

128. How important would BETTER NIGHT LIGHTING in your neighborhood be in your decision to walk or bike more?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neither important nor unimportant
- 4) Important
- 5) Very important

129. How important would an IMPROVED SIDEWALK NETWORK in your neighborhood be in your decision to walk or bike more?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neither important nor unimportant
- 4) Important
- 5) Very important

130. How important would SLOWING DOWN TRAFFIC to make pedestrians safer in your neighborhood be in your decision to walk or bike more?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neither important nor unimportant
- 4) Important
- 5) Very important

131. How important would providing MORE PLACES TO SHOP FOR GROCERIES in your neighborhood be in your decision to walk or bike more?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neither important nor unimportant
- 4) Important
- 5) Very important

132. How important would providing MORE PLACES TO SHOP FOR THINGS OTHER THAN GROCERIES (such as clothes or household items) in your neighborhood be in your decision to walk or bike more?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neither important nor unimportant
- 4) Important
- 5) Very important

133. How important would providing MORE PLACES TO EAT OUT in your neighborhood be in your decision to walk or bike more?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neither important nor unimportant
- 4) Important
- 5) Very important

134. How important would providing MORE PLACES TO GO FOR ENTERTAINMENT OR RECREATION in your neighborhood be in your decision to walk or bike more?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neither important nor unimportant
- 4) Important
- 5) Very important

135. How important would providing MORE PLACES WHERE PEOPLE CAN WORK in your neighborhood be in your decision to walk or bike more?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neither important nor unimportant
- 4) Important
- 5) Very important

136. How important would providing MORE PERSONAL SERVICE STORES (banks, laundries, etc.) in your neighborhood be in your decision to walk or bike more?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
137. How important would providing MORE STREET TREES, BENCHES, AND SIMILAR IMPROVEMENTS in your neighborhood be in your decision to walk or bike more?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
138. How important would providing MORE BIKE LANES in your neighborhood be in your decision to walk or bike more?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
139. How important would providing or improving the quality of PUBLIC PLAZAS, PARKS, or other GATHERING PLACES in your neighborhood be in your decision to walk or bike more?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important
140. How important would REDUCING CRIME in your neighborhood be in your decision to walk or bike more?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neither important nor unimportant
  - 4) Important
  - 5) Very important

141. SECTION SIX: THE LAST ONE! Thanks for sticking with us this far. --- Traffic researchers have learned that personal and family characteristics can influence travel. To help us understand how to improve transportation for a broad range of people, we need to know some general information about you and your family. ALL OF THIS INFORMATION WILL BE TREATED AS CONFIDENTIAL. It will never be reported in any fashion that allows your name or address to be linked to any of your answers. --- Please indicate your age range. (Please select ONLY ONE)
- 1) Less than 18 years old
  - 2) 18 to 25 years old
  - 3) 26 to 40 years old
  - 4) 41 to 55 years old
  - 5) 56 to 65 years old
  - 6) Over 65 years old
142. What is your gender?
- 1) Female
  - 2) Male
143. What is your race or ethnicity?
- 1) White non-Hispanic
  - 2) Hispanic
  - 3) African-American
  - 4) Asian/Pacific Islander
  - 5) Other
144. How many people in your household are infants or up to 6 years old?
145. How many people in your household are between the ages of 7 and 18 years old?
146. How many people in your household are between the ages of 19 and 30 years old?
147. How many people in your household are between the ages of 31 and 65 years old?
148. How many people in your household are older than 65?
149. How many people in your household have a driver's license?
150. On most days, how many cars do you have available for use by members of your household?
151. How long have you lived in this neighborhood?

- 1) Less than 1 year
- 2) 1 to 5 years
- 3) 6 to 10 years
- 4) More than 10 years
- 5) All my life

152. How many years did you go to school?

- 1) Less than 12 years
- 2) 12 years (high school diploma)
- 3) Between 12 and 16 years (some college)
- 4) 16 years (college degree, bachelors degree)
- 5) More than 16 years

153. How many years did your spouse (if applicable) go to school?

- 1) Less than 12 years
- 2) 12 years (high school diploma)
- 3) Between 12 and 16 years (some college)
- 4) 16 years (college degree, bachelors degree)
- 5) More than 16 years

154. How long have you lived in the United States

- 1) Less than 1 year
- 2) 1 to 5 years
- 3) 6 to 10 years
- 4) More than 10 years
- 5) All my life

155. What is your average annual household income? Please check ONLY ONE.

- 1) Less than \$15,000
- 2) \$15,000 to \$35,000
- 3) \$35,001 to \$55,000
- 4) \$55,001 to \$75,000
- 5) \$75,001 to \$100,000
- 6) More than \$100,000



## Appendix B

### South Bay Travel Survey (Phase II and Phase III)

You have been invited to participate in this survey because you live in one of two neighborhoods in the South Bay area of Los Angeles County.

If you live in Hawthorne, we would like you to answer the questions in relation to Hawthorne Boulevard corridor. By Hawthorne Boulevard corridor, we mean the commercial area along Hawthorne Boulevard between El Segundo Boulevard and Rosecrans Boulevard.

When answering questions in this section of the survey, think about your neighborhood, the area within a 10 minute walk from your home.

#### SECTION ONE:

Your answers should only apply to your neighborhood center, which was described in the cover letter that you received. Your neighborhood center typically is in the area within a 10 minute walk from your home.

1. When you go to Hawthorne Boulevard corridor, why do you go there? For each category below, write the number of trips that you make to Hawthorne Boulevard corridor for that purpose in a typical week.
2. How many times in a typical week do you go to Hawthorne Boulevard corridor to eat a meal?
3. How many times in a typical week do you go to Hawthorne Boulevard corridor to shop for groceries?
4. How many times in a typical week do you go to Hawthorne Boulevard corridor to do personal shopping (buy clothes, gas, etc.)?
5. How many times in a typical week do you go to Hawthorne Boulevard corridor for personal services such as going to a hair salon?
6. How many times in a typical week do you go to Hawthorne Boulevard corridor for entertainment or recreation?
7. How many times in a typical week do you go to Hawthorne Boulevard corridor to take someone to or pick someone up from school or to attend school yourself?

