The Mobility of Elderly Persons in the Portland Metropolitan Region

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Field Area Paper
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The Field Area Paper

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Professor Jennifer Dill served as first reader for this project, and Professor Irina Sharkova served as second reader.

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Abstract

In 2000, individuals aged 65 and older comprised roughly 12 percent of the U.S. population. In the coming decades, the 'Baby Boomer' generation will begin to retire, and by the year 2030 it is expected that the elderly population will make up 20 percent of the U.S. population. There has been a movement in past decades of individuals and families from the cities to the suburbs, settling in developments comprised of low-density housing and single-use zoning. The preferred mode of transportation for this form of development is the personal automobile, and many developments do not have basic treatments such as sidewalks that would allow for safe, effective transportation on foot or bicycle. One of the planning implications of these trends is that as people age and start losing the ability to drive, their mobility becomes increasingly restricted.

This study uses data from the 1994/1995 Metro Household Activity Survey to explore how mobility changes with age in the Portland metropolitan region. The following three questions are raised; how does age affect mobility as a whole, as defined by the total number of trips taken over a two-day period? Second, what explains the likelihood of elderly persons to take a certain type of trip over the same time period? Finally, which factors affect the overall mode choice of the elderly?

Age was found to have a negative association with mobility, both for the entire sample aged 16-98 and within various age categories separating the 'non-elderly,' the 'younger elderly,' and the 'older elderly.' The possession of a valid driver's license had a strong positive relationship with mobility in general, and with the consistency of trips and the likelihood of taking a trip by private automobile. A good pedestrian environment had a positive connection with overall mobility for all ages, and with the likelihood of an elderly person to take a trip by transit. The good pedestrian environment was negatively associated with the likelihood of an elderly person taking a trip by private automobile.

Planning recommendations from this study include producing automobiles which are safer and produce fewer emissions than ones on the road today; modifying transit vehicles to better accommodate elderly needs; building sidewalks and pedestrian treatments where appropriate in residential developments; and amending zoning codes to allow neighborhood commercial in residential areas, to reduce trip distance for elderly persons.

Introduction

In 2000, there were 35 million persons aged 65 and older living in the United States. These individuals, hereafter referred to as 'the elderly,' comprise 12.4 percent of the total U.S. population, and as a cohort demonstrate a population increase of 12 percent since 1990 (1). The increase in elderly persons as a percentage of the overall population has been attributed to longer life expectancies. Life expectancy in the U.S. has grown in recent decades, as a result of better nutrition, higher incomes, and improved health care (2). Current average life expectancy in the U.S. is 83 years, (84 years for women and 81 years for men). Over the next 30 years, the elderly population in the U.S. is expected to surge as a percentage of overall population, as those born between 1946 and 1964 – known as the 'Baby Boomers' – begin to retire. By 2030, it is expected that roughly 70 million Americans will be aged 65 or older – twice today's elderly population and comprising 20 percent of the total U.S. population (1).

This surge in growth of the elderly populace presents some land-use and transportation planning challenges. More than two-thirds of today's elderly live in suburban or rural environments, and this percentage is expected to increase as the 'Baby Boomers' retire (3). This phenomenon, called 'aging-in-place' and 'the graying of suburbia,' is the result of land-use and residential location trends dating back to the 1950s and 60s. Suburban developments, then as now, are considered to be an ideal setting for child rearing because of the perceived safety and other benefits associated with low-density housing and cul-de-sac streets. Many of the elderly currently in suburban or rural environments moved there before they reached the age of 65 (4). However, as people age in place, it becomes more challenging to sustain previous mobility levels. The distance from homes to goods and services tend to be longer in suburban or rural environments than in high-density urban settings. Because of nonexistent or discontinuous sidewalks, and a hierarchy of streets that makes it problematic to reach a store without crossing a major arterial, it is difficult to reach services without a private vehicle. However, mass relocation of the elderly back into the city, a deceptively simple resolution for some researchers and policy-makers, is not viable. One study found that 86 percent of seniors want to stay in their present home indefinitely (5).

This study explores how mobility changes with age, using data from the 1994/95 Metro Household Activity Survey for the Portland metropolitan region. There are three central research questions. First, how does age affect mobility as a whole, as defined by the total number of trips taken over a two-day period? Second, what explains the likelihood of the elderly to take a certain type of trip over the same time period? Finally, which factors affect the mode choice of elderly persons? Analysis for this study is based on a definition of elderly persons as being between 65 and 98 years of age (the highest age recorded for the 1994/95 Household Activity Survey).

Background

As Americans reach age 65, it is expected that the majority will retire. The labor force participation rate for 2002 shows that more than 65 percent of individuals aged 55 and older have left the work force. To break this into age groups, 38 percent of the 55-64 age group have retired, as compared to 74 percent of the 65-69 age group, 86 percent of the 70-74 age group, and 95 percent of the 75 and higher age group (6). Past studies have indicated that, as individuals retire, they substitute their work trips with a certain number of social, recreational, and medical-related trips, and the overall trip rate declines. One study shows that in 1995, men and women aged 18-64 had a total trip rate of 4.6 and 4.7 trips per day, respectively. This rate held relatively steady for men until age 75, and then dropped dramatically. The trip rate for women decreased steadily starting at age 65.

Men and women aged 85-89 displayed a much smaller trip rate than the non-elderly, of 2.1 and 1.3 trips per day respectively (7).

For several decades, however, the elderly have been following a trend of increasing mobility, largely stemming out of increasing reliance on private automobiles. For example, Rosenbloom found that individuals aged 65 and higher took 89 percent more trips per person in 1995 than just a little more than a decade before, in 1983. The number of miles traveled per person increased by 107 percent in those same years, and average person trip length increased by 11 percent (7). Over the same time period, Wachs found that daily auto travel by the elderly increased by 77 percent, and that the elderly drove 98 percent more miles. In 1995, elderly Americans took 90 percent of all their trips by automobile (8).

These data take into account the relatively limited licensing rates of the 1990's[1], and an elderly cohort that, when younger, were more likely to use public transportation[2] than those reaching retirement age in the 21st century. Within the next decade, it is expected that almost all men entering retirement years and over 90 percent of women over 65 years old will possess a valid driver's license (2). By conservative estimates, the number of elderly drivers on the road is expected to double by the year 2030 (9).

There are several implications associated with an increasing population of elderly relying on the private automobile for a greater number and larger percentage of trips. Three of these are discussed over the next two pages.

[1] Less than two out of three elderly American women were licensed drivers in 1997 (Rosenbloom, pg. 378).
[2] Transit ridership reached an overall peak in 1946, when Americans took 23.4 billion trips on trains, buses and trolleys (Source: American Public Transportation Association, www.apta.com, Historical Ridership Trends).

Increased Pollution

With the projected increase in elderly licensing rates, the current trend of more trips and increased vehicle miles traveled (VMT) by the elderly is likely to continue. Increased VMT leads to increased pollution. Cars and trucks, for example, make up the primary source of air pollution in the State of Oregon (10). Two recent studies have shown that elderly people are more likely to travel, or have transportation needs, outside the main commute peak, especially during the mid-morning and mid-afternoon hours (11, 12). As trips by the elderly continue to rise, it may lead to a spreading of peak hour congestion in some locations. Automobile emissions from driving during congested periods further impacts air quality. Finally, elderly persons are more likely to perform what some call 'wasted trips' (2). These trips include getting lost, practicing a trip before actually making it, avoiding left turns, and doubling a trip[3]. Each of these results in added VMT.

Decreased Safety

Although older people are not involved in more accidents than other age cohorts, their likelihood of being seriously injured or killed in an automobile crash is disproportionately high (13). This is generally attributed to an increased fragility of elderly persons – if they are involved in an accident they are more likely to be seriously hurt. Assuming that older drivers make up a greater proportion of all future drivers, there is a concern that the overall rate – as well as the overall severity – of crashes will increase significantly.

[3] Doubling a trip is defined as when a relative or friend drives to the elderly person's home to pick up the elderly individual, drives them to an errand, drives them home, and then drives to their next destination.

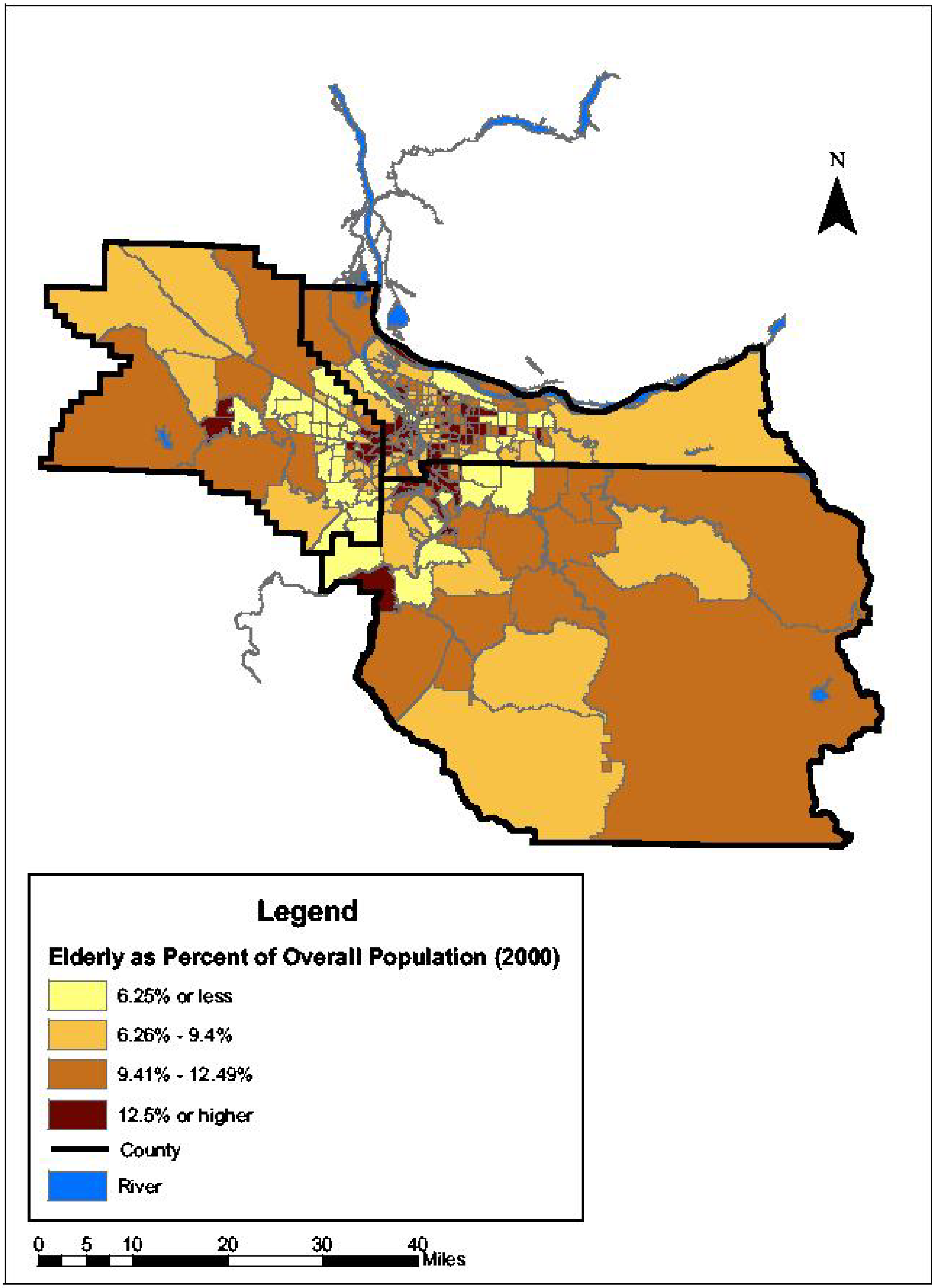
Increased Social Isolation

Finally, though studies have shown that mobility among the elderly is increasing over time, it is still decreasing in comparison with the under-65 population. This finding raises a concern of social isolation. Because current land-use patterns and locational choices make it difficult or impossible to make many social trips on foot or by public transit, the loss of a license generally leads to a decrease in these types of trips (3). One study cites a survey of licensing examiners and physicians – two groups required by law to report individuals who may be unsafe drivers – which showed that these groups had 'moral dilemmas' over recommending an elderly person's license be revoked. One respondent was quoted that taking a person's license away was 'revoking their choice and dignity' (14). Paratransit, a door-to-door transit service for the elderly and disabled, works to increase mobility for those requiring assistance with transportation. However, because of budget constraints many paratransit agencies prioritize trips so social visits are a low priority, and often they are not accommodated. Research and common sense show that ready access to family, friends, and social activities are a vital part of everyone's life (3).

