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Transit market evaluation of seniors losing driving privileges

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Transit Market Evaluation of Seniors Losing Driving Privileges

by

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DEDICATION

This research accomplishment is dedicated to three women in my life: my mother, Jlona; my sister, Belle; and my aunt, Myrtle, who, for their prayers, copious words of encouragement and support throughout my academic career have enabled me to reach this milestone in my life. It is also dedicated to the those individuals who in their academic careers keep on trying against all odds, recognizing that through persistence and prayers you can reach the “stature of the fullness of Christ.” To my family members, relatives and friends, at last I can say that, “I have crossed the final academic finish line, thank you for your prayers and cheering me on, even when at times all I did was study, study, study!!!”

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TRANSIT MARKET EVALUATION OF SENIORS LOSING DRIVING PRIVILEGES

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ABSTRACT

The projected growth of persons ages 65 and older in the U.S. over the next few decades will usher in an era of unprecedented numbers of seniors licensed to drive. For some members of this group, there will come a time where driving will have to cease due to a variety of factors. At that juncture in their lives, these seniors may have to consider transportation alternatives other than the personally operated vehicle. The objective of this study is to evaluate potential changes in transit market share arising from travel behavior changes of seniors who lose their driving privileges. This includes determining seniors interest in, ability to, and subsequent use of public transit.

First, a literature review of developments that have impacted senior travel behavior is presented. Developments such as the changing demographics of seniors, senior socio-economic status, the process of driving retirement, and factors influencing transit use by seniors are presented. Estimates of the numbers of licensed and former drivers are derived for the year 2030 using several methodological approaches. Trip rates are applied to the predicted non-driving population to derive estimates of the potential demand for transit and subsequent market share. Discussion of the estimated market share results also incorporates a descriptive overview of senior travel behavior as derived from analyses of publicly available datasets followed by focus group results illustrating the experiences of seniors and their transportation choices.

Recommendations range from transit agencies engaging in direct “generational” marketing to seniors in order to understand their transportation needs as well as perceptions about transit, promoting the use of transit, and demonstrating the viability of transit for specific trip purposes and partner with rideshare providers. Despite the predicted increase in transit market shares attributable to the senior population, transit providers have extensive work to do to change the perceptions of transit service provision and subsequently encourage the use of such services by senior populations in forthcoming generations if transit is to become a viable transportation alternative for those seniors ceasing to drive.

CHAPTER 1 – INTRODUCTION

1.1 Context

Effective January 1, 2004, Florida Statute 322.18, subsection 5, required drivers 79 years or older to pass vision tests when renewing their six-year licenses. Such a mandate is part of an "age-based" testing regime that several U.S. states have implemented in recent years with respect to enhancing the safety environment afforded to road users.[1] Age-based license renewal and testing is defined as a situation where "the nature or schedule of renewal testing changes with age" (Lange & McKnight 1996, p. 81). This action is one of many taking place that signal recognition of the impending boom in population that will reach age brackets where driving risks are known to increase. Perhaps more so than prior generations, the next generation of elders are individuals who, for the most part, have a long history of driving; are independent-minded; have grown accustomed to high levels of mobility, which they cherish; and are less likely to have spouses, siblings, and children who are able to provide for their mobility. Thus, the role of government in regulating driver licensing and in providing mobility alternatives promises to be a challenge over the next several decades.

Implementation of "age-based testing" will produce a group of travelers who could serve as a resource in understanding travel behavior changes and mode choice after driving cessation. A richer understanding of driving cessation and accommodation will enable informed planning and policy making to support the mobility of non-drivers in

[1] For the current status of senior licensing laws in the U.S. refer to the AAA Public Affairs website (www.aaapublicaffairs.com).

their communities, as “the [transportation] needs of older citizens are predictable so accommodating them is possible” (Freund, 2004, p. 114). Nevertheless, the wider implications of this potential challenge need to be placed against the backdrop that “mobility is critical to well-being” (Coughlin & Lacombe 1997, p. 91).

1.2 Study Objective

With an aging population, it is very important to understand older adult travel needs and behaviors, particularly at a point in time when they are no longer able to drive. The objective of this study is to evaluate potential changes in transit market share arising from travel behavior changes of seniors who lose their driving privileges, particularly their interest in, ability to, and subsequent use of public transit. In other words, to what extent could this group of seniors meet their transportation needs through the use of transit services, potentially contributing to transit market share?

The public transportation industry has shown a keen interest in the challenges and opportunities that can be presented as the baby boomers age (i.e., persons born between 1946 and 1965) and perhaps cease driving. With the predicted growth of new retirees expected over the next few years, some of them will lose their ability to drive, creating an opportunity for the public transportation community to provide a valuable service for these individuals. Within the industry, there is a range of expectations with respect to the size and opportunity this market may present to public transportation. While some feel there is an impending tidal wave of opportunity and need, others are more sanguine, reflecting on the prospect that few of the baby boomers have ever used public transportation; more are attached to auto mobility; and fewer live in areas sufficiently dense to support quality public transit service.

