CONSUMER BEHAVIOR AND TRAVEL MODE CHOICES

DRAFT Final Report

CONSUMER BEHAVIOR AND TRAVEL MODE CHOICES

by

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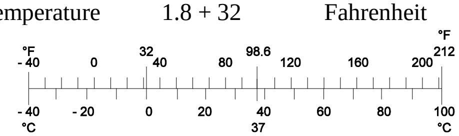
SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	millimeters squared	mm^2
ft^2	square feet	0.093	meters squared	m^2
yd^2	square yards	0.836	meters squared	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	kilometers squared	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	meters cubed	m^3
yd^3	cubic yards	0.765	meters cubed	m^3
NOTE: Volumes greater than 1000 L shall be shown in m^3.				
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9	Celsius temperature	°C

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
ha	hectares	2.47	acres	ac
km^2	kilometers squared	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	meters cubed	35.315	cubic feet	ft^3
m^3	meters cubed	1.308	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.102	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celsius temperature	1.8 + 32	Fahrenheit	°F



***** SI is the symbol for the International System of Measurement

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EXECUTIVE SUMMARY

This study represents a first attempt to answer a few of the questions that have arisen concerning multimodal transportation investments and the impacts of mode shifts on the business community. This research aims to merge the long history of scholarly work that examines the impacts of the built environment on non-work travel with the relatively new interest in consumer spending by mode of travel. This empirical study of travel choices and consumer spending across 89 businesses in the Portland metropolitan area shows there are important differences between the amounts customers spend on average at various businesses by their mode of travel. However, these differences become less pronounced when we control for demographics of the customer and other attributes of the trip. This study of consumer spending and travel choices has some compelling findings that suggest some key spending and frequency differences by mode of travel that will likely invigorate the discussion of the economic impacts of these modes.

Key findings are the following:

- Bicyclists, pedestrians, and transit riders are competitive consumers: when demographics and socioeconomics are controlled for, mode choice does not have a statistically significant impact on consumer spending at convenience stores, drinking establishments, and restaurants. When trip frequency is accounted for, the average monthly expenditures by customer modes of travel reveal that bicyclists, transit users, and pedestrians are competitive consumers and for all businesses except supermarkets, spend more, on average than those who drive.

- The built environment matters: we support previous literature and find that residential and employment density, the proximity to rail transit, the presence of bike infrastructure, and the amount of automobile and bicycle parking are all important in explaining the use of non-automobile modes. In particular, provision of bike parking and bike corrals are significant predictors of bike mode share at the establishment level.

Other findings lend more insight into the relationship between consumer behavior and travel choices. For the non-work destinations studied, the automobile remains the dominant mode of travel. Patrons are largely arriving by private vehicle to most of the destinations in this study, particularly to grocery stores where larger quantities of goods tend to be purchased. But, high non-automobile mode shares and short travel distances exist in areas of concentrated urban activity.

In sum, this study provides some empirical evidence to answer the questions of business owners about how mode shifts might impact their market shares and revenues. More work is needed to better understand the implications of future changes and to provide a robust assessment of the returns on these investments and their economic impacts.

Chapter 1 Introduction

American retailing and service sectors have been accommodating the automobile since its widespread adoption after World War II. The built environment in many communities was modified to support the automobile, often to the exclusion of other modes of travel. As a result, business owners often anticipate that patrons will travel by private vehicle and sometimes express concerns about policies to reduce automobile travel or that promote changes to the built environment that favor the use of non-automobile modes. Merchants may be concerned that mode shifts away from travel by private vehicle will lead to decreased sales revenue. Currently, there is little research evidence to prove that these fears are unfounded.

For the last thirty years, the policy question that has dominated much of travel behavior research is the anticipated demand associated with levels of infrastructure investment and built environment characteristics. Great progress has been made in this area and while many questions still remain, there is a rich and long literature to help inform policy and plans. Cities across the US are making new or expanded investments in bicycling, transit, and walking infrastructure, motivated by the anticipated benefits associated with decreases in automobile use and associated fuel and emissions reductions, improvements to societal health, increased transportation choices and greater equity for all system users.

Amid the ongoing discussion regarding the evidence supporting these benefits, new concerns have arisen about the economic impacts of these investments. The debates around increases in non-automobile transportation options have expanded to question how these investments impact businesses. While there is a wealth of information that examines the connections between the built environment and mode choices, information that contributes to a discussion about returns on investments in non-automobile infrastructure is lacking. This study seeks to fill that gap by examining the links between transportation choices and consumer spending and patronage.

Here we are guided by the following objectives:

1. Quantify the transportation mode shares of customers for a variety of business types, locations and transportation contexts

2. Test the associations of these establishment-level mode shares and attributes of the built environment

3. Examine the links between consumer spending and frequency of visits at these businesses and mode of travel while controlling for other factors

To achieve these objectives, this study makes use of intercept surveys of local business patrons and built environment data to inform its analysis. The locations included in this study were chosen based upon the characteristics of the individual business, area demographics, land use/built environment context, and the transportation environment. Analysis of these data at both the establishment and individual patron level will provide important evidence about important differences in customer transportation, spending and patronage to help address these emerging questions about economic impacts.

This report is organized as follows. A literature review summarizes the current state of the knowledge about the economic impacts of various modes, with an emphasis on consumer behavior. Then, the data used in this study and the methods used to collect them are described. Next, we present the results of our data analysis and key study findings. The report concludes with a discussion of the implications of our findings for planning and policy, study limitations, and suggestions for future work. Supporting documentation is provided in the Appendices.

Chapter 2 Literature Review

The following review begins by briefly summarizing the academic and professional studies examining travel behavior and the built environment, specifically focusing on non-work travel. Then, we present the few available studies that discuss consumer spending related to travel mode choice, with a section devoted to travel to supermarket. Finally, we discuss concerns and perceptions of business owners about how their patrons access their store.

THE CURRENT BUILT ENVIRONMENT

As automobile use increased after WWII, retailers expanded their conception of market area based on the speed and range of automobiles and delivery trucks, resulting in fewer but larger establishments located along major thoroughfares with an ample supply of off-street automobile parking (Handy, 1993). At the same time, conventional land use policy and development practices throughout the 20th century encouraged low-density, suburban housing developments. This resulted in increased separation of residential areas and shopping districts, making accessing retail locations by non-automobile mode inconvenient and sometimes unsafe. The result is a retail built environment that tends to favor car accessibility over other modes of transportation (Grant & Perrot, 2011).

Although the current US built environment caters to automobile use in most communities, it can be restructured to promote other transportation options. Cervero and Kockelman's 1997 study of travel behavior in the San Francisco Bay area found that density, land-use diversity, and pedestrian-oriented designs resulted in fewer automobile trips and more walking trips to neighborhood retail shops. Rodriguez and Joo (2004) found that higher residential densities and the presence of sidewalks and multi-use paths were positively associated with walking and bicycling. Similarly, McConville *et al.* (2011) found a negative relationship between trip distance and walking probability and a positive relationship between land use diversity and walking. Targa and Clifton (2005) found that access to transit is associated with higher levels of walking. In a comparative study of land use patterns and mode share in Boston and Hong Kong, Zhang (2004) found that density exerts an influence on the choice to walk, use transit, or drive after controlling for travel time and monetary cost. In all, the literature on travel and the built environment shows that measures of population and employment density, mixed land uses, access to transit, and designs that focus on pedestrians and bicyclists are the most important features related to non-automobile travel (Ewing & Cervero, 2010).

Looking specifically at how the built environment affects rates of bicycling, Pucher et al. (1999) noted that infrastructure upgrades, such as expanding the number of bicycle facilities and making all roads "bikeable" could lead to more bicycling in North America. Using US Census data, Dill and Carr (2003) found that "higher levels of bicycle infrastructure are positively and significantly correlated with higher rates of bicycle commuting." These findings were most significant for on street bike lanes. In a comparison between the US and Canada, Pucher and Buehler (2006) found density to be positively correlated and trip distance to be negatively correlated with bicycling rates.

MODE CHOICE AND SPENDING STUDIES

While links between non work travel and mode have been explored, research between mode and consumer behavior (consumer spending and spending frequency) is fairly nascent. Regardless, the results of several studies provide a starting place for a more rigorous examination of the effects of mode choice on consumer behavior.

The bulk of spending and mode choice studies have been conducted using random sidewalk intercept surveys of consumers in shopping districts of metropolitan areas (Transportation Alternatives, 2012; Brent & Singa, 2008; Forkes & Lea, 2011; Lee, 2008; Sztabinski, 2009). To measure traveler frequency, many studies ask participants to estimate how often they visit the area (Bent and Signa, 2008; Forkes and Lea, 2011). Other studies assign fixed frequency values to those who live or work in the area regardless of their actual shopping habits (Transportation Alternatives, 2012). One study did not examine frequency at all (Lee, 2008). Customer frequency is important in estimating spending over time—i.e. spending per week or per month—because most studies are cross-sectional and observe a snapshot of behavior at one point in time. Similar to frequency, most studies ask participants to estimate past spending and/or prospective spending levels (Transportation Alternatives, 2012; Bent & Singa, 2008; Lee, 2008; Forkes and Lea, 2011; Sztabinski, 2009).

The majority of mode and consumer behavior studies have been commissioned to study specific areas. Bent and Singa's report was done to examine the impact of a hypothetical congestion tax on downtown retailers in San Francisco (2008). They concluded that a congestion tax may not hurt retail revenues, and that there could be benefits to investing the tax proceeds into non-automobile transportation projects. Transportation Alternative found that non-automobile consumers were competitive with automobile consumers, had a larger mode share in the East Village of New York City, and that 61% of people surveyed noted that newly installed protected bike lanes increased their inclination to bike. Two studies done in Toronto found that non-automobile consumers spent similar or greater amounts than automobile customers and reported public support for bike lanes (Forkes and Lea, 2011; Sztabinski, 2009).

Past studies suggest that automobile based consumers spend more per trip, but when frequency is accounted for, non-automobile customers spend similar or greater amounts (Bent & Singa, 2008; Transportation Alternatives, 2012; Fietsberaad, 2011; Trendy Travel, 2010). These finding suggest that pedestrians, transit riders, and bicyclists are competitive consumers in comparison to automobile users. However, more controls for socioeconomic factors, demographics and built environment characteristics are needed to provide more conclusive results.

SUPERMARKET SPENDING

In the US, consumers spend on average $3,838 dollars per year on food at home, 46%, 49%, and 102% more then they spent on food away from home, entertainment, and apparel, respectively (BLS Consumer Expenditure Survey, 2011). Given the amount of consumer spending on food at home, it is unsurprising that there have been many studies that examine either consumer behavior or mode choice at supermarkets. However, few studies have examined the relationship between consumer behavior and mode choice at supermarkets.

A Seattle, WA, report estimated that 88% of supermarket shoppers arrive by car (Jiao *et al.*, 2011). The authors found that the strongest predictors for driving to a grocery store "were more cars per household adult member, more adults per household, living in a single-family house, longer distances between homes and grocery stores…and more parking at ground around the grocery store used." Research has also shown that people trade off convenience with price, quality, parking availability, and other intangibles when grocery shopping (Handy & Clifton, 2001). An empirical investigation of traditional shopping districts found that while these districts are associated with higher rates of walking, bicycling and transit, many people still access them by car, especially if visiting grocery stores (Steiner, 1998). Results of these studies have suggested and supported the notion that driving to supermarkets is attractive compared with other travel modes due to the ease of transporting and hauling grocery bags upon purchasing.

In an effort to develop a model of household shopping behavior, Bawa and Ghosh discovered that employment status, household size, age, the number of stores visited, and income all affect the frequency of shopping trips (1999). Expenditure per trip was influenced by income, household size, and the presence of children. Kim and Park found that 70% of shoppers visit grocery stores at random intervals, with the remaining 30% maintaining a fixed schedule (1997). The routine shoppers tended to visit stores less frequently and spend more per trip.

BUSINESS PERCEPTIONS

Merchants tend to overestimate the number of patrons that arrive by automobile (Forkes & Lea, 2011; Sustrans, 2006; Stantec, 2011). This could lead businesses to fear that shifting resources from automobile to alternative transportation projects will hurt revenue.

In 2010 the City of Vancouver, British Columbia installed protected bike lanes on two streets by removing 172 car parking spots, restricting turns in five locations, and altering loading zones (Stantec, 2011). One year later surveys were distributed to businesses and shoppers on the affected streets. Merchants and consumers reported decreased revenue and shopping frequency, ranging from 3 to 11 percent. To control for greater economic changes, the two streets were compared to similar streets that did not have bike lanes installed. The authors note that consumers need time to adapt to infrastructure changes, hence these reported decreases could be temporary. In June 2012 the Vancouver City Council voted unanimously to keep the protected bike lanes (CBC News, 2012).

Other studies examining the business impact of installing bike lanes have found increases in retail activity. On Valencia Street in San Francisco, a study of 27 businesses was conducted four years after a bike lane was installed (car parking was not impacted but the number of vehicle travel lanes reduced from four to three). The majority of respondents reported an increase in sales or no effect, and no business reported a decline in sales (Drennen, 2003). Similarly, a recent report by New York City DOT found increased retail sales after a protected bike lane was installed in Manhattan (NYC DOT, 2012 – preliminary report).

A Master's thesis in Melbourne, Australia looked at parking equity for bikes and automobiles (Lee, 2008). Given that a parked car takes up roughly the same space as six parked bikes, the report postulates that it would be economically beneficial to reallocate parking spaces from cars to bicycles. This conclusion was reached by estimating that one automobile generates $27 of economic activity per hour, whereas six bikes generate $97.20 per hour. Of course, the conclusion is dependent on their being a shortage of bicycle parking, an assumption that was not tested.

Business perceptions of biking corrals in Portland, Oregon, were studied by Alta Planning and Portland State University (Meisel, 2010). A bike corral typically has 6 to 12 bicycle racks in a row, often replaces on-street automobile parking and can park 10 to 20 bicycles. This uses space otherwise occupied by one to two cars. Forty-three business establishments located within half a block of bike corrals were surveyed. The majority of respondents indicated that bike and car parking demand had "increased over time" and that bike corrals decreased congestion. Thirty-eight percent of stores surveyed indicated that they would expect an "increased number of cyclists as customers…if additional bike corrals were installed near (their business)."

SUMMARY

The choice to walk, bike, drive or take transit is in part influenced by the built environment. Past literature illustrates various elements as being associated with higher levels of walking, cycling, and transit use. These measures include population density, employment density, distance to transit, presence of bike lanes and pedestrian orientation. As Portland and other communities build new infrastructure designed to promote alternative transportation modes, businesses are likely to see a shift in how customers arrive at their stores.

The body of literature examining consumer spending by transportation mode choice is rather limited, focused on small areas within metropolitan zones, and largely non-peer reviewed. Still, trends emerge. Perhaps most importantly, in studies that included frequency, cyclists, pedestrians, and transit riders spent similar amounts per month as automobile users. This signals that if automobile users shift to other transport modes they will not become lower spending consumers.

Regardless of political viewpoint, knowing how transportation mode choice affects spending is an important consideration for built environment discussions. If mode choice does not affect consumer spending, then the argument the economy would be harmed if resources are reallocated from automobile infrastructure to alternative forms of transportation becomes considerably weaker.

This study builds upon past literature on the connections between transportation mode choices and the built environment. The scope of this study expands to include the examination of spending patterns and frequency of trips. The use of diverse survey locations will enable a degree of transferability to other regions. Ultimately, this study aims to examine the competitiveness of non-automobile consumers.