Portland Context

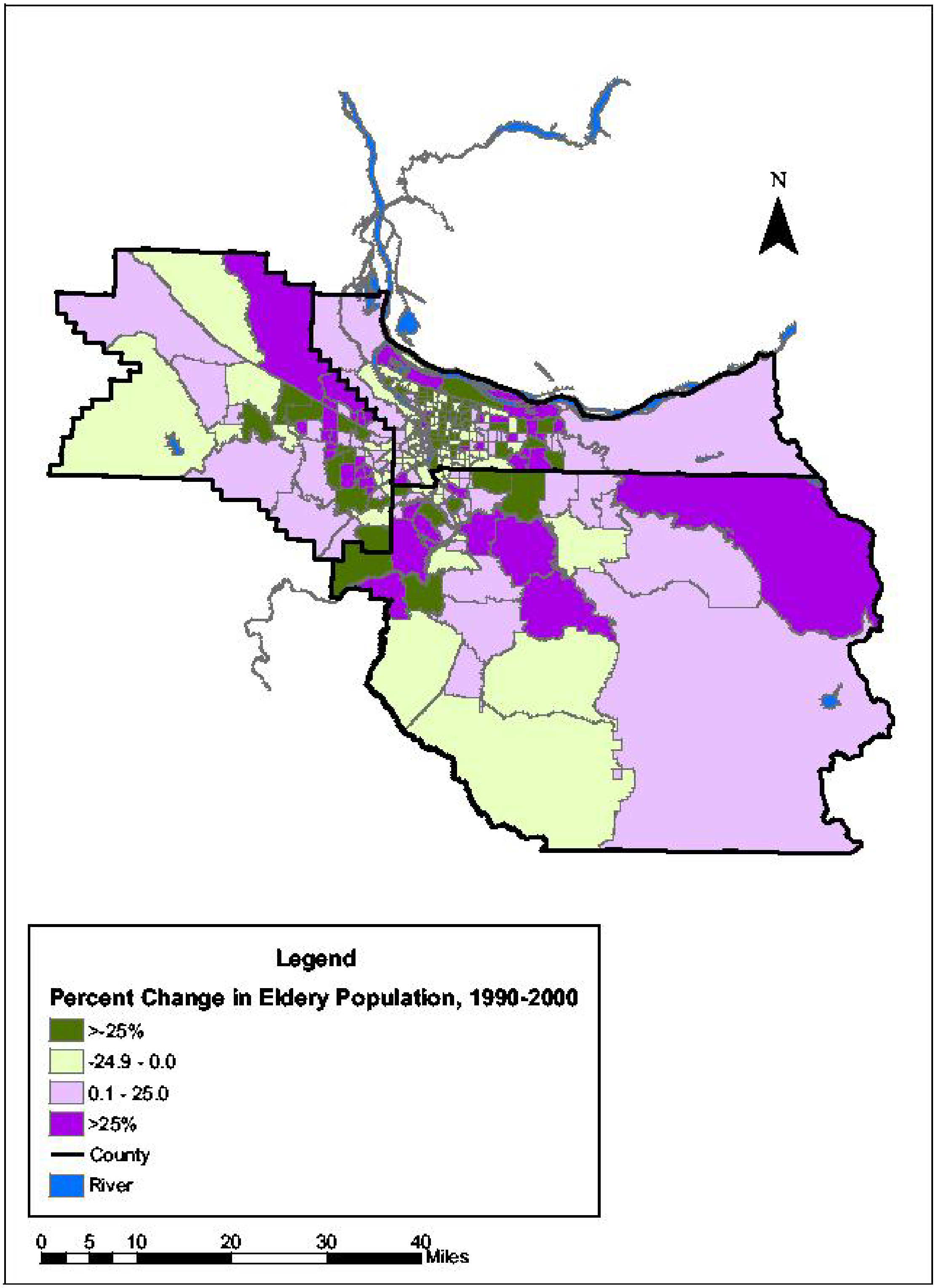
According to the U.S. Census Bureau, just under 200,000 elderly persons were living in the Portland metropolitan region in 2000, comprising approximately 10 percent of the total population (15). Figures 1-3 on the following pages contain information about the elderly in the region. Figure 1 shows the percentage of people over age 65 by census tract, as reported by the 2000 decennial census. Figure 2 shows the change in percentage of elderly persons by census tract, comparing 1990 to 2000 census data. Figure 3 shows the concentrations of elderly and disabled populations as a percentage of the mean elderly and disabled population throughout the region, as taken from the 2001 *Tri-County Elderly and Disabled Transportation Plan* (12).

Figure 1: Percent of Residents 65 Years of Age and Older for Three-County Portland Metropolitan Region (Oregon Side) in 2000, by Census Tract



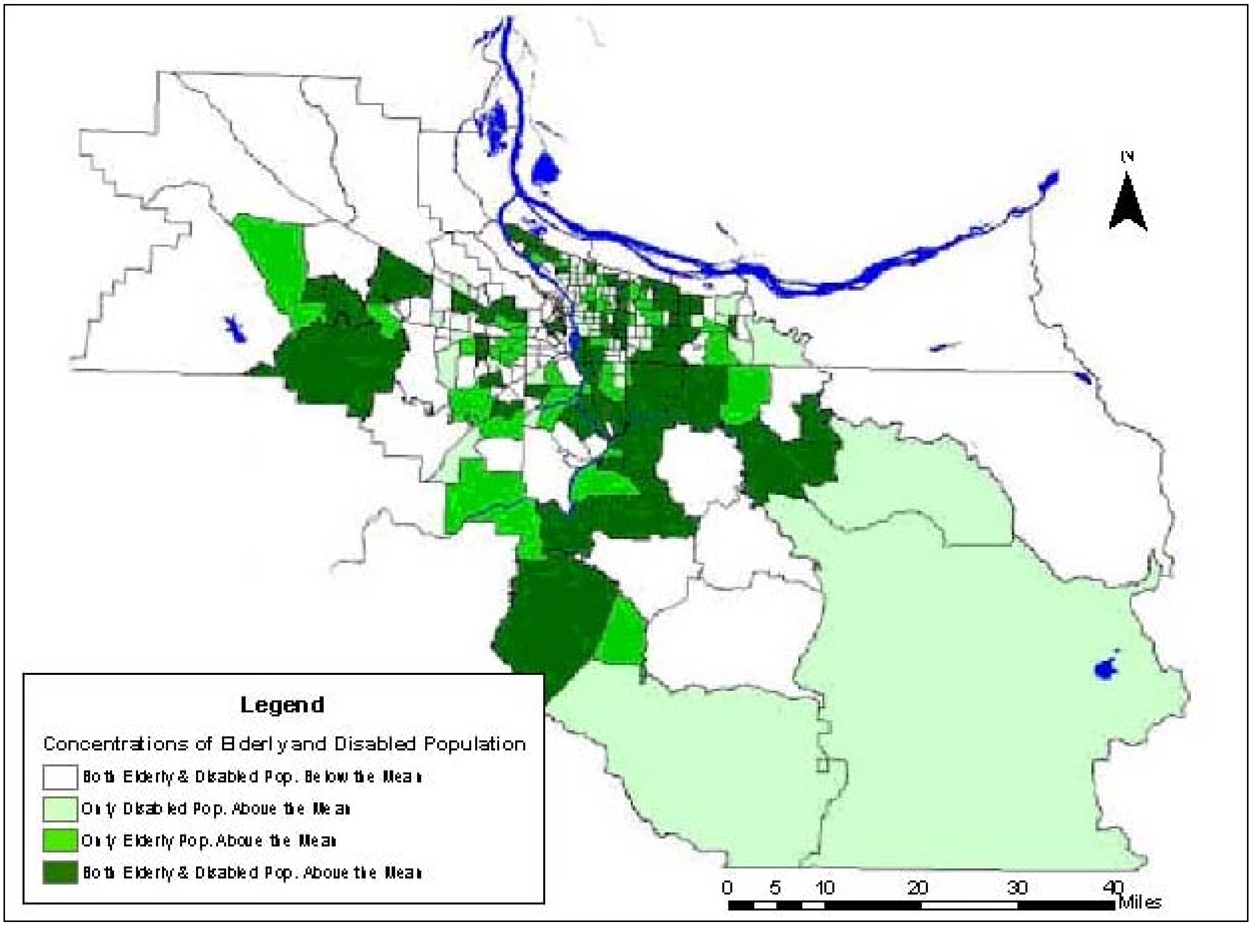
Sources: Metro Regional Land Information System (RLIS) and Census 2000, Summary File 1 (SF1), Table P012, Sex by Age.

Figure 2: Change in Percentage of Residents 65 Years of Age and Older for Three-County Portland Metropolitan Region (Oregon Side), 1990-2000, by Census Tract



Sources: Metro Regional Land Information System (RLIS), Census 2000, Summary File 1 (SF1), Table P012, Sex by Age (Total Population), and Census 1990, Summary Tape File 1 (STF1), Table P011, Age.

Figure 3: Concentrations of Elderly and Disabled Populations as a Percentage of the Total Elderly and Disabled Population in the Tri-County Area



Source: Tri-County Elderly and Disabled Transportation Plan, pg. 28.

As seen in Figure 1, there are fairly high concentrations of elderly in the inner suburban neighborhoods, such as the Southwest Hills, southeast Portland around I-205, and Holgate south into Clackamas County. Inside the downtown area, the highest concentration is seen in the Auditorium District, which extends south and east of Portland State University to the Willamette River. Other high concentrations are seen in eastern Clackamas County, western Washington County, and Wilsonville. All of these areas, including the Auditorium District, are characterized by limited transit service and auto-oriented environments.

Figure 2 shows the percent change in elderly population from 1990 to 2000, by census tract. Two distinct trends can be seen. First, the census tracts in the outer edges of the three counties have seen the greatest percentages of growth. This is especially true for eastern Clackamas and Multnomah Counties, and northern and western Washington County. Second, the inner neighborhoods – those with traditionally better transit access – appear to be seeing fewer elderly as a percentage of the overall population. This could be attributable to renewed interest on the part of younger persons in living an urban lifestyle.

Figure 3, taken from the *Tri-County Elderly and Disabled Plan*, displays the concentrations of elderly and disabled persons as a percentage of the overall elderly and disabled population in the metro region. This map, similar to Figures 1 and 2, show that the outer suburbs are seeing the largest numbers of elderly and disabled persons. The inner neighborhoods show the disabled – but not the elderly – population above the mean. The only city neighborhood with a higher elderly population than the mean is in the Southwest Hills, which has steep grades that make walking and cycling difficult, and has limited transit service. Different from the earlier figures is the finding that outer counties have an elderly and disabled population below the mean. This could be due to a lower overall population in the outer counties.

As seen in Table 1 below, the elderly respondents to the 1994/94 Metro Household Activity Survey are somewhat different from the non-elderly.

Table 1: Comparison of Portland Area Elderly (Aged 65-98) to Portland Non-Elderly (Aged 16-64)

Variable	Non-Elderly	Elderly	% Difference
Average Household Size	2.75 persons	1.86 persons	-32%
Valid Driver's License	93%	85%	-8%
Disability Affecting Outside Travel	2%	10.4%	420%
Annual Household Income (1993) (midpoint of range)	$42,500/year	$27,500/year	-35%

Roughly 85 percent of elderly respondents to Metro's activity survey reported having a valid driver's license, as opposed to 93 percent of the sample aged 16-64. The mid-point in the elderly sample's 1993 median household income range was $27,500/year, as compared to a mid-point median of $42,500/year for the sample aged 16-64. Over 10 percent of the elderly sample reported the presence of a handicap affecting outside travel, as compared to 2 percent of the sample aged 16-64 population. The elderly average a household size of 1.86 persons, as opposed to 2.75 persons per household for the sample aged 16-64. According to the *Tri-County Elderly and Disabled Transportation Plan*, roughly 42 percent of elderly and disabled persons in the Portland region use public transportation for some or all of their transportation needs[4].

[4] The study does not list transit utilization for the elderly populace alone. The elderly, including the elderly with disabilities, comprise roughly 88 percent of the cited 'elderly and disabled' population.

Literature Review

The unique transportation needs of the elderly population is not a new concern. In fact, the subject of elderly mobility outside the city has been an area of research dating back to the 1950s when large numbers of middle-class Americans began leaving the cities. Therefore, the literature that could be used as a resource for this study is immense. Those pieces consulted for this study can be grouped into one of the following topics: changes in travel behavior as people grow older, the influence of land-use on the transportation needs of the elderly, safety concerns surrounding elderly drivers, the effectiveness of transit in addressing elderly transportation needs, and finally, the differences between elderly women and/or elderly minorities and the larger elderly populace. Each of these research areas are discussed in this section.

Travel Behavior of the Elderly

Several studies have been undertaken to explore how the travel behavior of the elderly is different from the non-elderly population, and how it is changing over time. As part of an international study on travel behavior of the elderly, Rosenbloom found that older people around the world are more likely to have a driver's license, to take more trips, and to be the driver of a car than elderly persons a decade ago. She also found that the elderly are less likely to use public transit. Although Rosenbloom found that these trends were more pronounced in North America, she noted that European travel trends are moving in the same direction. Because tomorrow's elderly will be accustomed to using the automobile for their transportation needs, Rosenbloom contends that the mobility gap between the elderly and non-elderly populations will continue to narrow (7).

Evans used data from the 1995 Nationwide Personal Transportation Survey (NPTS) for non-driving individuals 75 aged years or higher to study factors that affect the mobility[5] of the elderly (16). He found that living in an apartment, living in a census tract with high levels of housing density, owning a home, and being highly educated increased the probability of taking a trip outside the home. Furthermore, Evans found that being of a very advanced age, a member of a large household, living in the central city, and living in a census tract with higher proportions of retail employment had a negative association with mobility. Evans suggests that the perception of danger has an impact on central-city dwellers who choose not to leave the house, and that densely-settled, non-commercial, affluent neighborhoods see greater levels of mobility among the elderly.

Kim analyzed mobility of people aged 65 or higher in the Seattle area, using data from the *Puget Sound Regional Council* (PSRC) 1999 Household Activity Survey. Observed variables for Kim's structural equation model[6] included age, gender, education level, presence of a disability, possession of a valid driver's license, and the number of vehicles owned per driver per household. A *latent* variable included in his study was employment/population density, which served as a proxy for land-use. The dependent variable was mobility, comprised of non-home activity time, travel time, and travel distance. Kim concluded that mobility declines with age, and that this is influenced by gender, race, access to a vehicle, and level of education. Being male, having a driver's license, and being highly educated had a positive impact on mobility. Being female, having increased age, and having a disability had a negative impact on mobility. Race also had an effect on mobility – white elderly had a slightly longer non-home activity time, but non-whites had a longer travel time and travel distance. The latent land-use variable was not shown to be significant (17).