While it is premature to determine the magnitude of the role that public transportation might play in meeting the travel needs of elder baby boomers, it is certainly reasonable to anticipate that public transportation will be an important provider for some segments of the population. There will be individuals who will lose their driving privileges and will not have alternative mobility options that might be afforded through privately-purchased services or strong family support. Public transportation will be called on to provide a safety net for this segment of the population. Thus, it is prudent for the public transportation research community to begin to explore the nature of the travel demand that may arise and how the industry might position itself to respond. Towards that end, this research effort can make a useful contribution.

1.3 Background

At a time when 85 percent of persons over the age of 15 years hold a driver's license (Office of Highway Policy Information [OHPI], 2005), and each person in 2001 traveled on average 40 miles per day, of which 35 miles were in a personal vehicle (U.S Department of Transportation 2003, p. 9), mobility has reached unprecedented levels. This is coupled with seniors experiencing "longer, happier, fuller lives than their counterparts today and certainly than the elderly of just a few decades ago" (Rosenbloom 2004, p. 3). The ability to drive, is for many people, highly correlated to their level of enjoyment of life. Using the 1995 Nationwide Personal Travel Survey (NPTS) data, Evans (2001, p. 152), found that there was a substantial difference in trip-making associated with driving and that this association increases with age. This difference is most pronounced and most critical among the 75+ population. While 75 percent of 75+ drivers went out at least once on their trip day, just 44 percent of non-drivers ages 75 and older went out. This finding suggests that having access to a car

allows greater participation in activities outside of the home, and thus elevates ones enjoyment of life and well-being.

A similar result was found by Straight (1997) in her study of travel behavior and preferences of drivers and non-drivers 75 years and older where she concluded that the "level of mobility is strongly related to whether or not one drives." However, caution needs to be exercised here, as some of the considerations that influence driving also influence the desire for mobility. For example, persons with serious mobility limitations such as being bedridden have constraints to mobility beyond their ability to drive a vehicle.

Rosenbloom (2004, p. 3), while reflecting on the potential rosy outlook, goes on to state that:

> *…… there is no evidence that older people's desire to travel will decline at the same rate as their ability to drive or to find other [mobility] options. Many older people may ultimately find themselves cut off from the very aspects of life that made their early retirement years so much better than those of older people only a few decades ago.*

Along with the inability to drive and its impact on mobility, "declining health may well result in reduced activity regardless of the ability to drive" (Marottoli et al. 2000, p. S335). Thus, it can be argued that there are at least two generalized mobility challenges faced by the elderly: the means of mobility, e.g., personal transportation; and the physical capacity to be mobile, influenced by the physical/health status of the individual.

Being able to operate a car has become synonymous (and, in many cases, a necessary requirement) to experience enhanced levels of livability and consumption. Foley et al. (2002, p. 1288) describe the operation of a car as a "pervasive task of

independence." The intimate relationship between man and the automobile has resulted in a situation where, "for most Americans, driving is considered essential to personal well-being" (Adler et al. 1999, p. 28) and "essential to maintain a good quality of life" (Adler et al. 2000, p. 40). This dependence on driving has created a situation where giving it up may be experienced "as the first step towards a downward spiral of dependency" (Horowitz et al. 2002, p. 262). This state of dependency becomes critical when no family member or friend is available nearby to assist the individual, which may lead to isolation, eating disorders, institutionalization, and premature death (McSwain, as quoted in Stanfield [1996]). Because of dependency on a lifestyle that has revolved around the capacity to drive an automobile, any changes brought about by transitions in personal mobility will have far reaching consequences, impacting not only the individuals involved, but their immediate families and society as well.

The uniqueness of the U.S. mobility environment has given rise to the above situation as "in many areas of the country there is no adequate public transportation, and many people must drive if they are to function in their community" (Freedman & Freedman 1996, p. 876). Indeed, "recent and contemporary urban development practices and public transportation policies have catapulted the private car into its role as the preeminent means of individual transportation" (Yassuda et al. 1997, p.525). This has resulted in negative and yet unwarranted perceptions of public transportation to be held by many people. Studies have related how the elderly view public transportation in the U.S. as inconvenient, unpleasant, and even dangerous if it requires waiting at secluded bus stops or crossing busy intersections (Messinger-Rapport & Rader 2000). Noting these negative perceptions of public transportation, the elderly may feel that, after driving for many years, "they deserve better" (Shope 2003, p. 58).

The myriad factors that can influence driving ability and the onset of driving cessation have given rise to the need for a greater understanding of travel behavior during and after this period of transition. Adler et al. (1999) surmised that the longer an individual drives, the more accustomed they become towards driving and the less likely they are to cease from driving even after diagnosis (of a condition that affects driving ability) and the greater risk they become to other road users. Mobility providers and, of particular interest in this research, public transportation operators can benefit from a better understanding of the potential size and mobility needs of the market of individuals who may be ceasing to drive.

