1-1-2013

Mobility and Aging in Denver, Colorado: Travel Behavior, Mobility Barriers, and Perceptions of Transit

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MOBILITY AND AGING IN DENVER, CO: TRAVEL BEHAVIOR, MOBILITY
BARRIERS, AND PERCEPTIONS OF TRANSIT

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A Thesis

Presented to

The Faculty of Natural Sciences and Mathematics

University of Denver

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In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

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by

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June 2013

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Title: Mobility of the Aging in Denver, CO: Travel behavior, mobility barriers, and perceptions of transit
Advisor: Dr. E. Eric Boschmann
Degree Date: June 2013

Abstract

The number of seniors in the U.S. today is growing rapidly because of longer life expectancies and the aging Baby Boomer generation. This age groups' travel behavior will have substantial impacts on transportation, economics, safety, and the environment. This research used a mixed-methods approach to address issues of mobility and aging in Denver, Colorado. A quantitative approach was used to answer broad questions about travel behavior and the effects of age, gender, work status, disability, residential location and socio-economic status on mobility. Qualitative interviews with seniors in the Denver metro area were conducted to identify barriers to mobility, decision-making processes and travel decisions, and seniors' perceptions of public transit. The results of the quantitative and qualitative analyses show that residential location is an important variable for determining seniors' travel behaviors and transportation options. Perceptions of public transit were positive, but accessibility and information barriers exist that prevent older adult from using transit. The findings of this study will help to provide transportation and service recommendations to policymakers and planners in the Denver area as well as to inform studies of other North American cities with large aging populations.

Acknowledgements

I would like to thank Dr. Eric Boschmann for his advising and guidance throughout the research process. I also wish to thank the older adults I interviewed who graciously gave their time to contribute to this research project.

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Chapter One: Introduction

The number of seniors in the U.S. today is growing because of longer life

expectancies and the aging Baby Boomer generation. As the aging population increases,

so does the significance of their travel behaviors and mobility needs. The mobility trends

of today's seniors are changing because they are living more active lives than seniors in

the past. This age groups' travel behavior will have significant impacts on the future of

transportation, economics, safety, and the environment. Although seniors are more

active, they will eventually reach an age when they will have to give up driving. It is

crucial to seniors' quality of life and wellbeing to maintain their mobility and

independence as they age (Zeigler and Schwanen, 2011). Even seniors that drive can

experience mobility barriers.

The aging and mobility research reveals that seniors today are more likely to age

in the place they retire, which is increasingly in the suburbs, rather than move to more

accessible locations (Rosenbloom, 2001; Páez, 2007; Lord et al., 2011). Many seniors

today live in low-density suburbs in single-family detached homes. Low-density housing

and retail requires seniors to rely on the private vehicle as their main mode of transport.

Seniors use their private vehicles for nearly all of their mobility needs, whether as a

passenger or driver (Rosenbloom, 2001). This reliance on the car adversely affects the

environment and increases the probability of decreased mobility, isolation and depression after driving cessation (Marottoli et al., 1997; Marottoli, 2000; Fonda et al., 2001).

To ensure the aging population's safety while maintaining their mobility and wellbeing, alternative transportation options to the private car must be made available for seniors to counteract the effects of driving cessation. If alternative forms of transportation do not meet the needs of older residents, seniors might continue to drive their personal vehicles longer than is safe. When deteriorating health forces the elderly to give up driving, they may find they are less mobile and more isolated from their previous social life (Lord et al., 2011). Even where public transit options do exist, seniors are often unfamiliar and uncomfortable with using them because of their previous reliance on the car.

The elderly's travel behavior and mobility varies by age, gender, health, and location (Rosenbloom, 2001; Alsnih and Hensher, 2003; Paez, 2007). In the United States, the potential mobility of an individual is not only determined by these factors, but also by the transportation services available in a given city. Much of the current research on aging and mobility has come from studies conducted in Australia, Canada, and Europe. Although the United States shares a similar age structure with Australia, Canada, and Europe, the available transportation options vary across cities and even within cities. More research is needed on older residents and their mobility within U.S. cities.

Denver, Colorado is a particularly relevant study area because the city and its surrounding counties will be significantly affected by the future growth of the elderly population due to its large population of Baby Boomers. In 2000, Colorado had the 6th highest population of Baby Boomers, people born between 1946 and 1964 (DRCOG

Area Agency on Aging, 2011). Denver metropolitan area's population over 60 is expected to increase by 30% in the next five years mainly, and by 2035, nearly one in four residents in the Denver area will by 60 or older (DRCOG Area Agency on Aging, 2011). In 2010, the percentage of the population age 65 and over for the U.S. was 13%, and Colorado's 65 and over population was 10.9%, which was below the national average. However, the older population 65 and over grew by 32% from 2000 to 2010, well above the national average of 15.1% (U.S. Census Bureau, 2011). Colorado has one of fastest growing older populations in the U.S. with a 53.1% change in the older population from 2000 to 2010; of its 64 counties, 34 exceeded the U.S. average of 15.1% change in the 65 and over population (U.S. Census Bureau, 2011). Several of these counties such as Jefferson and Douglas Counties were in the Denver metro area.

Goals and objectives

My research uses a mixed-methods approach to identify seniors' travel behavior, mobility needs, decision-making processes, and their perceptions and use of public transit in the Denver metro area. A mixed methods approach is used to study seniors' mobility because it provides broad, generalizable data about seniors' travel behavior while acknowledging individuals' experienced mobilities. Using data from the Denver Regional Council of Government's travel count survey, I establish the travel behavior and trends of Denver's current aging population. I perform a quantitative, statistical analysis of the survey data to determine the specific travel behaviors of seniors based on their age, gender, disability, work status, socio-economic status, and residential location. This analysis informs the qualitative portion of my research. Second, I interview seniors in the Denver metro area to determine their specific barriers to mobility, the factors that

affect their use of transit, and their perceptions of public transit. I use in-depth interviews to focus on individual travel experiences and to analyze the decision-making processes of older residents. This project answers the following research questions: **What are the travel behaviors and barriers to mobility of seniors in Denver, what variables affect travel, what is the decision-making process for seniors for residential and transportation choices, how does residential location affect urban mobility, and what are seniors' perceptions of transit**? These are complex questions that cannot be answered by quantitative methods alone because the elderly are not homogenous and display significant differences in their mobility issues. The findings of this study help to provide recommendations to policymakers and planners in the Denver area as well as to inform studies of other North American cities with large aging populations.

Theoretical background

Studies of aging and mobility span many subject areas including transportation, geography, gerontology, psychology, safety, engineering and technology. The concept of mobility is not well defined and varies among these fields. Some scholars have argued for or suggested a conceptual framework for measuring and defining mobility (Webber et al., 2010; Metz, 2000). Traditional transportation research often uses travel behavior as a proxy for mobility, but this fails to take into account potential travel that some argue should be included in the definition of mobility (Metz, 2000; Burnett and Lucas, 2010; Webber et al., 2010). The traditional, static view of mobility as the movement of people and things through physical space has led some to suggest a broader definition called the new mobilities paradigm, or the mobility turn (Sheller and Urry, 2006). The new mobilities paradigm defines mobility by fluidity and movement rather than stasis and

structure and also includes the social dimensions of movement. Webber et al. (2010) suggested a definition of mobility as "the ability to move oneself…within environments that expand from one's home to the neighborhood and to regions beyond" (p. 444). Another proposed definition is simply "movement or the potential to move" (Burnett and Lucas, 2010). The mobility turn in research is leading to a broader definition of mobility and encompasses moving through physical, virtual, and social space. Studies of safety and health have focused on the mobility of people within their homes while psychology and transportation studies are mainly concerned with travel that achieves psychological and exercise benefits within a community. The theoretical context of this study uses the new mobilities paradigm to inform the researcher and illustrate the complexity and individuality of mobility. The operational definitions of accessibility and mobility used in this research are taken from Hanson (2004): "Accessibility refers to the number of opportunities, also called 'activity sites,' available within a certain distance or travel time. Mobility refers to the ability to move between activity sites" (p.4). This research only analyzes out-of-home mobility and movement between home and other activity sites.

This mixed-methods research also draws on feminist geographic theory. In direct response to positivist geography, which states that it is possible to know all, feminist theory regards knowledge as situated and seeks to overcome the power relations present in much masculine, purely quantitative research. Feminist geographers focus on people's everyday life and seek to understand and collect unique, detailed information at the individual level. Research on underrepresented groups is also strongly emphasized.

In the 1990s, feminist geographers were critical of early GIScience, asserting that is was a gendered technology that produced singular representations of data (Kwan,

2002). More recently, prominent feminist geographers have argued that GIScience can be aptly used for feminist research and that it is not inherently positivist (Kwan, 2002). These scholars emphasize the importance of collecting primary data for use in GIS, using multiple methods to answers questions, and the role GIS can play in community activism (Kwan, 2002; Hanson, 2002; McLafferty, 2002). Kwan's (2002) research using space-time representations of women's lives illustrates the ability of GIS to produce rich visualizations and narratives of people's everyday lives that are well suited to the goals of feminist research. McLafferty's (2002) research mapping the incidence of breast cancer on Long Island is an example of how GIS can be used to empower women and challenge traditional expert knowledge. As I use GIS in the quantitative phase of my research, I am informed by these alternative uses of GIS as a feminist tool. In this study, I create traditional maps using secondary, aggregated data, but future research will incorporate qualitative data from my interviews to weave a more nuanced representation of individual's lives and mobility experiences, using GIS to create rich visualizations and narratives of the individual.

Thesis organization

Chapter two reviews the relevant literature and background on trends in elderly travel, transportation and mobility studies, aging in place and residential location, quality of life and driving cessation. Chapter three introduced the quantitative research and methods and discusses the results of the statistical and spatial analyses. Chapter three also includes a discussion of the important quantitative findings. Chapter four addressed the qualitative interviews, methods, and results, with a discussion following. Chapter

five concludes the research by tying together the results of the mixed-methods and

discussing the findings, future research needs, and implications of the study.

Chapter Two: Literature Review

Introduction

Developed countries of the western world are aging, and their aging populations are expected to double by the year 2025 (Rosenbloom, 2001). This expected growth creates an urgent research need as the rapidly expanding elderly population has major implications on healthcare, housing, and transportation policies. Research addressing the older population and their mobility, transportation, and wellbeing has been put forth from many different disciplines from the medical field to social sciences to transportation and urban studies. I draw on relevant literature from many of these fields, but because travel patterns vary across geographical space, this research takes a distinctly geographic approach. The location of a person's residence, a city's available transportation network and the characteristics of its built environment are all geographic factors that affect a person's mobility and transportation options. The reviewed literature addresses aging trends in North America, Europe, and Australia because these regions have similar age structures. Although data may vary regionally, trends found for these areas can be used to inform research in nations with similar populations. The following literature identifies major travel behavior trends of the current aging population and addresses the results of both quantitative and qualitative studies on aging and mobility.

Trends in elderly travel behaviors

The literature reveals that today's aging population exhibits different mobility trends than previous aging populations. In 2001, Rosenbloom found that older people were more active, healthier, and more likely to possess a driver's license and take more trips than older people ten years ago. Alsnih and Hensher (2003) and Rosenbloom (2001) note that more seniors are entering retirement driving than any time in history. Seniors are increasingly dependent on the private automobile for their mobility needs. According to a 1995 transportation study, approximately 92% of all trips taken by Americans over 65 were in private cars (Rosenbloom, 2001). People over the age of 65 are more likely to be the passenger than the driver, but this gap is closing.

Alsnih and Hensher (2003) show that age is an important variable for trip-making. They differentiate between the old elderly (over 75) and the young elderly (65-75 years old). Their study shows a clear difference between the trip-making of these two groups. They found that trip-making does not decrease substantially until the age of 75. Páez et al. (2007) found that trip generation decreases as age increases. The older elderly make fewer trips than the young elderly, but both groups are making more trips than previous cohort groups.

Differences in trip-making and driving also exist between older men and women (Rosenbloom 2001; Alsnih and Hensher, 2003; Páez et al., 2007). Men are more likely to hold a driver's license and are more likely to drive at an older age than women. This trend has been true in the past, but the differences between men and women's driving habits are lessening. Women were slightly less satisfied with their mobility opportunities

as they aged (Mollenkopf, 2011). These studies show that the elderly are not a homogenous group, and future research should use age and gender as important variables of mobility.

Studies on elderly mobility have taken both quantitative and qualitative approaches. Common qualitative methods used are interviews, focus groups, and surveys (Mullen, 2005; Michael et al., 2006; Burnett and Lucas, 2010; Lord et al., 2011; Ziegler and Schwanen, 2011). The quantitative studies use data from transportation surveys, census data, or land use and bus route data (Páez et al, 2007; Currie and Delbosc, 2010; Engels and Liu, 2011). Mollenkopf et al. (2011) use mixed methods to assess older people's perceptions of out-of-home mobility. The study used quantitative data to establish trends in older people's mobility, then followed up with in-depth interviews to focus on respondents' personal experiences and hone in on the meaning of out-of-home mobility. Future studies can use this qualitative-quantitative approach to get a more personal sense of mobility in the aging population.

Mobility and transport studies

Studies of mobility and aging have looked at several aspects of mobility. Rosenbloom (2001) focuses on the environmental impact of the growing number of elderly drivers. She concludes that the elderly population will have dramatic impacts on the environment, not just because of the increasing numbers of the aging, but because of the types of trips they take. Rosenbloom found that while the elderly still make fewer trips than younger age groups, the difference is smaller than in the past. The types of trips the elderly make were found to be more environmentally damaging. Seniors tend to

take shorter trips that involve more cold starts and create more pollutants. Seniors are also more likely to waste miles on scouting trips or getting lost.

The findings of several studies show that public transit is not a substantial form of transport for seniors. Rosenbloom (2001) found that seniors are less likely to use public transit than younger generations. In their review of the travel patterns of the elderly, Alsnih and Hensher (2003) found that public transit was not a major mode of transport for most seniors until the age of 75, and in a 2001 survey of U.S. households, public transit trips make up less than 2 % of older adults' daily trips (Collia et al., 2003). Although public transit is not used frequently, Davies and James (2011) find that access to good transport options becomes increasingly important with age as seniors begin their transition to driving cessation. In a longitudinal study, Currie and Delbosc (2009) found that the use of public transit for trip-making dropped slightly for the over 60 age group while car trips increased. However, the study also surveyed the Baby Boomer generation and noted a slight increase in public transit use as car rates stayed steady. Currie and Delbosc (2009) suggest that the decrease in public transit use of current seniors will not hold steady as the Baby Boomers enter retirement.

Mollenkopf et al. (2011) measured seniors' satisfaction level of transit services. They found that satisfaction with public transport increased over a ten-year period. The authors postulate that it could be due to improvements in the public transit system in the study areas over the ten-year period. These findings support the idea that in the future, public transport can provide an important alternative to the private vehicle while increasing mobility of the elderly and sustainability for the planet.

On the other hand, Alsnih and Hensher (2003) found seniors increasingly dissatisfied with traditional transport services. Alsnih and Hensher do not see traditional fixed-route public transit as a viable option to improve mobility for most seniors. Older adults prefer driving or being driven due to convenience and efficiency. Burnett and Lucas (2010) found similar results in their interviews of two groups of seniors: those living in a retirement community and those using a nearby senior center. Driving and walking were the most common modes of transportation, and bus transportation the least used by both groups. Residents of both groups used cabs more often than public transport. More flexible modes of transportation could increase transit usage of older people. Mullen (2005) found that non-driving seniors in Ottawa relied heavily on paratransit because it was cheap and allowed them to get around independently, but they also complained about the inconvenience of waiting and prescheduling appointments. Alsnih and Hensher (2003) note that specialized transport that offers door-to-door service and high levels of flexibility may become cost-effective as the number of elderly increase each year. The services that are currently provided require heavy subsidies from local governments, but they may be more cost-effective than updating old public transport systems for an aging population. In their interviews with service providers in Northern Ireland and Australia, Davies and James (2011) found that governments are relying more on volunteer agencies to provide supplementary transport services after driving cessation. Páez et al. (2007) found some potential for transit to replace automobility, but they do not explain how or why seniors would switch and whether it would be fixed-route or specialized transit.

Aging in place and the residential location dimension of mobility

The trend and desire of seniors to age in place is cited by several studies (Rosenbloom, 2001; Páez, 2007; Lord et al., 2011; Davies and James, 2011). Davies and James (2011) review several meanings of the term "aging in place," and they define the concept as seniors aging in the same home and/ or community where they previously lived instead of moving to an institutional care facility. The authors also note that this concept is becoming more of a guiding principle for public policy and planning as well. Place is an increasingly importance part of the aging equation, as people prefer to age in a familiar setting with access to known family, social, or cultural ties (Wiles, 2005).

This trend increases seniors' reliance on the private automobile (Lord et al., 2011). Páez et al. (2007) find this trend to be present in their study of Canada's Hamilton metropolitan area. Because suburbs have low housing density, Lord et al. (2011) argue that the distribution of destinations and inadequate transit services can contribute to social exclusion of seniors in locationally disadvantaged communities, especially those who have ceased driving. This leads scholars to question the effect of neighborhood design and residential location on older people's mobility, transportation options, and travel behaviors. New urbanism and smart growth principles promote dense, walkable, compact neighborhoods with mixed-used development, and transit-oriented developments, in addition to these principles, are located in walking distance to a transit line (Ratner and Goetz, 2013). Neighborhoods that incorporate these principles are also

referred to as neo-traditional or traditional neighborhoods, and they are contrasted against conventional design in suburban neighborhoods.

Several recent studies have looked at the effects of the built environment on older people's mobility to try to determine how to design age-friendly cities. Cao et al. (2010) found that older people drive less and use transit more in traditional neighborhoods than in suburban areas with conventional designs. The authors see the potential for neighborhood design to sustain and enhance accessibility of older people. Waldorf (2003) also finds that older adults in urban areas with higher densities depend less on the private vehicle than older people in suburban areas. Proximity to services can provide mobility options whether or not they use alternative modes to get there (Michael et al., 2006). Dumbaugh (2008) reviews the literature for elderly mobility barriers and relates the barriers to conventional design in order to argue for a more "universal design" of cities and neighborhoods. Dumbaugh makes a compelling argument against conventional neighborhood design using Rosenbloom (2004) to show that the vehicle miles traveled for older adults has doubled since 1983. He contends that this is a result of longer trips due to conventional suburban design rather than greater mobility. He argues that building at higher densities produces higher rates of walking, but only if there are meaningful destinations in walking distance. Walking distance is generally accepted to be a quarter-mile.

Michael et al. (2006) also links seniors' residential location decision-making to neighborhood amenities and proximity to shopping and services. Although seniors prefer to age in place, they are choosing whether to relocate or stay in their neighborhood based

on the accessibility of services. Ultimately Cao et al. (2010) conclude that neighborhood design may have more health and quality of life benefits than environmental benefits since they find only limited effects on driving and transit use. The impact of neighborhood design on quality of life is an important finding and dimension of the mobility of the aging, as improved mobility is linked to better quality of life.

