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An Analysis of Travel Trends of the Elderly and Zero-Vehicle Households in the United States

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An Analysis of Travel Trends of the Elderly and
Zero-Vehicle Households in the United States

by

Ravi Kiran Gorti

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Science in Civil Engineering
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College of Engineering
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**AN ANALYSIS OF TRAVEL TRENDS OF THE ELDERLY AND
ZERO-VEHICLE HOUSEHOLDS IN THE UNITED STATES**

Ravi Kiran Gorti

ABSTRACT

The elderly and persons residing in zero vehicle households require better transportation services by virtue of their need for special care and lack of mobility, respectively. An analysis of the travel trends of these population cohorts is essential to determine the best ways to improve transportation facilities to better serve them. Information about location of residence, life-cycle, differences by gender, employment status, driver status, highest level of education coupled with trip information like trip rate, travel times and distances trip purpose, modal split and percent of people immobile will facilitate understanding the factors that influence trip making among these people and help predict travel trends for the future. This work attempts to analyze the elderly and persons residing in zero vehicle households in the United States by using NHTS 2001 and NPTS 1990 datasets for the purpose of analysis and comparison.

CHAPTER 1

INTRODUCTION

1.1 Background

Data collected over the years demonstrates widespread prevalence of drivers and personal vehicles in the United States. During the last few years, major changes have occurred in lifestyles and households that have affected and are affected by transportation services. The population of the United States is booming and so is the need for better transportation services. Two cohorts of population stand out by virtue of their needs for better transportation services viz. elderly population 65 years and older and people residing in zero vehicle households.

1.2 Motivation

A good transportation network forms the backbone of every country. It is the vital link between people and their community and social values, as well as to goods and services. It should therefore be accessible, affordable and reliable and should increase the mobility of the nation. The transportation system of the United States of America should change in tune with the rapidly changing population in order to provide maximum efficiency. The elderly population in the country being the fastest growing segment of the population would be most affected by the changing transportation system. The number of elderly drivers on the road is expected to at least double in the next thirty years. This increase is

attributable to an overall increase in the elderly population as well as a huge increase in the number of older women drivers.

Such an increase would require extensive changes in transportation policy that is bound to be challenging. Policymakers would require an extensive analysis of data on travel behavior of elderly people, how it would change in the years to come. This requires a good understanding of the needs of the unique travel behavior and challenges facing the mobility of the older population.

The government has funded many projects that aim to improve the travel options of people residing in households without vehicles. This is a very rapidly decreasing segment of US population. An investigative analysis into the travel characteristics and demographic composition of residents of zero vehicle households would yield valuable information about the reasons why people tend to own personal vehicles. The mobility options of these people are very limited due to the lack of personal vehicles to perform daily travel like commuting to work. Hence they tend to live closer to their work place or in the vicinity of transit access. Hence this segment of population would be vital in performing planning and policy changes to transit networks. Policy planners will have to take into account, the accessibility options available to this target population that would enable them to use transit easily. Transportation equity planners will have to concentrate on this segment of population due to their limited travel options, which would require a good perception of their travel needs and problems.

1.3 Objectives

The primary objective of this dissertation is to investigate the travel behavior of special population segments; population 65 years and older and population living in zero vehicle households, and quantify and characterize any trends or patterns and analyze the possible reasons for the same. The other distinguishable objectives are as follows:

- Highlight policy implications of the needs of the elderly and suggest ways of implementing them.
- To perform a descriptive analysis of the general population using NHTS 2001 and compare travel characteristics of other population with those of these special population segments.
- To study the NHTS 2001 and NPTS 1990 datasets and develop a comprehensive dataset of travel characteristics at the disaggregate person level that can be used for such similar analyses of special population segments.

1.4 Outline of Thesis

The thesis is organized into six chapters. The first chapter gives a brief outline of the objectives and analysis done in the thesis. The second chapter provides a literature review of the research done on topics related to this work. The third chapter gives a brief description of NHTS 2001 and NPTS 1990, which were used in the analysis and their background. It also outlines ways in which the datasets were modified to suit the requirements of this work, and also be ready for use in a similar analysis. The fourth and fifth chapters are comprehensive studies of the possible demographic, social and other characteristics that affect the travel of population 65 years and older and population

residing in zero vehicle households, respectively. There is also a brief discussion about the possible policy implications of the requirements of these special population segments. Finally, conclusions and research findings are discussed in the sixth chapter.

CHAPTER 2

LITERATURE REVIEW

This chapter will review issues and research associated with the elderly and population residing in zero vehicle households. A rather extensive literature search was conducted for this study on recent publications regarding their travel behavior. In comparison to the extensive body of literature obtained about the travel characteristics of the elderly, little work has been done on the travel characteristics of persons living in zero vehicle households. The fact that the zero vehicle household population is a rapidly declining segment of US population may have contributed to the lack of research on this topic.

2.1 Elderly Drivers

There has been a lot of focus on the mobility issues of the elderly population in the United States, after the public release of the NHTS 2001. It would be prudent to look into the definition of mobility provided by authors in the context of elderly travel before going into the specific travel characteristics of the elderly. Metz (2000) articulates that population ageing will give rise to a substantial increase in the numbers of older people in society. Quality of life in old age is related to mobility, although the relationship is not clear, in part because the definition of mobility is not well defined. Hence, he argues that development of an operational concept of mobility would allow the measurement of group of benefits associated with individual movement which extend beyond those

normally taken into account in transport modeling. He speculates that this approach would be particularly useful when used to investigate the loss of mobility in the travel of the elderly.

There is also a lot of interest on issues like cessation of driving among older adults and the factors that could lead to cessation of driving among only a few cohorts of older drivers while the others continue to drive as usual. Many older drivers have been found to adapt their driving practices, like driving lesser and avoiding difficult traffic situations. There is evidence that these developments are linked to each other as a progressive, spontaneous development (Dellinger et al, 2001; Blomqvist et al, 1998). It has been found that lesser driving among older adults is associated with factors such as higher age, disability, worsened overall health and functional status, weakened vision, cognitive impairments, cataracts and high blood pressure (Kostyniuk et al, 2000; Lyman et al, 2001; Marottoli et al, 1993; Stutts, 1998). It has been found that these behaviors causing reduced driving are related to problems anticipated by these drivers. Reduced driving has also been associated with absence of work-related driving, since a drop in annual miles driven has been noted when most drivers retire (Lyman et al, 2001; Rosenbloom, 1988). Raitanen et al, 2003 compared and analyzed cross sectional data from three European countries (Finland, Germany and Italy) for reasons for cessation of driving with age. The similarities were being able to reach everything without a car, health reasons, high traffic volume and retirement. Older age, changes in leisure activities and chronic conditions were significantly associated with at least one of the locations.

Research indicates that only one section of older drivers tend to undergo cessation in driving, while the others continue to drive as usual. A TCRP report on the travel implications and changes in the older population states that there is a large amount of travel, a continued emphasis on the automobile mode, leading to an additional emphasis on the safety of the elderly using automobiles. There is also a new emphasis on the need for additional mobility options. There are high levels of expectations on the levels of service on the transportation system in the future that would serve the elderly of tomorrow. This would immensely raise the need for cost effective public transit solutions for public transit for low density areas a need for comprehensive solutions that addresses the travel needs of high income and high mobility seniors while at the same time, addressing the travel needs of low income, low mobility seniors.

Rosenbloom (2003) states that comprehensive and long-term solutions to the mobility needs of older people must take into account great variability not only for different people, but also for the same person in different situations. Policymakers must focus considerable attention to meet the growing mobility needs of older travelers and this would help solve many of the transportation problems facing today's society.

There has also been a lot of focus and research on the travel trends in the elderly population all over the world. Comparison of travel among elderly adults between various countries has been done and documented. There is a great volume of literature on the safety analysis of older drivers. These documents typically analyze the safety characteristics of older drivers and then suggest methodology or policy changes to

improve the current situation (Dellinger et al, 2004; Schinar, 2004; Lam et al, 2004; Langford, 2003)

2.2 Zero Vehicle Households

The Bureau of Transportation Statistics states that households with annual incomes of less than \$ 25,000 are nine times as likely to be a zero vehicle household as those with incomes greater than \$ 25,000. Households living in rented residences are six times as likely to be a zero vehicle household compared to non-renters. Similarly, households living in a condominium or apartment are almost five times more likely to be a household with zero vehicles than those living in a single family or other non-apartment dwellings.

An insight into automobile ownership would give a lucid picture about people's choices behind becoming (or choosing to be) a zero-vehicle household. There is a lot of literature about automobile ownership models. Many researchers have attempted to develop models to explain household automobile ownership decisions. Most studies include household income, residential density and access to transit as the dominant influences on household automobile ownership. Household income has been identified as the most important influencing factor. It has also been attempted to explain automobile ownership based on socio-economic and life cycle status (Lerman et al, 2003; Gardenhire, 2003). Income, residential location, and access to transit, race, age, marital status and life cycle are some variables that have been found to have a strong influence on household vehicle ownership.

There has been significant research on automobile ownership decisions and the logic and reasoning behind them. However, automobile ownership models in the past have not examined whether the automobile ownership decision for the poor household differs from that of the non-poor household in ways that extend beyond purchasing power. Gardenhire et al (2003) attempted an exploration of such relationships. They attempt to evaluate the automobile ownership choice behavior of American households using the 1995 National Personal Transportation Survey (NPTS).

Lave et al (1994) have analyzed the travel characteristics of zero vehicle households using NPTS 1990. The typical zero vehicle household has no one in the labor force, has lower than average household income and lives in the central part of a large urban area. Most of these are retired people or single adults without children. Women head most zero vehicle households. Though most zero vehicle households have incomes less than that of the general population, not many of them are below the poverty line. Hence they conclude that poverty alone is not the sole reason why these households do not possess vehicles. Also, almost 75% of adults living in households below poverty line have at least one vehicle. They had also performed extensive analyses on the geographic concentrations of zero vehicle households, how they travel, what kinds of trips they make and the like. An interesting finding in their research was that a significant percentage of zero vehicle households are elderly people over 65 years of age. They also state that the concentration of zero vehicle households in a particular area is independent of the effectiveness and reach of transit in that particular neighborhood.

CHAPTER 3

DATA DESCRIPTION

3.1 Evolution of the NHTS 2001

The Nationwide Personal Transportation Survey has always been the most comprehensive source of data on daily travel in the United States. The 2001 National Household Travel Survey updates information provided by two major survey series: The Nationwide Personal Transportation Survey conducted in the years 1969, 1977, 1983, 1990 and 1995 and the American Travel Survey conducted in the years 1977 and 1995. The Nationwide Personal Transportation Survey (NPTS) focused on daily travel in the United States while the American Travel Survey (ATS) focused on Long Distance Travel. The NHTS demonstrates widespread prevalence of drivers and personal vehicles in the USA.

The NPTS, sponsored by the Federal Highway Administration, primarily focused on daily travel, with an abbreviated long-distance component. The 1995 ATS, sponsored by the Bureau of Transportation Statistics, provided a detailed look at long-distance travel defined as trips of 100 miles or more from home. In 2001, these two prior data collection series were joined and the 2001 NHTS was created to provide the full continuum of

American travel, daily and long-distance. This resulted in a sample of approximately a quarter of a million daily trips and approximately 45,000 long-distance trips.

The 2001 NHTS was conducted on a representative sample of nationally representative households in the United States and was conducted from March 2001 to May 2002. Data were collected through telephone interviews with approximately 60,000 individuals (approximately 9,000 of the respondents were at least 65 years old) from about 26,000 households. Attempts were made to include the travel of all household members either directly from the respondent or through a proxy.