Chapter 3 Data Collection Methodology

This chapter presents the study design, data collection processes, and sample used in this study. Data were collected at 89 different businesses throughout the Portland, Oregon metropolitan region, including restaurants, drinking places, convenience stores, and supermarkets. Information collected at each location included: (1) customer intercept surveys; (2) establishment information, including site-specific attributes such as gross square footage, number of employees, parking capacity, and other site design characteristics; and (3) archived information about the built environment. The survey designs differed by type of establishment and are described in more detail in the following sections. The chapter is organized as follows:

1. Survey site selection, establishment types, and definition of area types
2. Survey instrument design and sample description
3. Built environment data

ESTABLISHMENT TYPES & SITE SELECTION

Given the resource limitations of this study, only a few business types are examined: a) high-turnover (sit-down) restaurants (pizza and Mexican restaurants), b) convenience markets (open 24-hours) without gas stations, c) drinking places, and d) supermarkets. These business types were chosen because they are found throughout the region and have similar price points. Establishments from a variety of urban locations with different built environment characteristics and levels of support for travel modes are represented in the sample. Table 3-1 summarizes the number of establishments that participated in the study, and Figure 3-1 shows the spatial distribution of the 89 survey establishments throughout the Portland region. The map illustrates how area types change from more urban to more suburban as distance from the Central Business District increases.

Table 3-1. Establishments Surveyed by Area and Land Use Type

Area Type	# Restaurant Locations	# Convenience Locations	# Bar Locations	# Grocery Locations	Total
Central Business District	12	4	3	0	19
Urban Core Neighborhoods	10	5	6	3	24
Neighborhood and Regional Centers	6	6	4	2	18
Suburban Town Centers	5	7	0	3	12
Suburban Areas	6	4	0	3	16
Total	39	26	13	11	89

Most establishments in the study are regionally owned and operated franchises. Local establishments are over-represented because they were more willing to participate than national chains. This introduces some bias to our sample in that local establishments are: a) generally smaller in size than national chains of restaurants and supermarkets, and b) may cater different market segments than those patrons of national chains.

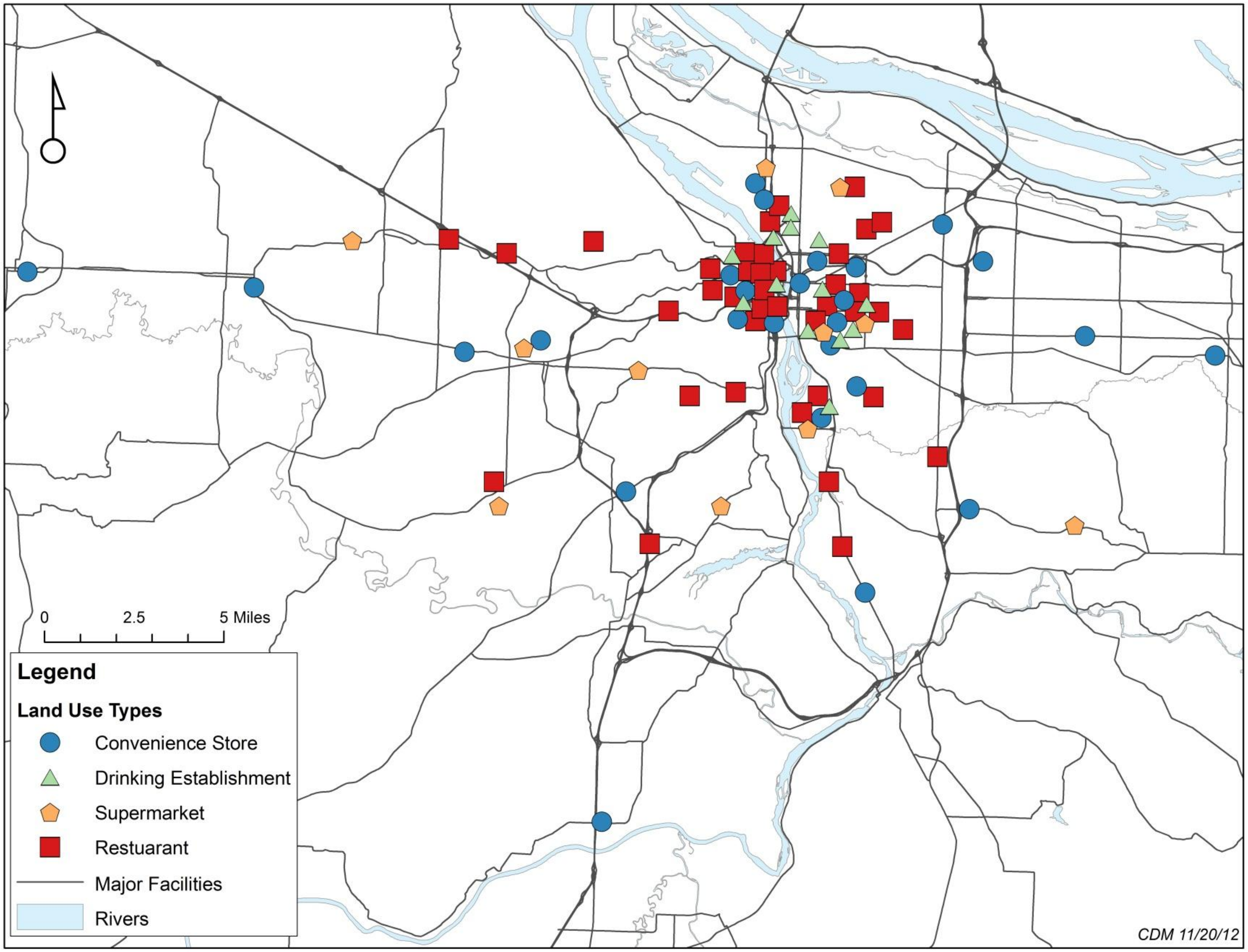

Figure 3-1. Locations of Survey Establishments

CUSTOMER SURVEYS

This section details the survey methodology. Two different survey designs were used for this study: one for collecting information from customers at restaurants, drinking places and convenience stores and another for supermarket patrons. These two surveys will be discussed separately.

Restaurants, Drinking Establishments and Convenience Stores

Intercept surveys were administered by students as customers exited the establishments. Two survey options were offered to patrons. First, a five-minute survey administered via handheld computer tablets was offered. This survey instrument can be found in Appendix A. This “long survey” collected information on: demographics of the respondent and his/her household, travel mode(s), consumer spending behavior, frequency of trips to this establishment, attitudes towards transportation modes, the trip to and from the establishment, and map locations of home, work, trip origin and the following destination.

If a potential respondent refused the long survey, a short survey with four questions was offered as an alternative. This survey instrument can be found in Appendix B. The short survey collected information about: mode of travel, amount spent on that trip, frequency of visits to the establishment, and the respondent’s home location. Gender was recorded by the survey administrator.

Data were collected for restaurants, convenience stores and drinking places in 2011 from June through early October. Because of the relatively small number of establishments surveyed, we controlled for weather by only collecting data on days with favorable conditions. Data collection occurred from 5:00PM to 7:00PM on Mondays, Tuesdays, Wednesdays, and Thursdays, as they are considered “typical” travel days. The 5:00PM to 7:00PM time window was chosen to overlap with the conventional weekday peak hour of automobile traffic (4:00PM to 6:00PM) as well as the estimated peak hour of customer traffic for some land uses.[1]

An average of 24 surveys was collected at each establishment, for a combined total of 1884 surveys (697 long surveys and 1187 short). The long survey had a response rate of 19%. The combined response rate for both the long and short survey was 52%. More detail on sample size is provided in Table 3-2.

[1] Data collected from this study were also used in a study of trip generation rates and thus the research design tried to accommodate the needs of both studies. “The Contextual Influences of Trip Generation” can be found online at: http://otrec.us/project/407.

Table 3-2. Survey Sample Size

Land Use	Establishments (N)	Long Surveys (N)	Short Surveys (N)	Response Rates		Total
				Long Survey	Short and Long Survey	
Drinking places	13	107	108	30%	50%	215
Convenience	26	281	710	14%	61%	991
Restaurants	39	309	369	24%	52%	678
Total	78	697	1187	19%	52%	1884

Demographic characteristics of the long survey respondents are shown in Table 3-3. Long survey data are used to analyze these differences because short survey data do not include customer demographic information other than gender. Overall, more men were surveyed than women and they have the greatest representation among customers who arrive by bicycle, comprising 72%. The average household income of respondents is $68,530. Patrons using the automobile have the highest average income at nearly $81,000 and bicyclists have the lowest average around $46,000. The average age is 37; customers using automobiles are the oldest group on average (39), followed by pedestrians (37), then bicyclists (34), then transit riders (32). On average, bicyclists live with more adults (2.8) but automobile users have more children (0.6). The average ownership of vehicles (bikes and motor vehicles) and possession of transit passes tends to be correlated with their recorded mode of travel. Bicyclists have more bicycles at home, transit riders likely have more transit passes and automobile users tend to have more automobiles.

Table 3-3. Demographic Characteristics and Transportation Mode of Long Survey Sample

	Automobile	Walk	Bicycle	Transit	All Modes
% Male	55%	51%	72%	64%	57%
Average household income	$80,938	$58,796	$46,354	$53,537	$68,530
Average age	39	37	34	32	37
Average number of adults in household	2.1	2.0	2.8	2.3	2.2
Average number of children in household	0.6	0.4	0.4	0.4	0.5
Average number of bikes in household	1.8	1.5	2.6	1.2	1.7
Average number of transit passes in household	0.4	0.5	0.5	0.9	0.5
Average number of automobiles in household	1.9	1.1	1.4	1.3	1.6
N	355	202	75	56	697

Supermarkets

Supermarket data were collected in 2012 for seven consecutive days in April 2012. The eleven grocery stores had similar selection and price points and were located in different urban contexts throughout the region. Patrons were surveyed during the store opening hours (10am to 8pm) for all days of the week, regardless of weather. The data were collected using the same tablet technology as the intercept surveys at convenience stores, high-turnover restaurants, and drinking establishments. The questionnaire used for the survey was streamlined at the request of the management of the stores out of concern about customer burden and privacy (see Appendix C for the survey instrument).

Store employees were provided a survey tablet with a survey application that was developed by the Portland State University team. The survey was administered as customers were completing their shopping transaction or leaving the store. The survey collected the following information:

- Time of day
- Date
- Customer home location
- Mode used to reach the store
- Whether or not the customer was coming from home
- Expenditures for that trip
- Frequency of shopping at that store
- Number of people the purchase was for (for that expenditure amount)
- Gender

Each store obtained approximately 1,500 responses for a total of nearly 20,000 surveys. After removing incomplete surveys, a total of 19,653 responses were eligible for analysis. Using the total number of register transactions for each of the survey days, an approximate response rate was calculated for each day and store location. The ratio of surveys collected to transactions ranged from 6% to 12% for all supermarkets, with an average 10%.

Characteristics and demographic information of the survey respondents are described below in Table 3-4. This survey did not collect demographic information about the consumer or household at the detailed level as the restaurant, bar and convenience store survey. To address this limitation, data from the 2010 U.S. Census and 2009 American Community Survey (ACS) from the block group were used to impute customer socio-economic information. The data from these sources include: the median household income (ACS), the average household size (ACS), and the percentage of people that are non-white (US Census). This imputation approach has limitations in that it assumes customer characteristics can be represented by the average characteristics of residents of their home neighborhoods.

Unlike the respondents surveyed at restaurants, bars and convenience stores, the supermarket patrons surveyed were overwhelmingly women (69%) but similar to the other survey, men have the greatest representation among customers who bicycle (52%). The sample lives in areas with an average median income of around $68,000. Of those surveyed, customers who arrive by car live in the highest median income neighborhoods on average and transit riders live in areas with the lowest. Information about home neighborhood (Census block group) of respondents shows that automobile patrons tend live in areas with more children per household and tend to live in areas that are less diverse than patrons that use other modes.

Table 3-4. Demographic Characteristics of Supermarket Sample

Attribute	Auto-mobile	Walk	Bike	Transit	All Modes
% Male	30%	39%	52%	39%	31%
Median income of home neighborhood[1]	$66,742	$53,960	$53,428	$52,288	$64,722
Avg. household size of home neighborhood	2.4	2.1	2.1	2.2	2.4
Avg. % non-white residents of home neighborhood	18%	17%	20%	22%	18%
N	17,130	1,653	637	204	19,653

[1]Home neighborhood corresponds to the Census block group of the respondent's residential location.

BUILT ENVIRONMENT DATA

Built environment information was gathered directly from the establishment sites (see Appendix D) and assembled from archived data sources. The archived information was assembled within a ½ mile radius (Euclidean distance) from each establishment location. The measures that were included in this study are described in detail below.

Several built environment features that are influential in travel choices, as informed by the literature, were considered in our analysis. We also considered some mode-specific attributes to measure amenities for walking and bicycling. Built environment features were measured at a ½ mile buffer around each establishment.[2] Neighborhood-level built environment characteristics were collected from US Census Bureau files and from RLIS (Regional Land Inventory System), the geographic data library for Metro, the regional government agency for the Portland area. The built environment variables are defined below in Table 3-5 and averages for the sample of business establishments included in this study are summarized in Table 3-6.

Population density: A variable that describes the number of residents per acre.

Employee density: A variable that describes the number of employees per acre.

Lot coverage: The percent of tax-lot parcel area covered by building footprints. This measure is a proxy for parcel setbacks and is calculated for all parcels within the establishment buffer.

Distance to rail: Direct distance in miles to nearest light rail station.

Intersection density: Number of 3+ leg intersections within the buffer zone.

Housing type mix: Percentage of housing units within the buffer zone that are single family.

Lane miles of low stress bikeways within 0.5 miles: The total length in lane-miles of multi-use paths, enhanced bike lanes, cycle tracks, bike boulevards, low-traffic streets, and streets with bike lanes and speeds under 35 miles per hour.

No Parking lot: A binary variable that indicates the presence of a parking lot.

[2] Water features were excluded from all calculations when water fell within the ½ mile buffer

Establishment is in shopping center: A binary variable that indicates if an establishment is located within a shopping center. Shopping centers as defined as strip mall-type developments with at least three stores. These are different than urban shopping districts.

Distance to nearest "low traffic" street: The straight line distance to the nearest street with no designated bikeway and posted speeds less than 25 miles per hour.

Length of "high traffic" bike facilities within 0.5 miles: The length in miles of roads with bike lanes and posted speed limits greater than 35 miles per hour within 0.5 miles.

Presence of bike corral within 200ft of establishment: A bike corral typically has 6 to 12 bicycle racks in a row, often replaces on-street automobile parking and can park 10 to 20 bicycles. This uses space otherwise occupied by one to two cars. This variable is a binary variable that indicates if the establishment has a bike corral within 200ft of the entrance.

Number of bicycle parking sports on site + adjacent street: A count of the number of bicycle parking spots on the street immediately serving the establishment and the adjacent street. The measure is calculated for the number of bicycles that could be parked, i.e. a bike parking staple has two bike parking spots.

Table 3-5. Built Environment Measures and Sources

Measure	Units	Data Source*
Population density	Residents per acre	Multifamily/Household layers (RLIS, 2010)
Employment density	Employees per acre	ESRI Business Analyst (2010)
Lot coverage	Percent	Tax lot and Building Layers (RLIS, 2010)
Distance to rail station	Miles	Light-rail Stop layer (RLIS, 2010)
Intersection density	# Intersections	Lines file (TIGER 2009)
Housing type mix	Percent single family	Household layer (RLIS, 2010)
Quantity of low stress bikeways	Lane-miles	Bike Route layer (RLIS, 2010)
No Parking lot	Binary	Site visits
Establishment is in shopping center	Binary	Site visits
Length of “high traffic” bike facilities within 0.5 miles	Miles	Bike route layer (RLIS, 2010)
Distance to nearest “low traffic” street	Miles	Bike route layer (RLIS, 2010)
Presence of bike corral	Binary	Site visits
Number of bicycle parking spots	Number of parking spots	Site visits

* RLIS: Regional Land Information System, Portland Metro.