Quality of life, driving cessation, and automobility

Studies of aging have linked mobility to increased measurements of wellbeing in later life (Metz, 2000; Banister and Bowling, 2004; Mullen, 2005; Zeigler and Schwanen, 2011); driving is often a symbol of independence and freedom for seniors (Coughlin, 2004). On the flip side, lack of mobility through driving cessation can lead to isolation and depression (Marottoli et al., 1997; Marottoli, 2000; Fonda et al., 2001), especially when there are no viable alternatives to driving. Zeigler and Schwanen (2011) used focus groups to assess the relationship of wellbeing and mobility. They found that older people's understandings of mobilities change over time. They note that driving cessation can be a very traumatic event in later life, but they also stress that the loss of mobility is not inevitably linked to a decrease in wellbeing. They found that an individual's mental disposition and determination can affect their view of mobility. Older people know the importance of "getting out" and those with the motivation make a conscious effort to do so. Decreased physical mobility can be compensated by adaptation strategies and other mobilities (Lord, et al. 2011).

Driving cessation can result in negative consequences for older people, but rarely is driving cessation an abrupt event that happens at a single point in time. Older people

make the decision to stop driving gradually, and until they decide to give up driving, they make adaptations and modifications to their driving habits and behaviors (Donorfio et al., 2008; Dumbaugh, 2008; Donorfio et al., 2009; Lord et al., 2011). Lord et al. (2011) term the gradual reduction in driving and modification of driving strategies "maintaining automobility." Donorfio et al. (2009) use the term "self-regulation," which encompasses behaviors of altering driving patterns and the amount and types of driving, avoiding challenging situations, and adjusting and compensating for reduced physical ability. Donorfio (2008) also found gender differences in self-regulation with women being more self-aware of age-related driving limits and more likely to modify or adjust their driving behaviors. Some of the adaptation strategies noted in the literature are avoiding rush hour, heavy traffic areas, freeways, unfamiliar areas, and driving at night (Donorfio, 2008; Lord et al., 2011). Some seniors choose to move to a new location or residence where driving conditions are safer and services are more conveniently located to maintain their automobility (Lord et al., 2011).

Gaps and limitations of current literature

The literature on aging and mobility has answered many important research questions from diverse academic perspectives; however, future research on mobility is required due to the immediate challenges presented by the aging population in the western world. A qualitative and/or mixed-method approach is supported by the literature. However, the qualitative studies reviewed here reveal some limitations and recommendations for future research.

In a longitudinal study using mixed methods, Mollenkopf et al., (2011) assess older people's perceptions of out-of-home-mobility. The research team used in-depth interviews over ten years to determine the change in people's definition of mobility and satisfaction with mobility opportunities. The authors note that over the ten-year period, some study participants had died, moved, or were no longer able to participate. Those no longer able to participate were usually those in poor health with lower physical mobility. This means that the participants in the later studies were usually selective survivors. The fact that the healthiest participants were the ones followed over the ten years can greatly impact the findings. This is a limitation that similar qualitative studies will have to address.

While some quantitative studies used cohort data to identify and analyze mobility trends, others used static data of age groups. Cohort data can provide useful information of the changing mobilities of certain generations through time. Mobility data comparing static age groups can often mask the mobility characteristics of different generations. Both sets of data are useful, but future research using longitudinal cohort data can provide a wealth of information that may help predict future behavior of the aging population and plan for their mobility needs. The type of data used in a study needs to be clearly expressed and justified according to the desired findings.

There is also a gap in the current research on how income affects public transit use versus private automobile use. Seniors are often on a tight budget, so information on how much money they are willing to spend on transportation can help inform transit authorities when planning new services. Determining whether income is a variable in

seniors' use of public transit can help establish potential ridership and cost of new transit services.

According to the new mobilities paradigm, movement and non-movement through physical space and virtual space should be taken into account in transportation research. The literature has had little to say on the virtual movement of today's seniors. Virtual movement has the potential to increase accessibility and wellbeing of the aging. Baby Boomers are more familiar and competent with computers and the Internet than previous generations. The effects of their virtual movement on mobility and wellbeing provide an important research topic.

A research agenda

An increase in the aging population and changes in their driving habits raises new research questions about older people's mobilities. Today's seniors are increasingly reliant on the automobile as their primary mode of transport. Previous assumptions and findings of elderly mobilities are changing with growing technology and longer life expectancies. Two major areas of study offer insight into improving seniors' mobilities, accessibilities, and wellbeing: the application of new urbanism, smart growth, and transit-oriented development principles to senior living and developing improvements in transportation services.

Older people are now likely to age in place, which is increasingly in the suburbs. Many geographers have noted the mobility and accessibility problems of aging in low-density developments. Seniors rely on walking as an alternative to the automobile, but few suburban destinations are within walking distance of residences. New Urbanist

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communities are built at higher densities with pedestrian-friendly streetscapes and have mixed-use development with access to shopping, open space, and community amenities. Many New Urbanist developments are also transit-oriented, creating better access to public transport. The emphasis on walking and high-density living increases the potential for social interaction as well. The number of New Urbanist developments is increasing, but the application of New Urbanist principles to improving elderly mobilities has not been fully researched.

To understand the role of New Urbanism in improving the mobility of seniors, both qualitative and quantitative methods should be used. Some redevelopment projects are incorporating senior living into their design. Research should be conducted on these developments to assess their impact on seniors' mobility and wellbeing. Interviews, surveys, and focus groups could provide data to compare the mobilities of older residents in New Urbanist communities to the mobilities of older people in conventional neighborhood developments. The New Urbanist communities may be welcomed alternatives to a retirement community because they include a diverse mix of ages. An additional question to address in this line of research is if and when people would be willing to move to such a development. The trend of aging in place may make it difficult to convince seniors to move, but the Baby Boomers and middle-aged people may be more likely to move to such developments and stay during old age. Research is needed on the affects of residential location in providing seniors with the ability to stay in their homes longer because of increased accessibility and mobility.

Research is also needed to recommend improvements to the transportation network for seniors. Public transportation is a promising alternative to the private auto as a means of increasing sustainability and mobility. Heavy reliance on the private automobile means that when seniors do cease driving, they are often unfamiliar with alternative transport options. To maintain mobility after driving cessation, seniors need to be educated about their mobility options. The effectiveness of retiring from driving education programs and travel training should be studied and used to inform future programs.

More research is needed to discern why seniors do not use public transit in order to plan for the future needs for seniors.   Studies have shown that seniors do not frequently use fixed-route transit services. A more flexible transport system is likely to attract more seniors, but the specific transit needs of seniors have not been determined. In-depth interviews of both driving and non-driving seniors could be helpful to identify trends in elderly transit use as well as suggestions for improvements. Quantitative data from transit use can be used to establish frequency of elderly ridership. New transportation innovations such as light rail service are reducing auto usage in the working population; however, the potential benefits of light rail to seniors has not been explored to the same extent.

Conclusion

Research shows that seniors are heavily reliant on their cars for transport, prefer car travel to public transit, and make more trips than previous generations of elderly. Seniors are more likely to age in place rather than move during retirement. These

findings have important implications for healthcare services, transportation services, and sustainability. Aging and mobility is a relevant and urgent research need because of the increasing aging population.   This research uses quantitative and qualitative methods to answer some of the research questions posed here. The mobility turn in transportation challenges researchers to move from how (the mode) people travel to the why, why not, where, and with whom questions. This perspective of mobility could provide new results and findings to improve the wellbeing of seniors.

Chapter Three: Quantitative Research and Analysis of the Travel Behaviors of

Older Adults in Denver, Colorado

Introduction

I used a mixed-methods approach of both quantitative and qualitative methods to conduct this research on aging and mobility in Denver, Colorado. Both methods serve a different function to help understand the complexity of aging and mobility. Quantitative methods are useful to answer questions about relationships between phenomena and place as well as differences between them (Johnston, 1978). This chapter addresses the quantitative portion of the research, and chapter four examines the qualitative interviews I conducted with older adults in the Denver area. I begin the quantitative chapter with an overview of the methods. Then I discuss the analysis and results of the quantitative research, which includes a statistical analysis of a travel diary survey collected by the Denver Regional Council of Governments (DRCOG) and a spatial analysis of the travel diary data and recent Census data from the Denver metropolitan area.

My research area is within the Denver metropolitan area in Colorado (USA). The travel diary data come from the area that includes the jurisdiction of the Denver Regional Council of Governments (DRCOG). The counties included in the DRCOG dataset are Adams, Arapahoe, Boulder, Broomfield, Clear Creek, Denver, Douglas, Elbert, Gilpin, Jefferson, and Weld County. According to a 2010 survey, the Denver metro area had

approximately 368,000 older residents (DRCOG Area Agency on Aging, 2010).

According to the 2010 Census, 10% percent of the population of the Denver metro area is

over 65, a commonly used definition of the aging and elderly. The Denver metro area is

a growth node for the Baby Boomer population in particular because people ages 50-64

currently make up nearly 19% of the population (U.S. Census Bureau, 2010). Due to the

trend of aging in place, this group is expected to stay in the Denver region during their

aging years. The need for research in Denver is urgent in order to plan for the future

needs of these Baby Boomers.

Methods

To answer my first research question, **what are the travel behaviors of seniors**

in Denver and what variables affect their travel, I used travel data from the Denver

Regional Council of Governments Front Range Travel Counts Survey to identify and

analyze trends of elderly travel and mobility in the Denver area. The survey collected

demographic and trip data at the household and individual levels. Participants were

asked to complete a travel diary of where they went and how they got there for one day.

The dataset has a sample of 6,966 households, 16,210 persons, and 80,090 trips. In my

analysis, I only looked at the population 60 and over. There were 4,268 people over the

age of 60 that participated in the survey, and 15,678 trips were analyzed.

I examined trip-generation, trip distance, total person miles traveled, and trip

mode data for seniors in the Denver area. In my research, I use the terms elderly, older

people, and senior citizens. These are generally accepted terms in the aging literature and

general society to describe people ages 65 and over. I further disaggregated the data into

age groups to better discern when significant changes in travel behavior occur. The age groups I compared were the pre-retirement group, ages 60-64, the young-old, ages 65-74, the old-old, ages 75-84, and the high longevity group, age 85 and above. In addition to age, I compared the travel data based on several variables: gender, work status, residential location, disability, and socio-economic variables of race, income, and educational attainment. I wanted to see how these variables affected the amount of travel and mode of travel of seniors.

The number of trips made by seniors does not significantly decrease until the age of 75 (Páez et al., 2007), so I tested this finding for Denver by analyzing trip data for the four age groups. Gender differences in travel were noted in chapter two, so I also analyzed gender differences in the four travel data dimensions. Many travel behavior changes depend more on life-stage changes, such as retirement, rather than age, so work status is also a key variable to analyze. Residential location, such as living in a transit-oriented development, has been shown to affect travel in older people as well as disability and socio-economic status. The effects of these variables on trip-making, travel distances, and trip modes are tested using statistical methods.

I imported the survey data tables from Microsoft Access into JMP, a statistical software program. The travel data were divided into several tables: person data, place data, and household data. The person table contained attributes of each survey participant and their total number of trips. The place table had the spatial location of each trip, trip distance, trip mode, time and duration of the trip, and the person associated with each trip in addition to many other characteristics. The household table contained

characteristics of each household that was surveyed and included the educational level and race of the head of household and household income. To analyze the trip data by each variable, I had to join the three tables in order to associate all of the variables with each person and each trip. In order to analyze the data by age group, I added an analysis column categorizing the people into age groups. I also combined the TOD columns, which were divided by location and distance, to create a new column for analyzing TOD and non-TOD residences.

When calculating the number of trips taken by each person, I used the column in the person table labeled PTRIPS. This number was already tabulated in the person table. I then calculated the mean number of trips according to each variable using JMP. To calculate the mean trip distance, I used the place table, which had a TRIPDIST column. Before calculating the mean trip distance using JMP, I cleaned the data and excluded trips with no mode or distance. I also excluded trips over 100 miles since the focus of this research was typical daily travel within the Denver metro area rather than long-distance travel. To analyze the trip modes, I aggregated the walking and biking trips into one mode- walking/biking, and I created a car/ non-car analysis column. The total person miles traveled is an aggregation of each person's trip distances for one day. To calculate this, I combined all the single trip distances for each person and added a person miles traveled column to the person table. Then, I calculated the mean person miles traveled by each of the variables using JMP.

To test the statistical significance of the differences between the mean number of trips, mean trip distance, and mean person miles traveled for each age group and each

variable, I used JMP to perform a two-way ANOVA, and one-way ANOVA to test the statistical significance of race, income, and educational attainment. To perform these statistical tests, I log transformed trip distance and person miles traveled to meet statistical assumptions. To test the statistical difference of trips by trip mode, I used the Pearson's chi-square test. By disaggregating the data by age, gender, work status, residential location, disability, and socio-economic status, I shed light on the heterogeneity of this older people and identify variables that affect travel behavior.

In addition to performing a statistical analysis of seniors' trips, I used the DRCOG survey data to conduct a spatial analysis in ArcGIS of where the aging live and travel. The trip data in the survey included spatial coordinates of trip destinations, and I mapped the locations in ArcGIS. The first analysis I did was looking for coincident features, or points that have the same x and y coordinates. This provides data on places where more than one trip was made. Using the collect events tool, I created a graduated symbol map of coincident locations.

In addition to mapping coincident features, I also created a standard deviation ellipse for the trip destinations using one standard deviation. This analysis measures whether the points exhibit a directional trend and where the mean center of the points is. This helps to show where in the Denver metro area more trips are being made. To further analyze the point patterns of the locations, I used both a density-based measure and distance-based measure. To measure density, I created a kernel density layer, which calculates a density of the points and fits a smooth surface over each point. The result is a map showing the density of points with a raster output. To measure the point pattern

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based on distance, I used the average nearest neighbor function. This tool measures the distance between each of the points to create a nearest neighbor index. Then, the results are compared to a hypothetical random distribution to determine if the points are randomly dispersed or clustered. If the resulting nearest neighbor ratio is less than one, then the pattern shows clustering. If it is greater than one, then the pattern trends towards dispersion. The resulting visualizations and spatial analyses helped identify areas of high senior use.

I also created choropleth maps of older residents' locations from 2000 and 2010 census data using ArcGIS. Using data from the U.S. Census Bureau website, American Fact Finder, I downloaded the population data by age for the state of Colorado. I mapped both the percentages of seniors and total number of seniors by census tract. These maps can be used to compare the spatial location, distribution, and density of the senior population and how it has changed over time from 2000 to 2010. In another map, I overlaid Denver's light rail network over the 2010 age data to identify areas inaccessible by rail transit and analyze how well the current rail network serves places of high elderly populations. In addition, I included the residential locations of the households in the travel count survey. Finally, I mapped the 2010 location of the Baby Boomer population, ages 45-64, in the City and County of Denver on a choropleth map. Due to the aging in place trend, this map can help plan for the future needs of seniors as the Baby Boomers age in Denver.

The results of my statistical and spatial analysis of the Front Range Travel Counts Survey informed the second phase of my research that incorporated qualitative interview

methods. I used the results of the statistical analyses to inform my selection of

interviewees. Based on findings from the travel counts survey, I selected a sample of the

population of predominantly females that lived near transit in an established urban

neighborhood to research.

Statistical Analysis of Front Range Travel Counts Survey

The travel survey collected data on the total number of trips per person, modes of

each trip, and trip distance. According to the literature, the senior population is not

homogenous and should not be looked at as one group because their travel behavior

varies greatly according to different variables. I compared descriptive statistics for

number of trips, trip distance, trip mode, and total person miles traveled by

disaggregating the data by age group, gender, work status, residential location, socio-

economic standing, and disability. The age classification are the pre-retirement group,

ages 60-64; the young-old, ages 65-74; the older-old, ages 75-84; and the high longevity

group, ages 85 and above.

Trip-making, trip distance and person miles traveled comparative

descriptive statistics

		Age Group			
	Total	**60-64**	**65-74**	**75-84**	**85+**
Mean number of trips					
Male	3.85	4.14	4.06	3.31	2.48
Female	3.52	3.96	3.82	2.84	1.76
Total	3.67	4.04	3.93	3.05	2.04
Mean trip distance (mi)					
Male	4.44	5.24	4.23	3.35	3.19
Female	3.83	4.21	3.64	3.52	3.08
Total	4.12	4.69	3.93	3.43	3.13
Mean person miles traveled (mi)					
Male	20.8	25.11	20.22	14.42	13.38
Female	17.5	19.73	17.27	14.42	11.37
Total	19.02	22.23	18.72	14.42	12.26

*See Appendix A for report of ANOVA statistical tests

Table 3.1: Summary of mean trips and mean trip distance by age and gender

The mean number of trips, trip distance, and person miles traveled for each age group and gender is summarized in Table 3.1. Overall, the trend for the older population of Denver is that trip-making, trip distances, and total miles traveled decrease with age. A significant drop in trips, however, does not occur until after the age of 75. The average number of trips drops by 22% from the 65-74 age group to the 75-84 age group. The number of trips made by the 85 and above age group drops by 33%.   There is not a significant decrease in trip-making from the pre-retirement group (ages 60-64) to the

young-old group (ages 65-74). This indicates that many people ages 65-74 are able to

sustain their level of trip-making from the pre-retirement stage of life. Figure 3.1 shows

the dramatic decrease in trip-making after age 75.
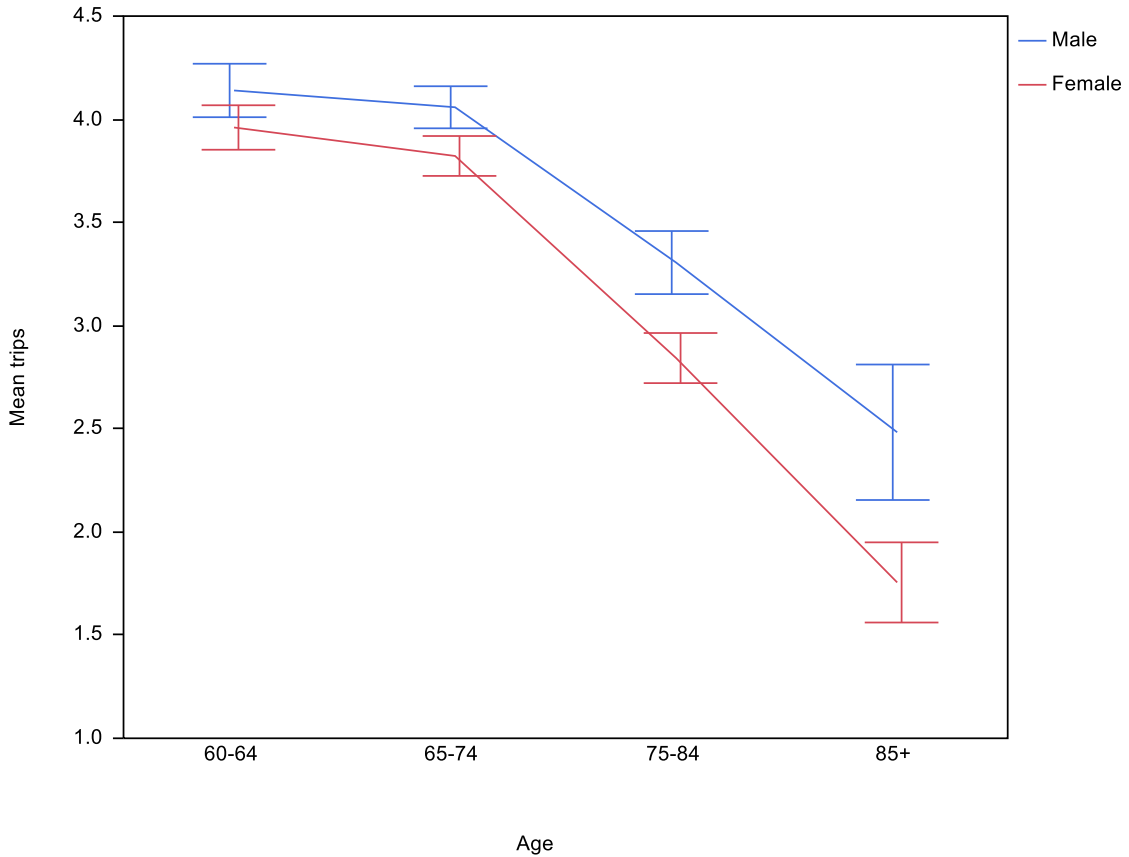
* Each error bar is constructed using +/- 1 standard deviation from the mean.