8. How many times in a typical week do you go to Hawthorne Boulevard corridor for medical or dental services?
9. How many times in a typical week do you go to Hawthorne Boulevard corridor for community, religious, volunteer, or political meetings or events?
10. How many times in a typical week do you go to Hawthorne Boulevard corridor with no specific destination in mind, just to walk around?
11. When you go to Hawthorne Boulevard corridor, how do you usually get there?
  - 1) Car
  - 2) Bus
  - 3) Walking
  - 4) Bicycling
  - 5) Other
12. Think about all the trips you take in a typical week. About what percentage of all of your trips during a typical week are trips to Hawthorne Boulevard corridor?
  - 1) None
  - 2) 10%
  - 3) 20%
  - 4) 30%
  - 5) 40%
  - 6) 50%
  - 7) 60%
  - 8) 70%
  - 9) 80%
  - 10) 90%
  - 11) All (100%)
13. Thinking about your neighborhood as a good place to live, how important is it to you that you can walk to nearby stores and restaurants?
  - 1) Not at all important
  - 2) Rather unimportant
  - 3) Neutral
  - 4) Important
  - 5) Very important
14. Thinking about your neighborhood as a good place to live, how important is it to you that you can walk to work?
  - 1) Not at all important
  - 2) Rather unimportant

- 3) Neutral
  - 4) Important
  - 5) Very important
15. Thinking about your neighborhood as a good place to live, how important is it to you that you live less than a ten minute drive from your work?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neutral
  - 4) Important
  - 5) Very important
16. Thinking about your neighborhood as a good place to live, how important is it to you that the schools are good?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neutral
  - 4) Important
  - 5) Very important
17. Thinking about your neighborhood as a good place to live, how important is it to you that the neighborhood is safe?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neutral
  - 4) Important
  - 5) Very important
18. Thinking about your neighborhood as a good place to live, how important is it to you that there are entertainment or recreation opportunities nearby?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neutral
  - 4) Important
  - 5) Very important
19. Thinking about your neighborhood as a good place to live, how important is it to you that there are many different transportation options (car, bus, walking, other) to take you where you want to go?
- 1) Not at all important
  - 2) Rather unimportant

- 3) Neutral
- 4) Important
- 5) Very important

20. Thinking about your neighborhood as a good place to live, how important is it to you that your neighborhood has a vibrant street life?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

21. Thinking about your neighborhood as a good place to live, how important is it to you that the people in your neighborhood are friendly?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

22. Thinking about your neighborhood as a good place to live, how important is it to you that your neighborhood allows you to live close to friends and relatives?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

23. Thinking about your neighborhood as a good place to live, how important is it to you that your neighborhood allows you to live close to your church or other house of worship?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

## South Bay Travel Study

### SECTION TWO:

Now think about your travel on a typical weekday (Monday through Friday). Please answer the following questions about how you travel to your work on a typical weekday. The first question also asks about whether you are employed.

24. Are you currently (Choose one)
- 1) Employed in a full-time job
  - 2) Employed in a part-time job
  - 3) Not employed (please skip to question 29 in SECTION THREE)
25. On a typical workday, how do you travel to work? (Check only the one that accounts for most of your trips.)
- 1) Car
  - 2) Bus
  - 3) Walking
  - 4) Bicycling
  - 5) Employee vanpool
  - 6) Other
  - 7) I work at home
26. If you work outside the home, how far is your workplace from your home?
- 1) Less than 1/4 mile
  - 2) 1/4 to 1/2 mile
  - 3) 1/2 to 1 mile
  - 4) 1 to 2 miles
  - 5) More than 2 miles
27. If you work at home, during a typical work week, on how many days do you work at home?
- 1) 1 day
  - 2) 2 days
  - 3) 3 days
  - 4) 4 days
  - 5) 5 days
  - 6) 6 days
  - 7) 7 days
28. If you work at home, typically how much of the day do you work at home?

- 1) All of the day
- 2) Part of the day

## South Bay Travel Study

### SECTION THREE:

This is your ONE DAY TRAVEL DIARY. This section is a series of questions that will document the trips you made yesterday. So please think about the trips you made yesterday. Start with the first trip and answer the questions below about that trip, and continue with all other trips that you made yesterday (up to ten trips).

Some things to remember about your travel diary: EVERY TIME YOU TRAVEL FROM PLACE TO PLACE IS ANOTHER NEW TRIP. For example: You drive from your home to work. On the way to work you first drop off your child at day care (trip 1), then stop at a drive-through restaurant to buy breakfast (trip 2), then drive from the restaurant to your work (trip 3). That is three trips. PLEASE LIST EACH OF THOSE AS A SEPARATE TRIP.

Your Travel Diary begins with this question. Remember, all information in this survey is anonymous.

29. YESTERDAY WAS WHICH DAY OF THE WEEK? Please choose only ONE day.
- 1) Monday
  - 2) Tuesday
  - 3) Wednesday
  - 4) Thursday
  - 5) Friday
  - 6) Saturday
  - 7) Sunday
30. For me, yesterday was:
- 1) A work day
  - 2) Not a work day
  - 3) I don't have a full-time or part-time job
31. IF YOU MADE NO trips outside your home yesterday, check the "NO TRIPS" box below and skip all the remaining questions in Section THREE by scrolling down to the bottom of this section and clicking on the "Next" button to go on to Question 84, which is the first question in SECTION FOUR.
- 1) I made AT LEAST ONE TRIP
  - 2) I made NO TRIPS (please go on to question 84)
32. IF YOU MADE AT LEAST ONE TRIP OUTSIDE YOUR HOME YESTERDAY,

please continue with this question. TRIP 1: When I started this trip, I was at:

- 1) Home
  - 2) Work
  - 3) School
  - 4) Other
33. TRIP 1: Thinking about your first trip, indicate the approximate time this trip began. (Example: 8:15 AM) Please answer in the format used in the example.
34. Continuing to think about your first trip, indicate the approximate time this trip ended. (Example: 1:16 AM) Please answer in the format used in the example.
35. Continuing to think about your first trip, how did you travel? (CHOOSE ONLY ONE, PLEASE)
- 1) Personal vehicle, single occupant
  - 2) Personal vehicle, multiple occupants (carpool, car with family members or friends)
  - 3) Vanpool
  - 4) Bus (not a school bus)
  - 5) School bus
  - 6) Walk
  - 7) Bicycle
  - 8) Motorcycle/Moped
  - 9) Taxi
  - 10) Other
36. Continuing to think about your first trip, what was the purpose of this trip? CHOOSE ONLY ONE of the following options.
- 1) Go to work
  - 2) Work related trips (including business meetings, buying business supplies, or similar trips)
  - 3) Return home (return home from any trip)
  - 4) School
  - 5) Eat a meal
  - 6) Go grocery shopping
  - 7) Do other personal shopping (buy clothes, personal items)
  - 8) Do other personal services (banking, legal or insurance services, laundry, barber or hair salon, or similar)
  - 9) Drop off or pick up passengers (such as friends, family, carpool partners)
  - 10) Entertainment or recreation
  - 11) Community/religious meetings
  - 12) Medical/dental appointments
  - 13) Other purpose not listed above



37. Was this your last trip of the day?

- 1) Yes
- 2) No

If you answer “YES” to this question, skip all the remaining questions in SECTION THREE by scrolling down to the bottom of this section and clicking on the “Next” button to go to Question 84, which is the first question in SECTION FOUR.

