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Choosing Transit: The Influence of Past Travel Behavior, Attitudes and Habits on Present Choices

Author
Rubin, James

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Choosing Transit:
The Influence of Past Travel Behavior, Attitudes and Habits on Present Choices

By

James Rubin

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Committee in charge:

Professor Elizabeth Deakin, Chair
Professor Robert Cervero
Professor Mark Hansen

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ABSTRACT

Choosing Transit:
The Influence of Past Travel Behavior, Attitudes and Habits on Present Choices

by

James Rubin

Doctor of Philosophy in City and Regional Planning

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Professor Elizabeth Deakin, Chair

In this study I have examined the role of prior experience in the use of transit using a combination of survey research and focus groups. In some ways this influence is examined directly. Otherwise, it is investigated through individuals' desire to locate near transit stations. While considering travel times and costs of available modes, this dissertation also looks at which features of transit are most likely to influence non-transit users to change their habits and use transit and which features are essential for keeping those who already use transit. These questions are explored for all trips and specifically for work trips.

One specific area of past experience that is examined in this research is the role of exposure to transit during high school, college and immediately after college. Does this exposure have a lasting influence on mode choice later in life?

I have found that, as previous research has shown, transit cost and time are the primary economic motivators of mode choice. Beyond these considerations, mode comfort, the ability to use travel time productively and perceived safety from crime are important determinants of mode choice. Childhood experiences proved to have little direct influence, but this is mostly due to the fact that few participants had exposure to transit during childhood. Exposure in college and immediately after proved to have an influence on mode choice for individuals who were exposed to it during this time.

This dissertation is dedicated to the memory of
Thelma Israelson, Edward Sagarin and Gertrude Sagarin,
who have instilled in me a sense of compassion,
a thirst for knowledge
and a desire for justice, respectively.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

Figures

Tables

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1: Introduction and Overview

Transit is promoted as a desirable mode choice for US urban areas, offering the potential for healthier lifestyles and reduced congestion, energy use, air pollution, and greenhouse gas emissions. Yet only five percent of work trips and even fewer of the trips for other purposes in the US are currently made by transit.

Transit's ability to compete with the automobile is heavily influenced by its time and cost. Where there is little traffic and cars can park for free, only a tiny share of trips are made by bus or rail. In areas where car travel is congested and parking is expensive, transit captures a much larger share. Still, time and cost are only part of the explanation for transit's difficulty in competing with the auto; there is some evidence that many Americans do not even consider it as a travel option. Understanding why this is the case, and identifying factors that could change this situation, are the objectives of this dissertation.

In particular, in this dissertation I examine the role that prior experience with transit has in influencing its consideration as a travel option. Using surveys and focus groups, I investigate how transit habits are created and broken. I also look at how knowledge, experience, attitudes and beliefs shape action. The results offer insights that can be used by transit planners to design programs for both sort term and life-long transit use.

The dissertation is organized as follows. In chapter 2, I review the benefits of transit, its costs, ridership trends, and efforts that have been made to increase ridership. In Chapter 3, I discuss the literature on habit and how knowledge, experience, attitudes and beliefs shape views on transit and willingness to use it. This chapter forms the theoretical framework for how I will investigate mode choice in the subsequent chapters. In Chapter 4, I present a methodology for investigating these issues in a case study in the San Francisco Bay Area. In Chapter 5, I present the results of a survey of Downtown Oakland commuters that explores their transit use for all the trips they make, regardless of purpose. In Chapter 6, I specifically examine mode choice for the work trip and present several models to represent this choice. In chapter 7, I present the results of focus groups that dig deeper into the underlying values, beliefs and experiences identified in the survey.

2: Transit Benefits and Costs, Ridership Trends and Attempts to Increase Use

2.1: Introduction

Contemporary policy concerning public transit in the United States is split. On one hand, transit is viewed as a socially desirable service, providing mobility to those who cannot or do not wish to use a private automobile, reducing congestion by diverting travelers from their cars during peak periods, and lowering energy use and emissions. On the other hand, it is also seen as a public policy problem – a service that is used by a small minority of travelers, one that is unable to cover its capital and operating costs, and one that can even create environmental problems in some cases. Transit planners thus are challenged to seek ways to maximize the benefits while controlling the costs of transit service provision.

This chapter reviews the benefits and costs of transit in the US. The chapter then examines ridership trends along with strategies that have been used in attempts to increase transit use. The chapter shows that despite major investments in transit and some successes in increasing total ridership, many transit systems are still struggling to capture a significant market share of urban travel. This provides the motivation for the research into traveler perspectives on transit and factors that affect its use, presented in the chapters that follow.

2.2: The Direct Benefits of Transit Use

Transit has the potential to provide a number of direct and indirect benefits, if it is well deployed. Direct benefits are those to its users, who obtain transit service and the access it provides. Indirect benefits include congestion relief, reduction of energy use, and reduced air pollution and greenhouse gas emissions. In considering transit use benefits, the costs of excessive automobile use must also be examined. There is evidence that over-reliance on the automobile has negatively impacted public health, sacrificed productive work hours, and consumed large quantities of gasoline. Studies have concluded that there is a higher occurrence of asthma in children from households adjacent to heavily used freeways (Gauderman et al. 2005). Several other negative health conditions are associated with high automobile usage including obesity which is more prevalent among residents of automobile-oriented communities (Jacobson et al. 2011). Just as transit reduces congestion on roadways, these negative aspects of automobile-oriented development can be mitigated by transit use in certain circumstances.

By decreasing automobile demand, transit use can reduce pollution and resource consumption, thus preserving the environment (Bae 1993, 2004; Deakin 2001).

Direct benefits to transit users are a key reason for the provision of transit in the US. Transit users include both those who have no other travel alternatives – the transit dependent population – and those who ride transit by choice. The benefits of travel for these groups are measured not only through accessibility, but also through customer satisfaction measured in broader terms. For individuals, the benefits of using transit can be both economic and personal. In some of the most congested areas, transit service provides a cheaper and faster alternative to driving. Even when transit travel times are longer, some individuals prefer transit, because they can relax, daydream, read, get work done, or socialize in a way that would be impossible in a private automobile. If an individual does not own an automobile or resides in a household in which there are fewer vehicles than traveling adults, the existence of good transit service can be a tremendous benefit, without which many essential tasks, including employment, would be almost impossible. By improving the accessibility of those who cannot or choose not to drive, transit helps to ensure some degree of social equity.

2.3: The Indirect Benefit of Transit Use

Congestion Relief: Perhaps the most important indirect benefit transit use provides is reduced congestion that would occur if transit users drove instead. To the extent that transit removes cars from the road, it provides an overall regional reduction in delay (see TABLE 2.1) including a reduction in delay for those choosing to drive. This benefit only occurs, however, when roads are congestion, principally during peak hours.

TABLE 2.1: 2009 Percent Increase in Delay without Transit Service in the 25 US Urban Areas with the Largest Population (SOURCE: Texas Transportation Institute)

Urban Area	**Delay Increase (percent)**	**Delay Increase per Auto Commuter (percent)**
New York-Newark NY-NJ-CT	81.0	76.2
Los Angeles-Long Beach-Santa Ana CA	6.4	6.3
Chicago IL-IN	24.8	12.9
Miami FL	6.6	7.7
Philadelphia PA-NJ-DE-MD	19.3	15.4
Dallas-Fort Worth-Arlington TX	3.8	4.2
Washington DC-VA-MD	18.9	14.3
Boston MA-NH-RI	27.7	16.7
Atlanta GA	7.4	6.8
San Francisco-Oakland CA	23.7	16.3
Houston TX	4.6	5.2
Detroit MI	2.2	3.0
Phoenix AZ	3.1	2.8
Seattle WA	16.4	13.6
San Diego CA	8.8	8.1
Minneapolis-St. Paul MN	6.8	7.0
Baltimore MD	16.0	10.0
Tampa-St. Petersburg FL	1.9	2.9
St. Louis MO-IL	6.0	6.5
San Juan PR	11.5	9.1
Denver-Aurora CO	7.9	8.5
Riverside-San Bernardino CA	2.8	3.3
Portland OR-WA	13.4	11.1
Sacramento CA	4.6	4.2
San Jose CA	4.4	2.9

Transit's congestion reduction benefit is more pronounced where rail service is provided, in part because rail service is usually limited to the densest and most congestion prone parts of the city. Several studies have shown that as rail systems are established or expanded, congestion declines (Castelazo and Garrett 2004, Winston and Langer 2004). Buses have less ability to reduce congestion because they often utilize the same roadways as automobiles and without a dedicated right-of-way, are subjected to the same traffic conditions. They may even add to congestion by blocking lanes of auto traffic as they move into and out of bus stops.

According to the Texas Transportation Institute (TTI), which compiles annual reports from the Federal Highway Administration's (FHWA) Highway Performance Monitoring System (HPMS) and service data reported to the Federal Transit Administration (FTA) by local transit operators, the elimination of transit service in 439 US urban areas would have increased delay on roadways by an average of 16.3 percent and increased delay for each automobile commuter by an average of 11.8 percent in 2009. In the largest US urban areas, with populations of more than 3 million, discontinuing transit service would have added an average of 24.1 percent more annual delay on roadways and 16.0 percent more annual delay for each automobile commuter. In the tri-state New York region, where there is an abundance of congested roadways and many individuals use public transportation, eliminating transit service completely would have increased overall annual congestion delay by 81.0 percent and delay per automobile commuter by 76.2 percent (TTI 2009).

Monetary estimates of the benefits transit provides in congestion relief have been examined by several researchers. The most straightforward approach has been to assign a value to reduced automobile vehicle miles of travel (VMT). Aftabuzzaman et al (2010) compiled estimates from several studies around the US. Litman (2003) estimates a range between 10 and 30 cents per urban peak vehicle mile. Others settle on a more precise measure; Skolnik and Schreiner (1998) found a value of 20 cents per VMT, the FHWA (2000) used 7.7 cents per VMT for urban interstate freeways, Schrank and Lomax (2005) estimated as much as 42 cents per VMT in 85 US cities, and Nelson et al. (2006) concluded that transit reduces congestion by 20.4 cents per VMT in Washington, DC.

TABLE 2.2: Annualized Construction, Operation and Maintenance Costs per Parking Space (SOURCE: Victoria Transport Policy Institute)

Type of Facility	Land Acquisition	Construction	Operations and Maintenance	Total
Suburban, On-Street	$76	$283	$300	$659
Suburban, Surface, Free Land	$0	$283	$300	$583
Suburban, Surface	$172	$283	$300	$755
Suburban, 2-Level Structure	$86	$1,416	$300	$1,802
Urban, On-Street	$378	$472	$300	$1,150
Urban, Surface	$787	$472	$500	$1,759
Urban, 3-Level Structure	$262	$1,699	$500	$2,461
Urban, Underground	$0	$2,360	$500	$2,860
CBD, On-Street	$1,888	$472	$400	$2,760
CBD, Surface	$3,630	$472	$400	$4,502
CBD, 4-Level Structure	$908	$1,888	$500	$3,295
CBD, Underground	$0	$3,304	$500	$3,503

Avoided Infrastructure Costs: Another important benefit transit service provides is the reduced need for parking spaces. If each automobile carries 1.59 persons (US Department of Energy 2010), a bus with 40 passengers eliminates the need for 25 parking spaces and a train with 240 riders eliminates the need for 150 spaces. Many trips, particularly for the purpose of commuting to work, are to destinations in dense urban central business districts (CBD), where land values are high and availability is scant. Transit use reduces the need for parking facilities in these locations and thus provides even greater benefits in downtown business districts. Based on data compiled by Todd Littman at the Victoria Transport Institute (TABLE 2.2), in CBDs, annual construction, operations and maintenance costs vary from $2760 to $4502 per space depending on the type of parking provided (Litman 2005). Costs are high in non-CBD areas of cities as well, ranging from $1150 to $2860 per space annually. Some of these costs are recouped through fees paid by customers to park, but in most cases, the funds collected only offset a small portion of the construction, operations and maintenance costs, which are absorbed instead by employers, retail establishments, etc. and passed along to consumers indirectly (Litman 2005).

Growth Management and Economic Development: In areas with well-developed public transportation systems and adequate service and demand, transit and development have been shown to form a symbiosis in which operators depend upon surrounding land-uses to generate enough customers to support the service provided and in turn, transit acts as a catalyst for development by improving access to the areas around stations (Cervero 1994). When new development is planned, many municipalities have found it to be cost effective to concentrate such development around areas that already have services. Taking advantage of the higher degree of accessibility around transit stations and the market advantage that it provides, many cities have turned their focus to infill growth in existing station-areas instead of leap-frog or fringe development. Planners can use transit stations as a focal point for development, using of the high level of accessibility around transit stations to create a market for commercial and residential development. Indeed this is a major tenet of transit-oriented development (TOD), a strategy that has become increasingly popular over the past ten years.

In a number of states, TOD is being used in this manner to manage growth and promote economic development. For example, in California, population growth requires substantial new development. How this development occurs has a significant impact on the environment; growth in low densities at the metropolitan fringe is associated with higher levels of vehicle miles traveled than infill and densification of existing communities and compact growth. California is attempting to steer its growth toward the latter, with the result that greater demands are being placed on transit. Further economic development in the state's largest cities depends on having a good transit option for commuting (CA State Senate 2001).

Improved Public Health: In order to access transit, many individuals walk to stations and stops. This increased exercise can help to maintain a healthier population.

2.4: Costs of Transit

While transit has the potential to deliver benefits both to users and to the broader public, as implemented in the US, it also is a major source of costs to governments. Transit operators are dependent on local, state and federal funding to cover capital costs as well as the differences between operating costs (see FIGURE 2.1) and fare revenues. Since 1991, the amount of total operating costs for transit agencies in the US that is covered by local funding has diminished. As a result, operators have become more dependent on state and federal funding (see FIGURE 2.2). Many operators have had to cut back services despite the fact that many travelers are seeking to use transit to save money and avoid high gasoline prices. Long term prospects for funding are equally precarious and uncertainties about the future have led a number of transit operators to defer capital investments.

FIGURE 2.1: 2009 Sources of Operating Funds for all Transit Operators in the US (SOURCE: US DOT)

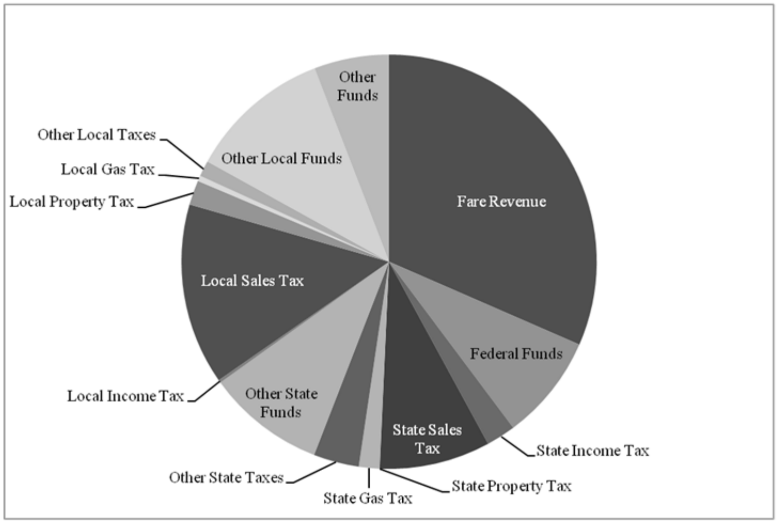
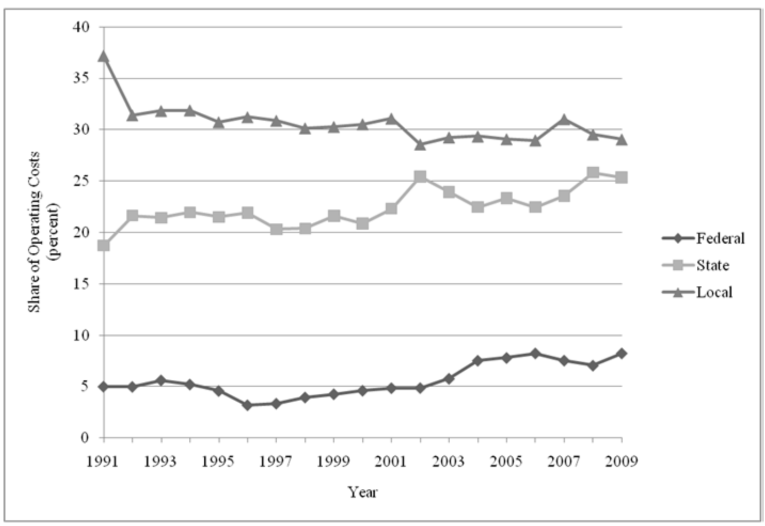


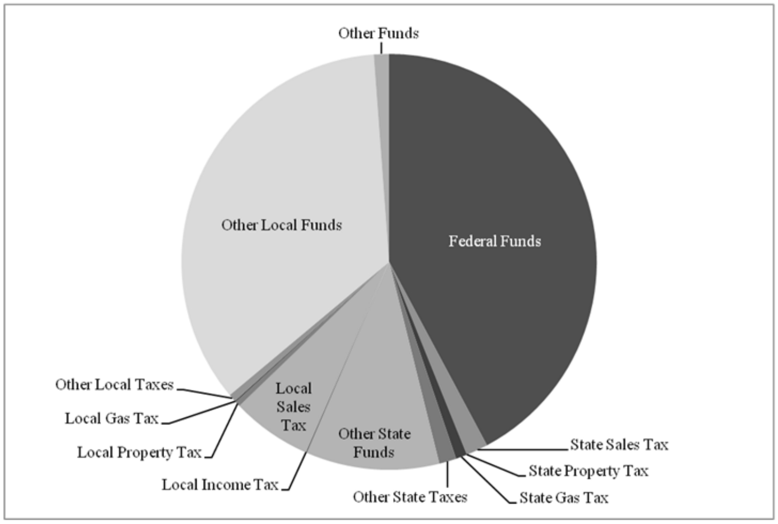
FIGURE 2.2: Total US Federal, State and Local Operating funding sources for Transit from 1991 to 2009 (SOURCE: US DOT)



Resources for capital projects are also a delicate mix of local, state and federal funding (see FIGURE 2.3). Shifting funding from operations to capital projects is not an option for many operators, who fear that reductions in operating funds will lead to reductions in service and thus fewer customers. Also, many funding sources, particularly on the federal level, do not permit funds to be shifted from capital projects to operations.

Future transit costs are a major concern for many transit operators, who are facing substantial shortfalls in securing funds to keep their systems in a good state of repair. The second generation of US heavy rail systems, the Bay Area Rapid Transit District (BART),

FIGURE 2.3: 2009 Sources of Capital Funds for all Transit Operators in the US (SOURCE: US DOT)



Washington Metropolitan Area Transit Authority (WMATA), and the Metropolitan Atlanta Rapid Transit Authority (MARTA) are nearing 40 years of service and require major investments to remain in a state of good repair. BART, for example, seeks to achieve a state of good repair within 10 years and replace assets over thirty years. That will take more than $15 billion (an average of $513 million per year) to achieve. Analysts have concluded that if only 50 percent of the needed investment is made, BART's on-time performance could drop to 76 percent with breakdowns occurring more than five times as often as they do now (Cambridge Systematics 2011). If the available funding could cover only 30 percent of the needed investment toward achieving a state of good repair over the next 30 years BART's on-time performance could decline by 67 percent and by 2042 breakdowns would occur almost 6.5 times as frequently as they currently do.

While it might seem that an increase in transit ridership would be beneficial in increasing revenues, such increases are not always positive. Ridership surges can be a detriment if systems are already operating at capacity, which is often the case during peak hours. Additional riders during those times put a further strain on the system that ultimately costs the agencies more to operate service and slows down service, thus eroding benefits. The challenge is to increase ridership when vehicle and station volumes are below capacity and can accommodate more users.

However, the number of passengers on a transit vehicle must exceed a given threshold to achieve any benefit at all. For example, the average fuel consumption for automobiles in 2009 was 23.8 miles per gallon with an average occupancy of 1.59 passengers per automobile and the average fuel consumption for buses was 6.4 miles per gallon (US DOT 2010). Based on these estimates, each bus would have to carry at least 6 passengers at all times in order for buses to consume less fuel than automobiles per passenger mile per gallon. Since buses usually have to follow somewhat circuitous routes, and since backhauls are often lightly utilized, these factors reduce the efficiency of bus operations further. For example, a bus that returns to the start of its peak period route with only a handful of passengers might need a dozen passengers to be as efficient as a car. A similar threshold can be estimated for each type of emissions pollutant.

Operating buses below these ridership thresholds exacerbates the fuel consumption and emissions problems faced by many regions, rather than helping to reduce the problems.

Because transit is a small share of the total travel market in the US, its fuel efficiency has not been a major cause of concern. In a typical year, more than two-thirds of oil consumed in the US is used to power transportation vehicles (Davis and Deigel 2002; Greene 2004), but public transportation vehicles comprised only a relatively small portion of the total consumed; of the five trillion total passenger miles travelled in the US in 2000, 90 percent were in automobiles and only four percent were on transit (US DOT 2010). Still, if environmental benefits of transit are to be realized, keeping passenger loads on buses relatively high is an important objective.

It follows from the above discussion, that benefits are maximized as transit vehicles reach their capacities. Unfortunately, few transit vehicles operate at capacity during non-peak hours (Vuchic 2005). Furthermore, if ridership increases exceed vehicle capacities and additional resources are required to meet an increase in demand, benefits may be compromised if the additional vehicles are not filled to capacity.

2.5: Improving the Benefit Cost-Ratio – Increasing Ridership

Though transit service requires subsidies to make up the difference between fare revenue and operating costs, several researchers have found these subsidies to be worthwhile. Nelson et al. (2006) found that the benefits provided by transit service outweigh the costs of transit subsidies in many cases. Parry and Small (2007) found that in Washington, DC and Los Angeles, CA, transit subsidies are welfare improving when congestion, pollution, accident reductions, and scale economies are considered. Because of this, increasing transit use to capture higher levels of benefit and cover costs is a widespread goal.

Faced with the substantial benefits that a mass movement toward transit use would provide, and barring some of the aforementioned circumstances in which transit ridership increases are not desirable, economists, engineers, planners and policy-makers have long sought to better understanding why some people use transit and others do not. With a better understanding, policy adjustments and investments can be made to encourage transit use and further achieve some of the benefits associated with it.

To better understand mode choice, two analyses are necessary. The first approach examines the general trends in transit and automobile use. In other words, what has happened in society as a whole to encourage or discourage the use of a particular mode? Some examples include the invention and promulgation of the automobile, resource conservation during wartime, and the mass exodus from cities to suburbs. A large literature has examined these issues (Warner 1978, Jackson 1985).

The second analysis is much more complicated and involves understanding why individuals choose or do not choose transit for specific trips. The fact that the demand for transportation is derived complicates the analysis. For this reason, an examination of mode choice cannot be extricated from an examination of the individuals making the choice, the households in which they reside, and the activities they seek to access. The majority of the research presented in this dissertation builds on an established theoretic framework that addresses the intricate process of mode choice for individuals.

2.6: Critical Views of Transit

There are of course some researchers who are critical of transit and the benefits it is purported to provide. One particular criticism focused on rail-based transit is that it seldom achieves the ridership forecasts that are predicted during planning stages, yet typically cost more than predicted capital and operating costs (Winston and Shirley 1988; Pickrell 1992). Much of this criticism is directed at the light rail systems that were constructed in the latter half of the twentieth century. More recent projects' forecast and cost projections have been more accurate. The improvement in forecasting may in fact be due to the attention these researchers cast on previously poor efforts.

Several researchers have concluded that transit is a declining industry. Arguments in favor of this are based on decreasing ridership statistics (Gordon 1999; Semmens 1999; Richmond 1999; Cox 2000). However, many of these analyses were performed in the late 1990s and since transit ridership has increased in many metropolitan areas.

Another referenced criticism of transit is that travel times are often longer than those of driving (Semmens 1999; Cox 2000). This is due to access time, the time it takes a traveler to reach a train station or bus stop from his or her home. In fact, some researchers have concluded that rail travel actually takes longer than bus travel when accounting for access, wait, delay and transfer time (Rubin and Moore 1996). The fact that most transit travelers prefer rail to bus if given the choice means that either this conclusion is inaccurate or more likely, other factors are equally if not more influential. In addition to access times, transit travel times tend to be longer because of the delays associated with frequent stops.

Some critics have claimed that transit doesn't significantly reduce congestion (Rubin and Moore 1996; O'Toole 1998; Cox 2000). Furthermore, rail projects draw riders who previously used buses and as such do not reduce the number of automobiles on the road (Gordon 1998). These conclusions are in stark contrast to the annual report produced by the TTI, which is widely used to show the congestion reduction impacts of transit service.

One particularly accurate criticism of rail transit is that most systems serve city centers and downtown areas well, but not suburban areas where employment is growing (Gordon 1998; Cox 1999). This deficiency is further aggravated by the fact that workers increasingly live in one suburb and commute to another – a scenario in which rail transit is not well suited at all (DeLong 1998). In some places, like suburban Portland, Oregon, large employers provide shuttle service to transport workers from rail stations to corporate campuses.

Some researchers are dubious about the potential for transit to influence economic development (Cox 2000). Many of these arguments are based upon downtown office space vacancy rates in cities with better transit networks compared to those without. However, office space vacancy is a much more complicated matter and is due more to supply/demand problems than transit inadequacies. Additionally, critics have characterized development from transit as localized and not regional significant. These ideas are somewhat in conflict with the fact that new development has occurred in suburban areas, not downtowns and that transit has been shown to have a "push and pull" effect. Stations tend to concentrate development around them as the existence of transit networks enables development in areas further from city centers.

Lastly, based on the cost to construct and operate rail transit systems, several researchers have proposed that simply providing and subsidizing automobile ownership would be a more cost-effective strategy than building new transit networks (Cox 1999). However, this does not take into account the increased congestion, pollution and resource consumption from such a strategy. It also does not offer a solution to individuals who cannot drive for physical or psychological reasons.

2.7: Ridership Trends

Until recently, it seemed as though the decline in transit use that began more than 50 years earlier (see FIGURE 2.4), particularly for work trips (see FIGURE 2.5), would continue into this century. The first major reduction in transit demand occurred during the Great Depression that followed a steady increase that began at transit's inception. Total ridership decreased by 22 percent from 1930 to 1935, exacerbating the financial difficulties of both public and private transit operators (APTA 2010). As the Depression lightened, from 1935 to 1940, transit patronage increased moderately. Transit use reached its peak during World War II.

FIGURE 2.4: US Transit Ridership 1902 to 2009 (SOURCE: APTA)

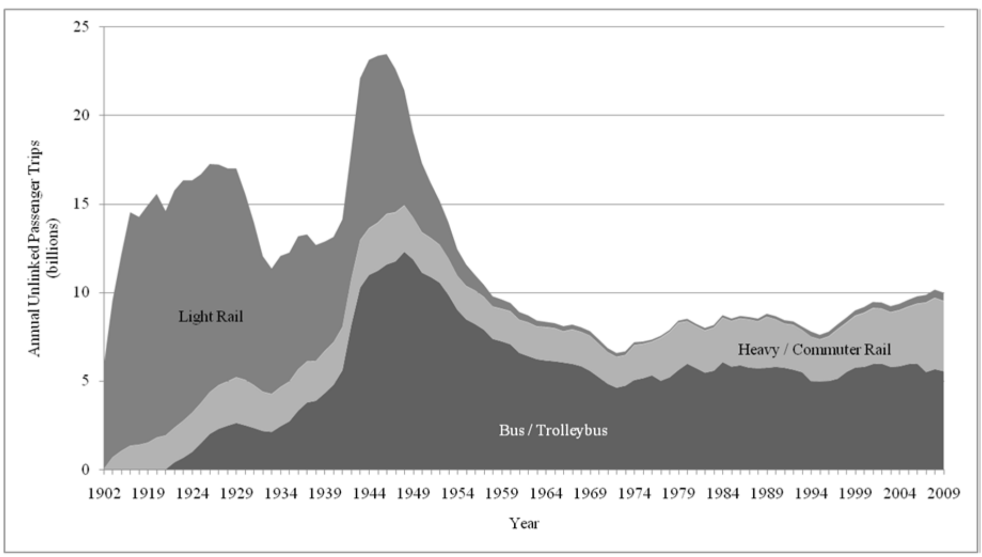
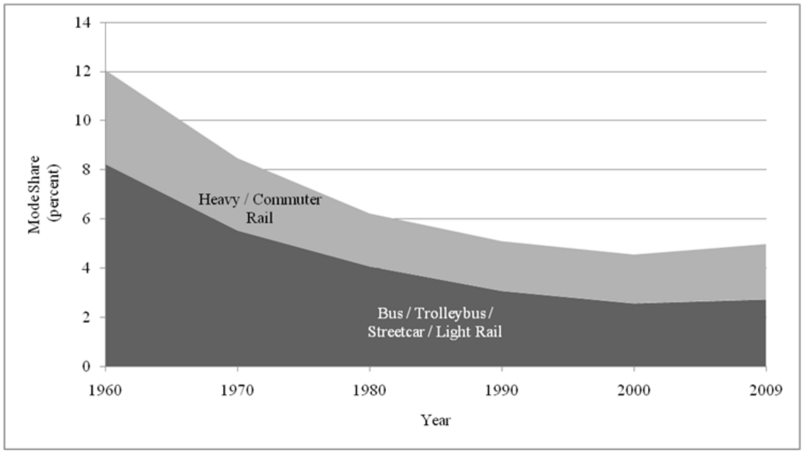


FIGURE 2.5: US Census Journey to Work Mode Share 1960 to 2009 (SOURCE: US Census Bureau)



In 1945, 23.3 billion trips were made on transit. Those record levels were attributed to fuel rationing, automobile part shortages, and the public's willingness to use transit, as it was seen as an act of patriotism (APTA 2010). This ridership boom was a mixed blessing, however, because it took a heavy toll on transit vehicles and infrastructure.

Some contend that the peaking nature of urban travel demand and the structure of transportation labor work-shifts were financial strains that began to negatively impact the transit industry in the 1920s, long before ridership statistics indicate (Jones 1985). Nevertheless, it is clear that after World War II, transit patronage began a steady decline that lasted well into the 1970s and for work trips, the trend continued through the 1990s. Ridership dropped from 23.3 billion trips in 1945 to a mere 7.3 billion in 1975 – nearly a 70 percent decrease, despite the fact the overall US population continued to grow during that time. Transit agencies, most of which became publicly owned and operated during this period, struggled to provide service as demand continued to drop; revenues from fares were insufficient to fund operations and maintenance.

By 1950, the automobile had become the mode of choice in America and since, the impact of transit on development has been overshadowed by the influence of the automobile (Harrison and Kain 1974). According to Cervero and Landis (1995), because of the ubiquity, high performance features, and the extensive roadway construction projects that accompanied it, the private automobile "helped usher in an era of seemingly unrelenting population and employment decentralization."