Figure 3.1 Mean number of trips by age group and gender

Trip distance follows a similar trend of decreasing with age. This is most

apparent when disaggregated by age group. However, trip distance decreases the most

from the pre-retirement ages to the young-old ages, by 16.2%. This suggests that during

working years, people are making longer trips, presumably to work. Nearly 60% of the

60-64 year old group were employed while only 30% of the 65-74 year old group were employed. As they enter the young-old ages of 65-74, they begin making shorter trips but continue to make nearly as many trips as when they were employed. Trip distances continue to decrease with age, but not at a significant rate (Figure 3.2). As with single trip distances and personal trips, the total miles traveled per day also goes down as age increased (Figure 3.3). The pre-retirement group has an average of 22.2 miles traveled per day, while the high longevity group over 85 has an average of only 12.2 miles.
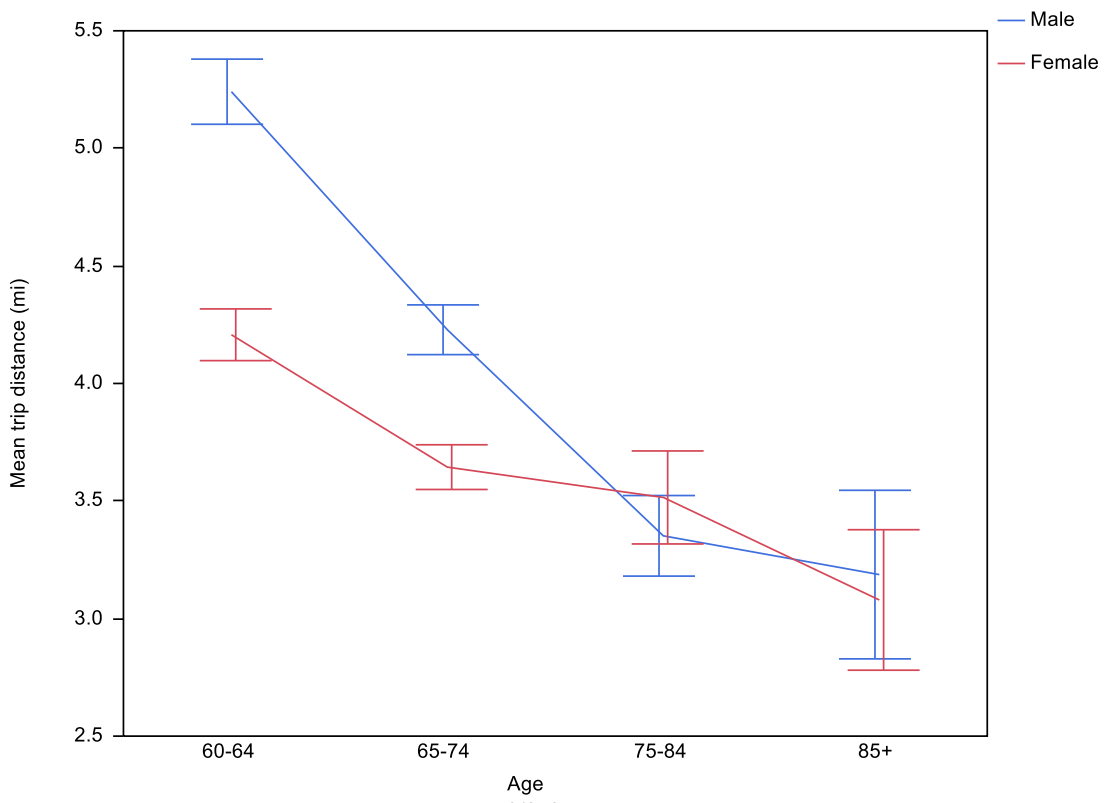
*Each error bar is constructed using +/-1 standard error from the mean.

Figure 3.2: Mean trip distance by age and gender
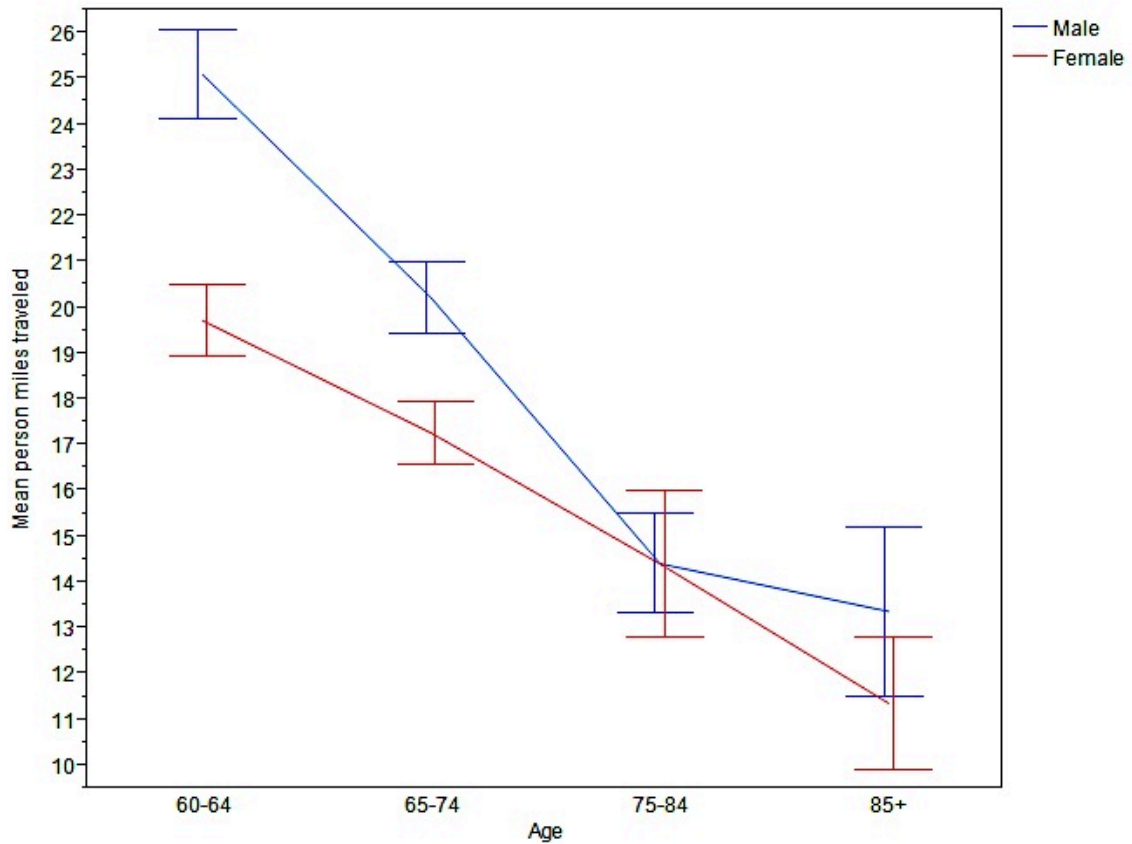
*Each error bar is constructed using +/-1 standard error from the mean.

Figure 3.3: Mean person miles traveled by age and gender

The trip data reveal some significant gender differences in trip-making as well (Figure 3.1). There is no statistical significance between the number of male and female trips at ages 60-64. Once older adults reach age 65, the difference in trips by gender becomes significant, with males on average making more trips. Females 85 and above experience a 38% reduction in trip-making compared to females in the 75-84 year old group. In contrast, the gender differences in trip distance and total miles traveled per day are only significant in the pre-retirement age group and young-old age groups, with men

making longer trips and more person miles traveled. Trip distance is the same for males and females at the old-old and high longevity groups (see Figures 3.2 and 3.3). Overall, older people in Denver take fewer and shorter trips as they age, with the most significant drop after the age of 75.

In addition to differences in travel behavior by age and gender, trip-making, trip distance, and person miles traveled also vary by employment status, disability status, residential location, income-level and race. Older adults who are employed make more trips and have longer single trip distances and more total miles traveled than those who are not employed. There is a significant difference between the number of trips and trip distances of older people with a disability and those without. Older people 65 and over with a disability make fewer and shorter trips than those without a disability.

	Age Group				
	60-64	**65-74**	**75-84**	**85+**	**Total**
Mean number of trips					
Disabled	3.28	3.33	2.56	1.78	2.86
Not Disabled	4.18	4.08	3.36	2.58	3.98
Employed	4.31	4.24	3.87	3.17	4.26
Not Employed	3.61	3.80	2.95	2.01	3.39
Mean trip distance (mi)					
Disabled	4.05	3.72	3.25	2.90	3.60
Not Disabled	4.79	3.97	3.54	3.44	4.24
Employed	5.06	4.39	5.69	3.94	4.86
Not Employed	4.01	3.71	3.08	3.10	3.60
Mean person miles traveled (mi)					
Disabled	18.44	16.09	12.96	11.35	15.28
Not Disabled	22.81	19.32	15.24	13.48	20.07
Employed	23.42	20.41	23.64	14.95	22.36
Not Employed	19.84	17.87	12.94	12.14	16.73

* See Appendix A for report of ANOVA statistical tests

Table 3.2: Mean trips, trip distance, and person miles traveled by age, disability, and employment

Residential location is a significant variable that affects travel behaviors of older adults as well. The survey categorized the sample households by whether or not they lived in a transit-oriented development (TOD) and where the TOD was located (downtown, urban, or suburban). A transit-oriented development is defined by DRCOG as an area within one mile of a RTD light rail station. The mean number of trips for people living in a TOD is higher than people not living in a TOD at all age groups except the high longevity group (Figure 3.4). The trip distances, however, are lower for older people living in a TOD than for those not living in a TOD (Figure 3.5). The difference in trip distance is further noted when disaggregating by type of TOD.   Trip distance is

lowest in a downtown TOD, then urban TOD, then suburban TOD (Table 3.3 and Figure 3.7). When analyzing the mean trips and trip distances by residential distance within a TOD, within a half-mile or mile of a rail station, there was not a discernable pattern and the distance from the rail station did not appear to affect the travel behaviors. This analysis shows that people who live in a TOD make more trips overall, but their trips are shorter distances.

Living in a transit-oriented development also affects the total person miles traveled as people not living in a TOD have a higher total mileage per day than those living in any other type of TOD (Table 3.3 and Figure 3.6). Where the TOD is located also shows some interesting results, with suburban TOD residents' total miles traveled only slightly lower than non-TOD residents, but downtown and urban TOD residents traveled significantly fewer miles than non-TOD residents. These findings show similar results to the single trip distance results.
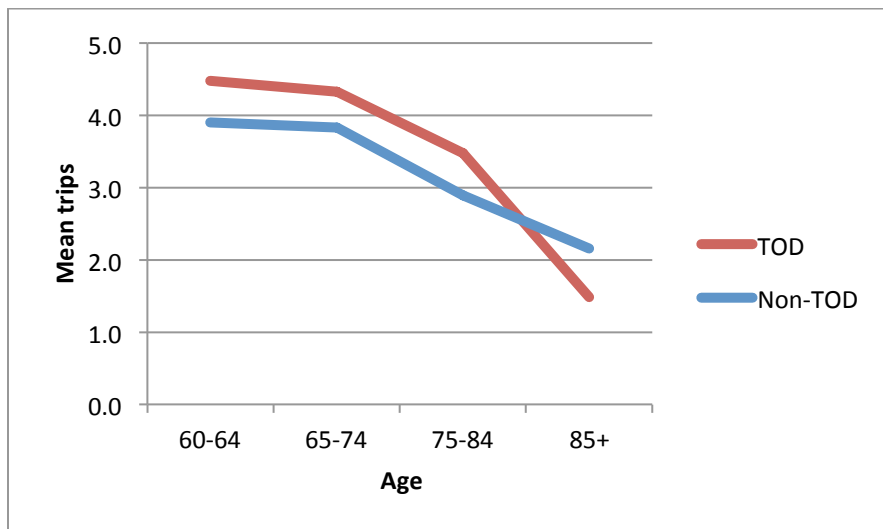
Figure 3.4: Mean number of trips by TOD and non-TOD residential location
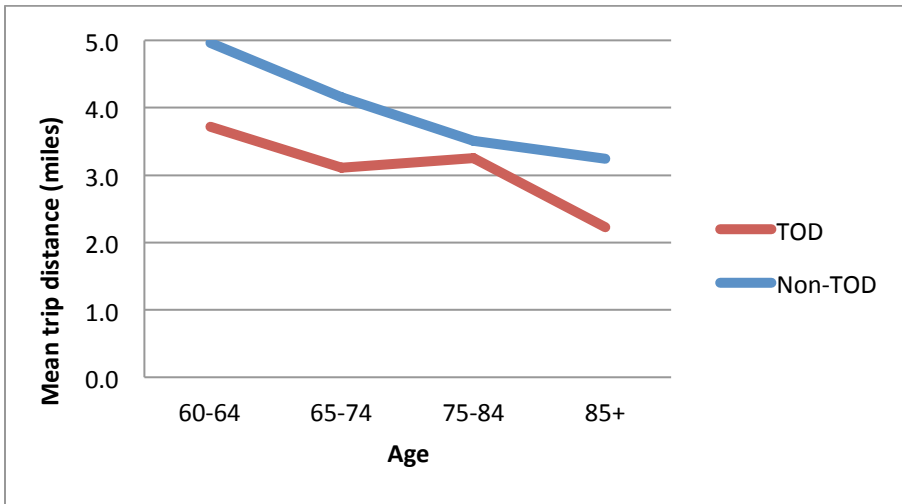
Figure 3.5: Mean trip distance by TOD and non-TOD residential location
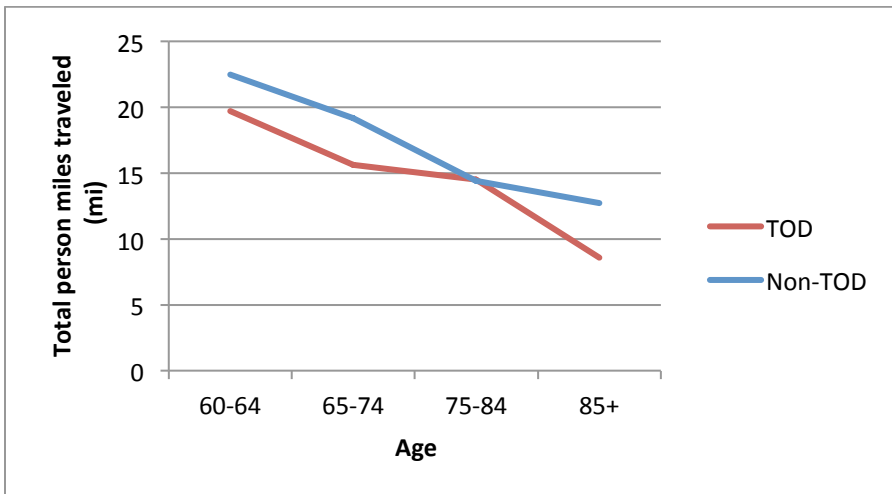
Figure 3.6: Mean person miles traveled by TOD and non-TOD residential location

		Number of trips	Mean trip distance (mi)	Mean person miles traveled (mi)
Non-TOD		3.59	4.29	19.40
TOD by type	Total	4.08	3.35	16.68
	Downtown TOD	4.27	2.74	14.88
	Urban TOD	4.08	3.04	14.97
	Suburban TOD	4.01	3.79	18.49
TOD by distance	Total	4.08	3.35	16.68
	< .5 mile	4.3	3.31	17.03
	.5 mile - <1 mile	3.94	3.38	16.45

Table 3.3: Mean trips and trip distance by TOD type and distance
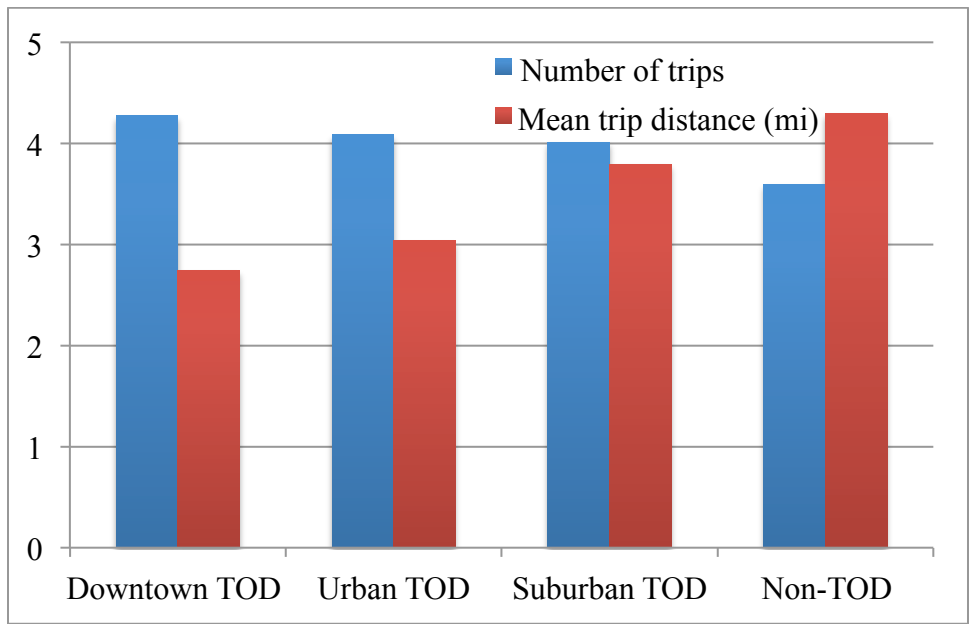
Figure 3.7: Mean trips and mean trip distance by type of TOD

