The Effect of Social and Environmental Factors on Transportation Mode Choice in Southeast Michigan

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Abstract

Personal transportation is one of the largest contributors to greenhouse gas emissions in the United States, as well as a source of economic and social disparity. This study seeks to understand the underlying factors of transportation mode choice so that appropriate policy options can be identified. Using data collected in Southeast Michigan as part of a larger household travel survey, the study examines differences in transportation behavior based on individual and environmental characteristics. The overwhelming majority of respondents used private vehicle for most of their trips, but there were some significant results. Overall, younger, less educated, and lower income people living in large cities were more likely to choose a transportation mode other than cars than were older, high-income, educated respondents in suburban and rural communities. The results imply that a more regional transportation system that serves low-income areas and more dense, mixed-use development could improve alternative transportation use.

Introduction

The U.S. has experienced unprecedented growth and innovation during the last century. One of the most significant changes in the American lifestyle has been the rise of the car as the dominant transportation mode. A half-century later, however, we are just beginning to feel the negative consequences of reshaping our cities and society around automotive mobility. The specter of climate change has called attention to just how hard it will be to shift to other fuel sources and modes of transportation. Although effort on the part of the individual will be essential in a national plan to curb carbon emissions, public policy and services will have to make those efforts possible. Governmental support of the private vehicle has made life without one difficult in many ways, and quite impossible in many places. Now, as the U.S. tries to wean itself off of fossil fuels, it is crucial to understand where to focus funding and policy to encourage alternative transportation. This study seeks to identify some of the determinants of current transportation mode choice, in the interest of identifying weaknesses in current transportation policy. Southeast Michigan, the home of American car manufacturers and wide suburbanization, provides an exemplary case study of American travel habits.

Personal automobile ownership expanded rapidly after World War II and by 2000, the U.S. population owned 771 vehicles per 1000 people (Shoup, 2005). Although the growth in car ownership did signify strong economic growth and technological innovation, it also caused a decline in travel by other means of transit, including public transportation, bicycle, and walking. In 1960, 12.6% of commutes to work were made by public transit and 10.3% by walking, versus 4.7% and 2.9% respectively in 2001 (Polzin, 2004), and by 2003, only 4% of the population made their commute by something other than car (Berstein , Makarewicz, and McCarty, 2005). Public transportation use in Detroit has decreased from 288 thousand passenger-miles traveled in 2000 to 267 thousand passenger miles traveled in 2005, while the population increased by 30,000 (Texas Transportation Institute (TTI), 2007). Although increased car ownership has a lot to do with these trends, the change in community design and land use also influenced the shift to car-dependent transit. Expansion of suburbs has reduced the average density of American towns and cities and encourages reliance on cars while offering little other choice. A common misconception is that this is the result of market demands, that this is simply what Americans want and what they are willing to pay for. However, a minority of Americans believes that they have adequate access to public transportation (Baxandall & Farhoodi, 2008). Lack of transportation options has contributed to some of the major challenges faced by the U.S. today such as climate change, economic inequity, and the neglect of inner cities.

Emissions of carbon dioxide and other greenhouse gases have increased exponentially over the past century, in large part due to increased travel by motor vehicle. Switching to mass transit could reduce fossil fuel use and carbon emissions dramatically. In 2006, transit ridership reduced oil consumption by 3.4 billion gallons (Baxandall & Farhoodi, 2008), proving that alternative transportation could be a climate change mitigation technique. Not only would increased transit use reduce physical emissions, it would decrease the amount of land needed for roads and parking, preventing further carbon emission from deforestation for land development.

The ubiquity of car ownership has also created numerous social equity problems. One major concern has been access to jobs for low-income people. As cities decentralized and suburbs became the center of economic activity, most job creation occurred on the fringes of metropolitan regions. Between 1980 and 1990, 65% of job growth was in suburbs (Polzin, 2004). However, the cost of living in those far suburbs prevents low-income and working-class employees from living nearby. Most affordable housing options are in the inner city or in older, inner-ring suburbs, and there is rarely public transportation service between cities and suburbs. Most low-income workers find themselves forced to take on the financial burden of a car in order to find a job. Many cannot afford new, efficient vehicles and so they end up paying more than wealthy drivers for gas and repairs (Bernstein et al., 2005). In Milwaukee, the issue was brought to light in a court case to require the state to provide light-rail transit to connect low-income urban neighborhoods to outer suburbs where jobs were located (Luberoff, 2002).

Expanding alternative transportation is also prudent economic policy. Public transportation creates local jobs in service and manufacturing that cannot be exported like auto industry jobs are. Alternative transportation options also provide less costly forms of travel for people of all income levels. Private car ownership costs are one of the largest expenses of American households, who spent 19 cents out of every dollar on transportation in 2001 (Surface Transportation Policy Project (STPP), 2003), making it second only to housing cost. In comparison, public transportation is a more affordable option. According to the Bureau of Transportation Statistics, Americans who use cars or trucks spent $1280 per year just for commuting, whereas those that used public transportation spent $765 per year (STPP, 2003). Unfortunately, many low-income people in rural areas and older suburbs do not get to opt for the lower costs of public transportation, and are saddled with the economic burden of owning a car that is out of their monetary means.

Despite the fact that most Americans travel by car, not all people make that choice voluntarily. Indeed, a number of factors made certain transit modes more or less possible, including individual and environmental characteristics. An individual's age, gender, income, education, and the number of vehicles to which they have access can greatly affect their travel behavior. Similarly, the design and the composition of a place can influence the relative ease of travel by different modes. Not everyone has equal access to convenient transportation and these inequalities can be controlled by specific planning choices. In fact, the federal government has formally recognized the connection between transportation, planning and social justice. President Clinton signed an executive order that the Environmental Protection Agency be responsible for coordinating the federal response to and regulation of environmental justice. In response, the Department of Transportation issued its own order to ensure that any federally funded transportation-related initiatives, projects, or policies that may have disproportionate adverse effect on minority and low-income populations make explicit efforts to take these effects into account (Forkenbrock & Schweitzer, 1999).

Women and racial minorities are more likely to experience the negative effects of transportation projects, or lack thereof, than men and whites simply because fewer of them own or have access to a car. According to the 2001 National Household Travel Survey, only 5% of white households did not own a car, yet 20% of black households, 14% of Native Hawaiian/Pacific Islander households, and 15% of Latino households did

not (Lucas, 2004). Although fewer minorities are driving, more of them are suffering from the negative consequences, such as air pollution and crashes involving pedestrians. Even the roads themselves have created unbalanced burdens on communities of color, whose neighborhoods were the default choice of planners for locating new highways earlier in the century.

The disparity between those that cause the externalities of private cars and those that suffer them has sparked many civil responses. In Atlanta, the Atlanta Transportation Equity Project seeks to correct the inequality between the large funding of highway projects in white suburbs and the problems caused in low-income neighborhoods by congestion, air pollution, and lack of alternative transportation (Luberoff, 2002). Even where public transit is provided, communities of color are often underserved or their transit is underfunded. Bus transit is just such an example. The majority of bus riders are minorities, and buses carry 60% of transit passengers, yet they receive just 33% of transit funding nationally (Luberoff, 2002). A striking example of the unequal funding of transit happened in Los Angeles in the mid-1990's when the Metropolitan Transit Association (MTA) proposed a fare increase for the overcrowded bus lines that serviced low-income neighborhoods. The increased revenue would go toward funding an expansion of a rail line in surrounding suburbs that did not have as high ridership. A wide coalition of community and national organizations (including the NAACP) sued the MTA, and the case was settled out of court (Luberoff, 2002). In New York in 1995, a court overturned a previous decision that forbade bus and subway line fares higher than commuter rail (Luberoff, 2002). These court cases demonstrate the institutional prejudices against transit for low-income and minority communities.