38. TRIP 2: Thinking about your second trip, indicate the approximate time this trip began. (Example: 8:15 AM) Please answer in the format used in the example.

39. Continuing to think about your second trip, indicate the approximate time this trip ended. (Example: 1:16 AM) Please answer in the format used in the example.

40. Continuing to think about your SECOND trip, how did you travel? (CHOOSE ONLY ONE, PLEASE)

- 1) Personal vehicle, single occupant
- 2) Personal vehicle, multiple occupants (carpool, car with family members or friends)
- 3) Vanpool
- 4) Bus (not a school bus)
- 5) School bus
- 6) Walk
- 7) Bicycle
- 8) Motorcycle/Moped
- 9) Taxi
- 10) Other

41. Continuing to think about your SECOND trip, what was the purpose of the trip? (CHOOSE ONLY ONE, PLEASE)

- 1) Go to work
- 2) Work related trips (including business meetings, buying business supplies, or similar trips)
- 3) Return home (return home from any trip)
- 4) School
- 5) Eat a meal
- 6) Go grocery shopping
- 7) Do other personal shopping (buy clothes, personal items)
- 8) Do other personal services (banking, legal or insurance services, laundry, barber or hair salon, or similar)
- 9) Drop off or pick up passengers (such as friends, family, carpool partners)

- 10) Entertainment or recreation
  - 11) Community/religious meetings
  - 12) Medical/dental appointments
  - 13) Other purpose not listed above
42. Was this the last trip of the day?
- 1) Yes
  - 2) No
43. TRIP 3: Thinking about your third trip, indicate the approximate time this trip began. (Example: 8:15 AM) Please answer in the format used in the example.
44. Continuing to think about your third trip, indicate the approximate time this trip ended. (Example: 1:16 AM) Please answer in the format used in the example.
45. Continuing to think about your THIRD trip, how did you travel?
- 1) Personal vehicle, single occupant
  - 2) Personal vehicle, multiple occupants (carpool, car with family members or friends)
  - 3) Vanpool
  - 4) Bus (not a school bus)
  - 5) School bus
  - 6) Walk
  - 7) Bicycle
  - 8) Motorcycle/Moped
  - 9) Taxi
  - 10) Other
46. Continuing to think about your THIRD trip, what was the purpose of the trip?
- 1) Go to work
  - 2) Work related trips (including business meetings, buying business supplies, or similar trips)
  - 3) Return home (return home from any trip)
  - 4) School
  - 5) Eat a meal
  - 6) Go grocery shopping
  - 7) Do other personal shopping (buy clothes, personal items)
  - 8) Do other personal services (banking, legal or insurance services, laundry, barber or hair salon, or similar)
  - 9) Drop off or pick up passengers (such as friends, family, carpool partners)
  - 10) Entertainment or recreation
  - 11) Community/religious meetings
  - 12) Medical/dental appointments

- 13) Other purpose not listed above
47. Was this the last trip of the day?
- 1) Yes
  - 2) No
48. TRIP 4: Thinking about your fourth trip, indicate the approximate time this trip began. (Example: 8:15 AM) Please answer in the format used in the example.
49. Continuing to think about your fourth trip, indicate the approximate time this trip ended. (Example: 1:16 AM) Please answer in the format used in the example.
50. Continuing to think about your FOURTH trip, how did you travel?
- 1) Personal vehicle, single occupant
  - 2) Personal vehicle, multiple occupants (carpool, car with family members or friends)
  - 3) Vanpool
  - 4) Bus (not a school bus)
  - 5) School bus
  - 6) Walk
  - 7) Bicycle
  - 8) Motorcycle/Moped
  - 9) Taxi
  - 10) Other
51. Continuing to think about your FOURTH trip, what was the purpose of the trip?
- 1) Go to work
  - 2) Work related trips (including business meetings, buying business supplies, or similar trips)
  - 3) Return home (return home from any trip)
  - 4) School
  - 5) Eat a meal
  - 6) Go grocery shopping
  - 7) Do other personal shopping (buy clothes, personal items)
  - 8) Do other personal services (banking, legal or insurance services, laundry, barber or hair salon, or similar)
  - 9) Drop off or pick up passengers (such as friends, family, carpool partners)
  - 10) Entertainment or recreation
  - 11) Community/religious meetings
  - 12) Medical/dental appointments
  - 13) Other purpose not listed above
52. Was this the last trip of the day?

- 1) Yes
  - 2) No
53. TRIP 5: Thinking about your fifth trip, indicate the approximate time this trip began. (Example: 8:15 AM) Please answer in the format used in the example.
54. Continuing to think about your fifth trip, indicate the approximate time this trip ended. (Example: 1:16 AM) Please answer in the format used in the example.
55. Continuing to think about your FIFTH trip, how did you travel?
- 1) Personal vehicle, single occupant
  - 2) Personal vehicle, multiple occupants (carpool, car with family members or friends)
  - 3) Vanpool
  - 4) Bus (not a school bus)
  - 5) School bus
  - 6) Walk
  - 7) Bicycle
  - 8) Motorcycle/Moped
  - 9) Taxi
  - 10) Other
56. Continuing to think about your FIFTH trip, what was the purpose of the trip?
- 1) Go to work
  - 2) Work related trips (including business meetings, buying business supplies, or similar trips)
  - 3) Return home (return home from any trip)
  - 4) School
  - 5) Eat a meal
  - 6) Go grocery shopping
  - 7) Do other personal shopping (buy clothes, personal items)
  - 8) Do other personal services (banking, legal or insurance services, laundry, barber or hair salon, or similar)
  - 9) Drop off or pick up passengers (such as friends, family, carpool partners)
  - 10) Entertainment or recreation
  - 11) Community/religious meetings
  - 12) Medical/dental appointments
  - 13) Other purpose not listed above
57. Was this the last trip of the day?
- 1) Yes
  - 2) No