Trip distance and the number of trips increase as income rises, then level off at the highest income brackets (Figure 3.8). The number of trips increases significantly with higher educational attainment, but trip distances rise only slightly with more education (Figure 3.9). White people make longer trips than any other race, but Asian make the most trips per day (Table 3.4). As income increases, so do the vehicle miles traveled; however, the total person miles traveled shows a similar pattern to trip distance, with miles traveled reaching a peak at the income level 9, then slightly decreasing at the highest incomes. Race is a significant variable, with white people having higher person miles traveled than all other races.
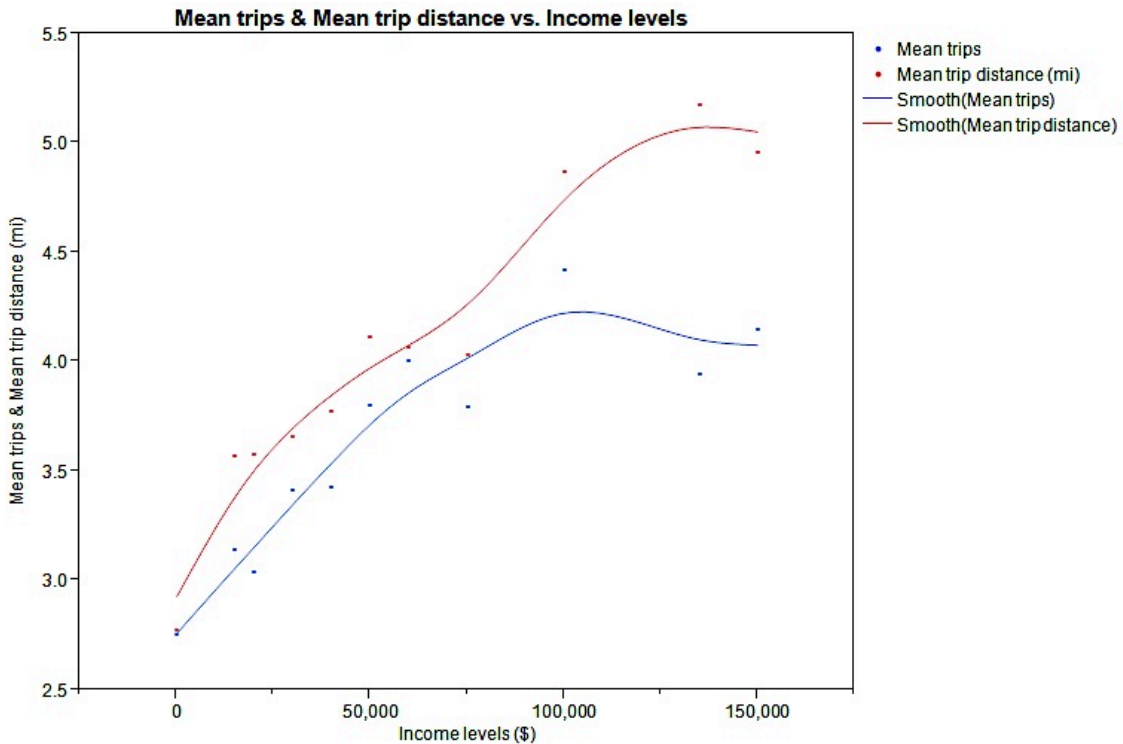
Figure 3.8: Mean trips and trip distance by income level
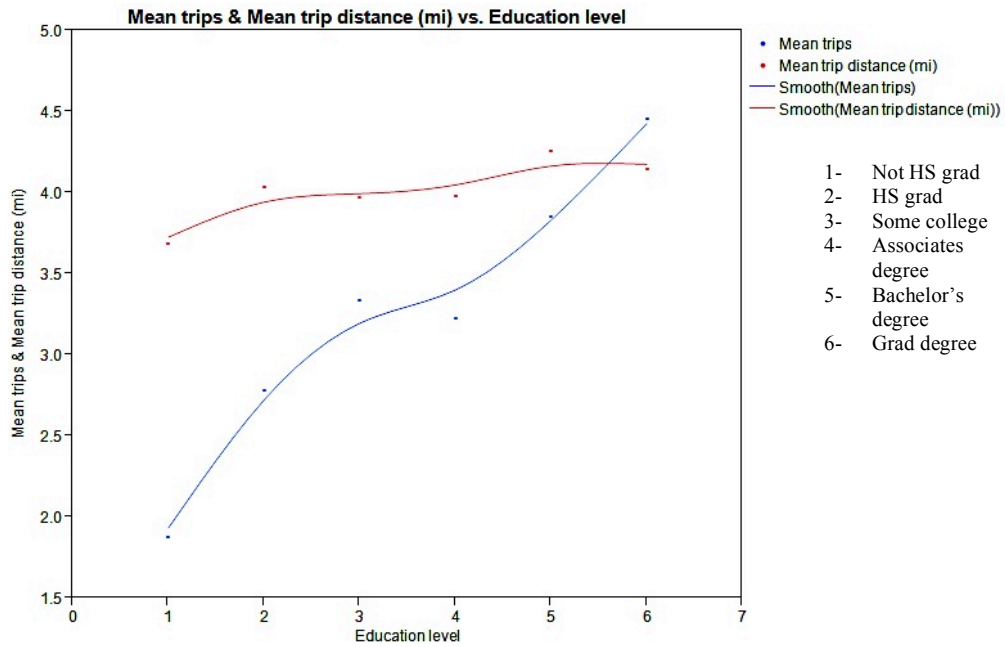
Figure 3.9: Mean trips and trip distance by education level

Race	N sample	Mean trips	Mean trip distance (mi)	Mean person miles traveled (mi)
White	3913	3.76	4.15	19.27
Black	93	3.28	3.65	16.83
American Indian	20	2.35	2.94	10.61
Asian	20	4.40	2.29	15.30
Other Race	155	3.12	3.63	15.91

Table 3.4: Mean trips, trip distance and person miles traveled by race

Trip mode comparative descriptive statistics

It is important to analyze the mode of older people's trips to determine the potential environmental impacts of their travel. Most older people's trips are taken using the personal vehicle, either as a driver or passenger. Car trips generate more harmful environmental impacts than more sustainable modes of transportation that include walking, biking, or transit. In addition, it is important to determine potential alternative transport options that are available to seniors if they must stop driving. The mode of older adults trips is summarized in Table 3.5.

Age group		Auto Driver %	Auto Passenger %	Transit %	Walk/ Bike %	Other %
60-64	Male	78.84	4.97	4.43	11.40	0.18
	Female	75.12	11.76	3.53	9.50	0.10
	Total	76.87	8.56	3.95	10.40	0.13
65-74	Male	81.65	7.24	2.53	8.27	0.29
	Female	75.84	16.11	2.01	5.73	0.32
	Total	78.71	11.74	2.27	6.99	0.31
75-84	Male	74.80	16.30	1.76	6.96	0.18
	Female	69.90	22.16	1.51	6.27	0.16
	Total	72.22	19.38	1.63	6.60	0.17
85+	Male	57.99	23.29	5.94	12.79	0.00
	Female	51.25	40.42	2.50	5.83	0.00
	Total	54.47	32.24	4.14	9.15	0.00

Table 3.5: Summary of trips by mode, age group, and gender

Both age and gender affect the mode of trips by older adults in Denver. Women have a higher rate of passenger trips than men, while men have a higher rate of driver trips than women at all ages. Men make more transit trips and walking and biking trips at all age levels. As expected, driving trips make up a lower percentage of the total trips as age increased. Car trips by older people 65-74 were a higher percentage of trips than for people 60-64. The pre-retirement age group 60-64 have higher levels of transit and walking/ biking trips than the older age groups, suggesting that while employed, people may be using alternative modes to get to work and then replacing those alternative modes with the car once they retire. Paratransit and taxi trips are virtually absent from the survey, as less than 1% of all trips for people 60 and over used these modes even though there were a substantial number of disabled people in the survey.

	Mode	% Trips by mode
Disabled	Car	86.96
	Non-Car	13.04
Not disabled	Car	89.04
	Non-Car	10.96

*Results significant, Pearson chi-square= 10.384, ρ<. 0013

	Mode	% Trips by mode
Employed	Car	84.87
	Non-Car	15.13
Not employed	Car	91.30
	Non-Car	8.70

*Results significant, Pearson chi-square= 156.279, ρ<. 0001

Table 3.6: Percentage of car/ non-car trips by disability, and employment status

When looking at disability as a variable for mode choice, people who are not

disabled make 80% of their trips by car while people who are disabled make 86% of their

trips by car (Table 3.6). Employment is also a factor when considering mode choice, as

employed people make more non-car trips, and people who are not employed make more

total car trips, with a large increase in trips as a passenger. Older adults who have not

completed high school make the lowest percentage of their trips by car, while older adults

with a graduate school education are the second lowest. Lower-income households

making less than $20,000 a year make the most non-car trips (Table 3.8). As income

rises, the pattern fluctuates, but middle-class status appears to significantly increase car

trips. White people make a higher percentage of car trips than all other races, other than

Asians who took all of their trips by car (Table 3.9). However, the sample size of non-

white races was quite small. Socio-economic status does affect trip mode with the

middle income and mid-level education groups making the highest percentage of car

trips.

Education	% Car	% Non-Car
Not HS grad	73.42%	26.58%
HS grad	90.16%	9.84%
Some college	91.95%	8.05%
Associate degree	90.09%	9.91%
Bachelor degree	89.57%	10.43%
Grad degree	86.63%	13.37%

Table 3.7: Percentage car/non-car trips by education

Income	% Car	% Non-car
$0 - $14,999	69.35	30.65
$15,000 - $19,999	79.18	20.82
$20,000 - $29,999	88.00	12.00
$30,000 - $39,999	93.51	6.49
$40,000 - $49,999	86.89	13.11
$50,000 - $59,999	89.52	10.48
$60,000 - $74,999	91.04	8.96
$75,000 - $99,999	90.00	10.00
$100,000 - $134,999	88.24	11.76
$135,000 - $149,999	86.30	13.70
$150,000 - More	87.61	12.39

Table 3.8: Percentage car/ non-car trips by income

Race	Total N trips	% Car	% Non-car
White	14568	89.17	10.83
Black	304	71.71	28.29
Am Indian	47	72.34	27.66
Asian	87	100.00	0.00
Other	482	78.63	21.37

Table 3.9: Percentage car/non-car trips by race

Where older people live does impact what mode of transportation they use. When aggregating the data by residential location, some interesting results can be seen. People living in a non-TOD took more car trips than people living in a TOD, and people living in a TOD used more alternative modes of transport including transit, walking, and biking. The difference in the percentage of car trips between non-TOD residents and TOD residents is greatest when comparing people in downtown TOD. These people have the lowest percentage of car trips compared to urban TOD, suburban TOD, and non-TOD residents (see Table 3.10). People living in a downtown TOD take 52% of their trips by

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car while people living in a non-TOD take over 90% of their trips by car. People living in suburban TOD actually take a higher percentage of their trips by car than people living in a non-TOD. This is important because it suggests that living near a light rail station alone does not decrease car usage, but living in a transit-oriented development in a downtown or urban area with closer higher density and proximity to services is also key.

	% Car trips	% Non-car trips
Non-TOD	90.35	9.65
TOD	83.84	16.16
DT	52.35	47.65
Urban	87.13	12.87
Suburban	92.19	7.81

Table 3.10: Percentage of car/ non-car trips by residential location

Spatial Analysis of Front Range Travel Counts Survey and Census Data

Using data from the Front Range Travel Counts survey and 2000 and 2010 Census Bureau data, I mapped the locations of senior residences in the Denver metropolitan area. I looked for patterns in the data and identified areas with a large senior population. In addition, I mapped the Baby Boomer population to identify areas of future growth based on the aging in place phenomenon stated in the literature.
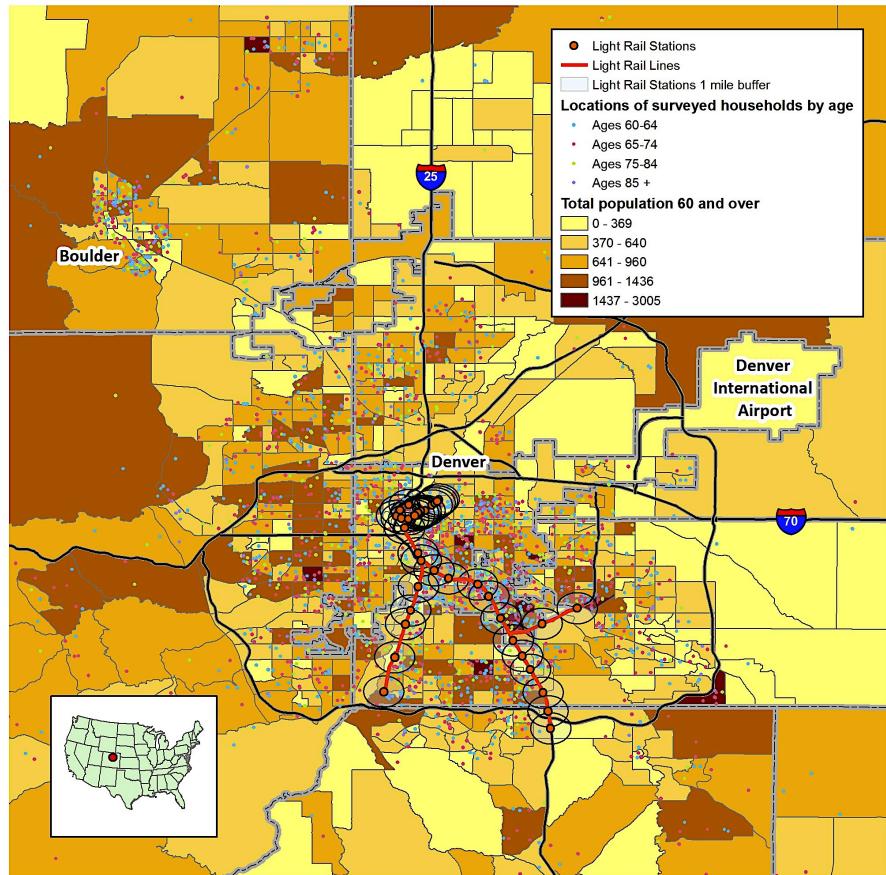
Figure 3.10: Survey households, senior population, and light rail network in Denver, CO

Figure 3.10 is a map of the older population household locations from the Front

Range Travel Counts survey. It is overlaid on a map of 2010 census data showing the

number of people over 60 by census tract. In addition, because I performed statistical

analysis on travel behaviors in transit-oriented developments, I added the current light

rail system and a one-mile buffer around each stop. The maps show the distribution of

households in the sample as well as their proximity to light rail and census tracts that have higher numbers of the aging population. Figures 3.11 -3.14 use census tract data to compare the over 65 population change from 2000 to 2010 in both total number and percentage. Looking at Douglas County in 2000, very few census tracts had large numbers of older people, whereas in 2010, several areas in Douglas County had increased their number of older people. Douglas County's older population grew by 177% between 2000 and 2010. In the map of the percentages of older people in 2000, only a few census tracts were in the highest class, and these were located more centrally to Denver. In 2010, the census tracts with the higher percentages of older people are more dispersed from Denver with many in Arapahoe, Jefferson, and Broomfield Counties. This illustrates the aging in place trend and the likelihood of more people aging in the suburbs. The 2010 community assessment survey found that 86% of older adults in the Denver metropolitan area stated they are somewhat likely or very likely to remain in the community throughout retirement (DRCOG Area Agency on Aging, 2010). As noted before, Denver's population is aging, and these maps help to identify places within the metro area that may experience the most growth.