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[5] For this study, mobility was defined as whether or not an elderly individual took one or more trips (from one address to another) in the designated trip day.

[6] According to Kim, Structural Equation Modeling (SEM) is a popular statistical method used to simultaneously capture and analyze the complex relationships among personal and household characteristics, activity participation, and travel behavior (Kim, pg. 5).

Elderly and Land-use

Several studies have been conducted that examine the impact of land-use patterns on elderly mobility and physical and mental health. In a policy article entitled *Aging and Smart Growth*, Howe (18) describes how land-use trends of the latter half of the 20th century have limited the residential options, accessibility, and transportation alternatives of the elderly U.S. population. She recommends specific planning initiatives for a change in land-use codes to allow for mixed-use, smart-growth[7] options in cities, suburbs, and small towns around America. Integral to mixed-use development which would benefit the elderly are treatments such as continuous sidewalks, nearby shopping and services, transit access, and an emphasis on safety.

In a research effort focusing on the problems facing the elderly population in the suburbs, Hare (4) addresses the subject of individuals "aging in place" – growing old in the same suburban low-density environments where many moved when they were raising a family. Living in low-density, single-family homes, Hare argues, requires the elderly to do several things that may be beyond their ability and/or their level of comfort, including using stairs, performing home maintenance, and driving an automobile for the majority of trips. Hare also points out that a growing number of elderly persons live alone in their single-family homes, compounding other negative impacts with isolation. He recommends a stepped approach to increasing mobility options for the elderly, such as subsidized taxi service, devices to slow traffic, the construction of continuous sidewalks, and changing local residential zoning codes to allow mixed-use, such as convenience retail, inside residential developments.

[7] The concept of smart growth attempts to combat urban sprawl by using land and public services efficiently, providing transportation options, designing buildings and roads on a human-scale, and incorporating a mix of uses.

Southworth (19) identified some indirect promise for the elderly in the design of neotraditional[8] developments. Older streetcar communities, and the neotraditional developments that attempt to replicate them, have sidewalks and traffic-slowing devices that make it safer and easier to walk than in traditional suburbs. Furthermore, neotraditional communities encourage mixing residential with neighborhood commercial, employment, and public/institutional development, in an attempt to reduce trip distance. Finally, Southworth highlights 'granny flats[9],' which are found in older streetcar neighborhoods and could serve to increase housing options for seniors, who may want a smaller dwelling with fewer maintenance requirements.

Elderly Drivers and Safety

One common concern voiced by researchers, media, and families alike is how to help the elderly maintain independence while preventing accidents. McKnight (13) conducted a study on the safety of the elderly behind the wheel and reported that the age cohort of 75 and higher are more likely to be seriously injured or killed in an automobile accident than any other cohort except teenagers. This is not due to an inability to drive, but to the frailty of the elderly – if they are in an accident, they are more likely to be seriously injured. Historically, this threat had been moderated by the fact that the elderly traveled less than the rest of the population, but this is changing over time. McKnight argues that, with greater mobility of the elderly through increased reliance on automobiles, the injury and fatality rate for elderly is likely to increase dramatically.

Wachs (8) describes accident statistics from California which show that males aged 85-years and older are 149 percent more likely to have a fatal collision than the male population as a whole, and females aged 85 and higher are 87 percent more likely to have a fatal collision than the female

[8] Neotraditional is defined as having "somewhat higher densities, a greater mix of uses, provision of public transit, accommodation of the pedestrian and the bicyclist, and an interconnected pattern of streets" (Southworth, pg. 28).
[9] An apartment on the same lot with a larger single-family home, often above the garage or attached to one level of the main house.

population as a whole. For those aged 75 and higher, Wachs states, this is due at least in part to a diminished ability to drive. Wachs recommends training health care professionals in the importance of reporting illnesses and conditions to the Department of Motor Vehicles (DMV), educating the elderly on compensating for reduced driving abilities, improving highway and vehicle design to improve driver safety, and improving community design to encourage walking.

Elderly and Transit

Fixed-route and paratransit services often cite the elderly as one of their major rider segments, yet land-use trends have made it more difficult for transit to serve the elderly living outside the central city. In a study on modeling senior acceptance of new transit systems, Abdel-Aty (20) researched whether elderly people would be willing to try new technologies, such as real-time paratransit[10], in-home information systems[11], or personal information systems[12], if these systems were made available to them. He used a Computer-Aided Telephone Interview to administer a 105-question survey to people aged 65 years and older in the Sacramento, CA area. His findings were that females were more likely to use transit, and are more likely than males to choose real-time paratransit. High-income people are also more likely to choose real-time paratransit. 'Younger' elderly (those aged 65-74) are more likely to use transit if information kiosks, in-home information systems, or personal information systems are available. His final conclusions are that many groups of senior travelers are willing to use new transportation systems, and change their primary mode of travel if better systems are available. Abdel-Aty did not address the possibility that his chosen

[10] Real-time paratransit is defined as door-to-door, shared-ride transit service that can be reserved the same day as the trip is made (Abdel-Aty, pg. 104).
[11] In-home information systems would deliver the same types of information at home as information kiosks provide at transit centers (Abdel-Aty, pg. 105).
[12] Personal information systems would provide the same type of information as in-home information systems and information kiosks, but in a small, portable device (Abdel-Ady, pg. 106).

Computer-Aided Telephone approach biased the results of his study by excluding those elderly persons who are hearing impaired or so wary of technology that they would not take the survey.

Correa, Jacoby, and Vogel researched how best to improve public transportation programs in the Pittsburgh, PA area to maximize elderly satisfaction, given certain budgetary constraints. They studied several transportation modes and financing options, and identified fully-subsidized paratransit services as the most effective approach to serving the needs of the elderly. Given this finding, they also concluded that providing the level of service for the elderly that would be required to be effective would take a very large amount of financial resources. (21).

Coughlin and Lacombe (3) addressed the need to maintain social well-being for the elderly, and outlined approaches for the transportation community to provide mobility and access to those unwilling or unable to operate an automobile. Tight budgets force existing paratransit operators – sometimes the only transportation option available to seniors – to serve only those trips considered as 'highest priority.' In general, this highest priority rating is given only to medically-necessary trips. Trips related to non-urgent medical and health care, and shopping for food and basic necessities, are provided as a second-tier priority. Trips related to social-health – visits with friends and family, "bingo nights," and similar – are given the lowest priority level and are largely ignored.

Elderly Women

Elderly women present special planning challenges because of their longer life expectancies and lower licensing rates. Several studies have highlighted these different travel patterns and transportation needs. Foley et al. (22) used data from a nationwide longitudinal study on aging to estimate total driving life expectancy of U.S. drivers aged 70 years and higher. They found that the time between the elderly population's cessation of driving and their life expectancy was different for men and women. Men were expected to rely on alternate sources of transportation for roughly seven years while women would rely on alternate sources of transportation for roughly ten years. The implication of this finding is that women are overall going to spend more time relying on public transit and other transportation alternatives than men.

Wilkins et al. (23) conducted a study on the mobility of elderly women who had voluntarily stopped driving. They found that females were twice as likely to report that they had stopped driving after retirement than males. The most common reason for this was that their husband was around more (after retirement) and wanted to drive them. However, some women who relied on their husbands to drive them everywhere outlived their husbands, and were then reliant on others or public transit. Many women who had avoided driving for many years found it difficult to resume. However, Wilkins et al. found that, with some instruction and practice with a trained driving educator, the women in their study regained their confidence in driving and felt greater mobility and independence.

A study conducted by Rosenbloom and Ståhl (2) found that a majority – roughly 70 percent in developed countries – of the oldest elderly (defined by their study as being over 80 years of age) are women. Elderly women are more likely to be widowed, to live alone, and to live in poverty. A growing percentage of older women are divorced or never married, and do not have children. This further isolates them in older age.

Elderly Minorities

Rosenbloom and Waldorf (24) tested the effects of race and ethnicity on the probability of the elderly to take transit, using data from the 1995 NPTS. The authors used a series of multinomial logistic regression equations to capture mode choice by race, ethnicity, and residential location. They concluded that elderly African-American women are more likely to use public transportation than any other race or ethnicity, and that elderly Hispanic women were significantly *less* likely to have a driver's license, but *more* likely to make trips in automobiles, than elderly Caucasian women. Elderly Hispanic women, it was found, generally travel with relatives and family members. Finally, this study found that older Caucasian women traveled more than three times as many daily miles as elderly African-American or elderly Hispanic women.

There are several emerging themes in the literature. First, the elderly population is growing at a faster rate than the population as a whole, and will continue to grow at this accelerated rate for at least the next 30 years. Second, more elderly are using the automobile as their preferred mode of transportation. Third, the majority of elderly persons live outside the central city, where non-vehicle transportation options are difficult to find. Fourth and finally, the literature agrees that the planning community needs to do more to address the growing mobility problems of the elderly cohort.

Although this paper builds upon many of the themes found in the literature, it is unique in many ways. A search of studies conducted using the Metro Household Activity Survey did not identify any prior study on elderly mobility. None of the literature reviewed combined all three research questions asked for this study, and very few studied a particular geographic location. Only one other study was found which studied mobility of the elderly for a specific geographic location (Seattle) (17).

This paper does borrow from the ideas and questions of other research works. For example, the first phase of analysis, exploring overall mobility levels, borrowed ideas for variables and technique from Kim (17) and Evans (16). The second phase of analysis, which explored the *type* of trip taken over the two-day period, borrowed ideas from Evans (16), Okola (11), and Stamatiadis et al. (25). Phase three was modeled very closely after Rosenbloom and Waldorf (24).

Methodology and Data Analysis

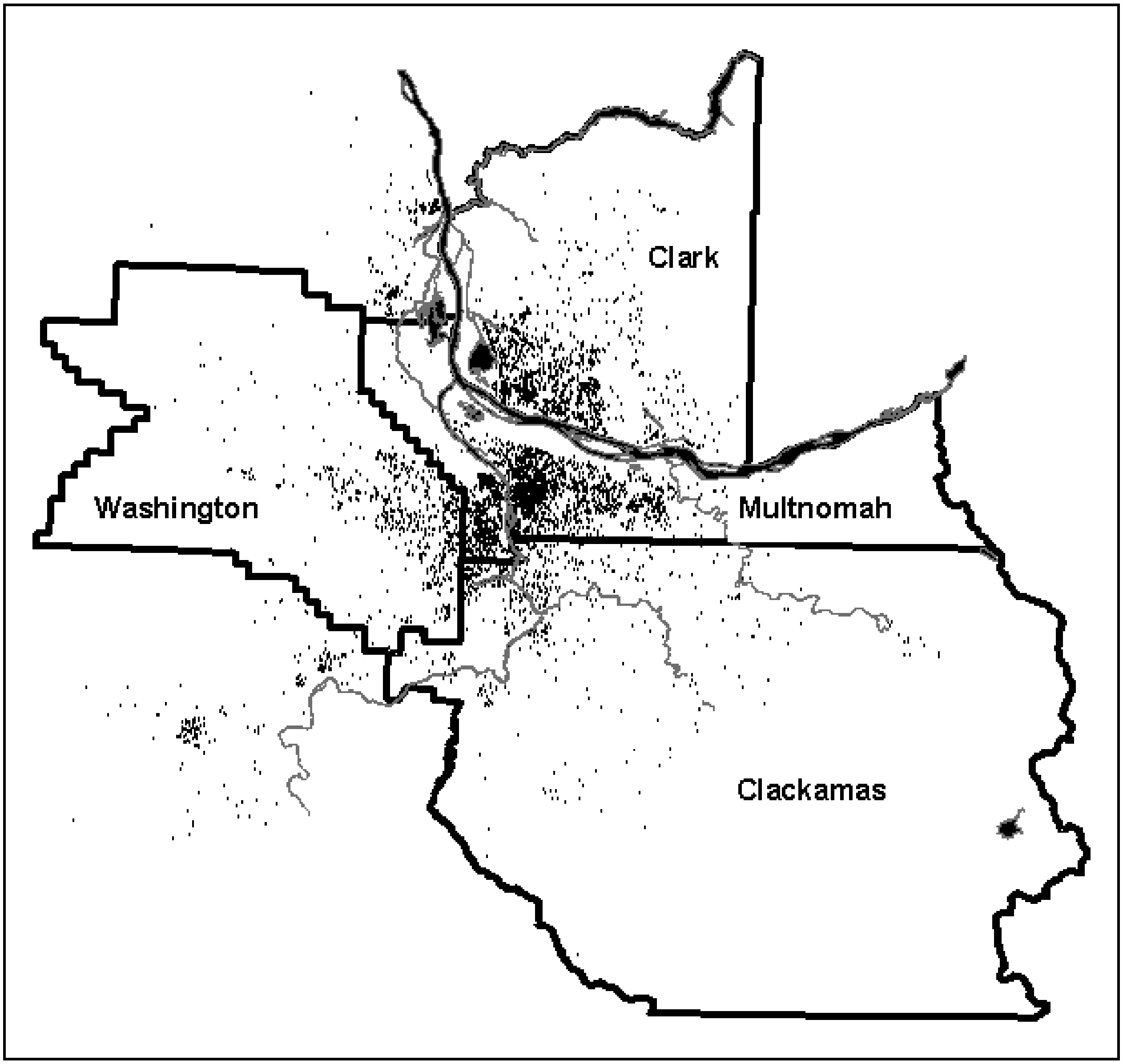
Metro's Household Activity Survey

The data used in this study came from the 1994/95 Metro Household Activity Survey. The 1994/95 survey was administered by Metro, the metropolitan planning organization for the three-county Portland region. The Metro survey collected household- and person- level demographic and activity data from a total of 10,048 individuals in 7,090 households in the region between March 1994 and April 1995. The age of respondents ranged from 0[13] to 98. Details about 164,991 separate activities involving 71,808 trips were collected over a two-day study period. Figure 4 on the next page shows the geographic distribution of respondents in the Portland metropolitan area.