58. TRIP 6: Thinking about your sixth trip, indicate the approximate time this trip began. (Example: 8:15 AM) Please answer in the format used in the example.
59. Continuing to think about your sixth trip, indicate the approximate time this trip ended. (Example: 1:16 AM) Please answer in the format used in the example.
60. Continuing to think about your SIXTH trip, how did you travel?
- 1) Personal vehicle, single occupant
  - 2) Personal vehicle, multiple occupants (carpool, car with family members or friends)
  - 3) Vanpool
  - 4) Bus (not a school bus)
  - 5) School bus
  - 6) Walk
  - 7) Bicycle
  - 8) Motorcycle/Moped
  - 9) Taxi
  - 10) Other
61. Continuing to think about your SIXTH trip, what was the purpose of the trip?
- 1) Go to work
  - 2) Work related trips (including business meetings, buying business supplies, or similar trips)
  - 3) Return home (return home from any trip)
  - 4) School
  - 5) Eat a meal
  - 6) Go grocery shopping
  - 7) Do other personal shopping (buy clothes, personal items)
  - 8) Do other personal services (banking, legal or insurance services, laundry, barber or hair salon, or similar)
  - 9) Drop off or pick up passengers (such as friends, family, carpool partners)
  - 10) Entertainment or recreation
  - 11) Community/religious meetings
  - 12) Medical/dental appointments
  - 13) Other purpose not listed above
62. Was this the last trip of the day?
- 1) Yes
  - 2) No
63. TRIP 7: Thinking about your seventh trip, indicate the approximate time this trip began. (Example: 8:15 AM) Please answer in the format used in the example.

64. Continuing to think about your seventh trip, indicate the approximate time this trip ended. (Example: 1:16 AM) Please answer in the format used in the example.
65. Continuing to think about your SEVENTH trip, how did you travel?
- 1) Personal vehicle, single occupant
  - 2) Personal vehicle, multiple occupants (carpool, car with family members or friends)
  - 3) Vanpool
  - 4) Bus (not a school bus)
  - 5) School bus
  - 6) Walk
  - 7) Bicycle
  - 8) Motorcycle/Moped
  - 9) Taxi
  - 10) Other
66. Continuing to think about your SEVENTH trip, what was the purpose of the trip?
- 1) Go to work
  - 2) Work related trips (including business meetings, buying business supplies, or similar trips)
  - 3) Return home (return home from any trip)
  - 4) School
  - 5) Eat a meal
  - 6) Go grocery shopping
  - 7) Do other personal shopping (buy clothes, personal items)
  - 8) Do other personal services (banking, legal or insurance services, laundry, barber or hair salon, or similar)
  - 9) Drop off or pick up passengers (such as friends, family, carpool partners)
  - 10) Entertainment or recreation
  - 11) Community/religious meetings
  - 12) Medical/dental appointments
  - 13) Other purpose not listed above
67. Was this the last trip of the day?
- 1) Yes
  - 2) No
68. TRIP 8: Thinking about your eighth trip, indicate the approximate time this trip began. (Example: 8:15 AM) Please answer in the format used in the example.
69. Continuing to think about your eighth trip, indicate the approximate time this trip ended. (Example: 1:16 AM) Please answer in the format used in the example.

70. Continuing to think about your EIGHTH trip, how did you travel?
- 1) Personal vehicle, single occupant
  - 2) Personal vehicle, multiple occupants (carpool, car with family members or friends)
  - 3) Vanpool
  - 4) Bus (not a school bus)
  - 5) School bus
  - 6) Walk
  - 7) Bicycle
  - 8) Motorcycle/Moped
  - 9) Taxi
  - 10) Other
71. Continuing to think about your EIGHTH trip, what was the purpose of the trip?
- 1) Go to work
  - 2) Work related trips (including business meetings, buying business supplies, or similar trips)
  - 3) Return home (return home from any trip)
  - 4) School
  - 5) Eat a meal
  - 6) Go grocery shopping
  - 7) Do other personal shopping (buy clothes, personal items)
  - 8) Do other personal services (banking, legal or insurance services, laundry, barber or hair salon, or similar)
  - 9) Drop off or pick up passengers (such as friends, family, carpool partners)
  - 10) Entertainment or recreation
  - 11) Community/religious meetings
  - 12) Medical/dental appointments
  - 13) Other purpose not listed above
72. Was this the last trip of the day?
- 1) Yes
  - 2) No
73. TRIP 9: Thinking about your ninth trip, indicate the approximate time this trip began. (Example: 8:15 AM) Please answer in the format used in the example.
74. Continuing to think about your ninth trip, indicate the approximate time this trip ended. (Example: 1:16 AM) Please answer in the format used in the example.
75. Continuing to think about your NINTH trip, how did you travel?

- 1) Personal vehicle, single occupant
- 2) Personal vehicle, multiple occupants (carpool, car with family members or friends)
- 3) Vanpool
- 4) Bus (not a school bus)
- 5) School bus
- 6) Walk
- 7) Bicycle
- 8) Motorcycle/Moped
- 9) Taxi
- 10) Other

76. Continuing to think about your NINTH trip, what was the purpose of the trip?

- 1) Go to work
- 2) Work related trips (including business meetings, buying business supplies, or similar trips)
- 3) Return home (return home from any trip)
- 4) School
- 5) Eat a meal
- 6) Go grocery shopping
- 7) Do other personal shopping (buy clothes, personal items)
- 8) Do other personal services (banking, legal or insurance services, laundry, barber or hair salon, or similar)
- 9) Drop off or pick up passengers (such as friends, family, carpool partners)
- 10) Entertainment or recreation
- 11) Community/religious meetings
- 12) Medical/dental appointments
- 13) Other purpose not listed above

77. Was this the last trip of the day?

- 1) Yes
- 2) No

78. TRIP 10: Thinking about your tenth trip, indicate the approximate time this trip began. (Example: 8:15 AM) Please answer in the format used in the example.

79. Continuing to think about your tenth trip, indicate the approximate time this trip ended. (Example: 1:16 AM) Please answer in the format used in the example.

80. Continuing to think about your TENTH trip, how did you travel?

- 1) Personal vehicle, single occupant
- 2) Personal vehicle, multiple occupants (carpool, car with family members or friends)



- 3) Vanpool
- 4) Bus (not a school bus)
- 5) School bus
- 6) Walk
- 7) Bicycle
- 8) Motorcycle/Moped
- 9) Taxi
- 10) Other

81. Continuing to think about your TENTH trip, what was the purpose of the trip?

- 1) Go to work
- 2) Work related trips (including business meetings, buying business supplies, or similar trips)
- 3) Return home (return home from any trip)
- 4) School
- 5) Eat a meal
- 6) Go grocery shopping
- 7) Do other personal shopping (buy clothes, personal items)
- 8) Do other personal services (banking, legal or insurance services, laundry, barber or hair salon, or similar)
- 9) Drop off or pick up passengers (such as friends, family, carpool partners)
- 10) Entertainment or recreation
- 11) Community/religious meetings
- 12) Medical/dental appointments
- 13) Other purpose not listed above

82. Was this the last trip of the day?

- 1) Yes
- 2) No

83. Did you take more than TEN trips yesterday?

- 3) Yes
- 4) No

## South Bay Travel Study

### SECTION FOUR: RESUME ANSWERING QUESTIONS HERE

**Now think about all your travel in a typical week.** For each type of trip, you will be asked how many trips you make in a typical week, the typical (or most common) way you travel for those trips, and how far you usually go. Unlike the travel diary in the previous section, do not count return trips as a separate trip. For example, on this section only, a trip to a restaurant to eat a meal and the return trip should be counted as only one trip.