Table 3-6. Average Site Characteristics of Establishments

Site attribute	Supermarket N= 11	Convenience Store N = 26	Bar/Restaurant N = 52	All N = 89
Population density (people per acre)	7.9	11.9	14.7	13.0
Employee density (employees per acre)	3.4	16.0	23.3	18.7
Lot coverage (%)	19%	25%	30%	27%
Distance to rail (mi)	1.5	1.7	1.3	1.5
Intersection density (# intersections)	13.0	15.1	18.1	16.6
Housing type mix (% single family detached)	55%	46%	43%	46%
Quantity of low stress bikeways (mi)	2.8	2.0	2.3	2.3
No parking lot	0%	4%	52%	32%
Establishment is in a shopping center	55%	12%	25%	25%
Length of "high traffic" bike facilities within 0.5 miles	.33	.27	.24	.26
Distance to nearest "low traffic" bike facility(mi)	0.20	0.20	0.21	0.21
Presence of bike corral within 200'	0%	12%	16%	13%
Bike parking spots	25	2.5	11	10

Restaurants and bars tend to be located in areas with the highest population and employment densities, on average, and have the most bike corrals. Supermarkets are located in the areas with the lowest densities. Average distance to rail, intersection density, and miles of low stress bikeways are all similar across establishment types. Supermarkets are usually located in shopping centers; however, they also provided the most bike parking.

The various built environment factors identified as most influential in the travel behavior literature are highly correlated. Places of high population and employment density also have good transit access, diverse mixing of housing and land use types, and pedestrian-friendly environments. Table 3-7 shows Pearson correlations (*r*) between the main built environment factors related to travel from the literature for the 89 establishments in this study. All of the measures are significantly correlated at 99.9% confidence. The high correlations between the measures cause multicollinearity issues in regression analysis models, so in the following section we typically will use just one or two of the measures as a proxy of the overall built environment.

Table 3-7. Correlations between Built Environment Measures

Built Environment Measure		Population Density	Employment Density	Lot Coverage	Distance to Rail	Intersection Density	Housing Mix
Population Density	*r*						
Employment Density	*r*	0.61*					
Lot Coverage	*r*	0.75*	0.80*				
Distance to Rail	*r*	-0.40*	-0.34*	-0.40*			
Intersection Density	*r*	0.72*	0.55*	0.84*	-0.46*		
Housing Mix	*r*	-0.65*	-0.69*	-0.61*	0.30*	-0.38*	

*significant at $p < 0.01$

SUMMARY

This chapter outlined the data collected at the restaurants, bars, convenience stores and supermarkets, comprising 89 unique business locations in the Portland Metropolitan area. The survey methodology includes two distinct survey designs.

The approach for bars, restaurants and convenience stores intercepted customers exiting the establishments from 5-7PM on Mondays through Thursdays and gave respondents two survey options – 1) a “long” survey instrument administered by students using computer tablet technology and inquiring about demographics, origin and destinations, transportation choices, amount spent and frequency of visits, and 2) a “short” survey instrument administered by students using a paper survey that asked respondents about their home location, mode of transportation, amount spend and frequency of visits.

The survey design for supermarkets intercepted customers at the checkout counter and was administered by store employees using a computer tablet. The tablet survey asks a short set of questions about transportation choices, frequency of visits, amount spent on that visit, the number of people included in that expenditure, gender, whether this was a home-based trip and home location.

These data are augmented by built environment information at a ½ mile buffer around each establishment. The data are pooled, where possible for analysis of mode shares at the establishment level and spending per visit at the individual customer level. The results of this analysis are included in the next chapter.

Chapter 4 Analysis and Results

In this chapter, the data are analyzed to understand the connections between mode of travel, frequency of trips, and spending at restaurants, bars, convenience stores, and supermarkets. In the first section, summary statistics are reported. Here, the analysis considers only a few elements and often presents averages. It is important to examine and control for the various characteristics and conditions that contribute to the consumer behaviors and mode choices of interest. As such, the second section presents the results of multivariate models that help better interpret and explain the relationships between the various choices and associated factors. The first set of models estimates mode shares of bicyclists and non-automobile travelers at the establishment level, and the second set estimates spending per trip at the individual level for different establishment types.

SUMMARY STATISTICS

This section details observed travel behavior and consumer spending data from customers at establishments described in the previous chapter. We describe differences between travelers, mode shares, trip lengths, trip frequencies, and spending behavior by establishment type. Unless otherwise noted, the supermarket data reported in this section refer to the entire seven day, 10AM – 8PM sample; reported data from convenience stores, drinking establishments, and high-turnover restaurants refer to the Monday through Thursday 5PM – 7PM sample.

Mode Shares

Figure 4-1 shows the observed mode shares[3] by each establishment type. The automobile is clearly the dominant mode for customers across all establishments and transit is the least used mode.

Supermarkets see the most use of the automobile, with 86% of trips made by private vehicle. This is likely due to the nature of grocery shopping: stores are typically located on arterial streets, shoppers purchase goods they have to transport, and the volume of goods purchased is typically greater than at convenience stores, restaurants, and drinking places. Drinking places have the lowest automobile mode share of the four business types surveyed. Only 43% of patrons arrive by automobile.

Of the non-automobile modes, walking has the highest mode share across land uses. Walking rates are highest for convenience stores and drinking places, both with 27% mode share. Restaurants have a 22% walk mode share and supermarkets have 9% of patrons as pedestrians. Bicycling is most popular at drinking establishments, where 22% of patrons arrive by bike. Restaurants, convenience stores, and supermarkets have 8%, 7%, and 4% bike mode share, respectively. Transit use is fairly consistent across convenience stores (6%), restaurants (6%) and drinking places (7%), but only 1% of shoppers at supermarkets arrived by transit.

[3] Calculated from all data for supermarkets; calculated from long and short surveys for drinking places, high-turnover restaurants, and convenience stores.

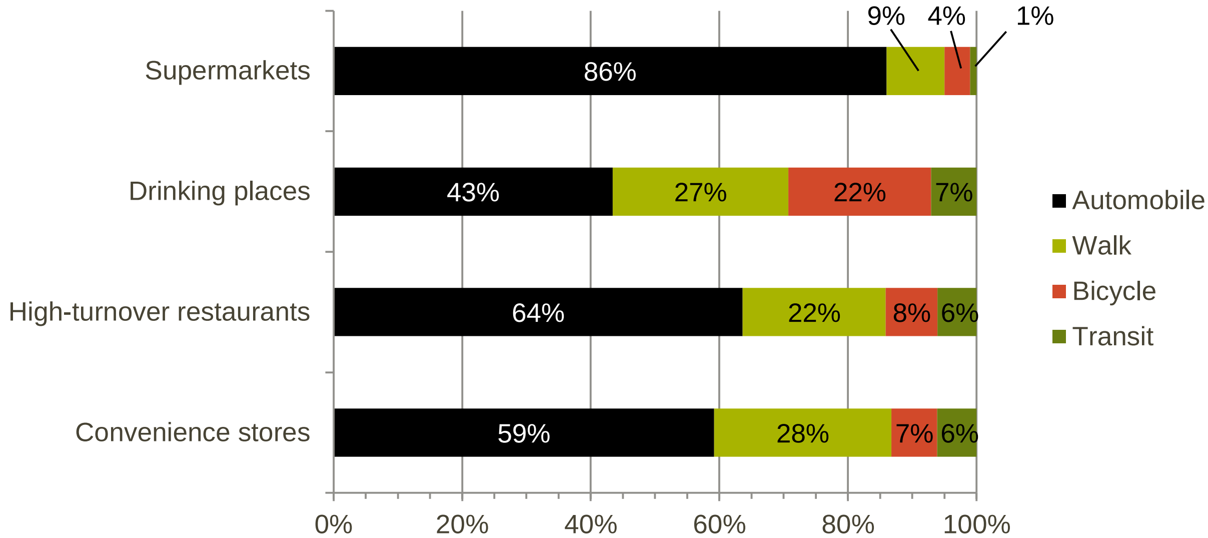

Figure 4-1. Observed Mode Share

Figure 4-2 shows the mode shares for all establishments surveyed in a spatial context.[4] Automobile mode shares are generally lower in establishments closer to the city center. There is variation in automobile mode share in the inner east side of Portland where neighborhoods transition from urban to suburban. Establishments located near light rail lines have higher transit mode shares than sites that are not.

Trip Length Distribution

Trip lengths are important for study because they lend insight to travel options. By examining trip lengths we can determine the capture area of establishments in the study. Also, short vehicle trips are believed to be more readily substituted with walking and cycling. The trip lengths for the business types in this study can give some insight into the “20 minute neighborhood”—the City of Portland’s concept for neighborhoods to have basic amenities within comfortable walking and bicycling distance. Comparing these differences also suggests how far customers are willing to or are required to travel to access certain destinations.

In Figure 4-3, the trip length distribution (network distance) of origin to the establishment is shown for each of the business types. Data for convenience stores, restaurants, and drinking establishments come from the long survey, and supermarket data are shown for trips from home (that questionnaire did not collect information on the location other trip origins). All of the business types have the greatest percentage of customers traveling less than a mile to access each destination. Convenience stores, almost by definition, have the highest concentration of short trips with over 50% of customers traveling less than a mile. Restaurants and supermarkets have somewhat distributions, with the lowest percentage of customers (around 30%) traveling less than one mile.

[4] Calculated from all data for supermarkets; calculated from long and short surveys for drinking places, high-turnover restaurants, and convenience stores.

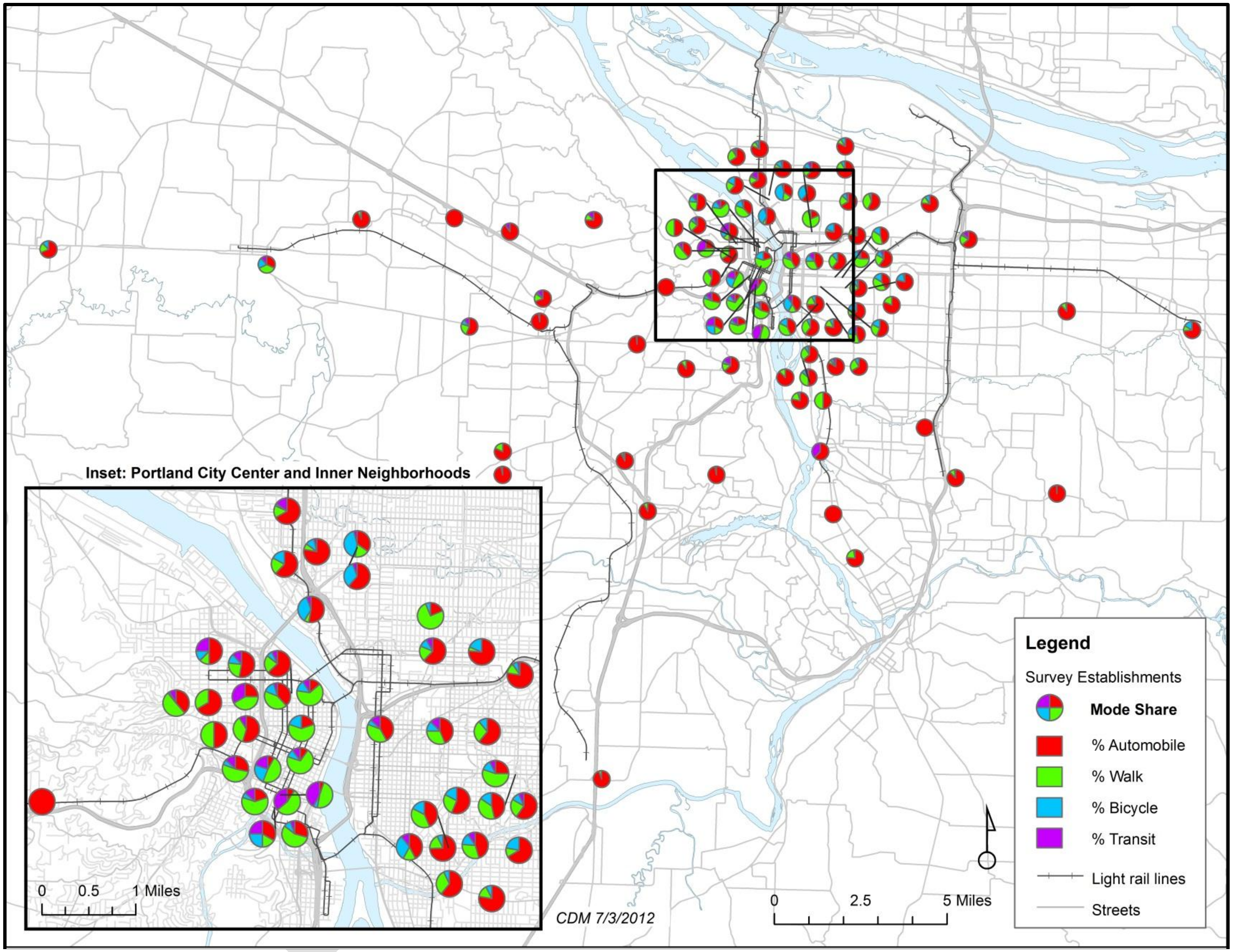

Figure 4-2. Mode shares of Survey Establishments

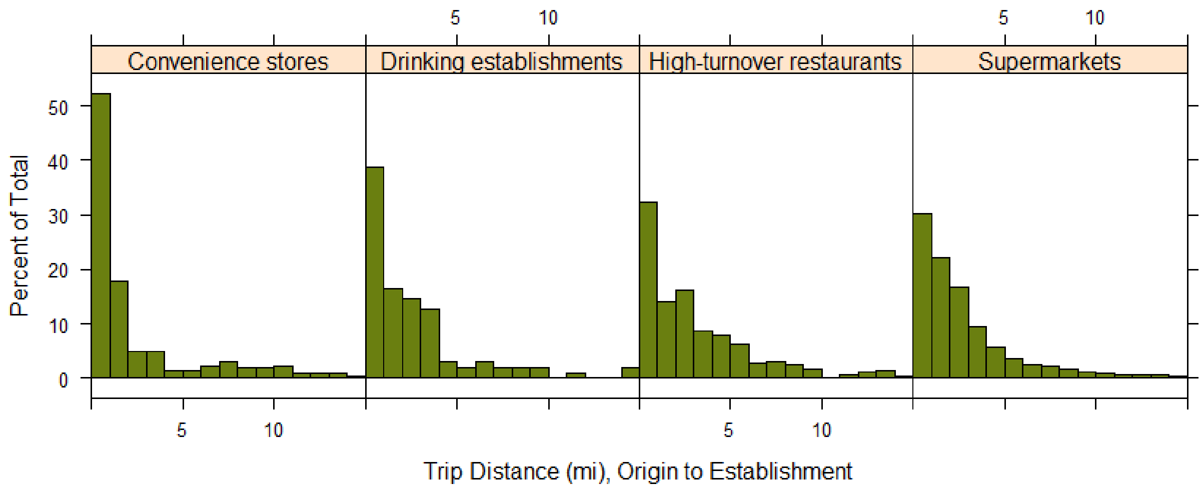

Figure 4-3. Trip Lengths, Origin to Establishment

Table 4-1 shows the percentage of trips less than three miles for each establishment type and travel mode. Automobile and transit modes have the smallest proportion of shorter trip lengths across all establishment types. Walking and bicycling have the largest proportions of trips shorter than three miles at all land uses. At least 87% of walking trips are shorter than 3 miles. Bicyclists travel shorter distances to convenience stores (85% bicycle trips less than 3 miles) and supermarkets (91% bicycle trips less than 3 miles) than drinking establishments (68% bicycle trips less than 3 miles) and restaurants (58% bicycle trips less than 3 miles). This may be due to the need to carry goods purchased at convenience stores and supermarkets.