1.4 Scope of Study

The focus of this study is mobility issues pertinent to the senior population in the U.S. Literature resources referenced in this project are based on studies conducted in the U.S., as published from January 1990 to September 2006. A variety of electronic databases related to aging/gerontology and transportation were searched, e.g., Ageline, PsyInfo, and Transportation Research Information Services (TRIS) to ascertain the extent and depth of prior research into senior mobility. The key search strings were "driving cessation" and "cessation of driving." The reader is referred to a publication entitled "Age-Related Disabilities That May Impair Driving and Their Assessment," which provides an exhaustive literature review by Janke (1994) or to search the above-named databases for further references.

1.5 Report Structure

This study is presented in five chapters. This first chapter provides an introduction and context setting of the study. Chapter 2 represents a literature review and findings from focus group discussions that have impacted senior travel behavior. Developments such

as the changing demographics of seniors, senior socio-economic status, the process of driving retirement (i.e., driving reduction ultimately resulting in driving cessation) and factors influencing transit use by seniors are presented are reviewed. Chapter 3, details the data used and methodology applied in developing the estimate of the potential senior transit market developed in this research project. Estimates of licensed and former drivers in the forecast year of 2030 are obtained. This is followed by a descriptive overview of senior travel behavior as derived from analyses of publicly available datasets. The application of trip rates (i.e., daily propensity to travel) to the forecast senior population produces an estimate of the size of the senior transit market, which is presented in Chapter 4. Chapter 4 continues with a discussion of the results through the creation of various hypothetical scenarios with respect to senior mobility as well as focus group results illustrating the experiences of seniors and their transportation choices. Finally, conclusions and recommendations emanating from this research project are presented in Chapter 5.

Note: In this report the terms “seniors” and the “elderly” are used interchangeably, generally referring to persons 55 years of age and older. In addition, persons between 55 - 64 years of age are also referred to as the “young-old,” 65 - 74 years the “old-old,” and those 75 years and older the “oldest-old.”

CHAPTER 2 – RECENT DEVELOPMENTS IMPACTING SENIOR TRAVEL BEHAVIOR

2.1 Introduction

Knowledge of the phenomenon of driving cessation will provide valuable insight into travel and transit use by the growing population of older Americans. Indeed, "the challenge to understand personal lifestyle and transportation decision-making as people age" (Transportation Research Board [TRB] 2005, p. 24) still represents an increasingly critical research need in 2006. In the process of striving to develop a richer understanding of driving cessation, determining its impact on subsequent travel behavior, and understanding the viability of public transit use in maintaining senior mobility and well-being, a number of recent developments influence our thinking. These developments are presented in this chapter.

2.2 Older Drivers and Driving Cessation

Kostyniuk & Shope (2003, p. 408) remark that "there is no precise age at which a driver becomes an older driver." This fact is further emphasized by Coughlin (2001, p. 2) when he states that the "chronological age is not a perfect indicator of who is an older driver." According to Marottoli et al. (2000, p. S339), "Caution should be exercised in crafting legislation until acceptable levels of risk are identified in order to avoid over-regulating and unnecessarily preventing large numbers of people from driving, with potential substantial negative effects on their lifestyles." Rosenbloom (2003, p. 10) has reported that "many countries and a few U.S. states are moving away from age-based testing to behavior-based testing." Such a strategy has been argued to have merit as

Rosenbloom, in the same article, states, “Age-based testing is rarely useful or cost-effective.” Nonetheless, widely reported incidents of tragic consequences resulting from elder driver accidents keep these issues in front of the public and result in different localities or states trying a variety of different strategies to address an acknowledged problem.

Driving cessation can be voluntary (i.e., without legal intervention) (Dellinger et al. 2001) or mandated (i.e., forced), stemming from the intervention by a third party such as a family member or court. Driving cessation differs from driving restriction; the latter is a process where individuals manage their impairment by driving at specific times of the day, along familiar routes and/or avoiding left turns for example. In a study by Straight (1997) of drivers and non-drivers over 75 years, it was found that 63 percent of drivers who were active drivers said they avoid traveling at night, 34 percent avoided driving in the rain, and 50 percent avoided driving during rush hour. According to Burkhardt et al. (1998, p. 450) to minimize the negative connotations surrounding the word “cessation” or “quitting,” phrases such as “graduating from driving” or “driving retirement” may be more amenable, especially to males.

During a period of driving restriction, trip-making can still be accommodated “without searching for alternative travel modes” (Waldorf 2001, p. 24). This period provides a “window of opportunity” (Wang & Carr 2004, p. 144) for the elderly to consider their future travel needs and transportation modes that may be suitable to meet them. This period of opportunity, evidenced by restrictions in driving behavior, may have a downside if remedial actions are not taken in that “anticipated mobility consequences actively discourage some persons from reducing or ceasing driving” (Burkhardt 1999, p. 11). Thus, unsafe drivers continue to drive, posing a danger to themselves and others while ignoring alternative transportation possibilities that may be available. By

considering alternative transportation possibilities during the period of driving restriction, the trauma of being forced to quickly consider alternative modes and trip-making behavior when driving has ceased altogether is reduced.