84. For the next 3 questions, please think of all the trips you take in a typical week that relate to SCHOOL (whether going to or from school yourself or taking or picking up someone else.) How many trips do you make during the typical week for this purpose?
85. Continuing to think about trips related to SCHOOL in a typical week, what mode of transportation do you usually use? (PLEASE CHOOSE ONLY ONE)
- 1) Car
  - 2) School bus
  - 3) Bus or other transit
  - 4) Walk
  - 5) Bicycle
  - 6) Other
86. Continuing to think about trips related to SCHOOL in a typical week, what is the most common distance for this type of trip?
- 1) Less than 1/4 mile
  - 2) Between 1/4 to 1/2 mile
  - 3) Between 1/2 to 1 mile
  - 4) Between 1 to 2 miles
  - 5) More than 2 miles
87. For the next 3 questions, please think of all the trips you take in a typical week to go EAT A MEAL. How many trips do you make during the typical week for this purpose?
- 1) None
  - 2) 1 trip
  - 3) 2 trips
  - 4) 3 trips
  - 5) 4 trips
  - 6) 5 trips

- 7) 6 trips
- 8) 7 trips
- 9) 8 trips
- 10) 9 trips
- 11) More than 9 trips

88. Continuing to think about trips taken to EAT MEALS in a typical week, what mode of transportation do you usually use? (PLEASE CHOOSE ONLY ONE)

- 1) Car
- 2) School bus
- 3) Bus or other transit
- 4) Walk
- 5) Bicycle
- 6) Other

89. Continuing to think about trips made to EAT MEALS in a typical week, what is the most common distance for this type of trip?

- 1) Less than 1/4 mile
- 2) Between 1/4 to 1/2 mile
- 3) Between 1/2 to 1 mile
- 4) Between 1 to 2 miles
- 5) More than 2 miles

90. For the next three questions, please think about all the trips you take in a typical week to BUY GROCERIES. How many trips do you make during the typical week for this purpose?

91. Continuing to think about trips taken to BUY GROCERIES in a typical week, what mode of transportation do you usually use? (PLEASE CHOOSE ONLY ONE)

- 1) Car
- 2) School bus
- 3) Bus or other transit
- 4) Walk
- 5) Bicycle
- 6) Other

92. Continuing to think about trips made to BUY GROCERIES in a typical week, what is the most common distance for this type of trip?

- 1) Less than 1/4 mile
- 2) Between 1/4 to 1/2 mile
- 3) Between 1/2 to 1 mile
- 4) Between 1 to 2 miles

- 5) More than 2 miles
93. For the next three questions, please think about all the trips you take in a typical week to do PERSONAL SHOPPING (buy clothes, gas, or similar things). How many trips do you make during the typical week for this purpose?
94. Continuing to think about trips taken to do PERSONAL SHOPPING in a typical week, what mode of transportation do you usually use? (PLEASE CHOOSE ONLY ONE)
- 1) Car
  - 2) School bus
  - 3) Bus or other transit
  - 4) Walk
  - 5) Bicycle
  - 6) Other
95. Continuing to think about trips taken to do PERSONAL SHOPPING in a typical week, what is the most common distance for this type of trip?
- 1) Less than 1/4 mile
  - 2) Between 1/4 to 1/2 mile
  - 3) Between 1/2 to 1 mile
  - 4) Between 1 to 2 miles
  - 5) More than 2 miles
96. For the next three questions, please think about all the trips you take in a typical week to use PERSONAL SERVICES (such as banking, laundry, legal, government, insurance and similar services). How many trips do you make during the typical week for this purpose?
97. Continuing to think about trips taken to use PERSONAL SERVICES in a typical week, what mode of transportation do you usually use? (PLEASE CHOOSE ONLY ONE)
- 1) Car
  - 2) School bus
  - 3) Bus or other transit
  - 4) Walk
  - 5) Bicycle
  - 6) Other
98. Continuing to think about trips made to use PERSONAL SERVICES in a typical week, what is the most common distance for this type of trip?
- 1) Less than 1/4 mile

- 2) Between 1/4 to 1/2 mile
  - 3) Between 1/2 to 1 mile
  - 4) Between 1 to 2 miles
  - 5) More than 2 miles
99. For the next three questions, please think about all the trips you take in a typical week to ENTERTAINMENT OR RECREATION destinations. How many trips do you make during the typical week to these places?
100. Continuing to think about trips taken to ENTERTAINMENT OR RECREATION destinations in a typical week, what mode of transportation do you usually use? (PLEASE CHOOSE ONLY ONE)
- 1) Car
  - 2) School bus
  - 3) Bus or other transit
  - 4) Walk
  - 5) Bicycle
  - 6) Other
101. Continuing to think about trips made to ENTERTAINMENT OR RECREATION destinations in a typical week, what is the most common distance for this type of trip?
- 1) Less than 1/4 mile
  - 2) Between 1/4 to 1/2 mile
  - 3) Between 1/2 to 1 mile
  - 4) Between 1 to 2 miles
  - 5) More than 2 miles
102. For the next three questions, please think about all the trips you take in a typical week to attend COMMUNITY, RELIGIOUS, VOLUNTEER OR POLITICAL MEETINGS OR EVENTS. How many trips do you make during the typical week for these purposes?
103. Continuing to think about trips taken to attend COMMUNITY, RELIGIOUS, VOLUNTEER OR POLITICAL MEETINGS OR EVENTS in a typical week, what mode of transportation do you usually use? (PLEASE CHOOSE ONLY ONE)
- 1) Car
  - 2) School bus
  - 3) Bus or other transit
  - 4) Walk
  - 5) Bicycle
  - 6) Other

104. Continuing to think about trips made to attend COMMUNITY, RELIGIOUS, VOLUNTEER OR POLITICAL MEETINGS OR EVENTS in a typical week, what is the most common distance for this type of trip?

- 1) Less than 1/4 mile
- 2) Between 1/4 to 1/2 mile
- 3) Between 1/2 to 1 mile
- 4) Between 1 to 2 miles
- 5) More than 2 miles

## South Bay Travel Study

### SECTION FIVE:

Thanks for continuing – we know this is lengthy, but you are almost done. There are only two brief sections left. **REMEMBER:** Your answers will help us learn ways to improve your neighborhood.