The NHTS 2001 provides detailed travel and demographic information for people living in all corners of the country allowing for comparison of peoples travel on fronts such as: geographic location, gender, education, life style, household composition, household income and other demographic characteristics. The NHTS 2001 data includes the following information:

- Household data on the relationship of household members, education level, income, housing characteristics, and other demographic information;
- Information on each household vehicle, including year, make, model, and estimates of annual miles traveled;
- Data about drivers, including information on travel as part of work;
- Data about one-way trips taken during a designated 24-hour period (the household's travel day) including the time the trip began and ended, length of the

trip, composition of the travel party, mode of transportation, purpose of the trip, and the specific vehicle used (if a household vehicle);

- Data describing round-trips taken during a four-week period (the household's travel period) where the farthest point of the trip was at least 50 miles from home, including the farthest destination, access and egress stops and overnight stays on the way to and from the farthest destination, mode, purpose, and travel party information;
- If no long-distance trips were made during the four-week travel period, data on the most recent long-distance trip by any mode and the most recent long-distance train trip;
- Information to describe characteristics of the geographic area in which the sample household and workplace of sample persons are located;
- Data on telecommuting;
- Public perceptions of the transportation system;
- Data on Internet usage; and
- The typical number of transit, walk and bike trips made over a period longer than the 24-hour travel day.

3.2 The Nationwide Personal Transportation Survey, 1990

The NPTS is a survey of personal travel conducted every 7 years. The NPTS 1990 obtains data on travel patterns of approximately 22,000 households by collecting information on all trips taken by the respondent on the travel day, combined with longer trips taken over a 14 day period. NPTS 1990 was a telephone survey based on a Random

Digit Dialing (RDD) telephone sample. This was the first NPTS that allowed a household member to report travel for another member that was not available for contact. The data were also edited by using Computer Aided Telephone Interview (CATI) techniques. Research Triangle Institute conducted the 1990 NPTS under the sponsorship of five agencies of the U.S. Department of Transportation (DOT). The sponsors were the Federal Highway Administration (FHWA), Urban Mass Transportation Administration (UMTA), National Highway Traffic Safety Administration (NHTSA), Office of the Secretary of Transportation (OST), and Federal Railroad Administration (FRA). FHWA had the lead role in coordinating the survey. Information from a national household sample was collected about all trips taken during a designated 24-hour period (travel day). Additional details were collected for trips of 75 miles or further (one-way) that were taken during the preceding 14-day period (travel period) including the 24-hour travel day. The information collected for each trip includes the purpose, mode, trip length, day-of-week, time-of day, vehicle used, and vehicle occupancy. The data presented in six files includes:

- Household data on relationship of household members, educational levels through graduate or professional school, income categories, and other demographic information.
- Information on availability of public transportation.
- Motor vehicle information including year, make, model and other vehicle-related information.
- Data about drivers, including information on travel as an essential part of their jobs.

- Data describing trips taken during a 14-day period (travel period) where the farthest point of the trip was at least 75 miles from home including the dates the trip started and ended, the day of the week, mode of travel, distance, number in travel party, and the purpose of the trip.
- Data about trips that were taken during, a designated 24- hour period (travel day) in including the time when the trip began, length of the trip, composition of the travel party, mode of transportation, purpose of the trip, and vehicle used (if travel was in a household vehicle).
- Data on traffic accidents and accident reporting for motor vehicle accidents that occurred, when the respondent was driving, within the last five years.

3.3 Data Preparation

The NHTS 2001 and NPTS 1990 datasets which have been used to prepare this report have been obtained from the internet from the website of the Oak Ridge National Laboratory. The data used was from four different files: the household file, person file, trip file and vehicle file. The person file and trip file were used more extensively than the others for analysis. Each record in the person file uniquely represents one person. Each record in the trip file uniquely represents a trip made by one person. Each record in the household file represents one household in the demographic sample, while each record in the vehicle file represents one vehicle.

The person file contains demographic information about every person in the final representative sample used for the surveys. Every person in the person file can uniquely

be identified by combining the person ID assigned to each person in the household and the household ID, assigned uniquely to each household in the dataset. The trip rate (total number of trips on travel day) has been calculated for each person on the travel day. Trip rates were also calculated by each trip purpose. The variable whytrip90 in the trip file of NHTS 2001 which gives the trip purpose according to the trip purposes used in NPTS 1990 was used for calculating trip rates by trip purpose in NHTS 2001. This was done to facilitate easy comparison of trips by purpose between NHTS 2001 and NPTS 1990. Care was taken to include persons who did not make any trips on the travel day in the trip rate calculations. Finally, the trip rates were imported to the person file so that each person record will indicate the number of trips that person made on the travel day for each trip purpose. Demographic variables indicating education, lifestyle, age, household income were recoded into variables with lesser categories for easy comparison across datasets. Travel variables like mode split, time of day for start and end times for trips were recoded for convenience. Separate person and trip files were created for each cohort of population being analyzed i.e. 65 and older persons and people residing in zero vehicle households. Persons 65 years and over were further classified into young old (65-74 years old); middle old (75 to 84 years old) and old old (over 85 years old). This was done to facilitate comparisons by age.

CHAPTER 4

TRAVEL CHARACTERISTICS OF THE ELDERLY

4.1 Introduction

Transportation Mobility is a critical link between older people and their community and social values as well as to goods and services. The quality of life of the elderly is largely determined by transportation and their ability to drive. The patterns of mobility, as the ability to get out and about is seen as a key element of quality of life, the locality within which the elders participate and social networks like relatives and friends are said to be the three most important characteristics of mobility that influence quality of life (David Banister et al, 2003). With the increasing number of adults over 65 years of age, older people's transportation is becoming more of a concern due to its possible impacts and policy issues it could raise. By 2051, the projected population of people aged 65 years and over is expected to be at least double its size in 1999. In addition to the overall increase in the absolute number and percentage of those over 65, there will be a large increase in the number of very old travelers, especially drivers over 80 years of age. It is estimated that by the year 2020, 80% of US residents will be or will have been licensed drivers; and 100% of males and 60-90% of women will enter retirement as drivers (Rosenbloom, 2001; Evans, 1999; Burkhardt et al., 1998).

It is imperative to identify the social, demographic and cultural changes being experienced by older Americans and to evaluate how these trends affect transportation patterns. This report identifies socio-demographic changes in the older population between 1990 and 2001 and ties these patterns to trends that emerge on comparing the NPTS 1990 and NHTS 2001. It also attempts to identify how the older population differs from the rest of population in the same year, both in 1990 and 2001. This report uses descriptive statistics and simple cross tabulations to identify such changes and trends, as meaningful use of sophisticated techniques is limited on disaggregated data where the numbers in each group become small. Moreover, while a descriptive approach has its limitations, it produces analyses that are simple and easy to comprehend.

4.2 Demographic Characteristics and Trends in Older Population

In the year 2000, about 12.4 percent (35 million) of the total US population was above the age of 65. By 2030, the numbers of older Americans will more than double, with 9 million being over the age of 85 (U.S. Bureau of the Census, “Projections of the Population by Age, Sex, Race, and Hispanic Origin for the United States, 1999 to 2100, Middle Series”, Washington: Department of Commerce, 2002, table NP-D1-A.). The proportion of older Americans (defined as those over 65) is projected to grow to 16.5 percent (Peddu, 2000) in the next two decades and to 20 percent (From “Changes in Demographics and Travel”, NHTS 2001 website) in the next three decades. The elderly population is increasing at a higher rate than before: there was a 2 percent annual percentage computed Annual rate of percent change (Summary statistics from NHTS 2001 website) change of elderly population above 65 from 1990 – 2001 compared to the

1.6 percent annual percentage change of elderly population above 65 from 1968 – 90. Elderly population is also growing at higher rate than the increase in overall population (1.3 annual growth rate from 1990 – 01) in United States. Burkhart, 1998 used population projections to project that daily vehicle miles traveled (VMT) by elderly people (above 65) will double between 2000 and 2020 and triple by 2030. U.S census divides the elderly (above 65) into three subgroups again, the young old (65-74 years), the aged (75-84 years), and the oldest old (85 years and older). The oldest is a small but rapidly growing group. It is the growth of this demographic segment that draws most attention.

Table 4.1

Split of Population by Age Cohort: NHTS 2001 and NPTS 1990

Year	2001	1990
N	33428016	26955210
65-74	6.7 %	7.5 %
75-84	4.3 %	3.8 %
Over 85	1.1 %	0.8 %
Others	87.9 %	87.9 %
Total	100.0 %	100.0 %

Factors contributing to the growth of elderly population are; aging baby-boomers, increased life expectancy, reduced mortality and decrease in birth rates. Americans are living longer and are expected to live beyond 80 for developed health care technology has contributed to increase in life expectancy. The demographic shift of increasing elderly population segment poses a unique challenge to transportation officials and policy makers. Transportation and Mobility needs of elderly people and safety of their travel are the issues of interest in this context.

Mertz (2000) defined mobility to be including various elements; Travel to achieve access to desired places and people, potential for travel (Knowing that certain trip could be made even if not actually undertaken), involvement in local community, and psychological benefits of movement. The term mobility in this report refers to the first three elements. Quality of life of elderly people is considered to be directly related to their mobility, for mobility helps them to retain their independence. Mobility decreases with ageing: Increased health and disability problems and lower levels of income are the reasons attributed to the decrease in mobility of elderly. Looking at the travel behavior and corresponding trends in the elderly population segment can help better understand the mobility issue of elderly.

Aging brings about changes in the human system like:

- Changes in Physical Characteristics
- Changes in Thinking Processes
- Health Problems
- Medications

Changes in Physical Characteristics: With aging, joints stiffen, muscles weaken. This makes turning ones head backwards to look back or steering and braking a tough physical exercise. Movements are slower and not accurate. Senses like smell, hearing, sight, touch and taste might grow weaker. Age also brings about changes in vision in the eyes. Older people's eyes need more light to sense objects and are more sensitive to glare. The ability to view things on the edges of the visible area, peripheral vision, etc narrows down. A host of vision problems start at this age.

Changes in Thinking Processes: Age brings about changes to thinking processes too, resulting in slower reaction times, slower reflexes, trouble in concentration, etc. Such people will have a difficult time to perform multi-tasking, something that is absolutely essential for driving safely.

Health problems: Other illnesses common among older people can affect ones ability to drive safely. For example, having arthritis, Parkinson's disease, or stroke, makes it harder to handle a car safely. Sleep problems or fainting make a person less alert at an age when he/she may already have a hard time focusing attention. A person with an automatic defibrillator or pacemaker, should be suggested to stop driving. There is a chance that the device might cause an irregular heartbeat or dizziness while driving. Diabetes may cause nerve damage in the hands, legs, or eyes.

Medications: Older Americans take more prescription medicines than any other age group. They often have one or more long-term illnesses such as arthritis, diabetes, high blood pressure, and heart disease and may be taking several different drugs. Their bodies may be more sensitive to the effects of medicine on their central nervous systems. The older body may not use up a drug as quickly as a younger body does, so the drug can be active in them for a longer time. Sometimes a combination of medicines increases the effects of each drug on the body. Several types of medication can make driving harder because they affect the central nervous system. Drugs that might interfere with driving include sleep aids, medicine to treat depression, antihistamines for allergies and colds, strong pain- killers, and diabetes medications.

An analysis of accident data (GES data) shows that the risk of accident severity increase with driver's age and highest risk is borne by drivers above 80. Researchers have also shown that older drivers cannot negotiate curves and difficult situations and hence cause accident threat to themselves and other road users as well. This indicates that ill health and disability due to ageing cause driver cessation, which is the main reason for the decrease in their mobility. Hall, 1990 in his accident study suggested that all of the accident characteristics including light condition, weather, roadway system, crash severity and type of accident clearly exhibited a dependence of age. The risk of accident severity increases with age and many older individuals choose to discontinue or limit driving for safety reasons associated with the aging process. Use of a car, which is an ultimate form of autonomy, may no longer be possible for older people; hence they become dependent and captive. They will have to either choose to "ride share" or travel in public transit. Though ageing decreases the amount of travel, increased and better health care enabled improving health status among older persons and longer life spans. So not many older people of future may restrain from driving. An analysis of NHTS 2001 indicates that around 80% of those above 65 report themselves as active drivers. Healthier people are more mobile and have higher travel needs. But there will also be more people with limited mobility. The segment of the population above 80 (The oldest old) will be the most of the less mobile population. Self reported active drivers fell down to 46% for oldest old. There will be a greater need of travel options for both the more mobile and least mobile elderly. Unless travel options are offered, there will be more drivers of old age and limited abilities on the road and automobile crashes could increase.