While the federal commitment to environmental justice in its own programs is a step in the right direction, the government cannot address the extremely high cost of owning a car. Although cars are relatively cheap in the U.S. compared to other countries and compared to past decades, all of the associated costs can be formidable. These cumulative costs make up a substantial portion of household expenditure; in 2003, the poorest 20% of the U.S. population (earning less than $13,000 a year) spent over forty percent of their income on transportation. Of that cost, 95% of it went to private vehicles alone. For people earning so little to begin with, car costs can be debilitating, and a slight increase in gas price can cripple a family's income (STPP, 2003). The sudden rise in gas prices in the summer of 2008 proved exactly this, and the Economic Stimulus package that gave qualifying families $1500 did not help much as most families had already spent the rebate by July (Baxandall & Farhoodi, 2008). Even the modest increased price in gas in 2003 was equal to what many low-income families paid for education and medical services in a year (Bernstein et al., 2005).

A simple response to the financial strain of owning a vehicle may be that such low-income individuals should be able to recognize that they cannot afford a car and should not invest in one. Unfortunately many do not have a choice. As mentioned above, the physical gap in many metropolitan areas between affordable housing and job opportunities makes owning a car a prerequisite of getting a job in some areas. Even in larger cities that have good public transportation systems, housing in well-serviced areas is much too expensive. More and more low-income families are being pushed out of the inner city to older, inner-ring suburbs by a renewed interest in urban lifestyles among the

wealthy. Since most municipalities underfund public transportation, most low-income families find it prohibitive to not own a car.

Even if they choose not to own a car, transportation can be expensive when no mass transit is available. Households that have two or more vehicles spend about 19% of their income on transportation; those that have 1 or less but don't use transit still spend 16%; those that have 1 or less vehicles *and* use public transit regularly spend only 10% (Berstein et al., 2005). In the city of Detroit, where unemployment in 2003 reached 13.9% (Bureau of Labor Statistics (BLS), 2008), the average number of vehicles per household from 2002-2003 was two (Bernstein et al., 2005). The fact that so many people who are suffering economically still find a car necessary enough to own two, despite the financial burden, is testament to how central the private car has become to American society.

Place also plays a significant role in travel behavior. The physical environment not only dictates what types of transportation are readily accessible, it can make some modes more attractive, affordable, or convenient than others. In this way, the planning and design of American cities and transportation systems can favor and promote certain travel behavior. Physical elements like density, parking policy and design, street layout, and other design specifications can make the difference between a walkable, easy to navigate, safe community and a sprawling, confusing community that's uncomfortable for pedestrians.

Density is one factor that has been proven to have a major effect on the rate of driving and walking. The more spread out places are in a community, the more people will choose to drive because they are going farther distances more often. It is also in general not very pleasant to walk in an area with little visual interest because the buildings are so far apart. In general, American cities have been trending toward lower density. In 2005, the average American driver drove 12.4% more than they did ten years earlier (Bernstein et al., 2005). Between 1977 and 2001, total domestic vehicle miles traveled (VMT) increased 151% but population only increased by 30% (Polzin, 2004). The increase in VMT associated with lower density development also causes higher transportation costs. More sprawling metro areas (e.g. Tampa) had transportation costs as high as 24 cents per dollar of income, while more compact metro areas (e.g. D.C.) had costs as low as 15 cents per dollar of income (STPP, 2003). This cost differential can have a major impact on a city like Detroit, that is already suffering economically, and whose population density decreased from 2,960 persons per square mile in 2000 to 2,816 persons per square mile in 2005 (TTI, 2007).

Structural components of places can also have a large influence on the travel choices of consumers and residents. For example, the rise of big-box retail stores in the recent decades has greatly contributed to the increase in VMT and the necessity of driving. The stores are of such a size that they must be spread out in order to be cost-effective (Polzin, 2004). Also, because of the land requirements of such large stores (and their required parking lots), most locate in the suburbs, which have lower land costs and property taxes. As a result, consumers have to drive further to reach the nearest stores, which are usually located outside of the public transportation service of the central city.

Zoning ordinances regulate the physical attributes of a place, and may even in some cases explicitly discourage density and connected communities. The street layout influences not only travel behavior, but the general comfort level of pedestrians and

visitors. Studies show that people prefer scenes that are easily navigable, where one can imagine walking through it and exploring without getting lost (Kaplan, 2003). Yet some ordinances purposefully avoid this; in Brighton, Michigan, a wealthy suburb of Detroit, the zoning ordinance stipulates that street configuration should discourage through traffic (Brighton 2006), a veiled way of saying that the street layout should be confusing. A confounding street pattern conflicts with the idea that people are most comfortable when they feel connected with their surroundings. Sociological studies have shown the importance of "way-finding" in determining comfort and confidence in one's environment, which is facilitated by landmarks and diversity in housing patterns. Strip malls and subdivisions fail to offer these, especially when combined with rounded roads and cul-de-sacs (Kaplan, 2003).

In light of the disparities described above, this study examines the effects of both individual and place level characteristics on people's choice of transportation mode. On the individual level, the study looks at the effect of income, education, employment, age, gender, and the number of vehicles in the household on mode choice and asks which has the strongest effect and in what direction. I hypothesize that lower-income, less educated, and unemployed people will drive less than those in higher income brackets with more education and employment. Also, all of these groups will use more public transportation than higher-income, well-educated and employed people. The type of place and activity that the person is doing there will also affect their mode choice. Destinations in denser, urban areas will make it easier to walk or take public transportation. More regular activities, such as work, school, or church, will facilitate using public transportation because it is easier to plan ahead and stick to a bus schedule. More spontaneous activities, like shopping and social activities, will have higher driving rates, so that the level of spontaneity will have a negative relationship with the choice of alternative modes.

Methods

Data Context

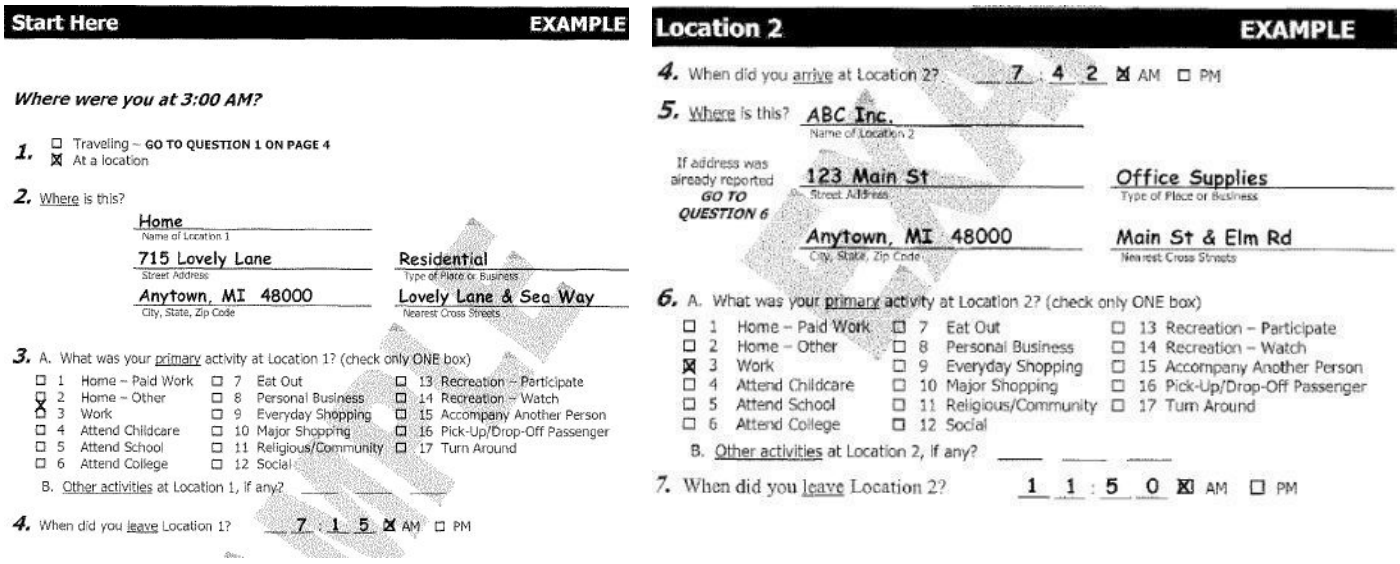
This study is based on data that the Southeastern Michigan Council of Governments (SEMCOG), in conjunction with the Michigan Department of Transportation, collected in southeast Michigan. The survey included seven counties: Livingston, Oakland, Macomb, St. Clair, Wayne, Washtenaw, and Monroe. These seven counties are home to 4.9 million people, 3.4 million of whom are licensed drivers. The annual number of vehicle miles traveled in these seven counties is 49 billion, on about 23,000 miles of road in 234 communities.