This group of questions asks if there are any changes you would like to make in your travel patterns and how important each of these types of changes are to you.

105. How important is it to you to be able to **REDUCE** the number of **CAR TRIPS** you have to make to go to **WORK**?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

106. How important is it to you to be able to **REDUCE** the number of **CAR TRIPS** you have to make for **WORK RELATED TRIPS** (buy materials, attend meetings, etc.)?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

107. How important is it to you to be able to **REDUCE** the number of **CAR TRIPS** you have to make to **EAT MEALS**?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

108. How important is it to you to be able to **REDUCE** the number of **CAR TRIPS** you have to make to **SHOP FOR GROCERIES**?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

109. How important is it to you to be able to REDUCE the number of CAR TRIPS you have to make to do OTHER SHOPPING (buy clothes or other items)?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neutral
  - 4) Important
  - 5) Very important
110. How important is it to you to be able to REDUCE the number of CAR TRIPS you have to make to use PERSONAL SERVICES (such as banking, laundry and such)?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neutral
  - 4) Important
  - 5) Very important
111. How important is it to you to be able to REDUCE the number of CAR TRIPS you have to make to drop off or pick up family members or friends from SCHOOL or DAY CARE?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neutral
  - 4) Important
  - 5) Very important
112. How important is it to you to be able to REDUCE the number of CAR TRIPS you have to make to go to ENTERTAINMENT OR RECREATION venues?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neutral
  - 4) Important
  - 5) Very important



## South Bay Travel Study

### SECTION SIX:

This group of questions asks if certain changes in your neighborhood would encourage you to travel to your neighborhood center more often. Think about the importance each of these changes would have on your decision to travel more often to Hawthorne Boulevard corridor.

**REMEMBER:** Your answers should only apply to the neighborhood within a 10 minute walk from your home.

113. How important would having SHUTTLE BUS SERVICE in your neighborhood be in your decision to travel to Hawthorne Boulevard corridor?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

114. How important would having BUS TRANSIT SERVICE in your neighborhood be in your decision to travel more often to Hawthorne Boulevard corridor?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

115. How important would INCREASED FREQUENCY of EXISTING SHUTTLE BUS SERVICE in your neighborhood be in your decision to travel more often to Hawthorne Boulevard corridor?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

116. How important would INCREASED FREQUENCY of EXISTING BUS TRANSIT SERVICE in your neighborhood be in your decision to travel more often to Hawthorne Boulevard corridor?

- 1) Not at all important
- 2) Rather unimportant

- 3) Neutral
- 4) Important
- 5) Very important

117. How important would an **INCREASED NUMBER OF PLACES THE BUS WOULD TAKE YOU IN YOUR NEIGHBORHOOD** be in your decision to travel more often to Hawthorne Boulevard corridor?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

118. How important would **BETTER NIGHT LIGHTING** in your neighborhood be in your decision to travel more often to Hawthorne Boulevard corridor?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

119. How important would an **IMPROVED SIDEWALK NETWORK** in your neighborhood be in your decision to travel more often to Hawthorne Boulevard corridor?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

120. How important would **SLOWING DOWN TRAFFIC** to make pedestrians safer in your neighborhood be in your decision to travel more often to Hawthorne Boulevard corridor?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

121. How important would providing **MORE PLACES TO SHOP FOR GROCERIES** in your neighborhood be in your decision to travel more often to Hawthorne Boulevard corridor?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

122. How important would providing MORE PLACES TO SHOP FOR THINGS OTHER THAN GROCERIES (such as clothes or household items) in your neighborhood be in your decision to travel more often to Hawthorne Boulevard corridor?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

123. How important would providing MORE PLACES TO EAT OUT in your neighborhood be in your decision to travel more often to Hawthorne Boulevard corridor?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

124. How important would providing MORE PLACES TO GO FOR ENTERTAINMENT OR RECREATION in your neighborhood be in your decision to travel more often to Hawthorne Boulevard corridor?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important
- 5) Very important

125. How important would providing MORE PLACES WHERE PEOPLE CAN WORK in your neighborhood be in your decision to travel more often to Hawthorne Boulevard corridor?

- 1) Not at all important
- 2) Rather unimportant
- 3) Neutral
- 4) Important

- 5) Very important
126. How important would providing MORE PERSONAL SERVICE STORES (banks, laundries, etc.) in your neighborhood be in your decision to travel more often to Hawthorne Boulevard corridor?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neutral
  - 4) Important
  - 5) Very important
127. How important would providing MORE STREET TREES, BENCHES, AND SIMILAR IMPROVEMENTS in your neighborhood be in your decision to travel more often to Hawthorne Boulevard corridor?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neutral
  - 4) Important
  - 5) Very important
128. How important would providing MORE BIKE LANES in your neighborhood be in your decision to travel more often to Hawthorne Boulevard corridor?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neutral
  - 4) Important
  - 5) Very important
129. How important would providing or improving the quality of PUBLIC PLAZAS, PARKS or other GATHERING PLACES in your neighborhood be in your decision to travel more often to Hawthorne Boulevard corridor?
- 1) Not at all important
  - 2) Rather unimportant
  - 3) Neutral
  - 4) Important
  - 5) Very important
130. How important would REDUCING CRIME in your neighborhood be in your decision to travel more often to Hawthorne Boulevard corridor?
- 1) Not at all important
  - 2) Rather unimportant

- 3) Neutral
- 4) Important
- 5) Very important

## **South Bay Travel Study**

### **SECTION SEVEN: THE LAST ONE!**

Thank you for sticking with us this far.

Traffic researchers have learned that personal and family characteristics can influence travel. To help us understand how to improve transportation for a broad range of people, we need to know some general information about you and your family.

**ALL OF THIS INFORMATION WILL BE TREATED AS CONFIDENTIAL.** It will never be reported in any fashion that allows your name or address to be linked to any of your answers.