4.3 Travel Behavior of the Elderly

Automobile is the dominant mode of transportation in America. About 90% of all miles traveled are in cars and an average American spend about 75 minutes a day in car (1995 NPTS Early results report, U.S DOT 1997). But the autonomy provided by car ownership is not universal. The low-income groups and elderly have lower automobile usage.

Table 4.2

Travel Day Totals for Population 65 Years and Older: NHTS 2001 and NPTS 1990

	1990 (N=26955210)		2001 (N=33428016)	
	All Ages	Over 65	All Ages	Over 65
Total number trips on travel day	3.75	2.49	4.06	3.44
Total travel time on travel day (min)	61.68	38.98	79.01	66.26
Total distance traveled on travel day (mil)	37.13	21.17	40.29	29.20

Table 4.3

**Distribution of Trips by Trip Purpose for Persons Over 65:
NHTS 2001 and NPTS 1990**

	65 – 74 years old		75 – 84 years old		Over 85 years old	
	2001	1990	2001	1990	2001	1990
To and from work	4.93	5.81	2.14	2.60	1.96	1.02
Work related	1.30	0.72	0.63	0.33	0.35	0.00
Shopping	27.27	30.16	29.78	32.91	26.93	30.12
Family/Personal	25.07	24.04	22.42	22.98	22.55	17.10
School/Church	5.39	7.99	6.88	9.23	5.97	14.44
Medical/Dental	3.84	2.16	6.13	4.19	7.55	7.54
Vacation	0.64	0.31	0.78	0.00	0.28	0.33
Visit Friend	7.74	9.66	7.54	8.24	8.00	9.42
Social/Recreation	22.73	17.85	22.89	17.42	25.90	18.94
Other	1.08	1.28	0.69	2.10	0.53	1.10

Table 4.4**Trip Rates by Trip Purpose for Persons Over 65:
NHTS 2001 and NPTS 1990**

	65 – 74 years old		75 – 84 years old		Over 85 years old	
	2001	1990	2001	1990	1990	2001
To and from work	0.19	0.13	0.07	0.04	0.04	0.01
Work related	0.05	0.02	0.02	0.00	0.01	0.00
Shopping	1.06	0.87	0.92	0.62	0.53	0.31
Family/Personal	0.98	0.78	0.69	0.49	0.44	0.20
School/Church	0.21	0.18	0.21	0.14	0.12	0.12
Medical/Dental	0.15	0.07	0.19	0.09	0.15	0.09
Vacation	0.02	0.01	0.02	0.00	0.01	0.00
Visit Friend	0.30	0.29	0.23	0.16	0.16	0.10
Social/Recreation	0.88	0.54	0.71	0.35	0.51	0.21
Other	0.03	0.03	0.01	0.03	0.01	0.01

Table 4.5**Trip Rates by Trip Purpose for All Persons:
NHTS 2001 and NPTS 1990**

	NHTS 2001	NPTS 1990
N	277208169	222100829
To and From Work	0.60	0.62
Work Related	0.11	0.04
Shopping	0.78	0.72
Family/Personal	0.93	0.93
School/Church	0.39	0.35
Medical/Dental	0.08	0.04
Vacation	0.02	NA
Visit Friend	0.31	0.39
Social/Recreation	0.74	0.60
Other	0.02	0.02
N/A	0.70	0.00

Table 4.6

**Modal Split Distribution for Persons Over 65:
NHTS 2001 and NPTS 1990**

	65 – 74 years old		75 – 84 years old		Over 85 years old	
	2001	1990	2001	1990	2001	1990
SOV	43.6	49.0	40.9	49.1	35.3	37.9
HOV Driver	23.1	20.4	20.1	20.0	17.0	15.2
HOV Passenger	24.2	22.5	27.7	23.2	35.1	31.6
Transit	0.9	1.6	1.5	2.3	1.9	2.5
Walk	7.0	6.0	8.7	4.1	9.1	11.0
Other	1.2	1.1	1.1	1.3	1.6	1.8

It can be seen from the above tables that there is a large increase in trip rates and travel times for the elderly between 1990 and 2001, in comparison to the rest of the population.

The increase in travel distance is not so significant. This means that the elderly are traveling more frequently but are making shorter trips, in terms of distance. This could mean that they are shifting to localities that are closer to their daily needs and trip destinations. Transportation needs and preferences of elderly shape their travel behavior.

An individual starts getting affected in many ways by ageing process. This could be because of their decreasing abilities to make longer trips. They start developing health problems that lead to lower physical capabilities, and this has the greatest impact on the travel behavior of elderly people. Other factors that could influence travel needs and preferences of the elderly are gender, income, education levels, their employment status, labor force participation, retirement year trends, their household structure and their values and attitudes. Transportation supply characteristics and access to transit also influence the way elderly people travel.

4.3.1 Gender Differences

The travel needs of either a man or a woman in widowhood increases for they may have to do additional travel for all the complimentary activities shared by the spouse before.

The travel goes down again after a few years as they start getting less mobile due to physical health constraints. Unmarried and single family persons are anyway used to travel and drive more. The reasons for their reduced travel with age are driver cessation and lower income. The elderly female non-driver percentage is higher than elderly males.

It is expected that a substantial number of poor women will be living alone with low levels of independence in the society and they will have a strong need for assistance with daily transportation. It was observed that a high percentage of oldest old (85 years and older) live in single households compared to young old (65-74 years old) and older old (75 to 84 years old) indicating the need to provide for the mobility of the oldest old. The decreasing household size, decreasing level of family ties and children living away from parents are the reasons behind elderly living alone. Elderly people living alone are much more likely to be poor and require non-family source of travel assistance, private or public. Driving was more common among men than women among past and present older cohorts, but driving is almost universal among both male and female Baby Boomers (Rosenbloom, 1995). Women are expected to live longer than males and hence they are the dominant portion of the oldest old (those above 85). The higher life expectancy of

Table 4.7

Distribution of Population by Over 65 Years old Gender and Age Cohort: NHTS 2001 and NPTS 1990

	Male		Female	
	2001	1990	2001	1990
N	33428016	26955210	33428016	26955210
65-74	44.27	43.57	55.72	56.42
75-84	40.60	41.01	59.39	58.98
85 and Over	33.32	32.92	66.67	67.07

women is also the reason why they are more prone to experience widowhood compared to males. A high percentage of oldest old women live in single households compared to young old and aged women. Also, a very high percentage of older women are single in comparison to men, both in 1990 and 2001. The percentage and number of women living alone is increasing over time, especially the oldest old women.

Table 4.8

Distribution of Population Over 65 Years old by Life Cycle and Gender: NHTS 2001

	Live Alone, working		Live Alone, Retired		Not Alone	
	Men %	Women %	Men %	Women %	Men %	Women %
65-74	20.65	79.35	26.46	73.54	49.03	50.97
75-84	9.03	90.97	22.67	77.33	50.02	49.98
85 +	9.85	90.15	25.93	74.07	39.12	60.88
Others	52.17	47.83	43.95	56.05	49.65	50.35

Table 4.9

Distribution of Population Over 65 Years old by Life Cycle and Gender: NPTS 1990

	Live Alone, Working		Live Alone, Retired		Not Alone	
	Men %	Women %	Men %	Women %	Men %	Women %
65-74	21.20	78.80	28.83	71.17	50.40	49.60
75-84	10.42	89.58	27.59	72.41	54.98	45.02
85 +	16.93	83.07	26.84	73.16	40.14	59.86
Others	50.30	49.63	35.05	64.95	48.64	51.33

4.3.2 Labor force participation

Increased education levels and better health care have enabled people to work for longer times than before. Despite essentially flat labor participation rates for man aged 50 years or older, early pensioners returned to work at increasing rates (Hertz, 1995). Even if they retire, they are looking forward to actively spending their retirement years. Besides this, increased influx of women in the labor force also contributes to increased travel. In any case there will be many more years of active life for older people even after retirement from the primary profession.

From the tables below (Tables 4.7, 4.8 and 4.9), it can be seen that the percentages of workers decreases with increase in age of the trip maker. There are lesser workers as the age of the trip maker increases. This is because people tend to become more fragile and unable to work as they lose the most important faculties that are required for any kind of work like sight and hearing. One interesting phenomenon that can be observed from this table is that the trip rate of old age workers 85 and older is very high in comparison with other workers in the old age category. The trip rate of workers is generally higher than

that of non-workers in the same category. This is very much evident in the trip rates of the old age workers and non-workers. Also, the trip rate of workers 85 years and older is much higher than that of non-workers in the same age category. Their trip rate is higher than that of workers in the general population.

Table 4.10

Distribution of People 65 Years and Older by Worker Status of Trip Maker and Age Cohort: NHTS 2001 and NPTS 1990

	Worker		Non-Worker	
	2001	1990	2001	1990
N	33428016	26955210	33428016	26955210
65-74	17.93	14.63	82.06	85.36
75-84	6.76	4.76	93.23	95.23
85 and Over	2.43	0.99	97.41	99.00

Table 4.11

Travel Day Totals for Population 65 Years and Older by Employment Status and Age Cohort: NHTS 2001 and NPTS 1990

		Trip Rate		Travel Time		Travel Distance	
		2001	1990	2001	1990	2001	1990
N		33428016	26955210	33428016	26955210	33428016	26955210
Worker	65-74	4.30	3.58	91.59	59.04	42.27	31.75
	75-84	3.73	3.53	85.14	53.87	41.01	22.69
	85 and Over	4.83	1.23	83.95	34.54	30.54	17.96
Non-Worker	65-74	3.80	2.82	72.29	44.39	34.23	24.77
	75-84	3.04	1.84	57.27	28.17	22.41	14.90
	85 and Over	1.89	1.04	33.11	14.16	9.85	6.11

Table 4.12**Travel Day Totals for Population in All Households by Employment Status:
NHTS 2001 and NPTS 1990**

	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	277208169	222100829	277208169	222100829	277208169	222100829
Not Working	3.68	3.13	69.43	48.47	31.46	26.83
Working	4.53	4.30	91.93	73.14	50.76	45.74

4.3.3 Effect of Driver Status on Travel

A significantly lower percentage of people over 65 report themselves as drivers compared to younger people. Overall, 93% of people reported themselves as drivers while about 80% of older people reported themselves as drivers in 2001. Although women in general, report to be drivers at a lower percentage than men in each group, the difference in driving rates is far greater among older adults than their younger counterparts. The percentage of persons reporting themselves as drivers is higher among the younger older people (65-74 years old) than in the older old people (85 years and Older).

Table 4.13**Distribution of People 65 Years and Older by Driver Status of Trip Maker and Age Cohort: NHTS 2001 and NPTS 1990**

	Driver		Non-Driver	
	2001	1990	2001	1990
N	33428016	26955210	33428016	26955210
65-74	87.67	82.99	12.32	16.89
75-84	74.96	68.83	25.01	30.93
85 and Over	45.92	35.14	53.79	64.85

The difference in trip rates between drivers and non-drivers can be seen very easily in older peoples travel characteristics. Drivers have a significantly higher number of trips than non-drivers, especially among the younger old cohort. Young old people (65 to 74 years old) spend much more time on the road than an average younger person. Other travel characteristics like the total distance traveled and trip rate also compare to the values of those of younger counterparts.