Survey Methods

The SEMCOG survey was based on a previous one done in 1994, which is now outdated. The survey was conducted from October of 2004 through May of 2005 from 3,800

households. Respondents were asked to keep a travel diary for twenty-four hours (see Figure 1). Survey questions included individual demographic information (age, gender, etc.), household demographic information (income, number of vehicles, etc.), and trip information (origin, destination, mode, etc.). Data accuracy was confirmed using Computer-Assisted Telephone Interviewing (CATI) logic checks.

Figure 1. Survey Questionnaire



Variables

The descriptive statistics analysis looked first at the proportion of trips made by each transit mode for five different personal characteristics: age range, gender, working status, household income, number of vehicles owned by the household, and level of education. Then the same descriptive statistics methods were used to examine the proportion of trips made by each transit mode for different place characteristics: destination/origin type, activity at destination/origin, household county, and type of place (city, suburb, rural, etc.).

Age: For the purposes of this study, only adult respondents were of interest and all data for persons under the age of eighteen were omitted. Ages were grouped into intervals of about ten years to better capture differences between life stages and generations. The forty-five to fifty-four age range contained the highest percentage of respondents, while the eighteen to twenty-four range had the lowest. The remaining respondents were distributed fairly evenly across the other ages (see the Total column in Table 1).

Gender and Working status: Both variables had few categories – two for gender and four for working status. These variables were not adjusted. Females made up the slight majority of respondents (see the Total column in Table 2). Half of respondents worked full-time, and over a quarter were not working (see the Total column in Table 3).

Income and Education: Income and education each had several categories, but they were not consolidated because they are both such important measures of inequality and socioeconomic status. The vast majority of respondents held high school diplomas, and about a quarter had at least a bachelor's degree (see the Total column in Table 4). The majority of respondents lived in households earning over $60,000 per year (see Total column in Table 5).

Type of place: The groupings came from the classification system used in the Detroit Area Study, another household survey done in Southeast Michigan and focused on quality of life aspects. These classifications are a result of several deductive steps; all of the minor civil divisions (MCD) in metro Detroit were split into incorporated cities and villages and unincorporated townships. The incorporated cities and villages were then classified into further groups based on population size and whether they were contiguous with the city of Detroit, or farther away and self-contained. The unincorporated towns were grouped based on population. These steps yielded seven categories: major city, large city, mid-sized city, new suburb, old suburb, small town, and rural. Two-thirds of respondents lived in old or new suburbs and small towns, while less than twenty percent lived in the major and large city categories (see the Total column in Table 12).

Destination/origin type: The original survey question of what the destination and origin were had over thirty response categories, which were consolidated into ten categories to better reflect general land uses. Almost half of all trips either originated or ended at home, and only about one-tenth of trips originated or ended in commercial areas or an institution (see the Total column in Tables 7 and 8).

Destination/origin activity: The possible activities originally totaled seventeen (see Figure1), and were consolidated to twelve. The new categories capture activities of varying levels of predictability. About a third of trips either originated or ended at home, and fifteen percent started or ended at the workplace. Almost ten percent of trips were taken to pick-up or drop-off another person (see the Total column in Tables 9 and 10).

Results

The results are arranged into four sections. First, the raw data for the individual characteristics are presented, along with the proportion of people in each response category that chose each of the four target modes. Then I present how each variable affected the choice of the alternative modes over personal vehicle. The results for the place characteristics are then presented in the same order.

Individual differences

The majority of trips by persons in all age groups were made by private motor vehicles (see Table 1). However, there are some interesting trends among those trips made by alternative modes. The age group that made the highest percentage of trips by bicycle was the 55-64 year range (this category also included the response of "scooter"). The 25-

34 year olds made almost four percent of their trips on foot, at least one percent more than any other group. The youngest age group, 18-24 year olds, used public bus more than any other group. In fact, the 18-24 year olds used public bus at twice the rate of the nearest age group (25-34 year-olds), and more than three times the rate of every other age group. The 25-34 year-olds used public bus almost twice as often as the other groups.

Table 1: Frequency of Transportation Mode by Age Range

Age Range	Type of Transit				
	Car, Van Truck	Bike*	Walking	Public Bus	Total
18-24	1379 (94.52%)	2 (0.14%)	34 (2.33%)	**44 (3.02%)**	1459 (5.45%)
25-34	2856 (94.44%)	7 (0.23%)	**117 (3.87%)**	44 (1.46%)	3024 (11.29%)
35-44	5605 (96.37%)	16 (0.28%)	165 (2.84%)	30 (0.52%	5816(21.72 %)
45-54	6229 (96.45%)	11 (0.17%)	170 (2.63%)	48 (0.74%)	6458 (24.12%)
55-64	4969 (95.89%)	**27 (0.52%)**	154 (2.97%)	32 (0.62%)	5182 (19.35%)
64 +	4657 (96.30%)	17 (0.35%)	138 (2.85%)	24 (0.50%)	4836 (18.06%)
Total	25695 (95.97%)	80 (0.3%)	778 (2.91%)	222 (0.83%)	26775 (100.%)

Bolded numbers are the highest or lowest rates in the column, or are terms of interest.

The number of trips made by men and women and the types of transit they used for those trips did not show much variation (see Table 2). Overall, men and women both used private motor vehicles for over 90% of their trips, and both walked about 3% of the time and used the public bus less than 1% of the time. Although both groups rarely made trips via bike, men were much more likely to use a bicycle, moped, skateboard, or scooter than women.

Table 2: Frequency of Transportation Mode by Gender

Gender	Type of Transit				
	Car, Van Truck	Biking	Walking	Public Bus	Total
Male	11563 (95.91%)	**61 (0.51%)**	355 (2.94%)	77 (0.64%)	12056 (45.06%)
Female	14139 (96.2%)	11 (0.07%)	423 (2.88%)	123 (0.84%)	14698 (54.94%)
Total	25702 (96.07%)	72 (0.27%)	778 (2.91%)	200 (0.75%)	26754 (100%)

Bolded numbers are the highest or lowest rates in the column, or are terms of interest.