2.3 The Driving Cessation Process

It is helpful to understand the concept of driving cessation from an aging perspective. Figure 2.1 presents the process of driving cessation and the ceasing of trips made as a driver and the possibility of future travel being made as a passenger using private or public transportation. It is accepted in the majority of cases that driving cessation is a process and has been appropriately described as a "cessation continuum" by Dellinger et al. (2001, p. 435). Here, the cessation process occurs in stages as a gradual progression of self-imposed restrictions on driving, culminating in permanent cessation. Gilley et al. (1991, p. 944) noted, "Cessation of driving is not an all or nothing phenomenon but the eventual end point of a gradual reduction in driving activity." A similar definition was also expressed by Horowitz et al. (2002).

In Figure 2.1, assuming a starting point at age 50, there is relatively little change in the miles driven per year by the individual in these early years of seniority. This period of continued competent driving ability creates a "window of opportunity" (Wang & Carr 2004, p. 144). According to Wang & Carr, during this phase there is the possibility for medical interventions to be applied (e.g., appropriate pharmacotherapy for neurological disease, treatment of reversible ophthalmologic diseases, physical therapy for fragility or muscle weakness and occupational therapy for functional deficits) that may help older adults maintain driving skills and confidence in their driving performance. According to Friedland (1997), factors affecting the duration of this "window of opportunity" are the patient (i.e., the driver), the family, and the medical care

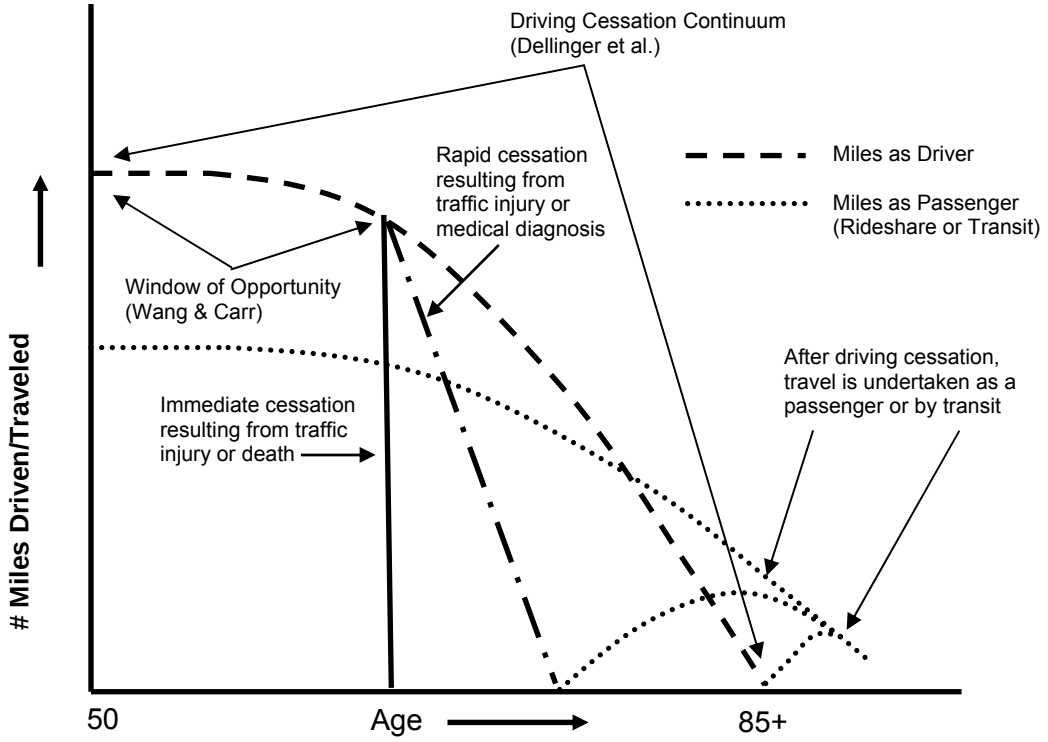

Figure 2.1 The Process of Driving Cessation

team of the patient. Other factors may include, difficulties of the individual adhering to team advice regarding driving cessation and failure of professionals to inform the individual of impairments impacting their driving ability.

2.4 Seniors Who Retire from Driving

Valid estimates of the numbers of senior drivers who give up driving are difficult to derive, as there is no way of determining if the holder of a driver's license is a regular/intermittent driver or permanent non-driver. As noted by Levy (1995, p. 461), "Not all drivers are legally licensed and not everyone who is licensed actually drives." This scenario is particularly pertinent to the senior population. As recently as 2001, it was noted that "the literature has not yet provided estimates of the current or future incidence of driving cessation" (Waldorf 2001, p. 23). Since that time there have been

several initiatives made to close this knowledge gap. A study of driving life expectancy of seniors in the U.S. by Foley et al. (2002) estimated that 600,000 senior drivers ages 70 years or older stop driving each year. Another more recent estimate indicated that 1 million license holders retire from driving annually (Staplin & Freund 2005).