Table 4-1. Percentage of Trips Shorter than 3 miles

Travel Mode	Convenience Stores	Drinking Establishments	High-turnover Restaurants	Supermarkets
Automobile	59%	57%	50%	62%
Walk	94%	87%	89%	98%
Bicycle	85%	68%	58%	91%
Transit	42%	50%	35%	48%
All Modes	72%	67%	59%	68%

Figure 4-4 shows the average trip distance by mode of travel and establishment type.[5] Transit riders travel the farthest, on average, for all destinations, followed by automobile users. Not surprisingly, walking trips tend to be shorter than bicycling, transit, and automobile trips. In fact, pedestrians travel longer distances, on average, than the ¼ mile "rule of thumb", commonly used in planning. Bicyclists travel shorter distances, on average, to supermarkets and convenience stores than restaurants and drinking establishments. Again, this may be due to the burden of carrying purchases.

[5] Calculated from all data for supermarkets; calculated from long and short surveys for drinking places, high-turnover restaurants, and convenience stores.

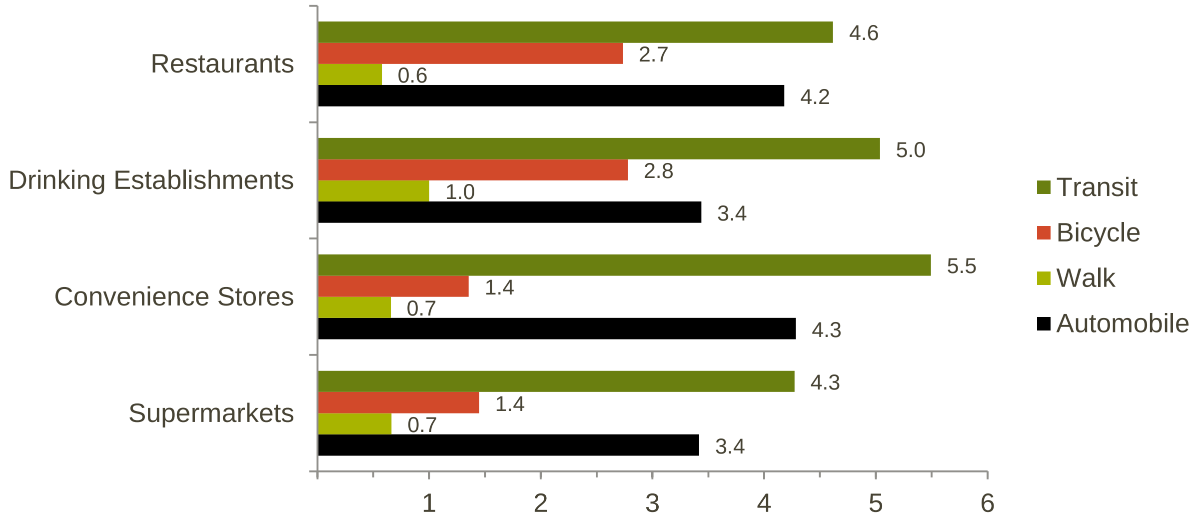

Figure 4-4. Average trip distance from origin to establishment

Consumer Spending and Trip Frequency

Figure 4-5 shows the average expenditures that patrons made on the day surveyed by mode and establishment type. Figure 4-6 shows the frequency of visits.

Table 4-2 shows these statistics along with an estimate of monthly spending, which is also shown graphically in Figure 4-7.[6] Note that the average expenditures per month reported in this table are based upon the average of the disaggregate expenditures per trip multiplied by the reported frequency of visits for each person surveyed. They are not calculated based upon the average values in the table.

At supermarkets, patrons that arrive by automobile spend the most – around $57 on average, compared to $31 for pedestrians, $37 for bicyclists and $36 for transit riders. However, when the expenditures per month are considered, these differences are less pronounced. Patrons that arrive by non-motorized and transit modes make more frequent trips than those who use a private vehicle. Pedestrians visit the grocery store most frequently, averaging almost 13 trips per month. Customers who arrived via bicycle make over 9 monthly trips on average, those arriving via transit make nearly 8 trips, and patrons arriving by automobile visit less than 9 times per month. When trip frequency is accounted for, monthly expenditures by mode are different, with pedestrians spending the most, followed by automobile users, then bicyclists and transit users. These differences are likely due to a variety of factors, most notably the greater ability to haul goods in an automobile on a per trip basis.

[6] We assume that the dollar amount spent at the time of data collection is the same every time that person shops at that establishment, and multiply dollar amount spent by number of trips per month to get estimated spending per month. We assume that a "daily" trip frequency relates to approximately 25 trips per month, and frequencies of "a few times a week," "once a week," "few times a month," "once a month," and "less than once a month" would relate to 13, 5, 3, 1, and 0.25 trips per month. Long survey and supermarket data were used.

The trend is different for other establishment types. For convenience stores, where goods are also purchased, although usually in smaller quantities than supermarkets, bicyclists spend the most per trip, averaging almost $8, and the most per month, averaging over $81. Pedestrians travel to the convenience store most frequently, with an average of 11 trips to the store per month, but tend to spend less per visit than customers arriving by other modes.

For drinking places, many of which also serve food, pedestrians spend the most per trip, with an average of over $22 per trip, perhaps suggesting that those that want to consume more alcohol opt not to drive. Bicyclists spend the most per month, almost $82, despite spending the least per trip, just under $17. This difference is largely due to their greater frequency of visits - five times per month. Patrons who use transit have a similar frequency as bicyclists but spend the least on average per month – just over $36.

Transit users frequent high-turnover restaurants more often than others, making almost 8 trips per month and expending an average amount of nearly $50 over that time. Patrons that use an automobile make the fewest number of trips, averaging only 2.5 visits per month, but spend the most per trip – over $19 per trip. Bicyclists spend the least per trip but come almost as frequently as transit users, making them the second highest spending group per month.

These variations across modes and establishment types are due to a complex set of factors, including income, gender, group size and other social and demographic characteristics of consumers. In the regression analyses to follow, we control for these factors to explore the relationships between modes and expenditures in more depth.

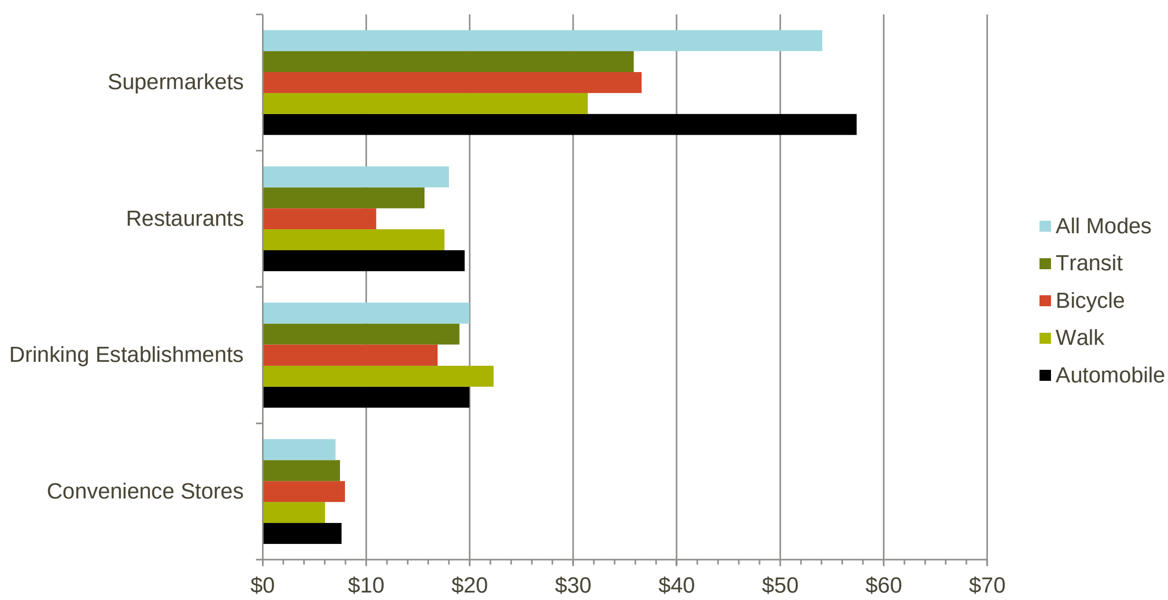

Figure 4-5 Average Consumer Expenditures per Trip

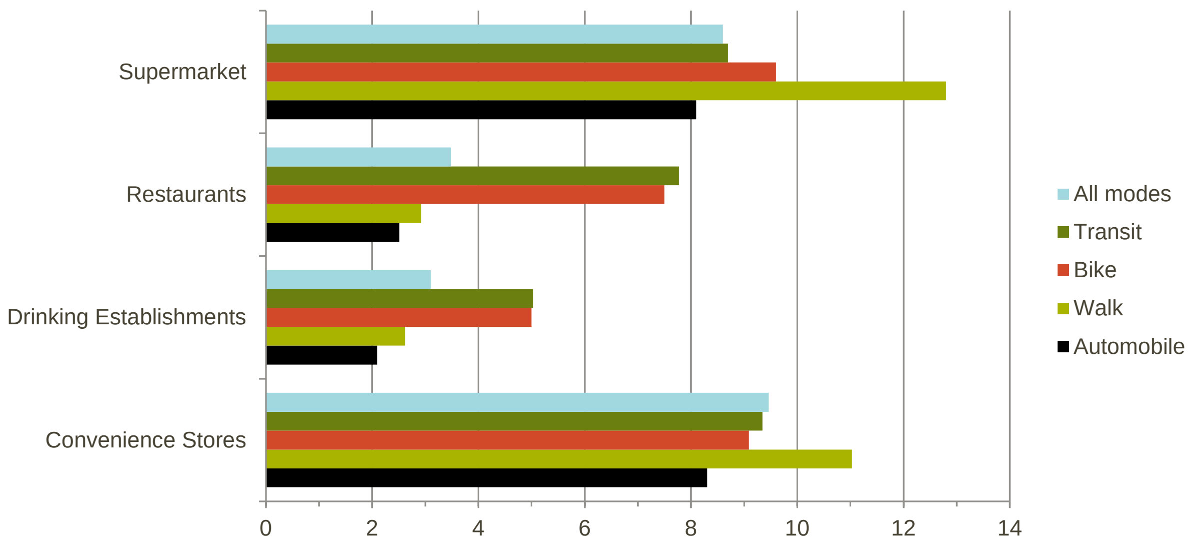

Figure 4-6 Average Consumer Trips per Month

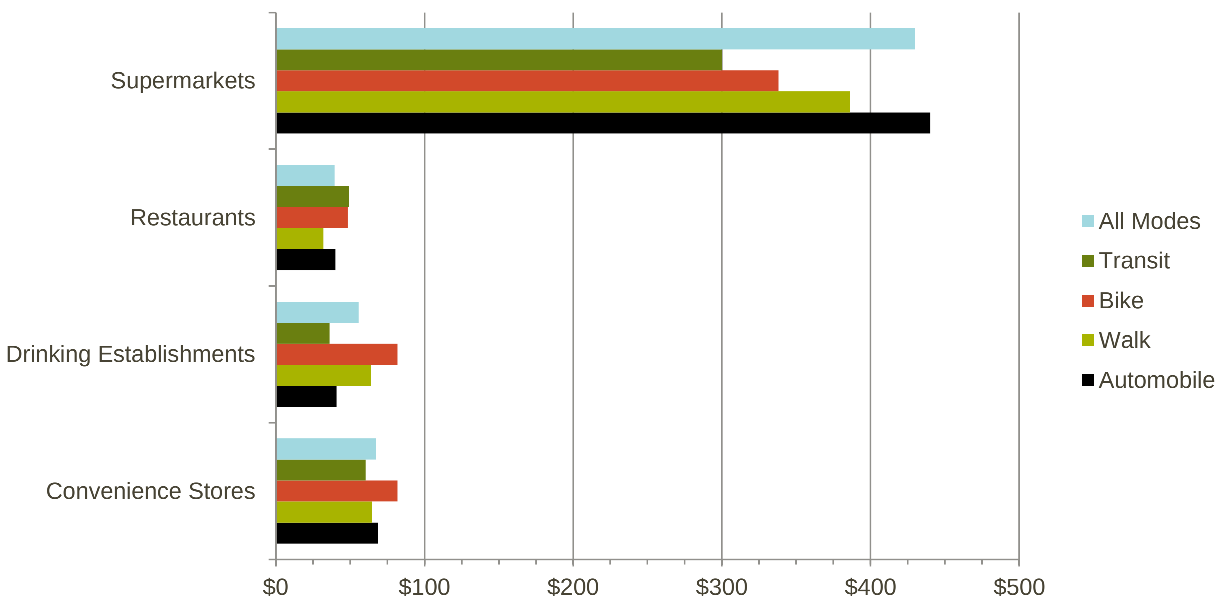

Figure 4-7 Estimated Average Spending per Month

Table 4-2 Consumer Expenditures and Frequency of Trips

		Average spending per trip	Average trips per month	Estimated spending per month[7]	N
Convenience stores	Walk	$6.02	11.0	$64.81	96
	Bike	$7.95	9.1	$81.76	19
	Transit	$7.46	9.3	$60.37	26
	Automobile	$7.61	8.3	$68.95	119
	All modes	$7.03	9.5	$67.50	260
Drinking places	Walk	$22.30	2.6	$63.94	30
	Bike	$16.90	5.0	$81.90	20
	Transit	$19.00	5.0	$36.25	8
	Automobile	$19.98	2.1	$40.78	41
	All modes	$19.98	3.1	$55.74	99
High-turnover restaurants	Walk	$17.56	2.9	$32.01	64
	Bike	$10.97	7.5	$48.40	29
	Transit	$15.64	7.8	$49.39	14
	Automobile	$19.52	2.5	$40.06	174
	All modes	$18.00	3.5	$39.55	281
Supermarkets	Walk	$31.42	12.8	$386.18	1620
	Bike	$36.61	9.6	$337.83	627
	Transit	$35.86	8.7	$300.58	195
	Automobile	$57.39	8.1	$440.19	15452
	All modes	$54.06	8.6	$429.98	17919

[7] The average expenditures per month are calculated by taking the average over the sample of the individual expenditures per trip multiplied by the frequency of visits. They are not calculated from the average values in the table.

MODELS OF MODE SHARES AT THE ESTABLISHMENT LEVEL

In this section, we estimate ordinary least squares (OLS) regression models to examine the built environment characteristics on and around the business location site associated with mode shares at the establishment level. For each of these models, data for all establishments are pooled; convenience stores, restaurants, drinking places, and supermarkets are all evaluated together. The data used in this estimation were collected between Mondays – Thursdays from 5-7 PM.

Bicycling Mode Share Model

What aspects of the built environment are associated with bicycling mode shares at the establishment level? This is the question we seek to answer with this analysis.

The percent of customers arriving by bicycle at each establishment is the dependent variable in the OLS regression model estimated here. We examine various built environment characteristics associated with bicycling. Model results are shown in Table 4-3, and the contributions of significant predictors are illustrated in Figure 4-8. The contributions in Figure 4-8 can be interpreted independently, i.e. each horizontal bar is independent of the other factors shown in the chart.

Drinking establishments are a binary variable included in the model because their bicycle mode shares are significantly greater than those of restaurants, convenience markets, and supermarkets. In other words, the characteristic of a business being a drinking place on its own is significantly associated ($p<0.01$) with a bicycle mode share 13% higher than the other types of businesses included in the study.