Denver Metro Area's Aging Population 2000
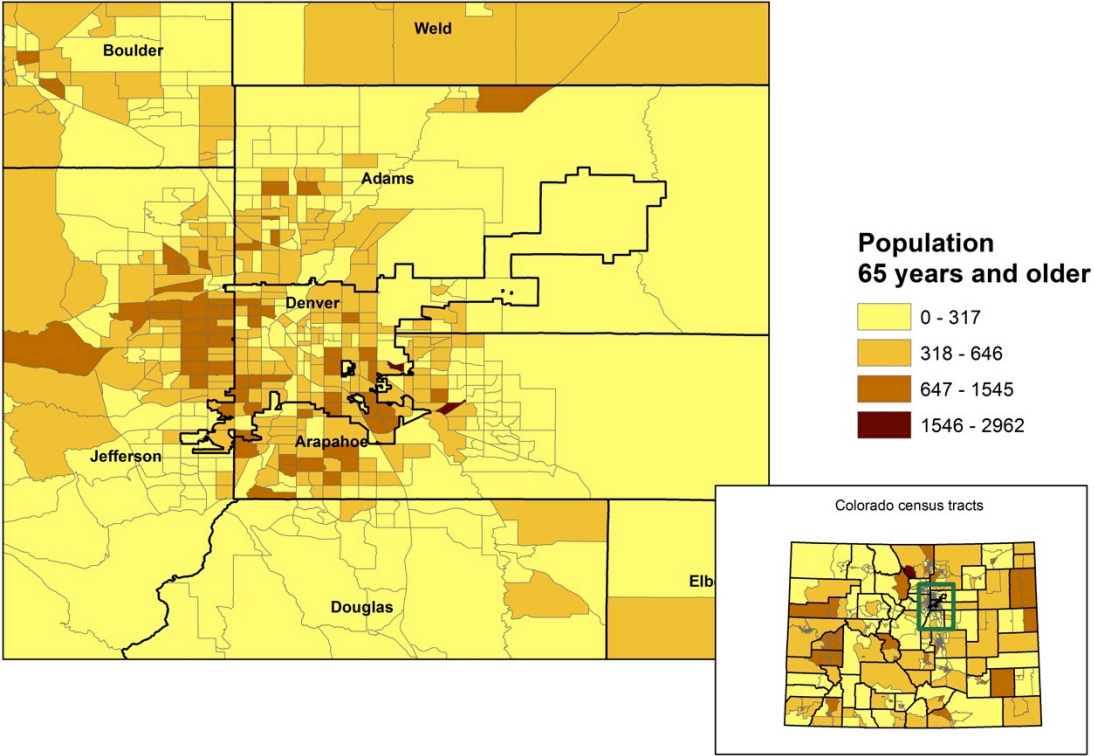
Figure 3.11: Denver's population total over 65 by census tract in 2000
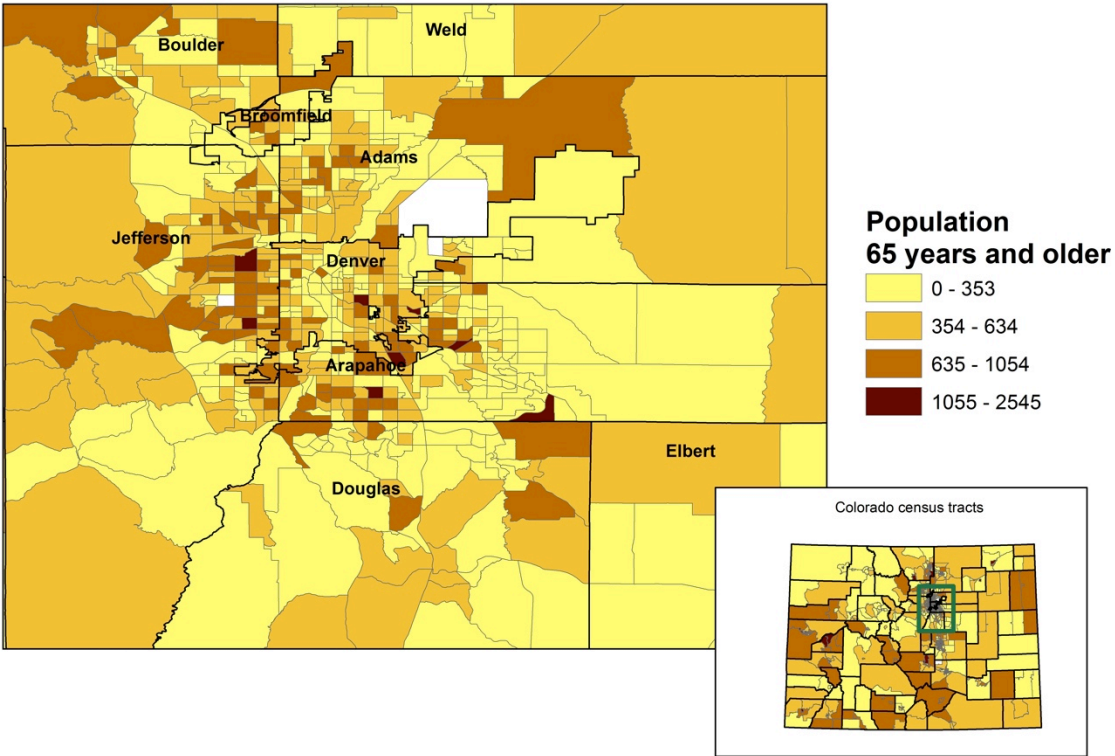
Figure 3.12: Denver's population over 65 by census tract in 2010
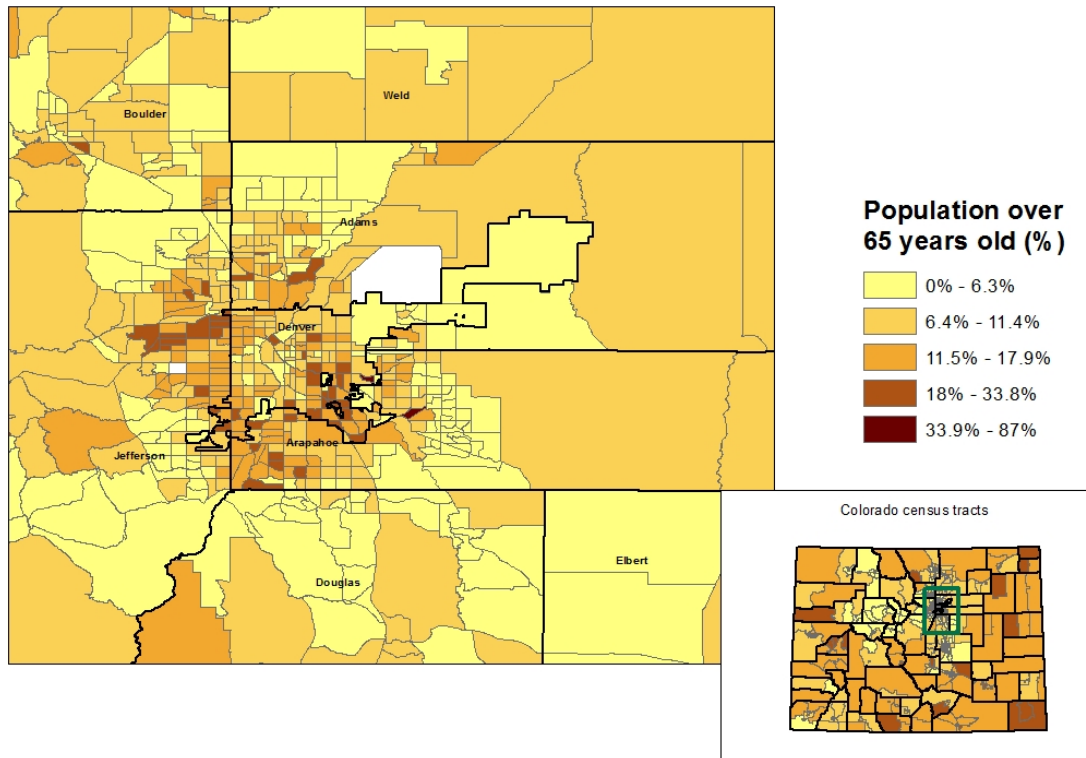
Figure 3.13: Denver's percentage of population over 65 by census tract in 2000
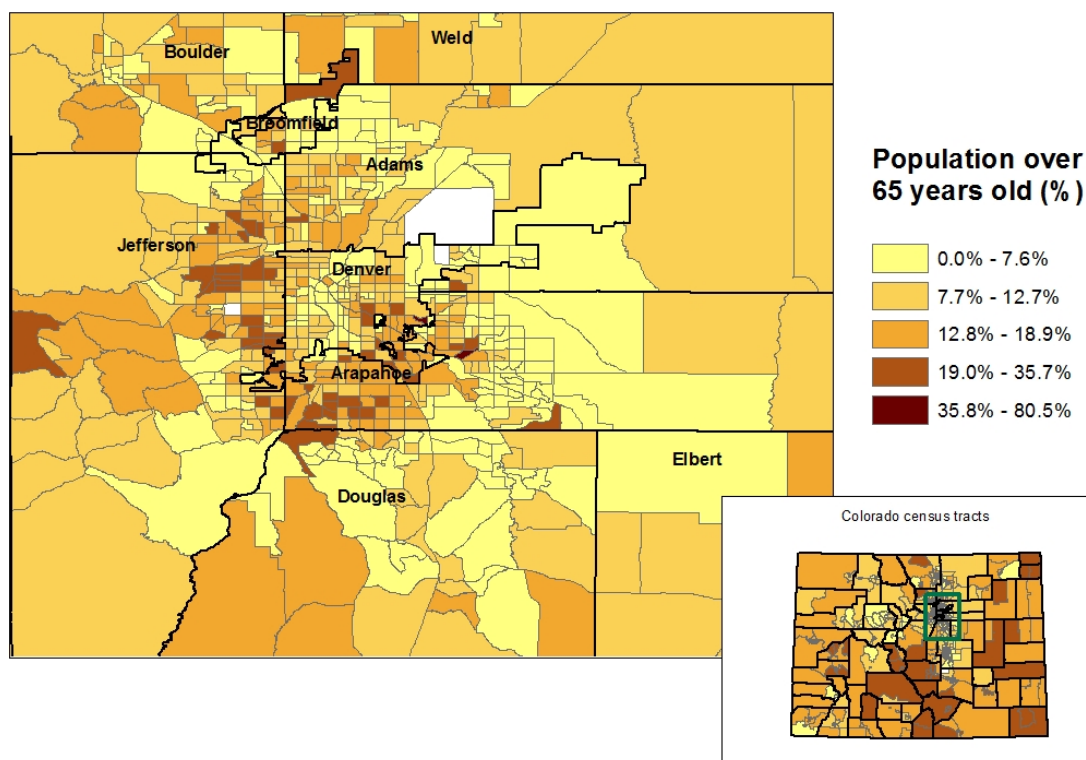
Figure 3.14: Denver's percentage of population over 65 by census tract in 2010.

Figure 3.15 shows a 2010 census map of the Baby Boomer generation, ages 45-64, in the City and County of Denver. This map shows large populations of the Baby Boomer generation in several census tracts. If these people continue to live in the same neighborhoods as they age, planners will need to determine where to locate services to access the most seniors. Aging in place in a relevant trend in the Denver metro area because according to the Area Agency on Aging community assessment survey, 53% of the older adults surveyed had lived in their community more than 20 years, and 72% had lived in the community 10 years or more (DRCOG Area Agency on Aging, 2010).

Looking at the Baby Boomers' locations can help with planning for the future rather than waiting until they age.
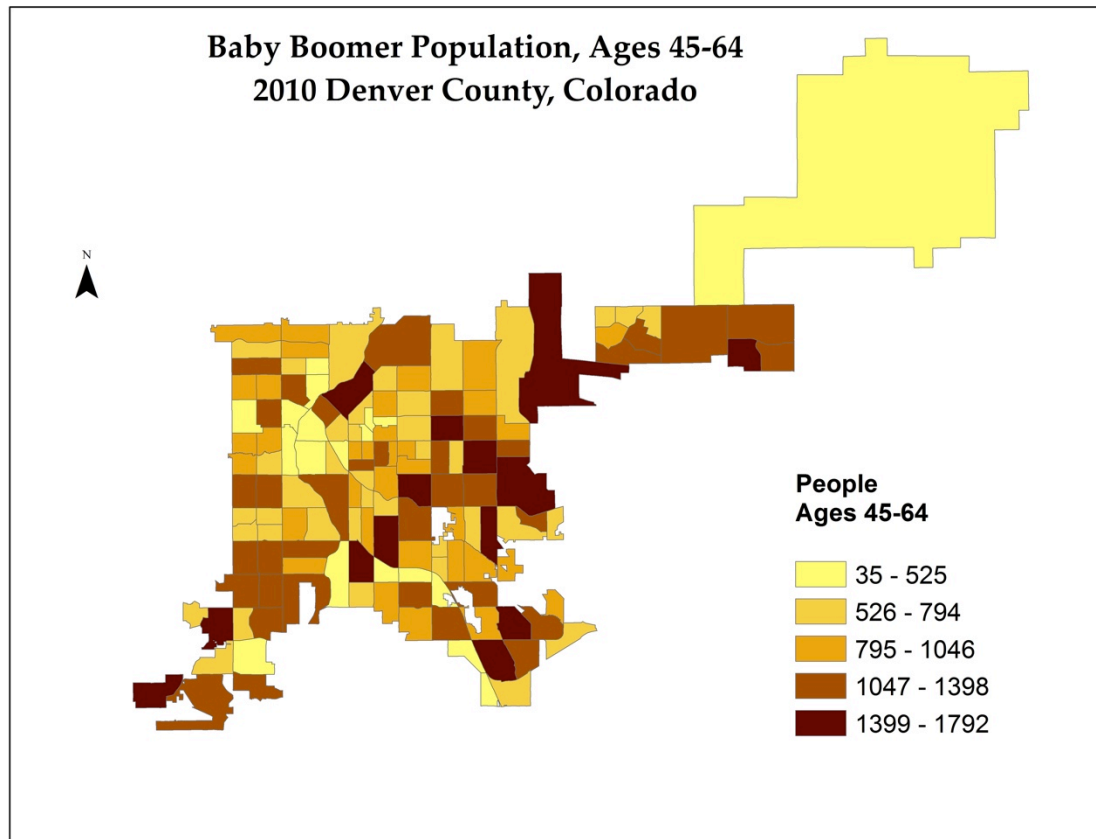
Figure 3.15: Denver's Baby Boomer population in 2010 by census tract

In addition to mapping the locations of older population in Denver, I used the household locations of older participants in the travel survey to perform a point pattern and cluster analysis in GIS to determine if there were significant clusters of older people's trip destinations. Figure 3.16 shows all of the trip destinations that occurred more than once in the dataset. The coincident features tool provided a count of coincident trip destinations, and of the 2,000 trip destinations, 750 locations occurred

more than one time. 122 locations occurred more than two times. From these maps, you can distill a few locations that warrant investigation to see where the elderly travel often. Most of these locations occur within Denver County and Boulder County. Several coincident trip locations exist along the Interstate 25 and southeast light rail corridor. A closer look at what is located at these coordinates is needed to determine their importance to seniors. It would also be important to see what transit connections exist to get to these locations from various points in the city.
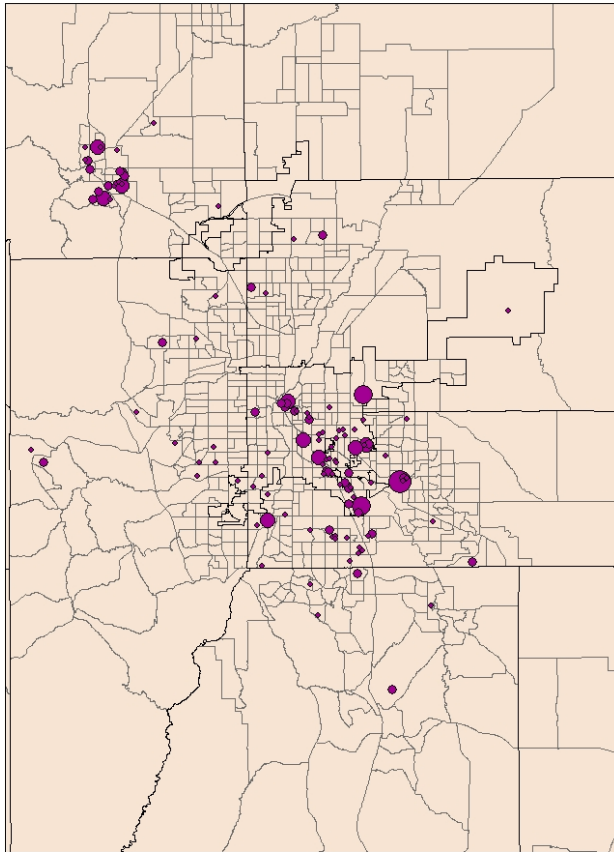
Figure 3.16: Coincident features of travel count survey trip destinations.

In addition to the coincident features tool, I created a standard deviation ellipse in ArcMap using one standard deviation to show the concentration of trip points and the mean center (Figure 3.17). From the ellipse, you can see that the trips have a directional bias of northwest to southeast. This can be attributed to the large number of trips in Boulder. The trips are centered around the Denver central business district as well. There are few trip destinations in the northeast compared to other areas.
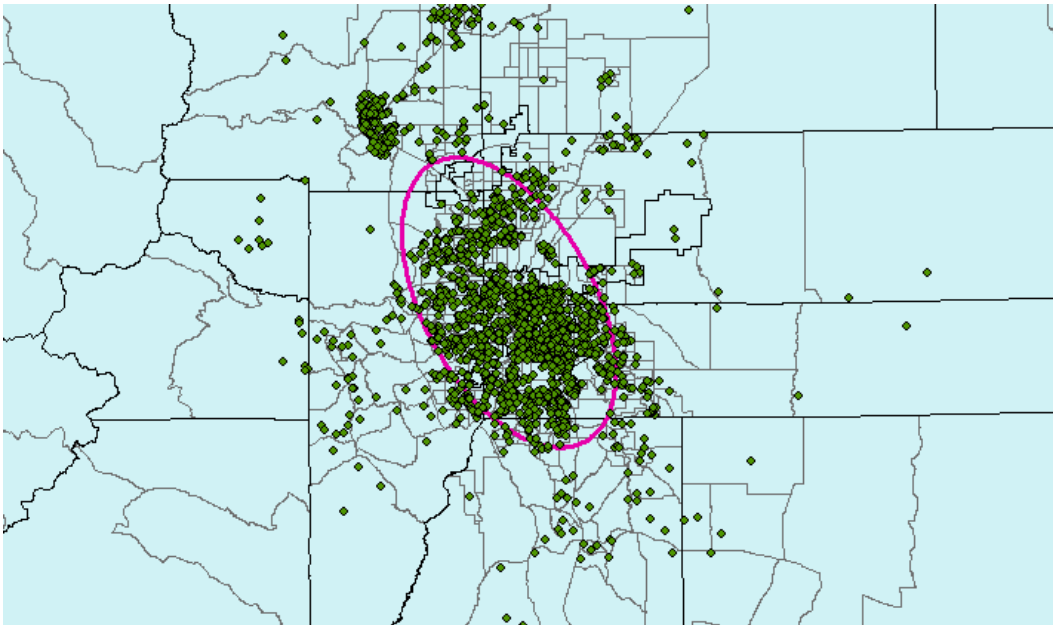
Figure 3.17: Standard deviation ellipse of travel count survey destinations

The kernel density map, which is a density-based point pattern measurement, is a way to better visualize the clustering of aging trip destinations in ArcGIS. The map analysis shows the clustering of trips in Boulder and central Denver and the I-25 corridor. The nearest neighbor analysis is a distance-based point pattern measurement that calculates the nearest neighbor ratio statistic. A nearest neighbor ratio of less than one

means that the data points are not randomly distributed and do exhibit clustering.   After

calculating the average nearest neighbor ratio to be .22, I determined that the points are

not randomly distributed and exhibit clustering. The trip destination locations tend to

correspond with areas of high population and services.
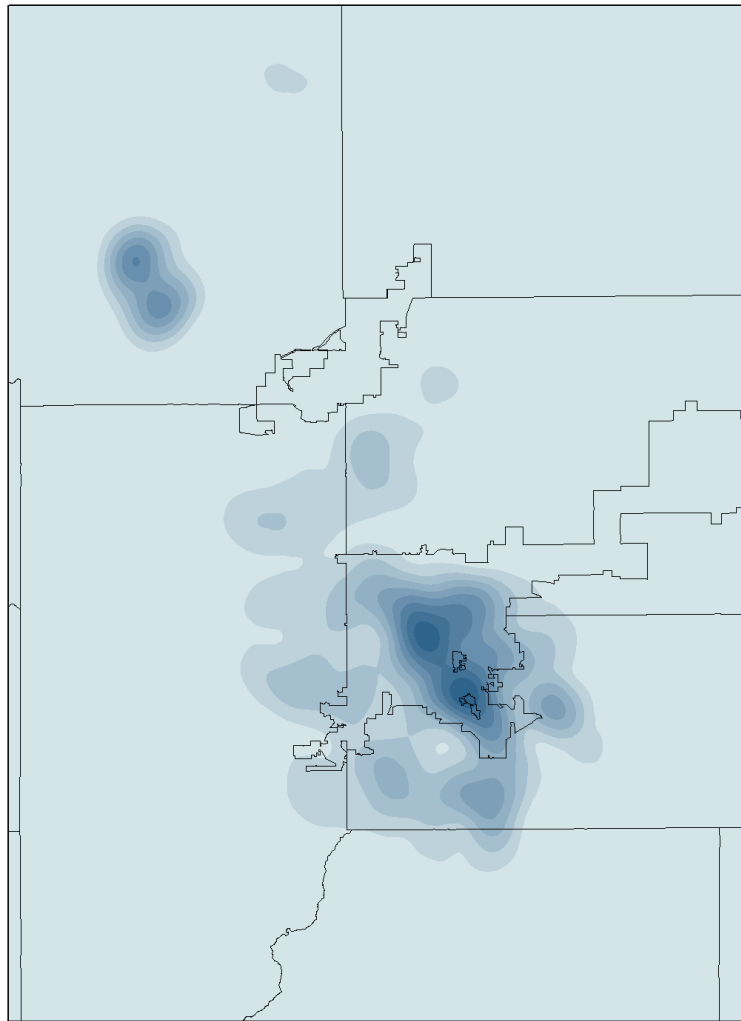
Figure 3.18: Kernel density analysis of travel counts survey trip destinations

Discussion

The statistical analysis of trip making, trip distance, vehicle miles traveled, and trip modes of seniors in the Denver area revealed significant variation in travel based on age, gender, employment status, disability level, residential location, and socio-economic factors. Although trips, trip distance, and person miles traveled went down with age, the most dramatic drop was after age 75, confirming the findings of Alsnih and Hensher (2003) and Páez et al. (2007). Older women overall made fewer and shorter trips than males; males were more likely to use transit and walk or bike as they age while women tend to replace driving with riding. These gender differences support previous studies that found gender to be an important variable for trip making and driving (Rosenbloom 2001; Alsnih and Hensher, 2003; Paez et al., 2007). People who are employed travel more that the non-employed, and disabled people travel less. Older white adults travel further and make more trips than other races, and as income and education levels rise, so does travel.

Analysis of the travel data showed that residential location, specifically in transit-oriented developments, is also a significant variable for travel. Older people living in TODs made more trips on average than people not living in a TOD, but the trips were shorter. Like Alsnih and Hensher (2003), Rosenbloom (2001) and Collia et al. (2003), I found that public transit was not a large percentage of trips made by seniors, but residing in a TOD did affect people's trip modes. People living in TODs made more non-car trips than their counterparts not living in a TOD, with the location of the TOD also being a factor in the reduction of trip distance and miles traveled. Older people living in

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downtown and urban TODs make more trips of shorter distances than people in suburban TODs.