2.5 Driving Cessation - Other Factors

Other factors, with the exception of anatomical or cognitive, can be grouped into two categories: gradual/planned and sudden/unplanned. Gradual/planned factors can be classified as being "involved," i.e., accepting that the impaired person is an adult who has the right to be included in decision affecting his or her life (Jett et al. 2002, p. 111). Such a strategy is time-consuming, and its success is dependent on the level of impairment in the individual concerned. In the case of sudden/unplanned factors, they can be incident- or accident-based or classified as being imposed, i.e., imposed on the individual by other parties, as the individual is unwilling to make the change by himself/herself (Jett et al. 2002, p. 111).

2.5.1 Gradual and Planned Cessation

Sixty percent of participants in a study by Campbell et al. (1993) indicated that they voluntarily ceased from driving. Campbell and her colleagues went on to explain that such a response, though commendable, may indicate that these participants had a less severe disease/health condition than those participants in the study who identified a condition that precipitated driving cessation, or the participants may have had a condition but, since its diagnosis, were in a state of denial about its impact. Another factor influencing driving cessation is for the impaired driver to acknowledge the potential danger that they may become to a loved one, neighbor or family pet, if they continue to drive (Jett et al. 2002).

Increasing age increases the chances of driving cessation (Campbell et al. 1993, Stewart et al. 1993). In a study by Dellinger et al. (2001) of those who ceased driving within the previous five years, two percent stopped in their 60s, 18 percent in their 70s, 63 percent in their 80s, and 17 percent in their 90s. Forrest et al. (1997) reported that, as well as driving less with increasing age, women participants also were more likely to use avoidance strategies, such as not using freeways. Horowitz et al. (2002) estimated a five percent reduction in the number of study participants who drove with every year of increased age. Though aging is an accepted predictor in driving cessation, Owsley et al. (1998) pointed out the inappropriateness of guidelines that determine the suitability of driving for older adults based on age alone.

Driving cessation is predominately exercised by elderly women (Freund & Szinovacz 2002). A study by Campbell et al. (1993) also found that women were twice as likely to report having stopped driving than were men. A similar finding also was reached in a study by Stewart et al. (1993). Approximately two-thirds of the participants in a study by Dellinger et al. (2001) who had stopped driving within the previous five years were female, though gender differences (with respect to driving cessation) did not reach statistical significance. In another study by Foley et al. (2002), women participants were three times more likely to cease from driving when compared to male participants.

One reason given by women participants who had ceased from driving, in a study conducted by Dellinger et al. (2001, p. 4), was that “someone else could drive them.” Yassuda et al. (1997) also found that focus group participants preferred other people to make the decision to cease from driving for them. Nevertheless, Dellinger et al. (2001) noted that, for respondents who had ceased from driving, a subjective assessment of the driver’s own driving ability was the primary factor in driving cessation, not advice from family or friends. A participant in Bauer & Rottunda’s study (2003)

indicated elderly drivers did not want involvement of their children in deciding when they should stop driving. Indeed, the majority of participants in Bauer & Rottunda's study decided for themselves. A similar finding was found in studies by Persson (1993) and Ralston et al. (2001). Campbell et al. (1993) found that participants did not include family as an influencing factor with respect to driving cessation; only the affected individual or legal requirement were involved. Despite the preceding, Hebert et al. (2002) noted that with family members/caregivers there may be difficulty in objectively evaluating driving abilities of the affected loved one; this, in turn, may prolong the period before permanent driving cessation (i.e., lengthen the driving reduction phase), as they are unlikely to limit or stop their spouse/significant other from driving based solely on diagnosis.

The definition of a co-pilot is "somebody available in the car that can directly instruct and supervise" (Jett et al. 2002). In a study by Foley et al. (2000), 10 percent of 59 participants diagnosed with dementia had not ceased from driving at the time of the study. These persons always drove with someone else present in the vehicle as a co-pilot, in most cases, the spouse of the driver. Research by Freund & Szinovacz (2002) suggests that the lack of an alternative driver in the home kept cognitively-impaired women on the road, especially where a spouse who may have been the primary driver had been outlived. Co-piloting as a strategy may work for a limited time, but, in situations where a decision is required quickly, driver response may be insufficient. Thus, it becomes a strategy that is not recommended in the process of driving cessation (Hartford Financial Services Group, 2000).

Some medications can affect driving skills, which, in turn, will influence driving cessation. Medications that may impair driving skills include antidepressants, hypnotics, antihistamines, glaucoma agents, and muscle relaxants (Carr, 2000). However, in a

study by Stewart et al. (1993), it was found that specific drug ingredients or the total number of drugs used were not a significant risk factor for driving cessation, a surprising result to the study team. Yassuda et al. (1997) noted that the low frequency of the medication topic (i.e., a participant response from the survey instrument) may reflect the participant's lack of knowledge of the effects of drugs on driving ability, denial that drugs had any negative effect on driving, or even the belief that taking medicine was a part of normal aging.