Generally, intersection density is considered a measure of the connectivity of a street network and represents the availability of direct and multiple routes. Intersection density is also important to consider because it is highly correlated with other built environment features and serves as a proxy for the overall built environment character of a neighborhood. For the establishments in the study, places with high intersection density also had high population and employment density, proximity to light rail, access to frequent bus transit, and high ratios of building to lot coverage, as explained in the previous chapter. The positive coefficient on the intersection density variable indicates that bike mode share increases as density increases in the neighborhood surrounding the establishment.

The length of high traffic bike facilities (roads with bike lanes and vehicular traffic speeds greater than 35 miles per hour – which are less safe and accommodating to cyclists than those on "low" stress facilities) within 0.5 miles of the establishment is also a significant ($p<0.05$) predictor of bicycle mode share: for every additional mile of high traffic streets within a 0.5 mile radius of the establishment, bike mode share reduces by 1%. These facilities typically have moderate to high volumes of vehicle traffic and although they have a bike lane, they may be stressful for inexperienced cyclists.

The distance from the establishment to the nearest low traffic street (no designated bikeway, speeds less than 25 miles per hour) has a negative relationship with bike mode share: one additional mile away from a low traffic street results in an estimated 4% reduction in bike mode share. This result suggests that proximity to calm, quiet streets for bicycling is an important characteristic for bicycling mode shares. However, this result is not independently a significant predictor of bike mode share.

Also significant were variables representing bicycle parking provision. If the establishment has a bike corral within 200 feet of the building, the model estimates a 7% increase in bike mode share. Bicycle parking (calculated as the number of bicycle parking spaces on-site and on the adjacent street, excluding those in bike corrals) is also a significant independent predictor of bicycling mode share: every 10 bicycle parking spaces provided is related to a 1% increase in bike mode share.

Table 4-3. Model results: bicycling mode share at establishment level

Independent variable	b	ß	t
Intercept	0.011		0.59
Establishment characteristics			
Establishment is a drinking place (binary)	0.094	0.38	4.85***
Built environment characteristics			
Intersection density	0.004	0.32	3.31***
Bicycling network characteristics			
Length (lane-miles) of high traffic streets within 0.5 mi	-0.012	-0.16	-1.83*
Distance (miles) to nearest low traffic street	-0.036	-0.10	-1.38
Presence of a bike corral within 200ft of establishment (binary)	0.071	0.27	3.31***
Number of bicycle parking spots on site + on adjacent street / 10	0.007	0.14	1.78*
Overall model statistics			
N		89	
R^2		0.59	
Adjusted R^2		0.56	
Standard error of the estimate		0.06	

*significant at $p < 0.10$; **significant at $p < 0.05$; ***significant at $p < 0.01$

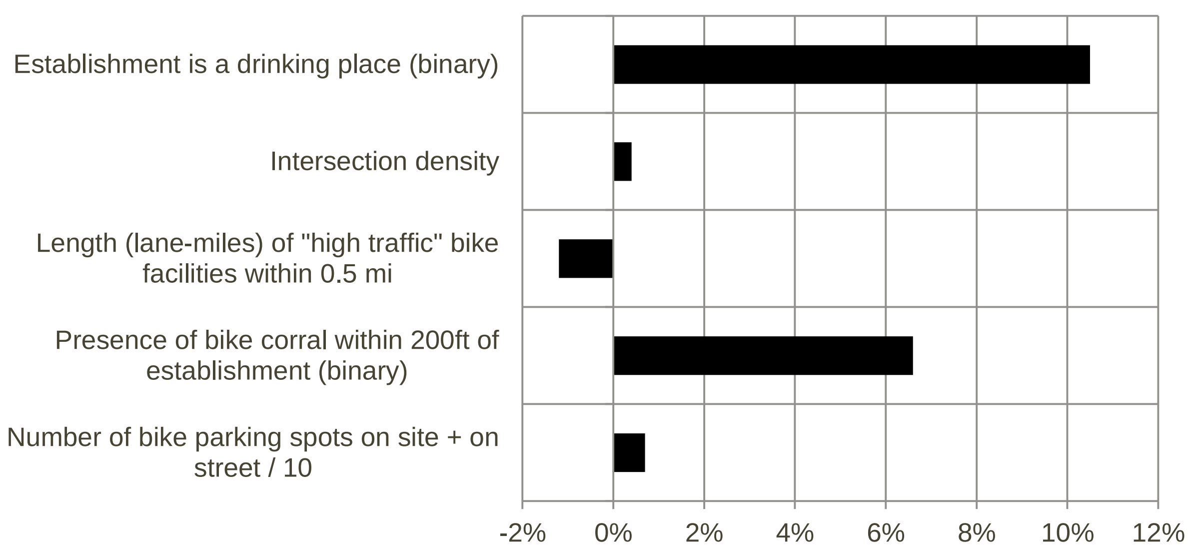

Figure 4-8. Bicycle mode share model results

Non-automobile Mode Share Model

Similar to the bicycling mode share model, here an ordinary least squares regression model was estimated with the percent non-automobile mode share (i.e. bicycling, walking, and transit modes combined) as the dependent variable. Table 4-4 presents the model results and Figure 4-9 illustrates the effects of independent variables in the same manner as the bicycling mode share section.

Controlling for the type of business shows that these land uses exhibit a significantly different level of automobile mode share than the other land uses in study. Supermarkets are associated with a non-automobile mode share that is 15% lower than other business types, likely due to the nature of grocery shopping.

The proportion of single-family detached housing is a measure of the density of housing in the area and the mix of housing types (single family, apartments and condominiums). The coefficient on this variable indicates that as amount of single family housing around the establishment increases, the non-automobile mode share decreases.

If the store is located in a shopping center, then predicted non-automobile mode shares are 19% lower than stores that are not. Shopping centers typically have high levels of automobile accommodation, including abundant parking, locations near busy arterials and site orientations with poor pedestrian and bike circulation.

The density of low stress bikeways (multi-use paths, enhanced bike lanes, cycle tracks, bike boulevards, low-traffic streets, and streets with bike lanes and speeds under 35 miles per hour) within a 0.5 mile radius of the establishment is a significant predictor of non-automobile mode share: for every additional mile of these facilities within 0.5 mile of an establishment, the non-automobile mode share increases 4%. This result is not surprising because streets with amenities that cater to bicyclists also tend to also accommodate pedestrians.

Proximity to light rail is also a significant predictor. For each additional mile a business is located away from a rail station results in a 2% reduction in non-automobile mode share, on average. If the establishment does not have an exclusive or shared parking lot, the model results indicate an 8% increase in non-automobile mode share at 90% confidence. Overall, the model suggests that businesses located in areas that provide transportation options catering to all types of travelers, not just automobiles, will see greater shares of traffic from pedestrians, bicyclists, and transit riders.

Table 4-4. Model results: non-automobile mode share at establishment level

Independent variable	b	ß	t
Intercept	0.533		10.65***
Establishment characteristics			
Establishment is a supermarket (binary)	-0.150	-0.20	-2.73**
Built environment characteristics			
% housing as single family detached within 0.5 mi	-0.004	-0.42	-5.80***
Establishment is in a shopping center (binary)	-0.190	-0.33	-4.49***
Transportation characteristics			
Lane-miles of low stress bikeways within 0.5 mi	0.038	0.18	2.43**
Straight-line distance (miles) to nearest light-rail station	-0.023	-0.16	-2.25**
No parking lot (shared or exclusive—binary)	0.078	0.15	1.98*
Overall model statistics			
N		89	
R^2		0.65	
Adjusted R^2		0.62	
Standard error of the estimate		0.15	

*significant at p < 0.10; **significant at p < 0.05; ***significant at p < 0.01

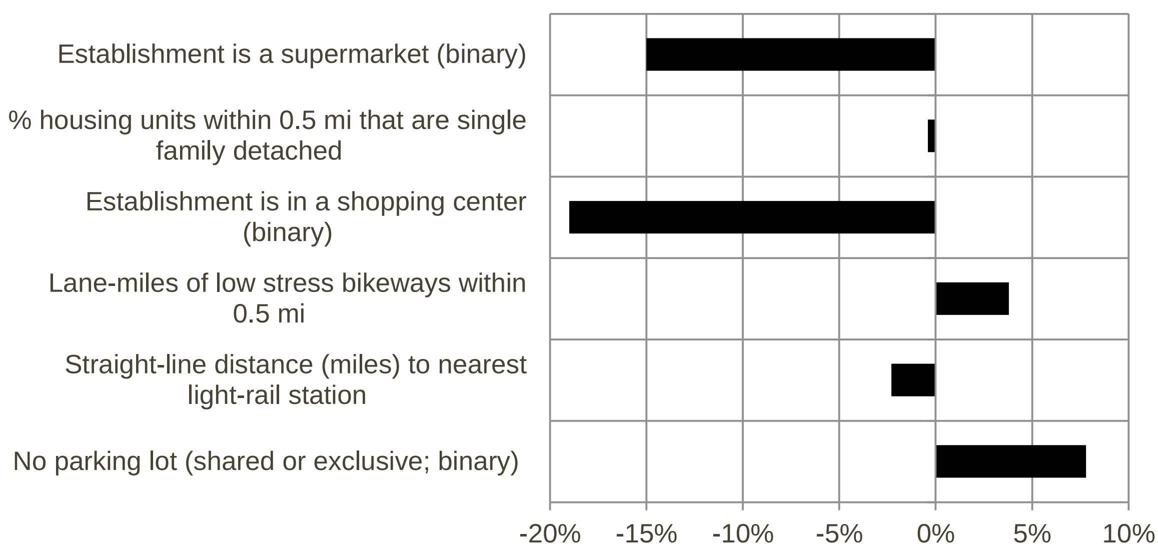

Figure 4-9. Non-automobile Mode Share Model Results

MODELS OF SPENDING AT THE INDIVIDUAL LEVEL

In this section, we aim to explain the differences in customer spending and explore the various characteristics of the customer and the business that contribute to these differences. To do this, we control for socio-demographics, the attributes of the customer experience and characteristics of the establishment to investigate their relationship to the amount that each customer spends per trip. The results of an ordinary least squares regression model estimation for restaurants, drinking establishments, convenience stores, and supermarkets are shown in Table 4-5.

The dependent variable for the estimations is the log transform of spending per trip for each customer. The customer spending is log-transformed[8] to better fit a normal distribution. Because of this transformation, the coefficients for independent variables are not easy to interpret. Thus we interpret the unstandardized regression coefficient of a particular independent variable (represented by B) as the predicted impact on amount spent per trip in percent, S, given by:

$$S = 10^{B*\Delta x} \quad (1)$$

where Δx is the change in the independent variable. This interpretation provides the sensitivity of money spent per trip to an incremental change in any independent variable. In discussion, we consider a unit change of one. Binary variables are interpreted by comparing to the base case. The base case for each of the binary variables is: gender = female; age = under 25; no children in the household; mode = automobile; trip frequency = "less than once per month"; restaurant type = pizza or bar (restaurant and bar model only); purchase time of day = afternoon (supermarket model only); purchase day = weekday (supermarket model only); store = store #8 (supermarket model only).

Spending per Trip at Restaurants and Drinking Establishments

We consider the consumer and travel behavior for restaurants and drinking establishments together because of the similarities in the nature of activities at these locations. Many of the drinking places also sell food and many of the restaurants sell drinks. The goods purchased are most commonly consumed on site. Thus, non-automobile modes are not disadvantaged by the lack of carrying capacity. Combining these land uses is confirmed statistically by an analysis of variance that showed average spending per trip was not significantly different between restaurants and drinking establishments.[9]

The model for restaurants and drinking establishments yields the following set of significant explanatory variables: presence of children in the household, household income, time spent in the establishment, the group size, and whether the establishment is a Mexican restaurant. Survey respondents report spending amounts anywhere from \$2 to \$150 at restaurants and bars.[10] The effects of the individual coefficients on amount spent are illustrated in Figure 4-10.

In terms of customer demographics, the presence of children in a patron's household has a significant impact on how much they spend: people with children spend an estimated 13.3% less than those without. Household income was also a significant predictor of spending per trip, but the impact was relatively small – for every additional \$10,000 in household income, respondents are expected to spend an estimated additional 1.6% at the establishment. Respondent gender, age, and household size are included in estimation but are not significantly associated with spending.

In terms of travel, no particular mode is significantly associated with spending, meaning that the patron's mode of transportation does not influence the amount spent once we control for other

[8] A logarithmic transform with a base of 10 was used.
[9] F(1,380) = 1.40, p-value = 0.237
[10] The 25 customers who spent either zero or over 150 dollars were excluded from analysis.

factors. Trip distance is also not a factor, and neither are the interactions between trip modes and distances. This result suggests that regardless of travel modes or distances, pedestrians, bicyclists, transit riders, and automobile users all spend similar amounts per trip on average, all else equal.

The variable with the greatest impact on restaurant expenditures is group size. Each additional person in a group is associated with a 59% increase in spending, on average. The amount of time spent at the establishment is also an independent predictor of spending – each minute in a restaurant or bar is associated with a 1% increase on the bill.

Travel frequency differences from the "less than once per month" category are not significant predictors of spending at restaurants and bars, but the signs and magnitudes of the coefficients for frequent travelers (visits a few times per week and visits daily) indicate reduced spending for each visit by regular customers compared to infrequent customers. Respondents spend an average of 15.6% more at Mexican restaurants than at pizza restaurants and drinking establishments.

Spending per Trip at Convenience Markets

The model of consumer spending per trip for convenience stores follows the same specification with the exception of a binary variable for Mexican restaurants. The set of significant explanatory variables includes: gender, age, the number of adults in the household, the time spent in the establishment, group size, and the travel frequency. Respondents with spending amounts between $1 and $50 at convenience stores were included in the analysis.[11] The effects of a unit increase in each of the significant variables on amount spent are illustrated in Figure 4-11.

In terms of customer demographics, respondent gender is a significant predictor of spending: women spend an estimated 18.5% more in convenience markets than men. Also, customers between 25-34 years old spend 38% more than patrons of other ages. The number of adults in the household is associated with more spending, on average – 9.6% more is spent for every additional adult. Unlike the spending model at restaurants and bars, household income and presence of children are not significant predictors of spending at convenience stores.

Like the spending model at restaurants and bars, no trip characteristics—travel modes, distances, and interactions of the two—are significantly related to spending per trip. This again suggests that all customers spend similar amounts per trip at convenience stores regardless of their travel mode or trip distance. Surprisingly, this indicates that the need to carry items purchased at convenience stores does not translate into lower spending amounts for non-automobile travelers. Perhaps the generally small quantity of goods purchased at these stores is not enough to have an effect.

Like the spending at restaurants and bars model, the amount of time spent at the establishment is an important indicator of spending – each minute spent in the store yields an additional 3.5%

[11] The13 respondents who spent either zero or more than 50 dollars were considered outliers and were not included in the analysis.

spent on average. Group size here is also significant. Each additional person in a group is related to a 13% increase in spending, which is unsurprising if the customer is buying goods for multiple people. Just one travel frequency category is significantly different than the base case. Customers who shop a few times per week are associated with spending amounts 54% higher than infrequent shoppers at convenience stores.

Spending per Trip at Supermarkets

The supermarket spending analysis, similar to those for convenience stores, restaurants, and bars, included variables describing the nature of the trip—frequency, mode choice, and time of day—as well as variables controlling for socio-demographics of the customer. We also control for the characteristics of each store and its market area that could not explicitly be included in the model specification through the use of indicator variables representing each supermarket. This analysis uses spending data beyond the Monday through Thursday, 5PM – 7PM window – data were collected every day of the week from 10 AM to 8 PM.[12]

The only socio-demographic attribute of the customer directly gathered by the survey of supermarket customers is gender. Information about a customers' household was imputed by using information collected from the Census block group associated with each customer's home location. Area wide averages from the US Census and American Community Survey are used as proxies for the socio-demographic characteristics of the individual customers.