Table 4.14

Travel Day Totals for People 65 Years and Older by Driver Status and Age Cohort: NHTS 2001 and NPTS 1990

		Trip Rate		Travel Time		Travel Distance	
		2001	1990	2001	1990	2001	1990
N		33428016	26955210	33428016	26955210	33428016	26955210
Driver	65-74	4.20	3.20	80.21	50.26	37.20	27.63
	75-84	3.54	2.42	66.09	36.48	27.57	20.00
	85 and Over	3.06	1.84	52.85	25.70	16.94	13.69
Non-Driver	65-74	1.71	1.62	43.73	28.15	24.53	16.14
	75-84	1.73	0.82	38.23	13.65	11.71	4.49
	85 and Over	1.02	0.61	18.44	8.04	4.69	2.50

Table 4.15

Travel Day Totals for Population in All Households (NHTS 2001 and NPTS 1990) by Driver Status

		Trip Rate		Total Travel Time		Total Distance Traveled	
		2001	1990	2001	1990	2001	1990
N		277208169	222100829	277208169	222100829	277208169	222100829
Driver		4.48	3.89	88.03	64.84	47.85	39.80
Non-Driver		2.66	3.09	59.65	45.85	19.32	22.85

4.3.4 Effect of Education Level on Travel

Increased education attainment is in a way related to higher income, better health status, and hence increased travel. Education level can be used as surrogate for income levels to explain travel behavior. It is assumed that boomers (those who are between 55 to 70 years of age in the NHTS 2001 data set) do not attain any higher level of education than they currently have attained. Baby boomers have higher levels of education compared to today's elderly; hence we can expect baby boomers to have higher travel requirements than matures.

The average level of education among older adults decreases with age. More and more older adults are having an education higher than a secondary school degree in 2001 than in 1990. This could be the result of better education facilities over time. This could also be the result of older adults moving to urban areas over time, since there are better education facilities in urban areas than in rural areas. Another noticeable change is the decrease in the level of education of the trip maker with age. Older old people have a lesser level of education than younger old people.

Table 4.16**Distribution of People 65 Years and Older by Highest level of Education Attained by the Trip Maker, with Age: NHTS 2001 and NPTS 1990**

	High School or Below		College		Graduate School	
	2001	1990	2001	1990	2001	1990
N	33428016	26955210	33428016	26955210	33428016	26955210
65-74	59.17	71.43	29.32	20.50	10.65	5.62
75-84	63.73	72.77	26.54	17.56	8.53	5.38
85 and Over	63.84	68.77	24.10	15.49	6.54	4.60

Table 4.17**Travel Day Totals for People 65 Years and Older by Highest Level of Education Obtained by the Trip Maker and Age Cohort: NHTS 2001 and NPTS 1990**

		Trip Rate		Travel Time		Travel Distance	
		2001	1990	2001	1990	2001	1990
N		33428016	26955210	33428016	26955210	33428016	26955210
School or Lower	65-74	3.52	2.62	69.44	40.75	32.13	21.22
	75-84	2.79	1.80	54.49	26.79	20.33	14.10
	85 and Over	1.70	0.99	29.42	13.41	8.38	4.55
College	65-74	4.42	3.82	82.96	62.33	40.29	40.48
	75-84	3.61	2.32	64.96	39.09	25.33	20.95
	85 and Over	2.42	1.45	43.22	19.25	13.26	11.92
Graduate School	65-74	4.64	4.35	93.15	67.10	43.33	32.37
	75-84	3.94	2.89	81.19	44.33	45.49	19.38
	85 and Over	3.73	2.00	66.98	35.10	21.40	22.32

Table 4.18

Travel Day Totals for Population in All Households by Highest Level of Education Obtained by the Trip Maker: NHTS 2001 and NPTS 1990

	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	277208169	222100829	277208169	222100829	277208169	222100829
School	3.84	3.38	77.04	54.68	36.96	31.41
College	4.64	4.53	91.40	75.92	49.91	48.36
Graduate School	4.91	4.77	98.06	82.22	61.81	52.49

Trip rate increases almost linearly with the highest level of education obtained by the trip maker. Trip rate also decreases linearly with age. Though there is not much difference in travel characteristics by the highest level of education attained by the trip maker in the general population, but this trend is more prominent in older people. Other trip characteristics like the total time spent on travel and total distance traveled also increase almost linearly with the highest level of education attained by the trip maker among older people (persons over 65 years of age)

4.3.5 Effect of Household Income on Travel

Retirement marks the beginning of decreased income of an individual. The sources of income for a retired person are social security or pension and a small amount from the work if one choose to work after retirement. Lower income constrains the owning and maintenance of an automobile. This may explain why low-income elderly persons drive substantially lower vehicle miles traveled (VMT) or not choose to drive at all. Older people are distributed almost equally between middle and low household incomes. There

is a slight shift from lower to higher incomes over time. There is also a difference across age cohorts.

Table 4.19

**Distribution of People 65 Years and Older by Household Income and Age Cohort:
NHTS 2001 and NPTS 1990**

	Low (under 25K)		Medium (25-50K)		High (Over 50K)	
	2001	1990	2001	1990	2001	1990
N	33428016	26955210	33428016	26955210	33428016	26955210
65-74	31.19	33.79	38.49	33.79	18.80	11.43
75-84	40.36	41.75	33.06	41.75	12.65	7.08
85 and Over	41.29	37.02	24.96	37.02	12.07	6.69

The mobility of older people increases with household income among the younger old and middle old age cohorts and is almost unaffected by household income among the oldest old cohort.

Table 4.20**Travel Day Totals for People 65 Years and Older Household Income and Age Cohort: NHTS 2001 and NPTS 1990**

		Trip Rate		Travel Time		Travel Distance	
		2001	1990	2001	1990	2001	1990
N		33428016	26955210	33428016	26955210	33428016	26955210
Low (Under 25 K)	65-74	3.12	2.68	61.07	38.43	23.59	19.50
	75-84	2.65	1.83	50.62	25.23	16.66	14.26
	85 and Over	1.74	1.11	30.95	13.19	9.19	3.62
Medium (25-50K)	65-74	4.29	3.47	82.39	58.34	38.27	37.55
	75-84	3.55	2.56	65.29	41.92	27.18	20.76
	85 and Over	2.55	1.06	43.40	30.20	12.97	21.29
High (Over 50K)	65-74	4.55	3.66	93.42	63.60	56.37	36.85
	75-84	3.59	2.20	76.20	47.76	40.56	25.11
	85 and Over	1.81	0.95	27.95	16.81	8.86	11.07

Table 4.21**Travel Day Totals for Population in All Households Household Income: NHTS 2001 and NPTS 1990**

		Trip Rate		Total Travel Time		Total Distance Traveled	
		2001	1990	2001	1990	2001	1990
N		277208169	222100829	277208169	222100829	277208169	222100829
Low (under 25 K)		3.50	3.39	70.12	51.58	27.90	28.36
Medium (25-50K)		4.10	4.05	77.97	64.58	38.77	38.36
High (Over 50K)		4.43	4.31	86.02	74.59	49.43	47.36

4.3.6 Effect of Location of Residence on Travel

More and more older people are shifting to urban areas with time. There seems to be a higher concentration of oldest old people in urban areas than the other age cohorts. This could be because of the adequately available medical and other health care facilities in urban areas.

Table 4.22

**Distribution of People 65 Years and Older by Location and Age Cohort:
NHTS 2001 and NPTS 1990**

	Urban		Not Urban	
	2001	1990	2001	1990
N	33428016	26955210	33428016	26955210
65-74	76.46	58.81	23.54	41.19
75-84	78.94	54.34	21.06	45.66
85 and Over	81.79	57.47	18.21	42.53

Table 4.23

**Travel Day Totals for People 65 Years and Older by Location and Age Cohort:
NHTS 2001 and NPTS 1990**

		Trip Rate		Travel Time		Travel Distance	
		2001	1990	2001	1990	2001	1990
N		33428016	26955210	33428016	26955210	33428016	26955210
Urban	65-74	3.98	2.89	75.39	44.42	35.11	23.94
	75-84	3.12	1.95	56.92	28.91	21.50	13.69
	85 and Over	1.91	1.09	34.24	12.67	9.58	3.54
Non-Urban	65-74	3.60	2.99	76.97	49.59	37.44	28.39
	75-84	2.97	1.91	67.51	30.04	31.67	17.16
	85 and Over	2.18	0.98	34.70	16.63	13.73	9.84

Table 4.24

**Travel Day Totals for Population in All Households by Location:
NHTS 2001 and NPTS 1990**

	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	277208169	222100829	277208169	222100829	277208169	222100829
Urban Area	4.13	3.75	77.24	60.45	39.76	34.67
Not Urban	3.88	3.76	78.37	63.72	43.73	41.16

There seems to be a slight relationship between location of residence and trip making characteristics of older people. The trip rates of older people living in urban areas are higher than those living in non-urban areas while the travel times are almost the same.

The trip distances however are higher for those living in non-urban areas. This means that the average driving speeds of older people in urban areas are lower than those of non-urban areas. People living in non-urban areas have to travel longer distances to access various necessities in comparison to rural areas. Facilities like hospitals and other health care facilities, on which people tend to depend on heavily as they age, are farther in non-urban areas. This could be the main reason why most older people tend to move to urban areas as they age.

4.4 Older Drivers and Safety

As a group, persons aged 65 and older are relatively safe drivers. Although they represent 14 percent of all licensed drivers, they are involved in only 8 percent of police-reported crashes and 11 percent of fatal crashes. This can be compared to drivers age 16 to 24,

who are involved in 26 percent of police-reported crashes and 26 percent of fatal crashes, but represent only 14 percent of licensed drivers. In fact, drivers age 65 and older have a lower rate of crash involvement per 1,000 licensed drivers than any other age group. They also drive fewer miles on average than any other age group. When drivers over 65 are involved in crashes, the situations and reasons are generally different from those associated with crashes involving younger drivers. For older drivers, the situations in which crashes occur most frequently are when they are turning left, whereas for younger drivers, crashes occur most often while they are driving on a straight road or highway. The errors most often involved in older driver crashes are failing to yield right of way or not responding properly to stop signs and traffic lights.

4.4.1 Propensity to Drive Among Older Adults

Many of the Older Adults, having owned and been completely dependent on automobile for their travel will be having a higher propensity to drive even in their older years. As men and women reach age 65, they will almost universally have been licensed drivers for approximately 30 years (Rosenbloom, 1995). As mentioned in the above sections, preferences, attitudes, changing female role and changing socio economic and cultural structure of the society are the reasons behind a rapid increase in driving propensity among elderly individuals. Apart from the factors like gender, socio, economic and demographic structure, health and preferences, and other constraints, the urban form also imposes constraints on Travel patterns of older people. Suburban sprawl increases the distances that must be traveled to access goods and services and to participate in community activities. Moreover, segregated-use zoning in communities is common, with

some areas zoned for commercial/office use only, other areas for retail establishments, and still others for residential use. Such land-use patterns increase the distances that must be traveled to access activities, goods, and services. These attributes of places will also contribute to driving to be the most commonly used mode of transportation of elderly. Similarly the distances are long and transit options are fewer and in rural areas also.

4.5 Role of Public Transit in Providing for Mobility of Elderly

Improved access to public transport for elderly and disabled people can make a major contribution to the financial and social independence of this large and growing sector of the population. Providing access to link to community and to perform various activities will help the elderly retain their independence as well as the society indirectly. Many public and private organizations serve the health, nutrition and social needs of elderly people. Without the mobility provided by public transit, the elderly are more likely to lose their independence. Instead if the same elderly individuals are provided for mobility and hence are active, state will be receiving more tax revenues. Public transit industry will also have an opportunity of turning itself into a universally common mode among all demographic segments. There is also an opportunity for controlling urban sprawl through transit oriented community developments.

4.5.1 The Difficulty with Providing Public Transit

Public transit providers will be challenged in many ways to find cost-effective options to provide mobility to widely spread and dispersed residences and activity locations.