131. Please indicate your age range.

- 1) Less than 18 years old
- 2) 18 to 25 years old
- 3) 26 to 40 years old
- 4) 41 to 55 years old
- 5) 56 to 65 years old
- 6) Over 65 years old

132. What is your gender?

- 1) Female
- 2) Male

133. What is your race or ethnicity?

- 1) White non-Hispanic
- 2) Hispanic
- 3) African-American
- 4) Asian/Pacific Islander
- 5) Other
- 6) Do not wish to state

134. How many people in your household are infants or up to 6 years old?

135. How many people in your household are between the ages of 7 and 18 years old?

136. How many people in your household are between the ages of 19 and 30 years old?

137. How many people in your household are between the ages of 31 and 65 years old?

138. How many people in your household are older than 65?
139. How many people in your household have a driver's license?
140. On most days, how many cars do you have available for use by members of your household?
141. How long have you lived in this neighborhood?
- 1) Less than 1 year
  - 2) 1 to 5 years
  - 3) 6 to 10 years
  - 4) More than 10 years
  - 5) All my life
142. How many years did you go to school?
- 1) Less than 12 years
  - 2) 12 years (high school diploma)
  - 3) Between 12 and 16 years (some college)
  - 4) 16 years (college degree, bachelors degree)
  - 5) More than 16 years
143. How long have you lived in the United States?
- 1) Less than 1 year
  - 2) 1 to 5 years
  - 3) 6 to 10 years
  - 4) More than 10 years
  - 5) All my life
144. Do you own or rent your residence?
- 1) Own
  - 2) Rent
145. What is your average annual household income? Please check **ONLY ONE**.
- 1) Less than \$15,000
  - 2) \$15,001 to \$35,000
  - 3) \$35,001 to \$55,000
  - 4) \$55,001 to \$75,000
  - 5) \$75,001 to \$100,000
  - 6) More than \$100,000

## Appendix C

### Definition of Neighborhood Businesses by NAICS Category

The following NAICS 6-digit categories were included in the definition of neighborhood businesses.

NAICS CODE Category Description	NAICS CODE Category Description
431101 POST OFFICES	599401 NEWS DEALERS
481207 CELLULAR TELEPHONES (SERVICES)	599504 OPTICIANS
	599902 CELLULAR TELEPHONES-EQUIPMENT & SUPLS
525104 HARDWARE-RETAIL	599905 WATER HEATERS-DEALERS
526106 LANDSCAPING EQUIPMENT & SUPPLIES	599909 TROPHIES AWARDS & MEDALS
531102 DEPARTMENT STORES	599913 SURGICAL APPLIANCES
531104 DISCOUNT STORES	599921 RELIGIOUS GOODS
533101 VARIETY STORES	599922 ARTIFICIAL LIMBS
539901 GENERAL MERCHANDISE-RETAIL	599927 PICTURE FRAMES-DEALERS
541103 CONVENIENCE STORES	599931 FACTORY OUTLETS
541105 GROCERS-RETAIL	599933 ORTHOPEDIC APPLIANCES
542101 SEAFOOD-RETAIL	599934 MEXICAN GOODS
542107 MEAT-RETAIL	599940 WEDDING SUPPLIES & SERVICES
543104 JUICES-RETAIL	599948 AFRICAN GOODS-RETAIL
546102 BAKERS-RETAIL	599949 COIN DEALERS SUPPLIES & ETC
546105 DOUGHNUTS	599967 ARTIFICIAL FLOWERS & PLANTS & TREES
549901 HEALTH & DIET FOODS-RETAIL	599969 ART GALLERIES & DEALERS
549904 VITAMINS	599974 HAWAIIAN GOODS
549913 HERBS	599992 COSMETICS & PERFUMES-RETAIL
549915 COFFEE & TEA	602101 BANKS
561101 MEN'S CLOTHING & FURNISHINGS-RETAIL	603501 SAVINGS & LOAN ASSOCIATIONS
562101 WOMEN'S APPAREL-RETAIL	606101 CREDIT UNIONS
562103 MATERNITY APPAREL	609902 MONEY ORDER SERVICE
562104 BRIDAL SHOPS	609903 CHECK CASHING SERVICE
563206 HOSIERY-RETAIL	701101 HOTELS & MOTELS
563207 HANDBAGS	721201 CLEANERS
563210 LINGERIE	721501 LAUNDRIES-SELF SERVICE
564103 CHILDRENS & INFANTS WEAR-RETAIL	723101 SKIN TREATMENTS
565101 CLOTHING-RETAIL	723102 MANICURING
566101 SHOES-RETAIL	723105 BEAUTY SCHOOLS
569904 DANCING SUPPLIES	723106 BEAUTY SALONS
569906 DRESSMAKERS	723119 SPAS-BEAUTY & DAY
569909 WIGS TOUPEES & HAIRPIECES	724101 BARBERS
569910 SHEEPSKIN SPECIALTIES	725102 SHOE & BOOT REPAIRING
569913 SPORTSWEAR-RETAIL	729901 HEALTH & FITNESS PROGRAM CONSULTANTS
	729906 EXERCISE & PHYSICAL FITNESS PROGRAMS
569915 SWIMWEAR & ACCESSORIES-RETAIL	
569917 T-SHIRTS-RETAIL	



NAICS  
 CODE Category Description  
 569919 TAILORS  
 569922 UNIFORMS  
 569927 HATS-RETAIL  
 569932 ALTERATIONS-CLOTHING  
 569947 APPAREL & GARMENTS-RETAIL  
 571211 KITCHEN CABINETS & EQUIPMENT-  
 HOUSEHOLD  
 571216 FURNITURE-DEALERS-RETAIL  
 571217 FURNITURE-DESIGNERS & CUSTOM  
 BUILDERS  
 571219 HOUSE FURNISHINGS-RETAIL  
 571220 MATTRESSES  
 571305 CARPET & RUG DEALERS-NEW  
 571405 DRAPERY & CURTAIN FIXTURES  
 571407 DRAPERIES & CURTAINS-  
 RETAIL/CUSTOM MADE  
 571916 WINDOW SHADES  
 571925 LINENS-RETAIL  
 572202 APPLIANCES-HOUSEHOLD-MAJOR-  
 DEALERS  
 572218 SEWING MACHINES-HOUSEHOLD  
 573103 TELEVISION & RADIO-DEALERS  
 573105 STEREOPHONIC & HIGH FIDELITY EQUIP-  
 DLRS  
 573113 AUDIO-VISUAL EQUIPMENT-DEALERS  
 573117 ELECTRONIC EQUIPMENT & SUPPLIES-  
 RETAIL  
 573121 TELEVISION-GIANT SCREEN  
 573401 COMPUTER SOFTWARE  
 573402 COMPUTER PARTS & SUPPLIES  
 573403 PUBLISHING-DESKTOP  
 573407 COMPUTER & EQUIPMENT DEALERS  
 573416 MEDICAL SOFTWARE  
 573502 VIDEO TAPES DISCS & CASSETTES  
 573609 MUSIC DEALERS  
 581203 ICE CREAM PARLORS  
 581206 FOODS-CARRY OUT  
 581208 RESTAURANTS  
  