Mieszkowski and Mills (1993) found some evidence that the trend toward suburbanization began before World War II and intensified after the war. They describe three distinct forces that explain suburbanization: (1) improvements in transportation infrastructure and technology, which reduce the costs of commuting and facilitate employment decentralization, (2) increases in household income that permit families to act on their desire for more space, and (3) the fiscal and social problems of cities, such as high taxes, inadequate public services, racial tensions, and crime.

As more Americans moved to the suburbs, they purchased more automobiles (Muller 2004). The automobile quickly became less of a luxury and more of a necessity as transit networks provided far less accessibility in suburban areas. By 1970, many urban transit operators were providing service in facilities that were criminal hotspots (Thrasher and Schnell 1974; Cudahy 1979; Clarke et al. 1996) and covered in graffiti (Cudahy 1982; Austin 2001). Since the initial rapid transit construction boom of the early 1900s, only two systems had opened in the US – Cleveland in 1955 and the Philadelphia-Lindenwold high-speed line in 1969. The public's perception of transit was so negative that there were several documented cases of communities opposing local transit service, despite obvious gains in accessibility, out of fear that it would bring unwanted persons to their neighborhoods (Pucher 1995; Clarke et al. 1996). During this time, many urban transit systems entered into a perpetuating cycle of deferred maintenance, increased crime, and reduced ridership (Carr and Spring 1993).

Soon thereafter, a second generation of heavy rail transit systems opened in the Bay Area in 1972, Washington in 1976 and Atlanta in 1979. These were followed by Los Angeles and Baltimore in 1983 and Miami in 1984. There also began a renewed interest in light rail, which had almost completely disappeared as a mode by the early 1970s. The next 25 years brought about new light rail systems in San Diego, Sacramento, Portland, and more recently in Dallas, Phoenix, Denver, San Jose and Salt Lake City among others. With a renewed investment in rail transit and a growing congestion problem on the roadways in many regions, transit use began to reverse course and by the late 1970s, ridership started to increase.

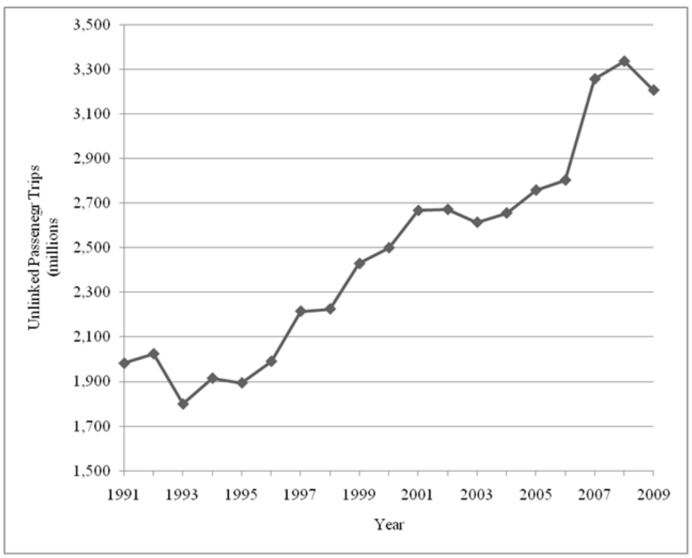
During the last third of the 20th century and achieving more prominence in the past ten years, there has been a growing acknowledgment of the negative impacts of over-reliance on the automobile, automobile-oriented development and the negative impacts that roadway facilities sometimes cause in communities. Many attribute the origins of this paradigm shift to Jane Jacobs' seminal book the Death and Life of Great American Cities and her successful effort to defeat Robert Moses' proposed cross-Manhattan freeway. Though Jacobs' book may very well be the harbinger of transformation from the prioritization of automobile access to a greater concern for individual communities, the concepts of walking environments and neighborhoods designed to encourage healthy interaction among residents were nothing new. In fact, many of the best planned compact walking communities are built around transit stations and date back to the beginning of the 20th century or earlier (Mineta Transportation Institute 2001).

The transit use rebound in the US has been attributed to several factors. Some report the growing sentiment of environmental stewardship among residents as motivation for using less polluting and resource consuming modes (Newman and Kenworthy 1999). As Census data reveals, the trend toward population growth in suburban areas and the urban exodus that began after World War II has slowed and in some regions reversed course. The construction and expansion of the second generation of heavy rail systems and the rediscovery of light rail as a cost-effective transit solution have also driven up ridership in many regions. More recently, car sharing has started to take hold in several cities; it provides an alternative to individuals and families that do not wish to own a car. This encourages transit use for other trips, particularly for the commute to work.

However, a closer examination of recent transit ridership data reveals that although it appears that transit's loss of ridership has indeed reversed, the gains made over the past 20 years are less impressive. When ridership data is analyzed without considering gains made by the New York City subway system (see FIGURE 2.6), transit use increases are much smaller (see FIGURE 2.7). Overall bus ridership declined from 1991 to 2009. Heavy and commuter rail usage remained relatively unchanged. Only light rail use has increased driving total transit ridership figures upwards, albeit only slightly. Transit use among commuters to work outside of the New York City region has started to increase since 2000 (see FIGURE 2.8), but that increase is only slight and still well below census figures reported in 1990.

Of concern is that there have been no substantial gains in bus ridership, which is still the most predominant form of transit in the US. This is despite efforts to improve bus service in many cities through the use of a set of features described as bus rapid transit (BRT). However there is reason to be optimistic about some of the most recent trends. When percent increases in VMT on public roads is compared to percent increases in passenger miles of travel (PMT) on transit, relative to 1991 as a base year, PMT increases have overtaken VMT increases for the last two years despite a substantial decline in the first half of the last decade (FIGURE 2.9).

FIGURE 2.6: New York City Transit Ridership 1991 to 2009 (SOURCE: US DOT)



Another reason to be optimistic is that most transit systems that include heavy rail service have increased ridership since 1991 (see FIGURES 2.10 and 2.11). Only the Chicago Transit Authority (CTA) and the Greater Cleveland Regional Transit Authority (GCRTA) have lost riders since 1991 and ridership on the Philadelphia area operators, the Southeastern Pennsylvania Transportation Authority (SEPTA) and the Port Authority Transit Corporation (PATCO) has remained unchanged.

FIGURE 2.7: US Transit Ridership Excluding New York City Transit 1991 to 2009 (SOURCE: US DOT)

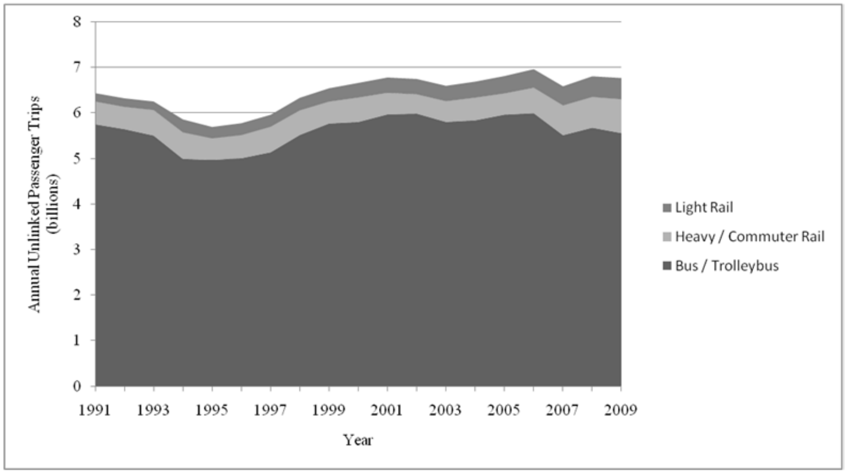


FIGURE 2.8: US Census Journey to Work Mode Share excluding New York-Newark Urbanized Area 1990 to 2009

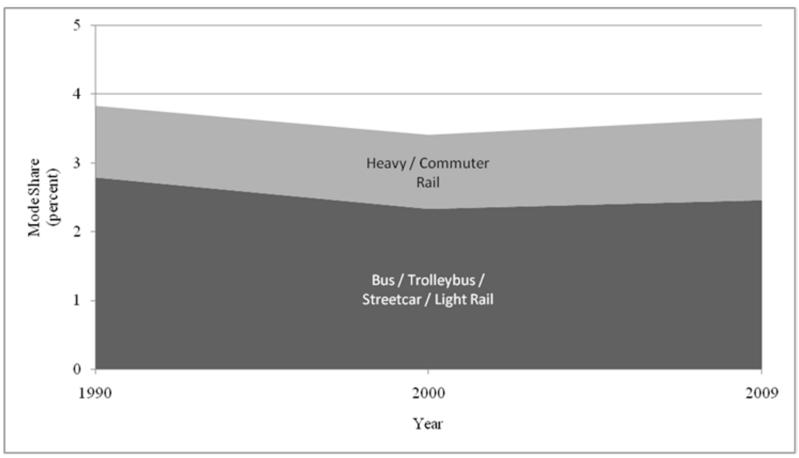
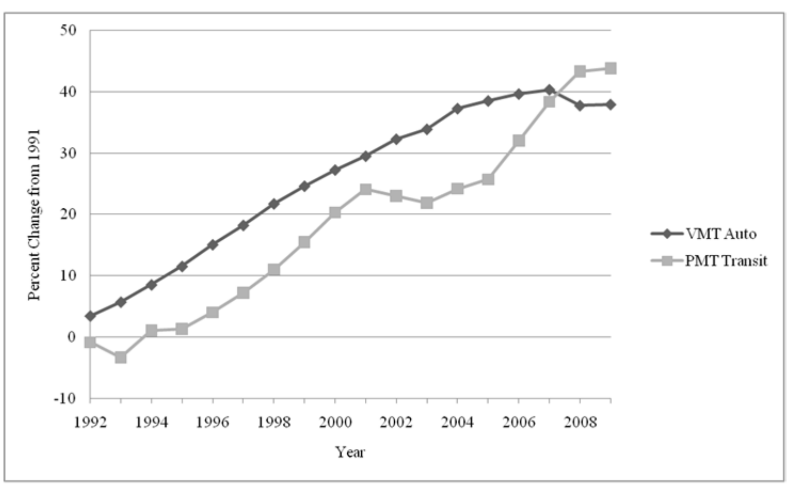


FIGURE 2.9: Percent Increases in US VMT on Public Roads and PMT on Transit Relative to 1991 levels from 1992 to 2009 (SOURCE: US DOT)



2.8: Attempts to Increase Transit Use

Strategies to increase transit use have focused on infrastructure improvements – making transit available where it did not previously exist, or upgrading service from bus to rail, or improving the quality of facilities – and on improvements in transit travel time and cost. Increasingly, however, analysts are concluding that more fundamental steps may be needed if transit is to ever be more than a minor mode or a mode for large central cities.

Infrastructure Improvements: Improvements to the physical features of transit systems fall into two categories: facility design improvements and new services. Facility-based solutions seek to increase transit usage by improving features such as fare collection systems, coordinating of transfer stations, increasing safety and security, upgrading station and vehicle amenities, and improving access to stations. Along with service improvements such as reliability (fewer break-downs and delays), expanded hours of operation and increased frequency, these characteristics of transit systems may affect ridership. But in most circumstances, even after infrastructure expansions and upgrades, automobiles still provide more accessibility, particularly in suburban and rural areas.

FIGURE 2.10: Ridership on Larger (more than 200 million annual Unlinked Passenger Trips) US Transit Systems with Heavy Rail 1991 to 2009 (SOURCE: US DOT)

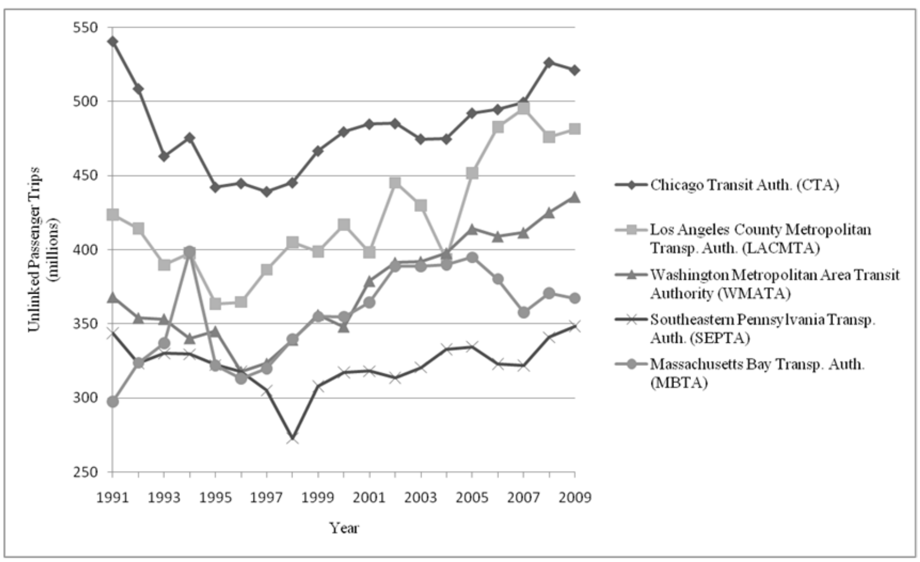
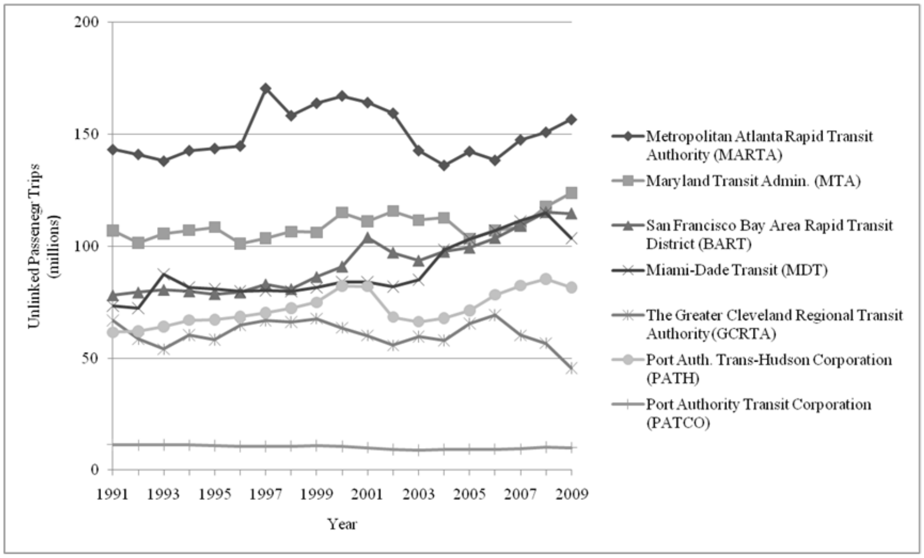


FIGURE 2.11: Ridership on Smaller (less than 200 million annual Unlinked Passenger Trips) US Transit Systems with Heavy Rail 1991 to 2009 (SOURCE: US DOT)



It is important to note that the automobile can be a suitable mode for almost any development pattern. However, transit is not suitable in low density areas. The provision of transit service to these areas is costly and unrealistic. Several researchers have shown that is more cost-effective to provide residents with automobiles in low-density areas than to try and provide any transit service at all (Lave 1979).

Travel Time and Cost: Mode choice models, widely used to study travel behavior, show that travel time and travel costs are dominant factors affecting choice. In many markets, transit is slower than the automobile, putting transit at a decided disadvantage. Transit makes many stops, may follow a less direct route than a driver would take, and can get caught in traffic to an ever greater extent than a car would. Where transit has its own right of way or is provided with priority treatments that let it bypass congestion, however, it can be as fast or faster than a car.

For transit, travel time is reduced through capital and operational improvements. Individuals are more likely to choose transit when travel times are comparable or less than those of automobiles. As a result, investments are made in infrastructure in order to increase the coverage and speed of transit networks to provide shorter travel times to more locations. These can range from rail on its own right of way, to exclusive bus lanes on city streets and highways, to bus-activated traffic signals at intersections, to fare prepayment and information systems (which reduce boarding and alighting times.)

Research on urban in-vehicle travel time (IVTT) reveals that slight improvements in transit travel times are not likely to have a major impact on transit use. IVTT is thought to have an elasticity of approximately -0.6 for both bus and rail (Meyer et al. 1965, McFadden 1974, Winston and Shirley 1998). So, a five percent decrease in IVTT is only associated with only a three percent increase in transit use. More importantly, strategies that speed up bus IVTT at the expense of longer walking distances or more transfers may be counterproductive, since most studies have found that transfer time and walk time are two or three times more onerous than IVTT (Kittleson Associates 2007).

The level of investment in transit infrastructure needed to compete with the automobile in terms of accessibility is daunting. For the majority of Americans and for most trips, the automobile is still the most efficient means of transport. Furthermore, funding for transit improvements is extremely limited and competitive; most regions are able to find funding for only a small portion of proposed transit improvements.

Another way to make buses more competitive would be to slow traffic down. Though there are plenty of successfully implemented plans to slow traffic for safety reasons, and some examples of speed control for energy and environmental purposes, there are no known examples of interventions to increase automobile travel times in order to discourage use.

Cost Factors: Transit fares can be lowered to be more desirable to users, but this has obvious drawbacks, since public transportation agencies depend on funding from fares to provide service and implement service improvements. Every dollar generated in operating revenue is essential to these agencies, because they operate at a loss. Furthermore, there is evidence that reducing transit fares to zero (making transit free) increases ridership, but not enough to substantially change traveler's choices. Several agencies around the US promote free transit days in order to reduce automobile use and thus reduce emissions on some of the highest ozone level days of summer. On these free transit days there is indeed an increase in transit use, but the vast majority of travelers still use automobiles.

Price elasticities are also low for transit. They are estimated to be between -0.33 and -0.22 (Gillen 1994). Therefore, lowering the price charged to passengers on transit is also not likely to generate a substantial number of new riders.

Automobile costs can be increased in order to make transit more competitive. Additional costs can be imposed on individuals using automobiles through mechanisms such as fuel taxes, tolls, parking fees, registration fees, permits, and variable time and/or conditional pricing schemes. These approaches can substantially influence transit ridership when implementation is large-scale. Many commuters to midtown Manhattan use transit because parking is too expensive. London experienced an increase in transit use when cordon pricing was implemented.

Unfortunately, these approaches have proven to be politically unpopular and as a result, are extremely difficult to implement. Few elected officials are willing to support increases in cost for automobile users, because in almost every circumstance, drivers comprise the majority of an elected official's constituents.

The personal cost of travel for both modes does little to encourage transit use. Disregarding the sunk cost of automobile purchase and maintenance, which do not usually factor into an individual's mode-choice for a specific trip, the monetary savings of making most trips by transit are insufficient to compensate for the discrepancy in travel time. In fact, lower priced fuel has helped secure the dominance of the automobile (Pucher 1988; Kenworthy et al. 1999).

Land Use Strategies: Another major approach used to bolster transit ridership is based upon the aforementioned symbiosis between transportation and development. Researchers have concluded that by raising residential and commercial densities around transit stations, more transit trips are generated and thus, transit is better supported. This is a primary reason why planners have focused regional population, housing, and employment growth around transit stations and why an analysis of transit-adjacent land-uses and densities is required of projects receiving federal funding. Unfortunately, the coordination of transit and land-uses has proven to be difficult for several reasons: (1) the multi-jurisdictional nature of many transit corridors and systems, (2) the local resistance to land-use regulation, (3) the inability of developers to turn a profit from such specialized projects, (4) the lack of an existing land-use control authority, (5) the shortage of transit-adjacent land, particularly within urban cores for infill projects.

Marketing: To shore up ridership, many transit agencies have embarked on a variety of campaigns, from mass media marketing to individualized information and incentive programs offered at the place of employment. Social marketing approaches go so far as to use one-on-one coaching on commute options and the benefits of transit (Turrentine and Kurani, 2001). The efficacy of all of these marketing strategies has been less than their proponents hoped for, however, even in areas where transit is competitive with the automobile in terms of total travel time and cost (McGovern, 2005).

Taken together, these strategies have not proven sufficient in most markets to produce a significant mode shift to transit. Instead, major new capital investments, operating subsidies, marketing, TOD, and more have stabilized transit and led to mild increases in mode shares in most markets. The vast majority of US travelers continue to use automobiles for their daily needs, commuting and other. This raises the questions, is transit even considered by most Americans when they make their travel choices? What are the factors that lead some travelers to use transit while others continue to travel by car? How much of the choice is due to purely economic factors (time and cost) and how much is affected by other factors, and what are those other factors? Would a better understanding of the way transit is viewed by the traveling public allow transit agencies to better position themselves? These questions are addressed in more detail in the following chapters.

3: Theoretical Framework and Research Approach

3.1: Introduction

If using transit provides substantial benefits to individuals and society as a whole, why are mode shares for transit still so low, particularly as environmental consciousness and stewardship have increased in recent years? Even more importantly, what sorts of interventions might be of value in increasing transit mode share? Travel behavior research has identified a number of factors as key to mode choice, such as actual availability of modal options, travel times and out-of-pocket costs. Researchers have examined how socio-demographic characteristics such as age, sex, income, disability, race, and ethnicity affect travel choices and have explored how lifestyle and lifecycle considerations affect activity scheduling and hence impose travel constraints (Goulias, 1992; Pucher 1990; Pucher and Renne, 2003). Factors such as having a partner, having children at home (especially preschoolers), and even having pets can restrict the amount of time available for travel, require trip chaining to fit in all of the day's activity needs, and otherwise limit the actual availability of otherwise apparent travel options, thus limiting an individual's mode choice (Picado 2000). Researchers have also noted the importance of lifestyle issues in location choice and travel choices. For example, people who like to walk are more likely to reside in places where walking is facilitated.

3.2: Travel Behavior Models and Predicting Mode Use

In the past fifty years or so, research on travel behavior has helped to explain why individuals choose particular modes. The effort to understand travel behavior has been greatly informed by the development of models that are used to both analyze and predict travel behavior. Many of these models have been the basis on which researchers have found that travel time and out-of-pocket cost are predominant factors in determining an individual's preference.

Travel demand models, a larger group of models of which mode choice models are a part, are widely used in analyzing the effects of capital improvements and other policy interventions. They are used to predict changes in demand in response to changes in existing and planned transportation networks and policies such as pricing and frequency of service. The resulting forecasts are used in analyses of major investment studies and often form the basis upon which projects are prioritized.

Yet even with these models, planners are often inaccurate in predicting usage. For example, ridership levels on many recently constructed public transit projects have been found to be much lower than forecast in the US (Pickrell, 1992) and in other developed countries (Flyvbjerg, 2007). Some scholars attribute the inaccuracy of forecasts to wishful thinking on the part of the forecasters (Wachs, 1990; Flyvbjerg et al., 2007). According to these researchers, in order to secure funding to implement transit projects, planners over-inflate projected ridership data to make projects seem more essential to regional mobility.

One of the major criteria used to prioritize federal funding for transit projects is ridership forecasts. Operators, municipalities, regional planning agencies and/or states must demonstrate either existing or future ridership sufficient to support federal funding. It is worth noting that this is a distinct paradigm change from the early days of US transit system development. During that time, as cities grew, private companies built transit lines to far reaching areas with little development with the assumption that growth would follow. In fact, some transit companies purchased the land around these new lines as a means of capitalizing on the expected growth and these investments paid off. Today, almost all transit expansion is publicly funded and few cities are growing at the rate in which they did when transit was new. As a result, few transit lines are built to undeveloped areas. In fact, it would be quite difficult to secure federal funding unless adequate ridership currently exists or would grow as a result.

The analysis of mode choice for individuals on a trip level is a major focus for transportation planners. These tools are essential for two reasons. First, they help to predict the total number of users and thus help in evaluating the impact of proposed projects and improvements. But perhaps most importantly, they provide insight into the reasons why some people are choosing what modes and with that information, planners and policy makers can try and bring about change in mode toward a direction that is deemed favorable.

3.3: Random Utility

Perhaps the most important tool used to better understand individuals' mode choices for specific trips are random utility models (RUMs). This class of choice models was first introduced and applied to transportation by Domencich and McFadden (1975) and has been improved upon by numerous researchers, including McFadden himself. The basic concept behind these models is that an individual weighs various factors, most notably travel time and cost, for each available mode. Thus, each mode is assigned a and an individual selects the mode for which his or her utility is the greatest. Initially, these models were formulated with the assumption that all relevant information about an individual's motivation is discernible to the researcher or modeler. But no one can know all the factors that influence a decision maker, there are far too many and often they are specific to the individual making the choice. This uncertainty was incorporated into RUM models by including both a deterministic observable component and a random unobservable component to represent this uncertainty, similar to the error term that is associated with tradition multivariate regression models. It is primarily the stochastic component that leads to assumptions and restrictions in the formulation and usage of these models and many more advanced models have been created as means by which to relax these assumptions.

The deterministic portion of each mode's utility specification in RUM models often contain four components – attributes of the mode itself, characteristics of the decision-maker, characteristics of the choice situation and a mode-specific constant. Modal attributes include travel time (this can be further disaggregated into in-vehicle, access, and transfer times), travel costs and reliability. Characteristics of the decision maker include sex, age, income, education, vehicles available and household size. Characteristics of the choice situation include trip purpose, weather conditions and densities at both the origin and destination. The mode-specific constants should not be confused with uncertainty or error; they reflect the observable factors that are not individually specified in each mode's utility.

The two most widely used RUM model formulations are logit and probit, which are relatively easy to specify, and analyze. More advanced modifications can be made to RUMs to model stated preference data and both stated and revealed preference data (Louviere et al. 2000). The coefficients obtained in RUM models provide a convenient means by which analysts can determine the elasticities of included variables. This enables researchers to determine the percentage change in probability of an individual using a particular mode from a one percent change in a specific variable, such as travel time or cost, while keeping other independent variables constant (Ben Akiva and Lerman 1985). The variable coefficients can also be manipulated to reveal interdependent relationships. This is commonly done by dividing travel time coefficient by the cost coefficient, thus determining what decision makers are willing to pay for a one minute reduction in travel time holding all other variable constant (Brownstone and Small 2005).

Standard logit models require that the error or uncertainty terms of the utility of each choice be independently identically distributed. This constraint has led to several advanced formulations that attempt to deal with this. Nested allows for come correlation among choices, for example if someone decides to use transit and then decides between bus and rail. More recently, mixed logit specifications are fully generalizable and are not dependent on the error terms being independently identically distributed (Train 2003). Mixed logit also allows for taste variation among individuals (Hensher and Greene 2003).

As useful and powerful as these models can be, there are some drawbacks that make a full understanding of why some individuals choose transit and others do not more difficult. For one thing, an individual's mode choice is interdependent with other decisions, such as the need to make stops along the way or on the way home (Bhat 1997, Ye et al. 2007) and residential or workplace location choices (Lerman 1976, Salon 2009).

Further complicating things is that individuals are rarely, if ever, perfectly informed about mode characteristics and using actual travel times and costs in models are an approximation of what each individual perceives. Several researchers have shown that models which incorporate perceptions are more accurate in representing mode choice (Meyer at al. 1978, Recker and Golob 1978, Louviere 1981, Koppelman and Lyon 1981).

More advanced specifications, called hybrid choice models, incorporate attitudes and beliefs either directly into the observed component of utility (Schwanen and Mokhtarian 2005, Domarchi et al. 2008) or as latent attitudes which are estimated from existing variables (Ben Akiva et al. 2002, Vredin et al. 2006, Vij et al. 2011).

3.4: Social Psychology

As an alternative to RUM models, the influence of attitudes in travel behavior is addressed most directly in research that is firmly grounded in social psychology. Studies that invoke social psychology theory illustrate that mode choice does not exist in a vacuum, but rather in the social context and practices of the society in which they exist (Schwanen and Lucus (2011).

In Ajzen's theory of planned behavior (1991), based on the earlier theory of reasoned action (Ajzen and Fishbein 1980), behavior is determined by behavioral intention which is a function of the choice-maker's attitudes, subjective norms and perceived behavioral control. Attitudes are an individual's subjective evaluation of the behavior. Subjective norms are the pressure an individual perceives to perform the behavior. Perceived behavioral control is the ability an individual has to help or hinder the implementation of the behavior.

Schwartz's (1977) norm-activation model has been used to explore the relationship between behavior and attitudes. In this model, behavior is a result of personal norms, awareness of consequences and responsibility beliefs. All three directly influence behavior with awareness of consequence and responsibility beliefs also influencing each other as well as personal norms. In this case, personal norms are defined as an individual's obligation to adhere to his or her own personal values, thus making the focus of this model on altruistic behavior rather than on personal benefit (Schwanen and Lucus (2011).

The theory of interpersonal behavior (Triandis 1977) is another approach to sorting out the social psychological aspects to behavior. As in Ajzen's model, intentions remain a precursor to behavior. However, in the Triandis model, habit also directly influences behavior. The influence of both intention and habit on behavior is mediated by facilitating conditions which are the physical constraints (Bamberg and Schmidt 2003). Intention is directly influenced by attitude, social factors and affect. Attitudes are formed based on beliefs about and evaluation of outcomes. Social factors include normative beliefs, personal norms, role beliefs, self-concept and interpersonal agreement. Affect is directly linked to the decision-maker's emotions. The important contribution of the Triandis theory is habit as a function of frequency of past behavior.

3.5: Habit

The influence of habit has been the subject of a growing body of literature in travel behavior in recent years. Bamberg and Schmidt (2003) found that the Triandis model more accurately predicted mode choice among university students in Germany and attributed the accuracy to the inclusion of habit. Several other researchers have used one of the aforementioned theories with the inclusion of habit to model mode choice to positive results (Verplanken et al. 1994, Aarts and Dijksterhuis 2000, Klockner and Matthies 2004, Gardner and Abraham 2008, Gardner 2009).

Researchers have identified past experience as an important factor in mode choice, particularly when the choice is made repeatedly without any major life changes. In these cases, individuals don't actually compare travel times and costs each time they are faced with the same choice set (Schank and Adelson 1977, Banister 1978, Verplanken et al. 1994). After the same choice is made repeatedly to the traveler's satisfaction, the decision-making process becomes script-based and thus automatic (Garling et al, 2002, Garling and Axhausen 2003).

Does habit transfer given a change in geography? If an individual who resides in Washington, DC and frequently uses transit moves to Atlanta, GA is he more likely to use transit there or choose to live near it? And conversely, if someone is raised in Riverside, CA and never once steps foot on a bus or train, will her choice of mode after moving to Boston, MA be the same as that of someone who was raised in New York City? The question of whether or not mode use in a previous location has an impact on mode-choice in an individual's current location has only recently been addressed by researchers (Goetzke and Weinberger 2011) and there is evidence that it does.

3.6: Research Approach

Though the role of habit in travel behavior has been identified and examined by researchers, few studies have focused on the formulation of habit. One of the main objectives of this dissertation is to explore the possibility that travel habits may form in childhood or early adulthood through exposure, experience and/or observation. Is there an opportunity in these early stages to influence habit formation so that later in life travel behavior is affected? Furthermore, how flexible are these habits and when and how are they likely to change?