The survey asked respondents to provide details on all activities they undertook over the two-day period. Information collected includes the type of activity, its time and duration, and whether or not it involved travel. If the activity did involve travel, a series of questions were asked in relation to the mode of transportation used to reach the desired location and the factors affecting that mode choice. Demographic data includes age, sex, race/ethnicity, type of employment, household income, and presence of a disability that impacts travel. Surveys were sent by mail, though all data were collected through follow-up telephone interviews. For more information on the household activity survey, see the Metro 1994-95 *Household Activity Survey Summary of Results* (26), available from Metro. Code books for the activity, household, and person datasets are attached as Appendix A, B, and C respectively.

[13] Parents were asked to fill out travel diaries for children too young to respond directly.

Figure 4: Geographic Distribution of Households in the Portland Metropolitan Area



Source: Metro RLIS and 1994/95 Household Activity Survey, Household Dataset

There are a number of reasons why these data are powerful for research studies. First, the sample size and variety of questions (roughly 95 questions in total) allows the analyst to ask many questions about travel behavior in the region. Second, the datasets can be linked to allow analysis to be done at both the individual and the household level. For example, one could explore how factors associated with a household, such as household size, length of time in residence, and household income, affect travel behavior, associated with the individual. Finally, the data can be linked to a geographic location which allows researchers to identify spatial patterns and trends. Although several researchers have used the data for academic and practical purposes, (the most notable of which has been the development of the Transportation Analysis Simulation System (TRANSIMS) model by the Los Alamos National Laboratory), no past studies were found using these data to specifically explore travel behavior of the elderly.

This section describes three phases of analysis conducted for this study. The first phase explored how age and other demographic variables affect mobility, as measured by the total number of trips taken over the two-day study period. The second phase looks at how the trip purpose can be explained for the elderly population. The third phase explores the factors that affect the mode of transportation used for a given trip.

Phase 1: The Impact of Age on Mobility

METHODOLOGY

The purpose of this phase of analysis is to explore how mobility changes with age. Much of the literature notes a decline in activity as people age, particularly as health starts to fade. This diminished mobility could be based on a number of factors. Rosenbloom (7) and Coughlin and Lacombe (3) have tied mobility of the elderly to income and the presence of a valid drivers license. Others, such as Howe (18), point to the importance of land-use as a factor – as the ability to drive fades, are other transportation options available? Finally, Rosenbloom and Waldorf (24) point to the importance of social networks for mobility options – if an elderly person lives in a large household, their ability to find someone to drive them is increased.

For this research, mobility was measured as the total number of trips taken by each respondent aged 16-98 over the two-day study period, and was derived from the activity dataset. Trips were defined as activities which took the individual away from their present location. The trip records used were for all modes of transportation, including automobile, school bus, city bus, light rail, bicycle, walking, and 'other.' Variables from the household and activity datasets were merged with the person dataset using a unique identification number. The starting sample size was the total number of respondents to the survey (N = 10,048). The sample size used in the analysis was smaller because those aged 15 and younger, as well as those that did not know or refused to give their age, were excluded from the analysis. Children were excluded to be consistent with other types of analysis, such as the U.S. Census. The actual sample size was 7,829.

The impact of age on mobility was measured by creating a linear regression model with the total number of trips as the dependent variable. The independent variables included in this phase are listed with their source in Table 2, and are described in the following paragraphs.

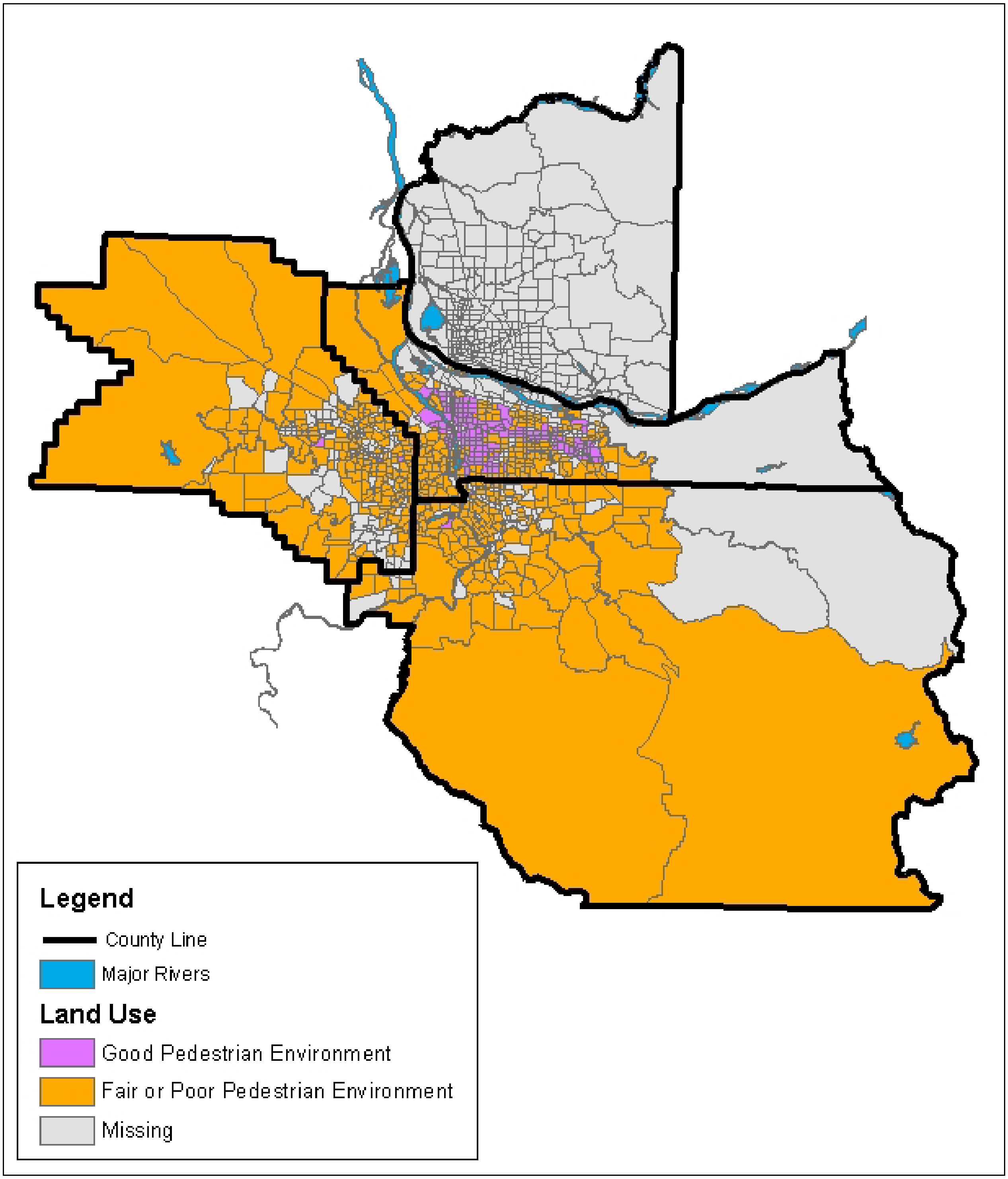
Household size is a continuous variable that ranged from one to eight (mean = 3). Licensed to drive is a dummy variable with zero indicating that the respondent is not licensed to drive, and a one indicating that the respondent has a valid license. Of the entire sample, 92 percent of respondents reported possessing a valid driver's license. Age is a modified continuous variable, which includes all respondents aged 16-98. The median age of the sample is 45. Disabilities affecting outside travel is a dummy variable with a one indicating the presence of a disability. Only three percent of the sample recorded the presence of a disability. Land-use was a dummy variable recoded from Metro's 'stratum' variable. The recode was rough and cursory; a 'good' land-use (value = 1) is one where transit is available and/or sidewalks and bike lanes are present in the immediate vicinity of the place of residences. A 'bad' land-use (value = 0) was one where sidewalks were not present or not continuous, and/or where the respondent lived far from services and activity destinations. Under this definition, only ten percent of respondents were reported as living in a 'good' land-use environment. See Appendix A for specific coding of the 'stratum' variable. Figure 5 displays the geographic distribution of 'good' land-use for the region. Finally, income was collected for the household, and was an incremental value ranging from 'under $5,000' to '$60,000 or more.' The midpoint of the median annual household income range was $42,500. The mean number of trips taken over the two-day study period is 7.5 trips.

Table 2: Variables Used in Phase 1 Analysis

Variable	Dataset	Mean (Median) Value
Household Size	Household	3 Persons
Licensed to Drive (1 = yes)	Person	92% Licensed
Age	Person	(45 Years)
Disability Affecting Outside Travel (1 = yes)	Person	3% Disabled
Land-use (1 = good pedestrian environment)	Household	10% Good Land-use
Annual Household Income (1993)	Household	($42,500/year)
Total Number of Trips (Over two days)*	Activity	7.5 Trips

* Dependent variable

Figure 5: Type of Pedestrian Environment



Source: Derived from Metro RLIS and 1994/95 Household Activity Survey, Household Dataset

DATA ANALYSIS

To clarify the impact of age on mobility, the analysis was performed for the sample as a whole, and again with ages split into four 'age bands.' These age bands included: ages 16-64, 65-74, 75-84, and 85-98. Table 3 shows the final regression coefficients for all variables.

Table 3: Final Regression Coefficients for Entire Sample and Split by Age Group

Age Group		Constant	Household Size	License Use	Age	Disability	Land-use	Income
All Age Groups	Beta		0.019	0.119	-0.079	0.014	0.074	0.083
N = 7,829	t	16.817	1.179	7.907	-5.082	0.968	4.873	5.445
	Significance	0.000	0.239	**0.000**	**0.000**	0.333	**0.000**	**0.000**
	Adjusted R^2 = .032							
16-64	Beta		0.033	0.110	-0.024	0.023	0.078	0.074
N = 6,679	t	14.558	1.960	6.766	-1.421	1.432	4.804	4.503
	Significance	0.000	**0.050**	**0.000**	0.155	0.152	**0.000**	**0.000**
	Adjusted R^2 = .021							
65-74	Beta		-0.164	0.111	-0.084	0.072	0.050	0.022
N = 718	t	2.861	-3.008	1.991	-1.562	1.331	0.919	0.400
	Significance	0.004	**0.003**	**0.047**	0.119	0.184	0.359	0.690
	Adjusted R^2 = .033							
75-84	Beta		-0.070	0.095	-0.155	-0.102	0.019	0.174
N = 357	t	2.374	-0.829	1.142	-1.908	-1.241	0.230	2.044
	Significance	0.019	0.409	0.256	0.058	0.217	0.818	**0.043**
	Adjusted R^2 = .049							
85-98	Beta		0.231	0.430	0.066	-0.029	0.355	-0.031
N = 75	t	-0.217	0.768	1.907	0.287	-0.129	1.479	-0.115
	Significance	0.831	0.453	0.074	0.778	0.899	0.158	0.910
	Adjusted R^2 = .017							

*NOTE: Numbers in **bold** denote significance at a 95 percent confidence interval or higher.*

The overall R^2 values for this analysis were small, indicating that other factors not studied or captured in the survey have an affect on the total mobility of the sample. However, the R^2 value for the individual age bands increases from .021 for the 16-64 age band, to .033 for the 65-74 age band, to .049 for the 75-84 age band. It drops, however, to .017 for the oldest age category (aged 85-98). This indicates that, on the whole, the factors studied have more of an influence on total mobility for the 75-84 age category than for the younger age groups, and the drop for the eldest category could be due to its small sample size (N = 75). The 85-98 age group comprised only 0.96 percent of the entire sample.

Household size was significant and positive for the 16-64 age group, significant and negative for the 65-74 age group, negative but not significant for the 75-84 age group, and positive and not significant for the sample as a whole as well as the 85-98 age group. It is not clear why the variable changed sign, though one possibility could be with couples growing old together – if there is someone inside the household who can run errands for the elderly person, the necessity for that person to go out decreases. This is not true for the oldest age group, which is also the age group where one spouse is likely to become deceased. Another person in the household at this advanced age is more likely to be a caretaker or child, who could take the elderly person with them on trips. This finding could also be a limitation of the study due to the small sample size. Household size could be positive for the non-elderly sample because with a median age of 45 children are more likely to be present in the household. Children trigger extra trips due to after-school activities, intramural sports, part-time jobs, or social activities.

Possession of a valid driver's license was positive for all age categories, and significant for the sample as a whole, the 16-64 age group, and the 65-74 age group. The variable was close to being significant at the 95 percent confidence interval (t = 1.91, significance = .074) for the 85-98 age group. This is consistent with the literature, which states that the ability to drive improves the ability of the elderly person to stay mobile. The variable had a positive but not significant association with mobility for the 75-84 age group.

Age was considered even though the analysis also split the sample by age category. Even within the age category, age was shown to have a negative impact, for all but the oldest age grouping. This indicates that those at the higher end of the age group are likely to take fewer trips than those at the lower end. This finding is not statistically significant for the individual age bands, but is significant for the sample as a whole.

Presence of a disability which affects travel outside the home was not significant in any of the age categories. The presence of a disability was expected to have a significant negative impact on the total number of trips taken by an individual, due to the greater amount of effort and longer period of time it could possibly take for the individual to make a trip. This was found to be true (though not significant) for the two oldest categories (ages 75-84 and 85-98), but not for the youngest two (ages 16-64 and 65-74). It is possible that younger individuals reporting a disability affecting outside travel have borne it for a longer period of time and have found ways to mitigate mobility loss (e.g., through a motorized wheelchair), whereas older individuals reporting a disability could have seen it brought on by age, and may be less confident with their ability to remain mobile, or operate equipment geared towards helping the disabled. Although only a small number of respondents – 283, or 3 percent of the total sample – recorded the presence of a disability, almost half of these (120 respondents) were aged 65 or higher. Not surprisingly, the percentage of respondents who recorded the presence of a disability which affected outside travel increased with age, from 2 percent of the under-65 sample to 25 percent of the 85 and higher sample. See Table 4.