Mode choice did vary somewhat among respondents of different working statuses (see Table 3). Again, the majority of trips made by people in all types of employment were made by private vehicle. However, those persons working full-time were much less likely to walk than those working part-time or not at all, and made trips on foot less than half as much as the unemployed and volunteers. Unemployed persons also used the public bus more than four times as often as those working full-time, but only slightly more than those working part-time. Interestingly, unpaid workers and volunteers used the bus only slightly more than full-time workers, but at one-third the rate of use of those not working.

Table 3: Frequency of Transportation Mode by Working Status

Working Status	Type of Transit				
	Car, Van, Truck	Biking	Walking	Public Bus	Total
Full-time	**12993 (97.47%)**	32 (0.24%)	252 (1.89%)	53 (0.4%)	13330 (49.86%)
Part-time	3657 (94.99%)	10 (0.26%)	**147 (3.82%)**	34 (0.88%)	3850 (14.40%)
Unpaid/ Volunteer	1246 (94.97%)	2 (0.15%)	**56 (4.27%)**	8 (0.61%)	1312 (4.91%)
Not Working	7787 (94.48%)	28 (0.34%)	**323 (3.92%)**	**104 (1.26%)**	8242 (30.83%)
Total	25683 (96.07%)	72 (0.27%)	778 (2.91%)	199 (0.74%)	26734 (100%)

Bolded numbers are the highest or lowest rates in the column, or are terms of interest.

Respondents of all education levels use private vehicle for the overwhelming majority of trips (Table 4). There are some interesting trends, though, when looking at the rates of use of the alternatives. Respondents that have a graduate or post-graduate degree had one of the lowest rates of private vehicle use, second only to those with less than high school. Graduate and post-graduate degree holders also had the highest walking and biking rates, which could signify a heightened awareness of the environmental and health benefits of these modes. This trend does not hold, however, for the rate of public bus use. Respondents with a high school diploma or less than a high school education had the

highest rates of bus use by far. All other levels of education used the public bus for less than one percent of trips.

Table 4: Frequency of Transportation Mode by Education Level

Bolded numbers are the highest or lowest rates in the column, or are terms of interest.

Level of Education	Type of Transit				
	Car, Van Truck	Bike	Walking	Public Bus	Total
Less Than High School	**668 (92.78%)**	0	**33 (4.58%)**	**19 (2.64%)**	720 (2.69%)
High School Graduate	5685 (96.24%)	11 (0.19%)	132 (2.23%)	79 (1.34%)	5907 (22.12%)
Some College	5243 (95.85%)	21 (0.38%)	158 (2.89%)	48 (0.88%)	5470 (20.48%)
Vocational/Technical Training	709 (97.52%)	2 (0.28%)	14 (1.92%)	2 (0.28%)	727 (2.72%)
Associates Degree	2377 (98.3%)	2 (0.08%)	34 (1.41%)	5 (0.2%)	2418 (9.05%)
Bachelors Degree	5967 (96.88%)	13 (0.21%)	147 (2.39%)	32 (0.52%)	6159 (23.06%)
Graduate/Post-Graduate Degree	**5008 (94.33%)**	**23 (0.43%)**	**260 (4.9%)**	16 (0.3%)	5309 (19.88%)
Total	25657 (96.06%)	72 (0.27%)	778 (2.91%)	201 (0.75%)	26710 (100%)

Mode choice for people of households with different incomes did vary substantially (see Table 5). The lowest income brackets had the highest rates of biking, walking, and using the public bus, and the lowest rate of driving. Overall, biking rates were low across incomes, but there were some anomalies. Only one bracket had more that one percent of trips made by bike, the $10-19,999 group. Walking rates also showed a split by income bracket. Overall, those making more than $30,000 a year had much lower walking rates than lower-income respondents, sometimes by as much as four times. But again, the drop in rates as income increased stopped at the $100,000 mark, after which walking rates increased, perhaps due to a lifestyle shift. However, the most marked differences occur in use of public bus. For this mode, use declines continuously with income, without any of the shifts at higher incomes seen for biking and walking. The two highest incomes only used public bus for 0.04% and 0.13%, respectively, for their trips. The lowest four income brackets used the public bus at least ten times as much as the highest, and use almost doubled for every decrease in income, from 1.29% for $30-39,999, to 2.34% for $20-29,999, and to 4.58% or more for those making under $19,999 per year.

Table 5: Frequency of Transportation Mode by Income

Income (in dollars)	Type of Transit				
	Car, Van, Truck	Bike	Walking	Public Bus	Total
Less than 10,000	**394 (76.8%)**	4 (0.78%)	**73 (14.23%)**	**46 (8.19%)**	513 (2.17%)
10,000-19,999	1073 (85.98%)	**18 (1.44%)**	**100 (8.01%)**	**57 (4.58%)**	1248 (5.29%)
20,000-29,999	1713 (93.09%)	5 (0.27%)	79 (4.29%)	43 (2.34%)	1840 (7.8%)
30,000-39,999	1842 (95.49%)	0 (0%)	62 (3.21%)	25 (1.29%)	1929 (8.17%)
40,000-49,999	2254 (96.7%)	13 (0.58%)	53 (2.27%)	11 (0.47%)	2331 (9.88%)
50,000-59,999	2497 (96.75%)	2 (0.08%)	74 (2.87%)	8 (0.31%)	2581 (10.94%)
60,000-74,999	3368 (97.54%)	7 (0.2%)	75 (2.17%)	3 (0.09%)	3453 (14.63%)
75,000-99,999	4456 (97.93%)	13 (0.29%)	77 (1.69%)	4 (0.09%)	4550 (19.28%)
100,000-124,999	2821 (97.85%)	4 (0.14%)	55 (1.91%)	1 (0.04%)	2883 (12.22%)
125,00 or more	2212 (97.44%)	4 (0.18%)	51 (2.25%)	3 (0.13%)	2270 (9.62%)
Total	22630 (95.9%)	143 (0.61%)	1252 (5.31%)	232 (0.98%)	23598 (100%)

Bolded numbers are the highest or lowest rates in the column, or are terms of interest.

The number of vehicles in the household had a great impact on mode choice (see Table 6). Not surprisingly, those living in households with no vehicles had the lowest rate of driving. However, even those in households without a car made more than half (54.62%) of their trips by car. Another important result is that the addition of just one car to a household increases the driving rate to 95.27%, almost doubling the driving rate of those with no car. Additionally, owning just one car brings use of public bus close to zero (0.73%), compared to almost one-fifth (19.65%) of trips made by those with no car in the household. Those living in households without a car also had the highest biking and walking rates (2.02% and 23.7%, respectively). It is also important to look at the raw results. More than twice as many households own two cars as own one car, and more households own three cars than own one. Almost twice as many households own five cars as do not own a car. While the number of people biking and walking for each category increases as the total number of people increases, this is not the case for the number of people using the bus, which continues to decline despite increasing totals.