One theory is that when accounting for the influence of travel time, cost, socio-economic variables, and other known factors that influence travel behavior, an individual's mode-choice is to some extent influenced by choices made and experiences from earlier in life. Furthermore, it is hypothesized that this influence diminishes in some time frame, given a new set of conditions – moving to a new urban area, for example. Of interest in this study is the identification of segments of the population for whom this influence dissipates quickly, gradually, or never at all and to understand how and why this is the case.

This dissertation also examines the influence of individual's attitudes toward transit and how those attitudes influence their choice process. How do system cleanliness, comfort, crime and reliability influence the formation of travel habits? How much of these are informed by actual transit use and how much are perceptions based on other sources?

4: Methodology

4.1: Introduction

The research questions posed in Chapter 3 have been addressed by means of a survey and subsequent focus groups. Recruitment was initially conducted on the street in the study area and thus, the resulting data is considered to have been obtained by means of an intercept survey. The survey itself was administered online. It contained traditional travel behavior and household characteristic questions, as well as questions addressing each respondent's attitudes toward transit and his or her childhood experience with it.

FIGURE 4.1: Map of BART system with station locations in Downtown Oakland in shaded circle

The focus groups also included questions and prompts that would be found in standard travel behavior interviews, but allowed for more elaborate responses and a guided exploration of participants' attitudes, perceptions and experiences. The small-group sessions were used to confirm some of the findings from the survey, in addition to facilitating the discovery of travel-related elements that were not and cannot be captured in data. A portion of these sessions was also dedicated to childhood and early adult exposure to transit and possible explanations as to how travel behaviors were formed and habituated.

4.2: Selecting Downtown Oakland, CA for the survey

Oakland was selected as the study area for several reasons. Travelers to downtown have several choices of modes to complete their journey. For bus transit, the area is served by many AC Transit lines with frequent service. For rail, the Bay Area Rapid Transit (BART) system has stations at both 12th and 19th Streets with entrances at several other streets along Broadway. Almost every BART line, with the exception of the Dublin-Pleasanton line, serves these two stations with frequent service, particularly during peak hours. FIGURE 4.1 shows the BART system with the two stations in the study area highlighted by a red circle. FIGURE 4.2 shows the AC Transit Lines that serve the study area. TABLE 4.1 presents information on morning peak period frequency for BART and AC Transit bus service.

FIGURE 4.2: Map of AC Transit service in Downtown Oakland

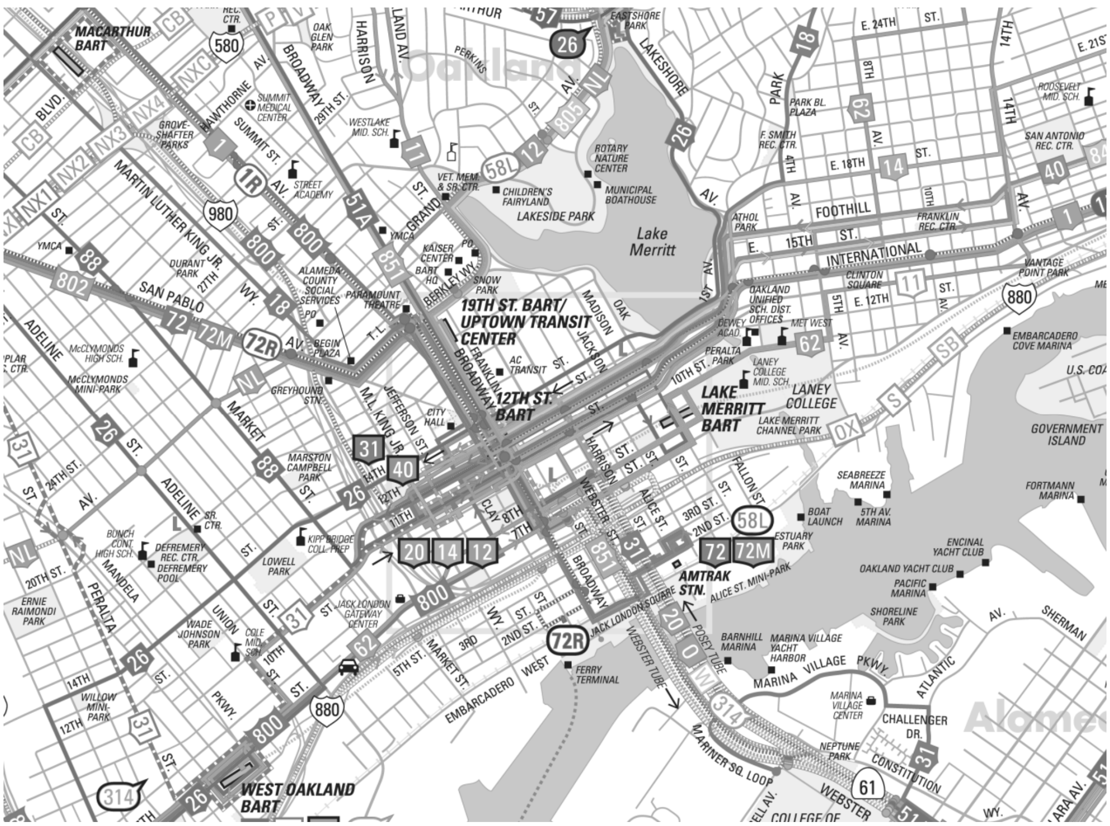


TABLE 4.1: Morning peak-period BART and AC Transit service frequency to Downtown Oakland

	Southbound			Northbound		
Route	7:00 to 7:59	8:00 to 8:59	9:00 to 9:59	7:00 to 7:59	8:00 to 8:59	9:00 to 9:59
BART	17	16	11	16	12	12
1	4	4	3	4	4	3
1R	5	5	5	5	5	5
12	3	3	2	3	2	2
18	3	4	4	4	5	3
31	2	2	2	2	2	2
40	5	6	6	6	6	6
51A	6	6	6	7	6	5
72	2	2	2	2	2	2
72M	2	2	2	1	2	3
72R	5	5	5	5	5	5
88	3	3	3	3	3	3

	Eastbound			Westbound		
Route	7:00 to 7:59	8:00 to 8:59	9:00 to 9:59	7:00 to 7:59	8:00 to 8:59	9:00 to 9:59
11	2	2	2	2	2	2
14	4	4	4	4	4	4
20	2	2	2	2	2	2
26	3	3	2	3	3	3
58L	1	2	2	2	2	2
62	3	3	3	3	3	3
NL	2	3	2	3	4	2

Driving to work in Downtown Oakland is also a possibility as there is fairly easy access via several freeways (I-580, I-880, I-980, SR 24) and there are many parking garages in the area (see FIGURE 4.3). Daily parking in these garages ranges from about $10 to $15 per day and parking is less expensive if purchased on a monthly basis. In addition, several large employers, such as Kaiser-Permanente, have dedicated parking garages in Downtown Oakland. These employees pay less than market rates to park.

FIGURE 4.3: Map of parking garages in Downtown Oakland

Downtown Oakland has a relatively weak shopping base. There are no major department stores in the downtown, for example. However, Oakland's large and vibrant Chinatown abuts the downtown; housing has been added to the downtown in recent years. The downtown area also has a convention center, major hotel and convention center complex as well as several eateries that attract visitors from outside the area. These activities generate peak and off-peak trips in addition to those produced by employment centers and work travel. During daytime hours and especially during lunch hours, both workers and visitors are likely to be on the street, and downtown sidewalks are bustling in the midday, especially in the core of downtown between the two BART stations. Nevertheless, because the resources for this study were limited, travelers were screened in survey recruitment to include only Downtown Oakland workers.

4.3: Survey Design

The survey was designed, tested and finalized through several iterations over a two-month period. First, traditional travel surveys and diaries were examined and relevant questions were rephrased and incorporated into the survey for this project. The initial survey was tested online by ten doctoral students and professors, who specialize in transportation planning. After this initial round of testing, several questions were rewritten based on comments from these survey-testers. In addition, non-essential questions were eliminated in order to reduce the time to complete the survey. The target completion time was fifteen minutes.

Next, the survey was administered online to ten individuals who do not study transportation. Questions were rephrased and modified based on feedback from this second test group. The number of questions on the survey was further reduced when this second round of testers indicated that it took around twenty minutes to complete the survey

The final version of the survey included fifty-two questions divided into five sections and is reproduced in APPENDIX A. The first section, called "Transit Attitude Assessment," asked survey-takers to enter the three words (or brief phrases) that came to their mind when they thought of public transportation. Next, respondents were asked ten questions on a five-answer Likert scale (strongly agree, somewhat agree, somewhat disagree, strongly disagree, no opinion). These questions addressed conditions in and on the transit system (cleanliness, comfort, reliability, crime), as well as how travelers used their en-route time, their opinions about how their coworkers traveled, how comfortable they were riding in transit with strangers, if they preferred to drive, what they thought about transit impact on the environment, and whether transit was only for those with no choice but to use it. These questions were written and sequenced in alternating positive and negative tones toward transit so respondents would have to address each one as opposed to simply selected the same answer for every question.

Part two of the survey asked questions about the respondent's typical and most recent trip to work. Questions include details about primary modes used to travel to work, access modes, time departing home, stops made on the way, the number of days in a typical week that those modes are used and the number of days in a typical week the respondent works in Downtown Oakland. Survey-takers were also asked whether or not their employer offers to pay any or all portion of transit fare and whether parking is paid for or partially subsidized. Respondents were asked where and for what period of time they parked and if they drove, how many passengers rode with them. If they took transit, they were asked what type of fare they paid and if they used a monthly pass. Finally, respondents were asked for the name of the street and nearest cross-street on which they lived and worked and the zip codes of both. Exact addresses were not asked in order to protect survey-takers anonymity.

Part three of the survey focused on household characteristics and information relating to all trips made, not just work trips. Respondents were asked about their overall frequency of mode use for automobiles, rail-based transit, bus and bicycle. Survey-takers were asked to indicate how many adults and children reside in their household, the number of licensed drivers and the number of vehicle available. They were also asked how far they live from the nearest bus stop and rail station in terms of both miles and walking distance. Other household data was collected in this section, including the year he or she last moved, whether or not the respondent rents or owns his or her home, whether he or she has moved since turning 18, if he or she lives near a childhood home and if he or she lived in the Bay Area at any point during childhood. Respondents were also asked to indicate how important on a five-point scale (not important, a little important, important, very important, extremely important) home size, cost, neighborhood, proximity to transit and proximity to shopping were when they moved last.

Part four of the survey asked respondents about their transportation experience during high school. Survey-takers were asked how frequently they used automobiles, rail-based transit, buses and bicycles during their four years of high school. They were also asked how far (in miles and walking distance) they lived from both a bus stop and a rail station during the same time period. Lastly, respondents were asked to indicate which members of their family, if any, used transit to commute to work while they were in high school.

Part five of the survey collected relevant personal data. Each respondent was asked their age, sex, household income and occupation. In addition they were asked if they had a license to drive and if there were any medical reasons that prevented them from driving.

4.4: Recruitment

Potential survey-takers were recruited from April 13 to 15, 2010 on a Tuesday, Wednesday and Thursday. Mid-week work days were selected to maximize potential participants. Recruitment hours were from 7:30am to 10:00am and again from 11:30am to 2:00pm. The morning peak was likely to recruit workers and perhaps some residents going to work elsewhere, while the lunch hour time slot was likely to recruit workers plus some shoppers and visitors. Screening questions were used to terminate participation requests for non-workers and also those who may have been contacted previously.

FIGURE 4.4: Flyer used for survey recruitment

Passers-by were handed flyers on their way into work and during their lunch hour (see FIGURE 4.4 for a reproduction of the flyer). The flyer indicated that the survey was intended only for workers who commute to Downtown Oakland and directed potential participants to the website www.onlinetravelsurvey.com, where more information about the study was available, informed consent materials were posted and a link to begin the survey was found. In addition, the initial page of the website reiterated that only Downtown Oakland workers were eligible to take the survey and receive a thank you gift. Though some survey takers who did not fit this profile ignored this information and took the survey anyway, their responses were eliminated from the sample.

As indicated on the flyer and at the website, survey-takers were offered a gift for completing the online survey. They were offered a five dollar gift card from Peet's Coffee, Target or Old Navy. Upon completing the survey, respondents were prompted to choose one of the three.

Specific recruitment locations were selected around Downtown Oakland with high pedestrian volumes. During the morning recruitment periods, flyers were distributed in locations that were specifically selected to be mode neutral. These locations targeted workers who could be coming from the bus, BART or a parking lot. Care was taken to not recruit directly in front of BART or parking lot entrances.

During the lunch recruitment periods, flyer distributors were more mobile and circulated around the entire downtown area, particularly in front of dining establishments. Over the course of three days and six recruitment periods, approximately 1300 flyers were distributed. In addition, several employees posted the flyers at their workplaces, which also helped in the recruitment process.

4.5: Survey Administration

The online survey was hosted by Survey Monkey and was accessed through a link on the main page at www.onlinesurvey.com. Data was transferred over a secure connection and the gift card selection portion was its own stand-alone survey so that the names and addresses collected could not be cross-referenced with the actual survey data to protect respondent's anonymity.

One drawback to using an online survey is the coverage error in the sample due to the exclusion of the population without Internet access and/or a computer. This is somewhat mitigated by the fact that the target population of the survey was workers, many of whom have computers at their workplace. In fact, as analysis of the time of day in which most surveys were completed indicates that many respondents completed the survey while at work. Though excluding those without internet access and/or computer access creates some bias in the sample, the cost of administering the survey by mail or phone was too prohibitive for this project.

Two other groups of workers were also excluded due to the time and methodology by which the survey was conducted. Only English-speaking workers could complete the survey, since no translation was provided online. In addition, individuals who do not work during normal business hours were also not sampled. For the former group, resources were limited and thus the survey's target population was revised to only include English-speakers. For the latter group, their exclusion may not prove as detrimental to the results, since they commute to and from work when transit service is less frequent and in some cases nonexistent. As such, the mode choices available to them and the process by which they select a travel mode may be quite different than workers who commute during the standard morning and afternoon peak periods. Therefore, the target population was revised to only include workers who are employed during typical daytime hours.

4.6: Data Review

565 individuals completed the survey, of which 63 cases were flagged as incongruous, incomplete, from unemployed persons or from individuals who do not work in Downtown Oakland. Therefore, the initial response rate thus was approximately 43 percent and the usable survey response rate was 39 percent. Of the 502 useable respondents, there were a disproportionate number of women respondents and workers who used transit to commute as compared to 2000 census data for the tracts in the study area.

318 respondents (62.6 percent) were women. This is consistent with observations made when the recruitment flyers were distributed. Recruiters found women to be more likely to take a flyer and more interested in engaging in conversation about the research project. This does not accurately represent the true percentages of male and female workers in the four census tracts in the study area. According to the 2000 Census, these tracts had approximately an even split of male and female workers with 50.2 percent being female.

In terms of vehicles available in the households of these workers, the survey results were quite similar to 2000 Census results. The survey slightly over-sampled workers who reside in zero and one car households and conversely under-sampled those who live in two, three and more vehicle households (see TABLE 4.2).

TABLE 4.2: Comparison of 2000 Census and survey percentages for household vehicles available

Vehicles available in household	Census	Survey
0	7.0	8.7
1	28.0	34.8
2	40.4	36.3
3 or more	24.6	20.2

Income ranges from the survey were also similar to those reported in the 2000 Census. The survey results have a slightly greater percentage of workers from the range of lowest income households (less than $10,000) – 3.3 percent compared to 2.0 percent from the census. The survey also has a slightly greater percentage of workers from the range of highest income households ($100,000 or more) – 40.0 percent compared to 36.7 percent from the census (see TABLE 4.3)

TABLE 4.3: Comparison of 2000 Census and survey percentages for annual household income ranges

Income range	Census	Survey
Less than $10,000	2.0	3.3
$10,000 to $49,999	23.6	20.9
$50,000 to $74,999	20.2	18.1
$75,000 to $99,999	17.6	17.7
$100,000 or more	36.7	40.0

In general, counts of age ranges from the survey correspond to counts of ranges from the census as presented in TABLE 4.4. The only exception seems to be that the survey under-represents 18 to 24 year olds.

TABLE 4.4: Comparison of 2000 Census and survey percentages for age ranges

Age range	Census	Survey
16 to 17	0.6	0.0
18 to 24	7.8	1.8
25 to 44	52.1	57.3
45 to 64	36.9	37.6
65 to 74	2.0	3.3
75 and over	0.5	0.0

A sample of eight occupations indicates that the survey is a reasonable representative of study area employment. Management seems to be under-represented. This is expected since these workers are probably earning larger salaries and are less likely to be enticed by the five dollar gift card. The sample of eight occupations is presented in TABLE 4.5.

TABLE 4.5: Comparison of 2000 Census and survey percentages for eight occupations

Occupation	Census	Survey
Architecture and engineering	5.6	9.8
Management	14.7	8.9
Business and finance operations	10.2	11.4
Commuinty and social services	1.8	5.9
Legal	5.0	6.1
Personal care and service	1.0	0.2
Sales and related	6.1	3.1
Office and administrative	20.5	13.4

245 respondents (48.8 percent) indicated they drove for some portion of their most recent trip to work (see TABLE 4.6). 317 survey takers (63.1 percent) said they used BART for at least part of their most recent commute. A smaller number used buses, light rail, bicycles or motorcycles for some portion of their most recent journey to work (18.1 percent, 2.6 percent, 7.8 percent and 1.8 percent, respectively).

TABLE 4.6: Summary of all non-walk modes used for any portion of most recent work trip to Downtown Oakland

Mode	Count	Percent
Automobile, private van or truck	245	48.8
BART	317	63.1
Bus	91	18.1
Light rail	13	2.6
Bicycle	39	7.8
Motorcycle, moped or scooter	9	1.8

In terms of primary mode to work for their most recent trip (primary mode is defined as the mode on which the most time is spent), 92 respondents drove (18.3 percent), 316 respondents used BART (62.9 percent) and 35 respondents used buses (7.0 percent). For non-motorized modes, 21 survey-takers indicated they bicycled the entire distance to work on their most recent trip (4.2 percent) and 25 respondents said they walked the entire way (5.0 percent). This is displayed in TABLE 4.7.

TABLE 4.7: Primary modes used for most recent work trip to Downtown Oakland

Primary mode	**Count**	**Percent**
Automobile, private van or truck	92	18.3
BART	316	62.9
Bus	35	7.0
Bicycle	21	4.2
Walk	25	5.0
Other	13	2.6

These primary mode shares for the most recent trip to work differ significantly from those reported in other travel surveys, which also ask a slightly different question. For example, the 2000 US Census reports workers "usual" primary mode to work. Such data sources report less transit use and more automobile use by workers in the area. TABLE 4.8 shows the survey mode shares for the most recent trip compared to mode shares reported for downtown Oakland from the 2000 US Census. Though the survey sample does not match official work trip mode choices, the sample size and response rates for both automobile and transit users are large enough to make statistical observations about their mode choices and influences.

TABLE 4.8: Comparison of primary modes used for most recent work trip to Downtown Oakland from survey and 2000 US Census

Primary mode	**Survey percent**	**Census percent**
Automobile, private van or truck	18.3	68.2
BART	62.9	18.2
Bus	7.0	8.1
Bicycle	4.2	1.0
Walk	5.0	3.0
Other	2.6	1.0

TABLE 4.9: Percent of days per week the most recent mode combination is used for work trip to Downtown Oakland

Percent of days per week	**Count**	**Percent**
1 to 24	10	2.0
25 to 49	27	5.4
50 to 74	32	6.4
75 to 99	49	9.8
100	384	76.5

384 of the 502 respondents (76.5 percent) indicated they use the same mode or mode combination to commute to work every day (see TABLE 4.9). 49 survey-takers (9.8 percent) use the reported mode combination on their most recent trip to work for 75 to 99 percent of the trips they make to work. 32 respondents (6.4 percent) use the reported mode combination for 50 to 74 percent of their commutes. 27 respondents (5.4 percent) indicated that they use the modes they used on their most recent work trip between 25 and 49 percent of the time. Only 10 survey-

takers (2.0 percent) use the reported modes for less than 25 percent of the trips they make to work.

The distribution of home counties and cities from which the respondents travel to work in Downtown Oakland is listed in TABLE 4.10. As expected, Alameda, Contra Costa and San Francisco counties had the highest representation with 56.4, 20.7 and 14.9 percent, respectively. San Francisco, Piedmont, Oakland and Berkeley were the cities with the highest representation.

4.7: Survey Analysis

A spreadsheet was generated from Survey Monkey that included the responses to all questions. The spreadsheet originally included all 565 cases (sets of respondent's answers). Each case was analyzed and flagged if the respondent indicated that he or she did not currently work at least one day in Downtown Oakland. Cases were also flagged if they were incomplete, indicating the respondent did not finish the survey. Additional flags were added if the time to complete the survey was less than 12 minutes, as this was impossible to accomplish and accurately read and respond to the survey questions. Cases were flagged if the respondent answered all ten attitude questions with the same answer. Lastly, flags were added to cases that had incongruous answers. For example, if a respondent indicated that he or she uses transit to commute to work on most days, but later in the survey indicated that he or she almost never uses transit when asked about all trips. Flagged cases were then eliminated from the dataset. After the flagged cases were removed, the dataset contained 502 cases.

TABLE 4.10: Home cities and counties for Downtown Oakland workers

County	City	Count
Alameda	Alameda	7
	Alameda Point	14
	Berkeley	30
	Fremont	12
	Hayward	14
	Kensington	21
	Livermore	2
	Newark	2
	Oakland	73
	Piedmont	69
	Pleasanton	11
	San Leandro	12
	Union City	6
Contra Costa	Antioch	9
	Concord	4
	El Cerrito	11
	Lafayette	6
	Moraga	3
	Orinda	5
	Pacheco	3
	Pinole	2
	Pleasant Hill	8
	Richmond	8
	Rodeo	4
	San Pablo	3
	San Ramon	7
	Tara Hills	4
	Walnut Creek	18
	West Pittsburg	5

County	City	Count
San Francisco	San Francisco	72
San Mateo	Belmont	2
	Brisbane	2
	Daly City	6
	Hillsborough	2
	Palo Alto	2
	San Bruno	2
	San Mateo	2
	Sharp Park	2
Santa Clara	San Jose	6
Solano	Suisun City	3
	Vacaville	2
	Vallejo	8

For some questions, responses were recoded or aggregated for easier analysis. For example, Likert-scale responses present a particularly challenging obstacle in statistical analyses, because the distances between responses (i.e. strongly agree to somewhat agree to somewhat disagree, etc.) cannot be assumed to be equal. Therefore, these responses must be treated as categorical variables and as such, statistical measures such as mean, median and standard deviation are inappropriate and model coefficient based on these measures could be inaccurate. In anticipation of this problem, two new sets of responses were created for each of the ten five-point Likert-scale attitude questions in the first part of the survey. A dummy variable (0 or 1) was created and coded as "1" if the respondent indicated that he or she "strongly agreed" or "somewhat agreed" and another dummy variable was generated and coded as "1" if the respondent indicated that he or she "strongly disagreed" or "somewhat disagreed." Though some information is lost when one of the dummy variables is used instead of the full five-point response range in the analysis, it was decided that the loss of information was a better approach than the possibility of generating false conclusions.

At this point, a subset of the original dataset was created. The original dataset containing 502 cases (designated as Dataset A) was used to analyze responses relating to all of an individual's trips and mode use for those trips. Mode use frequency for Dataset A is based upon revealed preference responses to the question, “How often do you use the following modes for all trips?” Respondents were asked about automobile, bus, rail and bicycle use. Each mode had six possible responses: (1) most days, (2) a few times per week, (3) once per week, (4) once or twice per month, (5) once or twice per year, and (6) almost never.

The goal in analyzing Dataset A is to summarize how people choose what mode to use regardless of trip purpose. How strong is the relationship between attitudes toward transit mode characteristics and frequency of use? Furthermore, does a relationship exist between frequency of use for transit and childhood experience with that mode? These questions for Dataset A will be addressed in Chapter 5.

The subset sample (designated as Dataset B) contained 249 cases drawn from the original 502. Dataset B contained only individuals who either drive or use transit to commute to work and have the other mode as an alternative. Dataset B did not did not include bicyclists and walkers, those with no choice of motorized modes. It only included commuters who work four days or more per week in Oakland and use the same mode to commute each day.

TABLE 4.11: Modes used in Dataset B (subsample) for most recent work trip to Downtown Oakland

Mode	Count	Percent
Automobile	66	26.5
BART	148	59.4
Bus	18	7.2
Bus to BART	10	4.0
LRT to BART	7	2.8

66 respondents (26.5 percent) in Dataset B indicated they use an automobile to commute the entire distance to work (see TABLE 4.11). 148 (59.4 percent) use BART to commute to work. 18 (7.2 percent) survey-takers in the subsample use the bus. 10 (4.0 percent) take the bus to BART. 7 (2.8 percent) respondents indicated they take MUNI light-rail to BART as their daily commute to work.

Though the objectives in analyzing Dataset B are similar to Dataset A, the fact that the subsample only includes work trips allows for a more detailed analysis using a logit model and utility theory. Results from Dataset B will be addressed in Chapter 6.

In order to prepare Dataset B for modeling, travel time and cost for both automobile and transit were computed for each respondent. In terms of travel costs, the cost of gasoline, tolls and parking were computed for a one-way automobile trip to work for each respondent. Parking costs were adjusted if the respondent indicated that their employer subsidized parking. If the survey-taker indicated that parking was completely paid for by their employer, it was reduced to \$0. If they indicated that parking was partially paid for, their parking cost was halved. The final cost for the trip via automobile was divided by the number of vehicle occupants that the respondent indicated. For respondents who took transit, their parking cost was assumed to be the average parking cost of the respondents who drive, approximately \$8.00 per day, unless they indicated their employer subsidizes their parking, in which case the same reduce to \$0 or halved approach was taken.

For transit costs, transit fares, cost of parking at the transit station and tolls (several respondents indicated they drive across a bridge and park at BART stations) were computed for the one-way trip to work.

For the respondents who indicated they use transit, access travel time was computed based on their home location and the mode they indicated they used to get to the transit station or stop. In-vehicle travel time was computed based on the time they indicated they leave home and the transit schedule for the service they use. For the respondents who said they drive to work, it was assumed that they would instead drive to the nearest transit station, park, and use transit. In a few cases, where the survey-taker indicated he or she drives, but lived within a ten minute walk to transit, it was assumed that he or she would walk to the transit station.

Automobile travel time was adjusted based on congestion levels at the indicated departure time. In most cases, free flow driving time was multiplied by a factor of 1.4, which is consistent with reported travel times in the Bay Area during the morning peak period as compared to free flow traffic conditions.

4.8: Focus Groups

The second phase of the research involved conducting focus groups in locations around the Bay Area. Initially, two focus groups were convened in Downtown Oakland with participants drawn from the survey respondents. The purpose of these focus groups was to explore attitudes and stated preferences of drivers and transit users in more depth than was possible in a written survey. An additional seven focus groups were conducted in Walnut Creek, Vallejo, Berkeley and Oakland and involved travelers who commuted to San Francisco or crossed the Bay frequently for other reasons. The stipulation that the participants cross the Bay frequently was introduced because tolls had recently been increased and rules on the use of carpool lanes changed, external factors that might have induced a reconsideration of travel modes. The additional groups were organized primarily by mode of travel to San Francisco. Before the hour-long focus group session, participants were asked to complete a brief survey on travel behavior, stated preferences, and personal and household socioeconomic information. This survey can be found in Appendix B.

The focus group participants were working adults with a balance of men and women who ranged in age from early 20s to mid-60s. African-Americans and Asian-Americans were represented roughly proportionally to their presence in workforce of the region. However, Latinos were under-represented. To partially compensate for this, additional surveys were distributed and collected at the Fruitvale BART station. The surveys were available in Spanish and English. 92 respondents completed the survey, nine in Spanish. Two-thirds of 92 respondents had incomes below the regional average and one-third had incomes under $25,000. An analysis of the surveys indicated that low income people were more sensitive to cost than their more affluent counterparts, as would be expected. Otherwise, their responses were similar to those of the other groups.

The focus groups examined actual and prospective responses to changes in transit, carpooling, and road use costs, and in particular investigated changes that had occurred due to toll increases as well as what changes travelers would be likely to make should declines in the BART system's reliability become unavoidable due to funding shortfalls. The goal was to derive rich insights into the factors that affect travel choices and the circumstances under which travelers will change behavior, or alternatively the lengths to which they will go to take steps to maintain current practices.

The final three focus group participants were currently enrolled students, both on the graduate and undergraduate level. This population was chosen to confirm and elaborate on some of the findings from the previous sessions. During the first nine focus groups, some participants indicated that their first exposure to transit was in college and that experience had had a lasting impact on their subsequent mode and residential location choices. Therefore, the last three sessions focused on college experience.

In all, twelve focus groups were conducted with a total of 112 participants. Participant and focus group details are summarized in TABLE 4.12.

TABLE 4.12: Focus group locations, dates and total participants

Date	Location	Participants	Selection criteria	Primary work mode
05/11/11	Oakland	14	Downtown Oakland workers	Mixed
05/11/11	Oakland	13	Downtown Oakland workers	Mixed
05/18/11	Walnut Creek	10	Bay Area workers	Mostly BART
05/19/11	Vallejo	9	Bay Area workers	Casual carpool in AM, transit in PM
05/19/11	Vallejo	6	Bay Area workers	Casual carpool in AM, transit in PM
05/25/11	Berkeley	10	Bay Area workers	Mostly BART
06/14/11	Berkeley	12	Bay Area workers	Mostly BART
06/21/11	Berkeley	5	San Francisco workers	Drivers
07/28/11	Oakland	4	San Francisco workers	Former casual carpoolers, now mixed
10/19/11	Berkeley	11	Undergraduate / graduate students	Bus and bicycle
10/19/11	Berkeley	9	Undergraduate / graduate students	Bus and bicycle
10/20/11	Berkeley	11	Undergraduate / graduate students	Bus and bicycle

5: Survey of Travel Choices for All Trips Considering Experience and Habit: Results from Dataset A

5.1: Introduction

Research on travel behavior has long shown that travel times and travel costs are primary determinants of mode choice, but not the only determinants. Over the past several decades there has been increasing interest in the portion of choice that is unexplained by time and cost factors. Attitudes and habits have been found to influence mode choice (Ouelette and Wood 1998, Verplanken et al. 1998, Garling and Axhausen 2003, Lucas and Jones 2009), but little is known about their formation. If a traveler is particularly negative toward transit, how or why did he or she get that way? Or conversely, why do some individuals favor trains and buses over automobiles?

If someone forms a habit of using a particular mode, there must have been some positive experience or exposure to that mode or a negative experience or exposure to alternate modes that led to the habit formation. Recent research has identified past experience, peer pressure, and observing others as possible explanations (Goetzke and Weinberger 2011).