Table 4: Percent of Respondents Reporting a Disability Affecting Outside Travel, by Age Category

Age Categories	Percent Reporting Disability
Under 65	2.0
65-74	6.8
75-84	14.6
85 and higher	25.3
(Total for Entire Sample)	(3 percent)

The presence of a good land-use environment was shown to be positive for all age categories, indicating that an environment which facilitates walking and transit trips has a positive impact on mobility of the elderly. The land-use finding however, was found to be significant only for the non-elderly sample and the total sample for this phase of analysis. Average household income was positive and significant for the sample as a whole, the 16-64 age category and the 75-84 age category, and positive but not significant for the 65-74 age category. The income variable was found to have a negative but not significant association with the 85-98 age category. The sign of this finding is as expected for all but this oldest age category, as with higher incomes presumably come greater choice, flexibility, and freedom to make more trips. One explanation for the negative sign with the oldest age category could be that the oldest elderly with higher incomes choose to not make trips, and have the ability to hire a caretaker who can go shopping and run other errands for them.

Phase 2: Factors Affecting Trip Purpose for the Elderly

METHODOLOGY

The goal of Phase 2 was to determine what factors influenced the *purpose* of those trips taken by the elderly over the two-day study period. As with Phase 1, trips were defined as activities that took the respondent away from their present location, and included all modes of transportation, including automobile, school bus, city bus, light rail, bicycle, walking, and 'other.' Metro's household activity survey asked respondents to classify their activities into 28 categories, ranging from meals to household maintenance to volunteer work to exercise/athletics (see Appendix A on page A-1 for a listing of the 28 categories in the Metro study). As mentioned earlier, a total of 71,808 trips were taken over the two-day study period. Of this amount, the elderly took 6,551, or 9 percent of those trips.

This study looked only at five types of trips – meals, work, shopping, medical care, and social. These trip types were chosen for two reasons. First, three out of the five types studied (meals, work, and shopping) were the predominant trip types in the study. One of the other trip types (social) was also commonly chosen, but the fifth (medical trips) was not. Table 5 provides specifics on the percentage of persons taking each type of trip. The other reason these trip purposes were chosen for study was based on other literature found on this subject. Coughlin and Lacombe, for example, maintain that seniors make more frequent health-related trips than the general population (3). Evans referenced a decrease in social and recreational trips associated with age (16). Stamatiadis et al. (24) found that age has a negative relationship to the priority given to dining out for non-urban elderly. The majority of these studies have identified the need for people to maintain a certain level of 'recreational' mobility as they age; the decrease in social and recreational trips is negatively associated with the individual's mental well-being.

Four of the five activity categories were selected directly from the categories provided by Metro. The fifth activity category – social trips – was a combination of three separate categories in Metro's study. These were 'visiting,' 'casual entertaining,' and 'formal entertaining.' Other possible social trips, such as 'culture,' 'out-of-home amusements,' and 'spectator athletic events,' were considered but dismissed for fear of diluting the category's intent. As in Phase 1, only activities involving travel were considered. Table 5 shows the frequency of each type of trip included in the study.

Table 5: Trips by Type of Activity

Trip Type	% Total Respondents Who Took This Type of Trip	% Elderly Respondents Who Took This Type of Trip
Meals	65.2	60.6
Work	45.6	9.8
Social	28.9	28.1
Shop	47.3	56.6
Medical	7.2	10.6
	N = 7,829	N = 1,150

As seen above, the elderly were slightly less likely to take a social- or meal-related trip than the population as a whole, and far less likely to take a work trip. However, the likelihood of taking a shopping trip or a medical trip increased after reaching age 65. Frequencies on the specific type of activity were taken from the 'Activity' dataset, and sorted by individual respondent. This information was then merged with the 'Person' dataset, and recoded into a dummy variable to answer the question of whether or not a person took a particular type of trip over the two-day study period. After the merge, the sample size was 7,829, which is equal to the total number of respondents in the study aged 16 to 98. The sample was then narrowed to include just those respondents aged 65-98 (N = 1,150).

This analysis involved five binomial logistic models – one for each type of activity. Each model considered six demographic variables, taken from the 'Person' or 'Household' dataset. Table 6 provides descriptive data on each of the variables considered.

Table 6: Description of Variables Used in Phase 2 Models (for Subset of Elderly)

Variable Name	Description	Dataset	% Responses = 1
Retired (retired or not retired)	0 = not retired 1 = retired	Person	83.2
Gender (male or female)	0 = male 1 = female	Person	56.7
1993 Household Income ($)	Continuous Categorical	Household	Mid-point of median income category is $27,500.
White (white or non-white)	0 = non-white 1 = white	Person	96.5
Handicap (presence of a handicap affecting travel)	0 = no handicap 1 = handicap	Person	10.4
License (presence of a valid driver's license)	0 = no license 1 = valid license	Person	85.9

N = 1,150

DATA ANALYSIS

The dependent variable for each of the five models was whether or not a specific type of trip took place. The question asked was – for the elderly sample, what affects the likelihood of making a (social, meal, work, shopping, or medical) trip? Results from the binomial logistic regression analysis are organized by particular model over the next few pages.

RESULTS OF MEAL TRIP MODEL ANALYSIS

Table 7: Final Regression Coefficients for Meal Trip Model

Variable	B	Wald	Sig.	Exp(B)
Retired	-.599	8.658	**.003**	.550
Gender	-.093	.381	.537	.911
Income	-.065	8.311	**.004**	.937
White	-.122	.091	.763	.885
Handicap	-.151	.382	.536	.860
License	.830	14.042	**.000**	2.294
Constant	.858	2.899	.089	2.358
Nagelkerke R^2 = .051				

*NOTE: Numbers in **bold** denote significance at a 95 percent confidence interval or higher.*

The R^2 values for all models are relatively small, which infers that there are reasons beyond the variables considered which explain why individuals make different types of trips. Three variables were found to be statistically significant at explaining the likelihood of taking a meal trip among the elderly – being retired, having a higher income, and the possession of a valid driver's license. All three are significant at the 99 percent confidence interval. The retired elderly are 45 percent less likely than the non-retired elderly to take a trip for a meal. This could be due to fixed retirement incomes, fewer transportation options, or less desire to have meals outside the home. Elderly individuals with a higher income are slightly (6 percent) less likely than lower income elderly to take a meal-related trip. This is surprising, as higher income elderly are expected to have greater levels of mobility and to take more 'fun' trips. Finally, elderly persons in possession of a valid driver's license were much (129 percent) more likely to take a meal-related trip. This is consistent with the literature, which states that a driver's license greatly enhances mobility levels among the elderly. Elderly women were slightly (9 percent) less likely than elderly men to take a meal-related trip. This finding was not significant. The presence of a disability affecting outside travel and being Caucasian had a negative but not significant influence on the likelihood of taking a meal-related trip among the elderly sample.

RESULTS OF WORK TRIP MODEL ANALYSIS

Table 8: Final Regression Coefficients for Work Trip Model

Variable	B	Wald	Sig.	Exp(B)
Gender	-.538	5.131	**.023**	.584
Income	.041	1.356	.244	1.042
White	-.396	.492	.483	.673
Handicap	-2.072	4.201	**.040**	.126
License	.849	2.506	.113	2.337
Constant	-2.470	10.194	.001	.085
Nagelkerke R^2 = .065				

*NOTE: Numbers in **bold** denote significance at a 95 percent confidence interval or higher.*

The work model had the highest R^2 value of all models run under this phase of analysis, but only two of the five variables included[14] were found to be significant. These two variables were gender and presence of a handicap which affects outside travel. Both variables were significant at the 95 percent confidence interval. Being female had a negative and significant influence on the likelihood of making a work trip among the elderly, with elderly females being 42 percent less likely than elderly males to make such a trip. Respondents reporting a handicap were 83 percent less likely to make a work trip. Household income had a positive but weak (4 percent) and not significant relationship with the likelihood of making a work trip within this sample. There could also be some collinearity between the income variable and the work trip, as presumable people with jobs make more money. However, the income is tied to the household and not to the individual, so the variable is still useful for this study. Those with a valid driver's license were 134 percent more likely to make a work trip, and elderly Caucasians were 32 percent less likely to take a work trip over the two-day study period. Neither of these latter two variables were found to be significant.

[14] The variable 'retired' was not included in this model because it was assumed to have collinearity problems with the work trip.

RESULTS OF SOCIAL TRIP MODEL ANALYSIS

Table 9: Final Regression Coefficients for Social Trip Model

Variable	B	Wald	Sig.	Exp(B)
Gender	.105	.437	.509	1.111
Income	-.022	.863	.353	.978
White	-.045	.011	.918	.956
Handicap	-.395	1.881	.170	.674
License	.714	6.907	**.009**	2.042
Retired	.075	.135	.713	1.078
Constant	-1.397	6.443	.011	.247
Nagelkerke R^2 = .021				

*NOTE: Numbers in **bold** denote significance at a 95 percent confidence interval or higher.*

Only one variable was shown to be significant for the social trip model. Elderly persons with a valid driver's license were found to be 104 percent more likely to make a social trip than the non-licensed elderly sample. This was significant at a 99 percent confidence interval. The finding is entirely consistent with the literature, which states that not only are the elderly increasing personal mobility through increased use of an automobile, but that losing one's license has a tremendously negative impact on mobility.

Three other variables, though not found to be significant, had an expected sign and level of magnitude. Elderly women were 11 percent more likely than elderly men to make a social trip. The retired elderly were slightly (8 percent) more likely to make a social trip than those elderly who are still working. The presence of a disability affecting outside travel had a negative and strong (33 percent) but not significant association with making a social trip. Findings from the other two variables were surprising both in their finding of non-significance and in their sign. Higher income and Caucasian elderly were both slightly (2 and 4 percent, respectively) less likely to make a social trip. It was expected that being both variables would have a positive effect on the social trip model. However, because 'social' trips were narrowly defined, it is possible that expanding the definition to include cultural or athletic events, and other activities would impact the results of this model.

RESULTS OF SHOPPING TRIP MODEL ANALYSIS

Table 10: Final Regression Coefficients for Shopping Trip Model

Variable	B	Wald	Sig.	Exp(B)
Gender	.270	3.329	.068	1.310
Income	-.029	1.664	.197	.972
White	-.104	.068	.794	.901
Handicap	-.571	5.581	**.018**	.565
License	.704	10.173	**.001**	2.023
Retired	.293	2.466	.116	1.341
Constant	-.366	.555	.456	.693
Nagelkerke R^2 = .040				

*NOTE: Numbers in **bold** denote significance at a 95 percent confidence interval or higher.*

The shopping trip model showed two demographic variables to be significant. Those elderly who recorded a presence of a disability affecting outside travel were 43 percent less likely than the non-disabled elderly to make a shopping trip. This was significant at the 95 percent confidence interval. As with other models, the presence of a valid driver's license had a large (102 percent) and positive association with the likelihood of making a shopping trip among the elderly population. This is significant at the 99 percent confidence interval. Both of these findings are as expected and discussed in earlier models.

Gender had a positive association with making a shopping trip among the elderly sample. Elderly persons with a higher income had a slight negative association with the likelihood of making a shopping trip. Elderly Caucasians also were slightly (10 percent) less likely to make a shopping trip, and the retired elderly were 34 percent more likely than non-retired elderly persons to make a shopping trip. This is somewhat intuitive, as the retired elderly supposedly have more non-work time to conduct shopping errands. None of these last set of variables were found to be significant.

<u>RESULTS OF MEDICAL TRIP MODEL ANALYSIS</u>

Table 11: Final Regression Coefficients for Medical Trip Model

Variable	B	Wald	Sig.	Exp(B)
Gender	.068	.083	.773	1.070
Income	-.038	1.113	.291	.962
White	.413	.304	.581	1.511
Handicap	.204	.335	.562	1.226
License	.056	.027	.869	1.058
Retired	.813	4.471	**.034**	2.256
Constant	-3.080	11.379	.001	.046
Negelkerke R^2 = .021				

*NOTE: Numbers in **bold** denote significance at a 95 percent confidence interval or higher.*

One variable was found to be significant for the medical trip model. Being retired had a very strong positive association with the likelihood of taking a medical trip – retired elderly were 126 percent more likely to take a medical trip than the non-retired elderly sample (significant at the 95 percent confidence interval). There are two explanations that support this finding. First, retired elderly could have more time to make medical visits for preventative care. Second, the older elderly are more likely to be retired than the younger elderly. As discussed on page 2, while just 74 percent of the 65-69 age group were retired in 2002, 95 percent of the 75 and higher age group were retired (6). Older elderly may be more likely to experience medical problems associated with advanced age.

Other variables in the study, though not found to be significant, are discussed below. Elderly women were slightly (7 percent) more likely to visit a medical office than elderly men. This could be due to the longer life expectancy associated with females, the caretaker role commonly taken on by women of all ages, or the perception that women pay more attention to their health than men. Income had a weak negative association with the likelihood of taking a medical trip, and being Caucasian had a positive association with the medical trip. Presence of a handicap had a strong positive association with the medical trip. Elderly in possession of a valid driver's license were slightly (6 percent) more likely to make a medical trip than those elderly without a license.