Table 6: Frequency of Transportation Mode by Number of Vehicles in Household

Household Number of Vehicles	Type of Transit				
	Car, Van, Truck	Biking	Walking	Public Bus	Total
0	**378 (54.62%)**	**14 (2.02%)**	**164 (23.7%)**	**136 (19.65%)**	692 (2.59%)
1	**4937 (95.27%)**	18 (0.35%)	189 (3.65%)	**38 (0.73%)**	5182 (19.37%)
2	11704 (97.18%)	30 (0.25%)	287 (2.38%)	23 (0.19%)	12044 (45.03%)
3	5452 (97.65%)	10 (0.18%)	117 (2.1%)	4 (0.1%)	5583 (20.87%)
4	2217 (99.06%)	0	18 (0.8%)	3 (0.13%)	2238 (8.37%)
5	707 (99.72%)	0	2 (0.28%)	0	709 (2.65%)
6	191 (99.48%)	0	1 (0.52%)	0	192 (0.72%)
7	78 (100%)	0	0	0	78 (0.29%)
8	20 (100%)	0	0	0	20 (0.07%)
10	9 (100%)	0	0	0	9 (0.03%)
Total	25693 (96.06%)	72 (0.27%)	778 (2.91%)	204 (0.76%)	26747 (100%)

Bolded numbers are the highest or lowest rates in the column, or are terms of interest.

Individual Differences Regression Output Tables

The inferential results were generated by multinomial logistic regressions that included income, age range, and education as continuous variables (see Tables 13 and 14). Gender and working status are included as covariates, with female and unemployed as the reference categories. The reference category for the entire model is trips made by car, truck or van.

Only two variables had statistically significant influences on choice of bike over car. Income had a significant negative effect on the choice of bike over car. People that earned more money were significantly less likely than low-income people to choose bike over car ($t = 10.76$, $p < 0.001$). For gender, males were much more likely to choose to bike over drive than were females ($t = 9.2$, $p < 0.01$), reflecting the trend seen previously in the descriptive statistics. Also, it should be noted that in the descriptive statistics, education seemed to have an effect on biking rates, with those having a graduate or post-graduate level of education biking more based on the raw data, but that difference did not show significance in the regression.

Walking was influenced by more demographic characteristics than was biking. Income again had a negative effect, so that as income increased, the likelihood of choosing to walk over drive decreased significantly ($t = 46.73$, $p < 0.001$; $t = 50.59$, $p < 0.001$). The negative effect of income was also seen in the descriptive statistics, but the increase in walking rates for the highest income bracket was not significant in the regression. Age

also had a negative effect on choosing to walk. Older people were less likely to choose to walk over drive than were young people ($t = 7.89$, $p < 0.01$; $t = 4.33$, $p < 0.05$). Level of education actually had a positive effect on walking. More educated people were more likely to choose walking over driving ($t = 11.55$, $p < 0.001$; $t = 26.61$, $p < 0.001$). Working full-time had a negative effect on walking, which is also seen in the descriptive statistical results, so that those working full-time were much less likely than the unemployed to choose to walk over drive ($t = 27.91$, $p < 0.001$; $t = 14.44$, $p < 0.001$).

Public bus use was significantly influenced by income, age, and working status. Income had a very significant negative effect on choosing bus over private vehicle. Those earning higher incomes were much less likely than low-income earners to take the public bus rather than drive ($t = 88.66$, $p < 0.001$; $t = 87.48$, $p < 0.001$). This result can be seen in the sharp difference in raw data in the descriptive statistics, where the rate of bus use dropped precipitously above the lowest two income brackets. Age also had a negative effect; as age increased, people were less likely to choose the bus over driving ($t = 20.87$, $p < 0.001$; $t = 16.16$, $p < 0.001$). The negative effect of age is consistent with the results of the descriptive statistics, which showed the youngest age group included taking the bus at least twice as often as anyone else. Working full-time had a negative effect on driving, such that full-time workers were significantly less likely than the unemployed to take the public bus than to drive ($t = 4.99$, $p < 0.05$, $t = 4.19$, $p < 0.05$). This finding holds true in the raw data shown in the descriptive statistics as well.

Table 13: Transit Type for Trip 1

Variable		Biking		Walking		Public Bus	
		Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Income		-0.46	10.76**	-0.34	46.73**	-0.788	88.66**
Age range				-0.18	7.89*	-0.376	20.87**
Gender	Male	2.30	9.20*				
	Female (Ref)						
Education				0.17	11.55**		
Working status	Full-time			-1.30	27.91**	-0.747	4.99
	Part-time						
	Not working (Ref)						
-2 log Likelihood							1244.57
McFadden pseudo R-squared							0.14**

*p<0.01; **p<0.001
Ref = Reference Category

Table 14: Transit Type for Trip 2

Variable		Biking		Walking		Public Bus	
		Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Income		-0.40	7.42*	-0.31	50.59**	-0.80	87.48**
Age range				-0.12	4.33	-0.33	16.16**
Gender	Male	2.86	7.56*				
	Female (Ref)						
Education				0.23	26.61**		
Working status	Full-time			-0.78	14.44**	-0.70	4.19
	Part-time						
	Not working (Ref)						
-2 log Likelihood							1348.995
McFadden pseudo R-squared							0.123**

*p<0.01; **p<0.001
Ref = Reference Category

Place Differences

The results did not show much variation between origin types in the percentage of trips taken by personal vehicle, with most being around 95% (see Table 7). Only trips originating at service locations (auto repair, salons, etc) had a much higher rate of private vehicle use, at almost 98%. Trips starting at businesses and offices had the highest biking rates, yet that might be more reflective of the small number of trips from that type of origin. Trips originating at restaurants and other food services had the highest walking rates at 4.23%, with trips from school or class and from retail locations also showing high walking rates at 3.75% and 3.43% respectively. Use of public bus was fairly low for all origin types, except for trips from transport terminals, which, not surprisingly, had an extremely high rate of bus use at 11.69%.

Table 7: Frequency of Transportation Mode by Type of Origin

Origin Type	Type of Transit				
	Car, Van, Truck	Biking	Walking	Public Bus	Total
Residential	10111 (95.73%)	34 (0.32%)	323 (3.06%)	94 (0.89%)	10562 (49.32%)
Business/Office	271 (95.1%)	3 (1.05%)	8 (2.81%)	3 (1.05%)	285 (1.33%)
Retail/ Commercial	2064 (95.6%)	7 (0.32%)	74 (3.43%)	13 (0.6%)	2159 (10.08%)
Service	1069 (97.98%)	4 (0.36%)	18 (1.65%)	0	1091 (5.09%)
School/ Class	1623 (95.02%)	3 (0.18%)	**64 (3.75%)**	18 (1.05%)	1708 (7.98%)
Food Service/ Restaurant	1469 (95.64%)	0	**65 (4.23%)**	2 (0.13%)	1536 (7.17%)
Grocery	1138 (96.28%)	4 (0.34%)	35 (2.96%)	5 (0.42%)	1182 (5.52%)
Government/ Institution	2231 (96.67%)	3 (0.13%)	58 (2.51%)	16 (0.69%)	2308 (10.78%)
Transport Terminal	64 (83.12%)	0	3 (3.89%)	**9 (11.69%)**	77 (0.36%)
Entertainment	488 (96.06%)	3 (0.6%)	14 (2.76%)	3 (0.59%)	508 (2.37%)
Total	20528 (95.85%)	61 (0.28%)	662 (3.09%)	163 (0.76%)	21416 (100%)

Bolded numbers are the highest or lowest rates in the column, or are terms of interest.

Overall, the trends of mode choice for different types of destination are consistent with the mode use for origin locations (see Table 8). Once again, service locations had the highest rate of private vehicle use. Office and business destinations had the highest rate of biking and school or class, restaurants, and transport terminals all had high walking rates. Bus use rates were again highest for school or class destinations, transport terminals, and business or office destinations.