2.5.2 Sudden and Unplanned Cessation

A life event may precipitate driving cessation (see Figure 2.1). Such an event may be in the form of a diagnosis of a disease or a personal loss such as the loss of a spouse/partner. In a study by Bauer & Rottunda (2003), such life events experienced by participants ranged from a heart attack to a fall. A traffic crash often is a precipitator of driving cessation, especially when the individual had been advised against driving while managing some form of impairment. According to Dobbs et al. (2002), while life events may have a severe negative impact on driving ability (in the case of the diagnosis of dementia), this should not be the sole justification for the revocation of a driver's license, which, in turn, can bring about an immediate cessation of driving.

As already noted, gradual change in the process of driving cessation will allow managed interventions, where various parties may become involved in the decision for an individual to cease from driving. On the other hand, if such interventions by persons closest to the affected individual are not forthcoming, medical professionals and/or government agencies, i.e., state driver's license agencies, have a "moral and legal obligation to care for the demented individual and to protect the safety of the public" (Berger & Rosner 2000, p. 306). Campbell et al. (1993) found that the potential of

license revocation/cancellation if driving is not curtailed, significantly increases the odds of driving cessation among elderly persons. The potential loss of insurance coverage (Carr 2000) also may bring about a sudden loss of driving privileges for the affected individual, leading to rapid or immediate cessation of driving. The revocation of the driver's license by a third party has the potential to have the opposite effect. Burkhardt et al. (1998) identified research that concluded older drivers might be more likely to resist driving cessation, while claiming that a third party (e.g., state driver licensing authority) had forced them to continue driving by taking away their license prematurely.

2.6 Demographics

Results from the U.S. Decennial Census in 2000 showed that persons 65 years and over represented 12.4 percent (35 million persons) of the total population. Population forecasts for the year 2030 indicate that this same age cohort will be more than 20 percent of the entire U.S. population. The primary reason resulting in this scenario is the maturing of the baby boom population, i.e., those persons born between 1949 and 1965. In 2000, the baby boomers would have been between 35 to 51 years, and as evident in Figure 2.2, this cohort causes the bulge in the population pyramid. Over the next few decades as this bulge matures, i.e., moves upwards, it will cause a "squaring" of the population pyramid away from the typical pyramid shape seen in nations with large youthful populations coupled with small elder populations. This squaring of the population pyramid is clearly depicted in Figure 2.3, reflecting population estimates for the year 2030.

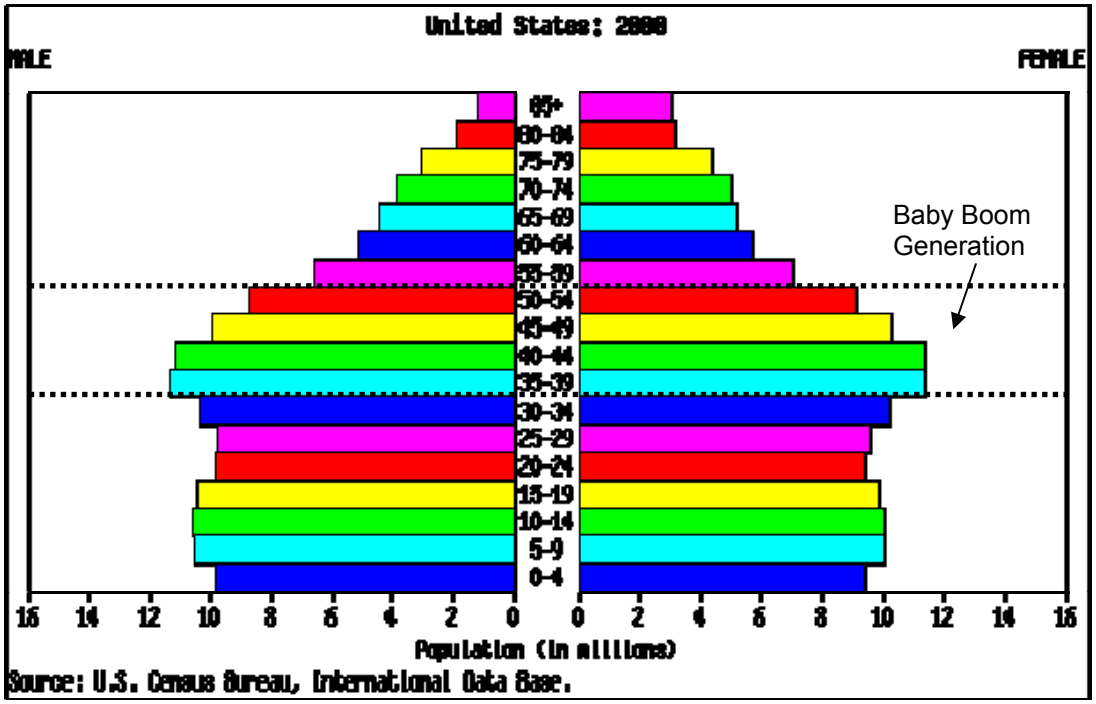

Figure 2.2 United States Population 2000
Source: Generated in September 2006 using data from the
U.S. Census Bureau International Data Base