Socio-demographic controls include gender, median income of the Census block of the customer's home location, average household size of the census block, and average percentage of non-white residents of the census block. Of these variables, gender and the average percent of non-white residents of the census block are the significant independent predictors of spending per trip. All of the significant variables and their impacts on spending per trip are shown in Figure 4-12. Women spend an estimated 7% more on average than men do. Percent of non-white residents has a slightly negative relationship with consumer spending: each additional percentage of non-white residents in the census block predicts a 0.1% reduction in the purchase price.

Unlike the models for restaurants, drinking establishments, and convenience stores, the supermarkets analysis reveals travel characteristics to be significant predictors of spending per trip. Customers who walk, bike, and ride transit to supermarkets spend an estimated 21%, 17%, and 11% less per trip than people who arrive in automobiles. The distance from the customer's home to the supermarket is also significant. Each additional mile from home to store is associated with a 0.2% increase in spending. Forty-seven percent of trips to supermarkets had origins other than the customer's home. By interacting travel modes with distance from home we see a moderating effect exists between distance from home and travel modes: when the distance from the home location to the supermarket increases by one mile, people who walk, bike, and ride transit spend an estimated 1.3%, 1.9% and 2.2% less per trip than people arriving in vehicles.

[12] Of the total 19,790 observations, 163 records have spending amounts exceeding $500 for a single trip. These observations are considered outliers. They are not included in analysis.

Table 4-5. Spending per Trip Model Results

	Restaurants & Drinking Establishments			Convenience Stores			Supermarkets		
Independent Variables	b	ß	t	b	ß	t	b	ß	t
Intercept	0.603		-4.06***	0.459		4.45***	1.182		47.08***
Socio-demographic characteristics									
Gender is male (binary)	-0.009	-0.02	-0.39	-0.089	-0.12	-2.01**	-0.069	-0.08	-10.82***
Age between 25-34 (binary)	0.043	0.07	1.11	0.140	0.18	2.26**	-	-	-
Age between 35-44 (binary)	0.037	0.05	0.87	0.070	0.09	1.12	-	-	-
Age between 45-64 (binary)	0.018	0.02	0.42	0.051	0.06	0.78	-	-	-
Age over 64 (binary)	-0.113	-0.06	-1.49	-0.157	-0.06	-1.01	-	-	-
# Adults in household	-0.018	-0.06	-1.31	0.040	0.13	2.06**	-	-	-
Children in household (binary)	-0.062	-0.16	-3.46***	-0.032	-0.09	-1.50	-	-	-
Household size[†]	-	-	-	-	-	-	-0.004	0.00	-0.47
Household Income ($10,000) [†]	0.007	0.14	3.48***	0.001	0.02	0.33	0.001	0.01	0.80
Average percent non-white residents[†]	-	-	-	-	-	-	-0.001	-0.03	-2.79***
Trip characteristics									
Mode: Walk (binary)	0.068	0.09	1.27	-0.089	-0.13	-1.54	-0.206	-0.14	-10.60***
Mode: Bike (binary)	-0.006	-0.01	-0.14	-0.057	-0.04	-0.44	-0.169	-0.07	-7.86***
Mode: Transit (binary)	0.076	0.06	1.40	-0.008	-0.01	-0.10	-0.113	-0.03	-3.97***
Trip Distance (miles) [‡]	0.004	0.04	0.93	-0.005	-0.06	-0.82	0.002	0.01	1.83*
Walk Mode * Trip Distance	0.008	0.03	0.41	-0.003	-0.01	-0.17	-0.013	-0.03	-1.91*
Bike Mode * Trip Distance	0.011	0.03	0.60	-0.048	-0.08	-0.84	-0.019	-0.02	-2.18**
Transit Mode * Trip Distance	-0.002	-0.01	-0.18	0.002	0.01	0.11	-0.022	-0.02	-2.52**
Customer shopping characteristics									
Duration in Establishment (min.)	0.003	0.31	7.92***	0.015	0.28	4.51***	-	-	-
Group Size[§]	0.202	0.61	13.40***	0.053	0.12	1.94*	0.110	0.31	44.47***
Visits once per month (binary)	0.029	0.04	0.96	0.046	0.02	0.37	0.078	0.04	4.50***
Visits a few times per month (binary)	0.037	0.05	1.16	0.094	0.11	1.37	0.130	0.11	9.12***
Visits weekly (binary)	0.002	0.00	0.05	0.150	0.14	1.90*	0.194	0.20	14.48***

	Restaurants & Drinking Establishments			Convenience Stores			Supermarkets		
Independent Variables	b	ß	t	b	ß	t	b	ß	t
Visits a few times per week (binary)	-0.063	-0.05	-1.23	0.189	0.26	2.94***	0.105	0.12	7.92***
Visits daily (binary)	-0.200	-0.06	-1.23	-0.087	-0.10	-1.19	-0.059	-0.04	-3.51***
Mexican restaurant (binary)	0.063	0.10	2.47**	-	-	-	-	-	-
Morning purchase (binary)	-	-	-	-	-	-	0.017	0.02	2.07**
Evening purchase (binary)	-	-	-	-	-	-	0.024	0.02	3.20***
Weekend purchase (binary)	-	-	-	-	-	-	0.061	0.07	9.42***
Individual supermarket controls									
Store #1 (binary)	-	-	-	-	-	-	0.046	0.03	3.61***
Store #2 (binary)	-	-	-	-	-	-	0.100	0.07	7.68***
Store #3 (binary)	-	-	-	-	-	-	0.023	0.02	1.85*
Store #4 (binary)	-	-	-	-	-	-	-0.033	-0.02	-2.59***
Store #5 (binary)	-	-	-	-	-	-	0.013	0.01	1.08
Store #6 (binary)	-	-	-	-	-	-	0.035	0.02	2.84***
Store #7 (binary)	-	-	-	-	-	-	-0.011	-0.01	-0.94
Store #9 (binary)	-	-	-	-	-	-	0.037	0.03	2.89***
Store #10 (binary)	-	-	-	-	-	-	-0.020	-0.01	-1.62
Overall model statistics									
N	356			255			17483		
R^2	0.53			0.23			0.19		
Adjusted R^2	0.50			0.15			0.19		
Standard error of the estimate	0.22			0.32			0.39		

*significant at $p < 0.10$; **significant at $p < 0.05$; ***significant at $p < 0.01$;
[†]Socio-demographic variables for supermarkets measured from census block averages. See section "Spending per Trip at Supermarkets" for explanation;
[‡]Supermarket measure is store distance from home (mi);
[§]For supermarkets, group size measured as "number of people the purchase was for".

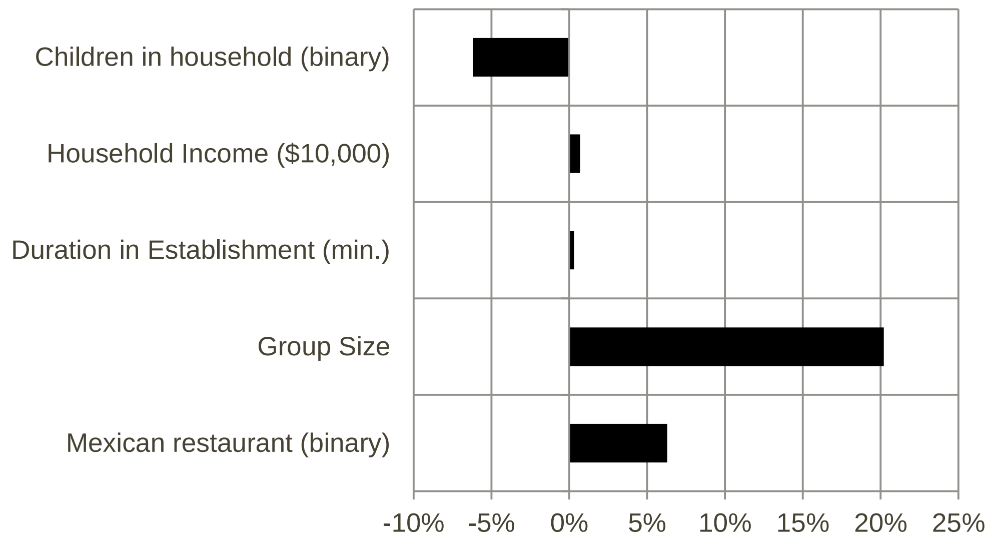

Figure 4-10. Significant Factors of Spending per Trip at Restaurants and Drinking Establishments

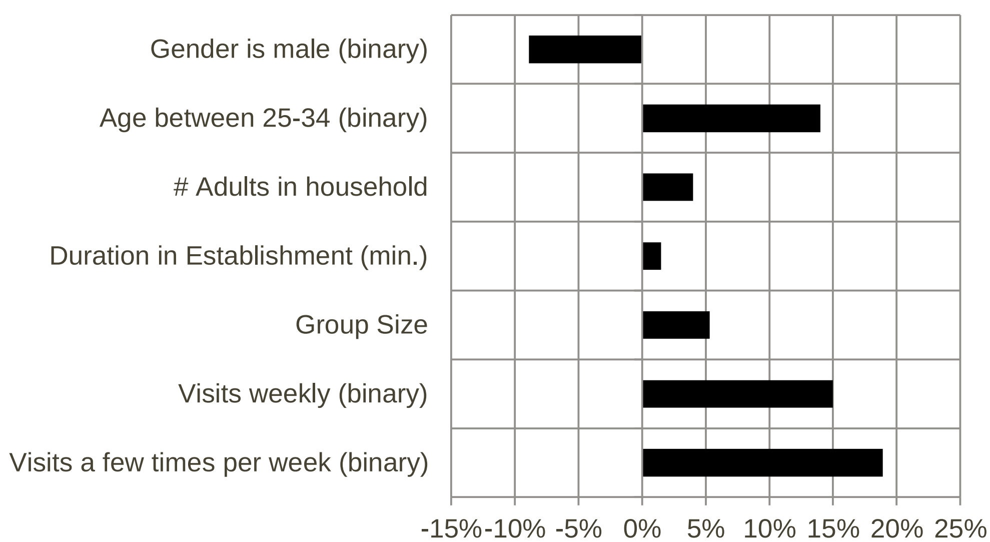

Figure 4-11. Significant Factors of Spending per Trip at Convenience Stores

Customer shopping characteristics are also important factors in consumer spending at supermarkets. As with the bar/restaurant spending model, the group size of the purchase—the number of people the transaction is meant to serve—is significantly related to spending. For each additional person, the purchase increases by an estimated 11%. Trip frequency has a statistically significant impact on the amount spent per trip as well. The variation of trip frequency observed in the model suggests that those who travel to the grocery store a “few times per month”, “once a week”, or “a few times a week” tend to spend more per trip than those that travel to the store “less than once per month” or “daily.” Morning and evening shoppers spend an estimated 2% more than those that shop in the afternoon, which may due to smaller spending amounts for lunch purchases. Weekend customers spend an estimated 6% more than weekday shoppers, potentially from grocery store trips meant to stock up on food for the upcoming week.

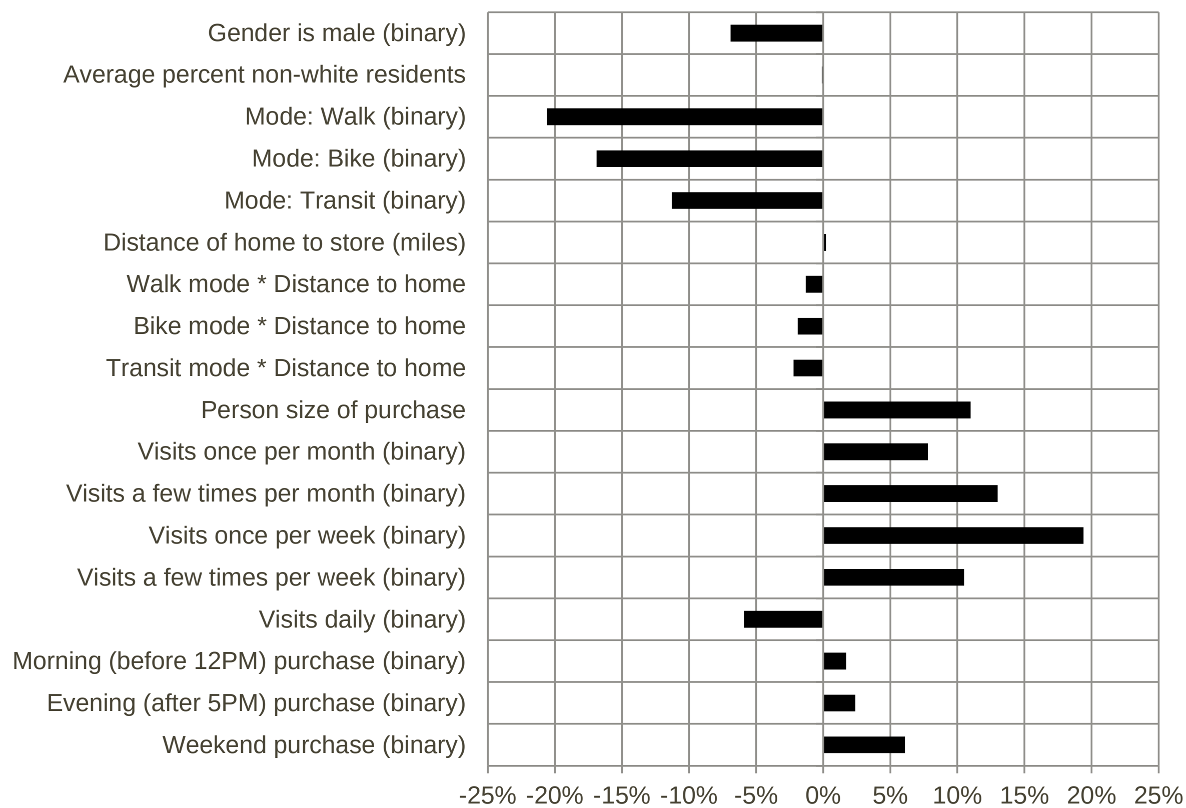

Figure 4-12 Significant Factors of Spending per Trip at Supermarkets

SUMMARY

This chapter describes the analysis of mode shares of customers at a variety of business types, locations, and transportation contexts, the analysis of connections between establishment-level mode splits and the built environment, and the analysis of the links between consumer spending and frequency of visits with travel modes. We find important differences in the relative mode shares across these different business types based upon their location in the region and the attributes of the built environment that support or detract from the use of various modes. There are also clear distinctions in the average amounts spent per trip and the frequency of travel by customers' mode of access. But when these differences are examined more closely in models of spending that control for the various demographic and other characteristics of consumers, these differences by mode disappear, except in the case of supermarkets. These results have important implications for planning and the impacts on local business community. We will discuss these findings and what this may mean for transportation planning and local economies in more depth in the next section.

Chapter 5 Conclusions

This study is a first attempt to answer a few of the questions that have arisen concerning the multimodal transportation investments and the impacts of mode shifts on the business community. This research aims to merge the long history of scholarly work that examines of the impacts of the built environment on non-work travel with the relatively new interest in consumer spending by mode of travel. This empirical study of travel choices and consumer spending across 89 businesses in the Portland metropolitan area shows there are important differences between the amounts customers spend on average by their mode of travel. However, these differences become less pronounced when we control for demographics of the customer and other attributes of the trip. This chapter starts with a discussion of these findings and the implications for businesses. Then, we discuss some of the limitations of this study and a few considerations for future work.