Agencies that are willing to provide public transit services may have a large number of

riders only if they can provide comprehensive solutions to provide high quality transit services to provide for the travel needs of high-income seniors while at the same time provide low-cost alternatives to address the mobility issues of low-income captive elderly passengers. The decreasing transit share in many regions shows the declining trend of transit industry in US. Transit is considered to be a less popular option for its limited availability and poor quality. Transit cannot provide the level of freedom to travel and mobility that is provided by an automobile. Total travel times are higher for transit compared to auto (transit can be cost effectively provided only if the ridership is higher and it is possible only if all demographic segments patronize transit, which to a large extent possible with lower travel time). Fear of crime and vandalism inhibits older people's use of public transit. The health problems and physical disabilities limit the use of transit by oldest old. Apart from the above, future elderly are more likely to reside in and travel to changing spatial patterns; work and activity patterns cause a spatial mismatch of transit services with desired routes to suburban activity locations and residences. Poor and minorities constitute majority of transit passengers and the transit fares in many places, even after subsidies are higher. This shows the nature of conflicting goals of 'basic mobility' versus 'alternative to private vehicle' and highlights the issue of 'who uses transit' versus 'who pays for subsidies'.

4.6 Transportation Policy for Transportation of the Elderly

Transportation officials, planners and policy makers will face a unique challenge of providing mobility options for elderly. Providing safe, convenient and cost-effective mobility of ageing baby boomers will definitely require rethinking of strategies and

active planning. A dedicated funding support, involvement of older people in policy making, educational campaign programs and appropriate land use policy to enable transit oriented community development, are some of the policy implications. There is also a necessity of suitable data collection effort to make better forecasts to predict travel behavior of elderly in order to make well informed policy decisions.

4.6.1 Planning for the Older Population

It is a well-known fact that transportation is the vital link that connects people, especially the elderly to the goods and services that are necessary for survival. With the advent of old age, elders tend to become frailer and as a result, become more dependent on being able to drive oneself, be driven or to use a public transit service to access activities. The location of housing facilities of elderly people is often linked to available forms of transportation providing access to health care, social services, shopping and recreational and religious activities. These facilities almost always tend to be concentrated in urban areas and hence the increased concentration of elderly residences in the vicinity of city centers. Hence, the majority of older population has been living in metropolitan areas and a majority of them live in the suburbs. This could be also be explained by the fact that most people living in the suburbs tend to continue staying in their houses even as they age and rear children. Although this is, in part, a function of land availability and land zoning, it also partially reflects proximity to services such as public Transportation. Accessibility to transportation includes proximity to available transportation routes, as well as availability of a variety of transportation styles. In recent times, it has also been important to have access to suitable forms of transportation vehicles.

CHAPTER 5
TRAVEL CHARACTERISTICS OF RESIDENTS
OF ZERO VEHICLE HOUSEHOLDS

5.1 Introduction

This chapter addresses the travel characteristics and trends among zero vehicle households. There has been a lot of funding and focus on improvement of travel options for people residing in zero vehicle households. This chapter offers a description and analysis of the various travel characteristics of people residing in zero vehicle households and makes an attempt to describe various policy changes that should be made regarding this segment of the US population.

5.2 Zero Vehicle Households: 1990 to 2001

The percentage of Zero vehicle households in the overall population is decreasing. In 1990, about 6.6% of all households were zero-vehicle households, while this number dropped to 5.1% in 2001. This could mean that more and more people are opting to own a personal vehicle. The residents of zero vehicle households are still predominantly female, though the number of males has increased from 34% to 40%. An increasing number of people with jobs are opting not to own vehicles. From 1990 to 2001, the employment rate has risen in zero vehicle households from 30% to 41%. Zero vehicle households are typically composed of adults with little or no education, with their highest

level of education being high school or technical training. A large percentage of the zero vehicle households belong to the age group of 25 to 64 years of age, with the rest of residents of zero vehicle households distributed equally among the other age groups. The residents of zero vehicle households are growing younger with time, the average age of the zero vehicle household residents falling from 44 years in 1990 to 40 years in 2001. The size of the average zero vehicle household is increasing with time. The typical zero vehicle household consists of one adult living alone or two adults without any children. Zero vehicle households are greater in number in urban areas, owing to better transit facilities in urban areas. It has been observed that the average household income of these households is increasing over time, leading to the conclusion that household income is not the determining factor in opting to be a zero vehicle household. The above trends are explored in detail in the following sections and an explanation of dominant travel trends is attempted based on these demographic trends.

5.3 Demographic and Trip Characteristics

Trip rates and daily totals for time spent on travel and distance traveled have been used as measures of mobility in this report. The number of people immobile on the travel day has also been used as a measure of mobility. It would be prudent to compare the trip making characteristics of people living in households without vehicles and households with vehicles. But people residing in zero vehicle households comprise of a very small percentage of population, and hence inclusion of zero vehicle households in the dataset of households with vehicles will not affect the results. People in zero vehicle households are traveling much more in 2001 than in 1990, in terms of distance and time spent for travel

per day. Tables 5.1 and 5.2 list the travel day totals for people residing in zero vehicle households, for the years 1990 and 2001. From these tables, it can be seen that there has been a small increase between 1990 and 2001 in the trip rate but there was a significant increase in the amount of travel in terms of total travel time. The increase in total distance traveled was not proportionate to the increase in travel times. This means that there has been a shift from shorter trips to lengthier trips. An increase in travel times, with the trip rate unchanged and a lesser increase in travel distance could mean that the average speed for each trip is decreasing.

Table 5.1

Travel Day Totals for Persons Residing in Zero Vehicle Households: NHTS 2001

	N	Minimum	Maximum	Mean	Std. Deviation
Trip Rate	14007465	0.00	18.00	2.75	2.38
Travel Time (min)	11940172	0.00	149.00	43.15	41.39
Distance Traveled (mi)	12622707	0.00	97.00	9.22	14.98

Table 5.2

Travel Day Totals for Persons Residing in Zero Vehicle Households: NPTS 1990

	N	Minimum	Maximum	Mean	Std. Deviation
Trip Rate	14601913	0.00	20.58	2.28	2.80
Travel Time (min)	13309283	0.00	148.60	27.56	36.99
Distance Traveled (mi)	11558594	0.00	99.00	7.48	15.31

Table 5.3

**Average Trip Time and Trip Distances for Residents of Zero Vehicle Households:
NPTS 1990 and NHTS 2001**

	2001		1990	
	N	Mean	N	Mean
Average Trip Time (min)	13658438.3	20.97	14137234	10.89
Average Trip Distance (mi)	12982930.5	7.03	11748606	3.27

Tables 5.4, 5.5 and 5.6 give descriptive statistics by mobility status of the trip makers on the travel day. It can be seen from Table 5.4 that there is a greater incidence of immobility in the zero vehicle households' dataset in comparison to the overall dataset. Also, there is a significant decrease in the number of persons immobile on the travel day, both among persons residing in zero vehicle households and also among the overall population. There is a greater improvement in the mobility of persons residing in zero vehicle households in comparison to the overall dataset. This could be because of better availability of other means of transportation other than private vehicle, like transit, ride sharing, etc. Tables 5.5 and 5.6 give the percentages of people residing in zero vehicle households, by gender and employment status for the years of 2001 and 1990 respectively. It can be seen from these tables that there is a significant increase in the mobility of both males and females from 1990 to 2001. These tables demonstrate that there is a greater incidence of immobility among females than males. The greater immobility of females, who comprise of a greater percentage of the persons residing in zero vehicle households, contributes largely to the lower mobility rates among people residing in zero vehicle households.

Table 5.4

**Percentage of People Immobile on Travel Day:
NPTS 1990 and NHTS 2001**

	2001		1990	
	Zero Vehicle	Whole Dataset	Zero Vehicle	Whole Dataset
N	14007465	277208169	14601913	222100829
Immobile on Travel Day	23.78	11.82	42.89	21.50
Others	76.22	88.18	57.11	78.50

Figure 5.1

**Percentage of People Immobile on Travel Day:
NPTS 1990 and NHTS 2001**

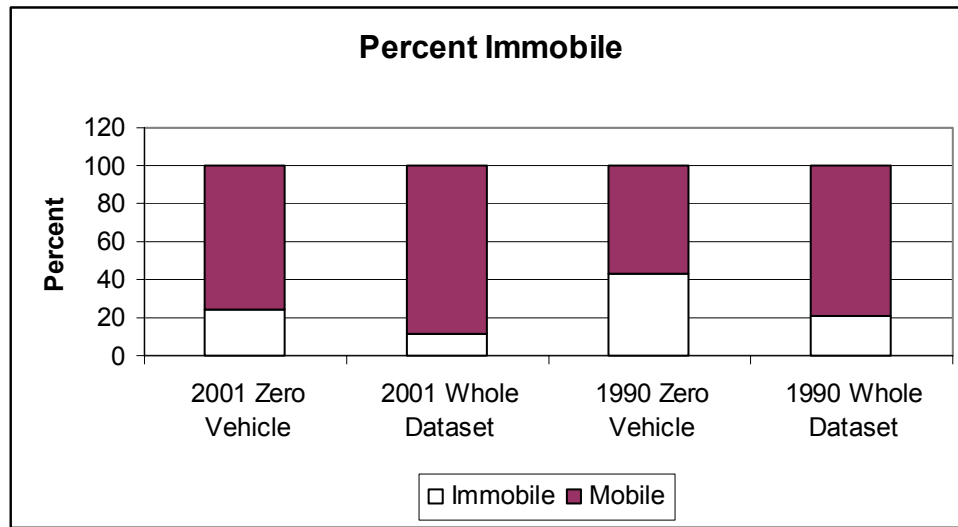


Table 5.5

Distribution of Persons Residing in Zero Vehicle Households by Immobility and Gender and Employment Status: NHTS 2001

	Mobile			Immobile		
	N	Row	Column	N	Row	Column
Male	4606438	82.8%	43.1%	956175	17.2%	28.7%
Female	6070487	71.9%	56.9%	2374364	28.1%	71.3%
Worker	4548888	89.7%	54.3%	521731	10.3%	18.3%
Non-Worker	3833811	62.2%	45.7%	2332001	37.8%	81.7%

Table 5.6

Distribution of Persons Residing in Zero Vehicle Households by Immobility and Gender and Employment Status: NPTS 1990

	Mobile			Immobile		
	N	Row	Column	N	Row	Column
Male	3198968	64.0%	38.4%	1801079	36.0%	28.8%
Female	5140602	53.5%	61.6%	4461264	46.5%	71.2%
Worker	3489478	80.0%	41.8%	871288	20.0%	13.9%
Non-Worker	4850092	47.4%	58.2%	5391055	52.6%	86.1%

The tables 5.7, 5.8 and 5.9 give the trip rates, total travel times and total distances traveled on the travel day by trip purpose. From these tables, it can be seen that the trip rate and travel distance to and from work have not changed significantly but there is a considerable increase in the time of travel to work. This can be explained by these people walking to access non-auto modes of transportation. This increase in travel time to and from work is not so prominent in the general population. The trip rates to and from work were lesser for persons residing in zero vehicle households than those for the general population. This is justified by lesser number of employed people in zero vehicle

households. People in the general population made more trips for family/personal purposes than any other purpose while those in zero vehicle households made more trips for shopping. The zero vehicle household segment is mostly comprised of unemployed people living alone or with other adults with no children in the household. The effects of such demographic variables on mobility of persons in zero vehicle households are further explored later in this chapter. People in zero vehicle households made many more trips per day in 2001 for the purposes to and from work, shopping and social/recreation than in 1990. People in zero vehicle households spent much more time on the road in 2001 for trip purposes to and from work, shopping, family/personal and social/recreation. The trip purposes that contributed to the increase in total daily distance traveled of residents of zero vehicle households are shopping and visit friend.