 581209 DELICATESSENS  
  
 581212 CATERERS  
 581213 CAFETERIAS  
 581214 CAFES  
 581222 PIZZA  
 581228 COFFEE SHOPS  
 581301 BARS  
 581303 COCKTAIL LOUNGES

NAICS  
 CODE Category Description  
 729917 MASSAGE THERAPISTS  
 729944 TANNING SALONS  
 729963 MASSAGE  
 733403 COPYING & DUPLICATING SERVICE  
 783201 THEATRES  
 784102 VIDEO TAPES & DISCS-RENTING &  
 LEASING  
 791101 DANCING INSTRUCTION  
 792207 THEATRES-LIVE  
  
 799101 HEALTH CLUBS STUDIOS & GYMNASIUMS  
 799912 BILLIARD PARLORS  
 799936 GYMNASTIC INSTRUCTION  
 799945 MARTIAL ARTS INSTRUCTION  
 799951 PARKS  
  
 799973 TICKET SALES-ENTERTAINMENT SPORTS  
 801101 PHYSICIANS & SURGEONS  
 801104 CLINICS  
  
 802101 DENTISTS  
 804101 CHIROPRACTORS DC  
 804201 OPTOMETRISTS OD  
  
 804301 PODIATRISTS  
 804907 NURSES-PRACTITIONERS  
  
 804909 NUTRITIONISTS  
 804911 OCCUPATIONAL THERAPISTS  
 804913 ACUPUNCTURE  
 804918 PHYSICAL THERAPISTS  
 804922 PSYCHOLOGISTS  
 804924 PSYCHOTHERAPISTS  
 804925 SPEECH PATHOLOGISTS  
 804926 HOMEOPATHS  
 821101 RELIGIOUS SCHOOLS  
 821103 SCHOOLS  
 821107 SCHOOLS WITH SPECIAL ACADEMIC  
 EDUCATION  
 822101 SCHOOLS-UNIVERSITIES & COLLEGES  
 ACADEMIC  
 823106 LIBRARIES-PUBLIC  
 824301 COMPUTER TRAINING  
 824401 SCHOOLS-BUSINESS & VOCATIONAL  
 829901 SCHOOLS-GENERAL INTEREST  
 829909 TUTORING  
 829912 LANGUAGE SCHOOLS  
 829915 MUSIC INSTRUCTION-VOCAL

NAICS  
 CODE Category Description  
 591205 PHARMACIES

592102 LIQUORS-RETAIL  
 592103 WINES-RETAIL  
 593201 BOOK DEALERS-USED & RARE  
 593202 ANTIQUES-DEALERS  
 593222 THRIFT SHOPS  
 593226 SECOND HAND STORES

593229 PAWNBROKERS  
 593233 RECORDS-PHONOGRAPH-USED & RARE

593235 CLOTHING-COLLECTIBLE PERIOD &  
 VINTAGE  
 594112 SURFBOARDS  
 594113 SPORTING GOODS-RETAIL  
 594130 GOLF EQUIPMENT & SUPPLIES-RETAIL  
 594137 DIVERS EQUIPMENT & SUPPLIES

594141 BICYCLES-DEALERS  
 594201 BOOK DEALERS-RETAIL

594205 COMIC BOOKS  
 594301 OFFICE SUPPLIES

594305 STATIONERS-RETAIL  
 594408 JEWELRY DESIGNERS  
 594409 JEWELERS-RETAIL  
 594501 CRAFT SUPPLIES  
 594503 WEAVING-LOOM  
 594505 MINIATURE ITEMS FOR COLLECTORS  
 594508 HOBBY & MODEL CONSTR SUPPLIES-  
 RETAIL  
 594509 GAMES & GAME SUPPLIES  
 594514 CERAMIC PRODUCTS-DECORATIVE  
 594517 TOYS-RETAIL  
 594701 BALLOONS-NOVELTY & TOY  
 594705 COLLECTIBLES  
 594707 NOVELTIES-RETAIL  
 594709 INDIAN GOODS  
 594712 GIFT SHOPS  
 594713 GIFT BASKETS & PARCELS  
 594716 PARTY SUPPLIES

594801 LUGGAGE-RETAIL  
 594911 YARN-RETAIL  
 599201 FLORISTS-RETAIL  
 599206 WEDDING FLOWERS

NAICS  
 CODE Category Description  
 829916 MOTIVATIONAL & SELF IMPROVEMENT  
 TRAINING  
 829918 MUSIC INSTRUCTION-INSTRUMENTAL  
 829972 EDUCATION CENTERS  
 832201 COUNSELING SERVICES  
 832210 DAY CARE CENTERS-ADULT  
 832215 MARRIAGE & FAMILY COUNSELORS  
 832218 SOCIAL SERVICE & WELFARE  
 ORGANIZATIONS  
 832221 SOCIAL WORKERS  
 832222 CHILDREN'S SVCS & ACTIVITIES  
 INFORMATION  
 832235 HOUSING PROVIDERS

832252  
 832256 PROBATION SERVICES  
 833102 REHABILITATION SERVICES  
 833104 MENTAL RETARDATION & DEV DISABLED  
 SVCS  
 833106 CAREER & VOCATIONAL COUNSELING  
 833108 GOVERNMENT-JOB TRAINING/VOC  
 REHAB SVCS  
 835101 CHILD CARE SERVICE  
 835102 SCHOOLS-NURSERY & KINDERGARTEN  
 ACADEMIC  
 835104 CHILD CARE CENTERS-CONSULTANTS  
 839901 Social Services not otherwise classified  
 839902 Social Services not otherwise classified  
 839911 Social Services not otherwise classified  
 839919 Social Services not otherwise classified  
 839998 Social Services not otherwise classified  
 841201 MUSEUMS

864101 FRATERNAL ORGANIZATIONS  
 864102 VETERANS' & MILITARY ORGANIZATIONS  
 864121  
 866104 CHURCH ORGANIZATIONS  
 866107 CHURCHES  
 866110 RELIGIOUS ORGANIZATIONS  
 866123 MEDITATION ORGANIZATIONS  
 869903 ORGANIZATIONS  
 869904 WOMEN'S ORGANIZATIONS & SERVICES  
 911103 COUNTY GOVERNMENT-EXECUTIVE  
 OFFICES  
 911104 CITY GOVERNMENT-EXECUTIVE OFFICES  
 912102 GOVERNMENT OFFICES-STATE  
 912103 GOVERNMENT OFFICES-COUNTY  
 912104 GOVERNMENT OFFICES-CITY, VILLAGE &

NAICS  
CODE Category Description  
  
599301 CIGAR CIGARETTE & TOBACCO  
DEALERS-RETAIL

NAICS  
CODE Category Description  
TWP