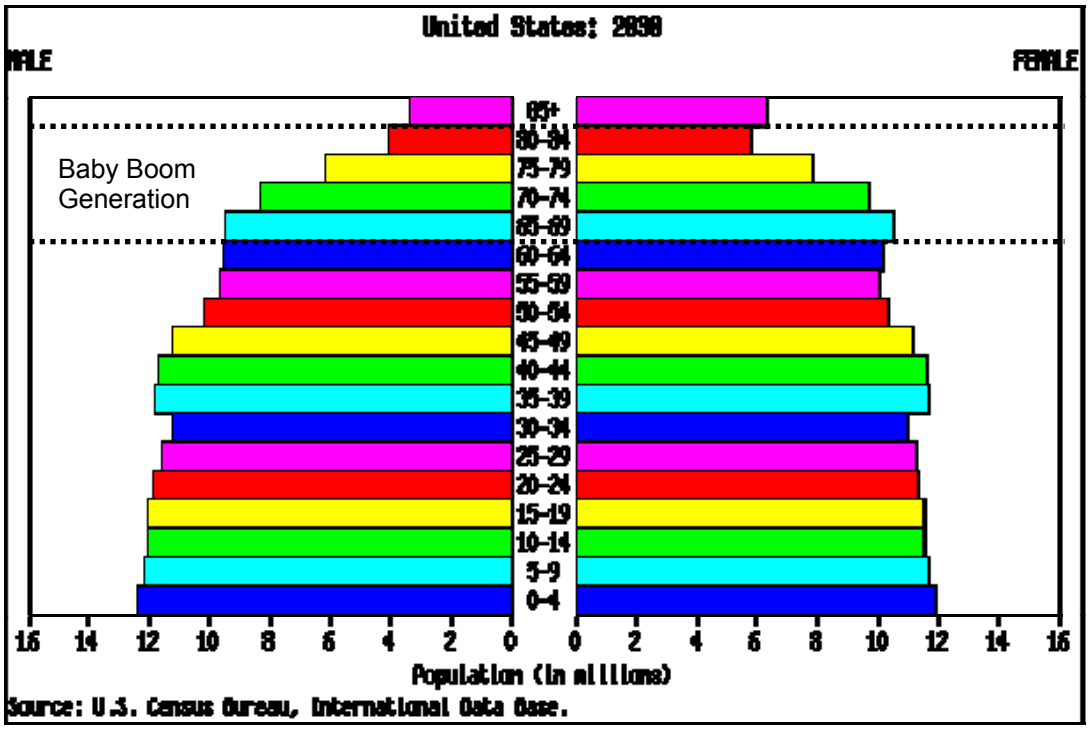

Figure 2.3 Projected United States Population 2030
Source: Generated in September 2006 using data from the
U.S. Census Bureau International Data Base

Figure 2.4 indicates that the forecasted percentage of persons of the total U.S. population over 65 years of age will continue to grow for the foreseeable future. By the year 2030, the number of persons 65 years or older (estimated to be over 71 million) will have increased by more than 100 percent (based on Census 2000 population figures of 35 millions for persons ages 65 years and older).