Table 5.7

**Trip Rates by Trip Purpose for Persons Residing in Zero Vehicle Households:
NHTS 2001 and NPTS 1990**

Trip Rates by Purpose	2001	1990
N	14007465	14601913
Trip Rate	2.753	2.277
Trip Rate (To and from work)	0.398	0.316
Trip Rate (Work related)	0.058	0.011
Trip Rate (Shopping)	0.647	0.506
Trip Rate (Family/Personal)	0.489	0.421
Trip Rate (School/Church)	0.279	0.290
Trip Rate (Medical/Dental)	0.112	0.054
Trip Rate (Vacation)	0.018	NA
Trip Rate (Visit Friend)	0.299	0.301
Trip Rate (Social/Recreation)	0.427	0.355
Trip Rate (Other)	0.024	0.023

Table 5.8

**Trip Rates by Trip Purpose for All Persons:
NHTS 2001 and NPTS 1990**

	NHTS 2001	NPTS 1990
N	277208169	222100829
To and From Work	0.60	0.62
Work Related	0.11	0.04
Shopping	0.78	0.72
Family/Personal	0.93	0.93
School/Church	0.39	0.35
Medical/Dental	0.08	0.04
Vacation	0.02	NA
Visit Friend	0.31	0.39
Social/Recreation	0.74	0.60
Other	0.02	0.02
N/A	0.70	0.00

Table 5.9**Total Travel Time on Travel Day by Trip Purpose for Persons Residing in Zero Vehicle Households: NHTS 2001 and NPTS 1990**

Total daily Travel Times by Purpose	NHTS 2001	NPTS 1990
N	14007465	14601913
Total travel time	67.9	39.3
Travel duration (To and from work)	12.9	7.3
Travel duration (Work related)	2.4	0.4
Travel duration (Shopping)	12.1	6.2
Travel duration (Family/Personal)	11.3	6.3
Travel duration (School/Church)	5.7	4.6
Travel duration (Medical/Dental)	2.9	1.0
Travel duration (Vacation)	69.5	NA
Travel duration (Visit friend)	8.0	5.9
Travel duration (Social/Recreation)	10.1	6.3
Travel duration (Other)	0.4	0.3

Table 5.10**Total Travel Distance on Travel Day by Trip Purpose for Persons Residing in Zero Vehicle Households: NHTS 2001 and NPTS 1990**

Total Distances Traveled by Purpose	NHTS 2001	NPTS 1990
N	14007465	14601913
Total distance traveled	20.31	11.07
Daily travel distance (To and from work)	2.08	1.71
Daily travel distance (Work Related)	4.45	0.55
Daily travel distance (Shopping)	3.47	0.95
Daily travel distance (Family/Personal)	2.18	1.37
Daily travel distance (School/Church)	0.67	0.58
Daily travel distance (Medical/Dental)	0.50	0.25
Daily travel distance (Vacation)	27.55	NA
Daily travel distance (Visit friend)	3.12	2.01
Daily travel distance (Social/Recreation)	1.56	1.92
Daily travel distance (Other)	0.83	0.05

The table below gives the distribution of trips by purpose. It can be seen that there are more shopping trips in both 1990 and 2001. Shopping trips are followed closely by Family/Personal and Social/Recreational trips. One noticeable aspect in this table is the decrease in the percentage of work trips from 1990 to 2001. An analysis of the composition of zero vehicle households is done to explain this change in travel. About 70 percent of the people in zero vehicle households were unemployed in 1990 while the corresponding figure for the year 2001 is about 60 percent. Since the percentage of workers increased by almost 10 percent while the work trip rate did not increase (0.316 to 0.398) as much as the increase in some other more frequent trip purposes, the percentage share of work trips fell down.

Table 5.11

Split of Total Trips by Trip Purpose for Persons Residing in Zero Vehicle Households: NHTS 2001 and NPTS 1990

	NHTS 2001	NPTS 1990
N	14007465	14601913
To and From Work	14.47	16.81
Work Related	2.06	0.57
Shopping	23.44	21.54
Family/Personal	17.71	15.89
School/Church	10.09	15.44
Medical/Dental	3.98	2.04
Vacation	0.60	NA
Visit Friend	10.85	12.15
Social/Recreation	15.45	14.31
Other	0.83	1.24
N/A	0.52	0.00
Total	100.00	100.00

In 2001, about 57% of all trips made on the travel day by the general population were made on a single occupant vehicle with the person making the trip as the driver and about 29% of trips were made as a passenger on the trip (also there is a low percentage of walk and bike trips). In the zero vehicle household's dataset, about 10% of the trips were made on a single occupant vehicle with the person making the trip as driver and 25% of trips were made as a passenger. The rest of trips are mostly walk and bike trips. This means that there was a lot of carpooling done by residents of zero vehicle households in comparison to the general population. This is confirmed by analyzing the average occupancy for vehicle trips in the trips made by the general population and people residing in zero vehicle households. There is a shift towards the auto mode from 1990 to 2001, as more people from zero vehicle households are driving vehicles, with the percentage of people residing in zero vehicle households carpooling remaining the same over time.

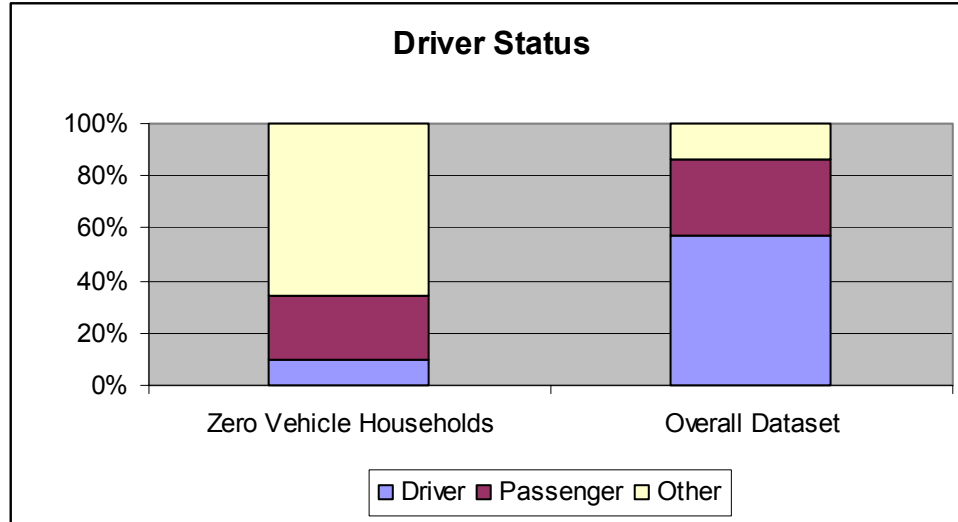
Table 5.12

Distribution of Trip Makers by Driver Status: NHTS 2001 and NPTS 1990

	2001			1990		
	Driver	Passenger	Other	Driver	Passenger	Other
Zero Vehicle Households	13.9	24.6	61.5	4.5	24.5	71.0
Overall Dataset	57.0	29.0	14.0	48.0	39.0	13.0

Figure 5.2

Distribution of Trip Makers by Driver Status: NHTS 2001 and NPTS 1990



It can be seen from Table 5.12 that there is a high percentage of walk trips among persons residing in zero vehicle households, both in 1990 and in 2001. This could be because most people in zero vehicle households reside in areas with close access to transit or in areas in the vicinity of their daily work/shopping/other trips. They make most of their trips by walk, hence requiring them to stay in neighborhoods that facilitate walking. This could encourage segregation of such people and should be looked into in greater detail in order to be understood.

Table 5.13

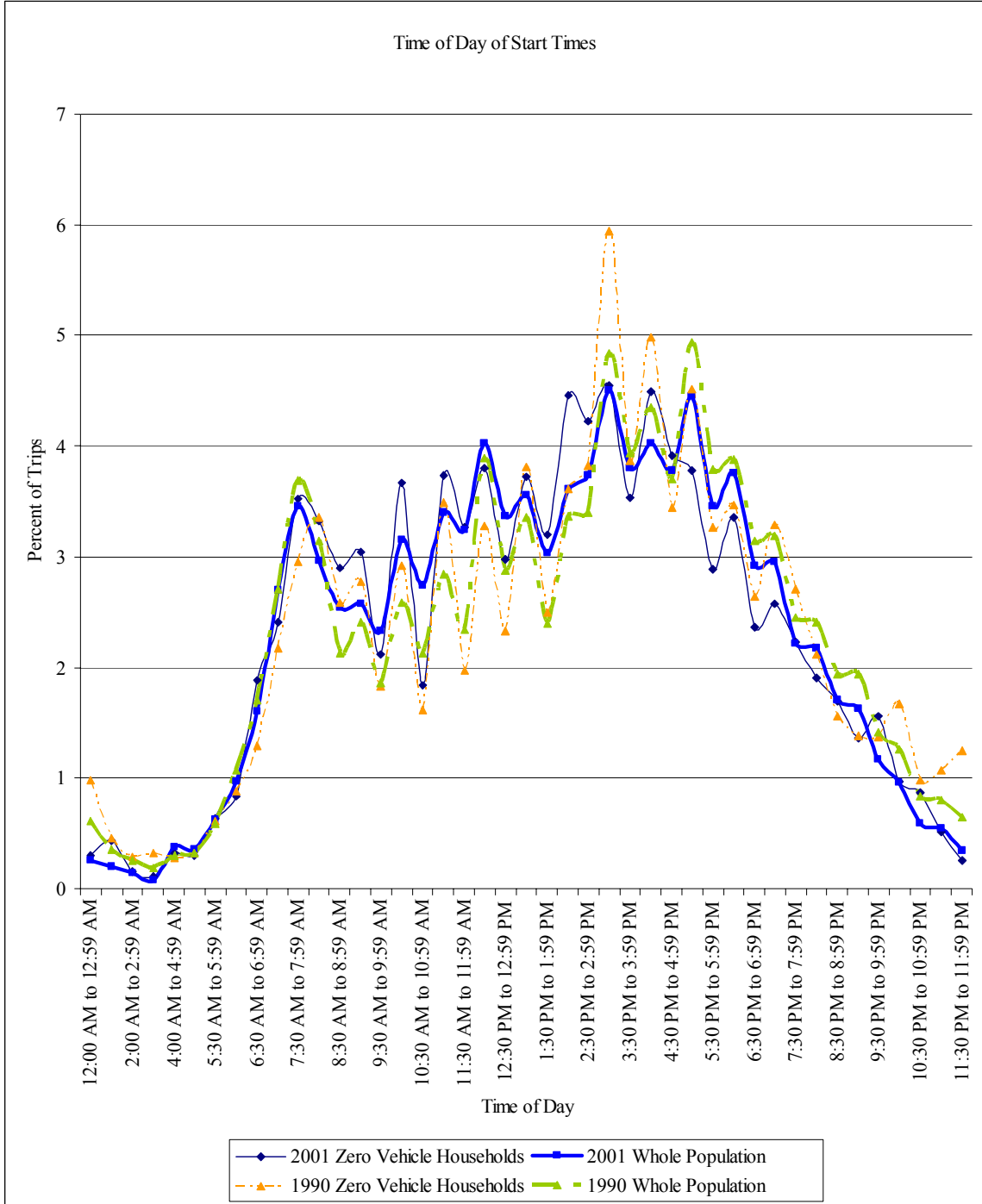
**Mode Split among Persons Residing in Zero Vehicle Households:
NHTS 2001 and NPTS 1990**

	NHTS 2001	NPTS 1990
N	14007465	14601913
Driver	10.04	4.5
Passenger	24.56	24.5
Transit	21.43	19.25
Others	6.35	7.23
Walk	36.63	44.31
Total	100	100

It can be seen from the Figure 5.3 that time of time of day for trips by residents of zero vehicle households that the AM peaks are rising in 2001 in comparison to 1990. The PM peaks are however, falling over time. There is not much difference between travel by people living in zero vehicle households and by those in the general population. The curve representing the time of day of travel of the whole population is smoother in comparison to the curve representing the time of day of travel of people residing in zero vehicle households. This could be because the whole population has more observations than the zero vehicle household's dataset.