Phase 3: The Impact of Age on Mode of Transportation

METHODOLOGY

This final phase of analysis investigated how certain demographic factors affected the mode of transportation used for each trip taken by the elderly in the Metro Household Activity survey. This question has been addressed in at least two pieces of research using data from the 1995 NPTS. In the first study, Rosenbloom and Waldorf (24) looked at effects of race on mode choice for the elderly, and found that racial minorities, particularly African Americans, are less likely to make auto trips and more likely to use public transportation than Caucasians, and that Hispanics were less likely to use public transportation than other races and ethnicities. Another study conducted by Evans (16) found that women, the elderly, African Americans, and people living in census tracts with higher median home values were positively associated with public transit availability. Furthermore, he found that for the non-driving elderly population with 'good' levels of transit availability, transit ridership was positively associated with incomes and education, and negatively associated with being Caucasian and a larger household size.

For each activity that involved a trip, Metro asked respondents what mode of transportation was used to reach the destination. Choices included the following:

- Walk
- Bicycle
- School Bus
- Public Bus
- MAX (light rail)
- Personal Vehicle
- Non-Personal Vehicle

- Other[15]

Because this study was only concerned with the modes of walk, bicycle, transit, and automobile, the 'school bus' and 'other' modes were not included in the analysis. This step brought the initial sample size of 71,808 trips down to 69,967 trips. The 'transit' variable was a combination of 'public bus' and 'MAX' categories and the 'auto' variable was a combination of 'personal vehicle' and 'non-personal vehicle' categories. The 'walk' category and the 'bicycle' category were selected directly from the categories provided from Metro. Unfortunately, paratransit was not listed as a category. For this analysis, it is assumed that paratransit fell under the 'public bus' category. Table 12 below provides a breakdown of trips taken by mode.

Table 12: Mode Split by Survey Respondents (Entire Sample)

Mode	Frequency	Percent of Trips Made by This Mode
Auto	59,883	83.4
Transit	2,229	3.1
Bicycle	823	1.1
Walk	7,032	9.8
Total Trips Included	69,967	97.4
Other (school bus, other)	1,841	2.6
Total Trips Overall	71,808	100.0

The sample size was further decreased by filtering out only those trips made by persons aged 65 and higher. The resulting sample size was 6,551 trips. A multinomial logistic regression was used with mode of transportation as the dependent variable[16]. The 'walk' mode was listed as the baseline – the question asked of the model was "compared to taking a walk trip, what affects an elderly individual's decision to take a trip by automobile, transit, or bicycle?" Because it served as the baseline for analysis, results specifically explaining the walk trip are not included. Seven individual

[15] Typical choices in the 'other' category included boat, airplane, and Intercity Rail.

[16] Multinomial logistic regressions are used where the analysis covers a choice to be made (e.g., mode of travel). This is different from the Phase 2 binomial logistic models, where respondents were choosing whether or not to take a *certain type* of trip, and the possibility of taking one type of trip did not affect the individual's choice to take another type of trip.

variables were included in the analysis; most of these were also included in Evans' and Rosenbloom's studies. Table 13 provides some descriptive data on the variables considered, in relation to *trips* taken by the elderly (not percentage of elderly respondents).

Table 13: Description of Variables Used in Phase 3 Model

Variable Name	Description	Dataset	% Responses = 1
Land-use (good pedestrian environment defined as being near sidewalks and transit)	0 = poor environment 1 = good environment	Household	9.2
Retired (retired or not retired)	0 = not retired 1 = retired	Person	79.2
Gender (male or female)	0 = male 1 = female	Person	54.3
White (race, white or non-white)	0 = non-white 1 = white	Person	96.6
License (presence of a valid driver's license)	0 = no license 1 = license	Person	92.3
Home Language (language other than English spoken at home)	0 = English 1 = other language	Person	4.9
Handicap (presence of a handicap that affects travel)	0 = no handicap 1 = handicap	Person	6.5

N = 6,551 trips

Similarly to past phases, the variables in Phase 3 came from the Activity, Household, and Person datasets, and were merged based on household ID and individual ID. Home language was included in this phase in addition to being Caucasian. Home language was initially considered in earlier phases but not found to be significant.

DATA ANALYSIS

Table 14 shows the results of this analysis.

Table 14: Final Regression Coefficients for Phase 3 Analysis

	Variable	B	Wald	Sig.	Exp(B)
Auto Trip	Intercept	2.081	10.286	.001	
	Income	.080	16.692	**.000**	1.084
	Land Use	-1.621	115.253	**.000**	.198
	Retired	-.372	4.790	**.029**	.689
	Gender	.045	.128	.720	1.046
	White	-1.397	5.004	**.025**	.247
	Licensed	1.539	71.802	**.000**	4.660
	Home Language	.428	1.533	.216	1.535
	Handicap	.933	10.153	**.001**	2.543
Transit Trip	Intercept	-15.866	590.729	.000	
	Income	-.119	5.959	**.015**	.888
	Land Use	.876	9.150	**.002**	2.400
	Retired	.563	1.045	.307	1.756
	Gender	.623	4.335	**.037**	1.865
	White	14.478	.000	.991	
	Licensed	-.956	9.088	**.003**	.384
	Home Language	-13.842	.000	.988	.000
	Handicap	-14.444	.000	.986	.000
Bicycle Trip	Intercept	-15.916	.000	.984	
	Income	.194	2.441	.118	1.214
	Land Use	-15.057	.000	.995	
	Retired	-.782	.360	.548	.457
	Gender	.331	.066	.797	1.392
	White	-4.579	14.101	**.000**	.010
	Licensed	14.467	.000	.986	
	Home Language	2.572	4.694	**.030**	1.309
	Handicap	-13.160	.000	.995	.000
Nagelkerke R^2 = .210					

*NOTE: Numbers in **bold** denote significance at a 95 percent confidence interval or higher.*

This model tells us that being an elderly female has a positive relationship with taking an automobile, transit, or bicycle trip as compared to walking. This is significant at the 95 percent confidence interval for the transit trip, but not significant for the auto or bicycle modes. Income is positively related to taking an auto trip, which is consistent with other transportation findings. This finding is significant at the 99 percent confidence interval. Income is also positively associated with taking a bicycle trip, but this finding is not significant. Finally, there is a negative relationship between income and taking a transit trip (significant at the 95 percent confidence interval) for the elderly sample, which is also consistent with the literature.

The land-use finding shows that having a 'good' pedestrian environment has a negative and significant relationship with taking an auto trip, and that elderly people are 80 percent less likely to take an auto trip if the pedestrian environment is 'good.' However, the pedestrian environment also had a negative, though not significant, impact on taking a cycling trip. This is somewhat understandable however, when considering that these findings are in comparison to taking a walking trip, and that the U.S. is challenged to create a cycling environment considered safe and comfortable for the elderly population. Finally, land-use had a positive association with taking a transit trip among the elderly – elderly were 140 percent more likely to take a transit trip as compared to walking if the pedestrian environment is 'good.' Although at first this may seem contradictory, it could be that, though the elderly may have difficulty walking to their destination, if they have a 'good' pedestrian environment, they are more likely to use it to walk to the nearest transit stop.

Being retired had a negative association with the likelihood of taking a trip by auto or bicycle as compared to walking, and a positive association with the likelihood of taking a trip by transit. This finding was significant at the 95 percent confidence interval for the automobile trip only. Similarly to the Phase 2 analysis, this may be because the oldest elderly are more likely to be retired, and are also more likely to have lost the ability to drive. Furthermore, the oldest elderly may not possess the physical strength to ride a bicycle.

As expected, having a valid driver's license had an positive and significant association with taking an auto trip, and a negative and significant relationship with taking a transit trip. Surprisingly, the finding for a bicycle trip was positive, though the WALD statistic for this variable was zero, indicating that it had no significance. Presence of a handicap which affects travel had a positive and significant association with taking a trip by auto, and a negative, though not significant, relationship with taking a trip by transit or bicycle, when compared to walking. This finding is not completely surprising, as the ability of some disabled persons to walk or ride a bicycle is limited. However, the negative relationship between handicap and transit is surprising – elderly and disabled persons are commonly believed to be transit patrons. The difference might be in the combination of the two., as disabled elderly may have too difficult a time riding traditional transit. It would have been useful to study paratransit as a separate mode for this specific variable, as disabled elderly are probably more likely to ride paratransit than fixed-route transit.

Being Caucasian had a significant and negative impact on taking a trip by automobile and bicycle, and a positive but not significant relationship with taking a trip by transit or bicycle. This finding is surprising – other studies have found that being Caucasian had a positive effect on the likelihood of taking an automobile trip (23, 16). This could be a limitation to the study – white respondents comprised 95 percent of the sample and biased the results. Alternatively, this finding could be typical for the Portland area, but atypical for other geographic areas, or the nation as a whole.

Finally, having a home language other than English had a significant and positive association with taking a trip by bicycle (at a 95 percent confidence interval), a negative but not significant impact on taking a trip by transit, and a positive but not significant relationship with taking a trip by automobile. This variable, though not included specifically in any of the reviewed literature, is not surprising. Those with limited English skills could be intimidated of transit, because it requires them to communicate with others and carefully read signage. The finding could also complement Rosenbloom and Waldorf's finding (24) that those of a Hispanic ethnicity are more likely to travel by automobile than other races and ethnicities. Finally, those speaking a language other than English at home are likely to be immigrants to the U.S. Many immigrants are not paid as highly as

U.S. Citizens, and thus may not have sufficient funds to purchase a vehicle, but need to travel too far for walking to be feasible. Therefore, riding a bicycle could be a necessity for this segment of the population.

Conclusions and Recommendations

Conclusions

A number of conclusions can be drawn from the data analysis. First, growing older has a significant negative relationship with overall mobility. From Phase 1, age had a negative and significant relationship with overall mobility for the sample as a whole, and a negative but not significant relationship with mobility for the 16-64 age band, the 65-74 age band, and the 75-84 age band. Although the specific age bands were not found to be significant, the levels of significance did move upwards – from a 0.155 (84 percent confidence interval) to 0.119 (88 percent confidence interval) to 0.058 (94 percent confidence interval) respectively. The oldest age group, aged 85-98, had a positive association with age. Apart from the eldest group, these findings correspond with much of the literature. As people grow older, their likelihood of sustaining the same level of mobility as younger generations is decreased. There could be two explanations for the surprising finding that age had a positive relationship with mobility for the 'oldest' elderly. First, it is commonly perceived that a healthy, active lifestyle extends a person's life expectancy. The 'oldest' elderly, therefore, could be healthier and more active than the population as a whole, and as such they could retain a certain level of mobility. Second, at a certain age elders start to rely on others (e.g., friends, family, social workers) to help with errands and other, out-of-the-home, tasks. For the oldest age group, the elderly could be more dependent on the caretaker. In this sense, the caretaker could have a positive influence on total mobility.

Phases 2 and 3 looked at just the subset of the elderly population, and compared retired elderly with non-retired elderly. Phase 2 showed a negative and significant association between being retired and taking a meal trip, and a positive and significant association between being retired and taking a medical trip. The negative association with the meal trip could be explained by the limited income associated with being retired, and the positive association with a medical trip could be related to (a) the greater likelihood of 'older' elderly to be retired than 'younger' elderly, and experience illnesses brought on with age, and (b) greater amounts of non-work time to visit doctors for preventative care. Social and shopping trips were found to be positive but not significant. Earlier analysis (not included in this paper) comparing non-elderly with elderly populations showed that the elderly were less likely to take a meal trip, a work trip, and a social trip than the non-elderly. The findings included in this study show that – among the elderly – retired persons are more likely to take a social trip and a medical trip. The 'retired' variable was not included in the work model because of concerns with collinearity. Using walking as a baseline, retired persons showed a negative and significant (at a 95 percent confidence interval) relationship with taking a trip by automobile, and a negative but not significant relationship with taking a trip by bicycle.

Retired persons also showed a positive (though not significant) relationship with the likelihood of taking a trip by transit (as compared to walking). This also is different from earlier analysis (not included in this paper) which showed that elderly persons were less likely to take a transit trip than the non-elderly population. What the finding in this study could mean is that – among the elderly – retired elderly are more likely to be older than the non-retired elderly. Licensing rates are also lower in the older age categories than in the younger elderly age groups. Retired elderly, being less likely to possess a valid driver's license, would be more reliant on alternative transportation modes such as transit than the non-retired sample.

The 'valid driver's license' variable was one of the strongest in this study. The possession of a valid driver's license had a positive and significant relationship with total mobility (for the entire sample, the non-elderly age group, and the 65-74 age group), the meal trip, social trip, and shopping trip, and the likelihood of taking a trip by automobile. Furthermore, the variable had a positive but not significant association with the eldest two age groups (aged 75-84 and aged 85-98), the work trip, the medical trip, and the likelihood of taking a trip by transit. The only model that showed a negative association with the 'license' variable was the bicycle trip. This finding is consistent with much of the literature, which is generally in agreement that having a valid driver's license greatly improves the mobility of an elderly person. The limitation with this finding is that possession of a valid driver's license does not guarantee that a person has a vehicle available to them, or that they still drive. One study covering the licensing rates of seniors found that the percentage of licensed seniors who actually drove was between 76 and 96 percent (9).

The presence of a 'good' pedestrian environment had a positive and significant relationship with total mobility, for the entire sample of elderly and non-elderly, and a positive but not significant relationship with all of the individual age categories. Furthermore, the presence of a 'good' pedestrian environment inferred that elderly individuals were 80 percent less likely to take a trip by automobile as compared to a walking trip, and 140 percent more likely to take a trip by transit. These findings are not contradictory – the presence of a good pedestrian environment could mean that the elderly are able to walk to the nearest bus stop, even if their destination is too far to reach on foot. The surprising element of this finding is the strength of the coefficient. Other studies have shown a positive relationship between land-use and trip making, but not with the strength of this study. The finding would be exciting for many researchers if it had not been such a broad categorization of land-use. Metro's survey was unable to classify the pedestrian environment of 25 percent of its survey respondents. In addition, Metro has moved away from using the pedestrian environment factor in favor of other land-use variables such as the number of intersections or the number of retail establishments within one mile of a household's location.