Furthermore, there is evidence that transit travel time and cost are, to some degree, a function of self-selection (Schwanen and Mokhtarian 2005, Cervero and Duncan 2008). Individuals choose residential locations based on desired access to modes. Someone's decision to locate next to a transit station will obviously reduce his or her travel time via transit to many destinations, particularly to downtown areas to where transit service is often concentrated. It also may reduce costs – the individual who chooses to live within a quick bus ride or within walking distance to work will face lower costs as well. Therefore, analyzing individuals' mode choices in terms of travel times and costs only might be misleading – because the choice of mode could have been made long before any particular trip that needs to be examined.

This chapter presents the results of a survey that was designed to explore how travel choices have been shaped by past experience and attitudes toward transit mode characteristics. The survey was conducted in downtown Oakland, an area to where many travelers have good transit options (bus and rail) and freeway access is also high. The area is walkable from a physical design perspective, with ubiquitous sidewalks and marked pedestrian crossings, and it is bikeable from many residential neighborhoods as well. In this multimodal context, the survey was designed to identify the features that travelers consider most important when deciding to use a mode for a particular trip as well as when making larger life choices that influence mode choice, such as residential location choice. The survey also explores possible origins for attitudes toward the various modes, particularly transit.

5.2: Mode Use Frequency Results

An important finding from the survey is that there is a fairly high variation in day to day use of available modes among the larger sample. Nearly 25 percent of the 502 respondents indicated that they don't always take the same mode combination to commute to work.

TABLES 5.1 under the headings "Disaggregate Count" and "Disaggregate Percent" shows the count and percentages for the six-category frequency of use for automobiles, rail-based transit modes (heavy rail, commuter rail, subway, elevated, light rail, and streetcar), buses and bicycles. Of the 502 respondents, 243 (48.4 percent) indicated that use an automobile on most days regardless of the trip purpose. Another 135 survey-takers (26.9 percent) said they use an automobile a few times per week. 56 respondents (11.2 percent) indicated they use an

TABLE 5.1: Mode use frequency for all trips

Disaggregate Count

Frequency	Auto	Rail	Bus	Bicycle
Almost never	24	45	224	332
Once or twice per year	9	40	77	43
Once or twice per month	35	72	62	43
Once per week	56	36	23	17
A few times per week	135	86	36	36
Most days	243	223	80	31

Disaggregate Percent

Frequency	Auto	Rail	Bus	Bicycle
Almost never	4.8	9.0	44.6	66.1
Once or twice per year	1.8	8.0	15.3	8.6
Once or twice per month	7.0	14.3	12.4	8.6
Once per week	11.2	7.2	4.6	3.4
A few times per week	26.9	17.1	7.2	7.2
Most days	48.4	44.4	15.9	6.2
	100.0	*100.0*	*100.0*	*100.0*

Aggregate Count

Frequency	Auto	Rail	Bus	Bicycle
Less often than once per week	68	157	363	418
At least once per week, but not most days	191	122	59	53
Most days	243	223	80	31

Aggregate Percent

Frequency	Auto	Rail	Bus	Bicycle
Less often than once per week	13.5	31.3	72.3	83.3
At least once per week, but not most days	38.0	24.3	11.8	10.6
Most days	48.4	44.4	15.9	6.2
	100.0	*100.0*	*100.0*	*100.0*

automobile once per week. Regardless of trip purpose, 35 (7.0 percent) and 9 (1.8 percent) said they used a car once or twice per month and once or twice per year, respectively. 24 survey-takers (4.8 percent) reported that they almost never use an automobile. Since a greater number, 45 respondents (9.0 percent), indicated they live in households with no vehicles available, it is assumed that about half of those get rides from others with an automobile a few times per year or more often. Only 17 survey-takers (3.4 percent) revealed that they do not have a license to drive, so it appears that there are some participants who have elected to live without an automobile even though they could drive if they had one.

223 respondents (44.4 percent) from Dataset A use rail on most days when all trips are considered. Another 86 (17.1 percent) use rail a few times per week. 36 survey-takers (7.2 percent) use rail modes once per week. 72 individuals (14.3 percent) from the sample reported using rail once or twice per month. 40 (8 percent) and 45 (9 percent) indicated they use rail once or twice per year or almost never, respectively.

Bus use frequency was substantially less than both automobile use and rail use. Of the 502 respondents, only 80 (15.9 percent) reported using the bus on most days for all trips types. 36 survey-takers (7.2 percent) use the bus a few times per week and 23 (4.6 percent) use the bus once per week. 62 (12.4 percent) and 77 (15.3 percent) respondents said they use the bus once or twice per month or once or twice per year, respectively. Finally, 224 survey-takers (44.6 percent) reported that they almost never use the bus. That is almost equal to the number of respondents who indicated they use rail on most days.

Of the 243 respondents who indicated they use an automobile on most days, 97 (39.9 percent) also use a rail-based transit mode on most days (see TABLE 5.2). Therefore 19.3 percent of the 502 individuals in Dataset A use both an automobile and rail transit on most days. The number of respondents who use an automobile on most days and a bus or bicycle on most days as well is far lower. Only 19 (7.8 percent) and 2 (0.8 percent) of the 243 individuals who reported using cars on most days use buses and bicycles on most days, respectively. Among the respondents who reported using an automobile on most days, 48 (19.8 percent) indicated they use a bus once or twice per year and 149 (61.3 percent) indicated they almost never use a bus. Considering the entire 502 cases of Dataset A, that’s 9.6 percent and 28.7 percent, respectively.

TABLE 5.2: Rail, bus and bicycle use frequency among respondents who use automobiles on most days for all trips

Count

Frequency	Rail	Bus	Bicycle
Almost never	30	149	190
Once or twice per year	31	48	18
Once or twice per month	43	18	16
Once per week	11	4	7
A few times per week	31	5	10
Most days	97	19	2

Percent of Most Days Auto Users

Frequency	Rail	Bus	Bicycle
Almost never	12.3	61.3	78.2
Once or twice per year	12.8	19.8	7.4
Once or twice per month	17.7	7.4	6.6
Once per week	4.5	1.6	2.9
A few times per week	12.8	2.1	4.1
Most days	39.9	7.8	0.8
	100.0	*100.0*	*100.0*

Percent of Dataset A

Frequency	Rail	Bus	Bicycle
Almost never	6.0	29.7	37.8
Once or twice per year	6.2	9.6	3.6
Once or twice per month	8.6	3.6	3.2
Once per week	2.2	0.8	1.4
A few times per week	6.2	1.0	2.0
Most days	19.3	3.8	0.4

20 fewer respondents indicated they use rail on most days as compared to automobiles. As such, the percent of those who use rail on most days as well as automobiles is slightly higher at 48.4 percent of the 223 most frequent rail users (see TABLE 5.3). However, while only 31 (12.8 percent) of most days automobile users reported using rail a few times per week, 58 (26.0 percent) of most days rail users reported using an automobile a few times per week.

TABLE 5.3: Automobile, bus and bicycle use frequency among respondents who use rail on most days for all trips

Count

Frequency	Auto	Bus	Bicycle
Almost never	11	101	150
Once or twice per year	6	33	20
Once or twice per month	20	25	22
Once per week	31	8	9
A few times per week	58	14	12
Most days	97	42	10

Percent of Most Days Rail Users

Frequency	Auto	Bus	Bicycle
Almost never	4.9	45.3	67.3
Once or twice per year	2.7	14.8	9.0
Once or twice per month	9.0	11.2	9.9
Once per week	13.9	3.6	4.0
A few times per week	26.0	6.3	5.4
Most days	43.5	18.8	4.5
	100.0	*100.0*	*100.0*

Percent of Dataset A

Frequency	Auto	Bus	Bicycle
Almost never	2.2	20.1	29.9
Once or twice per year	1.2	6.6	4.0
Once or twice per month	4.0	5.0	4.4
Once per week	6.2	1.6	1.8
A few times per week	11.6	2.8	2.4
Most days	19.3	8.4	2.0

TABLE 5.4: Automobile, rail and bicycle use frequency among respondents who use buses on most days for all trips

Count

Frequency	Auto	Rail	Bicycle
Almost never	12	6	52
Once or twice per year	1	4	7
Once or twice per month	8	11	11
Once per week	16	8	4
A few times per week	24	9	6
Most days	19	42	0

Percent of Most Days Bus Users

Frequency	Auto	Rail	Bicycle
Almost never	15.0	7.5	65.0
Once or twice per year	1.3	5.0	8.8
Once or twice per month	10.0	13.8	13.8
Once per week	20.0	10.0	5.0
A few times per week	30.0	11.3	7.5
Most days	23.8	52.5	0.0
	100.0	*100.0*	*100.0*

Percent of Dataset A

Frequency	Auto	Rail	Bicycle
Almost never	2.4	1.2	10.4
Once or twice per year	0.2	0.8	1.4
Once or twice per month	1.6	2.2	2.2
Once per week	3.2	1.6	0.8
A few times per week	4.8	1.8	1.2
Most days	3.8	8.4	0.0

As displayed in TABLE 5.4, among the 80 survey-takers who said they used a bus on most days, 19 (23.8 percent), 24 (30.0 percent) and 16 (20.0 percent) indicated they used an automobile on most days, a few times per week, or once per week, respectively. Nearly half, 42 respondents (52.5 percent), reported also using rail on most days, which constitutes 8.4 percent of the entire Dataset A.

Frequent bicycle use was more prominent among individuals who reported using rail and bus on most days as opposed to automobiles. Of the respondents who indicated they use cars on most days, only 7.8 percent also use a bicycle at least once per week. However, of the respondents who indicated they use rail on most days, 13.9 percent also use a bicycle at least once per week and of the respondents who indicated they use a bus on most days, 12.5 percent also use a bicycle at least once per week.

To facilitate analysis and to make sure there were enough respondents in each category to achieve statistical significance, the six categories of frequency for all trips, (1) most days, (2) a few times per week, (3) once per week, (4) once or twice per month, (5) once or twice per year, and (6) almost never, were aggregated into three categories: (1) most days (leaving the previous category 1 intact), (2) at least once per week, but not on most days (combining the previous categories 2 and 3), and (3) less often than once per week (combining the previous categories 4 through 6). The results are presented in TABLE 5.1 under the "Aggregate Count" and "Aggregate Percent" headings and reflect more balanced frequencies for the three categories.

5.3: Attitude Question Results

TABLE 5.5 shows the count and percent for each of the ten transit attitude questions. A large majority, 305 respondents (60.8 percent), somewhat agreed that transit is comfortable. This question also yielded the fewest respondents (0.8 percent) who did not have an opinion. 73 survey-takers (14.5 percent) indicated that they strongly agree that transit is comfortable. 84 individuals (16.7 percent) indicated that they somewhat disagreed that transit is comfortable. Only 36 respondents (7.2 percent) strongly disagreed that transit is uncomfortable.

TABLE 5.5: Five category responses to attitude questions

Count

Attitude	Strongly disagree	Somewhat disagree	No Opinion	Somewhat agree	Strongly agree
Transit is comfortable	36	84	4	305	73
Crime occurs frequentrly in/on transit	133	175	36	137	21
Transit is dirty	35	113	6	225	123
Transit is often late	74	181	15	165	67
I like to ride transit because I can read or get work done	41	63	24	173	202
I am uncomfortable riding on transit with strangers	268	143	10	65	16
Taking transit reduces my impact on the environment	10	7	14	119	352
Many of my coworkers use transit	15	50	8	195	234
People take transit when they have no choice	69	141	12	175	105
I prefer to drive when I can	180	130	17	101	74

Percent

Attitude	Strongly disagree	Somewhat disagree	No Opinion	Somewhat agree	Strongly agree	
Transit is comfortable	7.2	16.7	0.8	60.8	14.5	*100.0*
Crime occurs frequentrly in/on transit	26.5	34.9	7.2	27.3	4.2	*100.0*
Transit is dirty	7.0	22.5	1.2	44.8	24.5	*100.0*
Transit is often late	14.7	36.1	3.0	32.9	13.3	*100.0*
I like to ride transit because I can read or get work done	8.2	12.5	4.8	34.5	40.2	*100.0*
I am uncomfortable riding on transit with strangers	53.4	28.5	2.0	12.9	3.2	*100.0*
Taking transit reduces my impact on the environment	2.0	1.4	2.8	23.7	70.1	*100.0*
Many of my coworkers use transit	3.0	10.0	1.6	38.8	46.6	*100.0*
People take transit when they have no choice	13.7	28.1	2.4	34.9	20.9	*100.0*
I prefer to drive when I can	35.9	25.9	3.4	20.1	14.7	*100.0*

The results from the question, "Crime occurs frequently on/in transit" were more evenly spread among the categories of agreement with the most "no opinion" respondents (7.2 percent) of any of the ten attitude questions. Few survey-takers, only 21 (4.2 percent) strongly agreed that crime occurs frequently. 137 individuals (27.3 percent) somewhat agreed that crime occurs frequently. The largest number of respondents, 175 (34.9 percent) somewhat disagreed and 133 (26.5 percent) strongly disagreed.

In general, survey-takers agreed that transit is dirty. 123 respondents (24.3 percent) strongly agreed that it is dirty. The most respondents, 225 (44.8 percent) somewhat agreed that transit is dirty. 113 survey-takers (22.5 percent) somewhat disagreed it is dirty. Only 35 individuals (7.0 percent) strongly disagreed that transit is dirty. 6 respondents (1.2 percent) had no opinion on the cleanliness question.

The survey responses to "transit is often late" display remarkable balance with an almost equal number of individuals strongly agreeing and strongly disagreeing. The number of respondents who somewhat agreed and somewhat disagreed are also nearly the equal. 67 survey-takers (13.3 percent) strongly agreed that transit is often late and 74 (14.7 percent) strongly disagreed. 165 respondents (32.9 percent) somewhat agreed and 181 respondents (36.1 percent) somewhat disagreed that transit is often late.

Most survey-takers agreed that they like to take transit, because they can read and get work done on their way to their jobs. 202 respondents (40.2 percent) strongly agreed on this question. 173 survey-takers (34.5 percent) somewhat agreed. 63 individuals (12.5 percent) and 41 (8.2 percent) somewhat disagreed and strongly disagreed, respectively. This question also had a larger number of respondents who had no opinion as compared to some of the other questions. 24 respondents (4.2 percent) neither agreed nor disagreed.

In general, respondents indicated they felt comfortable riding in transit vehicles with strangers. More than half the survey-takers, 268 (53.4 percent) strongly disagreed with the statement, "It makes me uncomfortable to ride on a train or bus with strangers." Another 143 respondents (28.5 percent) somewhat disagreed, which combined is 81.9 percent of the survey-takers. 65 individuals (12.9 percent) somewhat agreed that taking transit with strangers makes them uncomfortable. Only 16 survey-takers (3.2 percent) strongly agreed. 10 respondents (2.0 percent) had no opinion on this question.

Almost every survey-taker agreed that taking transit reduces one's impact on the environment. 352 respondents (70.1 percent) indicated they strongly agree. By far the largest percentage of strongly agree for any of the ten attitude questions. 119 individuals (23.7 percent) somewhat agreed, for a combined 93.7 percent in agreement. 7 (1.4 percent) and 10 (2.0 percent) respondents somewhat disagreed and strongly disagreed, respectively. 14 survey-takers (2.8 percent) did not have an opinion.

A large majority of survey-takers also agreed that many of their coworkers use transit. Nearly half, 234 respondents (46.4 percent) strongly agreed with this question. 195 individuals (38.8 percent) somewhat agreed. Far fewer disagreed, which is expected since Dataset A contains many more respondents who use transit to travel to work than who use automobiles. 50 survey-takers (10.0 percent) somewhat disagreed and only 15 survey-takers (3.0 percent) strongly disagreed. Just 8 (1.6 percent) respondents did not have an opinion on this question.

Responses to the statement, "people take transit when they have no choice" were mixed. 105 individuals (20.9 percent) strongly agreed. 175 survey-takers (34.5 percent) somewhat agreed. 141 respondents (28.1 percent) somewhat disagreed with the statement and only 69 (8.2 percent) strongly disagreed. 12 survey-takers (2.4 percent) did not have an opinion.

The results from responses to the statement, “I prefer to drive when I can” are interesting given that a large number of respondents use transit to commute to work. A large number of respondents either somewhat disagreed or strongly disagreed indicating that not only do they choose to use transit, they prefer to use it. 130 respondents (25.9 percent) somewhat disagreed and the largest number, 180 respondents (35.9 percent) strongly disagreed. 74 survey-takers (14.7 percent) strongly agreed and another 101 (20.1 percent) somewhat agreed.

5.4: Household and Individual Characteristic Results

TABLE 5.6: Annual household income

Disaggregate

Income range	Count	Percent
Less than $10,000	15	3.0
$10,000 to $25,000	22	4.4
$25,000 to $50,000	81	16.1
$50,000 to $75,000	91	18.1
$75,000 to $100,000	90	17.9
$100,000 to $150,000	102	20.3
$150,000 to $200,000	65	12.9
$200,000 to $250,000	17	3.4
$250,000 to $300,000	9	1.8
More than $300,000	10	2.0

Aggregate

Income range	Count	Percent
Less than $50,000	118	23.5
$50,000 to $100,000	181	36.1
$100,000 to $150,000	102	20.3
$150,000 to $200,000	65	12.9
More than $200,000	36	7.2

In order to balance the total number of survey-takers in each category of income and to make each category equal to $50,000 in range, annual household incomes were aggregated from ten into five categories. The counts for the ten categories is displayed in TABLE 5.6 under the heading “Disaggregate”. The resulting five categories are displayed under the “Aggregate” heading. This will make cross-tabulation easier, more interpretable and more likely to be statistically significant in the next phase of analysis.

The greatest number of respondents, 181 (36.1 percent), indicated they lived in households with annual incomes in the $50,000 to $100,000 range. 118 respondents (23.5 percent) reported that they lived in households with an annual income range of less than $50,000, which is substantially below the regional median household income. 102 survey-takers (20.3 percent) indicated they lived in households where annual income was in the $100,000 to $150,000 range. 65 individuals (12.9 percent) live in households in which the annual income is from $150,000 to $200,000 and 36 (7.2 percent) live in the highest category of household income, greater than $200,000.

TABLE 5.7: Vehicles available in household

Vehicles in household	Count	Percent
Fewer vehicles than drivers	159	31.7
Equal or more vehicles than drivers	343	68.3

Approximately one-third of respondents, 159 survey-takers (31.7 percent), reside in households in which there are fewer vehicles available than there are licensed drivers (see TABLE 5.7). 343 individuals (68.3 percent) reported that they lived in households in which there are either an equal number of or more vehicles per licensed driver.

The distance from respondents' homes to the nearest transit station or stop is shown in TABLE 5.8. A large majority indicated they live in close proximity to a bus stop. 448 (89.2 percent) reside within a half-mile of a bus stop with another 33 (6.6 percent) living between a half and one mile. Only 12 survey-takers (2.4 percent) said they lived farther than 2 miles from a bus stop.

Distances from home to rail stations were more evenly distributed among the four categories. 160 respondents (31.9 percent) indicated they lived within a half-mile of a rail station. 107 individuals (21.3 percent) reside in households that are between a half-mile and one-mile from a rail station. 88 survey-takers (17.5 percent) live between one and two miles of a rail station. 147 respondents (29.3 percent) reported living more than two miles from the nearest rail station.

TABLE 5.8: Distance from home to transit

Count

Distance	Rail	Bus
Less than half mile	160	448
Half to one mile	107	33
One to two miles	88	9
More than two miles	147	12

Percent

Distance	Rail	Bus
Less than half mile	31.9	89.2
Half to one mile	21.3	6.6
One to two miles	17.5	1.8
More than two miles	29.3	2.4
	100.0	*100.0*

Approximately the same number of survey-takers indicated that their parking costs were fully subsidized by their employers as did indicate that parking costs were partially subsidized. Both of these totals, 40 (8.0 percent) and 44 (8.8 percent) were far smaller than the number who indicated that they received no help from their employer for parking costs – 418 (83.3 percent). In order to balance these categories and to facilitate cross-tabulation, the partially subsidized and fully subsidized were combined into one category. Disaggregate and aggregate totals and percentages are shown in TABLE 5.9.

Few respondents, 50 (10.3 percent), indicated that proximity to transit when they moved last was not important. Due to the subjective nature of this question – one respondent's definition of a level of importance may not correspond to another's – the five categories of importance of proximity to transit when last moved were combined into three. "Not important" and "a little importance" were aggregated into one category. "Important" was left alone. "Very important" and "extremely important" were also combined into one category.

TABLE 5.9: Parking costs paid by employer

Disaggregate

Amount paid	Count	Percent
All	40	8.0
Some	44	8.8
None	418	83.3

Aggregate

Amount paid	Count	Percent
All or some	84	16.7
None	418	83.3

TABLE 5.10: Importance of proximity to transit when last moved

Disaggregate

Level of importance	Count	Percent
Not important	50	10.3
A little important	65	13.4
Important	106	21.8
Very important	126	25.9
Extremely important	139	28.6

Aggregate

Level of importance	Count	Percent
Not or a little important	115	23.7
Important	106	21.8
Very or extremely important	265	54.5

115 of the survey-takers (23.7 percent) fell into the first category with the lowest level of importance. 106 individuals (21.8 percent) remained in the middle category of proximity to transit importance. The majority of respondents, 265 (54.5 percent), stated that proximity to transit was either very or extremely important when they last moved. These results are displayed in TABLE 5.10.

5.5: Childhood Experience Results

Data collected from the survey indicates that many respondents were either driven or drove automobiles themselves during high school, but fewer had experience riding buses and even fewer riding trains. TABLE 5.11 presents the respondents' frequencies of use for automobiles, rail, buses, school buses and bicycles during high school. Like the current frequencies of use presented in TABLE 5.1, these frequencies were also combined into three categories. The results are displayed before and after this aggregation.

228 respondents (45.4 percent) indicated they used an automobile on most days during high school and another 104 respondents (20.7 percent) indicated they used an automobile a few times per week. 101 survey-takers (20.1 percent) said they almost never used an automobile in high school.

Three-quarters of the respondents, 376 (74.9 percent), indicated they almost never used rail while they were in high school. Most of the remaining respondents indicated they used rail infrequently with 35 (7.0 percent) and 32 (6.4 percent) individuals stated that they used rail once or twice per month, or once or twice per year, respectively. Only 25 survey-takers (5.0 percent) used rail on most days during high school with even fewer using it a few times per week (3.8 percent) or once per week (3.0 percent).

TABLE 5.11: Mode use frequency in high school for all trips

Disaggregate Count

Frequency	Auto	Rail	Bus	School bus	Bicycle
Almost never	101	376	265	356	318
Once or twice per year	9	32	33	19	20
Once or twice per month	32	35	39	16	43
Once per week	28	15	18	7	25
A few times per week	104	19	48	38	53
Most days	228	25	99	66	43

Disaggregate Percent

Frequency	Auto	Rail	Bus	School bus	Bicycle
Almost never	20.1	74.9	52.8	70.9	63.3
Once or twice per year	1.8	6.4	6.6	3.8	4.0
Once or twice per month	6.4	7.0	7.8	3.2	8.6
Once per week	5.6	3.0	3.6	1.4	5.0
A few times per week	20.7	3.8	9.6	7.6	10.6
Most days	45.4	5.0	19.7	13.1	8.6
	100.0	*100.0*	*100.0*	*100.0*	*100.0*

Aggregate Count

Frequency	Auto	Rail	Bus	School bus	Bicycle
Less often than once per week	69	82	90	42	88
At least once per week, but not most days	41	67	72	35	63
Most days	32	35	39	16	43

Aggregate Percent

Frequency	Auto	Rail	Bus	School bus	Bicycle
Less often than once per week	48.6	44.6	44.8	45.2	45.4
At least once per week, but not most days	28.9	36.4	35.8	37.6	32.5
Most days	22.5	19.0	19.4	17.2	22.2
	100.0	*100.0*	*100.0*	*100.0*	*100.0*

Transit bus use was more common among respondents during their high school years. Though the majority, 265 (52.8 percent) said they almost never used buses, 99 respondents (19.7 percent) indicated they used buses on most days. Another 48 survey-takers (9.6 percent) stated that they used buses a few times per week in high school.

TABLE 5.12: Distance from home to transit in high school

Disaggregate Count

Distance	Rail	Bus
Less than half mile	57	324
Half to one mile	47	58
One to two miles	51	35
More than two miles	347	85

Disaggregate Percent

Distance	Rail	Bus
Less than half mile	11.4	64.5
Half to one mile	9.4	11.6
One to two miles	10.2	7.0
More than two miles	69.1	16.9
	100.0	*100.0*

Aggregate Count

Distance	Rail	Bus
Two miles or less	155	417
More than two miles	347	85

Aggregate Percent

Distance	Rail	Bus
Two miles or less	30.9	83.1
More than two miles	69.1	16.9
	100.0	*100.0*

School bus use was less common than transit bus use. 66 respondents (13.1 percent) used school buses on most days and another 38 (7.6 percent), used school buses a few times per week.356 individuals (70.9 percent) indicated they almost never used school buses while in high school.

318 survey-takers (63.3 percent) almost never used a bicycle while in high school. 43 respondents (8.6 percent) and 53 respondent (10.6 percent) indicated they used a bicycle a few times per week or once per week, respectively.

The majority of survey-takers indicated they lived within a half-mile of a bus stop and more than two miles from a rail station during high school (see TABLE 5.12). 57 (11.4 percent), 47 (9.4 percent), and 51 (10.2 percent) respondents lived less than a half mile, between a half and one mile, and between one and two miles from a rail station during high school, respectively. 347 individuals (69.1 percent) indicated that they lived beyond two miles from a rail station during that time.

324 survey-takers (64.5 percent) lived within a half-mile of a bus stop during high school. 58 (11.6 percent), 35 (7.0 percent), and 85 (16.9 percent) respondents said they lived between a

half and one mile, between one and two miles, or more than two miles from a bus stop, respectively.

In anticipation of using respondents' distances from home to rail stations, the data was combined into two categories: two miles or less and greater than two miles. The results are presented in TABLE 5.12 under the "aggregate" headings for count and percentages.

Total number of parents or guardians who used transit to commute to work while the respondent was in high school could not be used without some manipulation as that data would not fully represent each household adequately. For example, a two-parent household with one parent using transit would be equivalent to a one-parent household with that parent using transit. As such, this variable was changed into "at least one parent or guardian used transit to commute to work". A large majority, 376 survey-takers (74.3 percent), reported that nether parent or guardian used transit. 130 respondents (25.7 percent) lived in a household in which at least one parent used transit. This data is shown in TABLE 5.13.

TABLE 5.13: Parent(s) or guardian(s) use of transit while respondent was in high school

Parent(s) or guardian(s)	Count	Percent
None	376	74.3
One	105	20.8
Two	25	4.9
At least one	130	25.7

5.6: Associations between Attitude Question Results and Rail Use Frequency

In order to determine the strength of the relationship between the three categories of transit use frequency and the responses to the attitude questions, an appropriate measure of association had to be selected. For tables of greater size than two by two (for which Phi would have been used), Cramer's V is the acceptable measure of the strength of association. Phi is not used for tables larger than two by two, because it may be computed to be greater than 1. Cramer's V, on the other hand, always is computed to be between 0 and 1.

Cramer's V, first computed in 1946 by Harald Cramer, a Swedish statistician, is determined by taking the square root of the chi-squared statistic divided by the sample size and the length of the minimum dimension (k is the smaller of the number of rows r or columns c). It is considered to be a measure of the association between two variables as a percentage of their maximum possible variation. The interpretation of the Cramer's V coefficient, which indicates the strength of the relationship, varies from statistics textbook to textbook. For this research, the relationship will be considered weak if the Cramer's V coefficient is 0.10 or less. From 0.11 to 0.30 the relationship will be considered moderate. Variables with a computed Cramer's V coefficient of greater than 0.30 will be considered to have a strong relationship. This is consistent with several interpretations of Cramer's V.

TABLE 5.14: Three category responses to attitude questions

Count

Attitude	Agree	No Opinion	Disagree
Transit is comfortable	378	4	120
Crime occurs frequentrly in/on transit	158	36	308
Transit is dirty	348	6	148
Transit is often late	232	15	255
I like to ride transit because I can read or get work done	374	24	104
I am uncomfortable riding on transit with strangers	81	10	411
Taking transit reduces my impact on the environment	471	14	17
Many of my coworkers use transit	429	8	65
People take transit when they have no choice	280	12	210
I prefer to drive when I can	175	17	310

Percent

Attitude	Agree	No Opinion	Disagree	
Transit is comfortable	75.3	0.8	23.9	*100.0*
Crime occurs frequentrly in/on transit	31.5	7.2	61.4	*100.0*
Transit is dirty	69.3	1.2	29.5	*100.0*
Transit is often late	46.2	3.0	50.8	*100.0*
I like to ride transit because I can read or get work done	74.5	4.8	20.7	*100.0*
I am uncomfortable riding on transit with strangers	16.1	2.0	81.9	*100.0*
Taking transit reduces my impact on the environment	93.8	2.8	3.4	*100.0*
Many of my coworkers use transit	85.5	1.6	12.9	*100.0*
People take transit when they have no choice	55.8	2.4	41.8	*100.0*
I prefer to drive when I can	34.9	3.4	61.8	*100.0*

For each of the ten attitude question, respondents who indicated they had no opinion were omitted from further analysis. Initial cross-tabulations with the three frequency categories for rail use and attitude questions yielded some statistically significant and interpretable results. Cross-tabulations with bus use frequencies were very weak and not at all statistically significant. This is likely due to the fact that few respondents indicated they frequently used buses, but many indicated they frequently used rail. Consequently, the three categories of rail use frequency were used in cross-tabulations with the attitude questions.

In order to facilitate interpretation and to determine if further aggregation would lead to stronger associations, for each of the transit attitude questions in the first part of the survey, "somewhat agree" and "strongly agree" were combined into a singular "agree" category. Likewise, "somewhat disagree" and "strongly disagree" were combined into one "disagree" category. The results of the aggregation are presented in TABLE 5.14.

For three of the attitude questions, (1) transit is dirty, (2) I like to ride transit because I can read or get work done, and (3) taking transit reduces my impact on the environment, the results after aggregation were weaker. As such, the results of these three associations with transit use frequency will be presented prior to the aggregation, with all four categories of agreement intact.