The results of the TOD analysis have important implications for urban and transportation planners, developers, and the older population. These findings show the potential of transit-oriented developments to improve the mobility and accessibility of adults as they age. Lord et al. (2011) and Cao et al. (2010) both note the detrimental effects of conventional design on the mobility of older adults. They argue for higher density development for seniors with meaningful, walkable destinations to improve mobility options; Cao et al. (2010), however, dismiss the environmental benefits of older adults living in traditional neighborhoods. I found TOD residents made shorter trips and more non-car trips than non-TOD residents, which shows that urban design does have the potential to reduce the negative environmental impacts of seniors' trip as they age. Living in a transit-oriented development is not a panacea for reducing travel, however, because suburban TOD residents did not show much reduction in their trip distances or person miles traveled. Neighborhood design that is dense, walkable, and has meaningful destinations near transit is what is needed to enhance mobility while decreasing seniors' reliance on the private automobile.

The spatial analysis of the survey and census data revealed locational patterns of the elderly in the Denver metro area. Census data showed that from 2000 to 2010, the older population has become more dispersed away from central Denver into the suburbs. As already mentioned, conventional suburban design is not conducive to walking or transit so older people in these areas may experience decreases in their mobility if they

cease driving. The cluster analysis showed that the locations of trips in the travel survey

did exhibit clustering, and people were making trips to the same destinations. Further

investigation is needed to determine the accessibility of these frequent destinations.

Mapping the current Baby Boomer population can be an important tool for

planners and city officials as they prepare for growth of the aging population. The aging

in place trend is cited by several studies (Paez, 2007; Rosenbloom, 2001; Lord et al.,

2011; Davies and James, 2011), so areas with large numbers of Baby Boomers may

expect this group to stay during retirement. This type of spatial analysis can help

policymakers and developers when deciding where to locate future senior services,

transportation, and residences.

Future research is needed to build upon the findings here. Specifically, effects of

the residential location and urban design on travel and mobility are areas ripe for

research. This travel count data can also be used to look at travel behavior differences by

urban, suburban, and exurban locations, not just TOD location. The true potential of

smart growth principles and transit-oriented development for older people has yet to be

fully explored. Cities such as Denver are encouraging transit-oriented development

around light rail stations, but more research needs to be conducted on how seniors could

benefit from these developments. Future research should also focus on the Baby Boomer

cohort to analyze their travel behaviors and where they live or plan to live in the future.

Although it is clear that seniors do not frequently use transit, more qualitative research

should be conducted to explore their barriers to using transit and their decision-making

processes.

These results support the findings of many studies that travel and mobility decrease with age and that the older population is not homogenous. This study contributes to the aging and mobility literature by disaggregating the data according to several additional variables such as disability, work status, and socio-economic characteristics. Variation in travel is also found by residential location, and this dimension of mobility is especially important to study as cities prepare for the aging Baby Boomer population.

Chapter Four: Qualitative Research and Analysis of Interviews with Older Adults

in Denver, Colorado

Introduction

The number of older people in the United States is growing because of longer life expectancies and the aging Baby Boomer generation. As the aging population increases, so does the significance of their travel behaviors and mobility needs. The mobility trends of people over 65, generally referred to as seniors or older adults, are changing because they are living more active lives than seniors in the past. This age groups' travel behavior will have significant impacts on the future of transportation, economics, safety, and the environment. Although seniors are more active, they will eventually reach an age when they will have to give up driving. It is crucial to seniors' quality of life and wellbeing to maintain their mobility and independence as they age (Zeigler and Schwanen, 2011; Marottoli et al, 1997; Banister and Bowling, 2004). Both driving and non-driving seniors can experience mobility barriers, and studies have shown that a small percentage of seniors use public transportation as an alternative to driving (Rosenbloom, 2001; Alsnih and Hensher, 2003; Collia et al., 2003). This study uses qualitative interviews to identify seniors' travel behavior, mobility needs, and their perceptions and use of public transit in the Denver metro area. I use in-depth interviews to focus on individual travel experiences and to analyze the decision-making processes of older residents.

The aging population's travel behaviors are not homogenous (Schwanen et al., 2001; Paez et al., 2007), and an individual's mobility can be affected by their age, gender, income, driving status, or physical health. In the United States, the potential mobility of an individual is not only determined by these factors, but also by the transportation services available in a given city. Much of the current research on aging and mobility has come from studies conducted in Australia, Canada, and Europe. Although the United States shares a similar age structure with Australia, Canada, and Europe, they do not necessarily share similar transportation networks, so more research on older residents and their mobility is needed within U.S. cities. This study contributes to the growing aging and mobility literature by examining the mobility and travel of seniors in Denver, Colorado, a western, auto-centric city with an expanding public transit network and growing older population. Denver, Colorado is a particularly relevant study area because the city will be significantly affected by the future growth of the elderly population due to its large population of Baby Boomers. Denver's population over 60 is expected to increase by 30% in the next five years, and by 2035, nearly one in four residents in the Denver area will be 60 or older (DRCOG Area Agency on Aging, 2011).

Studies on aging and mobility have utilized both quantitative and qualitative methods. Qualitative methods are used to answer questions about social structures and individual experiences (Winchester, 2000). This research is the qualitative portion of a larger mixed-methods research project. The quantitative research used travel diary data from the 2009 Denver Regional Council of Governments Front Range Travel Counts Survey to identify and analyze trends of elderly mobility in the Denver area (see chapter

2). I examined data collected for seniors and analyzed trip data according to various age groups: the pre-elderly, ages 60 -64, the young-old, ages 65-74, and the old-old, ages 75 and over, as well as ages 85 and over. The results of this quantitative analysis informed the qualitative interviews I conducted with Denver area seniors. Through the quantitative analysis, I established that transit use among older adults is relatively low and that residential location, especially near transit, can affect mobility and travel behaviors. From the quantitative analysis, questions about why seniors did not use transit and how they make decisions about travel and residential location emerged. Based on findings that living near transit increases mobility using alternative modes, I interviewed seniors living in a bus-oriented community to better assess the factors of transportation accessibility and walkability on seniors' travel behaviors.

This project used qualitative methods to answer the following research questions: **What are the travel behaviors and barriers to mobility of seniors in Denver, what is the decision-making process for seniors for residential and transportation choices, how does residential location affect urban mobility, and what are seniors' perceptions of transit?** These complex questions cannot be answered by quantitative methods alone because the elderly are not homogenous and display significant differences in their mobility issues. The literature on aging and mobility is growing, and the findings of this research inform studies of other North American cities with growing aging populations, as well as help to provide recommendations to policymakers and planners in the Denver area.

The rest of this chapter begins with a methods section that includes a description of the study area in Denver, Colorado, characteristics of the study sample, and an overview of the interview methods and coding process. In the analysis and results section, I discuss the following themes that emerged from the interviews: positive perceptions of transit, lack of knowledge and misinformation as a barrier to public transit use, dissatisfaction with paratransit, driving cessation as gradual and mitigated by driving adaptation strategies, and neighborhood design providing mobility options.   The findings provide insight into older people's decision-making and individual mobility experiences.

Study Area

My interview sample was drawn from the Denver metropolitan area in Colorado (USA). The Denver area has approximately 368,000 older residents (DRCOG Area Agency on Aging, 2010), and according to the 2010 Census, 10% of the population of the Denver metro area is over 65, a commonly used definition of seniors and the aging population. Denver's population over 60 is expected to increase by 30% in the next five years, and by 2035, nearly one in four residents in the Denver area will be 60 or older (DRCOG Area Agency on Aging, 2011). Denver is a relevant study area because the city will be significantly affected by the future growth of the older adult population due to its large population of Baby Boomers. The Denver metro area is expected to be a growth node because people ages 45-64 currently make up over 26.2% of the population, which is right at the national average of 26.4% (U.S. Census Bureau, 2010). Gilpin County and Clear Creek County, two counties within the Denver metro area, are in the top five counties in the country in percentage of Baby Boomers, at 38% and 36% respectively.

Due to the trend of aging in place, this group is expected to stay in the Denver region during their aging years, and planning for the future needs of these Baby Boomers is urgent for the city of Denver.

I chose my sample group from one independent living, senior apartment building in Denver so that differences in the built environment would not be a factor since accessibility depends on a person's residential location. All of the interviewees had access to the same transportation options and walkable destinations. The apartment building is located in Denver's West Highlands neighborhood. West Highlands is an established urban neighborhood that lies just north and west of Denver's downtown and is the location of several other seniors living facilities. The neighborhood's housing values have recently been increasing and going through what some of the residents' described as gentrification. Several of the residents noted the improvements in the neighborhood and linked them to the redevelopment of a main street thoroughfare with shops, eateries, and other businesses. The senior apartment building houses approximately sixty residents and was built in 2001 as a part of an urban infill redevelopment project.
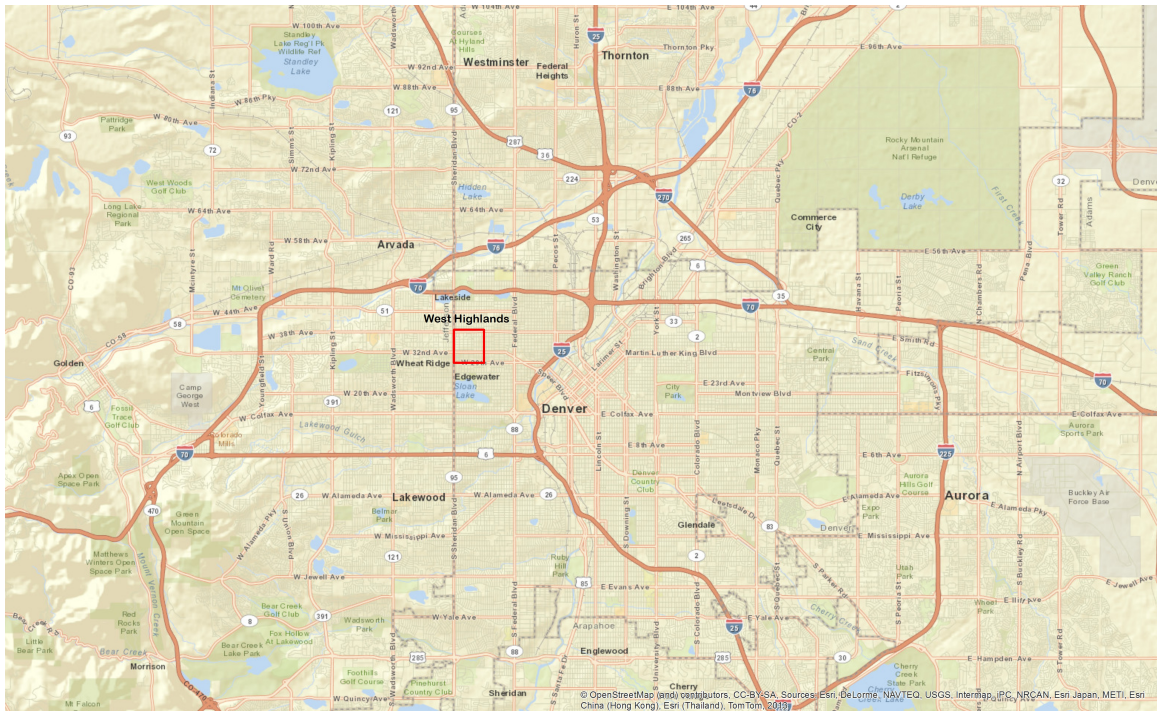
Figure 4.1: Map of study area in West Highlands neighborhood, Denver, CO

I also chose my sample from this apartment because of its location in a development designed according to New Urbanist and Smart Growth principles that emphasize compact, walkable spaces with mixed-use retail and residences and access to public transportation. New Urbanist and Smart Growth proponents point to the potential of such developments to improve the quality of life for older adults and maintain their mobility as they age. I wanted to explore the residential location dimension of urban mobility and the effects of these developments on the mobility of older adults. The apartments are within walking distance (less than a quarter mile) of grocery shopping, medical and dental services, and other amenities such as a fitness club, coffee shop, and bank. A few of the apartments are federally subsidized for low-income residents.

The senior apartments, and the neighborhood as a whole, are what I term bus-oriented, meaning that people living there have access to several bus lines, with two main bus lines that go to and from downtown and out to a nearby suburb with more retail options. Once downtown, transfers can be made to the light rail or other bus lines with access to nearly any area of the city and some surrounding suburbs. The Regional Transportation District (RTD) administers the public transportation system in Denver. This study focuses on use of RTD bus transit rather than light rail because of its proximity to the apartment building. RTD also provides a form of paratransit called Access-a-Ride, for people with disabilities, and Senior Ride, which is a service seniors can use if they have a group of several people attending certain prescheduled activities.

Methods

This research used semi-structured interviews to discern seniors' perceptions of public transit, determine why they make certain transportation choices, describe their mobility experiences, and identify what they perceive as barriers to their mobility. Additional data were collected about their decision-making process when choosing both the neighborhood and apartment building. Qualitative methods such as interviews are useful to find out what people think, know, or feel (Secor, 2010) and to answer questions about social structures and individual experiences (Winchester, 2000). Because this research project sought to identify important factors in the decision-making process of older adults and their perceptions of transportation options, qualitative methods work well to address these research questions, and follows the lead of several studies on aging and mobility that have used qualitative methods or mixed-methods (Mullen, 2005;

Burnett and Lucas, 2010; Lord et al., 2011; Ziegler and Schwanen, 2011). Interviews specifically are used to fill a gap in knowledge, investigate complex behaviors and motivations, collect a diversity of opinion and experiences, and to show respect for and empower the informants (Dunn, 2000). Semi-structured interviews allow the researcher to develop open-ended, content-focused questions while still allowing for flexibility and change during the interview (ibid). I pursue questions of seniors' perceptions of transit, decision-making processes, the role of residential location in mobility, and barriers to mobility here using interviews; these questions emerged from the quantitative analysis and can be better answered through qualitative methods.

I recruited participants from the senior apartment building by attending a weekly coffee hour and participating in and observing resident activities (Figure 4.2). I was also able to use snowball sampling, whereby I got the names of potential participants from current participants. In this qualitative research, I interviewed eighteen people. The sample size is not intended to be a representation of the population, but rather to provide an in-depth look at older people's mobility. This number was large enough to allow me to code and analyze the interviews for common themes.

Figure 4.2: Participant observation and recruitment at social events

The interviews began with demographic data and then proceeded to content-focused questions (see Appendix B for interview guide). The questions mainly dealt with the interviewee's barriers to travel, changes in travel mobility, transit usage, and perceptions of transit, as well as sense of community and residential location decision-making. I recorded the interviews using an audio recorder and took notes during and immediately after the interviews. I transcribed each interview and coded the data to look for patterns and themes that emerged. I used Computer Assisted Qualitative Data Analysis Software (CAQDAS), NVivo, to assist in my data analysis and coding. Using software sped up text retrieval and kept the coding organized. It also allowed for adding codes and themes after the initial analysis (van Hoven, 2003).

Sample Description

Demographic characteristics of the sample are summarized in Table 4.1. The ages of participants ranged from 67 to 91. Eight interviewees were between the ages of 67 and 74, five interviewees were between the ages of 75 and 84, and five interviewees were over the age of 85. I interviewed five males and thirteen females. This uneven gender ratio corresponded to the uneven ratio of males to females in the apartment complex as a whole, with females being the predominant gender in the apartment building. The sample, like the apartment in general, had little racial diversity, with all participants being white and/or Hispanic. Only two couples were interviewed, and the rest of the seniors lived alone. Half of the sample I identify as "drivers," meaning they regularly drive and have consistent access to a car. The other half of the sample was "non-drivers" who had recently given up driving, had never driven, or did not have regular access to a vehicle. All of the participants were retired, but four people worked part-time for pay, and three people regularly volunteered in the community. A couple of participants had lived in the apartments since they opened 12 years ago, and the most recent residents had only lived there two months. Five people moved from another state into the apartments and five moved from other parts of the Denver metro area. Eight of the participants' previous residence was within the same neighborhood.

While I did not directly ask about participants' income or disability levels, I made informal observation of both these characteristics. The apartment rent ranged from $800 to $1000 a month for a one bedroom, and although some of the apartments were subsidized to provide affordable housing, most of the participants' apartments were not

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subsidized. The sample was generally comfortable in their finances, mostly relying on

social security, some pensions, and other savings for income. The residents were solidly

in the middle and lower middle-income categories. Only three of the interviewees

identified themselves as having a physical disability that qualified them to use the

disability transportation services. People's physical limitations ranged from having to

use a walker or cane to get around, using portable oxygen, to having no physical

limitations. None of the interviewees were in wheelchairs or completely homebound.

Because the apartment is an independent living facility, the sample consisted of people

who still got out and about by various transportation methods. This research does not

address the needs or behaviors of older people who are homebound or unable to get out.

Gender		Ages	
Males	5	67-74	8
Females	13	75-84	5
		85+	5
Driving status		Work status	
Drivers	9	Retired	18
Non-driver	9	Part-time	4
		Volunteer	3

Table 4.1: Characteristics of interview sample

Analysis and Results

Perceptions of transit were fairly positive; transit-users had more positive

perceptions than non-transit users

Generally speaking, both transit users and non-transit users had fairly positive

perceptions of the bus system, and even more positive views of the light rail system.

People who used the bus saw it as a way to get around and fulfill their need for

transportation without a car, so they understandably saw a greater benefit to using the bus than people who had a car and drove to get around. When asked about benefits of riding the bus, non-transit users often mentioned how "cheap" it is to ride. The $1.10 one-way fare for senior citizens was not prohibitive for anyone, and all of the people I interviewed said this was a fair price. This was a stark contrast to people who qualified for Access-a-Ride door-to-door service, but did not use it because of the high price of at least $4.50 one-way.

Seniors that regularly used the bus saw it as simple, easy, and pleasant. For example, Rhonda has never driven and has been using the Denver bus system for over sixty years. At the age of 83, she still had very positive experiences and perceptions of the bus system stating, *"The buses are clean, the drivers are good. I've never had, I have to admit, never had a bad experience."* For her, public transit is the only way she can get around without a car, and she finds it has always met her needs and has continued to as she has aged.

> No, I can't complain, I never had a rude bus driver or nothing. I have no complaints, really. I've never fell, I've never lost anything on the bus. Cause my purse is here, my bag is on my lap, either I was knitting or reading, I knew the stop to get off…Oh yeah. I never thought it was a problem. You just, you know the schedule, they have schedules. And you get out there, you hop on the bus, if you need another one, you get a transfer, hop on the other one. And while on the bus you are either reading, you knit, or you just look out the window. I mean, it's no problem whatsoever. (Rhonda)

Past transit experiences, both positive and negative, affect people's perceptions of the bus system, even if these experiences were over twenty years ago. People also related their perceptions of Denver's transit network to other places they had lived. Bob had used the bus in Chicago and Phoenix, and he viewed the transit system in Chicago as much more convenient and on schedule than in Phoenix. He assumed that Denver's bus system was similar to Phoenix, which in his opinion was not good, even though he had never ridden the bus in Denver. Past negative experiences using transit can lead to older people making transportation decisions based on transit experiences that are not relevant to the current transit system in Denver. On the other hand, someone who had positive experiences using transit in the past during their career may also carry those opinions with them into retirement.