The findings related to gender in this study are interesting. Elderly women were found to be less likely to make a work trip and a meal trip than elderly men, but more likely to make a social trip, a shopping trip, and a medical trip. Additionally, women were more likely to make a trip by automobile, transit, or bicycle as compared to walking. The first set of findings are in line with traditional gender roles – men, even elderly men, being more likely to make the work trip and to make a meal trip than elderly women, and women may be more likely to be responsible for shopping and errands. Furthermore, the positive association with the medical trip is consistent with a common perception that women pay more attention to their overall health than men. The finding that elderly women are more likely to take a trip by all modes (as compared to walking) than elderly men, however, is surprising. Wilkins et al. (23) found that elderly women were *less* likely than elderly men to drive. The finding could be related to health and level of activity. If women are more likely to make regular medical trips, they could retain a level of mobility (measured by the number of trips regardless of mode) not seen by elderly men.

Race was only found to be significant for one model in the entire study. This was the likelihood to take a trip by automobile, and Caucasians were found to be 75 percent less likely to take a trip by automobile than non-Caucasians as compared to walking. This is a surprising finding, but not completely inconsistent with findings of Evans (16) and Rosenbloom and Waldorf (24). Evans found that, among the elderly, being Caucasian had a positive association with the likelihood of taking a walking trip, and that being Hispanic was positively associated with the likelihood of taking a trip in a privately-owned vehicle. Rosenbloom and Waldorf also found that Hispanic elderly were more likely to take an automobile trip, though as the passenger in the vehicle. However, they also found that Caucasians were more likely to choose a privately-owned vehicle than other races and ethnicities. This finding could also be explained as a geographic phenomenon – Caucasians in Portland may enjoy walking more than Caucasians in other areas of the Country.

Overall, income had a positive association with one's mobility in many of the models, including the total number of trips taken over the two-day study period, the likelihood of taking a work trip, the likelihood of taking a trip using a private vehicle, and the likelihood of taking a trip by bicycle. As expected, income had a negative association with mobility amongst the oldest age group (aged 85-98), the likelihood of taking a shopping trip, the likelihood of taking a meal trip, a social trip, and a medical trip, as well as the likelihood of taking a trip by transit, and of taking a trip by bicycle. Many studies on elderly mobility do not include income as a variable. The results are mixed for the few that do study income. Evans, for example, found that indicators of affluence (high levels of education and home ownership) were positively associated with trip taking among the 75 and older non-driving population (16). Kim's study found that income was not a significant factor, though level of education had a positive and significant influence on mobility (17).

Finally, the size of the household had a negative relationship with total mobility for the 65-74 and 75-84 age groups, and a positive relationship with total mobility for the sample as a whole, the non-elderly age group, and the 85-98 age group. The presence of a disability affecting outside travel had a negative association with taking a meal trip, social trip, work trip, and shopping trip, and a positive relationship with taking a medical trip. A disability was found to have a negative influence on total mobility for the 'older' elderly – those in the 75-84 and the 85-98 age groups, but was a positive influence on total mobility for the non-elderly sample as well as the 65-74 age group. The presence of a disability affecting outside travel had a positive association with taking a trip by private automobile, and a negative association with taking a trip by transit or bicycle.

In summary, the findings of this study are fairly consistent with the literature. Total mobility was seen to decrease with age, and the possession of a valid driver's license had a very strong relationship with retaining mobility, with the likelihood of taking a meal, work, shopping, social, or medical trip, and with the likelihood of taking a trip by automobile. Presence of a good pedestrian environment had a positive association with mobility as a whole and the likelihood of taking a trip by transit. These findings support work by Howe (18), who recommends a mix of land uses and continuous sidewalks to encourage shorter trips by foot; Rosenbloom and Ståhl (2), who recognize that the elderly are traveling more by automobile and recommend safer and less polluting vehicles; Coughlin and Lacombe (3), who cite the importance of a driver's license to elderly persons, and McKnight (13), who recommends better monitoring of license renewals and training for elderly drivers. Policy recommendations stemming out of these findings are described below.

Planning Recommendations

Ultimately, the test of this set of conclusions is how they can be applied within the planning community to address some of the issues associated with loss of mobility. These issues, as discussed earlier, include social isolation, decreased automotive safety, and increased pollution. The recommendations outlined here follow one of three avenues, and generally align with recommendations found in the literature. First, policy-makers should acknowledge the trends of increasing reliance on the automobile, and work towards increasing the safety of vehicles for the elderly, while reducing vehicle emissions. Second, transit could be restructured so routes are more effective for the elderly, and riding transit is more comfortable and convenient. Finally, the planning community should work to provide alternatives for those older Americans who wish to live closer to services. Each of these three sets of recommendations is discussed in more detail over the next four pages.

VEHICLE DESIGN AND LICENSING

Acknowledging the trends that the elderly are relying more on the automobile than other forms of transportation, a great deal could be done in automobile research and development to minimize the negative impacts associated with increased VMT. Two impacts that were discussed in the background section and are addressed through vehicle design and licensing are decreased safety and increased pollution.

INCREASING SAFETY

Automobiles could be designed so that they are safer for older drivers. Intelligent vehicles[17] can alert the driver and help to avoid collisions, regulate speeds, and provide directions to ease some driving burden while increasing automotive safety. Furthermore, highways and roadways could be designed with the older driver in mind. This, to some extent, is already underway. The U.S. Department of Transportation has now required that older drivers be considered in all studies that it funds, and that roadway designers consult the Older Driver Highway Design Handbook (13).

A second approach relates to licensing older drivers. The problem with requiring older drivers alone to perform vision, hearing, and reflex tests is that it discriminates against them as an age group. The concern about requiring this type of test for all people renewing their driver's license is that it is time consuming and expensive. According to McKnight (13), the Maryland Motor Vehicle Administration has found a happy medium. The agency has integrated an automatic screening program for all individuals renewing their driver's license, which quickly tests "visual acuity, scanning, visualization of spatial relationships, and visual search and sequencing, as well as

[17] Intelligent vehicles are developed to reduce the number and severity of crashes through driver assistance systems. These include preventing accelerated distraction, and facilitating accelerated development and deployment of crash avoidance systems (U.S. Department of Transportation, Intelligent Transportation Systems website, http://www.its.dot.gov/ivi/mission.html, last accessed August 11, 2003).

tests of memory and limb and head/neck mobility" (McKnight, pg. 66). Those that do not pass this precursory test are required to undergo more detailed tests. Recalling Coughlin and Lacombe's (3) findings that license examiners are wary of taking a license away from an elderly person because it impacts their mobility, an approach that could be employed is remedial driver's education before revoking the license. Also, programs such as the American Association of Retired Person's Driver Safety Program provide refresher courses targeted specifically seniors to help improve driver skills and avoid accidents (27).

DECREASING POLLUTION

There are two concerns associated with the concept of the elderly driving more than previously assumed. The first is simply that increased VMT means increased pollution. Even though newer cars burn fewer emissions, many elderly are on fixed incomes and are unable to buy a new car periodically throughout retirement. The second problem is that of peak-spreading. For urban areas that see some level of congestion throughout the day, a spurt of travel in the mid-morning and mid-afternoon could have the effect of spreading the peak-hour congestion period. One solution to the emissions problem is the development of vehicles that burn less fuel or alternative fuels. Research in this area is underway for electric and hybrid vehicles, as well as vehicles that use corn, mustard, and rapeseed oils, or other designs, fuels, and power sources that release fewer or no emissions (28). Combined with making cars safer to drive, cleaner vehicles that reduce the impacts of pollution associated with greater VMT can mitigate the two largest concerns associated with a larger population of elderly meeting their transportation needs through use of the automobile.

TRANSIT SERVICE

The literature review section of this study described the issues associated with current paratransit service. Not many elderly know about it, and it requires a good deal of planning, usually at least a day beforehand, to make a trip on paratransit. Finally, transit agencies have limited funds and often need to provide service only for "high-priority" trips, such as trips to the hospital or doctor. The concerns associated with providing enough service to fulfill every trip demanded is that paratransit service is extremely expensive. Tri-Met, the transit service operator for the Portland metropolitan area, spent $19.90 per unlinked passenger trip on demand response[18] in 2001, compared with $2.35 per unlinked passenger trip on bus transit and $1.60 per unlinked passenger trip on light rail transit (29). Coughlin and Lacombe (3) suggest that public agencies do not need to be the only providers of paratransit service. Community organizations can employ volunteer drivers to serve the elderly, and cut down tremendously on operating costs. Businesses can group together to provide shuttles to malls and downtown areas where the elderly can shop. Finally, many group retirement living homes provide shuttle buses to more popular destinations.

Additionally, though some researchers such as Abdel-Aty (20) and Correa et al. (21) found support among the elderly for paratransit services, others have found that fixed-route service can be improved to better serve elderly patrons. The Tri-County Elderly and Disabled Steering Committee conducted a study of transit needs of the elderly in the Portland metropolitan area in 2001 (12). They found that of 1,218 respondents to a telephone survey, 55 percent said they would be able to get to the nearest bus stop, and 39 percent reported living less than two blocks from the nearest stop. The movement in recent years towards procuring low-floor buses with more visible liquid crystal display (LCD) signage could work to attract more elderly riders to fixed-route service. In

[18] Also known as paratransit, usually door-to-door transit service provided to elderly and disabled individuals.

addition, agencies could ensure that schedules are legible, buses and trains are fully accessible, and drivers are trained to be sensitive to the special needs[19] of the elderly (30).

LAND-USE PLANNING AND ZONING

This analysis shows a clear relation between providing a good pedestrian environment and the likelihood of an elderly person taking a trip on transit or on foot. Another element to improving mobility for the elderly population, therefore, should be to provide more options and incentives for them to live in areas where there is a good pedestrian environment, services are nearby and more transportation options are available. Zoning codes could be amended to allow more mixed-use development in residential areas, both in the cities and the suburbs. Cities can play a larger role by offering incentives for developers to build more mixed-use in downtown cores, and that housing is available at different price ranges so the elderly are not priced out of accessible homes.

The principles of New Urbanism works well for the elderly. Common elements of New Urbanism, such as front porches and sidewalks, mixed-use development, different types of housing stock within one neighborhood, interconnected streets, and convenient transit service, provide the elderly with transportation options, close proximity to services, and variations in housing stock. In addition, one study mentions the existence of 'granny flats' above garages in one New Urbanist development in Gaithersburg, Maryland (19). Enacting zoning codes which allow for these different housing options only improves the alternatives for the elderly.

Study Limitations

There are several limitations to this study. The first is the low explanatory power of the models. This indicates that, even though many of the variables were found to be significant, something else is influencing mobility and the consistency and mode of trips. Another limitation is

[19] Such as limiting vision and hearing, limited ability to discern colors and textures, and the limited ability to read signage.

the age of the data. Data were collected nearly a decade ago, and findings may no longer be indicative of current travel behavior. Further limitations include the small number of medical trips (7.2 percent), the small number of non-white respondents (5.6 percent), and the small number of individuals with a disability (3 percent).

Future Study

For future studies, it would be useful to include travel time and activity duration to the analysis for type of trip and mode of trip, to test the impact of race on travel time and activity duration among elderly persons. Furthermore, studies such as Evans' (16) and Kim's (17) included education level, and found this to have a significant and positive impact on mobility. This variable is not included in the 1994/95 Metro's activity survey, but would be worthwhile to include in future versions of the survey. Finally, it would be useful to link these data with other Metro geographic datasets, which contain information about the number of intersections, the amount of retail space, and the level of transit service within a ½ mile of a person's residence, to better identify land-use impacts on elderly mobility.