Though much attention has been recently focused on system cleanliness, particularly that of BART and its seating, respondent attitudes toward system cleanliness do not appear to have an association with rail use frequency. For "transit is dirty," each category of frequency of rail use has the greatest number in the somewhat agree column (see TABLE 5.15). The most respondents indicated they somewhat agree that transit is dirty and they use rail on most days. Of the respondents who use rail on most days, approximately the same number strongly agree and somewhat disagree, with fewer strongly disagreeing. Among individuals who strongly agree, approximately the same number use rail less often than once per week as do use rail on most days. The percent of survey-takers who somewhat agree and somewhat disagree is approximately the same for all three categories of rail use frequency. Among those who

TABLE 5.15: Cross-tabulation of responses to "transit is dirty" and rail use frequency for all trips

Count

Frequency	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	Total
Total	35	113	225	123	496
Less often than once per week	8	33	65	50	156
At least once per week, but not most days	6	30	61	23	120
Most days	21	50	99	50	220

Percent

Frequency	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	Total
Less often than once per week	22.9	29.2	28.9	40.7	31.5
At least once per week, but not most days	17.1	26.5	27.1	18.7	24.2
Most days	60.0	44.2	44.0	40.7	44.4
	100.0	*100.0*	*100.0*	*100.0*	*100.0*

Cramer's V = 0.102

somewhat agree, the largest percent use rail on most days, which is unexpected. As expected, among those who strongly disagree, the largest percent use rail on most days. However, among those who strongly agree, the same percent use transit on most days as do those who use it less often than once per week and thus partially responsible for the weak association between the two variables. The resulting Cramer's V correlation is only 0.102 and not statistically significant.

The largest number of respondents use rail on most days and strongly agree that they like to ride transit because they can read or get work done (see TABLE 5.16). As expected, the number of survey-takers who use rail on most days declines as opinions move from strongly agree to strongly disagree about use of time on transit. Even those who use rail less often than once per week, mostly somewhat agreed that they like to ride transit to read or get work done. Among the respondents who strongly disagree, the greatest number use rail less often than once per week, which is expected. For the somewhat agree, somewhat disagree and strongly disagree opinions, the percent of users is similar for each of the three categories of rail use frequency. As expected, among the survey takers who strongly agree, the percentages decline as rail use frequency declines. The association between respondent opinions on use of time on and rail use frequency is positive and moderate with a Cramer's V correlation of 0.202 and significant at the 0.01 level.

TABLE 5.16: Cross-tabulation of responses to "I like to ride transit because I can read or get work done" and rail use frequency for all trips

Count

Frequency	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	Total
Less often than once per week	18	23	66	35	142
At least once per week, but not most days	9	20	46	44	119
Most days	14	20	61	123	218
Total	41	63	173	202	479

Percent

Frequency	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	Total
Less often than once per week	43.9	36.5	38.2	17.3	29.6
At least once per week, but not most days	22.0	31.7	26.6	21.8	24.8
Most days	34.1	31.7	35.3	60.9	45.5
	100.0	*100.0*	*100.0*	*100.0*	*100.0*

Cramer's V = 0.202 (significant at the 0.01 level)

Almost every respondent indicated that he or she was aware that taking transit reduces his or her impact on the environment and as such, the relationship between this opinion variable and rail use frequency is weak and not statistically significant with a Cramer's V correlation of 0.082. Regardless of frequency of rail use, a large number of survey-takers strongly or somewhat agreed (see TABLE 5.17). Among those who use rail on most days, the largest number strongly agreed. The ratio of respondents who strongly agree to somewhat agree is largest for those who use rail on most days and approximately equal for those who use rail at least once per week and less often. As expected, strongly agree has largest percent of respondents in the use rail on most days category as does the somewhat agree.

The analysis of the association between rail use frequency and the remaining seven opinion questions use the aggregated agree and disagree categories.

TABLE 5.17: Cross-tabulation of responses to “taking transit reduces my impact on the environment” and rail use \ frequency for all trips

Count

Frequency	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	Total
Less often than once per week	4	4	40	105	153
At least once per week, but not most days	3	1	34	80	118
Most days	3	2	45	167	217
Total	10	7	119	352	488

Percent

Frequency	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	Total
Less often than once per week	40.0	57.1	33.6	29.8	31.4
At least once per week, but not most days	30.0	14.3	28.6	22.7	24.2
Most days	30.0	28.6	37.8	47.4	44.5
	100.0	*100.0*	*100.0*	*100.0*	*100.0*

Cramer's V = 0.082

Among the respondents who use rail on most days, many more agree that it is comfortable than disagree (see TABLE 5.18). This trend continues for both of the other two rail use frequency categories as well, but the margin between the numbers who agree as opposed to disagree gets much smaller for those that use rail less often than once per week. For those that agree, the greatest percent of respondents use rail on most days. Also, the percentage of individuals who agree decreases as rail use frequency decreases. In the disagree column,

TABLE 5.18: Cross-tabulation of responses to “transit is comfortable” and rail use frequency for all trips

Count

Frequency	Disagree	Agree	Total
Less often than once per week	56	98	154
At least once per week, but not most days	17	105	122
Most days	47	175	222
Total	120	378	498

Percent

Frequency	Disagree	Agree	Total
Less often than once per week	46.7	25.9	30.9
At least once per week, but not most days	14.2	27.8	24.5
Most days	39.2	46.3	44.6
	100.0	*100.0*	*100.0*

Cramer's V = 0.203 (significant at the 0.01 level)

the percentage who use rail most days is lower than the percentage who use rail less often than once per week, which is expected. However, the middle category of rail use frequency has a surprisingly low percentage for those who disagree. There is a moderate positive relationship between respondents who indicated that they agree that transit is comfortable and frequency of rail use with a Cramer's V correlation of 0.203 that is statistically significant at the 0.01 level.

Among the respondents who use rail on most days, many more disagree that crime occurs frequently on or in the transit system than agree (see TABLE 5.19). This trend continues for those who use transit at least once per week, but at a smaller margin. A greater number of survey-takers who use rail less often than once per week also disagree, but the split between agree and disagree is close to equal. Of the respondents who disagree that crime occurs frequently, the greatest percent use rail on most days and of the respondents who agree, the

TABLE 5.19: Cross-tabulation of responses to "crime occurs frequently on transit" and rail use frequency for all trips

Count

Frequency	Disagree	Agree	Total
Less often than once per week	76	62	138
At least once per week, but not most days	75	41	116
Most days	157	55	212
Total	308	158	466

Percent

Frequency	Disagree	Agree	Total
Less often than once per week	24.7	39.2	29.6
At least once per week, but not most days	24.4	25.9	24.9
Most days	51.0	34.8	45.5
	100.0	*100.0*	*100.0*

Cramer's V = 0.171 (significant at the 0.01 level)

greatest percent use rail less often than once per week. An almost equal percentage of those that disagree use rail once per week or less often. Among the survey-takers that use rail at least once per week, the percentages for both agree and disagree are somewhat unexpected. The association between rail use frequency and opinion about crime would likely be higher if the percent of respondents in the middle category of frequency was between the percent of respondents for the most frequent and least frequent categories. Nonetheless, rail use frequency and opinions that crime occurs frequently on transit have a negative moderate association with a Cramer's V correlation of 0.171 that is statistically significant at the 0.01 level.

As shown in TABLE 5.20, survey-takers who use rail on most days tend to disagree that transit is often late. Given that BART typically reports an excellent on-time performance (approximately 92 percent on-time), one would expect the number of respondents who disagree to be greater. Among the 119 individuals who indicated they use rail at least once per week, but not most days, an almost equal number agree as disagree with slightly more agreeing that transit is often late. As expected, those who use rail less often agree more than they disagree. Among respondents who agree, it is surprising to see that a similar percentage use rail most days as use rail less often than once per week. However, among those that disagree, the largest percent use rail on most days. Rail use frequency and agreement (or disagreement) with the statement, "transit is often late" exhibit a negative moderate association with a Cramer's V of 0.162 that is significant at the 0.01 level.

TABLE 5.20: Cross-tabulation of responses to "transit is often late" and rail use frequency for all trips

Count

Frequency	Disagree	Agree	Total
Less often than once per week	65	84	149
At least once per week, but not most days	56	63	119
Most days	134	85	219
Total	255	232	487

Percent

Frequency	Disagree	Agree	Total
Less often than once per week	25.5	36.2	30.6
At least once per week, but not most days	22.0	27.2	24.4
Most days	52.5	36.6	45.0
	100.0	*100.0*	*100.0*

Cramer's V = 0.162 (significant at the 0.01 level)

A large number of respondents who use rail on most days disagree with the statement, "it makes me uncomfortable to ride on a train or bus with strangers" (see TABLE 5.21). This trend continues for both of the other two categories of rail use frequency, but as rail use frequency decreases, the margins between agree and disagree decrease as well. Among survey-takers who disagree, the greatest percentage use rail on most days. Among those that agree, the greatest percentage use rail less often than once per week. An almost equal percentage of those that agree and disagree use rail at least once per week, but not on most days. Opinions on this statement and rail use frequency have a negative moderate association, albeit a weaker one than any of the previously discussed statistically significant associations. The computed Cramer's V correlation is 0.145 and significant at the 0.01 level.

TABLE 5.21: Cross-tabulation of responses to "it makes me uncomfortable to ride on a train or bus with strangers" and rail use frequency for all trips

Count

Frequency	Disagree	Agree	Total
Less often than once per week	117	37	154
At least once per week, but not most days	101	19	120
Most days	193	25	218
Total	411	81	492

Percent

Frequency	Disagree	Agree	Total
Less often than once per week	28.5	45.7	31.3
At least once per week, but not most days	24.6	23.5	24.4
Most days	47.0	30.9	44.3
	100.0	*100.0*	*100.0*

Cramer's V = 0.145 (significant at the 0.01 level)

A large number of respondents indicated they both agree that many of their coworkers use transit, and use rail themselves on most days (see TABLE 5.22). This is expected since many respondents indicated they use transit to commute to work. It is interesting that 119 respondents indicated that they agree that many of their coworkers use transit, but use rail less often than once per week. The ratio of those who agree to those who disagree decreases as rail use frequency decreases. This ratio in the "most days" category is 11.3, in the "once per week, but not most days" category is 7.6, and in the "less often than once per week" category it is 3.6.

TABLE 5.22: Cross-tabulation of responses to "many of my coworkers use transit" and rail use frequency for all trips

Count

Frequency	Disagree	Agree	Total
Less often than once per week	33	119	152
At least once per week, but not most days	14	106	120
Most days	18	204	222
Total	65	429	494

Percent

Frequency	Disagree	Agree	Total
Less often than once per week	50.8	27.7	30.8
At least once per week, but not most days	21.5	24.7	24.3
Most days	27.7	47.6	44.9
	100.0	*100.0*	*100.0*

Cramer's V = 0.174 (significant at the 0.01 level)

Among the survey-takers who agree, the largest percent use rail on most days. Among those who disagree, the largest percent use rail less often than once per week. A similar percentage of those who agree and those who disagree use rail at least once per week, but not on most days. Opinions on this question and rail use frequency display a moderate positive association with a Cramer's V of 0.174 that is statistically significant at the 0.01 level.

As displayed in TABLE 5.23, the association between responses to the statement, “people take transit when they have no choice” and rail use frequency is barely moderate and negative with a Cramer's V of 0.111 that is significant at the 0.05 level. One likely explanation for the weaker association is that the largest number and percentage of respondents who both agree and disagree indicate that they use rail on most days. Among those that use rail on most days, a slightly greater number agree than disagree with the statement. This trend holds for those who use rail once per week, but not most days, with an even greater margin between those who agree and disagree. The margin between agree and disagree is largest for respondents who use rail less often than once per week. Among individuals who indicated they agree, the percent that use rail less often than once per week is almost the same as the percent who use rail on most days with only a 5.4 percentage point difference. Among survey-takers who disagree, the same percent use rail once per week, but not on most days as use rail less often than once per week.

TABLE 5.23: Cross-tabulation of responses to “people take transit when they have no choice” and rail use frequency for all trips

Count

Frequency	Disagree	Agree	Total
Less often than once per week	53	98	151
At least once per week, but not most days	53	69	122
Most days	104	113	217
Total	210	280	490

Percent

Frequency	Disagree	Agree	Total
Less often than once per week	25.2	35.0	30.8
At least once per week, but not most days	25.2	24.6	24.9
Most days	49.5	40.4	44.3
	100.0	*100.0*	*100.0*

Cramer's V = 0.111 (significant at the 0.05 level)

The final attitude question, which asked for respondents to agree or disagree with the statement, “I prefer to drive when I can,” is expected to have a strong association with rail use frequency. Among respondents who use rail on most days, a large majority disagreed (see TABLE 5.24). More survey-takers who use rail at least once per week, but not on most days disagreed than agreed, however the margin between agree and disagree is much smaller than for those who use rail on most days. As expected, among those who use rail less often than once per week, more respondents agreed that they prefer to drive when they can. The largest percent of individuals who agreed used rail less often than once per week and the largest percent who disagreed used rail on most days. Among respondents who disagree, percentages decrease as rail use frequency decreases. The Cramer's V correlation between opinions on this statement and rail use frequency is 0.337 and statistically significant at the 0.01 level, indicating a strong negative association between the two variables.

TABLE 5.24: Cross-tabulation of responses to "I prefer to drive when I can" and rail use frequency for all trips

Count

Frequency	Disagree	Agree	Total
Less often than once per week	61	90	151
At least once per week, but not most days	83	37	120
Most days	166	48	214
Total	310	175	485

Percent

Frequency	Disagree	Agree	Total
Less often than once per week	19.7	51.4	31.1
At least once per week, but not most days	26.8	21.1	24.7
Most days	53.5	27.4	44.1
	100.0	*100.0*	*100.0*

Cramer's V = 0.337 (significant at the 0.01 level)

5.7: Associations between Household and Individual Characteristic Results, Rail Use Frequency, and Distance from Home to Rail Station

In determining the associations between rail use frequency and household or individual characteristics, the same three categories of rail use frequency were used. TABLE 5.25 shows the cross-tabulation between annual household income and rail use frequency. From an analysis of this bivariate table, it is difficult to see any trends that would help identify an association between the two variables. In fact, the Cramer's V correlation between rail use frequency and annual household income is just barely moderate and statistically significantly.

TABLE 5.25: Cross-tabulation of annual household income and rail use frequency for all trips

Count

Frequency	Less than $50,000	$50,000 to $100,000	$100,000 to $150,000	$150,000 to $200,000	More than $200,000	Total
Less often than once per week	35	63	27	20	12	157
At least once per week, but not most days	36	46	17	18	5	122
Most days	47	72	58	27	19	223
Total	118	181	102	65	36	502

Percent

Frequency	Less than $50,000	$50,000 to $100,000	$100,000 to $150,000	$150,000 to $200,000	More than $200,000	Total
Less often than once per week	29.7	34.8	26.5	30.8	33.3	31.3
At least once per week, but not most days	30.5	25.4	16.7	27.7	13.9	24.3
Most days	39.8	39.8	56.9	41.5	52.8	44.4
	100.0	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

Cramer's V = 0.117 (significant at the 0.10 level)

In contrast, when bus use frequency is used, the association is much stronger, as displayed in TABLE 5.26. Clearly, as respondents' annual household income increases, they are less likely to use buses as frequently. Among the 118 survey-takers who live in households with annual income less than $50,000, 31.4 percent use buses on most days and 56.8 percent use buses less often than once per week. Among the other categories of annual income, the percent of respondents who use buses on most days is much lower and the percent that use buses less often is much greater. For example, of the 65 individuals in the $150,000 to $200,000 range, only 4.6 percent use buses on most days and 87.7 use buses less often than once per week. Bus use frequency and annual household income have a Cramer's V correlation of 0.190, which is statistically significant at the 0.01 level. The association between the two variables is negative and moderate. Based on these results, the association between annual household income and transit use is mode-specific.

TABLE 5.26: Cross-tabulation of annual household income and bus use frequency for all trips

Count

Frequency	Less than $50,000	$50,000 to $100,000	$100,000 to $150,000	$150,000 to $200,000	More than $200,000	Total
Less often than once per week	67	128	82	57	29	363
At least once per week, but not most days	14	26	10	5	4	59
Most days	37	27	10	3	3	80
Total	118	181	102	65	36	502

Percent

Frequency	Less than $50,000	$50,000 to $100,000	$100,000 to $150,000	$150,000 to $200,000	More than $200,000	Total
Less often than once per week	56.8	70.7	80.4	87.7	80.6	72.3
At least once per week, but not most days	11.9	14.4	9.8	7.7	11.1	11.8
Most days	31.4	14.9	9.8	4.6	8.3	15.9
	100.0	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

Cramer's V = 0.190 (significant at the 0.01 level)

Among the respondents from households with fewer vehicles than drivers, 44.7 percent use rail on most days (see TABLE 5.27). An almost identical percentage of survey-takers from households with equal or more vehicles than licensed drivers, 44.3 percent, use rail on most days. However, a greater percentage of survey-takers from households with equal or more vehicles than licensed drivers (34.4 percent) use rail less often than once per week than do respondents from households with fewer vehicles than drivers (24.5 percent). These two variables display a moderate association, albeit only slightly greater than weak, with a Cramer's V correlation of 0.122, which is statistically significant at the 0.05 level.

One of the main tenets of transit-oriented development is that transit use is more prevalent among individuals from households that are closer to transit stations. In general, the results from the survey confirm this (see TABLE 5.28). Of the 223 respondents who use rail on most days, the largest number (83) live within a half-mile of a rail station and that number decreases as distance is increased with 44 living one half to one mile and 26 living one to two miles from the nearest rail station. However, 67 survey-takers reported living more than two miles from the nearest rail station and taking rail on most days. This is consistent with the fact that beyond a certain distance, individuals are willing to drive to transit stations.

TABLE 5.27: Cross-tabulation of vehicles available in household and rail use frequency for all trips

Count

Frequency	Fewer vehicles than drivers	Equal or more vehciles than drivers	Total
Less often than once per week	39	118	157
At least once per week, but not most days	49	73	122
Most days	71	152	223
Total	159	343	502

Percent

Frequency	Fewer vehicles than drivers	Equal or more vehciles than drivers	Total
Less often than once per week	24.5	34.4	31.3
At least once per week, but not most days	30.8	21.3	24.3
Most days	44.7	44.3	44.4
	100.0	*100.0*	*100.0*

Cramer's V = 0.122 (significant at the 0.05 level)

TABLE 5.28: Cross-tabulation of distance from home to rail station and rail use frequency for all trips

Count

Frequency	Less than half mile	Half to one mile	One to two miles	More than two miles	Total
Less often than once per week	32	29	37	59	157
At least once per week, but not most days	42	34	25	21	122
Most days	86	44	26	67	223
Total	160	107	88	147	502

Percent

Frequency	Less than half mile	Half to one mile	One to two miles	More than two miles	Total
Less often than once per week	20.0	27.1	42.0	40.1	31.3
At least once per week, but not most days	26.3	31.8	28.4	14.3	24.3
Most days	53.8	41.1	29.5	45.6	44.4
	100.0	*100.0*	*100.0*	*100.0*	*100.0*

Cramer's V = 0.176 (significant at the 0.01 level)

Among the 157 individuals who use rail less often than once per week, the greatest number (59) live beyond 2 miles from the nearest rail station. Of the 122 respondents who indicated the middle frequency category, at least once per week, but not most days, the numbers decrease as distance from the nearest rail station increases.

Among the respondents who live within a half mile of rail, 53.8 percent use rail on most days and only 20.0 percent use rail less often than once per week. This downward trend of rail use frequency continues for survey-takers who live between one half and one mile from rail, but the differences in percentages is less pronounced than for those who live closer to rail stations. Beyond one mile, the trend no longer holds. In fact, 45.6 percent of respondents who live more than two miles from rail use it on most days compared to 40.1 percent who use rail less often than once per week. The association between distance from rail and rail use is negative and moderate with a Cramer's V correlation of 0.176, which is significant at the 0.01 level.

Whether or not a respondent's employer provides free or discounted parking also appears to be associated with the frequency of an individual's rail use. Based on the percentages in TABLE 5.29, those who get free or discounted parking at work appear to use transit less frequently. Among the 84 respondents who said they received either part or full subsidization of their parking costs, 46.4 percent indicated they used rail less often than once per week. This is in contrast to the 35.7 percent who use rail on most days and 17.9 percent who use rail once per week, but not most days. Among the 418 survey-takers who receive no assistance from their employer in paying for parking, 46.2 percent use rail on most days as opposed to 25.6 percent who use rail at least once per week, but not on most days, and 28.2 percent who use rail less often than once per week. Rail use frequency and employer parking subsidization have a Cramer's V correlation of 0.147, which is moderate and statistically significant at the 0.01 level.

TABLE 5.29: Cross-tabulation of parking costs paid by employer and rail use frequency for all trips

Count

Frequency	None	Some or all	Total
Less often than once per week	118	39	157
At least once per week, but not most days	107	15	122
Most days	193	30	223
Total	418	84	502

Percent

Frequency	None	Some or all	Total
Less often than once per week	28.2	46.4	31.3
At least once per week, but not most days	25.6	17.9	24.3
Most days	46.2	35.7	44.4
	100.0	*100.0*	*100.0*

Cramer's V = 0.147 (significant at the 0.01 level)

As expected, there is a moderate association between the level of importance respondents placed on being in close proximity to transit when they last moved and rail use frequency, with a Cramer's V of 0.155 that is significant at the 0.01 level. The results of this cross-tabulation are presented in TABLE 5.30. Of the 214 survey-takers who use rail on most days, 128 indicated proximity to transit was very or extremely important the last time they moved residences compared to only 46 who said proximity to transit was not or a little important and only 40 who stated that proximity was important. A similar trend exists for those who use rail at least once per week, but not on most days. 77 of the 118 respondents in this frequency category indicated proximity to transit on their last move was either very or extremely important. However, among the 154 individuals who use transit less often than once per week, only 60 said proximity was very or extremely important. Among the 265 respondents who stated that proximity to transit was very or extremely important when they moved last, 48.3 percent use rail on most days compared to 22.6 percent who use rail less often than once per week.

TABLE 5.30: Cross-tabulation of importance of proximity to transit when last moved and rail use frequency for all trips

Count

Frequency	Not or a little important	Important	Very or extremely important	Total
Less often than once per week	50	44	60	154
At least once per week, but not most days	19	22	77	118
Most days	46	40	128	214
Total	115	106	265	486

Percent

Frequency	Not or a little important	Important	Very or extremely important	Total
Less often than once per week	43.5	41.5	22.6	31.7
At least once per week, but not most days	16.5	20.8	29.1	24.3
Most days	40.0	37.7	48.3	44.0
	100.0	*100.0*	*100.0*	*100.0*

Cramer's V = 0.155 (significant at the 0.01 level)

TABLE 5.31: Cross-tabulation of importance of proximity to transit when last moved and distance from home to rail station (half-mile)

Count

Distance	Not or a little important	Important	Very or extremely important	Total
Half mile or less	12	21	122	155
More than half mile	103	85	143	331
Total	115	106	265	486

Percent

Distance	Not or a little important	Important	Very or extremely important	Total
Half mile or less	10.4	19.8	46.0	31.9
More than half mile	89.6	80.2	54.0	68.1
	100.0	*100.0*	*100.0*	*100.0*

Cramer's V = 0.339 (significant at the 0.01 level)

TABLE 5.32: Cross-tabulation of importance of proximity to transit when last moved and distance from home to rail station (one-mile)

Count

Distance	Not or a little important	Important	Very or extremely important	Total
One mile or less	27	47	186	260
More than one mile	88	59	79	226
Total	115	106	265	486

Percent

Distance	Not or a little important	Important	Very or extremely important	Total
One mile or less	23.5	44.3	70.2	53.5
More than one mile	76.5	55.7	29.8	46.5
	100.0	*100.0*	*100.0*	*100.0*

Cramer's V = 0.393 (significant at the 0.01 level)

TABLES 5.31 to 5.33 show the association between the distance from home to the nearest rail station and the importance of proximity to transit. TABLE 5.31 shows the importance of proximity to transit and whether or not the respondent lives within a half mile of a rail station. TABLE 5.32 expands that distance to one mile. TABLE 5.33 further expands the distance to whether or not the respondent lives within two miles of a rail station. All three distances have a strong association with the importance of proximity to transit and the association gets stronger as the radii increase. The Cramer's V correlations are 0.339, 0.393, and 0.413 for half mile, one mile and two mile radii, respectively, and all are significant at the 0.01 level.

TABLE 5.33: Cross-tabulation of importance of proximity to transit when last moved and distance from home to rail station (two-miles)

Count

Distance	Not or a little important	Important	Very or extremely important	Total
Two miles or less	48	67	230	345
More than two miles	67	39	35	141
Total	115	106	265	486

Percent

Distance	Not or a little important	Important	Very or extremely important	Total
Two miles or less	41.7	63.2	86.8	71.0
More than two miles	58.3	36.8	13.2	29.0
	100.0	*100.0*	*100.0*	*100.0*

Cramer's V = 0.413 (significant at the 0.01 level)

5.8: Associations between Childhood Experience Results and Rail Use Frequency, Importance of Proximity to Transit when Last Moved, and Distance from Home to Rail Station

Based on data from the survey, neither present-day rail nor bus use frequency is associated with rail or bus use frequency while the respondent was in high school. TABLE 5.34 shows the cross-tabulation for rail use frequency now and in high school and TABLE 5.35 shows the same for bus use frequency.

TABLE 5.34: Cross-tabulation of rail use frequency for all trips and rail use frequency for all trips in high school

Count

Frequency	Less often than once per week in high school	At least once per week, but not most days in high school	Most days in high school	Total
Less often than once per week	135	15	7	157
At least once per week, but not most days	109	8	5	122
Most days	199	11	13	223
Total	443	34	25	502

Percent

Frequency	Less often than once per week in high school	At least once per week, but not most days in high school	Most days in high school	Total
Less often than once per week	30.5	44.1	28.0	31.3
At least once per week, but not most days	24.6	23.5	20.0	24.3
Most days	44.9	32.4	52.0	44.4
	100.0	*100.0*	*100.0*	*100.0*

Cramer's V = 0.060

For rail use frequency, among survey-takers who indicated they used rail less often than once per week in high school, 199 respondents (44.9 percent) presently use rail on most days compared to 109 (24.6 percent) and 135 (30.5 percent) who use rail at least once per week, but not most days and less often than once per week, respectively. One possible explanation for the lack of association (Cramer's V correlation of 0.060) is that very few respondents indicated they used rail frequently in high school.

TABLE 5.35: Cross-tabulation of bus use frequency for all trips and bus use frequency for all trips in high school

Count

Frequency	Less often than once per week in high school	At least once per week, but not most days in high school	Most days in high school	Total
Less often than once per week	248	49	66	363
At least once per week, but not most days	42	6	11	59
Most days	47	11	22	80
Total	337	66	99	502

Percent

Frequency	Less often than once per week in high school	At least once per week, but not most days in high school	Most days in high school	Total
Less often than once per week	73.6	74.2	66.7	72.3
At least once per week, but not most days	12.5	9.1	11.1	11.8
Most days	13.9	16.7	22.2	15.9
	100.0	*100.0*	*100.0*	*100.0*

Cramer's V = 0.066

Many more used buses as opposed to rail on most days and at least once per week, but not most days in high school, but there is still a weak association between bus use then and now (Cramer's V correlation of 0.066). Among the 99 respondents who used buses on most days in high school, 66.7 percent use buses less often than once per week now. For the other two categories of bus use frequency in high school, most respondents indicated they presently use buses less often than once per week.

TABLE 5.36 combines bus and rail use and compares overall transit use in high school and today. The association is even weaker than for bus and rail, with a Cramer's V of 0.046. Clearly, if there is a relationship between respondents' transit use of any kind in childhood and present-day transit use, the correlation is not direct and must be examined using other variables, such as the distance from home to transit and the importance of proximity to transit.

TABLE 5.36: Cross-tabulation of transit use frequency for all trips and transit use frequency for all trips in high school

Count

Frequency	Less often than once per week in high school	At least once per week, but not most days in high school	Most days in high school	Total
Less often than once per week	79	20	27	126
At least once per week, but not most days	79	17	19	115
Most days	169	34	58	261
Total	327	71	104	502

Percent

Frequency	Less often than once per week in high school	At least once per week, but not most days in high school	Most days in high school	Total
Less often than once per week	24.2	28.2	26.0	25.1
At least once per week, but not most days	24.2	23.9	18.3	22.9
Most days	51.7	47.9	55.8	52.0
	100.0	*100.0*	*100.0*	*100.0*

Cramer's V = 0.046

There is a statistically significant at the 0.10 level, albeit weak association between rail use frequency and distance from home to rail in high school (see TABLE 5.37). There appears to be almost no discernible pattern in the counts or percentages that would reveal a trend toward rail use based on distance from home to rail in high school, which is not surprising given the resulting Cramer's V correlation of 0.100.

TABLE 5.37: Cross-tabulation of rail use frequency for all trips and distance from home to rail station in high school (two-miles)

Count

Frequency	Two miles or less in high school	More than two miles in high school	Total
Less often than once per week	55	102	157
At least once per week, but not most days	28	94	122
Most days	72	151	223
Total	155	347	502

Percent

Frequency	Two miles or less in high school	More than two miles in high school	Total
Less often than once per week	35.5	29.4	31.3
At least once per week, but not most days	18.1	27.1	24.3
Most days	46.5	43.5	44.4
	100.0	*100.0*	*100.0*

Cramer's V = 0.100 (significant at the 0.10 level)

There is a stronger association between respondents' reported level of importance of proximity to transit and distance from home to the nearest rail station in high school (see TABLE 5.38). Among the 145 individuals who lived two miles or less from rail, only 15.9 percent indicated that proximity to transit was either not or a little important the last time they moved. 22.1 percent said proximity was important and 62.1 percent indicated proximity was either very or extremely important. There is a similar trend for the 341 respondents who lived more than two miles from rail in high school, but the percentage who indicated not or a little important is greater and the percentage who indicated very or extremely important is less than those who live closer to rail. 27.0 percent selected not or a little important, 21.7 percent selected important and 51.3 percent indicated very or extremely important. The Cramer's V correlation between importance of proximity to transit and distance to rail in high school is 0.124 and statistically significant at the 0.05 level.

TABLE 5.38: Cross-tabulation of importance of proximity to transit when last moved and distance from home to rail station in high school (two-miles)

Count

Level of importance	Two miles or less in high school	More than two miles in high school	Total
Not or a little important	23	92	115
Important	32	74	106
Very or extremely important	90	175	265
Total	145	341	486

Percent

Level of importance	Two miles or less in high school	More than two miles in high school	Total
Not or a little important	15.9	27.0	23.7
Important	22.1	21.7	21.8
Very or extremely important	62.1	51.3	54.5
	100.0	*100.0*	*100.0*

Cramer's V = 0.124 (significant at the 0.05 level)

The association between respondents' current distance from home to rail and distance from home to rail in high school is even stronger as presented in TABLE 5.39. For survey-takers who live between one half and two miles there appears to be no distinction between those who lived two miles or less from rail in high school and those that live more than two miles. The percentages for both one half to one mile and one to two miles current distance are nearly identical for both columns. However, among the respondents who lived two miles or less from rail in high school, 38.7 percent presently live one half mile or less from the nearest rail station and 22.1 percent presently live more than two miles from the nearest rail station. Among the respondents who live more than two miles from rail in high school, 29.0 percent presently live one half mile or less from the nearest rail station and 32.0 percent presently live more than two miles from the nearest rail station. This indicates that those who lived closer to rail in high school seem more likely to live within a half mile of rail now and those that lived farther from rail in high school seem more likely to live beyond two miles of the nearest rail station now. The two variables have a Cramer's V correlation of 0.136, which is significant at the 0.10 level.