> I always enjoyed when I worked downtown, I worked for a law firm and they gave us a pass. And so that just made it so much more, I mean everyone used the bus because there is no point of driving downtown and paying for parking if you have the free pass. So I rode the bus everyday back and forth. I worked there for about 6 years at the law firm. I enjoyed riding the bus. I loved to see the different people. You would see the same people everyday on your route and you became friends with them. So I have no feeling of fear, you know, or distaste about riding the bus. (Patricia)

Public transit services geared towards seniors can also positively affect older adults' perceptions of transit. Senior Ride is a service provided by RTD that takes groups

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of seniors to area attractions. Several people had used this service through an area senior center or their local church. In addition, the apartment building used to have an activities director that would also coordinate activities using Senior Ride. People who had used Senior Ride responded with more favorable opinions of the bus in general. In addition to Senior Ride, RTD provides a Shopper's Special bus that stops at several senior apartments in the area and provides door-to-door transport from the apartment to a local grocery store (Figure 4.3). More people had used Senior Ride or the Shopper's Special compared to the fixed-route bus. These transportation services are essential for many seniors to get out and to provide for their needs. These services for seniors help to contribute to positive perceptions of the bus system. People often commented on the helpfulness of these bus drivers and the convenience and low cost of the services.

Figure 4.3: The RTD Shopper Special Bus

Although most people had generally positive perceptions of the bus, several people also noted negative associations. These people were mostly drivers who rarely, if ever, used the fixed-route bus. A common negative perception of non-transit users was that the bus service was not convenient and that waiting for a bus is not even a comparable alternative to driving. Regular bus riders, however, did not comment on the bus schedule being inconvenient. They knew how to read the bus schedule, to arrive a few minutes before the scheduled time, and to look at the frequency of the bus service before leaving. Most of the bus riders used the paper bus schedules that were in the lobby of the apartment building and on the bus. One woman also used the "My Stop" phone service that allows the bus rider to call a phone number to see when the next scheduled bus will arrive at a particular bus stop. The bus riders talked about bringing something to do on the bus or while waiting at the bus stop, while drivers generally saw this down time as inconvenient and as waste of time when they could just drive to their destination. Only a couple non-transit users described the bus as "unkempt" or "unclean," and these descriptions were based on experiences on the bus in another city or past experience using the bus more than twenty years ago.

Overall, most of the people who did not use the bus stated that they would or could use the bus if they had to or needed to (i.e. if they could not drive anymore). They see public transportation as a potential alternative to driving, but not usually as their first alternative if they ceased driving.

Oh I think, obviously if I need to ride the bus it is right out there. It is close. It's great, it's close by. And what is nice about this area is that you can get to places to buy food. (Fiona)

I could use the bus, if I had to. I would not really want to. Because it's only a block and a half away, I could get on the bus okay. (Samantha)

When I used it a couple times, people have been really nice, the bus drivers help you a lot, and I guess if I had to I would use it and I would get more familiar with it, and it would be, another possibility (Samantha)

If I don't succeed in getting a car, I wouldn't ever hesitate to ride the bus except maybe late at night by myself. I enjoy riding the bus, but I probably wouldn't be a very good customer because I have other means of transportation. (Patricia)

Jenny: Sure (I would consider using public transportation in the future), if I knew where I was going or had someone like Rhonda with me that knew where to get off because I have no idea how it even works. Because when we go on the RTD trips, we just go on, pay our money and he takes us and drops us right in front and picks us right up, so that's really nice.

Samantha: I would get more familiar with it (if I used the bus in the future), and it would be, another possibility, I don't know, I'd have to use the routes. I'd have to learn about it. So if I had to use it, I could use it and I would use it, but I probably would be a little bit uncomfortable at first until I got familiar with how

the system works… I think it is just my own unfamiliarity with it, and that's just a matter of getting used to it.

Compared to the bus, people had very positive perceptions of the light rail and were interested in using it, but the location of the apartment building is not along current or planned light rail lines. Only three people had been on the light rail line in Denver, and two of the women were heavy transit users who did not have a car and relied solely on public transportation to get around. Dorothy used the light rail to get to her medical appointments at a hospital in a nearby city/suburb. She used the regular bus to connect her to the rail station, and then utilized a free art shuttle to get from the station to the hospital.

> Right, the thing about Englewood, the city of Englewood, once you get off the light rail, at the terminus there, the city of Englewood, Monday - Friday has got a wee little art bus that you can take for naught, it's free. And that goes right by Swedish hospital. Said, hey I can do that, can handle that. (Dorothy, 70)

Rhonda rode the light rail when she had a transit pass that covered both bus and rail, just to explore.

> And I get on light rail just to see where it was going. Here, there, south just for the experience. And of course now they've expanded it, it goes behind the old train station. This that and the other. So I haven't been back in there yet because I don't need to. (Rhonda, 83)

The third woman who drove only used the light rail within the downtown area.

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Georgia: Yes, oh, just going downtown, and like, going to the theater or something. Going down and parking in a cheap lot somewhere, and then taking the light rail. Yeah. That's easier because you can kind of step, well not always, but the step is usually manageable on the light rail.

SB: So you would use it for travel within downtown?

Georgia: Once I was in downtown uh-huh.

Although many older people generally have positive perceptions about public transportation, lack of awareness and misinformation about the transit system prevents them from using it

Despite their generally positive perceptions of public transit, only four of the older adults regularly used the fixed-route RTD bus system, three of them being non-drivers. While some people's physical limitations prevent them from using the bus, another major barrier to these seniors' use of the bus was misinformation about the accessibility and safety of the bus, as well as their lack of knowledge about how to use it.

According to a recent survey by the Area Agency on Aging (2010), 63% of older adults in the Denver metro area had not used public transportation in the last year. From my quantitative research using the travel diary data, I found that only 2.9% percent of the older population trips used public transportation, including both the bus and light rail. Because most of the people interviewed did not currently utilize the transit network, I wanted to focus on what barriers prevented their use of transit.

One major barrier to using transit for these non-drivers was their physical limitations to get to the bus stop or onto the bus. A few of them qualified for Access-a-Ride, the door-to-door transportation service provided for people with disabilities. However, both drivers and non-drivers stated misinformation about the bus when asked why they do not use it. Many people did not know about the accessibility features of the bus that could potentially allow them to use it.

SB: So what is the main reason you don't use the bus?

Karen: Well, now, I can't step up. Steps and things like that. And it's more safety.

SB: Safety in terms of...

Karen: Getting on and off the bus.

SB: And if they had a lift?

Karen: Well, I supposed that, I've never ridden on. I know at the apartments I know they had a bus that came in there every Thursday and took them to King Soopers. And I watched them getting on and off that, on that lift. I lived right above the door in the apartment, second floor there. So I could see all that coming and going.

SB: And do you think that would be a possibility in the future, to use to bus?

Karen: For me? No.

SB: Because of getting on and off?

Karen: Yeah.

Georgia: I don't take the buses. It is very hard for me to get, to get in them, the big step. And if the bus doesn't come up close to the curb, then it is just a huge step, which is really hard. So I'm not a bus rider.

Pamela also did not use the fixed-route bus because she thought she would not be able to get up the bus stairs. She did regularly use the "Shopper's Special" bus to go to the grocery store because she knew it had a lift. She stated that not every bus has a lift, and she could not lift her foot to get on the bus because the step is too high.

In each of these cases, the people were either unaware of the accessible features of the bus or misinformed about them. Throughout the RTD service area, all buses have either a lift or a ramp for people with mobility issues or mobility devices such as wheelchairs or walkers. Some buses are also kneeling buses that lower the step to curb level. While in some cases, the person's physical limitations would still prevent them from using the fixed-route transportation, in other cases knowing about the ramp or lift would make a difference in a person's decision to ride the bus.

SB: And what are your perceptions of the bus?

Georgia: Oh, I think it is wonderful, and if they had a lower step to get on the bus, you know, one more lower step, I could make it happily. But, you know, I can't step that high. But I think the bus is great. And I have taken it before, and I would if it was easy to get in. I'm worried about falling off the bus.

Another major barrier to riding the bus was that people did not feel comfortable with their knowledge of how to use the bus. For seniors who had driven most of their

lives and relied on their car for getting around, using the bus was an unfamiliar concept. Many did not know the common practices of how to board the bus, pay, or get off at their destination. A couple who had just sold their car for financial reasons and were interested in using the bus in the future had many questions about how to access and read the schedule and where the bus went. It cannot be taken for granted that older people who have not been transit users can easily make the transition after they cease driving. The prospect of boarding the bus without proper knowledge of how to use it can bring anxiety and worry. A person unfamiliar with the bus system may also worry about getting lost or not getting off at the right stop. A seasoned transit rider may not view a bus ride as an "adventure," but older people who have little transit experience may.

> Jenny: I don't know if she (another resident) was born here or lived here a long time, but she knows the area. I'm not adventurous where I would go out to the corner and get on the bus, and then I would be stuck.

> Jenny: It's not the people, it's not the drivers, it's not the neighborhood it's going through, it's just my own need to get more familiar.

> SB: Would you consider using the bus in the future?

> Jenny: If somebody went with me because I get really lost. I don't know east from west. I'm not really adventurous.

> SB: So the main reason you wouldn't really go is because you wouldn't know where to go?

Jenny: Yup.

For older adults, physical safety when riding the bus is more of a concern than personal safety. Therefore, it is fundamental for older adults to be aware of the accessible features of the bus and to be comfortable using them. Seniors may also need help navigating the bus system and learning or relearning how to use it. Instituting educational programs or information campaigns targeted at the senior rider may help encourage seniors to ride the bus or at least consider it as a viable alternative to driving.

Public paratransit in Denver is not working for these seniors because of expense and perceived inconvenience

Paratransit is identified as a door-to-door, not fixed-route, transportation service. The public paratransit option provided by the Regional Transportation District (RTD) is called Access-a-Ride. Only people who have been assessed by RTD and are determined to be unable to use the fixed-route bus are able to use the service. It is used by disabled people of all ages, including older people with mobility issues. None of the people I interviewed currently used Access-a-Ride. Five of the women qualified for the service as disabled passengers, but they had either determined the cost was too high or the service was too inconvenient for their needs.

Pamela, 91 years old, gave up driving a few years earlier and now walks using a walker. She had been approved to use the Access-a-Ride service, but deemed the cost of $4.50 each way to be too expensive for regular use. For her to spend this kind of money, she would prefer to be able to go somewhere at the drop of a hat, rather than having to plan her activities around the transportation. Gwen also qualified for Access-a-Ride, but

found that it was very inconvenient.

> The fact that you generally have to, you do make reservations three days ahead. It does not tend to be spur of the moment kind of thing. And then you have to be ready about an hour before pick up time, or they give you a pick up time and they can be within a half-an-hour of time one way or the other. And so you are almost spending an hour waiting not knowing for sure. And then the same way when you come back, you have the same issue. So that really didn't work for me. (Gwen)

Although she had good experiences with the accessibility of getting her walker on the vans, she chose not to use the service because of the inconvenience. Instead of using the paratransit, Gwen relied on a housekeeper who comes once a week to do chores and take her to do her shopping and errands. She still does not go places on the spur of the moment, but her family and friends take her places for leisure and entertainment. When asked what would a more convenient service look like, she said that being able to call just one day in advance and only having a half-an hour pickup window would be better.

Georgia used paratransit for a few months after a major surgery and being immobile and unable to drive. The evaluation process for being approved for Access-a-Ride prohibited her from using the service to get to her medical appointments after surgery.

> I didn't try Access-a-Ride, because it seemed very complicated and I, I didn't have enough time. You have to go out to their office somewhere, and then you have to be evaluated, and walk around. And they will watch and see how you are. I

couldn't do any of that, I didn't have time. So that was so much for Access-a-Ride. (Georgia)

Instead, she relied on a volunteer paratransit service called Volunteer Drivers to get her to medical appointments during this time. The service is free with a suggested donation of $3. It is mainly for medical appointments, but she had very positive experiences with this service.

Taxis can act as a form of on-demand paratransit for some older people. Only Gwen used taxis for on-demand needs like going to a party. People did not use taxis mainly because of the cost (Beth: "I'd have to get a second mortgage"), but also because of the perceived unwillingness of the taxi drivers to "go the extra mile" to help the older people with their walkers or wait for them to slowly get into the car. Gwen used a walker and had difficulty getting into the cab as her illness progressed. She did not know about the handicap accessible taxi vans or a program for disabled people to use taxis at a reduced fare.

Well, when I started using the walker, I could not get in and out of the taxi myself, and some of the drivers were not as pleasant about doing the extra and everything. It just didn't seem to be a way I wanted to go. Or I just didn't feel comfortable doing that. (Gwen)

Again, education and knowledge of community programs and resources can help improve the mobility options for older adults who give up driving. When programs exist but

people do not know about them, the resources are wasted and people's mobility options are limited.

Driving cessation is a gradual process rather than an abrupt one; seniors gradually modify and self-regulate their driving to prolong driving and reduce the effects of driving cessation

Previous research has shown that older adults will continue to drive as long as possible. As people age, however, they begin to modify their driving behaviors to prolong driving and delay driving cessation. Studies have noted specific driving modifications and self-regulation of seniors' driving habits such as avoiding freeway driving, scouting routes, and not driving at night (Donorfio et al., 2008; Donorfio et al., 2009; Dumbaugh, 2008; Lord et al., 2011). These interviews support many of these findings and contribute additional information on older people's driving behaviors. Trip generation and trip distance decrease with age; despite the fact that people are still driving, they begin to go fewer places and stay more local. While some travel decrease may be due to declining health and ability to get out, others are slowly adjusting their travel behaviors as they age, continuing to drive, but modifying their driving habits to an appropriate comfort level. As they decrease their travel or avoid traveling in certain areas or at certain times, they begin to explore alternative transportation options before complete driving cessation.

Many seniors, both men and women, said that they do not drive at night or when it is dark. This is a self-imposed driving modification, and people are okay with this limitation on their travel. Nearly everyone mentioned their eyesight as the reason they do

not drive at night; they find it difficult to see street signs and the glare of the car lights is also a problem. If they do drive at night, it is only to familiar places where they can put it on "autopilot" and do not need to read the signs.

> If I go to Golden, I can put it on autopilot at night 'cause I do it so often. But if I were having to seek out a new area with street signs, I probably wouldn't tackle it [at night]. And I don't drive downtown. Not anymore. (Beth)

Despite this reduction in their travel, the seniors did not seem to mind this limitation. Overall, they did not feel the need to go out at as much at night and were happy enough to stay home or when needed, have someone else drive them at night.

> I have a car that I can drive anytime I want to besides at night. Which doesn't bother me, not going anywhere at night, 'cause if I do, somebody picks me up. (Fiona)

> But you know, it is getting a little more difficult to drive at night, so I think someday it'll be harder. I'm fine if I know where I am going. (Georgia)

Transit-users also rarely used the bus at night, citing the issue of personal safety. But again, they did not mind limiting their travel because they did not feel the need to go out at night a lot and they could usually get a ride when needed. Marge, a bus rider, said that she does not get out at night because, *"I don't think it's safe, and I don't have any business getting out at night."* If she wants to go somewhere at night, she will often go

with her family who will drive. Rhonda echoes this sentiment and does not ride the bus at night:

> I'm not a night person, I mean I'm not going to go, I mean you have to be practical, come on now, you know, why go? No.

> …And like I said, I wouldn't go out at night, 'cause you know all the weirdos out there, the creeps and everything.

Older drivers also modify their driving routes by avoiding the interstate, but women much more than men. Nearly every woman driver I interviewed mentioned their preference to avoid the interstate, mostly due to the heavy traffic and their perceived slower reflexes. Some of them would go significantly out of the way to avoid driving on the freeway, and in some cases, this prohibited them from going to visit family and friends a few hours away. Fiona would only be able to visit her daughter in Northeast Colorado when her other daughter would drive because she would have to drive on the interstate. The men, on the other hand, made it clear that they go wherever they want and that they have no problem driving. According to research, men tend to drive longer into old age, and women stop driving earlier (Rosenbloom 2001; Alsnih and Hensher, 2003; Páez et al., 2007); their self-regulation and driving habits also differ by gender.

Both genders try to avoid traffic as much as possible, by modifying the time of day they travel or the routes they drive. The morning and afternoon rush hours are the periods people avoid driving the most. When making appointments, they try to schedule them mid-day for an easier drive. Those who do drive on the interstate tended to avoid it

during peak rush hour as well. Because most people do not work, their activities are flexible and can be scheduled around the traffic. Late morning and early afternoon are the most common times for seniors' travel (Boschmann and Brady, 2013). The location of the apartment building also allows many people to easily travel to their most frequent destinations without concern about the interstate or traffic. Their most frequent destinations are the grocery, library, church, and the senior center, all of which are within a few miles of the apartment in the same neighborhood. Whether they walk, drive or take the bus, these activities are very accessible to them and they did not have to modify their travel to get to most of these places.

Rosenbloom (2001) found that older adults are more likely than younger people to scout their route for a trip prior to the actual travel. Many people I interviewed do scout their routes, but others use online mapping or paper maps to find the location of new places. Although the seniors were concerned about finding unfamiliar places, some did not scout the route because they did not want to waste gas. Instead, they utilized online maps, most often Map Quest, or a GPS in their cars to find a location prior to travel. Some people avoided going new places at all, relying on others to drive if needed. The main reason they would drive to a new place before hand was to avoid getting lost on the way to an important meeting or appointment. Samantha noted the added stress that this would cause her:

> If I was going like to, say a new dentist or some other place I wasn't really
> familiar with, yeah, I would try to go and find the place ahead of time. I did this
> when I needed to get to Kaiser in downtown Denver. I had my sister go with me

and she would tell me how to go and I memorized the route so I knew how to get there and that's generally, if it is a new place that is far like Highlands Ranch or somewhere in Golden, I try to do a practice route ahead of time, so and I'll look at a map or ask somebody how to get there or I'll get a map of Denver and see what's the best route. I used to use Google, but that's kind of confusing to me so I don't do that. I just don't, I don't want to make it an adventure unless I'm really going to an adventure. I don't want to have to be lost somewhere and have a deadline that I have to get to the appointment because I'm running late because I can't find the place. That makes me very nervous. Unless I just want to go driving around to see stuff, I try to plan ahead. (Samantha)

The instructions I get from MapQuest are going this route, this route, (making gestures), going in convoluted ways, to get there and coming back is even worse. (Bob)

Better online mapping tools that are senior friendly could reduce the need for older adults to scout routes, thereby reducing the potential environmental impacts of increasing senior travel.

Choosing a residence in a transit-oriented or walkable neighborhood can increase mobility options but will not always change travel behavior

One factor that affects the mobility of seniors is their choice of residence. Where seniors live affects their opportunity for travel and movement. Mobility can be defined as "the potential to move," and the opportunities for transportation and movement are

inherently related to the physical location of a person. All of the women who had given up driving had done so after moving into the senior apartment building. The location of the apartments seemed to be accessible for people without a car. When these women gave up driving, it was not necessary for them to move residences to still be able to get around. The location of the apartment along a major bus route, near walkable retail and services, and near family and friends made it a viable option for non-drivers.

Living in a senior residence along major bus or transit lines can help seniors transition from driving to non-driving and provides seniors with an option for transportation that still gives them independence. They may see other people in their building using the bus and become more comfortable with the idea of using the bus as an option if they had to give up driving.