Table 8: Frequency of Transportation Mode by Type of Destination

Destination Type	Type of Transit				
	Car, Van Truck	Biking	Walking	Public Bus	Total
Residential	9539 (95.56%)	34 (0.34%)	320 (3.21%)	89 (0.89%)	9982 (47.23%)
Business/ Office	291 (95.4%)	**3 (0.98%)**	7 (2.3%)	4 (1.31%)	305 (1.44%)
Retail/ Commercial	2126 (95.68%)	7 (0.32%)	75 (3.38%)	13 (0.59%)	2222 (10.51%)
Service	1093 (98.29%)	4 (0.36%)	14 (1.26%)	1 (0.09%)	1112 (5.26%)
School/ Class	1667 (94.83%)	3 (0.17%)	**69 (3.92%)**	19 (1.08%)	1758 (8.32%)
Food Service/ Restaurant	1518 (95.89%)	0	**59 (3.73%)**	6 (0.38%)	1583 (7.5%)
Grocery	1158 (96.02%)	4 (0.33%)	38 (3.15%)	6 (0.5%)	1206 (5.71%)
Government/ Institution	2280 (96.82%)	2 (0.08%)	56 (2.38%)	17 (0.72%)	2355 (11.14%)
Transport Terminal	67 (83.75%)	0	3 (3.75%)	9 (11.25%)	80 (0.38%)
Entertainment	516 (96.81%)	4 (0.75%)	11 (2.06%)	2 (0.38%)	533 (2.52%)
Total	20255 (95.83%)	61 (0.29%)	652 (3.08%)	166 (0.79%)	21136 (100%)

Bolded numbers are the highest or lowest rates in the column, or are terms of interest.

The mode choice for different activities showed some interesting trends (see Table 9). Although these trends are similar to those for origin type, it is more reflective of the spontaneity of the trip, which may impact mode use. Private vehicle use was very high for all activities, although there are some important variations. The driving rate for work was particularly high at over 97%, while the rate for recreation was considerably low at 92.66%. Recreation also had the highest rates of biking and walking, at 0.77% and 6.31% respectively. Religious and community related activities also had high rates of biking and walking, and social activities had even higher walking rates. Perhaps not surprisingly, the highest public bus use was for attending college at 5.91%. The next highest rates, for paid work at home and for social activities, were far behind the college rate at 1.49% and 1.4% respectively.

Table 9: Frequency of Transportation Mode by Activity at Origin

Origin Activity	Type of Transit				
	Car, Van, Truck	Biking	Walking	Public Bus	Total
Home (Paid Work)	64 (95.52%)	0	2 (2.99%)	1 (1.49%)	67 (0.26%)
Home (Other)	8478 (95.94%)	30 (0.34%)	249 (2.82%)	80 (0.91%)	8837 (33.73%)
Work	4255 (97.06%)	6 (0.14%)	88 (2.01%)	35 (0.79%)	4384 (16.73%)
Attend College	184 (90.64%)	0	7 (3.45%)	**12 (5.91%)**	203 (0.77%)
Eat Out	1415 (95.41%)	1 (0.07%)	63 (4.25%)	4 (0.27%)	1483 (5.66%)
Personal Business	3065 (95.9%)	8 (0.25%)	92 (2.88%)	31 (0.97%)	3196 (12.2%)
Everyday Shopping	3307 (96.58%)	11 (0.32%)	92 (2.68%)	14 (0.41%)	3424 (13.07%)
Major Shopping	428 (97.94%)	0	7 (1.6%)	1 (0.23%)	437 (1.67%)
Religious/Community	362 (94.76%)	2 (0.52%)	18 (4.71%)	0	382 (1.46%)
Social	731 (93.24%)	2 (0.26%)	40 (5.1%)	11 (1.4%)	784 (2.99%)
Recreation	720 (92.66%)	**6 (0.77%)**	**49 (6.31%)**	2 (0.26%)	777 (2.97%)
Accompany Another	440 (96.7%)	1 (0.22%)	12 (2.64%)	1 (0.22%)	455 (1.74%)
Pick-up/ Drop-off	1748 (98.53%)	1 (0.06%)	23 (1.3%)	2 (0.11%)	1774 (6.77%)
Total	25197 (96.17%)	68 (0.26%)	742 (2.83%)	194 (0.74%)	26201 (100%)

Bolded numbers are the highest or lowest rates in the column, or are terms of interest.

The mode choices for destination activity were similar to those for origin activity (see Table 10). Perhaps not surprisingly, the highest rates of walking and biking were for trips to recreational activities, including outdoor physical activities. If the purpose of the trip is to go play a sport or do some other physical activity, it may actually be more convenient to walk or bike and it adds to the level of exercise gotten on that trip. While the rate of walking to recreational activity is extremely high (5.77%), more than a full percentage point above the next highest rate for social activities (4.58%), the rate of biking is still less than one percent (0.86%). Trips going to social activities also had a relatively low rate of driving (93.68%), and a high rate of both walking (4.58%) and taking the public bus (1.49%). Walking may be easier because people are going from one residence to another, and thus are staying in the same neighborhood, as most zoning segregates uses. Trips going home had a relatively high rate of public bus use (1.56%), which may be reflective of return legs of trips that started at home. Religious and community-related activities also had a high walking rate, again perhaps due to the fact that most of this activity takes place within residential zones, creating shorter, aesthetically-pleasing trips. Trips to attend college had the highest public bus use rates (5.82%), probably because many colleges provide free bus systems.

Table 10: Frequency of Transportation Mode by Activity at Destination

Destination Activity	Type of Transit				
	Car, Van, Truck	Biking	Walking	Public Bus	Total
Home (Paid Work	61 (95.31%)	0	2 (3.13%)	**1 (1.56%)**	64 (0.24%)
Home (Other)	7657 (95.64%)	31 (0.39%)	244 (3.05%)	**74 (0.92%)**	8006 (30.25%)
Work	4266 (97.06%)	6 (0.14%)	85 (1.93%)	38 (0.86%)	4395 (16.61%)
Attend College	186 (90.29%)	1 (0.49%)	7 (3.40%)	**12 (5.82%)**	206 (0.78%)
Eat Out	1457 (95.67%)	1 (0.07%)	60 (3.94%)	5 (0.33%)	1523 (5.76%)
Personal Business	3323 (96.21%)	7 (0.2%)	95 (2.75%)	29 (0.84%)	3454 (13.05%)
Everyday Shopping	3390 (96.53%)	11 (0.31%)	95 (2.71%)	16 (0.46%)	3512 (13.27%)
Major Shopping	439 (97.99%)	0	7 (1.56%)	1 (0.22%)	448 (1.69%)
Religious/ Community	424 (95.5%)	1 (0.23%)	19 (4.28%)	0	444 (1.68%)
Social	**756 (93.68%)**	**2 (0.25%)**	**37 (4.58%)**	12 (1.49%)	807 (3.05%)
Recreation	**760 (93.25%)**	**7 (0.86%)**	**47 (5.77%)**	1 (0.12%)	815 (3.08%)
Accompany another	775 (97.85%)	1 (0.13%)	13 (1.64%)	2 (0.25%)	792 (2.99%)
Pick-up/Drop-off	1958 (97.95%)	2 (0.1%)	38 (1.9%)	1 (0.05%)	1999 (7.55%)
Total	25452 (96.18%)	70 (0.26%)	749 (2.83%)	192 (0.73%)	26463 (100%)

Bolded numbers are the highest or lowest rates in the column, or are terms of interest.