TABLE 5.39: Cross-tabulation of distance from home to rail station and distance from home to rail station in high school (two-miles)

Count

Distance	Two miles or less in high school	More than two miles in high school	Total
Less than half mile	56	99	155
Half to one mile	31	74	105
One to two miles	26	59	85
More than two miles	32	109	141
Total	145	341	486

Percent

Distance	Two miles or less in high school	More than two miles in high school	Total
Less than half mile	38.7	29.0	31.9
Half to one mile	21.4	21.7	21.6
One to two miles	17.9	17.3	17.5
More than two miles	22.1	32.0	29.0
	100.0	*100.0*	*100.0*

Cramer's V = 0.136 (significant at the 0.10 level)

There are two noteworthy comparisons among whether or not at least one parent or guardian used transit to commute to work while the respondent was in high school, rail use frequency and the importance of proximity to transit. There is no association between parent or guardian transit use and present-day rail use frequency as shown in TABLE 5.40. There are similar percentages for both columns in each of the three frequency categories. There is a weak, though just below what would be considered moderate and statistically significant, association between parent or guardian transit use and the importance of proximity to transit (see TABLE 5.41). 26.3 percent of the 365 respondents who did not have at least one parent or guardian use transit indicated proximity to transit was not or a little important when they moved last compared to 15.7 percent of the 121 respondents who did have at least one parent or guardian use transit. In contrast, 52.3 percent of the group with no parental transit use indicated proximity was very or extremely important compared to 61.2 percent of the group with parental transit use. The Cramer’s V correlation is 0.109 and significant at the 0.10 level.

TABLE 5.40: Cross-tabulation of frequency of transit use and parent(s) or guardian(s) use of transit while respondent was in high school

Count

Frequency	Neither parent nor guardian used transit	At least one parent or guardian used transit	Total
Less often than once per week	118	39	157
At least once per week, but not most days	91	31	122
Most days	163	60	223
Total	372	130	502

Percent

Frequency	Neither parent nor guardian used transit	At least one parent or guardian used transit	Total
Less often than once per week	31.7	30.0	31.3
At least once per week, but not most days	24.5	23.8	24.3
Most days	43.8	46.2	44.4
	100.0	*100.0*	*100.0*

Cramer's V = 0.021

TABLE 5.41: Cross-tabulation of importance of proximity to transit when last moved and parent(s) or guardian(s) use of transit while respondent was in high school

Count

Level of importance	Neither parent nor guardian used transit	At least one parent or guardian used transit	Total
Not or a little important	96	19	115
Important	78	28	106
Very or extremely important	191	74	265
Total	365	121	486

Percent

Level of importance	Neither parent nor guardian used transit	At least one parent or guardian used transit	Total
Not or a little important	26.3	15.7	23.7
Important	21.4	23.1	21.8
Very or extremely important	52.3	61.2	54.5
	100.0	*100.0*	*100.0*

Cramer's V = 0.109 (significant at the 0.10 level)

5.9: Summary of Survey Results from Dataset A for All Trips

TABLE 5.42 shows the statistically significant associations between variables discussed in Chapter 5. Four associations are considered strong and of those four, three of them are measuring the same thing, but at different distances. The strongest relationship is between the distance from home to rail and the importance of proximity to transit. This association is the strongest among respondents who live within a two miles radius of the nearest rail station.

TABLE 5.42: Summary table of statistically significant associations

Attitude, household characteristic, or childhood experience	Rail use frequency		Importance of proximity to transit		Distance from home to rail station	
	Cramer's V	P-value	Cramer's V	P-value	Cramer's V	P-value
I like to ride transit because I can read or get work done	0.202 (moderate)	0.01				
Transit is comfortable	0.203 (moderate)	0.01				
Crime occurs frequently on transit	0.171 (moderate)	0.01				
Transit is often late	0.162 (moderate)	0.01				
It makes me uncomfortable to ride transit with strangers	0.145 (moderate)	0.01				
Many of my coworkers use transit	0.174 (moderate)	0.01				
People take transit when they have no choice	0.111 (moderate)	0.05				
I prefer to drive when I can	0.337 (strong)	0.01				
Annual household income	0.117 (moderate)	0.10				
Annual household income*	0.190 (moderate)	0.01				
Vehicles available in household	0.122 (moderate)	0.05				
Distance from home to rail station	0.176 (moderate)	0.01				
Parking costs paid by employer	0.147 (moderate)	0.01				
Importance of proximity to transit when last moved	0.155 (moderate)	0.01				
Half mile distance from home to rail			0.339 (strong)	0.01		
One mile distance from home to rail			0.393 (strong)	0.01		
Two mile distance from home to rail			0.413 (strong)	0.01		
Distance from home to rail in high school	0.100 (weak)	0.10	0.124 (moderate)	0.05	0.136 (moderate)	0.10
Parent or guardian use of transit in high school			0.109 (weak)	0.10		

* association measured with bus use frequency

However, it remains strong for those who live within a mile and those who live within a half mile of the nearest rail station.

There is also a strong association between respondents who prefer to drive and rail use frequency. This is not surprising since one would expect respondents who prefer to drive to drive more often.

Among the associations that are considered moderate, the strongest relationship is between respondents' opinion as to whether or not transit is comfortable and rail use frequency. Those who find transit comfortable tend to use it more often. That this association is stronger than rail use frequency and cleanliness, crime and reliability is an important finding from the research. It suggests that potential and existing rider perceptions of features such as seat availability, seat comfort and on-board climate control are important in the mode choice process and improving and/or maintaining these features should be a primary concern of transit operators.

The relationship between income and transit use frequency is clearly mode-specific. Individuals from all economic backgrounds seem willing to use rail service. However, buses don't appeal to wealthier individuals. This could be a major obstacle to increasing bus ridership, particularly when efforts toward improving bus service in lieu of more expensive rail system expansion is popular among transit operators. It remains unclear if bus rapid transit approaches can overcome this.

The next strongest of the moderate associations is between individuals who view their time on transit as productive and their frequency of rail use. The obvious difference between driving and taking transit and using the travel time for other purposes is the ability to read, either for business or leisure. This seems to be an important factor for respondents who are choosing to ride transit and perhaps can be a selling point to those who currently drive if marketed properly.

Confirming one of the benefits of TOD to transit operators, the distance from home to the nearest rail station is moderately associated with rail use frequency. Transit operators and municipalities should continue to encourage this type of development. The fact that this relationship is not strong is somewhat expected when considering all trip-types, not just work trips

The fact that there is a moderate association between respondents who indicated that "many of my coworkers use transit" and rail use frequency, implies that observing others and perhaps even peer-pressure may in fact encourage transit use.

Frequency of crime also showed a relatively high negative association with rail use. Safety concerns are known to discourage transit use, particularly during off-peak hours when stations and trains are less crowded. If transit operators seek to increase ridership, particularly during off-peak hours, when there is almost certainly excess capacity for more riders, efforts to reduce crime and increasing police presence may be helpful.

As expected, reliability is also moderately related to rail use frequency. Though this survey didn't ask about different levels of reliability, transit operators should determine how much unpredictability riders are willing to endure before they decide to use an alternative mode.

Employee cash-out and other parking policies to encourage workers to use transit should be continued and expanded. From the survey, individuals appear more likely to drive if parking is subsidized by employers. Employers should be discouraged from providing free parking, particularly if transit stations are nearby.

Lastly, the relationship between distance to rail in high school and current distance to rail from home indicates that there is some multi-generational effect of early exposure to transit. This may be the result of individuals choosing to live near where they lived during childhood or choosing to live in areas that are similar to those they lived in during high school. Or, the early exposure may be evidence of habit formation that carries over into adulthood.

5.10: Additional Analysis as Ordinal Values

So far, the survey results, particularly the attitude questions, have been analyzed as nominal data. However, since the attitude questions can be ranked from strongly disagree to strongly agree and rail use frequency is inherently ranked from least frequent to most frequent, ordinal measures of association can be used that are more powerful than simple Cramer's V correlations. Ordinal measures of association are typically reported from -1 to +1 and as such indicate the strength and direction of the relationship.

For ordinal analysis, Spearman's rho is used. Spearman's rho is a statistical calculation that produces a numerical relation from 1 to -1. Spearman's rho evaluates the degree to which individuals or cases with high rankings on one variable were observed to have similar rankings on another variable.

For this analysis, the attitude question responses were used in their original five point scale: (1) strongly disagree, (2) somewhat agree, (3) no opinion, (4) somewhat agree, and (5) strongly agree. The rail-use frequency responses are aggregated to (1) less often than once per week, (2) at least once per week but not most days, and (3) most days. The other variables, such as income, distance from rail station and importance of proximity to transit, are used in the same format as they were used in the nominal analysis. Likewise, the childhood variables are also used in the same format as in the nominal analysis.

TABLE 5.43 presents the Spearman's rank correlations that are statistically significant at the 0.10 level or better. Neither annual household income nor vehicles available per licensed driver are statistically significantly associated with rail use frequency in the ordinal analysis. However, respondents' opinions on transit system cleanliness and whether or not taking transit is environmentally friendly both are significant. The signs (positive or negative) for each of Spearman's rank correlations are as expected.

TABLE 5.43: Summary table of statistically significant ordinal associations

Attitude, household characteristic, or childhood experience	Rail use frequency		Importance of proximity to transit		Distance from home to rail station	
	ρ value	P-value	ρ value	P-value	ρ value	P-value
I like to ride transit because I can read or get work done	+ 0.275	0.01				
Transit is comfortable	+ 0.184	0.01				
Crime occurs frequently on transit	- 0.134	0.01				
Transit is often late	- 0.166	0.01				
It makes me uncomfortable to ride transit with strangers	- 0.148	0.01				
Many of my coworkers use transit	+ 0.150	0.01				
People take transit when they have no choice	- 0.092	0.05				
I prefer to drive when I can	- 0.324	0.01				
Taking transit reduces my impact on the environment	+ 0.084	0.10				
Transit is dirty	- 0.090	0.05				
Annual household income*	- 0.237	0.01				
Distance from home to rail station	- 0.143	0.01				
Parking costs paid by employer	- 0.128	0.01				
Importance of proximity to transit when last moved	+ 0.154	0.01				
Half mile distance from home to rail			- 0.338	0.01		
One mile distance from home to rail			- 0.392	0.01		
Two mile distance from home to rail			- 0.411	0.01		
Distance from home to rail in high school			- 0.116	0.05	+ 0.106	0.05
Parent or guardian use of transit in high school			+ 0.096	0.05		

* association measured with bus use frequency

The association between rail use frequency and whether or not individuals prefer to drive is among the stronger correlations with a value of -0.324. Among the other attitude associations with rail use frequency, productive use of time on transit and transit comfort are also stronger with values of +0.275 +0.184, respectively.

As was the case with the nominal analysis, there is a relatively strong association between importance of proximity to transit and actual distance to the nearest rail station. As distance increases, the association strengthens. And similar to the nominal analysis, the association between childhood transit experience indicators and rail use frequency, importance of proximity to transit and distance to nearest rail station are not particularly strong.

5.11: Ordinal Regression Model

Thus far, the analysis has taken a bivariate approach. This doesn't account for the combined influence of the attitude variables and how these variables may interact with individual and/or household characteristics to influence rail use frequency. This section does so by means of an ordinal regression model.

The first step in this process is to distill the ten attitude questions into a few core dimensions using factor analysis. Based on a principal components extraction routine, two factors were created to capture the effects of the attitude responses. The factor loadings or component matrix is presented in TABLE 5.44.

TABLE 5.44: Component 1 and 2 factor loadings for the ten attitude questions

Attitude	Component 1	Component 2
Transit is comfortable	-0.680	0.096
Transit is dirty	0.558	0.370
Many of my coworkers use transit	-0.174	0.475
Transit is often late	0.513	0.491
I like to ride transit because I can read or get work done	-0.467	0.450
Crime occurs frequentrly in/on transit	0.657	0.229
Taking transit reduces my impact on the environment	-0.309	0.622
People take transit when they have no choice	0.448	0.329
I prefer to drive when I can	0.673	-0.250
I am uncomfortable riding on transit with strangers	0.665	-0.058

Each respondent is assigned a factor score for each of the two newly created factors based on the factor loadings. These factor scores are used as independent variables in an ordinal regression model with other relevant variables. An ordinal regression logit model is used, because the dependent variable, the three levels of rail use frequency, is ordinal.

In addition to the factor scores, typical relevant socio-economic data from the survey are used as independent variables. This includes income, age, number of vehicles available, and gender. The income variable used in the ordinal regression is the mid-point of the income ranges as reported on the survey. Based on the bivariate analysis previously conducted, it is not expected that the coefficients of these socio-economic variables will be statistically significant, since they were shown to have a weak association with rail use frequency. However, since existing literature indicates that they may have some influence on mode choice, they are utilized in the ordinal regression. Furthermore, the bivariate analysis indicated that income was much more strongly associated with bus use frequency than rail use frequency.

A dummy variable was used to indicate whether or not the respondent lived within two miles of the nearest rail station. Also, since there was a relatively strong association between employer parking subsidization and rail use frequency, a dummy variable to capture whether or not parking was at least partially paid for (or provided) was used as an independent variable in the ordinal regression.

Because many of the cells that count the dependent variable levels by combinations of predictor variable values have zero frequencies, the goodness of fit tests are not applicable. Overall, the final version of the model achieves a -2 Log Likelihood of 1072.034 compared to 1001.319 for the intercept-only model with a chi-square of 70.715 that is statistically significant at the 0.01 level. The McFadden pseudo R-square value of 0.066 indicates that this model has somewhat limited predictive power and is only slightly better than the intercept-only model. The parameter estimates and their significance levels are presented in TABLE 5.45.

TABLE 5.45: Ordinal regression model results

Parameter Estimates

Parameter	Estimate	Std. Error	Wald	Sig.
Annual household income	0.000	0.00	0.209	0.648
Household vehicles available	0.062	0.08	0.606	0.436
Age	0.001	0.01	0.020	0.887
Gender	-0.170	0.18	0.881	0.348
Some or all parking is paid for by employer	-0.477	0.23	4.202	0.040
Lives within half-mile of rail station	0.562	0.20	8.033	0.005
Attitude factor 1	-0.573	0.09	38.777	0.000
Attitude factor 2	0.233	0.09	6.927	0.008

Model Fit

Model	-2 Log Likelihood	Chi-Square	Degrees of freedom	Sig.
Intercept Only	1072.034			
Final	1001.319	70.715	8	0.000

Pseudo R-Square

Cox and Snell	0.131
Nagelkerke	0.149
McFadden	0.066

As expected, none of the individual or household characteristics are significant. This will also be the case in the analysis of the work trip in Chapter 6. The coefficients of the two extracted factors from the attitude responses are significant as are living within a half mile of rail and employer parking provided (either free or at a discount).

The signs of the statistically significant coefficients are as expected. If parking is partially or fully subsidized at work, individuals use rail less frequently. Individuals who live within a half-mile of rail stations use rail more frequently. Attitude factor 1, which generally captures the negative aspects of transit has a negative sign, which indicates that individuals who scored higher on this factor are less likely to use rail more frequently. Conversely, attitude factor 2, which captures mostly positive aspects of transit has a positive sign, indicating respondents who scored higher on this factor tend to use rail more frequently.

6: Survey of Travel Choices for the Work Trip Considering Experience and Habit: Results from Dataset B

6.1: Introduction

Chapter 5 used Dataset A to explore the relationships among transit use, attitudes, mode features, household characteristics and childhood experience. This chapter focuses exclusively on work trips and uses the subsample (Dataset B) of 249 workers who commute to Downtown Oakland from beyond walking distance at least four days per week and use the same mode every day. The mode choices of the 249 individuals are displayed in TABLE 6.1.

TABLE 6.1: Modes used in Dataset B (subsample) for most recent work trip to Downtown Oakland

Mode	Count	Percent
Automobile	66	26.5
BART	148	59.4
Bus	18	7.2
Bus to BART	10	4.0
LRT to BART	7	2.8

In order to analyze work trip mode choice, a binary logit model with automobile or transit as the possible value of the dependent discrete variable is used. Ideally, a nested logit model would be used that would enable better examination of access modes and also allow for a more detailed analysis of choice among the specific transit modes available, but the data collected from the survey does not contain enough cases to allow for this type of model and as such, a simple binary structure is used.

Several assumptions in preparing Dataset B for modeling were presenting in Chapter 4. In addition, the logit model itself has several implicit assumptions. The error terms of the utility of both modes, the portions of the specified utilities that are unobserved, are assumed to be independently identically distributed extreme value. Since the variance of this distribution is $\pi^2/6$, the scale of the utilities is normalized.

All logit models estimated in this chapter will use Biogeme, which is an open source freeware statistical program designed to estimate discrete choice models by Michel Bierlaire (2003).

6.2: Model Specification

Based on the logit model specification, the probability (P) of an individual selecting a particular mode (i), which can be either an automobile or transit, for his or her trip to work is:

$$P_i = e^{V_i} / (\Sigma e^{V_i}).$$

So the probability of choosing an automobile (P_{AUTO}) is $e^{V_{AUTO}} / (e^{V_{AUTO}} + e^{V_{TRANSIT}})$. Likewise, the probability of choosing transit ($P_{TRANSIT}$) is $e^{V_{TRANSIT}} / (e^{V_{AUTO}} + e^{V_{TRANSIT}})$.

This chapter presents three models. The first model will use time and cost variables as well as household characteristics from Dataset B to predict mode choice. The second model will incorporate attitude variables into the estimation to see if they lead to a better and more accurate model. The third model will add childhood experience variables to see if they lead to a better overall fit.

6.3: Logit Model with Time and Cost Variables

The initial version of the model uses time and cost variables to specify utilities for both the automobile and transit choices. In addition, a mode-specific constant is included in the utility specification for the transit option. Therefore, the utilities for each choice are:

$V_{AUTO} = ß_1x_1 + ß_2x_2$
$V_{TRANSIT} = ß_0 + ß_1x_3 + ß_3x_4 + ß_4x_5$.

The variables used in the utilities above are defined as follows:

x_1 = Automobile cost (in dollars)
x_2 = Automobile travel time (in minutes)
x_3 = Transit cost (in dollars)
x_4 = Transit in-vehicle time (in minutes)
x_5 = Transit access time (in minutes)

All costs are measured in dollars for a one-way trip from home to work. Automobile costs include fuel, tolls and parking. If a respondent indicated vehicle occupancy, the total automobile cost is divided by number of vehicle occupants. Transit costs include fare and any access costs. Access costs may include toll, parking and fuel, depending on access mode and route. Automobile and transit costs are adjusted based on employer subsidizations and monthly pass use.

TABLE 6.2: Binary logit model of automobile or transit choice with time and cost variables for most recent trip from home to work

Variable	Auto	Transit	P-value	Odds ratio
Constant		-1.920	0.00	0.147
Cost (in dollars per one-way trip)	-0.920	-0.920	0.00	0.399
Travel time (in minutes per one-way trip)	-0.062		0.06	0.940
In-vehicle travel time (in minutes per one-way trip)		-0.036	0.25	0.965
Access time (in minutes per one-way trip)		-0.044	0.19	0.957

Pseudo rho-square = 0.62
Final log-likelihood = -65.224
Number of parameters estimated = 5

Travel times are measured in minutes for a one way trip from home to work. Automobile travel times are computed with consideration of typical congested roadway conditions at the time the respondent indicated that he or she departed home. Overall transit travel time is separated into access time, the time it takes the respondent to travel from home to transit, and in-vehicle travel time. Congestion is also considered in transit access time if the respondent drives to transit.

The results of this model are presented in TABLE 6.2. Overall, the model achieves a pseudo rho-square of 0.62 and therefore the parameterized model is 62 percent better at predicting mode choice than a constant-only model. The model does an excellent job of predicting choice as it accurately predicts 223 out of the 249 cases for an accuracy of 89.6 percent.

The lack of statistical significance of the transit travel time coefficients, both in-vehicle and access times, is somewhat unexpected. One possible explanation is that some commuters travel to alternative rail stations based on parking availability and/or traffic conditions. However, a version of the same model that combines in-vehicle transit travel time and transit access time does not produce a more significant coefficient, which would be expected if the two were being substituted for each other. A more likely conclusion is that travel costs are much more dominant in the decision-making process for many commuters to Downtown Oakland. Nonetheless, the transit travel time coefficients are included in the model and help to achieve its high level of accuracy.

The signs for coefficients in the model for both automobile and transit are negative, which is expected. This reflects the fact that an increase in cost or time for either mode leads to a reduction in overall utility for that mode and thus reduces the probability that an individual will choose that mode.

The odds-ratio for cost is approximately 0.4 compared to the odds-ratios for all three travel time coefficients, which are almost one. This means that a one dollar increase in cost for either mode is associated with an individual being 0.4 times less likely to choose that mode. However, a one minute increase in time has a much smaller effect. In fact, an odds ratio of one would be associated with no effect on the likelihood of selected that mode.

TABLE 6.3: Average travel cost by mode combination used for most recent trip from home to work

Mode combination	Auto	*Auto (with vehicle occupancy)	Transit
Auto	$4.31	$3.58	$3.54
All transit	$8.21	$8.21	$3.51
BART	$8.49	$8.49	$3.77
Bus	$5.13	$5.13	$1.40
Bus to BART	$8.53	$8.53	$3.90
LRT to BART	$9.77	$9.77	$2.77
All modes (weighted average)	$6.99	$6.99	$3.51

* One-way trip cost per vehicle occupant. Auto occupancy for respondents who used transit modes are assumed to be one.

The major influence of travel cost is clearly displayed in TABLE 6.3, which shows the average travel cost by mode combination used for the trip to work. For the 66 automobile users, whether or not vehicle occupancy is considered, the difference between automobile cost and would-be transit cost is small. Taking transit would only save these commuters an average of $0.77 if they drove alone and $0.04 if they drove considering their reported vehicle occupancy. However, for commuters who use transit, it would cost them an average of $4.70 more per trip to work to drive. Much of this difference is due to transit fare subsidization by employers. For example, among the seven commuters who live in San Francisco and take the MUNI light-rail to BART to travel to work, four indicated that part of their transit fare is paid for by their employers and one indicated that all of it is paid for by their employer. Thus, their average one-way transit cost is only $2.77 compared to $9.77 by automobile. For the 148 commuters who use BART, the average savings in using transit over driving is $4.72 per one-way trip.

TABLE 6.4: Average travel time in minutes by mode combination used for most recent trip from home to work

Mode combination	Auto	Transit access	Transit in-vehicle	Transit total
Auto	27	12	19	31
All transit	36	12	24	37
BART	38	14	24	38
Bus	13	5	13	18
Bus to BART	42	3	43	46
LRT to BART	42	3	34	37
All modes (weighted average)	33	12	23	35

TABLE 6.4 shows the average travel time by mode combination used for the trip to work. Clearly, the differences between automobile travel time and transit travel time are much smaller compared to the differences in cost. Commuters who drive to work in Downtown Oakland on average save four minutes of total travel time by choosing to drive instead of using transit. Those who use transit only incur an average of one additional minute of travel time over their would-be drive times by doing so. In fact, for BART users, the average travel times are equal. For the MUNI light-rail to BART commuters, their average transit travel times are less than if they were to drive.

The same model was re-specified to include household and individual characteristics. Age, gender, annual household income and vehicle availability were each included separately and in every possible combination. The resulting coefficients were not statistically significant, overall model accuracy decreased and pseudo-rho squares were less than the original model which only included time and cost variables.

TABLE 6.5 presents the average age, percent male, average annual household income and average number of vehicles available per licensed driver in the household for each mode combination used to commute to work. On average, drivers are three years older than transit users. Considering the difference in average age between BART users and drivers is only 2.2 years, it is not surprising that this variable didn't improve the model. It is worth noting that bus users appear to be younger than any other mode. Commuters who only use buses are on average 39.7 years of age and 7.3 years younger than automobile users. Commuters who use buses and BART for their trip are on average 40.5 years of age and 6.5 years younger than automobile users.

Of these four variables, gender was the closest to achieving statistical significance, but did not improve the model nor did it achieve a significance level worthy of reporting. It appears from survey results that men are more likely to use transit to commute to work than women. Among automobile commuters, 33.3 percent were male compared to 41.0 percent of transit users. Among transit users who transfer between transit modes, bus to BART and LRT to BART, there is an even greater percentage of male respondents, 60.0 and 42.9 percent, respectively.

TABLE 6.5: Household and individual characteristics by mode combination used for most recent trip from home to work

Mode combination	Average age	Percent male	Average household income	Vehicles available per driver
Auto	47.0	33.3	$117,917	1.1
All transit	44.0	41.0	$109,016	0.9
BART	44.8	39.9	$112,872	1.0
Bus	39.7	38.9	$77,639	0.7
Bus to BART	40.5	60.0	$100,500	0.8
LRT to BART	43.0	42.9	$120,357	0.7
All modes (weighted average)	44.8	39.0	$111,376	1.0

In general, average annual household incomes were greater for automobile users than for transit users. The one exception to this is the average annual household income for the LRT to BART users is more than that of the automobile users. This is somewhat expected since those commuters live in San Francisco, where rents and property values tend to be higher than in the East Bay. Bus users reported substantially lower incomes on average than any other modes. Commuters who only use buses have an annual average income of $77,639 which is much lower than that of BART users and automobile users. Commuters who take buses to BART also reported lower incomes with an average of $100,500, far below average incomes for other modes.

On average, automobile users reside in households in which there are more vehicles available per licensed driver than transit users. The average for automobile users is 1.1 compared to 0.9 for transit users. Of note is that 1.1 is slightly greater and 0.9 is slightly less than the important 1:1 ratio of vehicles to drivers. Bus commuters were among the lowest with only 0.7 vehicles per driver. Also among the lowest were the LRT to BART users, which once again reflects that fact that they live in San Francisco where parking is less available and more expensive.

6.4: Logit Model with Time, Cost and Attitude Variables

Each of the ten attitude response questions were added to the time/cost model to identify which, if any, of these attitudes improved the model and thus helped to better explain individuals' mode choice. Attitude responses were coded in the utility specification for transit as dummy variables. The attitude responses were used from the perspective that reflects positively on transit. For example, responses to "transit is comfortable" were coded as (1) for agree and (0) for all others and responses to "crime occurs frequently on transit" were coded as (1) for disagree and (0) for all others.

The attitude responses were coded twice for each question. First, (1) for agree (or disagree) and (0) for all others was used. This is comparable to the three category tables in Chapter 5 (TABLES 5.18 to 5.24) that combined "strongly agree" and "somewhat agree" into "agree", and "somewhat disagree" and "strongly disagree" into "disagree". Next, (1) for strongly agree (or strongly disagree) and (0) for all others was used. This is comparable to the tables in Chapter 5 (TABLES 5.15 to 5.18) that left the five categories intact.

After each attitude variable was modeled with time and cost variables, the attitude variables with statistically significant coefficients were combined and used together. To confirm that the selected variables were each contributing to the model, a forward stepwise method was used. In the end, three attitude variables were incorporated into the model: (1) agree that transit is comfortable, (2) strongly agree that respondent likes to read or work on transit, and (3) disagree that crime occurs frequently on transit.

It is worth noting that as in the previous chapter, (2) is the only attitude variable of the three that retains the "strongly agree" designation as opposed to the combined "agree" or "disagree" designation. In the previous chapter, the association between respondents' opinions on "I like to ride transit so I can read or get work done" and rail use frequency for all trips was stronger in the cross-tabulation with uncombined agreement categories. The other two variables, (1) and (3) had stronger associations with rail use frequency in the combined agreement categories.

The utility specifications for automobile and transit are as follows:

$V_{AUTO} = ß_1x_1 + ß_2x_2$
$V_{TRANSIT} = ß_0 + ß_1x_3 + ß_3x_4 + ß_4x_5 + ß_5x_6 + ß_6x_7 + ß_7x_8$.

The variables used in the utilities above are defined as follows:

x_1 = Automobile cost (in dollars)
x_2 = Automobile travel time (in minutes)
x_3 = Transit cost (in dollars)
x_4 = Transit in-vehicle time (in minutes)
x_5 = Transit access time (in minutes)
x_6 = Transit is comfortable (1 = agree, 0 = all others)
x_7 = I like to read or get work done on transit (1 = strongly agree, 0 = all others)
x_8 = Crime occurs frequently on transit (1 = disagree, 0 = all others)

TABLE 6.6: Binary logit model of automobile or transit choice with time, cost, and attitude variables for most recent trip from home to work

Variable	Auto	Transit	P-value	Odds ratio
Constant		-4.170	0.00	0.015
Cost (in dollars per one-way trip)	-0.979	-0.979	0.00	0.376
Travel time (in minutes per one-way trip)	-0.071		0.06	0.931
In-vehicle travel time (in minutes per one-way trip)		-0.031	0.32	0.969
Access time (in minutes per one-way trip)		-0.048	0.23	0.953
Agree that transit is comfortable		1.380	0.02	3.975
Strongly agree likes to read or work on transit		1.480	0.02	4.393
Disagree that crime occurs frequently on transit		1.130	0.04	3.096

Pseudo rho-square = 0.70
Final log-likelihood = -52.318
Number of parameters estimated = 8
Likelihood ratio test between two models = 25.812 (Improvement in the 90% and 95% CIs)

The results of the model are presented in TABLE 6.6. The model's pseudo rho-square is increased to 0.70 with 90 percent of the choices predicated accurately. The initial model's final log-likelihood of -65.224 with 5 estimated parameter as compared to the second model's log-likelihood of -52.318 with 8 estimated parameters indicates that the second model is an improvement based on the likelihood ratio test between the two models of 25.812, which is good at 90 percent and 95 percent confidence intervals. The sign for each of the three attitude coefficients is positive, which is expected. Based on the odds-ratios, agreement with "transit is comfortable" is associated with an individual being almost four times more likely to use transit. Strongly agreeing with "I like to take transit to read or get work done" makes someone 4.4 times more likely to choose transit. Disagreeing with "crime occurs frequently on transit" makes an individual almost three times more likely to choose transit.