Living in a senior community also gives people access to transportation opportunities that may not be available to people still living in their homes. Older people become more familiar with the bus system through services like Senior Ride and the Shopper's Special bus. Senior Ride is a service available to groups of seniors who wish to attend activities in the area. An RTD bus will come to pick up the seniors, drop them at the activity, and pick them up again. The group of seniors signs up several weeks before the activity. This service is primarily used by church groups, senior centers, or groups from senior living communities. People living in their own home would not have access to this unless they were a member of a church or senior center, and then they would still have to find a way to get to the church or senior center if they did not drive. The Shopper's Special bus is similar in that the RTD bus will come pick up a group of

seniors to go to a local grocery store once a week. The Shopper's Special provides a

necessary service to seniors who cannot drive or who have mobility issues; the service

allows people to take care of their shopping needs independently. This service is only

available to locations that have a large enough group of seniors who will use the service.

The Shopper's Special bus that services the apartments stops at two other senior

apartments in the area. Living in a senior community can provide additional mobility

opportunities that people living in their home may not have access to.

This apartment building was built as a part of a redevelopment project that used

smart growth and new urbanist principles, characterized by compact, mixed-use

development with walkable amenities and services. The development has a grocery

store, dental and medical offices, coffee shop, pet store, fitness center, and other various

retail shops. All these are within a quarter mile of the senior apartments. Near the

apartment is a major redevelopment project of retail and restaurants along another major

arterial street. These amenities are not walkable for everyone, but the location of the

apartment does allow seniors to have access to more walkable destinations than a typical

suburban or urban neighborhood that is not mixed-use. Some of the seniors still drove

their cars to these places, but others who did not drive could walk to meet most of their

basic needs. Locating senior living in mixed-used redevelopments can increase the

opportunity for walking and travel for seniors, and the interviews showed that people

chose to move to the apartments because they were centrally located.

Although research shows that aging in place is a common trend for the older

population, this does not mean that older adults are always choosing to age in place in

their current home. Many people I interviewed spoke of choosing to live in the senior

apartments because of the neighborhood, which was "home," and people may still be

willing to move to more accessible locations within their current neighborhood. When

asked what brought about their move to the senior apartments, many of the people spoke

of a major life change that facilitated their move. The death of a spouse, a divorce, or a

personal illness often prompted the move. For others, it was a slower realization of not

wanting to take care of a house or yard and the need for more social interaction and

senior-friendly living. The people who did move from another state or city chose to

move to be closer to their family. The location of the apartments in a walkable

neighborhood also contributed to their choice of moving to the senior apartments. The

aging in place trend does not mean that seniors are not willing to move to more accessible

places, but that they are choosing to stay within their home cities and neighborhoods as

they age. The location of senior housing can play an important role in increasing the

mobility opportunities for seniors as they age.

Discussion

One major finding of this qualitative study is that seniors' lack of knowledge of

resources and services can be a barrier to mobility, and specifically to the use of

alternative transportation. Very few of the drivers interviewed used public transportation,

and only about half of the non-drivers did. Many people had physical limitations that

they thought would prevent then from using the bus. Others did not know how to use the

bus or were concerned about their ability to find their way on the bus route. Educational

programs that are geared specifically to seniors could greatly increase the viability of

public transit as an alternative to driving. Seniors who do not have experience using

transit in the past are not likely to use it in the future unless they have adequate training

and feel comfortable with their ability to navigate the system. The recent Community

Assessment Survey for Older Adults found that only 44% of seniors rated the ease of bus

travel as excellent or good, whereas 77% rated the ease of car travel as excellent or good

and 73% rated the ease of walking as excellent or good (DRCOG Area Agency on Aging,

2010). These statistics support the findings from the interviews that the car is still the

preferred option but that improving the ease of bus travel could increase ridership of the

elderly. Currie and Delbosc (2010) note that public transit usage by the Baby Boomer

generation has increased, so the challenge for planners and transit officials in the future is

to encourage the Boomers to continue ridership in their retirement years.

This finding is also important because it suggests to policymakers, transit

companies, and senior advocates that implementing transit education programs may

increase seniors' comfort level and use of public transit. Some transportation providers

currently have travel-training programs for people who want to learn to use the transit

system. One example is a non-profit organization called Via, that mainly services

Boulder County in Colorado. The organization provides mobility specialists and rider

training for people with disabilities and older adults. With better educational and

outreach programs and knowledge of how to use transit systems, seniors may be able to

add to their mobility options and see transit as a more viable alternative to driving. In a

recent community assessment survey of older adults' needs in the Denver metro area,

40% of people surveyed said they were very uninformed or somewhat uninformed about

services and activities available to older adults in the community (DRCOG Area Agency on Aging, 2010). The Area Agency on Aging plans to create a clearinghouse for senior resources and increase public awareness of senior services (DRCOG Area Agency on Aging, 2011).

The residential choices of seniors can impact their current and future mobility options. As their mobility changes as they age, alternatives to driving become more important. In a community assessment survey, 26% of older adults said that finding safe and affordable transportation was at least a minor problem (DRCOG Area Agency on Aging, 2010). Choosing to live in areas with walkable destinations or near transit lines can provide non-driving seniors with more options than relying on others to drive them as a passenger. In this sample, people who transitioned to driving cessation were able to continue living in the apartments because they had alternatives to driving including walking, bus transit, and riding with other drivers who live nearby. As other studies have suggested (Cao et al., 2010; Michael et al., 2006; Lord et al., 2011), accessible and centralized residential locations can help seniors maintain their quality of life after driving cessation.

This finding is important because communities need to plan for the aging of their citizens, and providing senior living near transit and walkable destinations can reduce the need to continue driving or to move when driving ceases. Transit-oriented developments have been heralded for their benefits to seniors, yet relatively few such developments include senior housing in their plans. As the rail network expands in Denver and the city

focuses on transit-oriented development around rail stations, senior housing should be considered an important part of this growth.

These results of this study support previous findings and add to the growing literature in the aging and mobility field. Aging in place has been identified as a current trend in the aging population. While more seniors are choosing to stay within their communities as they age, I found that they are not opposed to moving residences, especially after a significant life change. Informing seniors of their residential options for maintaining their independence and mobility as they age can prevent seniors from having to move as their mobility changes with age. Finding a place where a transition can be made as a person's mobility changes is linked to the built environment and the available travel options in a particular location.

Alsnih and Hensher (2003) found that public transit can be a viable alternative for seniors if it is safe, clean, reliable, and accessible. Through my interviews, I found that seniors' perceptions of public transit can be shaped by travel experiences in different cities as well as travel experiences from many years ago. Past negative experiences of transit can inhibit future ridership of older adults. Transit users in my study generally had more positive perceptions of public transit than non-transit users. They identified the bus as safe (during the day), fairly clean, and reliable service. Non-transit users were more likely to see the bus as unkempt and inconvenient, often citing past travel experiences as their guide. Non-transit riders stated their perceived inability to access the bus, mainly due to the high step up from the curb; they did not know about required accessibility features of the fixed route bus and caused them to view the bus as unsafe. To change

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perceptions of public transit, older adults must experience the system to overcome their past perceptions of the transit system. As transit usage by Baby Boomers and working adults today is increasing (Currie and Delbosc, 2010), they will carry their experiences and perceptions into retirement. Positive experiences using transit during the pre-retirement stage may help encourage people to use public transportation as they age. Transportation services targeted at seniors can also improve the perception of bus transit for older adults.

Rosenbloom (2001) noted the potential for negative environmental impacts due to the aging of the Baby Boomer population and the travel behaviors of seniors. These findings support her assertion that seniors are more likely than younger people to scout trips before driving to unfamiliar places. However, many also stated that they use online mapping services or GPS to help them navigate unfamiliar areas. They are also not likely to go to unfamiliar places at night and will often have others drive them to new places. New technologies may decrease the environmental impact of seniors' way-finding and decrease mileage due to getting lost. Due to the high cost of gas, seniors are also cognizant of wasted trips and wasted money. Trip-chaining is an important part of seniors' travel behavior. They try to make several trips when going out so they reduce their trips to and from home. Seniors may be more motivated by saving money than saving the environment, but their money-saving actions decrease the negative impact of their travel on the environment.

This study does have some limitations in its design and findings. I recruited my sample through attending social events at the senior apartments and through snowball

sampling as other residents introduced me to their friends. Therefore, my interviewees were the people who were social and mobile enough to attend these events. Despite this, I still ended up interviewing several people who were very social and liked to attend the coffee hours, but who were not that mobile and needed assistance through mobility devices to get around. As this apartment was an independent living facility, I was only interviewing people who still had a fairly high potential for mobility and movement. The findings are not meant to be generalized for a larger population, as the sample size was only eighteen. However, qualitative interviews give a rich sense of the individual mobility experiences and perceptions of seniors in this urban neighborhood of Denver. The findings are indicative of seniors living in an independent senior living apartment in a bus-oriented neighborhood of Denver, Colorado.

Future research should look at the current use of public transit, both rail and bus, by the Baby Boomer population. Research is showing (Rosenbloom, 2001, Collia et al., 2003) that the travel behaviors of the current older adult population are different than previous senior cohorts, with more older people today being licensed and driving longer into retirement than previous cohorts. The increased use of public transit in Denver, especially by the working population, could affect the Baby Boomer's use of transit as they age. Future research should also focus on how to continue the use of transit after retirement as this generation ages.

This study focuses on the use of transit and travel behaviors of seniors in the urban context. Many Baby Boomers live in suburban areas that are notorious for being inaccessible by bus or walking. The trend of aging in place means that as Baby Boomers

age, they will likely stay in these suburban communities. Future research is warranted to describe the travel behaviors of seniors in the suburban context and the potential of new seniors housing that provides alternative transportation in the suburbs. Studying the effects of living near transit lines and the use of transit is also important to inform community decision makers and developers who are building transit-oriented developments. New transit-oriented developments are springing up around the light rail stations, and some are planning to include senior housing in the developments. Future research on senior use of light rail and commuter rail is needed to inform developers, city planners, and seniors of the potential benefits or travel opportunities such developments may have for seniors.

Generally, the seniors I interviewed were satisfied with their mobility and transportation options. Although some seniors wanted to go more places, all of the seniors were able to address their basic mobility needs (getting food, medical care, etc.) by driving, using transit, or having friends or family take them places. Non-driving seniors who depend on other people to take them places expressed their desire to go more on the spur of the moment to visit friends or go to restaurants and other social activities. The main barrier to using public transportation is lack of knowledge of how to use the bus and the accessible features of the bus. Improved education programs and communication initiatives targeted toward the senior community could increase transit ridership and provide seniors with more mobility options and alternatives to driving. Seniors see transit as a potential alternative to driving, but not as the first option.

Chapter Five: Conclusion

This study sought to answer the following research questions: What are the travel behaviors and barriers to mobility of seniors in Denver, what variables affect travel, what is the decision-making process for residential and transportation choices, how does residential location affect urban mobility, and what are seniors' perceptions of transit? These questions were answered using a mixed methods approach that used both quantitative statistical and spatial analyses and qualitative interviews. This approach allowed me to answer these questions at the broader metropolitan scale as well as at the neighborhood level. The quantitative analyses identified trends in the travel and mobility of seniors in Denver, Colorado. Age, gender, work status, disability, residential location, and socio-economic factors were found to be important variables for seniors' travel. The qualitative interviews resulted in an understanding of seniors' mobility in one bus-oriented, walkable neighborhood. The interviews explored their barriers to mobility, travel and residential choices, and perceptions and use of transit.

This research revealed some important findings that contribute to the current aging and mobility literature and to future studies. Residential choice and neighborhood design have significant influence on the travel behaviors of seniors, with older people in TODs making more trips that are shorter distances. They also make more non-car trips than people not living in a TOD. These findings show the potential of certain

neighborhood elements, like density and walkability, to increase mobility for seniors and to lessen the environmental impacts of their travel. Future research on the effects of the built environment and urban design on senior travel specifically can provide further insight for urban planners, developers, and city officials.

In the qualitative interviews, perceptions of public transit were found to be fairly positive, but despite this, public transit use was still low. Lack of information and misinformation about the bus prevented many seniors from using public transit. Not knowing about the accessibility features of the fixed route bus and how to ride the bus were barriers to utilizing the bus system. These findings show that improved educational programs and travel training directed at seniors could increase ridership and provide alternative transportation options. Paratransit services were not working for frail and disabled seniors due to the high cost and inconvenience. As the older population in Denver grows, changes in door-to-door transportation services may be necessary to provide for their growing mobility needs. Older drivers usually begin to modify their driving habits to put off driving cessation as they age. They sustain their automobility by avoiding freeways and driving at night. Programs that help older drivers ease into driving cessation and provide them with alternatives to driving can prevent isolation or decreased mobility.

One theme that emerged from the interviews and statistical analysis is that residential choice plays an important role in the accessibility of services and the availability of mobility options. Older adults living near transit have better access to a greater variety of transportation options. Further, living in a senior community opens up

even more transportation options, such as Senior Ride or the Shopper's Special, that are only available to larger groups of seniors living in a single location. The residential location dimension of aging and mobility deserves much more study in order to develop aging-friendly cities and improve quality of life for older adults.

The aging population in Denver and other cities in western countries will continue to grow. Policymakers and planners must be prepared to meet the growing and varied mobility needs of this group. This study helps to address the need to understand how different groups of people get around the city and to identify potential ways of improving mobility and accessibility for seniors.

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Mean trips by age and gender- ANOVA			
Source	**DF**	**F ratio**	**Prob > F**
Model	7	21.6623	<.0001*
Error	4260		
C. Total	4267		
Age group	3	42.3194	<.0001*
GENDE	1	10.1783	0.0014*
Age group*GENDE	3	0.8246	0.4801

Mean trip distance(log) by age and gender-ANOVA			
Source	**DF**	**F ratio**	**Prob > F**
Model	7	19.78	<.0001*
Error	15670		
C. Total	15677		
Age_group	3	29.9097	<.0001*
GENDE	1	1.1316	0.2875
Age_group*GENDE	3	5.4387	0.001*

Mean person miles traveled (log) by age and gender-ANOVA			
Source	**DF**	**F ratio**	**Prob > F**
Model	7	22.5695	<.0001*
Error	3380		
C. Total	3387		
Age group	3	43.6042	<.0001*
GENDE	1	8.894	0.0029*
Age group*GENDE	3	0.7464	0.5243

*Statistically significant

Mean trips by age and disability- ANOVA			
Source	DF	F ratio	Prob>F
Model	7	27.6545	<.0001*
Error	4260		
C. Total	4267		
Age_group	3	22.3094	<.0001*
DISAB of PER_deliv_final_ID	1	35.9639	<.0001*
Age_group*DISAB of PER_deliv_final_ID	3	0.0897	0.9657

Mean trip distance (log) by age and disability-ANOVA			
Source	DF	F ratio	Prob>F
Model	7	13.5915	<.0001*
Error	15670		
C. Total	15677		
Age_group	3	22.0122	<.0001*
DISAB	1	4.9692	0.0258*
Age_group*DISAB	3	1.1014	0.3471

Mean person miles traveled (log) by age and disability-ANOVA			
Source	DF	F ratio	Prob>F
Model	7	20.4066	<.0001*
Error	3380		
C. Total	3387		
Age_group	3	32.8502	<.0001*
DISAB of PER_deliv_final_ID	1	6.309	0.0121*
Age_group*DISAB of PER_deliv_final_ID	3	0.2107	0.889

Mean trips by age and employment-ANOVA

Source	DF	F ratio	Prob>F
Model	7	24.9896	<.0001*
Error	4259		
C. Total	4266		
Age_group	3	9.7363	<.0001*
EMPLY of PER_deliv_final_ID	1	6.134	0.0133*
Age_group*EMPLY of PER_deliv_final_ID	3	0.8868	0.4471

Mean trip distance (log) by age and employment- ANOVA

Source	DF	F ratio	Prob>F
Model	7	19.0185	<.0001
Error	15670		
C. Total	15677		
Age_group	3	5.3175	0.0012*
EMPLY	1	11.2921	0.0008*
Age_group*EMPLY	3	1.8217	0.1408

Mean person miles traveled (log) by age and employment- ANOVA

Source	DF	F ratio	Prob>F
Model	7	23.5319	<.0001*
Error	3380		
C. Total	3387		
EMPLY of PER_deliv_final_ID	1	3.8409	0.0501
Age_group	3	11.9693	<.0001*
EMPLY of PER_deliv_final_ID*Age_group	3	1.3852	0.2453

Appendix B: Interview Guide

Interview Guide

1. Previous Living Situation
   a. Tell me about your living situation before you moved to these apartments. Where did you live? Who did you live with?
   b. Tell me about your family. Do any of them live nearby or in the area?
   c. How often do you see them?
   d. How long have you lived here? How long did you live in your previous home?
2. About your choice to live in this neighborhood
   a. Tell me about your decision to move here. When and why did you decide to move here?
   b. How did you find out about this development?
   c. What were some of the most important factors in your decision to move here? (TOD, walking, transportation, community, senior living)
   d. Do you see yourself being able to stay in this area in the future?
3. Destinations and walking
   a. Walk me through a typical day.
   b. Where do you go and how do you get there?
   c. Where do you go most often? Tell me about the places you go the most.
   d. Do you often walk? Do you walk for exercise? Where do you walk? When do you walk instead of drive or vice versa?
   e. Can you give me an example of a recent trip where you walked somewhere?
4. Driving behaviors
   a. Do you drive? When did you stop or plan to stop driving?
   b. Can you give me an example of a recent trip where you drove somewhere?
   c. Tell me about times when you might modify your travel route or avoid certain areas.
   d. Do you have any restrictions on when you travel?
   e. Do you ever scout a location before your first trip there?
   f. How do you decide what route to take somewhere?
5. Transit
   a. Do you ever use the bus? When and what for? Tell me about a recent experience using the bus.
   b. Have you ever used the light rail? When and why? Tell me about this trip.
   c. Do you ever use paratransit or taxis? Tell me about an experience using these services.
   d. Would you consider using public transportation in the future?
   e. Why or why not?

6. Barriers to Mobility
    a. Do you consider yourself fully mobile? What does that mean to you?
    b. How has your travel/ mobility changed as you have aged?
    c. Do you find that money is an obstacle to getting around?
    d. Can you tell me about a time when you wanted to go somewhere, but couldn't?
    e. What prevents you from getting somewhere you want to go?
7. Changes in mobility
    a. How has your travel behavior changed in the last few years?
    b. Since you retired? Since you stopped driving?
    c. How is your travel different in your (70s, 80s) then it was in the past?
    d. How has your neighborhood changed since you moved here?
    e. How has this affected how you get around?
8. Perceptions and attitudes of transportation
    a. What are your perceptions of the bus? Where would you go on the bus?
    b. What do you like about public transportation?
    c. What do you dislike about it?
    d. Are you concerned about safety when you travel? Does your concern about safety prevent you from using any particular forms of transportation?
    e. Tell me about a time when you felt unsafe going somewhere.
9. Sense of community
    a. In your view, what is a community?
    b. What do you feel about the sense of community in your neighborhood? In your apartment building?
    c. What are some instances/ events that illustrate the sense of community?
    d. Compare your living situation before you moved here. Which area would you say has a better community situation? Why?
    e. Do the mixed ages integrate? Do you socialize with people outside the community or just in the apartment buildings?
    f. Could you define the factors that contribute to the lack of or strong sense of community?
10. Living in the neighborhood
    a. What are some of the things that you like about living in this neighborhood or development?
    b. What is your favorite aspect of living here?
    c. Are there any drawbacks of living here? What are they?
    d. Tell me about some concerns you have about the community? Are there any needs of the community that are not being met?