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Appendix A: Original Codebook for Activity Dataset

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1994/95 Metro Household Activity Survey
Activity File Codebook

Variable Information:

Name Position
PHASE Phase 1
Format: F1
Value Label
1 Spring
2 Fall
3 Winter

STRATUM Stratum 2
Format: F2
Value Label
1 Multnomah Co-Urban,good PEF,LUM & Transit
2 Multnomah Co-Urban,bad PEF & Transit
3 Multnomah Co-Urban, good PEF & Transit
4 Multnomah Co-Ligh Rail Corridor
5 Rest of Multnomah Co
6 Clackamas County
7 Washington County
8 Columbia County (partial)
9 Yamhill County (partial)
10 Sample Enrichment (park-n-ride users)

SAMPNO Sample number 3
Format: F6
PERSNO Person number 4
Format: F2
DAYNO Day number 5
Format: F1
ACTNO Activity number 6
Format: F2

Q1 Q1 - What was your (first/next) activity? 7
Format: F2
Value Label
11 Meals
12 Work
13 Work-related
14 Shopping (general)
15 Shopping (major)
16 Personal services
17 Medical care
18 Professional services
19 Household or personal business
20 Household maintenance
21 Household obligations
22 Pick-Up/Drop-Off passengers
31 Visiting
32 Casual entertaining
33 Formal entertaining
41 School
42 Culture
43 Religion/Civil Services
44 Civic
45 Volunteer work
51 Amusements (at-home)
52 Amusements (out-of-home)
53 Hobbies

54 Exercise/Athletics
55 Rest and relaxation
56 Spectator athletic events
90 Incidental trip
91 Tag along trip

Q2NAME Q2 - [LOCATION NAME] Where did the activity take place? 8
Format: A30

Q3 Q3 - Were you already there? 12
Format: F1
Value Label
1 Yes
2 No

Q4 Q4 - When did you start that activity? 13
Format: F4

Q4AMPM Q4 AM or PM 14
Format: F1
Value Label
1 am
2 pm

Q5 Q5 - When did you end that activity? 15
Format: F4

Q5AMPM Q5 AM or PM 16
Format: F1
Value Label
1 am
2 pm

Q6 Q6 - Did you make any trips during those [RESPONE TO Q5]? 17
Format: F1
Value Label
1 Yes
2 No

Q7 Q7 - How did you get to the activity? 18
Format: F1
Value Label
1 Other
2 Walk
3 Bicycle
4 School Bus
5 Public Bus
6 MAX
7 Personal Vehicle
8 Non-personal Vehicle

Q7A Q7a - Other mode 19
Format: A20

Q8 Q8 - Did you have a vehicle available? 22
Format: F1
Value Label
1 Yes
2 No

Q8A Q8A - Would you have had to pay if you went by car? 23
Format: F1
Value Label
1 yes
2 no

Q8B Q8B - How much would you have had to pay? 24
Format: F5.2

Q8BTIME Q8TIME 25
Format: F1
Value Label
1 Hourly
2 Daily
3 Weekly
4 Monthly
5 Semesterly
6 Other

Q9 Q9 - How many people were in your party? 26
Format: F2

Q10 Q10 - Did you have a vehicle available? 27
Format: F1
Value Label
1 Yes
2 No

Q11 Q11 - Would you have had to pay to park if you went by car? 28
Format: F1
Value Label
1 Yes
2 No

Q11A Q11A - How much would you have had to pay? 29
Format: F5.2

Q11ATIME Q11TIME 30
Format: F1
Value Label
1 Hourly
2 Daily
3 Weekly
4 Monthly
5 Semesterly
6 Other

Q12 Q12 - What was the first route taken? 31
Format: A20

Q13NAME Q13 - Where did you board? 34
Format: A30

Q14 Q14 - How did you get to the stop? 38
Format: F1
Value Label
1 Drove and parked
2 Dropped off
3 Walked
4 Carpooled
5 Other

Q14A Q14a - How did you get from the stop to your destination? 39
Format: F1
Value Label
1 Drove & parked
2 Picked up
3 Walked
4 Carpooled
5 Other
6 Not asked - spring

Q15 Q15 - How did you pay for the trip? 40
Format: F1
Value Label
1 Cash
2 Ticket
3 Pass
4 Fareless square
5 Transfer

Q16 Q16 - Who subsidized your fare? 41
Format: F1
Value Label
1 Employer
2 Business/store
3 Other
4 None

Q17 Q17 - Did you transfer to another bus? 42
Format: F1
Value Label
1 Yes
2 No

Q18 Q18 - To what line did you transfer? 43
Format: A30

Q19 Q19 - Did you transfer again? 47
Format: F1
Value Label
1 Yes
2 No

Q19A Q19a - How many people were in your party? 48
Format: F2

Q20 Q20 - Which vehicle did you use? 49
Format: F2

Q21 Q21 - Were you the driver or passenger? 50
Format: F1
Value Label
1 Driver
2 Passenger

Q22 Q22 - Number in vehicle 51
Format: F2

Q23 Q23 - Where did you park? 52
Format: F1
Value Label
1 Parking lot/parking garage
2 Street

3 Driveway
4 Drive-through/Drop-off
5 Other
6 Did not park

Q24 Q24 - Did you pay for parking? 53
Format: F1
Value Label
1 Yes
2 No

Q25 Q25 - How much did you pay for parking? 54
Format: F5.2

Q25TIME Q25TIME 55
Format: F1
Value Label
1 Hourly
2 Daily
3 Weekly
4 Monthly
5 Semesterly
6 Other

Q26 Q26 - Who subsidized your parking? 56
Format: F1
Value Label
1 Employer
2 Business/store
3 Other
4 None

Q27 Q27 - What was the full unsubsidized price to park? 57
Format: F5.2

Q27TIME Q27TIME 58
Format: F1
Value Label
1 Hourly
2 Daily
3 Weekly
4 Monthly
5 Semesterly
6 Other

Q28 Q28 - What time did the trip start? 59
Format: F4

Q28AMPM Q28 AM or PM 60
Format: F1
Value Label
1 am
2 pm

Q29 Q29 - What time did the trip end? 61
Format: F4

Q29AMPM Q29 AM or PM 62
Format: F1
Value Label
1 am
2 pm

Q29AHOUR Q29a - Trip duration hours 63
Format: F2

Q29AMIN Q29a - Trip duration minutes 64
Format: F2

Q30 Q30 - Did you change modes? 65
Format: F1
Value Label
1 Yes
2 No

Q31NAME Q31 - Where did you change modes? 66
Format: A30

Q32 Q32 - To/from what mode did you change? 70
Format: F1
Value Label
1 Bus
2 Car
3 Walk
4 Bicycle
5 Light Rail

HALFMILE Households w/in 1/2 mile of the light rail 71
Format: F1
Value Label
0 no
1 yes

Appendix B: Original Codebook for Household Dataset

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1994/95 Metro Household Activity Survey
Household File Codebook

Variable Information:

Name Position

PHASE Phase 1
Format: F1
Value Label
1 Spring
2 Fall
3 Winter

INTWNUMB Interview Number 2
Format: F6

SAMPNO Sample Number 3
Format: F6

CITY City 12
Format: A30

ZIP Zip code 17
Format: A5

SAMPTYPE Sample Type 18
Format: A1
Value Label
1 Listed sample
2 Unlisted sample
9 Intercept sample

STRATUM Stratum 19
Format: F2
Value Label
1 Multnomah Co-Urban,good PEF,LUM & Transit
2 Multnomah Co-Urban,bad PEF & Transit
3 Multnomah Co-Urban,good PEF & Transit
4 Multnomah Co-Light Rail Corridor
5 Rest of Multnomah Co
6 Clackamas County
7 Washington County
8 Columbia County (partial)
9 Yamhill County (partial)
10 Sample Enrichment (park-n-ride users)

HHSIZE Household size 20
Format: F2

PHONES Number of separate phone lines 21
Format: F1
Value Label
1 One
2 Two
3 Three
4 Four or more
5 DK/RF

PARTYLIN Party line 22
Format: F1
Value Label
1 Yes
2 No
3 DK/RF

CARPHONE Car phones 23
Format: F1
Value Label
0 None
1 One
2 Two
3 Three or more
5 DK/RF
6 Not asked - spring

VEHICLES Number of vehicles owned 24
Format: F2

OWNHOME Own or rent 25
Format: F1
Value Label
1 Own/buying
2 Rent
3 DK/RF

YRSHOME Time in resdence 26
Format: F1
Value Label
1 Less than 6 months
2 6 months but less than 1 year
3 1 - 5 years
4 Greater than 5 years but less than 10 years
5 10 - 20 years
6 More than 20 years
7 DK/RF

HOMETYPE Dwelling type 27
Format: F1
Value Label
1 Single family home
2 Apartment
3 Hotel or motel
4 Mobile home or trailer
5 Some other type
6 DK/RF

OLDAREA Last residence located in Portland 28
Format: F1
Value Label
1 Yes-in the study area
2 No-outside of the study area
3 DK/RF
4 Not asked - spring

INCOME 1993 annual household 29
Format: F2
1 $0 - $4,999
2 $5,000 - $9,999
3 $10,000 - $14,999
4 $15,000 - $19,999

5 $20,000 - $24,999
6 $25,000 - $29,999
7 $30,000 - $34,999
8 $35,000 - $39,999
9 $40,000 - $44,999
10 $45,000 - $49,999
11 $50,000 - $54,999
12 $55,000 - $59,999
13 $60,000 or more
14 DK/RF

TRAVELD 1st activity day 30
Format: DATE9

TRAVELD2 2nd activity day 31
Format: DATE9

DAY1 1st activity day of week 32
Format: F1
Value Label
1 Monday
2 Tuesday
3 Wednesday
4 Thursday
5 Friday
6 Saturday
7 Sunday

DAY2 2nd activity day of week 33
Format: F1
Value Label
1 Monday
2 Tuesday
3 Wednesday
4 Thursday
5 Friday
6 Saturday
7 Sunday

DAY1ACT Total activities day 1 34
Format: F2

DAY2ACT Total activities day 2 35
Format: F2

TOTLACT Total activities 36
Format: F3

DAY1TRIP Total trips day 1 37
Format: F2

DAY2TRIP Total trips day 2 38
Format: F2

TOTLTRIP Total trips 39
Format: F3

HALFMILE Households w/in 1/2 mile of light rail 40
Format: F1
Value Label
0 no
1 yes

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Appendix C: Original Codebook for Person Dataset

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1994/95 Metro Household Activity Survey
Person File Codebook

Variable Information:

Name Position

PHASE Phase 1
Format: F1
Value Label
1 Spring
2 Fall
3 Winter

SAMPNO Sample number 2
Format: F6

PERSNO Person number 3
Format: F2

RELATION Relation to head of household 9
Format: F1
Value Label
1 Spouse or partner
2 Parent
3 Sibling
4 Grandparent
5 Child
6 Aunt/uncle
7 Other
8 DK/RF
9 Head of household

GENDER Gender 10
Format: F1
Value Label
1 Male
2 Female

AGE Age 11
Format: F2

RACE Ethnicity 12
Format: F1
Value Label
1 White/Caucasian
2 Black/African American
3 Hispanic/Mexican American
4 Asian/Pacific Islander
5 Native American
6 Other
7 DK/RF

HOMELANG Speak language other than English at home 13
Format: F1
Value Label
1 Yes
2 No
3 DK/RF

OTHLANG Other language spoken at home 14
Format: F2

Value Label
1 Spanish
2 Italian
3 Polish
4 Chinese
5 Korean
6 Cambodian
7 Russian
8 Japanese
9 Vietnamese
10 French
11 Other
12 DK/RF

SPEAKENG Speak English 15
Format: F1

Value Label
1 Extremely well
2 Well
3 Not well
4 Not at all
5 DK/RF

LICENSED Licensed to drive 16
Format: F1

Value Label
1 Yes
2 No
3 DK/RF

EMPLOYED Employment status 17
Format: F1

Value Label
1 Employed full-time
2 Employed part-time
3 Self-employed full-time
4 Self-employed part-time
5 Unemployed but looking for work
6 Retired
7 Full-time homemaker
8 Not employed
9 DK/RF

WORKHRS Hours worked in a typical week 18
Format: F2

OCCUPAT Occupation 19
Format: F1

Value Label
1 Managerial/professional
2 Technical/sales/administrative support
3 Service
4 Farming/forestry/fishing
5 Precision production/craft/repair
6 Operators/fabricators/laborers
7 Military
8 Homemaker
9 DK/RF

INDUSTRY Industry 20
Format: F2

Value	Label
1	Construction
2	Mining
3	Agriculture
4	Manufacturing
5	Transportation/communication/public relations
6	Wholesale
7	Retail trade
8	Finance/insurance
9	Business and repair service
10	Personal services
11	Entertainment
12	Professional
13	Public administration
14	Military
15	DK/RF

WORKHOME Works at home 21
Format: F1

Value	Label
1	Yes
2	No
3	DK/RF

HRSHOME Hours worked at home in a typical week 22
Format: F2

SUBPARK Subsidized parking or transit pass from employer 23
Format: F1

Value	Label
1	Yes
2	No
3	DK/RF

SHIFTWRK Shift work/flex-time offered by employer 24
Format: F1

Value	Label
1	Yes
2	No
3	DK/RF

PAY2PARK Pays to park at work 25

Value	Label
1	Yes
2	No
3	DK/RF

COST2PRK Cost of parking at work 26
Format: F3

DRIVE Drove alone to work past 5 days 27
Format: F1

CARPOOL Carpool to work last 5 days 28
Format: F1

TRANSIT Public transit to work last 5 days 29
Format: F1

OTHER Other mode of transportation to work last 5 days 30

Format: F1

NOWORK Did not work last 5 days 31
Format: F1

YRSWORK Years employed at current place of employment 32
Format: F2
Value Label
1 < 1 year
2 1 - 1.9 years
3 2 - 2.9 years
4 3 - 3.9 years
5 4 - 4.9 years
6 5 years or more
7 DK/RF

TWOJOBS Works 2 or more jobs 33
Value Label
1 Yes
2 No
3 DK/RF

LASTJOB Last job located in _____ area 34
Format: F1
Value Label
1 Yes
2 No
3 Never worked
4 DK/RF
5 Not asked - spring

STUDENT Student status 35
Format: F1
Value Label
1 Full-time student
2 Part-time student
3 Not a student
4 DK/RF

HHSTU Head of household student level 36
Format: F1
Value Label
1 Post-graduate
2 College
3 Vocational/technical school
4 Secondary school
5 DK/RF

STULEVEL School level 37
Format: F1
Value Label
1 Daycare
2 Preschool
3 Elementary school (k-6)
4 Secondary school (7-12)
5 Vocational/technical school
6 College
7 Post graduate
8 DK/RF

SCHOOL Name of school 38
Format: A38

SCHCITY City location of school 43
Format: A38

SCHDRIVE Drove alone to school last 5 days 48
Format: F1

SCHPOOL Carpooled to school last 5 days 49
Format: F1

SCHBUS Public transit to school last 5 days 50
Format: F1

SCHOTHER Other transportation to school last 5 days 51
Format: F1

NOSCHOOL No school last 5 days 52
Format: F1

HANDICAP Disabilities affecting outside travel 53
Format: F1

Value	Label
1	Yes
2	No
3	DK/RF

HANDIOTH Specific disability 54
Format: F1

Value	Label
1	Blind/visually impaired
2	Wheelchair (transferable)
3	Wheelchair (non-transferable)
4	Deaf/hearing impaired
5	Mentally disabled
6	Cane/walker
7	Other
8	DK/RF