TABLE 6.7: Responses to "transit is comfortable" by mode combination used for most recent trip from home to work

Count

Mode combination	Strongly disagree	Somewhat disagree	Total disagree	No opinion	Somewhat agree	Strongly agree	Total agree	Total
Auto	12	18	30	2	31	3	34	66
All transit	10	26	36	1	110	36	146	183
BART	8	22	30	1	87	30	117	148
Bus	0	2	2	0	14	2	16	18
Bus to BART	1	1	2	0	6	2	8	10
LRT to BART	1	1	2	0	3	2	5	7
All modes	22	44	66	3	141	39	180	249

Percent

Mode combination	Strongly disagree	Somewhat disagree	No opinion	Somewhat agree	Strongly agree	
Auto	18.2	27.3	3.0	47.0	4.5	*100.0*
All transit	5.5	14.2	0.5	60.1	19.7	*100.0*
BART	5.4	14.9	0.7	58.8	20.3	*100.0*
Bus	0.0	11.1	0.0	77.8	11.1	*100.0*
Bus to BART	10.0	10.0	0.0	60.0	20.0	*100.0*
LRT to BART	14.3	14.3	0.0	42.9	28.6	*100.0*
All modes	8.8	17.7	1.2	56.6	15.7	*100.0*

TABLE 6.7 shows the count and percentages for responses to "transit is comfortable". Among respondents who drive to work there is an almost even split between those who agree (51.5 percent) and disagree (45.5 percent). However, among transit users, a much greater percentage think transit is comfortable. 79.8 percent agree and only 19.7 percent disagree. In general, this pattern holds for all forms of transit.

From the responses to "I like to ride transit so I can read or get work done", it is clear why this attitude variable achieved statistical significance as "strongly agree" as opposed to "agree" (see TABLE 6.8). 60.6 percent of automobile users and 79.8 percent of transit users agreed, with similar percentages disagreeing – 22.7 percent and 18.0 percent. However, 50.3 percent of transit users strongly agreed compared to only 12.1 percent of automobile users.

Transit modes that include BART have a larger percentage of riders strongly agreeing. This is likely due to the fact that it is easier to read and work on BART as compared to buses.

TABLE 6.8: Responses to "I like to ride transit because I can read or get work done" by mode combination used for most recent trip from home to work

Count

Mode combination	Strongly disagree	Somewhat disagree	Total disagree	No opinion	Somewhat agree	Strongly agree	Total agree	Total
Auto	5	10	15	11	32	8	40	66
All transit	14	19	33	4	54	92	146	183
BART	11	15	26	2	43	77	120	148
Bus	2	3	5	1	8	4	12	18
Bus to BART	0	1	1	1	1	7	8	10
LRT to BART	1	0	1	0	2	4	6	7
All modes	19	29	48	15	86	100	186	249

Percent

Mode combination	Strongly disagree	Somewhat disagree	No opinion	Somewhat agree	Strongly agree	
Auto	7.6	15.2	16.7	48.5	12.1	*100.0*
All transit	7.7	10.4	2.2	29.5	50.3	*100.0*
BART	7.4	10.1	1.4	29.1	52.0	*100.0*
Bus	11.1	16.7	5.6	44.4	22.2	*100.0*
Bus to BART	0.0	10.0	10.0	10.0	70.0	*100.0*
LRT to BART	14.3	0.0	0.0	28.6	57.1	*100.0*
All modes	7.6	11.6	6.0	34.5	40.2	*100.0*

Responses to "crime occurs frequently on transit" are displayed in TABLE 6.9. Once again, there are an almost equal percentage of drivers who agree and disagree. Among transit users, 68.3 percent disagree and 26.2 percent agree, thus making this attitude variable significant.

There are several attitude variables that did not make it into the model that are worth examining. Since cleanliness is often cited as a problem for BART, the responses to this question are presented in TABLE 6.10. Most respondents agreed that transit is dirty. And although among automobile users a larger percentage agrees (80.3 percent) than all transit users combined (68.6 percent) and BART users (66.9 percent), transit users who used buses or LRT for some or their entire trip to work agreed at an even larger percentage. Automobile users did tend to strongly disagree more than others, but apparently not at large enough rates as to be statistically significant or to add any explanatory power to the model.

TABLE 6.9: Responses to “crime occurs frequently on transit” by mode combination used for most recent trip from home to work

Count

Mode combination	Strongly disagree	Somewhat disagree	Total disagree	No opinion	Somewhat agree	Strongly agree	Total agree	Total
Auto	16	12	28	9	26	3	29	66
All transit	55	70	125	10	42	6	48	183
BART	43	59	102	8	32	6	38	148
Bus	8	5	13	2	3	0	3	18
Bus to BART	1	5	6	0	4	0	4	10
LRT to BART	3	1	4	0	3	0	3	7
All modes	71	82	153	19	68	9	77	249

Percent

Mode combination	Strongly disagree	Somewhat disagree	No opinion	Somewhat agree	Strongly agree	
Auto	24.2	18.2	13.6	39.4	4.5	*100.0*
All transit	30.1	38.3	5.5	23.0	3.3	*100.0*
BART	29.1	39.9	5.4	21.6	4.1	*100.0*
Bus	44.4	27.8	11.1	16.7	0.0	*100.0*
Bus to BART	10.0	50.0	0.0	40.0	0.0	*100.0*
LRT to BART	42.9	14.3	0.0	42.9	0.0	*100.0*
All modes	28.5	32.9	7.6	27.3	3.6	*100.0*

TABLE 6.10: Responses to “transit is dirty” by mode combination used for most recent trip from home to work

Count

Mode combination	Strongly disagree	Somewhat disagree	Total disagree	No opinion	Somewhat agree	Strongly agree	Total agree	Total
Auto	1	11	12	1	28	25	53	66
All transit	17	37	54	3	88	38	126	183
BART	16	31	47	2	67	32	99	148
Bus	0	5	5	0	11	2	13	18
Bus to BART	1	1	2	0	6	2	8	10
LRT to BART	0	0	0	1	4	2	6	7
All modes	18	48	66	4	116	63	179	249

Percent

Mode combination	Strongly disagree	Somewhat disagree	No opinion	Somewhat agree	Strongly agree	
Auto	1.5	16.7	1.5	42.4	37.9	*100.0*
All transit	9.3	20.2	1.6	48.1	20.8	*100.0*
BART	10.8	20.9	1.4	45.3	21.6	*100.0*
Bus	0.0	27.8	0.0	61.1	11.1	*100.0*
Bus to BART	10.0	10.0	0.0	60.0	20.0	*100.0*
LRT to BART	0.0	0.0	14.3	57.1	28.6	*100.0*
All modes	7.2	19.3	1.6	46.6	25.3	*100.0*

Respondents' opinions on transit on-time performance reveal that they vary greatly depending on the specific transit mode used (see TABLE 6.11). Transit users who use buses agreed that transit is often late at a greater rate than BART users. The largest percentage of transit users who agree, use MUNI LRT for some portion of their work trip. This is confirmation of the reported on-time performance of the LRT lines, which can be as low as 65 percent (ref). In fact, several focus group participants who live in San Francisco near these lines reported that they prefer to walk to BART to avoid the uncertainty in schedule. Some even suggested they walk more than a mile to avoid using the MUNI LRT.

TABLE 6.11: Responses to "transit is often late" by mode combination used for most recent trip from home to work

Count

Mode combination	Strongly disagree	Somewhat disagree	Total disagree	No opinion	Somewhat agree	Strongly agree	Total agree	Total
Auto	8	15	23	6	27	10	37	66
All transit	38	68	106	2	52	23	75	183
BART	36	58	94	1	39	14	53	148
Bus	0	7	7	0	8	3	11	18
Bus to BART	2	2	4	0	3	3	6	10
LRT to BART	0	1	1	1	2	3	5	7
All modes	46	83	129	8	79	33	112	249

Percent

Mode combination	Strongly disagree	Somewhat disagree	No opinion	Somewhat agree	Strongly agree	
Auto	12.1	22.7	9.1	40.9	15.2	*100.0*
All transit	20.8	37.2	1.1	28.4	12.6	*100.0*
BART	24.3	39.2	0.7	26.4	9.5	*100.0*
Bus	0.0	38.9	0.0	44.4	16.7	*100.0*
Bus to BART	20.0	20.0	0.0	30.0	30.0	*100.0*
LRT to BART	0.0	14.3	14.3	28.6	42.9	*100.0*
All modes	18.5	33.3	3.2	31.7	13.3	*100.0*

Of note are respondents' opinions on BART's reliability. BART reports an on-time performance of around 92 percent (ref) and this consistency is reflected in these percentages. Among BART users, 63.5 percent disagreed with the statement "transit if often late", by far the largest percentage of any of the transit modes. BART riders strongly disagreed and somewhat disagreed at greater rates than any of the other transit modes. Only 9.5 percent (14 out of 148) BART patrons strongly agreed that transit is often late.

Responses to "I prefer to drive when I can" were not used in the model despite the resulting coefficient's statistical significance. Agreement or disagreement with the statement is essentially what the model is trying to predict and determining the relationship between mode choice and preference to drive would overshadow the influence of other attitude variables. From the results in TABLE 6.12, there is an almost perfect counter balance between agreement and disagreement for automobile and transit users. 75.8 percent of automobile users agree and 22.8 percent disagree compared to 22.4 percent of transit users agree and 75.4 percent disagree. Responses to this question alone would accurately predict approximately three-quarters of individuals' mode choices, but stating that people who prefer to drive tend to drive more often isn't helping to explain the choice process.

TABLE 6.12: Responses to "I prefer to drive when I can" by mode combination used for most recent trip from home to work

Count

Mode combination	Strongly disagree	Somewhat disagree	Total disagree	No opinion	Somewhat agree	Strongly agree	Total agree	Total
Auto	2	13	15	1	24	26	50	66
All transit	90	48	138	4	26	15	41	183
BART	71	37	108	2	23	15	38	148
Bus	10	4	14	2	2	0	2	18
Bus to BART	5	4	9	0	1	0	1	10
LRT to BART	4	3	7	0	0	0	0	7
All modes	92	61	153	5	50	41	91	249

Percent

Mode combination	Strongly disagree	Somewhat disagree	No opinion	Somewhat agree	Strongly agree	
Auto	3.0	19.7	1.5	36.4	39.4	*100.0*
All transit	49.2	26.2	2.2	14.2	8.2	*100.0*
BART	48.0	25.0	1.4	15.5	10.1	*100.0*
Bus	55.6	22.2	11.1	11.1	0.0	*100.0*
Bus to BART	50.0	40.0	0.0	10.0	0.0	*100.0*
LRT to BART	57.1	42.9	0.0	0.0	0.0	*100.0*
All modes	36.9	24.5	2.0	20.1	16.5	*100.0*

6.5: Logit Model with Time, Cost, Attitude and Childhood Experience Variables

The third version of the model attempted to incorporate childhood experience variables to determine if the inclusions of these variables led to a more explanatory model and a better fit. Five childhood experience variables were tried: (1) frequency of bus use in high school, (2) frequency of rail use in high school, (3) frequency of transit use in high school, (4) distance from home to rail in high school, and (5) parent or guardian's use of transit while in high school.

None of these variables produced a statistically significant coefficient. Worse, many reduced the pseudo-rho square of the model and resulted in more inaccurately predicted choices. Of these five variables, only parent or guardian's use of transit while in high school didn't affect the model's accuracy. The p-value for this coefficient was also the lowest of the five, though not significant. For illustrative purposes, the model including this variable is presented in TABLE 6.13.

The second model's final log-likelihood of -52.318 with 8 estimated parameter as compared to the third model's log-likelihood of -51.955 with 9 estimated parameters indicates that the third model is not an improvement based on the likelihood ratio test between the two models of 0.726, which fails at 90 percent and 95 percent confidence intervals.

TABLE 6.13: Binary logit model of automobile or transit choice with time, cost, attitude variables, and childhood experience variables for most recent trip from home to work

Variable	Auto	Transit	P-value	Odds ratio
Constant		-4.290	0.00	0.014
Cost (in dollars per one-way trip)	-0.974	-0.974	0.00	0.378
Travel time (in minutes per one-way trip)	-0.066		0.09	0.936
In-vehicle travel time (in minutes per one-way trip)		-0.028	0.37	0.973
Access time (in minutes per one-way trip)		-0.042	0.29	0.958
Agree that transit is comfortable		1.410	0.02	4.096
Strongly agree likes to read or work on transit		1.570	0.02	4.807
Disagree that crime occurs frequently on transit		1.110	0.04	3.034
One or more parent used transit while in HS		0.585	0.41	1.795

Pseudo rho-square = 0.70

Final log-likelihood = -51.955

Number of parameters estimated = 9

Likelihood ratio test between two models = 0.726 (Fails to improve in the 90% and 95% CIs)

The utility specifications for automobile and transit are as follows:

$V_{AUTO} = ß_1x_1 + ß_2x_2$
$V_{TRANSIT} = ß_0 + ß_1x_3 + ß_3x_4 + ß_4x_5 + ß_5x_6 + ß_6x_7 + ß_7x_8 + ß_8x_9$.

The variables used in the utilities above are defined as follows:

x_1 = Automobile cost (in dollars)
x_2 = Automobile travel time (in minutes)
x_3 = Transit cost (in dollars)
x_4 = Transit in-vehicle time (in minutes)
x_5 = Transit access time (in minutes)
x_6 = Transit is comfortable (1 = agree, 0 = all others)
x_7 = I like to read or get work done on transit (1 = strongly agree, 0 = all others)
x_8 = Crime occurs frequently on transit (1 = disagree, 0 = all others)
x_9 = At least one parent used transit to commute while in HS (1 = yes, 0 = no)

The resulting coefficient for childhood experience, representing whether or not at least one parent or guardian used transit to commute while the respondent was in high school, has a smaller odds-ratio than the three attitude coefficients. This indicates that if it is included in the model and its lack of statistical significance is ignored, “yes” respondents are 1.8 times more likely to use transit, which is well below the influence of the attitude variables.

TABLE 6.14: Whether or not at least one parent or guardian used transit while respondent was in high school by mode combination used for most recent trip from home to work

Count

Mode combination	No	Yes	Total
Auto	51	15	66
All transit	135	48	183
BART	109	39	148
Bus	14	4	18
Bus to BART	7	3	10
LRT to BART	5	2	7
All modes	186	63	249

Percent

Mode combination	No	Yes	
Auto	77.3	22.7	*100.0*
All transit	73.8	26.2	*100.0*
BART	73.6	26.4	*100.0*
Bus	77.8	22.2	*100.0*
Bus to BART	70.0	30.0	*100.0*
LRT to BART	71.4	28.6	*100.0*
All modes	74.7	25.3	*100.0*

TABLE 6.14 shows the responses to "at least one parent used transit to commute while the respondent was in high school". Both automobile users and bus users have a slightly lower percentage of survey-takers who are in the "yes" column, with 22.7 percent and 22.2 percent, respectively. Transit modes that include BART appear to have a slightly larger percentage, albeit not that much larger than other modes.

6.6: Conclusions

One possible explanation for the childhood variables having no significance and adversely affecting the model is that without them, the model is an excellent predictor of choice. In other words, because travel cost is so importance to the decision maker, and to a lesser degree travel time, the influence of additional variables doesn't add any explanatory power to the model.

Travel cost is paramount in the mode choice process for Downtown Oakland workers. This suggests that transit fares should not be increased without concurrent increases in tolls and parking costs in order to maintain the advantage transit has over driving. Transit pass programs that enable riders to pay reduced per trip fares should be encouraged and if possible, expanded. Also, employers should be encouraged to and perhaps assisted in offer employees discounted transit passes and fare subsidies. Employers should also be dissuaded from offering employees free or discounted parking.

Among attitudes that are most likely to affect mode choice, comfort appears to be the more influential. Though much attention has focused in recent months on BART's dirty seats and what materials will be used for seats in future vehicles, based on the results from this research, it is more important that riders have seats to sit on than their perceived cleanliness.

Transit operators could influence travelers' perceptions of safety and security in their systems by enhancing some of the crime reduction strategies they are currently using. In-system crime rates and reports should be made more available to the public, particularly as they show a reduction in incidents. It is also essential that this information reach non-transit users.

Operators should promote their service by highlighting some of the things a traveler can do while riding transit that he or she cannot do while driving. If possible, features should be enhanced, such as cell phone service and wireless internet service.

7: Focus Group Results

7.1: Introduction

This chapter presents the findings from focus groups on mode choice and the role of current conditions, habit, and the likelihood of travelers to change modes. Unlike the results from the survey discussed in Chapters 5 and 6, which included only travelers who worked in Downtown Oakland, the focus groups were held in several in locations around the Bay Area and included travelers who worked in San Francisco as well as Oakland and Berkeley.

Initially, two focus groups were convened in Downtown Oakland with participants drawn from the survey respondents. The purpose of these focus groups was to explore attitudes and stated preferences of drivers and transit users in more depth than was possible in a written survey. Additional focus groups then were conducted in Walnut Creek, Vallejo, Berkeley and Oakland and involved travelers who commuted to San Francisco or crossed the Bay frequently for other reasons. The stipulation that the participants should be ones who crossed the Bay frequently was introduced because tolls had recently been increased and rules on the use of carpool lanes changed, external factors that might have induced a reconsideration of travel modes. The additional focus groups were organized mostly by primary mode of travel to San Francisco – transit, drive-alone, and carpool users.

Before each hour-long focus group session, participants were asked to complete a brief survey on travel behavior, stated preferences, and personal and household socioeconomic information. In all, twelve focus groups were conducted with a total of 112 participants. A summary of focus group composition is displayed in TABLE 7.1.

TABLE 7.1: Focus group locations, dates and total participants

Date	Location	Participants	Selection criteria	Primary work mode
05/11/11	Oakland	14	Downtown Oakland workers	Mixed
05/11/11	Oakland	13	Downtown Oakland workers	Mixed
05/18/11	Walnut Creek	10	Bay Area workers	Mostly BART
05/19/11	Vallejo	9	Bay Area workers	Casual carpool in AM, transit in PM
05/19/11	Vallejo	6	Bay Area workers	Casual carpool in AM, transit in PM
05/25/11	Berkeley	10	Bay Area workers	Mostly BART
06/14/11	Berkeley	12	Bay Area workers	Mostly BART
06/21/11	Berkeley	5	San Francisco workers	Drivers
07/28/11	Oakland	4	San Francisco workers	Former casual carpoolers, now mixed
10/19/11	Berkeley	11	Undergraduate / graduate students	Bus and bicycle
10/19/11	Berkeley	9	Undergraduate / graduate students	Bus and bicycle
10/20/11	Berkeley	11	Undergraduate / graduate students	Bus and bicycle

The findings from the surveys and focus groups confirmed, as expected, that travel times and costs are the key factors in travel choices, but also illuminated the importance of employer policies, prior experience, and habit in shaping and re-shaping travel choices. Here we present the major findings, drawing both from the surveys and the focus groups.

7.2: Economically Rational Travel Choices

Many participants were highly rational in their assessment of their travel choices. They knew what it cost them to make their trips in terms of fuel, tolls, and parking, and they calculated the per traveler costs by each mode and usually chose the one that was least expensive. The factors that most significantly affected mode choice for the journey to work were whether the traveler had a free parking space and whether access to and from the mainline transit service, bus or rail, was fast. Most of those driving to work had a free parking space there, usually but not always provided by the employer. Those who took transit generally did not have a free parking space at work.

Most transit riders in our sample (which was composed of employed adults and was heavily oriented toward white collar workers) have a car available for the trip, but prefer transit for reasons of economy and comfort. Those who commute by transit generally find it less expensive than the available alternatives, especially if they are going to San Francisco, Oakland or Berkeley where parking costs $2 per hour or more and $10 to $15 or more per day. In comparison, most Bay Area transit users pay under $8 per day round trip.

Using BART for shopping and social recreational trips also works from a cost perspective for many, as long as only one or two people are traveling. If a larger group is traveling together, it is often more economical and convenient to drive, even if the travelers have to pay for parking.

7.3: Where Cost is a Barrier

Not everyone finds Bay Area transit economical. Lower income workers expressed concerns about the pinch that fare increases were putting on their already tight pocketbooks. For this group, driving and paying for parking at work was out of the question and employer assistance with commute costs was extremely rare.

People from outlying areas like Vallejo who work in San Francisco are another group that does not find transit economical, in part because most must take two or more transit links each way, paying a substantial total fare. Commuters from such areas often casual carpool to work (pick up riders or get a ride at designated gathering points) to save money. They also save time, because carpools can use express lanes. Many also casual carpool on the return trip but some take transit back in the evening because it is hard to get a return carpool trip.

7.4: Other deterrents to transit use

As previous work on mode choice would predict, long access distances, long wait times, and transfers are significant deterrents to transit use. Many drivers to San Francisco are going to locations far from a BART station. Focus group participants traveling to San Francisco reported that they would rather walk half a mile to a mile from BART to their destinations than wait for and ride the connecting bus or trolley, because bus and trolley arrival times were unreliable and travel times were long and highly variable. Suburban dwellers preferred to drive to BART and park, even if they had to hunt at several stations to find a parking space, rather than schedule their trips to match a low-frequency feeder bus service to the BART station and endure the feeder bus' slow speed and frequent stops along the way. When parking is filled up, as it sometimes is at suburban transit stations, many of these suburbanites proceed to drive to work, even though for most of the respondents that meant paying a toll and for parking at their destination.

Multiple work locations and irregular work hours are additional deterrents to transit use. Workers who commute to multiple work locations during the week are less likely to use transit, even if some of the time they work near transit. Because they need their cars to get around to multiple sites, many in this category report that their employers pay for their parking. Workers who report in at varying times of day also are likely to be drivers, in part because off peak transit services are limited.

7.5: Effects of Toll Changes

Focus group discussions also explored whether driving and carpooling had been deterred by toll increases from $4 to $5 on the region's bridges ($6 during peak periods on the San Francisco-Oakland Bay Bridge) and the addition of a $2.50 carpool toll (carpools previously paid no toll). There is evidence from traffic counts that solo driving is down one to three percent and that carpooling has declined about nine percent. However, some of the traffic change is the result of economic downturn and other external changes (including gas price increases) rather than tolls per se. For many bridge users, vehicle operating costs including tolls are considerably less than parking fees, and the $1 to $2 toll increases did not appreciably increase daily commute costs. While some former drivers and carpoolers did switch to BART or buses, the tolls were not necessarily the determinative factor. BART's strong on-time performance and reasonable costs (for individual travelers), in the range of $7 to $12 per day, made it a superior choice for many. TABLE 7.2 shows one-way travel times and round-trip out-of pocket costs from points where focus groups were conducted to downtown San Francisco; the data confirms that toll changes are a minor cost fluctuation for most travelers.

TABLE 7.2 One-way travel times and round-trip out-of-pocket costs for trips to San Francisco from focus group cities

	One-way		Round-trip				
Origin city	**Auto time**	**Transit time**	**Auto cost (1 pers.)**	**Auto cost (2 pers.)**	**Auto cost (3 pers.)**	**Auto cost (4 pers.)**	**Transit cost**
Vallejo	70	86	$29.53	$14.76	$7.84	$5.88	$18.10
Berkeley	27	37	$18.86	$9.43	$5.12	$3.84	$7.30
Walnut Creek	48	50	$22.21	$11.11	$6.24	$4.68	$9.50
Oakland	27	31	$18.81	$9.40	$5.10	$3.83	$6.60

Assumptions:
Destination is US-101 and Howard Street in San Francisco
Vallejo origin is I-80 and CA-37 for driving, York and Marin Sts. for transit
Berkeley origin is I-80 and University Av. for driving, Downtown Berkeley BART for transit
Walnut Creek origin is CA-24 and I-680 for driving, Walnut Creek BART for transit
Oakland origin is CA-24 and 51 St. for driving, MacArthur BART for transit
Wednesday 8am departure
$3.90 per gallon fuel cost
Autos operate at 30 miles per gallon
$10 per day parking cost at destination

7.6: Experience and Change

To understand how experience shaped attitudes, choices, and habits, we asked both survey respondents and focus group participants about their earlier experience with transit. The survey had found a mild effect from having experience with transit while growing up. In the focus groups, it became clear that college was a more important factor in providing transit experience than earlier years. Indeed, having used transit in college was a strong indicator of adult transit use. It was uncommon for our respondents to have a parent who had used transit, but many who had tried transit in those who did were also likely to be transit users.

It should be noted that participants who reported that favorable experience with transit as young adults had not necessarily experienced transit before college. The survey respondents and focus group participants had grown up in a variety of communities from all over the US and abroad, and many had no exposure to transit before they had graduated from high school. For the transit users, a typical story was that as young adults, often before they owned a car, they learned to use transit to get around, formed a favorable impression of transit, and then considered it seriously when as working adults they were evaluating their travel options.

Adults who lacked such experience or role models were likely to decline to consider transit use, even to well-served destinations, and even if transit would be more economical. Many whose primary mode was auto reported that they had used transit only on rare occasions (e.g., going to the city for a special event with friends who wanted to go by transit) and did not seriously consider it for their own regular travel needs. This group was also likely to comment that they felt transit was unsafe, dirty, and unreliable – speaking of the same services that regular users called very safe and reliable and only moderately a sanitation concern.

7.7: User and Non-User Perceptions

BART's high reliability is a major attraction for its users, who noted that their train is late perhaps one day a month and that they can count on BART for good information if a problem does occur. BART riders also cited the comfort of the trip because they usually can get a seat and can read or relax. Taking BART to work and for trips to downtown San Francisco is a habit for most – they drive when they have to go to meeting, or have a dinner or other engagement in city after work, but their routine is to use BART. Many BART users grew up in other parts of the country but tried BART when they moved to the Bay Area because they had had good experiences with transit elsewhere (often in college) and peers used it. Some BART frequent riders specifically looked for housing in areas close to BART because they wanted to use the system it and thought it would be a smart move. Some even moved to the Bay Area because of the good transit.

Ironically, this high level of confidence in BART works against it when it comes to "state of good repair" issues, which are currently a major concern of BART managers. Most of the frequent BART riders in our respondent group were resistant to a future scenario in which reliability might decline significantly. They did not believe that the Board or staff would allow it. They did express concerns about station and parking lot crime issues, unsanitary seats, and dirty stations, as well as increasingly noisy trains. However, they also believed BART would fix these things in short order, or at least as the economy improves.

In contrast, some of those who did not use BART had serious concerns about crime risks, sanitation, and noise levels. This illustrates the limitations of relying on surveys of customer s to measure overall satisfaction with a public system (whose funding may well depend on non-users as well as users). Current customers ranked these issues as troubling but not of highest priority, but those who found the issues to be unacceptable had already left.

Given the confidence that most riders have in BART, it is not surprising that they doubt that a crisis in maintenance, rehabilitation and renewal is brewing. In addition, it became clear in the focus group discussions that the ways that transit experts express the consequences of underinvestment is problematic. Most study participants found costs in billions of dollars incomprehensible and did not understand the implications of other supply-side metrics such as hours between car failure and number of cars available at 4am. Expressing costs in user terms, e.g., days you would be late by more than 20 minutes or number of days you would not get a seat for the entire trip, was far more effective at communicating the issues and increased willingness to pay for high reliability and levels of service.

A factor affecting attitudes toward costs of reliability was that almost none of the participants had a working knowledge of what transportation facilities and services cost, or how they are paid for now. Knowledge gaps were large. Participants were unsure what portion of the cost of gasoline was the gas tax or what transportation services could be paid for with the gas tax. They did not know how much a parking space costs to build and operate, had no idea what a mile of freeway lane or BART tracks would cost, and were equally in the dark about what it would cost to build a BART station, purchase a bus or rail car, or operate a bus or rail line for an hour. Many would find this sort of information useful, especially if it were coupled with information on what similar equipment, facilities and services cost elsewhere; the latter information would provide some assurance that BART's costs are not out of line with industry norms. In contrast, there were concerns that lump sum numbers of billions needed to get to a state of good repair were based on worst case scenarios designed to scare people. Public education and information would be useful in helping people understand the need for investment.

Ultimately, almost all of the BART riders said they would pay an extra dollar, maybe two, to avoid service cuts, worsened service, crowded trains, and dirtier cars and stations. Most were also willing to support fare discounts for low income transit users. At the same time, almost all transit riders believed that costs of transit facilities and services should be shared widely, using funds from state income taxes, local sales taxes, state and local gas taxes, in addition to fares. In their view, such cost-sharing is appropriate because drivers benefit from less traffic when travelers choose transit, and everyone benefits from the economic activity supported by good transit. In contrast, drivers who do not consider transit a viable alternative for themselves were also dubious that transit delivers a significant economic benefit or does much to relieve traffic. This is another area where public information and education would be useful.

7.8: Conclusions

This study has illuminated factors that affect mode choice, including ways in which mode choice habits are established or disrupted, and has illustrated the interplay between economic factors (value of time and out of pocket costs) and psycho-social factors such as habit. The study confirms that parking costs can be a major factor on the economic side, and finds that programs to encourage transit use during high school and college can have effects that last into adulthood. Positive experience using transit in high school or college was a strong indicator of adult transit use. Adults who lacked such experience were likely to decline to consider transit use, even to well-served destinations.

Experience with transit also affects perspectives on funding issues. BART riders were resistant to the idea that reliability would be allowed to decline and found it hard to believe that a crisis in reliability could develop. Committed riders believed that a responsible Board and a competent staff would never allow such a crisis. They also would be willing to help assure continued availability of the BART service they appreciate by paying more for it. In contrast, those who did not use BART or had already exited from the system because of dissatisfaction were dubious that its fate was their concern. These views are consistent with ideas about loyalty from the literature on political economy (Hirschman 1970) as well as with the psychology literature on factors that lead individuals to be biased in favor of early experiences and learning, to selectively recall evidence that supports their actions.

8: Conclusions

8.1: Introduction

In this study I have examined the role of prior experience in the use of transit using a combination of survey research and focus groups. In some ways this influence is examined directly. Otherwise, it is investigated through individuals' desire to locate near transit stations. While considering travel times and costs of available modes, this dissertation also looks at which features of transit are most likely to influence non-transit users to change their habits and use transit and which features are essential for keeping those who already use transit. These questions are explored for all trips and specifically for work trips.

One specific area of past experience that is examined in this research is the role of exposure to transit during high school, college and immediately after college. Does this exposure have a lasting influence on mode choice later in life?

I have found that, as previous research has shown, transit cost and time are the primary economic motivators of mode choice. Beyond these considerations, mode comfort, the ability to use travel time productively and perceived safety from crime are important determinants of mode choice. Childhood experiences proved to have little direct influence, but this is mostly due to the fact that few participants had exposure to transit during childhood. Exposure in college and immediately after proved to have an influence on mode choice for individuals who were exposed to it during this time.

I interpret the findings in this chapter to draw some conclusions and identify areas needing further study.

8.2: Travel Cost

Based on results from both the survey and focus groups, the most important determinant of mode choice among the Bay Area commuters that I studied is the monetary cost of travel. Transit appears to have an advantage in cases where it is less costly than driving. This is consistent with a long line of previous work on the subject.

Many focus group participants were highly rational in their assessment of travel choices. They knew what it cost them to make their trips in terms of fuel, tolls, and parking, and they calculated the per traveler costs by each mode and usually chose the one that was least expensive. When transit becomes more expensive than driving, for example when more than two persons are traveling and automobile costs are less per person than transit costs, travelers tend to favor driving. In many cases, however, transit is the more economical choice. Yet, for low-income travelers, though transit was often the more economical choice, many feel that it is expensive and are particularly sensitive to cost increases.

From the research, two things had a substantial influence on travel costs that are noteworthy. First, in cases where parking is provided for free, travelers are more likely to drive as this reduces their travel costs substantially and in many instances to less than transit costs.