DISCUSSION

This study of consumer spending and travel choices has some compelling findings that suggest some key spending and frequency differences by mode of travel that will likely invigorate the discussion of the economic impacts of these modes. There are some results that are perhaps less surprising. For these non-work destinations, the automobile remains the dominant mode of travel. Patrons are largely arriving by private vehicle to most of the destinations in this study, particularly to grocery stores where larger quantities of goods tend to be purchased. However, important differences exist in the mode shares based upon the type and location of the establishment and the levels of accommodation for a various modes.

The built environment matters. We see clear differences in the use of walking, bicycling, and transit modes based upon the establishment location within the greater urban context, i.e. central business district, town centers, commercial corridors, etc. The amount of activity, reflected by residential and employment density, the proximity to rail transit, the presence of bike infrastructure, and the amount of automobile and bicycle parking are all important in explaining the use of non-automobile modes. The site design, while not explicitly examined here, seems to play a role as well. The results suggest that businesses located in shopping centers see more automobile travel than those located elsewhere. These shopping centers were dominated by large parking lots that separated establishments from transit stops and had little consideration for bike or pedestrian circulation within the site.

In terms of bicycling specifically, the built environment features that the literature has shown to be associated with lower rates of automobile use and greater bicycling mode share were also significant in this study. The directness of routes and connectivity was an important predictor of customers choosing this mode. Intersection density is used as the measure of street design, but it is also highly correlated with and a proxy for density, mixed use, block sizes, orthogonal street layout and an older era of development. Convenient and abundant bicycle parking, including that provided by on-street bike corrals, is associated with higher bicycle use by customers. However, the direction of influence is not always clear. These corrals have historically been installed at the request of businesses with a large share of bicycling patrons, although the practice of allocating this kind of bicycle parking is changing. Thus, corrals may merely be an indicator of businesses that already have a high bicycle mode share, rather than a causal factor in increased bicycle use. Finally, bicycle facilities located on streets with high automobile traffic seem to deter the levels of patronage of nearby businesses by bicyclists. While the presence of a bike lane on these busy streets may provide better accommodation, it may be that cyclists use these as through routes, rather than for local access. It also may mean that businesses located along these high vehicular corridors are more likely to cater to the automobile than bicycling.

Advocates have long suggested that automobile trips of shorter lengths may be more amenable to substitution by other modes. Portland has tried to incorporate this into the Portland Plan (2012) by introducing the concept of the "20-minute neighborhood", where residents can walk or bike to meet their non-work needs. In addition, Joe Cortright (2007) has suggested that the urban growth boundary has led to shorter trips, even by those made by automobile, and the resulting reductions in transportation expenditures impart a "green dividend" to residents. While the results of this study cannot confirm this green dividend theory, they do suggest that it is worth exploring further. For example, in this study, the businesses in this study have at least 30% of their customers traveling less than one mile, on average, to access the establishment. Similarly, the majority of trips are less than 3 miles, although not all of these trips originate from home. These results suggest the potential for substitution by walking, bicycling, and transit if they are not already made by those modes.

The consumer spending results also contribute to this "green dividend" idea, although we cannot confirm this theory without more research. On average, we see important differences in consumer spending across the businesses in this study per trip and by mode of access. But customers who walk, bicycle, and take transit have a greater frequency of trips on average than those who drive for all of business types. This was a surprising result for bars and restaurants where the hauling of purchases is not a consideration and lends some support for Cortright's supposition that the use of non-automobile modes may lead to greater capacity for individuals to spend money on other things besides transportation.

These differences in trip frequency are key to the customers' monthly spending patterns. Once trip frequency is accounted for, the average monthly expenditures by customer modes of travel reveal that bicyclists, transit users, and pedestrians are competitive consumers and for all businesses except supermarkets, spend more, on average than those who drive. The greater numbers of trips to these establishments also mean that these are regular customers, returning to the establishment more often. Managers and business owners perhaps have greater opportunities to get to know this segment of their market and cater to this constituency.

The analysis here examines average spending behaviors more closely and attempts to untangle whether these differences in spending are due to customers' mode of travel or other personal characteristics that might be associated with their transportation choices. Indeed, the model results indicate that the mode choice itself has little bearing on expenditures, except in the case of supermarkets. Once the characteristics of customers are controlled for the mode of transportation is not a significant contributor to the amount spent per trip at restaurants, bars, and convenience stores. This is somewhat reassuring news for those concerned about the impacts of shifting patronage away from automobile users. This suggests that it is not the mode itself that matters but the characteristics of the people making these choices.

On the other hand, this raises the question of how these results might hold over the long term if we aim to shift travel choices away from the automobile and towards more sustainable modes of transportation. For example, if the aim of new infrastructure investments in bicycling is to attract from those "interested but concerned" about bicycling, the impact on local businesses may depend more upon the characteristics of this new group of bicyclists, which may differ significantly than those currently bicycling. The argument is similar for walking and transit as well. The results of this study cannot be extrapolated to a longitudinal framework. We can only speculate about how changes in modal uses in the future might impact customer patronage and spending based upon the characteristics of various road users today.

For grocery stores, where food and other goods tend to be purchased in larger quantities than at convenience stores, the findings reveal distinct associations between spending and mode. Customers who walk, bike, and take transit spend significantly less each trip than those who drive even when we control for their characteristics. In addition, the distance that they travel to access the store from home matters. In general, customers buy more at the grocery store when they have to travel farther, but distance has different impacts on spending by mode of travel. The longer a customer has to travel and thus haul goods by transit, bike, or walk modes, the less they spend per trip. Our results suggest that these lower expenditures per trip by these non-automobile patrons are compensated by more frequent trips to the store and thus, these spending differences may matter less over the long term.

STUDY LIMITATIONS

There are various limitations with this study. The convenience store, restaurant, and drinking establishment surveys were administered during summer months on days without rainfall, which are better conditions than winter months for non-motorized modes. An additional limitation was administering the survey during the evening peak hours of 5 PM to 7 PM Because of limits on the timing of data collection, customers were only surveyed during the evening peak hour of the roadway facility. However, this may not be the peak hour of customer traffic at the establishment.

For example, using data from household travel surveys, we can see that the peak time of day for travel varies by mode and trip type. A time-of-day distribution of travel modes for shopping trips from 2011 Oregon Household Activity Survey (OHAS, 2011) data for Portland, OR metropolitan region is shown below in Figure 5-1.[13] Each line represents the percentage of the mode share for shopping trips at different time intervals. It allows us to see differences throughout the day – for example, 3:30 PM is the most common time for cyclists to go shopping. The 5 PM to 7 PM collection time seems to do an adequate job of capturing consumer spending by mode choice. Automobiles appear to have higher use from 5 PM to 7 PM, suggesting that the percent mode share observed during this study may be biased to the time of day of data collection.

Customer data were collected on expenditures and the frequency of visitation to the establishment. The data collected are a cross-sectional snapshot of the customer's behavior. This makes it difficult to accurately apply frequency and extract trends. Customers did not confirm whether they always traveled to the establishment using the same mode each time or if they tend to spend the same amount of money at the establishment on each visit.

The nature of the establishment survey required researchers to request establishment participation in the study. It was difficult to reach large chains due to organizational barriers, resulting in the usage of mostly local stores. This may introduce bias towards smaller, locally owned establishments. Additionally, customers that patronize these smaller local establishments may in turn have a bias for opting for environmentally friendly modes of transportation.

[13] Transit shopping trips are not shown due to a low sample size for this survey.

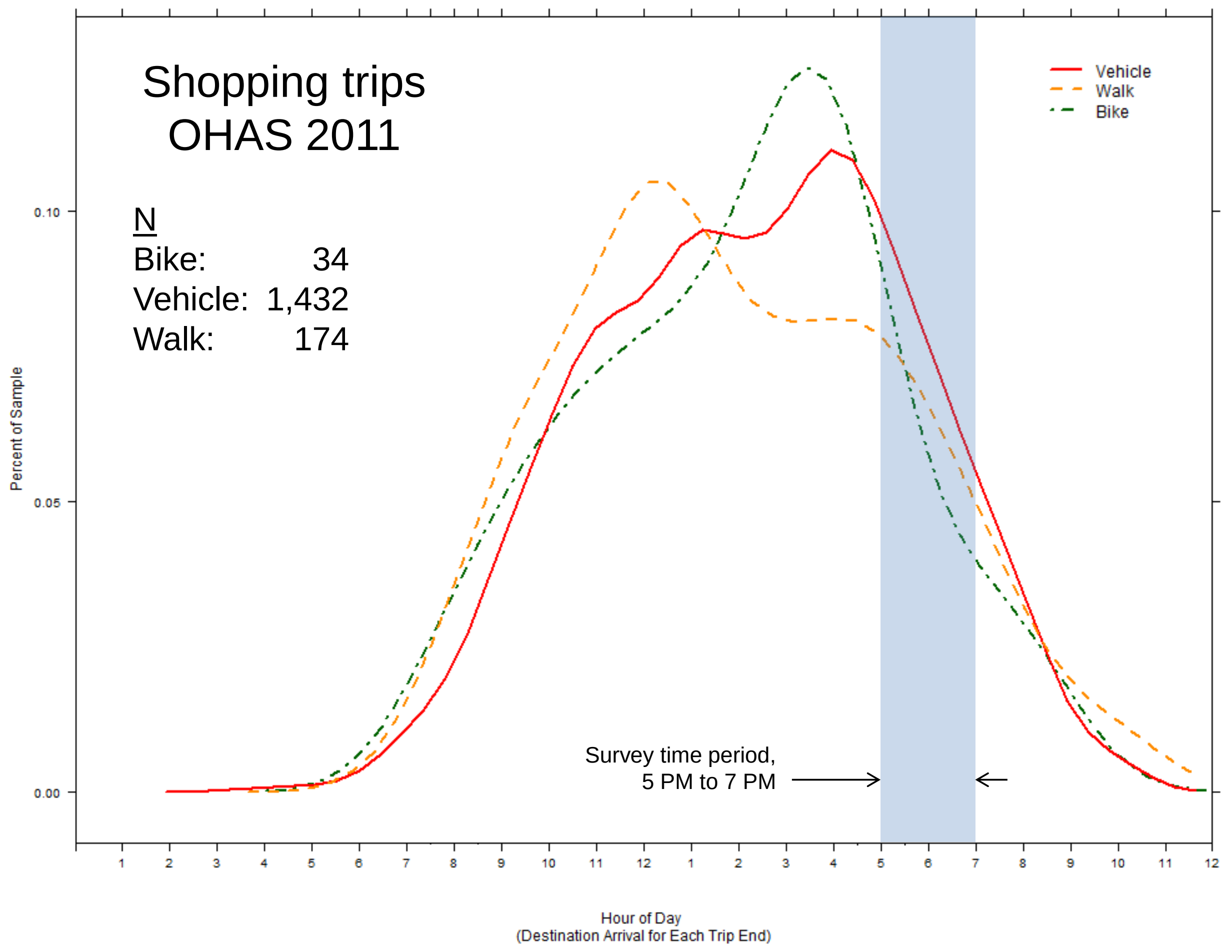

Figure 5-1. Time-of-day Distribution of Travel Modes

Due to a large amount of customer personal information being omitted from the grocery store survey (income, age, race, etc.), information available from the 2009 American Community Survey and the 2010 U.S. Census for the Census block group where the customer lived were used to proxy for or impute the household level socioeconomic data. More detailed information about customers at grocery stores and their demographics would improve this study.

There may be limitations in generalizing these results to other U.S. cities. This study was conducted in the metropolitan region of Portland, Oregon, which boasts higher than average non-automobile mode usage. More study in other regions is needed to fully understand the link between mode choice and consumer spending.

FUTURE CONSIDERATIONS

This study, while perhaps the first of its kind in the US, is certainly not the last. Although the study provides important evidence that suggests that customers that access establishments by non-automobile modes are competitive consumers and are important patrons for these businesses, more research is needed to understand the implications of mode shifts away from the automobile. In a climate of constrained financial resources for transportation, cities are asking more detailed and difficult questions about what returns they are getting from transportation investments that expand beyond demand and facility usage to consider broader economic benefits.

As cities making changes to better accommodate bicycling, walking, and transit and encourage a range of transportation choices, it is unclear where shifts away from the automobile may lead. The results from this study are encouraging for local businesses but this research is limited in its reach. For example, a business owner that questions the impact of adding bike corrals at the expense automobile parking will not find definitive answers about the optimal combination that creates the greatest return. This will require a more in-depth study of longitudinal customer behaviors as well as the relative costs to businesses to provide accommodation for various modes, including capital and operating costs.

Again, a longitudinal framework is needed capture changes in behavior, including mode shifts, frequency of trips and changes in spending. So should an establishment become more accommodating for non-motorized modes, it is not clear whether the business will see changes among its current customer base and their trip making behavior (modes, frequencies and times of day/days of week) or if their customer base grow or shrink, attracting perhaps patrons who have different modal preferences and shopping behaviors.

Finally, we must acknowledge that travel behavior is complex and multi-modal. Single mode use is rare. We use multiple modes for multiple purposes and there is much variation in our behavior. The bicyclists included in our study may travel by automobile, walking, or transit to access many of their activities and on different days, times or seasons, and may vary their mode choices to access even the same destination. Therefore, our research must take serious consideration of our multimodal nature and find ways to accommodate this in our planning practice. US cities are working to provide more transportation options – including more flexible vehicle and bicycle sharing – that can change the way we think about our daily travel and routines. We are no longer bound to travel by the mode use to leave our homes and this is like going to impact not only our travel patterns but our consumer behavior as well.

Chapter 6 References

Bawa, K, and Ghosh. "A Model of Household Grocery Shopping Behavior," *Marketing Letters*, Vol. 10, 1999. pp. 149-160.

Bent, E. and Singa, K. "Modal Choices and Spending Patterns of Travelers to Downtown San Francisco, California: Impacts on of Congestion Pricing on Retail Trade," *Transportation Research Record: Journal of the Transportation Research Board*, No. 2115, Transportation Research Board of the National Academies, Washington D.C., Transportation Record, 2009, pp. 66-74.

US Bureau of Labor Statistics. "Consumer Expenditures – 2011," Economic news release, accessed online, 2012.

Cao, X., P.L. Mokhtarian, and S.L. Handy. "Examining the Impacts of Residential Self-Selection on Travel Behaviour: A Focus on Empirical Findings," *Transport Reviews*, Volume 29, pp. 359-395, 2009.

CBC News. "Vancouver Bike Lanes to Stay, City Council Decides," Accessed online, 2012.

Cervero, R. (2006). "Effects of Light and Commuter Rail Transit on Land Prices: Experiences in San Diego County." University of California Transportation Center, Faculty Research Paper, #769.

Cervero, R. and K. Kockelman. "Travel Demand and the 3Ds: Density, Diversity, and Design," *Transportation Research Part D: Transport and Environment*, Volume 2, Issue 3, pp. 199-219, September 1997.

Cortright, J. "Portland's Green Dividend," White Paper, CEOs for Cities, 2007.

Dill, Jennifer and Carr, Theresa. "Bicycle Commuting and Facilities in Major U.S. Cities: If You Build Them, Commuters Will Use Them," *Transportation Research Record: Journal of the Transportation Research Board*, vol. 1828, 2003. pp. 116-123.

Drennen, E. "Economic Effects of Traffic Calming on Urban Small Businesses," Department of Public Administration, San Francisco State University. 2003.

Ewing, R. and R. Cervero. "Travel and the Built Environment: A Meta-Analysis," *Journal of the American Planning Association*, Volume 76, Number 3, pp. 1-30, Summer 2010.

Fietsberaad News Report. "Cyclists spend as much in supermarket as motorists," May 23, 2011. Fietsberaad.