Mode choice by county highlighted some important differences in travel behavior between counties (see Table 11). Washtenaw County had the lowest driving rate (89.55%) and the highest rates of use in every other mode. The walking rate (7.25%) is almost twice that of the second highest (Wayne with 3.7%), and three times that of Livingston (1.22%), Macomb (1.36%), Monroe (1.13%) and St. Clair (2.16%). Monroe had the highest driving rate (98.67%) and the lowest walking and public bus use (0.1%) rate. Wayne County, which includes the city of Detroit, had a relatively low driving rate (94.78%), but still fell far below Washtenaw in all alternative modes.

Table 11: Frequency of Transportation Mode by County

	Type of Transit				
County	Car, Van, Truck	Biking	Walking	Public Bus	Total
Livingston	2420 (98.53%)	0	30 (1.22%)	6 (0.24%)	2456 (9.18%)
Macomb	4184 (98.15%)	11 (0.26%)	58 (1.36%)	10 (0.23%)	4263 (15.93%)
Monroe	**2008 (98.67%)**	**2 (0.1%)**	23 (1.13%)	2 (0.1%)	2035 (7.61%)
Oakland	4739 (96.87%)	16 (0.33%)	124 (2.53%)	13 (0.27%)	4892 (18.28%)
St. Clair	2796 (97.35%)	2 (0.07%)	62 (2.16%)	12 (0.42%)	2872 (10.73%)
Washtenaw	**2580 (89.55%)**	**29 (1.0%)**	**209 (7.25%)**	**61 (2.12%)**	2881 (10.77%)
Wayne	**6976 (94.78%)**	12 (0.16%)	272 (3.7%)	100 (1.36%)	7360 (27.51%)
Total	25703 (96.06%)	72 (0.27%)	778 (2.91%)	204 (0.76%)	26757 (100%)

Bolded numbers are the highest or lowest rates in the column, or are terms of interest.

The results for place type are somewhat more indicative of the differences between communities than county was (see Table 12). The lowest driving rate was in the large city category, which included the city of Ann Arbor. The culture of the university town, which is both environmentally and health conscious, may be an influential factor in the lower driving rate. However, Ann Arbor also has more progressive planning policies that make it easier to choose walking and biking over driving. Those in the large city category had much higher biking and walking rates (1.13% and 8.61% respectively) than the other categories, almost double the next highest rate of walking and triple the next highest rate of biking. Surprisingly, the major city category, which included only Detroit, had a higher rate of driving than the large city category, and only had the highest rate for public bus use (3.18%). The raw numbers also provide some interesting information. The type of place that has the highest population is the old suburb, followed closely by the small town. There are twice as many people living in small towns as live in Detroit, and almost four times as many living in older suburbs. Another interesting result is that old and new suburbs have similar biking and bus use rates, but people in old suburbs walk two and half times more than those in new suburbs. This may reflect the change in planning and the recent emphasis on curvy streets and no sidewalks.

Table 12: Frequency of Transit Mode by Destination Place

Type of Place	Type of Transit				
	Car, Van Truck	Biking	Walking	Public Bus	Total
Major City	2290 (91.05%)	4 (0.16%)	141 (5.61%)	80 (3.18%)	2515 (9.99%)
Large City	**1855 (87.29%)**	**24 (1.13%)**	**183 (8.61%)**	63 (2.96%)	2125 (8.44%)
Mid Sized City	2243 (96.56%)	8 (0.34%)	54 (2.32%)	18 (0.77%)	2323 (9.23%)
Old Suburb	7988 (96.74%)	24 (0.29%)	218 (2.64%)	27 (0.33%)	8257 (32.81%)
New Suburb	4091 (98.6%)	7 (0.17%)	43 (1.03%)	8 (0.19%)	4149 (16.49%)
Small Town	4522 (97.48%)	5 (0.11%)	107 (2.31%)	5 (0.11%)	4639 (18.44%)
Rural	1147 (99.22%)	0	9 (0.78%)	0	1156 (4.59%)
Total	24136 (95.91%)	72 (0.29%)	755 (3.0%)	201 (0.79%)	25164

Bolded numbers are the highest or lowest rates in the column, or are terms of interest.

Place Differences Regression Output

Most of the place differences examined in the descriptive statistics were not included in the inferential statistics because of the limitations of the multinomial logistic regression. The destination and origin activity and type variables had too many response categories for the regression to run properly. Unlike some of the individual variables that had many categories, such as age range and income, the place variables could not be entered as continuous variables. The Place Type variable, however, was used in combination with the individual variables to gain a sense of the role of density and community type in transportation mode choice.

The results of the two regressions run for the individual characteristics were very similar, varying very minimally in the coefficient and t-statistic, so that it was unnecessary to run both with the type place variable. The regression for Trip 1 was run a second time, with the addition of the place type variable. The seven categories seen in the descriptive statistics were consolidated into three larger categories based on the percentages/rates of use generated by the descriptive table. Major city and large city were combined into “Large City”, mid-sized city and old suburb were combined into “Suburb/Mid-sized City”, and new suburb, small town, and rural were combined into “Rural”. Place type was added as a covariate, and the rest of the regression was run as before.

The addition of place type increased the percentage of difference explained by about five percentage points. None of the general trends seen in Tables 13 and 14 changed, though the coefficients and test statistics did change slightly. The reference category for place type was the third category: new suburb, small town, and rural. The Large City category showed significant differences for all three alternative transit modes. People living in a major or large city are much more likely than those living in new suburbs, small towns, or rural areas to choose to bike over drive ($t = 8.63$, $p < 0.01$). They were also more likely choose to walk or to take the public bus over drive than those living in new suburbs, small towns, or rural areas ($t = 27.94$, $p < 0.001$; $t = 23.69$, $p < 0.001$). People living in

mid-sized cities or old suburbs were more likely than those living in new suburbs, small towns and rural areas to walk instead of drive ($t = 5.27$, $p < 0.05$), but there was not a significant difference in choosing to bike or take the bus.

Table 15: Transit Type for Trip 1 with Type of Place

Variable		Biking		Walking		Public Bus	
		Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Income		-0.38	7.42*	-0.30	34.54**	-0.67	58.55**
Age range				-0.12	4.33	-0.26	9.06*
Gender	Male	2.39	9.90*				
	Female (Reference)						
Education				0.15	8.22*		
Working status	Full-time			-1.26	25.94**	-0.75	4.74
	Part-time						
	Not working (Reference)						
Place Type	Large City	3.11	8.63*	1.35	27.94**	2.38	23.69**
	Suburb/Mid-sized City			0.59	5.27		
	Rural (Reference)						
-2 log Likelihood							1389.84
McFadden pseudo R-squared							0.186**

*p<0.01; **p<0.001

Conclusion

Overall, the results did support the hypotheses concerning individual results and some of the hypotheses made about place differences. Income had a negative effect on choice of a mode other than private vehicle, and lower-income respondents had a much lower driving rate than those in higher income brackets. Education also had a negative effect on alternative mode choice. Those with less education drove at lower rates than those with higher levels of education, though in the descriptive data, there was a slight increase in the percentage in higher education brackets that chose walking or biking. The results for working status were also consistent with the hypothesis that those not working would use more public transportation and drive less than those that are working. People working full-time were significantly less likely to choose to walk or take the bus rather than drive than those not working. However, those working part-time drove, biked and walked at about the same rate as those not working, and although the descriptive data showed that

slightly more unemployed people chose the bus than part-time workers, the difference was not significant.

Respondents living in major and large cities drove less than those living in suburbs, small towns, and rural areas. Those living in new suburbs and rural areas had the highest rates of driving, and older suburbs had a driving rate most similar to the mid-sized cities, as well as similar rates of walking and biking. Respondents living in a large city actually drove less than those living in Detroit, and they biked at ten times the rate and walked at one and half times the rate of those living in Detroit. Yet respondents from Detroit still used the bus slightly more than those in large cities. Activities that are more regular in schedule, such as work did not have a significantly higher rate of public transit rate. In fact, trips made to and from work actually had a higher driving rate than trips made for more "spontaneous" activities like going out to eat and social activities.