Figure 5.3

Time of Day of Trips (Start Times) For Residents of Zero Vehicle Households:
NHTS 2001 and NPTS 1990



5.4 Effect of Employment Status on Travel

From Tables 5.13, 5.14 and 5.15, it can be seen that there are more employed persons residing in zero vehicle households in 2001 (41.1%) than in 1990 (29.9%). This could be the result of more and more people shifting to locations closer to work, as a result of which a vehicle is not necessary to travel to work. A striking difference in the trip characteristics can be noticed between workers and non-workers, both in 1990 and 2001. This difference is also evident on comparing unemployed people belonging to zero vehicle households and all households in the same year. Unemployed people without any household vehicle do not make as many trips as employed people in the same category because they will not be required to travel to and from work; the only trips that they usually make are shopping trips, visit friends and social or recreational purposes. These trips for shopping, visiting friends and recreation by unemployed people in zero vehicle households are also limited due to the absence of a household vehicle. Also, the very high values of travel time and distance to by employed people living in zero vehicle households can be explained by their use of transit or carpooling. Another reason why employed people living in zero vehicle households have very high travel times is because of the high percentage of walk trips made by them.

Table 5.14**Distribution of Zero Vehicle Households by Employment Status of Trip Makers:
NHTS 2001 and NPTS 1990**

Employment Status	NHTS 2001	NPTS 1990
N	14007465	14601913
Unemployed	58.87	70.14
Employed	41.13	29.86
Total	100.00	100.00

Table 5.15**Travel Day Totals for Persons Residing in Zero Vehicle Households by Employment
Status: NHTS 2001 and NPTS 1990**

Year	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	14007465	14601913	14007465	14601913	14007465	14601913
Not Working	2.31	1.81	54.91	28.48	14.01	6.60
Working	3.39	3.38	89.83	64.28	36.30	21.42

Table 5.16**Travel Day Totals for Persons Residing in All Households by Employment Status:
NHTS 2001 and NPTS 1990**

Year	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	277208169	222100829	277208169	222100829	277208169	222100829
Not Working	3.68	3.13	69.43	48.47	31.46	26.83
Working	4.53	4.30	91.93	73.14	50.76	45.74

5.5 Effect of Gender of Trip Maker on Travel

From Tables 5.16, 5.17 and 5.18, it can be seen that there is a high percentage of women residing in zero vehicle households. The percentage of women has come down from 1990 to 2001 but there is still a large gap between the percentages of male and female population in zero vehicle households. The difference between men and women is prominent in zero vehicle households than in all households. Men travel more than women in terms of the number of trips on the travel day and the distance traveled. This difference by gender is not so prominent in the dataset of all households (whole population).

Table 5.17

**Distribution of Persons Residing in Zero Vehicle Households by Gender:
NHTS 2001 and NPTS 1990**

Gender	NHTS 2001	NPTS 1990
N	14007465	14601913
Male	39.71	34.31
Female	60.29	65.69
Total	100.00	100.00

Table 5.18

**Travel Day Totals for Persons Residing in Zero Vehicle Households by Gender:
NHTS 2001 and NPTS 1990**

Year	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	14007465	14601913	14007465	14601913	14007465	14601913
Male	2.89	2.50	73.64	45.26	26.04	13.67
Female	2.66	2.15	64.09	36.23	16.63	9.68

Table 5.19

**Travel Day Totals for Persons Residing in All Households by Gender:
NHTS 2001 and NPTS 1990**

Year	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	277208169	222100829	277208169	222100829	277208169	222100829
Male	4.04	3.66	83.51	64.63	44.26	40.27
Female	4.08	3.84	74.73	59.00	36.48	34.25

5.6 Effect of Education of Trip Maker on Travel

Zero Vehicle households are mostly composed of people who are either uneducated or have a high school degree or technical training after high school. The level of education among zero vehicle households is increasing with time, from 1990 to 2001. It can be seen that there is a strong correlation between education and travel characteristics in both the datasets: Zero Vehicle Households and All Households. Though trip rates are lower for the zero vehicle households segment, this correlation between trip rate and education level of the trip maker is equally evident. Trip rates, travel day totals for travel times and travel distances increase with the level of education of the trip maker. It was also observed that this correlation between education level of the trip maker and his/her trip characteristics are independent of household income of the trip maker.

Table 5.20

**Distribution of Persons Residing in Zero Vehicle Households by Education:
NHTS 2001 and NPTS 1990**

Education Status	2001	1990
N	14007465	14601913
School/Technical Training	71.81	79.00
College (4 years)	22.57	18.34
Graduate School	5.62	2.66
Total	100	100

Table 5.21

**Travel Day totals for Persons Residing in Zero Vehicle Households by Education
Status: NHTS 2001 and NPTS 1990**

Year	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	14007465	14601913	14007465	14601913	14007465	14601913
School	2.50	2.08	63.57	35.46	11.58	9.82
College	3.42	3.11	84.34	56.44	25.35	13.36
Graduate School	3.73	3.79	91.38	64.66	142.71	40.11

Table 5.22

**Travel Day totals for Persons Residing in All Households by Education Status:
NHTS 2001 and NPTS 1990**

Year	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	277208169	222100829	277208169	222100829	277208169	222100829
School	3.84	3.38	77.04	54.68	36.96	31.41
College	4.64	4.53	91.40	75.92	49.91	48.36
Graduate School	4.91	4.77	98.06	82.22	61.81	52.49

5.7 Effect of Age of Trip Maker on Travel

The Zero Vehicle household's population is getting younger with time. This is because the percentage of elderly population (65 years and over) is decreasing with time (29.3% to 23%) and the percentage of population living in zero vehicle households that is under 65 years of age is increasing correspondingly. This means that more and more old people are keeping their personal vehicles even as they age (and their sight and hearing faculties diminish). The mobility of people under 16 years of age is falling with time and more and more people under 16 years of age are belonging to zero vehicle households. This can be seen from the fact that the trip rate of under 16 cohort fell from 3.61 to 3.23 (zero vehicle households) and 4.27 to 4.14 (all households) from 1990 to 2001 while the trip rate of the over 65 and over cohort increased from 1.21 to 1.65 (zero vehicle households) and 2.44 to 3.49 (all households) form 1990 to 2001.

Table 5.23**Distribution of Population Residing in Zero Vehicle Households by Age:
NHTS 2001 and NPTS 1990**

Age Group	2001 NHTS	1990 NPTS
N	14007465	14601913
<16	20.98	13.58
16-24	12.41	18.40
25-64	43.57	38.72
65 and over	23.04	29.30
Total	100.00	100.00

Table 5.24**Travel Day Totals for Persons Residing in Zero Vehicle Households by Age
Category: NHTS 2001 and NPTS 1990**

Year	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	14007465	14601913	14007465	14601913	14007465	14601913
16-24	3.23	3.61	85.33	53.09	18.15	12.04
25-64	3.22	2.55	83.17	51.30	31.58	16.55
65 and Older	1.65	1.21	35.47	19.10	7.22	6.22

Table 5.25**Travel Day Totals for Persons Residing in All Households by Age Category:
NHTS 2001 and NPTS 1990**

Year	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	277208169	222100829	277208169	222100829	277208169	222100829
16-24	4.14	4.27	80.78	66.73	40.69	39.11
25-64	4.49	4.12	90.05	70.18	49.21	44.18
65 and Older	3.44	2.49	66.26	38.98	29.20	21.17

An analysis of the modal split of Zero Vehicle Households by age cohort revealed that more people are using private vehicle for travel than going by walk, from 1990 to 2001. This change from walk trips to private vehicle trips is very prominent in the under 16 cohort. People belonging to zero vehicle households aged less than 16 years made 53.3 % of trips by walk in 1990 while they made only 38.9 % of all trips by walk in 2001. Another interesting finding is that people aged between 16 and 64 used public transit more than the other age cohorts, and this usage is increasing over time (21.3 % to 25.7 %). Hence this cohort of population belonging to zero vehicle households and aged 16 to 64 years can be used as target population while planning for transit use.

Table 5.26

**Mode Split of People Residing in Zero Vehicle Households by Age Cohort:
NHTS 2001**

Percentages	Private Vehicle	Transit	Walk	Others
Under 16	35.86	11.64	38.90	13.61
16-64	33.14	25.66	36.50	4.71
Over 65	46.38	18.20	33.49	1.94

Table 5.27

**Mode Split of Persons Residing in Zero Vehicle Households by Age Cohort:
NPTS 1990**

Percentages	Private Vehicle	Transit	Walk	Others
Under 16	18.69	12.55	53.34	15.42
16-64	29.14	21.33	44.22	5.31
Over 65	40.02	17.06	37.23	5.69

5.8 Effect of Location of Residence on Travel

The high concentration of zero vehicle households concentrated in urban areas is another factor that stands out. There has been a steady and rapid increase in the population of zero vehicle households in urban areas in the past ten years from about 79% to 93%. Most urban areas are characterized by a high concentration of facilities and other needs including transportation. One reason for such high concentration of zero vehicle households in urban areas is because of availability better transportation facilities like transit. There has been more focus on providing better transit in urban areas in the past few years, resulting in greater incidence of zero vehicle households in urban areas. This raises an important question: do people residing in urban areas decide not to buy vehicles for transportation because of the proximity of facilities and many accessibility options available or do people who decide not to own vehicles move to cities because of the many transportation and accessibility options available in the urban areas?

Table 5.28

**Distribution of Persons Residing in Zero Vehicle Households by Location:
NHTS 2001 and NPTS 1990**

	NHTS 2001	NPTS 1990
N	14007465	14601913
In an urban area	92.90	78.90
Not in urban area	7.10	21.10
Total	100	100

There is a large increase in travel time and distance traveled by people residing in zero vehicle households residing in urban areas though there is no such significant change in the trip rate. This means that people residing in zero vehicle households, residing in urban

areas are traveling longer and spending more time on the road in 2001 than in 1990. The trip rate of persons residing in zero vehicle households rose from 2.32 to 2.86 from 1990 to 2001 while the daily total for travel time increased from 42 minutes to 66 minutes and the daily total for distance traveled almost doubled 11.6 miles to 22.1 miles. Hence more and more people residing in zero vehicle households are moving to urban areas and are making more trips and staying longer on the road.

Table 5.29

**Travel Day Totals for Persons Residing in Zero Vehicle Households by Location:
NHTS 2001 and NPTS 1990**

Year	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	14007465	14601913	14007465	14601913	14007465	14601913
Urban Area	2.86	2.32	65.83	42.19	22.13	11.61
Not Urban	2.12	2.12	48.08	28.58	17.37	9.22

Table 5.30

**Travel Day Totals for Persons Residing in All Households by Location:
NHTS 2001 and NPTS 1990**

Year	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	277208169	222100829	277208169	222100829	277208169	222100829
Urban Area	4.13	3.75	77.24	60.45	39.76	34.67
Not Urban	3.88	3.76	78.37	63.72	43.73	41.16

5.9 Effect of Household Income of Trip Maker on Travel

People in Zero Vehicle households are getting richer with time. There are lesser people in the low income group belonging to zero vehicle households in 2001 than in 1990.

Table 5.31

**Distribution of Persons Residing in Zero Vehicle Households by Household Income
NHTS 2001 and NPTS 1990**

Income Group	NHTS 2001	NPTS 1990
N	14007465	14601913
low (Under 25K)	74.55	83.57
medium (25K – 50K)	18.34	13.38
High (Over 50K)	7.11	3.05
Total	100.00	100.00

The effect of household income on the travel patterns of people residing in zero vehicle households is almost linear. There is a steady increase in trip rate, daily totals for travel time and travel distance with income in zero vehicle households and all households, both in 1990 and 2001. However, the trip rate, travel time and distance for zero vehicle households in 1990 for households with zero vehicles and income greater than 50,000 dollars are lesser than the corresponding characteristics for other income categories in the same year. This could be because this cohort was very small in 1990, giving rise to distortions in the values of trip rates.