Second, employer subsidization of transit costs, usually in the form of monthly passes, is an effective means by which to further give transit a cost advantage over driving and encourages transit use. Combining these two approaches is a good idea and may have a sizeable influence on mode choices.

8.3: Travel Time

For work trips, travel time considerations are also important in Bay Area mode choice, particularly for commuters who travel long distances, like those who commute from Vallejo to San Francisco. According to the estimated model, a one percent increase in travel time is associated with a one percent decrease in the likelihood of an individual selecting that mode. The estimated value of time is approximately seven cents per minute.

As expected from previous work, transit access time is more influential than in-vehicle travel time. Individuals who live far from rail stations are less likely to use transit and typically drive more often. Similarly, for commute trips, workers who are traveling to locations that are not near transit also tend to drive more often.

Workers who commute to multiple work locations tend to drive more often than use transit. This is true for those who commute to multiple work locations on the same day and for those who commute to multiple work locations on different days, but more so for the former.

One means by which access times can be improved to make transit more desirable is through better coordination of connecting services. For example, several focus group participants indicated that the frequency of BART service is inconsequential to their choice so long as the bus they would need to get to BART is infrequent. This presents an operations obstacle since these services are provided by separate agencies. The planning of such connector service requires inter and intra-agency coordination and as such, resources that each individual operator may not have.

8.4: Household Characteristics

Obviously, individuals who reside in households with no vehicles available use transit more frequently, but based on the survey data and focus groups, having access to an automobile does not necessarily significantly influence transit use, particularly when compared to the influence of travel time and cost. Likewise, age and gender also do not appear to have much of an impact on mode choice in my sample.

Annual household income impacts willingness to consider specific types of transit. Rail service is used by individuals from all households, regardless of annual income. However, at least in my sample, bus service is not frequently utilized by individuals who reside in households with higher annual incomes. There continues to be a stigma associated with bus use and it is avoided by travelers who have other options, particularly when cost is less of a consideration. It is unclear whether this stigma is the result of perceived service deficiencies, such as travel time and reliability or perceived conditions on board buses, such as unpleasant passengers and uncomfortable conditions. Realistically, it is probably a combination of both perceptions.

8.5: Proximity to Transit

From the survey and focus groups, it is clear that individuals who have prioritized living near transit often use it, and vice versa. While this may seem like an obvious conclusion, it is noteworthy in that it shows that regardless of their reasons for wanting to live near transit, their motivation is strong enough to be fulfilled and thus influence mode choice. The policy implications of this conclusion are important as well. If use of transit is a matter of self-selection and not just proximity, putting more people close to transit may not increase ridership. On the other hand, efforts to motivate transit use may be successful if focused on increasing desire to live near transit because transit is seen as a positive good. And while this bodes well for the success of approaches such as TOD, it also identifies an important means by which past experience and/or acquired attitudes can influence use.

According to focus group participants, residing in close proximity to transit is particularly appealing to individuals who live in multi-worker households. Participants indicated that the primary motivation for this may is that only one vehicle is available and one household member uses it while the other uses transit.

Also, based on focus group participants, in the context of my study, many students prefer to live near transit. This is mostly due to the fact that it is costly to park on or near campus, particularly for long periods of time and many students use transit passes which makes transit even more desirable. Additionally, students are often on a limited budget and may not be able to afford to own and maintain a car. As car ownership is less costly in other metropolitan areas, findings from other regions may diverge significantly.

Almost all the participants in the Cal FGs indicated that proximity to transit was an important factor when selecting their home locations. They also tend to use BART much more often for trans-bay trips than the bus, which is free for students. BART was seen as providing a better level of service. The one exception to this I found was students who commute across the bay every day. Those students seem more likely to use the bus, because cost becomes a big factor.

Berkeley students tended to live on bus lines and initially used the bus until they became frustrated with service. As a result, many resorted to biking and like it better anyway, but also like having the bus as an alternative, particularly on bad weather days.

Some focus group participants were extremely resistant to the idea of using transit, either based on actual past experience, or for those with limited or no past experience, the experience they imagined they'd have if they used transit. These individuals are unlikely to consider transit proximity when selecting a residential location. However, on the opposite end of the spectrum are individuals who select a region (or city) to live in specifically because of good transit service. This group reports that they prioritize transit access when selecting a home location. Though there is a substantial literature on the transit factor in location choice within a region, intra-regional impacts of transit service on location choice is understudied and more work should be done on the topic. .

8.6: Mode Attitudes and Habits

Transit use is a well-established habit for some individuals, and is especially important for frequent trips made to the same destination at the same time of day, as for many work and school trips. If conditions remain unchanged, travelers are unlikely to change their mode choices. However, when significant events occur in life, such as a new home, job, marriage or the birth of a child, individuals are more likely to change their travel habits. Interventions that target individuals at these times may be more successful than at other times. The research in this dissertation adds to this by showing that exposure to transit in college and soon thereafter may have a positive long-term impact on an individual's attitudes toward transit. College and immediate post-college years are yet another opportunity to exposure young adults to transit and further solidify using transit as habit.

Beyond travel cost and time, among modal features, comfort seems to be most important to travelers when deciding on whether to use transit or drive. In addition to survey results, several focus group participants indicated that getting a seat on the train was an important factor in choosing transit. Other comfort issues, such as climate control and ease of transfer, also were referenced as influential in mode choice.

Travelers reported that they value the ability to productively use their time on transit vehicles, either to get some work done or for leisure activities such as reading a book. Even the ability to relax, daydream and avoid the stress associated with driving motivated focus group participants to use transit instead of driving. Efforts to improve in-vehicle comfort, such as wireless internet service, may be effective in convincing more travelers to use transit and keeping those that currently do.

Crime and feeling safe from it were also influential factors in the survey and focus groups. Participants were particularly concerned with crime during less crowded, off-peak hours. In fact, several individuals indicated they do not use transit at night and on the weekends for fear of crime. Transit operators should focus crime-reduction strategies on nights and weekends.

Lack of cleanliness and intrusive noise were often cited as unpleasant in relation to transit, but few survey takers and focus group participants indicated that these were deciding factors.

8.7: Childhood Experience

Use of transit in childhood appears to encourage use later on, based on the surveys and focus group findings. However, few adults in my samples reported using transit frequently as children and even fewer reported using rail. Some indicated they were exposed to transit when on vacation with their families. Others got their first concentrated exposure when they took summer jobs or internships that they reached using transit. Most adults who reported such experiences also indicated that those experiences were positive and helped them feel more comfortable using transit later on.

Young adults who went to college in transit-rich areas, particularly with good rail service, used it in college and it left a lasting positive impression. Some reported that they were first exposed to good transit service when they did a year or semester of studying abroad during college. However, in some cases they were discouraged when they returned to the US and found transit service here to be poor in comparison.

Young adults who moved from rural or suburban areas to places like the Bay Area tended to bring their cars along, but many found transit service to be good enough that their cars were used infrequently.

8.8: Important Policy Conclusions

There are two important policy implications from this research that are noteworthy. The first deals with comfort and use of time on transit. Of the attitude questions, these two consistently had stronger associations with choosing transit. Keeping the transit network comfortable should be a major focus of transit operators. This includes ease of transfer, seat availability and system climate.

In addition, transit has an advantage over driving in that time on-board (and to some extent waiting) can be used for leisure or business activities that would be impossible in an automobile. This could be promoted and amenities to facilitate this advantage can be expanded, such as in network wireless internet access.

Lastly, college transit experience has proven to be important in establishing long-term transit use habits. Programs designed to encourage college students to use transit may prove to have a much longer-lasting influence than was previously thought.

8.9: Areas for Future Study

With additional resources, this research can be expanded and sufficient data collected to produce more advanced nested logit models. One possible nested logit model would further disaggregate transit into bus and rail. In order to produce such a model, a larger sample of bus users is needed.

Another possible nested logit formulation involves disaggregating transit access modes. Each access mode would have to have a sufficient number of cases in order to produce this type of model.

Intra-regional residential location choice in relation to transit service availability is another area that has yet to be explored, but was mentioned in several focus groups and may prove to be important. For individuals (and families) who have some regional flexibility in where they choose to live, good transit service may prove to be influential in their choice process.

With additional surveying, a larger sample of individuals who were exposed to transit during their childhood years could help to draw better conclusions about the influence of this experience on their mode choices as adults.

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APPENDIX A: On-Line Travel Survey

PART I: TRANSIT ATTITUDE ASSESSMENT

The first part of the survey will ask you questions intended to reveal your impressions of public transportation.

1. What are the three words (or brief phrases) that come to your mind when you think of public transportation? There is no right or wrong answer - enter anything that comes to your mind.

A

B

C

2. For each of the following statements, select the response the best represents your opinion.

	Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree	No opinion
It is comfortable to ride transit.	○	○	○	○	○
The transit system is dirty.	○	○	○	○	○
Many of my coworkers use transit.	○	○	○	○	○
Transit is often late.	○	○	○	○	○
I like to ride transit because I can read or get work done.	○	○	○	○	○
Crime occurs frequently in/on the transit system.	○	○	○	○	○
Taking transit reduces my impact on the environment.	○	○	○	○	○
People use transit when they don't have any other choice.	○	○	○	○	○
I prefer to drive when I can.	○	○	○	○	○
It makes me uncomfortable to ride on a train or bus with strangers.	○	○	○	○	○

PART II: TRIPS TO AND FROM WORK

In the next part of the survey, you will be asked how you recently traveled to and from work and about the stops you made on those trips.

3. Which mode or modes did you use on your most recent trip FROM HOME TO WORK? Select all that apply. For example, if you were dropped off by car at the BART station and rode the train to work, select "Automobile, private van or truck" and "BART".

- [ ] Automobile, private van or truck
- [ ] Amtrak
- [ ] BART
- [ ] Bicycle
- [ ] Bus
- [ ] Commuter van
- [ ] Ferry
- [ ] Light rail or streetcar
- [ ] Motorcycle, moped or scooter
- [ ] Taxicab
- [ ] Other (please specify)

4. Approximately what time did you depart your home?

5. What stops, if any, did you make on your trip to work? Select all that apply.

- [ ] Personal shopping (clothes, gifts, electronics, etc.)
- [ ] Household shopping and chores (groceries, dry cleaners, pet care, auto care, etc.)
- [ ] Drop off or pick up someone
- [ ] Gym, exercise (working out, playing sports, yoga, etc.)
- [ ] Doctor, therapy, personal health (out-patient medical services, dental, optomologist, physical therapy, psychotherapy, etc.)
- [ ] Attend school, class
- [ ] Meal, drink, snack (restaurant, bar, coffee, etc.)
- [ ] Entertainment (movie, theater)
- [ ] Visit family, friend
- [ ] Other stops (please specify)

6. How many days in a typical work week do you use this mode or combination of modes to get to work?

- ◯ 1 or fewer
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5 or more

7. Does your employer offer to pay for transit fare?

☐

8. Does your employer offer to pay for parking?

☐

9. Were you the driver of the automobile, private van or truck?

- ◯ Yes
- ◯ No

10. Including yourself, how many people total rode in the automobile, private van or truck? Include people who were dropped off or picked up at other locations.

☐

11. Where was the car parked while you were at work?

- ◯ In a garage or surface lot
- ◯ On a street at a parking meter
- ◯ On a street not at a parking meter
- ◯ I was dropped off
- ◯ Other (please specify)

12. For what increment of time did you pay to park? If you previously paid for the entire month or year, select "Month" or "Year".

- ◯ Hour
- ◯ Day
- ◯ Week
- ◯ Month
- ◯ Year
- ◯ I did not pay to park
- ◯ Other (please specify)

13. Approximately how much did you pay to park per HOUR? If you were or will be reimbursed for some or all of your parking costs, select the amount you paid before reimbursement. Select "$0.00" if you parked for free.

14. Approximately how much did you pay to park per DAY? If you were or will be reimbursed for some or all of your parking costs, select the amount you paid after reimbursement. Select "$0.00" if you parked for free.

15. Approximately how much do you pay to park per WEEK? If you were or will be reimbursed for some or all of your parking costs, select the amount you pay after reimbursement. Select "$0.00" if you parked for free.

16. Approximately how much do you pay to park per MONTH? If you were or will be reimbursed for some or all of your parking costs, select the amount you pay after reimbursement. Select "$0.00" if you parked for free.

17. Approximately how much do you pay to park per YEAR? If you were or will be reimbursed for some or all of your parking costs, select the amount you pay after reimbursement. Select "$0.00" if you park for free.

18. How did you get to the transit station or stop from your home? Select "Walk" even if you only walked a few steps. If you used more than one transit mode, indicate how you got to the first transit mode (the mode closest to your home).

- ◯ Automobile, private van or truck
- ◯ Bicycle
- ◯ Motorcycle, moped or scooter
- ◯ Taxicab
- ◯ Walk

19. What type of fare did you pay for your trip by transit? If you used a single adult ticket (or paid for a single adult fare) select "Single ride". If you used a weekly or monthly pass, please select the type of pass.

- ◯ Single ride
- ◯ 10-trip
- ◯ Weekly pass
- ◯ Monthly pass
- ◯ Other (please specify)

In order to measure your travel time and cost, a STARTING point for your daily journey to work must be established. To maintain your anonymity, you will not be asked for your exact home address. Instead, please provide only the name of the street you live on, the name of the nearest cross-street, and your home zip code. Please DO NOT include your house or building number in any of the following questions.

20. What is your HOME street name? Please indicate the full name of your street (include road, court, street, drive, etc.)

21. What is the name of the nearest cross-street to your HOME? Please indicate the full name of your street (include road, court, street, drive, etc.)

22. What is your HOME zip code?

In order to measure your travel time and cost, an ENDING point for your daily journey to work must be established. To maintain your anonymity, you will not be asked for your exact work address. Instead, please provide only the name of the street you work on, the name of the nearest cross-street, and your work zip code. Please DO NOT include the building number in any of the following questions.

23. What is your WORK street name? Please indicate the full name of your work street (include road, court, street, drive, etc.)

24. What is the name of the nearest cross-street to your WORK? Please indicate the full name of your work street (include road, court, street, drive, etc.)

25. What is your WORK zip code?

26. How many days in a typical week do you work in Downtown Oakland?

27. In what year did you begin traveling to your current work location, regardless of where you were living at the time?

PART III: HOUSEHOLD INFORMATION

In the next part of the survey, you will be asked questions about you, your home and household.

28. How often do you use the following transportation modes? Consider all the trips you make, not just trips to and from work.

	Most days	A few times per week	Once per week	Once or twice per month	Once or twice per year	Almost never
Car	○	○	○	○	○	○
Bus	○	○	○	○	○	○
Train, Trolley, Subway, Streetcar, or Light Rail	○	○	○	○	○	○
Bicycle	○	○	○	○	○	○

29. Including yourself, how many adults (18 years and older) live in your household? Please do not include anyone who usually lives somewhere else or is just visiting.

30. How many children (under 18 years old) live in your household?

31. Including yourself, how many members of your household are licensed drivers?

32. How many motor vehicles are available for use at your household? Select the number of motor vehicles that are owned or leased by members of your household. Please be sure to include motorcycles, mopeds and motorized scooters, but DO NOT include bicycles.

33. How far is your home from the nearest bus stop?

- ◯ 0 to 1/4 mile (0 to 7.5 minutes walking time)
- ◯ 1/4 to 1/2 mile (7.5 to 15 minutes walking time)
- ◯ 1/2 to 1 mile (15 to 30 minutes walking time)
- ◯ 1 to 2 miles (30 to 60 minutes walking time)
- ◯ More than 2 miles (over an hour walking time)

34. How far is your home from the nearest train or light rail station?

- ◯ 0 to 1/4 mile (0 to 7.5 minutes walking time)
- ◯ 1/4 to 1/2 mile (7.5 to 15 minutes walking time)
- ◯ 1/2 to 1 mile (15 to 30 minutes walking time)
- ◯ 1 to 2 miles (30 to 60 minutes walking time)
- ◯ More than 2 miles (over an hour walking time)

35. Do you rent or own your home or apartment?

- ◯ Rent
- ◯ Own
- ◯ Other (please specify)

36. Since turning 18 years old, for how many years total have you resided in the Bay Area? Please round up 6 months or more to a full year and do not include periods of less than 6 months. The answer need not be in consecutive years. For example, if lived in the Bay Area for 3 years, moved away for 2 years, and have since returned for 4 years, the answer would be 7.

37. Did you live in the Bay Area for at least one year or more at any point during your childhood (under 18 years old)?

- ◯ Yes
- ◯ No

38. Do you live in a house or apartment that you lived in for any part of your childhood (under 18 years old)?

- ◯ Yes
- ◯ No

39. Do you live within 5 miles of a house or apartment that you lived in for any part of your childhood (18 years and under)?

- Yes
- No

40. Have you moved since you turned 18 years old?

- Yes
- No

41. In what year did you move into your current home?

42. How important were each of the following when you selected your current home?

	Extremely Important	Very Important	Important	A little Important	Not Important
Cost or price of home / rent					
Quality of home					
Home or lot size					
Quality of local public school system					
Neighborhood quality					
Convenient to work					
Convenient to school					
Convenient to retail (shopping, entertainment, restaurants, night life, etc.)					
Close to friends and family					
Close to public transportation					
Close to scenic locations (beach, lake, golf course, etc.)					

PART IV: CHILDHOOD TRANSIT USE

In the next part of the survey, you will asked about your exposure to transit during your high school years.

43. During your high school years (from age 14 to 17), how often did you use the following transportation modes? Consider all the trips you made during that time, not just trips to and from school.

	Most days	A few times per week	Once per week	Once or twice per month	Once or twice per year	Almost never
Car	◯	◯	◯	◯	◯	◯
School bus	◯	◯	◯	◯	◯	◯
Transit bus	◯	◯	◯	◯	◯	◯
Train, Trolley, Subway, Streetcar, or Light Rail	◯	◯	◯	◯	◯	◯
Bicycle	◯	◯	◯	◯	◯	◯

44. During your high school years (from age 14 to 17), did any members of your household use public transportation to get to work? Select the members of your family who used transit to travel to work. Also select "Extended family" if any uncles, aunts, cousins, etc. lived with you and used transit to get to work. Select ALL that apply.

- ☐ Mother
- ☐ Father
- ☐ Brother
- ☐ Sister
- ☐ Other guardian
- ☐ Extended family

45. During your high school years (from age 14 to 17), how far was your home from the nearest bus stop?

- ◯ 0 to 1/4 mile (0 to 7.5 minutes walking time)
- ◯ 1/4 to 1/2 mile (7.5 to 15 minutes walking time)
- ◯ 1/2 to 1 mile (15 to 30 minutes walking time)
- ◯ 1 to 2 miles (30 to 60 minutes walking time)
- ◯ More than 2 miles (over an hour walking time)

46. During your high school years (from age 14 to 17), how far was your home from the nearest train or light rail station?

- ◯ 0 to 1/4 mile (0 to 7.5 minutes walking time)
- ◯ 1/4 to 1/2 mile (7.5 to 15 minutes walking time)
- ◯ 1/2 to 1 mile (15 to 30 minutes walking time)
- ◯ 1 to 2 miles (30 to 60 minutes walking time)
- ◯ More than 2 miles (over an hour walking time)

PART V: RELEVANT PERSONAL INFORMATION

In the final part of the survey, you will be asked to provide information that past research has shown may influence an individual's choice of mode or modes.

47. In what year were you born?

[ ]

48. What is your gender?

- ◯ Male
- ◯ Female

49. What is your current occupation?

[ ]

50. What was your total 2009 household income before taxes? Indicate how much you and your spouse or partner (if applicable) earned last year combined.

[ ]

51. Do you currently have a valid license to drive?

- ◯ Yes
- ◯ No

52. Do you have a physical or mental condition that interferes with your ability to drive?

- ◯ Yes
- ◯ No

APPENDIX B: Focus Group Travel Survey

Please tell us a few things about yourself and your travel. We will use this information for statistical purposes only.

(1) What is your first name and last initial? ______________________________

(2) What is your HOME zip code? _______________

(3) What is your WORK zip code? If you are not currently employed, leave blank. _______________

(4) Do you live with a spouse or partner?

___Yes ___No

(5) What is your current occupation?

___Architecture and Engineering
___Arts, Design, Entertainment, Sports, and Media
___Building and Grounds Cleaning and Maintenance
___Business and Financial Operations
___Community and Social Services
___Computer and Mathematical Science
___Construction and Extraction
___Education, Training, and Library
___Farming, Fishing, and Forestry
___Healthcare Practitioner and Technical
___Healthcare Support
___Installation, Maintenance, and Repair
___Legal
___Life, Physical, and Social Science
___Management
___Office and Administrative Support
___Personal Care and Service
___Preparation and Serving Related
___Production
___Sales and Related
___Service
___Transportation and Material Moving
___I am not currently employed
___Other (please specify)_______________________________________

(6) What was your total 2010 household income before taxes? Indicate how much you and your spouse or partner (if applicable) earned last year combined.

___Less than $25,000 ___$25,000 to $49,999 ___$50,000 to $74,999
___$75,000 to $99,999 ___$100,000 to $124,999 ___$125,000 to $149,999
___$150,000 to $174,999 ___$175,000 to $199,999 ___$200,000 to $224,999
___$225,000 to $249,999 ___$250,000 to $274,999 ___$275,000 to $299,999
___$300,000 or more

(7) How many days per week do you usually travel to work at the zip code indicated in (2)? Circle one.

0 1 2 3 4 5 6 7

(8) What was the primary mode that you used on your most recent trip from home to work? The primary mode is the mode in which you spent the most time. For example, if you drove to BART and then rode the train to work, select BART. Select only one.

___Drive alone
___Pre-arranged carpool (2 people in the vehicle)
___Pre-arranged carpool (3 or more people in the vehicle)
___Casual carpool
___Amtrak
___BART
___Bicycle
___Bus
___Commuter van
___Ferry
___Light rail or streetcar
___Motorcycle, moped or scooter
___Taxicab
___Walk
___Other (please specify) ______________________________

(9) How many days per week do you usually use this primary mode to travel to work? Circle one.

0 1 2 3 4 5 6 7

(10) How do you usually get to the primary mode you indicated in (8) from your home? Select "Walk" even if you only walk a few steps.

___Drive in automobile, private van or truck and park
___Drop off by automobile, private van or truck
___Bicycle
___Bus
___Motorcycle, moped or scooter
___Taxicab
___Walk
___Other (please specify) ___________________________________

(11) When you don't use the primary mode indicated in (8) to travel to work, which of the following primary modes do you use? Select ALL that apply.

___Drive alone
___Pre-arranged carpool (2 people in the vehicle)
___Pre-arranged carpool (3 or more people in the vehicle)
___Casual carpool
___Amtrak
___BART
___Bicycle
___Bus
___Commuter van
___Ferry
___Light rail or streetcar
___Motorcycle, moped or scooter
___Taxicab
___Walk
___Other (please specify) ______________________________
___I never use any other primary mode other than the one I listed in (8)

(12) How often do you use the following transportation modes for any trip purpose (not just trips to and from work)? Circle one for each mode.

	Almost never	At least once per year	At least once per month	At least once per week	A few times per week	Most days
(A) BART	1	2	3	4	5	6
(B) MUNI Metro (streetcar)	1	2	3	4	5	6
(C) MUNI Bus	1	2	3	4	5	6
(D) AC Transit Bus	1	2	3	4	5	6
(E) Amtrak	1	2	3	4	5	6
(F) Ferry	1	2	3	4	5	6

(13) How do you rate the overall quality of service for each of the following transportation modes? Circle one for each mode. Please rate each mode, even if you do not use it.

	Very poor	Poor	Needs improvement	Tolerable	Good	Very good	Excellent
(A) BART	1	2	3	4	5	6	7
(B) MUNI Metro (streetcar)	1	2	3	4	5	6	7
(C) MUNI Bus	1	2	3	4	5	6	7
(D) AC Transit Bus	1	2	3	4	5	6	7
(E) Amtrak	1	2	3	4	5	6	7
(F) Ferry	1	2	3	4	5	6	7

(14) Do you have an automobile, van, truck, motorcycle, moped or scooter available for you to use?

___Yes ___No

(15) How far do you live from the transit station or stop that you use most often?

___0 to 1/4 mile (0 to 7.5 minutes walking time)
___1/4 to 1/2 mile (7.5 to 15 minutes walking time)
___1/2 to 1 mile (15 to 30 minutes walking time)
___1 to 2 miles (30 to 60 minutes walking time)
___More than 2 miles (over an hour walking time)

Next, we would like you to answer some questions about your travel preferences.

(16) Which of the following two scenarios would you prefer? Select one.

___Your daily travel time to work averages 20 minutes, but some days it takes 10 minutes and some days it takes 30 minutes
___Your daily travel time to work always takes twenty minutes, with very little variation

(17) What do you like most about your primary mode of travel to work?

(18) What do you like least about your primary mode of travel to work?

(19) If the cost of using your most frequent mode of travel to work were to increase by $3/day, what mode(s) of travel would you use? Select ALL that apply.

___Drive alone
___Pre-arranged carpool (2 people in the vehicle)
___Pre-arranged carpool (3 or more people in the vehicle)
___Casual carpool
___Amtrak
___BART
___Bicycle
___Bus
___Commuter van
___Ferry
___Light rail or streetcar
___Motorcycle, moped or scooter
___Taxicab
___Walk
___Other (please specify)________________________________

(20) If reliability of the mode you use most often were to decline, so that about once per week you were 20 minutes later than you expected, would you continue to use that mode as often as you currently do?

___Yes ___No ___Not sure

(21) If congestion on your current mode of transportation worsened, so that the trip was more crowded and less comfortable on the typical day, would you use this mode as often as you currently do?

___Yes ___No ___Not sure

(22) If your trip to work by your usual mode took ten more minutes more on the typical day, would you continue to use this mode as often as you currently do?

___Yes ___No ___Not sure

(23) How would you prefer to cover the costs of maintaining transit services in the Bay Area? Select ALL that you would support.

___Reduce frequency of service in order to reduce costs (e.g. run fewer trains)
___Reduce services in areas where ridership is low in order to reduce costs
___Reduce service late evenings (e.g. after 9pm) in order to reduce costs
___Reduce service on weekends in order to reduce costs
___Increase overall fares to cover costs of services, but do not cut back
___Increase fares for weekend, late evening, and low use areas only
___Add an extra half cent sales tax set aside for transit
___Add a state income tax surcharge to cover statewide transit needs
___Increase bridge tolls and use the revenues to cover regional transit needs
___Add toll lanes to more freeways and use the revenues to cover regional transit needs
___Add 10% tax on commercial parking spaces and use revenues to cover regional transit needs
___Other (please specify) ____

(24) If transit fares went up by 20% to pay for new vehicles, station/stop improvements, maintenance, and other capital improvements would you continue to use transit as often as you currently do?

___Yes ___No ___Not sure

(25) What are some improvements you would suggest to encourage more frequent transit use?

(26) Please rate the following characteristics, (A) to (R) of **BART** trains and stations. Circle the number that indicates what you think about that aspect of service or the system.

	Very poor	Poor	Needs improvement	Tolerable	Good	Very good	Excellent
(A) Cost	1	2	3	4	5	6	7
(B) Travel time	1	2	3	4	5	6	7
(C) Reliability	1	2	3	4	5	6	7
(D) Cleanliness onboard trains	1	2	3	4	5	6	7
(E) Cleanliness of stations	1	2	3	4	5	6	7
(F) Comfort onboard trains	1	2	3	4	5	6	7
(G) Comfort in stations	1	2	3	4	5	6	7
(H) Crime onboard trains	1	2	3	4	5	6	7
(I) Crime in stations	1	2	3	4	5	6	7
(J) Crime in area around station	1	2	3	4	5	6	7
(K) Safety onboard trains	1	2	3	4	5	6	7
(L) Safety in stations	1	2	3	4	5	6	7
(M) Noise onboard trains	1	2	3	4	5	6	7
(N) Noise in stations	1	2	3	4	5	6	7
(O) Parking availability at stations	1	2	3	4	5	6	7
(P) Hours of operation	1	2	3	4	5	6	7
(Q) Employee helpfulness	1	2	3	4	5	6	7
(R) Signs, maps and information	1	2	3	4	5	6	7

(27) Please rate the following characteristics, (A) to (R) of **AC Transit** buses and bus stops. Circle the number that indicates what you think about that aspect of service or the system.

	Very poor	Poor	Needs improvement	Tolerable	Good	Very good	Excellent
(A) Cost	1	2	3	4	5	6	7
(B) Travel time	1	2	3	4	5	6	7
(C) Reliability	1	2	3	4	5	6	7
(D) Cleanliness onboard buses	1	2	3	4	5	6	7
(E) Cleanliness of bus stops	1	2	3	4	5	6	7
(F) Comfort onboard buses	1	2	3	4	5	6	7
(G) Comfort of bus stops	1	2	3	4	5	6	7
(H) Crime onboard buses	1	2	3	4	5	6	7
(I) Crime at bus stops	1	2	3	4	5	6	7
(J) Crime in area around stops	1	2	3	4	5	6	7
(K) Safety onboard buses	1	2	3	4	5	6	7
(L) Safety at bus stops	1	2	3	4	5	6	7
(M) Noise onboard buses	1	2	3	4	5	6	7
(N) Noise at bus stops	1	2	3	4	5	6	7
(O) Parking availability stops	1	2	3	4	5	6	7
(P) Hours of operation	1	2	3	4	5	6	7
(Q) Employee helpfulness	1	2	3	4	5	6	7
(R) Signs, maps and information	1	2	3	4	5	6	7

(28) Please rate the following characteristics, (A) to (R) of MUNI trains, streetcars, buses, stations and stops. Circle the number that indicates what you think about that aspect of service or the system.

	Very poor	Poor	Needs improvement	Tolerable	Good	Very good	Excellent
(A) Cost	1	2	3	4	5	6	7
(B) Travel time	1	2	3	4	5	6	7
(C) Reliability	1	2	3	4	5	6	7
(D) Cleanliness onboard vehicles	1	2	3	4	5	6	7
(E) Cleanliness of stations or stops	1	2	3	4	5	6	7
(F) Comfort onboard vehicles	1	2	3	4	5	6	7
(G) Comfort in stations or stops	1	2	3	4	5	6	7
(H) Crime onboard vehicles	1	2	3	4	5	6	7
(I) Crime in stations or stops	1	2	3	4	5	6	7
(J) Crime in area around stations or stops	1	2	3	4	5	6	7
(K) Safety onboard vehicles	1	2	3	4	5	6	7
(L) Safety in stations or stops	1	2	3	4	5	6	7
(M) Noise onboard vehicles	1	2	3	4	5	6	7
(N) Noise in stations or stops	1	2	3	4	5	6	7
(O) Parking availability at stations or stops	1	2	3	4	5	6	7
(P) Hours of operation	1	2	3	4	5	6	7
(Q) Employee helpfulness	1	2	3	4	5	6	7
(R) Signs, maps and information	1	2	3	4	5	6	7