In general, the extremely low use of alternative modes of transportation shows that the policies currently in place have not succeeded in decreasing driving rates and that change is needed if the region is to reduce its energy use. It is clear that low-income areas need more and better public transit service and that a more regional public transportation system would be beneficial. To make public transit more viable, the region will need to shift its model of development to focus on more dense, walkable planning strategies.

Discussion

The results of the descriptive statistics show clearly that the people in Southeast Michigan travel by personal vehicle for the overwhelming majority of trips. The type of alternative travel mode utilized the most was walking, which creates interesting implications of the efficacy of public transportation in the area. Biking was used the least, not altogether surprisingly. The pattern of the descriptive results mirror what has been recorded across the country, to a certain extent. Americans as a whole make over ninety percent of trips by personal vehicle. The rate of driving for all variables as a whole was about 96%, according to the descriptive statistics, which is comparable to the national average of only four percent of people using alternative transportation to commute (CNT & STPP 2005).

The results also point to ways in which the Detroit metro area differs from other major metropolitan areas in the country. First, it is clear from the lower rate of driving in Washtenaw County than in Detroit that Detroit is lagging behind other cities in public transportation. If the study had been done in almost any other major city, there would have been a fifth transportation option: train or rail. There are current efforts to create a rail line between Ann Arbor and Detroit, and perhaps expand it to other area cities as well. However, intercity rail does not address the problem of travel within and around Detroit itself, which is now limited to car and public bus. The high rate of public bus use in Detroit suggests that there is demand for public transportation where available.

At the same time, a regional transportation system is also needed. The largest group of survey respondents live in old suburbs, most of which surround Detroit and are largely contiguous with it, creating a more regional physical and economic structure. Accordingly, a more regional transportation system would better address the needs of

both the suburban and the urban populations. Regional transit would improve access to jobs in other areas and decrease the need to use a private car to commute. It would be beneficial to do further research on how many people in the seven counties of Southeast Michigan work somewhere other than where they live.

Many of the patterns in the descriptive statistics point directly to policy options to increase alternative transit use. One major trend is the low use of bicycles by people of all demographics. Men are more likely to bike than women are, but still bike for less than one percent of trips. One deterrent to biking might be safety concerns. Increasing the number of streets with bike lanes, especially on major thoroughfares, could help ease safety concerns and encourage more people to bike.

Working status had a large affect on the rates of walking and taking the bus. People who work full-time drove the most frequently, while the unemployed took the bus most often. One policy option to combat this inequality is to target full-time workers by improving bus service between residential areas and business districts and between suburbs and Detroit. Another option could be to increase parking permit costs for employees. Instituting minimum parking fees could encourage full-time workers to find alternative ways to commute, including by carpool.

Another possible explanation of the propensity for driving to work is the concentration of jobs in areas not serviced by public transportation. It is well known that the Detroit metro area has experienced a wide decentralization of industry and business. Most companies have fled the inner city for cheaper land plots farther out in the suburbs, where there is no public transportation and ample parking. A possible policy response would be a tax or other economic incentive for business opening in downtowns, particularly in old or historic building that probably do not have large parking lots.

The results also showed that lower-income people drive significantly less than people in higher-income brackets. Yet the fact that people living in households without a car still made over half of their trips by private vehicle implies that alternative transportation is not always available or feasible. Part of the problem is the small amount of federal and state funding that goes toward public transportation. Devoting the majority of government transportation funds toward highway repair and expansion while neglecting public transit systems gives a blatant advantage to those that can afford a car. Unequal allocation of funds has long been a form of discrimination in transportation issues, as was discussed in the introduction. Increasing the funding for public transportation, especially in poor areas that already have a high demand, is a valuable use of government money and will make it easier for those without a car to participate in the local economy.

By far, walking is the cheapest mode of transportation, and having more services within walking distance would greatly benefit people of all income levels. The highest walking rates were seen in the large city category, which included Ann Arbor, part of Washtenaw County. The county differences show that Washtenaw as a whole had a much lower rate of driving than Detroit (Wayne County), despite having a lower rate of public bus use, due to high rates of walking and biking. Ann Arbor is much denser than Detroit, which has been emptied by economic woes and is plagued by brownfields and abandoned properties, making Ann Arbor more comfortable to walk in and making trips shorter. Ann Arbor also has a more vibrant economy, so there are more places to walk to, and has a more healthy and environmentally conscious population, so more people walk voluntarily

instead of out of financial necessity. To combat these land use problems and encourage walking in Detroit and lower-income areas, zoning should require higher density and mixed-use buildings, and small business tax cuts should encourage redeveloping abandoned plots or vacant storefronts.

Walking rates in new suburbs and old suburbs also highlighted the influence of land use and planning on transportation mode choice. Old suburbs actually had a higher walking rate than mid-sized cities, and people living in old suburbs and mid-sized cities were significantly more likely than those in new suburbs to choose walking over driving. This may be indicative of the adherence to older planning strategies in old suburban designs, such as a grid street layout, sidewalks, and a mix of land uses, which make them easier to navigate and shorten distances to non-residential destinations. Obviously, if Southeast Michigan is to decrease its dependence on personal vehicles and increase access to alternative transportation, it will need to shift its development pattern from outlying, low-density suburbs to more urban areas.

Although there were some interesting and unexpected variations in the data output, people in all demographic and geographic categories make the overwhelming majority of their trips by personal vehicle. While this is consistent with the country at large, other major cities are doing drastically better. Over half of New York City's population commutes on public transportation, and thirty-seven percent of Washington, D.C. residents use public transit to get to work. These cities also have much higher biking and walking rates, with nine percent of D.C. commuters walking and twelve percent in Boston (Karlenzig, 2008). So while the driving rate for southeast Michigan may be consistent with the rest of the country, the city of Detroit performs more like a suburb or small town than a city.

Study Limitations

The data came with several limitations that made it difficult to get a complete understanding of who is taking alternative transportation. One particularly detrimental omission is the race or ethnicity of the respondents. Southeast Michigan is well known for the racial segregation of the Detroit metro area, and, based on the results of county and place type, there is likely a large correlation between race and public bus use. However, such a possibility will have to be further investigated in future studies.

Another concern is the time period in which the survey was taken. Respondents completed the survey between October and May, covering the coldest months in Michigan. May and October alone may be the only months in this period that are nice enough for a large number of people to choose to bike or walk. Biking and walking rates in these data may not accurately represent the yearly rates because they do not account for the months of the year when people are most likely to bike or walk.

Additionally, the working status survey question left out a possibly key category, the stay-at-home spouse. When looking at the data for working status, it is easy to think of it as a proxy for class or economic status, as those not working or only working part-time will earn less than those working full-time. However, if some of the respondents classified as "not working" are actually part of a wealthy household and choose not to work, then the data may not be completely representative.

Future Research

This study only begins to investigate the drivers behind transportation mode choice and leaves open several avenues for further research. One factor that was not included was the distribution of transportation services and the relationship between the quality and frequency of service and mode choice. Another possible point of study would be the relationship between parking requirements and mode choice, as well as their impact on land use. Also, it would be beneficial to look at the proportion of people that traveled to cities or counties other than their home city or county. This information would provide an idea of the importance of a regional transit system and which areas are most in need of connection by public transit.

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