Table 5.32

Travel Day Totals for Persons Residing in Zero Vehicle Households by Household Income: NHTS 2001 and NPTS 1990

Year	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	14007465	14601913	14007465	14601913	14007465	14601913
Low (under 25 K)	2.64	2.37	62.87	39.72	12.87	11.16
Medium (25-50K)	3.10	3.65	87.04	64.43	40.86	14.42
High (Over 50K)	4.08	2.84	98.83	60.38	63.63	17.23

Table 5.33

Travel Day Totals for Persons Residing in All Households by Household Income: NHTS 2001 and NPTS 1990

Year	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	277208169	222100829	277208169	222100829	277208169	222100829
Low (under 25 K)	3.50	3.39	70.12	51.58	27.90	28.36
Medium (25-50K)	4.10	4.05	77.97	64.58	38.77	38.36
High (Over 50K)	4.43	4.31	86.02	74.59	49.43	47.36

5.10 Effect of Household Size of Trip Maker on Travel

The average size of the zero vehicle household is increasing over time. Greater the number of adults in the household, greater is the trip rate of adults in the household. This also demonstrates the trend that exists in most households: the trip rates of persons in the households increase with household size. Another interesting trend that can be noticed is that the trip rate, total travel time and total travel distance increase up to a certain household size and then decrease. This trend is prominent in the total travel time and total

travel distance by residents of zero vehicle households. In the set of all households, though the trip rate decreases after the household size crosses 4 persons, the travel time does not fall correspondingly.

Table 5.34

Distribution of Persons Residing in Zero Vehicle Households by Household Size: NHTS 2001 and NPTS 1990

Household size	NHTS 2001	NPTS 1990
N	14007465	14601913
1	28.10	37.00
2	24.10	22.02
3	12.97	15.54
4	18.44	10.11
>4	16.39	15.33
Total	100.00	100.00

Table 5.35

Travel Day Totals for Persons Residing in Zero Vehicle Households by Household Size: NHTS 2001 and NPTS 1990

HHSIZE	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
	14007465	14601913	14007465	14601913	14007465	14601913
1	2.45	1.91	54.83	29.95	24.98	10.26
2	2.80	2.51	67.58	44.85	19.78	14.77
3	2.92	2.36	82.24	43.96	22.22	10.59
4	2.73	2.91	74.01	36.21	16.23	8.94
>4	2.79	2.63	73.77	58.46	11.81	13.18

Table 5.36

**Travel Day Totals for Persons Residing in All Households by Household Size:
NHTS 2001 and NPTS 1990**

Year	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	277208169	222100829	277208169	222100829	277208169	222100829
1	4.06	3.66	76.16	56.85	36.09	33.46
2	4.09	3.73	84.17	64.75	45.37	39.13
3	4.01	3.90	79.99	66.37	41.51	42.70
4	4.18	3.92	77.24	61.28	39.70	36.10
>4	3.93	3.48	75.26	56.71	33.27	30.38

5.11 Effect of Driver Status of Trip Maker on Travel

There is no prominent change in the composition of zero vehicle households with time with respect to driver status. There is almost the same percentage of drivers and non-drivers in zero vehicle households in 1990 as well as 2001. This observation is interesting because zero vehicle households are changing with time with respect to demographic characteristics like education status, life cycle which are correlated to driver status of the trip maker.

Table 5.37

**Distribution of Persons Residing in Zero Vehicle Households by Driver Status:
NHTS 2001 and NPTS 1990**

Driver Status	NHTS 2001	NPTS 1990
N	14007465	14601913
Driver	30.34	30.79
Not Driver	69.66	69.21
Total	100 %	100 %

Though there is no change in the composition of drivers in zero vehicle households over time, there is a change in their trip making characteristics over time. The most remarkable of these changes is the decline in the trip rate, travel time and travel distances of non-drivers in zero vehicle households over time. This means that more and more non drivers are staying back at home rather than going out.

Table 5.38

**Travel Day Totals for Persons Residing in Zero Vehicle Households by Driver
Status: NHTS 2001 and NPTS 1990**

Year	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	14007465	14601913	14007465	14601913	14007465	14601913
Not Driver	2.70	3.16	57.61	51.58	13.06	18.64
Driver	2.77	1.92	70.47	35.10	22.09	8.46

Table 5.39

**Travel Day Totals for Persons Residing in All Households by Driver Status:
NHTS 2001 and NPTS 1990**

Year	Trip Rate		Total Travel Time		Total Distance Traveled	
	2001	1990	2001	1990	2001	1990
N	277208169	222100829	277208169	222100829	277208169	222100829
Not-Driver	2.66	3.09	59.65	45.85	19.32	22.85
Driver	4.48	3.89	88.03	64.84	47.85	39.80

CHAPTER 6

CONCLUSION

6.1 Travel by the Elderly

The rapid increase in travel by the elderly could be directly related to metropolitan decentralization and the increasing dependency on the private car. Older people who have been driving all their lives will find it very difficult to lose their ability to drive due to old age, resulting in a great loss in mobility, if they had made an irreversible decision about housing based on mobility. With many more elderly individuals living in the United States, the travel demands of the elderly will become a more significant policy issue. Tomorrow's older persons are projected to have aged in place in suburban and in rural communities that seldom have good public transit service now. They are likely to be highly active and travel more frequently and to a wider range of destinations than today's seniors. Older persons of the future will have been automobile drivers all their life and will be expected to demand high levels of mobility high quality transportation services from all travel modes that they use. On the other hand, there could be more mobility and income limitations in the elderly in the coming future. There may be a substantial number of frail and poor women living alone at a low level of independence. Decreasing family ties may lead to a greater focus on non-family sources of travel assistance. Advanced travel options will need to consider older persons from a diverse array of backgrounds and cultures.

The combination of these factors is supposed to pose a substantial challenge to public transportation planning officials who wish to capture a significant portion of the trips of tomorrow's older persons. High quality travel services are likely to receive greater emphasis, but low cost travel alternatives are also expected to have a strong role in urban and non-urban areas.

6.1.1 Need for Increased and Safer Travel Options for the Elderly

It is expected that future elderly will travel differently than today's elderly population. Most of them will be active, with independent and mobile lives. But there will also be a major share of oldest old, low-income, and physically challenged elderly who will definitely need travel assistance. Trip rates will be certainly higher than today's elderly and there will be a substantial number of old drivers on the roads, warranting better transportation safety measures and programs. The amount of travel in terms of mileage will also be higher because of dispersed and a wide range of activities taken up. All these trends clearly demonstrate and reiterate an extremely strong need of travel alternatives other than driving for active and mobile drivers and less mobile elderly. New strategies will be required to address the mobility and safety needs of the elderly, along with infrastructure provision, public transit options, new technology in safer vehicle design and corresponding regulation and policy making (ex: driver licensing requirements and training).

6.1.2 Need for Transit

The recent trends of no declining public transit shares, and the very possible future market of older persons who will not be able to drive is a saving grace for public transit. There are older people who are willing to take public transit if the services meet their requirements. More over, the society cannot cease from providing the option of public transit even if it is not cost effective; there is a social element and equity issue associated with providing mobility to elderly. Provision of public transit may be more fruitful in terms of achieving the goal of mobility of elderly if the following steps are also taken up. Transit services that offer better services to older people can attract other population segments as well. There is a high necessity for transit agencies to recognize what old people want and how they respond to the services provided. The transit agencies should start responding to the changing needs and demands of elderly to be responsive. There should be a paradigm shift in terms of transit agencies being customer oriented. Not a single alternative is perfect option for every one; a variety of options with varying prices will attract customers from all segments. Use of advanced technology to provide real time information and make transit vehicles easier to get into out of them will help improve mobility of oldest old. Easy access to transit is important; hence transit service should be as dense as possible in those areas served by conventional fixed route services. Provision of just public transit may not be the solution in terms of comprehensiveness of options provided. Oldest old may not be able to use public transit due to their physical disabilities. Providing them Para-transit option with door-to-door service will increase alternatives for them to choose from. More flexible forms of transit and use of new technology to improve Para transit is helpful for low-density environments as well. A

future transit agency should also inculcate the art of attracting customers apart from just providing services.

A TCRP report on “Improving Transit Options for Older Persons ” suggested following strategies for transit agencies to attract more old riders.

1) Improve schedule reliability and provide real time information, 2) Provide door-to-door and guaranteed ride home services, 3) Be customer oriented and flexibly demand responsive, 4) work with voluntary organizations to better serve the specialized needs and 5) Minimize physical barriers such as steep long stairs, and minimize standing and waiting in extreme weather, 6) Multiple types of services at varying prices to give more choice.

Planning transportation for seniors is going to have to proceed along two tracks in the 21st century. With each new cohort of seniors, a growing percentage of them will continue to own and operate their own vehicles, even after aged 75. This trend has direct implications for the planning of city streets, urban expressways, inter-city highways and parking. It also has indirect implications for public transit systems that are likely to lose a proportion of their `captive' ridership. On a more direct level, public transit planners will be faced with the challenge of delivering services to seniors who are likely to be older and frailer.

Seniors like their working age counterparts are more likely to use a private vehicle than public transit. Unlike their working age counterparts, age and gender effects with respect

to holding a valid driver's license and owning a vehicle are more pronounced among seniors. It is evident from analysis of the NHTS 2001 and NPTS 1990, that a greater percentage of men have licenses and own cars than women. While holding a valid driver's license and vehicle ownership is very high among young-old males (65 to 84 years old), it drops off in the elderly males aged 85 and over. The trends are similar among elderly women, although the percents in each age group are about half of what they are for elderly males in the corresponding group.

At some point in time, the operation of a private vehicle or riding as a passenger is no longer an option. A switch is made to public transit. There are also seniors who have used public transit throughout their younger years who will continue to do so. In proportional terms, seniors are among the most important users of public transit. As the proportion of seniors who drive their own vehicles increases, public transit operators are likely to face the prospect that a declining proportion of their ridership will be seniors, but the absolute number might increase. Unfortunately, even if the absolute number of seniors increases relative to other age groups using public transit, public transit operators might still be faced with difficult choices because seniors make fewer trips. It is also likely that seniors who use public transit systems will be older, more frail and more likely to be disabled than those who currently use public transit. This too raises a set of difficult questions for transportation planners.

Beyond the costs of making their services accessible, the future challenges for public transit planners will be how to provide services to an elderly population which might

actually decline in proportional terms and which is aging-in-place in areas least amenable to the operation of public transit services. Many of the members of future cohorts of the elderly will grow old living in suburban developments, smaller urban places and even rural areas which are not amenable to regular public transit services. In fact, many of these places do not have regular public transit services now. In theory, this would suggest that the solution is to develop special transit services based on demand response systems, but this may not be acceptable if the normalization principle is to be applied. The perverse response (some might say the practical response), which operates today in many of these locations, is to offer no public transit services. Whether this will remain an acceptable response for seniors and the public in general in the future remains an open question.

6.2 Travel by Persons Residing in Zero Vehicle Households

The average person residing in a zero vehicle household is traveling longer and farther in 2001 than in 1990. These people are the worst affected by congestion in comparison to the general population. The significant increase in travel time and the travel distance and trip rate not increasing significantly, confirm this. Most of the persons residing in zero vehicle households live in urban areas. They do not typically use transit but prefer to walk to nearby locations. There is a majority of single women living in these households. There are younger people in these households now than in 1990, because more and more old people prefer to keep their cars now. The number of people residing in zero vehicle households is declining rapidly. This is because the dependency of adults in the United

States on private vehicle is growing as very few people can do without the convenience provided by the car.

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