Forkes, Jennifer, and Lea, Nancy. "Bike Lanes, On-Street Parking, and Business, Year 2 Report: A Study of Bloor Street in Toronto's Bloor West Village," Prepared for the Clean Air Partnership, 2011.

Grant, J. and K. Perrot. "Where is the Café? The Challenge of Making Retail Uses Viable in Mixed-use Suburban Developments," *Urban Studies*, Volume 48, Issue 1, pp. 177-195, 2011.

Handy, S. “A Cycle of Dependence: Automobiles, Accessibility, and the Evolution of the Transportation and Retail Hierarchies,” *Berkeley Planning Journal*, Volume 8, pp. 21-43, 1993.

Handy, S. and K. J. Clifton. “Local Shopping as a Strategy for Reducing Automobile Travel,” *Transportation*, Volume 28, pp. 317–346, 2001.

Jiao, J., A.V. Moudon and A. Drewnowski. “Grocery Shopping: How individuals and built environments influence travel mode choice,” *Transportation Research Record: Journal of the Transportation Research Board*, CD-ROM. No. 11-2322, Transportation Research Board of the National Academies, Washington D.C., Transportation Record, 2011.

Jones, Peter, and Peter R. Stopher. “Transport survey quality and innovation,” Emerald Group Publishing, 2003.

Kim, B and Park, K. “Studying Patterns of Consumer's Grocery Shopping Trip,” *Journal of Retailing*, Vol. 73, 1997. pp. 501-517.

Lee, A. “What Is The Economic Contribution Of Cyclists Compared To Car Drivers In Inner Suburban Melbourne’s Shopping Strips?,” University of Melbourne. Melbourne, Australia, 2008. Master's Thesis.

McConville, Megan; Rodríguez, Daniel A. , Clifton, Kelly J; Cho, Gihyoug, and Fleischhacker, Sheila. “Disaggregate Land Uses and Walking,” *American Journal of Preventive Medicine*, Volume 40, Issue 1, January 2011. pp 25-32.

Meisel, D. Bike Corrals: Local Business Impacts, Benefits, and Attitudes. Portland State University School of Urban Studies and Planning. 2010.

New York City DOT. “Measuring the Streets: New Metrics for 21st Century Streets,” 2012.

Oregon Travel & Activity Survey (OHAS or OTAS), Oregon Department of Transportation, 2009-2011.

The Portland Plan. 2012. City of Portland, Oregon. Available online at http://pdxplan.com

Pucher, John, and Buehler, Ralph. “Why Canadians cycle more than Americans: A comparative analysis of bicycling trends and policies,” *Institute of Transport and Logistics Studies*, 2005.

Pucher, John; Komanoff, Charles, and Schimek, Paul. “Bicycling renaissance in North America? Recent trends and alternative policies to promote bicycling,” *Transportation Research Part A*, Vol. 33, 1999. pp. 625-654.

Rodriguez, D. A., and J. Joo. “The Relationship Between Non-Motorized Mode Choice And The Local Physical Environment,” *Transportation Research Part D*, Volume 9, pp. 151-173, 2004.

Stantec Consulting Ltd, Site Economics, and Mustel Group Market Research. “Vancouver Separated Bike Lane Business Impact Study,” Prepared for the Vancouver Economic Development Commission, City of Vancouver, Downtown Vancouver Association, Downtown Vancouver Business Improvement Association, The Vancouver Board of Trade, 2011.

Steiner, Ruth. "Trip Generation and Parking Requirements in Traditional Shopping Districts," *Transportation Research Record: Journal of the Transportation Research Board*, vol. 1617, 1998. pp 28-37.

Sustrans, UK. "Shoppers and How they Travel," Livable Neighborhoods information sheet, 2006

Sztabinski, F. Bike Lanes, On-street Parking, and Business: A Study of Bloor Street in Toronto's Annex Neighborhood. The Clean Air Partnership. 2009.

Targa, Felipe and Clifton, Kelly J. (corresponding author). "The built environment and trip generation for non-motorized travel," *Journal of Transportation and Statistics*, vol. 8(3), 2005. pp. 55-70.

Transportation Alternatives. "East Village Shoppers Study, a Snapshot of Travel and Spending Patterns of Residents and Visitors in the East Village," 2012.

Trendy Travel. "Trendy Cycling," Report produced by Trendy Travel in conjunction with Intelligent Energy Europe, 2010.

Zhang, M. "The Role of Land Use in Travel Mode Choice: Evidence From Boston and Hong Kong," *Journal of American Planning Association*, Volume 70, Issue 3, pp. 344-361, 2004.

Appendices

APPENDIX A: LONG SURVEY

Question	Text To Read to Respondent	Answers
Q1. Age	*What best describes your AGE?*	[ ] under 18, [ ] 18-24, [ ] 25-34, [ ] 35-44, [ ] 45-54, [ ] 55-64, [ ] 65-74, [ ] 75 and over
Q2. HH	*Please provide the following information for your household:* *Number of Adults*	[ ] 0, [ ] 1, [ ] 2, [ ] 3, [ ] 4, [ ] 5 or more
	Number of Children	[ ] 0, [ ] 1, [ ] 2, [ ] 3, [ ] 4, [ ] 5 or more
	Number of Automobiles	[ ] 0, [ ] 1, [ ] 2, [ ] 3, [ ] 4, [ ] 5 or more
	Number of people with BICYCLES	[ ] 0, [ ] 1, [ ] 2, [ ] 3, [ ] 4, [ ] 5 or more
	Number of Transit Passes	[ ] 0, [ ] 1, [ ] 2, [ ] 3, [ ] 4, [ ] 5 or more
Q3. Decision	*When did you decide that you would visit [LOCATION]?*	[ ] passing by, [ ] after leaving home, [ ] today before leaving home, [ ] yesterday, [ ] before yesterday, [ ] do not know
Q4. Origin	*We would like to ask you some questions about your travel here today, Can you tell me the nearest intersection or address from where you came from?*	Identify location with Google Map
Q5. Beginning of Day	*Is this the place where you began your day?*	[ ] yes, [ ] no
Q6. Origin Type	*The best description of this location is one of the following:*	[ ] Home, [ ] Work, [ ] School, [ ]Restaurant, [ ] Coffee shop, [ ] Service errand, [ ] Other: ___________________
Q7. Origin Mode	*How did you travel to [establishment]?* **Explain that we want travel modes in the order used. Remind respondent for walk trips if >1 block.**	
	Segment 1: [ ] Walk, [ ] Bicycle, [ ] MAX/WES, [ ] Bus, [ ] Streetcar, [ ] Vehicle-driver, [ ]Vehicle-passenger, [ ] Other:_______________	
	Segment 2: [ ] Walk, [ ] Bicycle, [ ] MAX/WES, [ ] Bus, [ ] Streetcar, [ ] Vehicle-driver, [ ]Vehicle-passenger, [ ] Other:_______________	
	Segment 3: [ ] Walk, [ ] Bicycle, [ ] MAX/WES, [ ] Bus, [ ] Streetcar, [ ] Vehicle-driver, [ ]Vehicle-passenger, [ ] Other:_______________	
	Segment 4: [ ] Walk, [ ] Bicycle, [ ] MAX/WES, [ ] Bus, [ ] Streetcar, [ ] Vehicle-driver, [ ]Vehicle-passenger, [ ] Other:_______________	
	Segment 5: [ ] Walk, [ ] Bicycle, [ ] MAX/WES, [ ] Bus, [ ] Streetcar, [ ] Vehicle-driver, [ ]Vehicle-passenger, [ ] Other:_______________	
	Segment 6: [ ] Walk, [ ] Bicycle, [ ] MAX/WES, [ ] Bus, [ ] Streetcar, [ ] Vehicle-driver, [ ]Vehicle-passenger, [ ] Other:_______________	
Q8. Veh Occ	**IF VEHICLE CHOSEN:** *For trip segment [#], how many people were in the vehicle?*	[ ] 1, [ ] 2, [ ] 3, [ ] 4, [ ] 5 or more
Q9. Parking cost	**IF VEHICLE CHOSEN:** *How much did you pay for PARKING in traveling to [LOCATION]? (Enter zero if you have a parking pass)*	$__________
Q10. Transit Cost	**IF TRANSIT CHOSEN:** *How did you pay for your public transportation in travelling to [LOCATION] today?*	[ ] cash only, [ ] ticket at kiosk, [ ] transit pass, [ ] free zone
Q11. Mode Attitudes	*Now, we will ask you about your attitudes towards different transportation options in traveling to [LOCATION]. Please evaluate the following on a scale from 1 (strongly disagree) to 5 (strongly agree), even if you do not use these modes:*	
	Car parking here is easy and convenient	[ ] 1, [ ] 2, [ ] 3, [ ] 4, [ ] 5

Question	Text To Read to Respondent	Answers
	Bike parking here is easy and convenient	[ ] 1, [ ] 2, [ ] 3, [ ] 4, [ ] 5
	Biking here is safe and comfortable	[ ] 1, [ ] 2, [ ] 3, [ ] 4, [ ] 5
	Walking here is safe and comfortable	[ ] 1, [ ] 2, [ ] 3, [ ] 4, [ ] 5
	Taking transit here is convenient	[ ] 1, [ ] 2, [ ] 3, [ ] 4, [ ] 5
Q12. Shopping frequency	*In order to understand more about why you came here, we will ask a few questions about your consumer habits. Can you tell me how frequently you come here?*	[ ] rarely, [ ] once a month, [ ] a few times per month, [ ] once a week, [ ] a few times a week, [ ] daily
Q13. Time spent	*Could you tell me the approximate amount of TIME you spent here at [LOCATION]*	________ Minutes
Q14. Money spent	*Could you tell me the approximate amount of money you spent here at [LOCATION]?*	$_________
Q15. Group size	*How many people in your group did this purchase pay for?*	[ ] 1, [ ] 2, [ ] 3, [ ] 4, [ ] 5 or more
Q16. Destination location	*We are going to ask you a series of questions about where you will be going after [Location]. Can you tell me the nearest intersection or address you will be going NEXT?*	Identify location with Google Map
Q17. Destination type	*The best description of this location is one of the following:*	[ ] Home, [ ] Work, [ ] School, [ ]Restaurant, [ ] Coffee shop, [ ] Service errand, [ ] Other: __________________
Q18. Destination mode	*How will you travel to the next location from here?* **Explain that we want travel modes in the order used. Remind respondent for walk trips if >1 block.**	
	Segment 1: [ ] Walk, [ ] Bicycle, [ ] MAX/WES, [ ] Bus, [ ] Streetcar, [ ] Vehicle-driver, [ ]Vehicle-passenger, [ ] Other:______________	
	Segment 2: [ ] Walk, [ ] Bicycle, [ ] MAX/WES, [ ] Bus, [ ] Streetcar, [ ] Vehicle-driver, [ ]Vehicle-passenger, [ ] Other:______________	
	Segment 3: [ ] Walk, [ ] Bicycle, [ ] MAX/WES, [ ] Bus, [ ] Streetcar, [ ] Vehicle-driver, [ ]Vehicle-passenger, [ ] Other:______________	
	Segment 4: [ ] Walk, [ ] Bicycle, [ ] MAX/WES, [ ] Bus, [ ] Streetcar, [ ] Vehicle-driver, [ ]Vehicle-passenger, [ ] Other:______________	
	Segment 5: [ ] Walk, [ ] Bicycle, [ ] MAX/WES, [ ] Bus, [ ] Streetcar, [ ] Vehicle-driver, [ ]Vehicle-passenger, [ ] Other:______________	
	Segment 6: [ ] Walk, [ ] Bicycle, [ ] MAX/WES, [ ] Bus, [ ] Streetcar, [ ] Vehicle-driver, [ ]Vehicle-passenger, [ ] Other:______________	
Q19. Home location	**IF HOME NOT ALREADY GIVEN IN ORIGIN/DESTINATION QUESTIONS:** *Can you tell me the nearest intersection or address for your HOME?*	Identify location with Google Map
Q20. Work location	**IF WORK NOT ALREADY GIVEN IN ORIGIN/DESTINATION QUESTIONS** *Can you tell me the nearest intersection or address for your WORK?*	Identify location with Google Map
Q21. Limitations	*Do you have any medical limitations that prevent you from walking, bicycling or driving?*	[ ] yes, [ ] no

Question	Text To Read to Respondent	Answers
Q22. HH Income	*What best describes your total annual HOUSEHOLD INCOME?*	[ ] less than $25,000, [ ]$25K - $49,999, [ ] $50K - $99,999, [ ] $100K - $149,999, [ ] $150K - $199,999, [ ] $200K or more
Q23. Gender	*What gender do you most identify with?*	[ ] male, [ ] female
Q24. Follow up	*Finally, would you like to participate in follow-up research about travel & consumer choices?*	Name:__________________ ____________________ Phone/email: ________________________ ________
END	*We appreciate your time in completing this survey. Thank you, and have a great day!*	

APPENDIX B: SHORT SURVEY

Contextual Influences on Trip Generation Survey II
Location: ____________________
Date: ________________

Thank you for taking this 30 second survey about your travel choices and consumer behavior. The information you provide will inform Portland State University research about transportation, environment and behavior. Your participation in this study is voluntary, your information will be kept confidential and you can opt out at any time.

Questions:

1. How did you get here? (multiple modes allowed)

    (Walk; Bicycle; MAX/WES; Bus; Streetcar; Vehicle driver; Vehicle passenger; Other--write in)

2. Can you tell me the nearest intersection or address to/of your home?

3. Can you tell me how frequently you come to this plaid pantry?

    (Rarely; Once / month; A few times / month; Once / week; A few times / week; Daily)

4. Could you tell me the approximate amount of money you spent here during this visit?

Survey administrator circles M for male respondents and F for Female respondents.

APPENDIX C: GROCERY STORE SURVEY

Question	Text for Respondent	Answers
Q1	*Where do you live? Please click on home location on map.*	Identify home location with Google Map
Q2	*How did you get here today?*	[ ] Walk [ ] Bike [ ] Car [ ] Bus [ ] MAX [ ] Other
Q3	*Did you come from home?*	[ ] Yes [ ] No
Q4	*Please tell us exactly how much you spent at the grocery store TODAY?*	Enter exact amount spent to the decimal
Q5	*How often do you shop here?*	[ ] Less than once a month [ ] Once a month [ ] A few times a month [ ] Once a week [ ] A few times a week [ ] Daily
Q6	*Please tell us how many people you are shopping for at the grocery store TODAY?*	[ ] 1 person [ ] 2 people [ ] 3 people [ ] 4 people [ ] 5 or more people
Q7	*What gender do you most identify with?*	[ ] Male [ ] Female [ ] Other

APPENDIX D: SITE DATA COLLECTION TABLE

Table 8 Site Data collection Sheet

Date*:		
Location*:		
Team*:		
Weather:		
Entrance Description	❒ **Single Entrance** ❒ **Multiple Entrance (number____)** ❒ **Shared entrance** ❒ **Awning present**	
Description of parking	**Automobiles** ❒ **On Street unrestricted** ❒ **On street, restricted** ❒ **Lot** ❒ **Garage**	**Bikes** ❒ **Bike Corrals________** ❒ **Bike Racks_________**
Site Amenities	❒ **Drive Through** ❒ **Awning** ❒ **Tree Canopy** ❒ **Benches** ❒ **Sidewalks** **Width ________**	❒ **Bio-swales** ❒ **Pedestrian Refuge** ❒ **Sidewalk Bump-out** ❒ **Bus line** ❒ **Bus Stop**
Is there construction present?*		
Other observations about site & customer behavior*		
Pictures Taken	❒ **Entrance** ❒ **Example Auto Parking & Parking Lot** ❒ **Example Bike Parking** ❒ **Streetscape** ❒ **Surveyors in action (Smile!)**	
Data entered Date: **Data entry name:**		