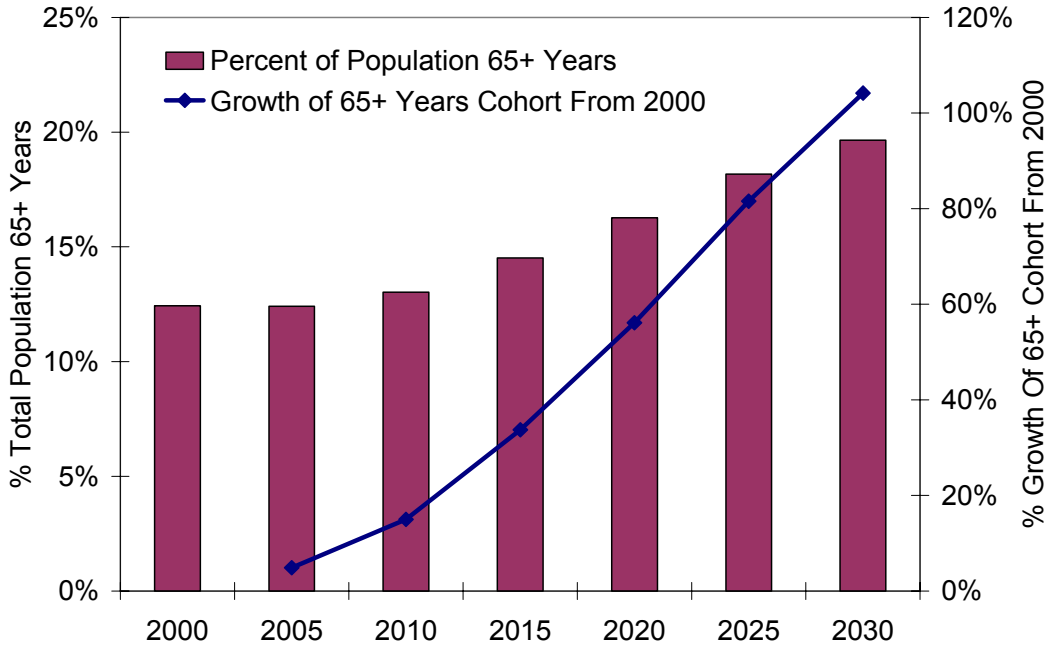

Figure 2.4 Percentage of Persons 65 Years or More of Total Population (2000 – 2030)
Source: U.S. Census Bureau (2004)

2.7 Closing Gap of Licensure Rates by Gender

In the year 2000, 92 percent of males over the age of 65 years in the U.S. were licensed, compared to 68 percent of females, a difference of 24 percentage points (Office of Highway Policy Information 2001; U.S. Census Bureau 2004). As illustrated in Figure 2.5, in the year 2000, with each age cohort less than 65 years, the percentage of licensed persons increased while the difference between the proportions of persons

licensed according to gender decreased. For example, for the age cohort 55 – 64 years, 97 percent of males and 89 percent of females were licensed in 2000 compared to the 35 – 44 year cohort, where 95 percent of males and 93 percent of females were licensed at that time. It will become evident that, with each passing decade, the differences between male and female licensure rates will close and stabilize above 90 percent.

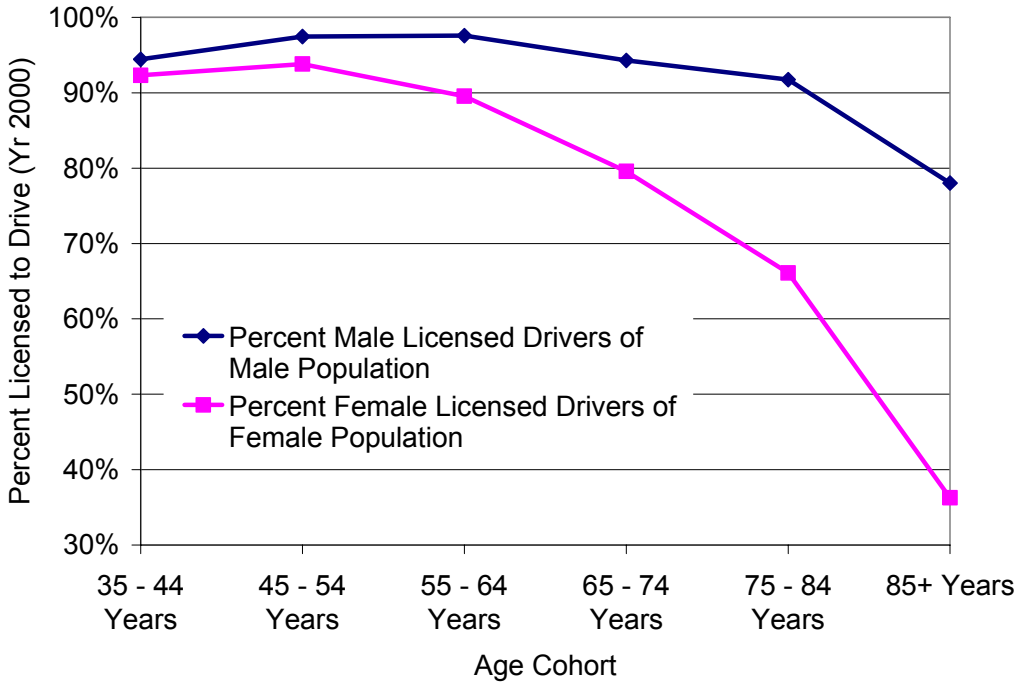

Figure 2.5 Percentage of Population Licensed by Age Cohort and Gender in 2000

Source: U.S. Census Bureau 2005 & OHPI/FHWA 2001

2.8 Moves Toward Age-Based Driver Testing by State Licensing Authorities

In Chapter 1, it was noted that several U.S. states in recent years have implemented "age-based" driver licensing regimes. In 2001, 33 states did not require any further licensing requirements as people aged (Coley 2001). In contrast, 18 states in 2001 did require seniors to fulfill age-based requirements when applying for or renewing their

drivers' licenses. In the space of four years, as of July 2005, the number of states imposing age-based requirements on seniors when applying for or renewing their drivers' licenses increased to 24, a 33 percent increase (AAA 2005). The threshold for accelerated renewal (i.e., a situation where the frequency of testing is increased once an age threshold is reached) also varies from state to state. According to Molnar & Eby (2005), "the beginning age for accelerated renewal ranges from 61-years-old (Colorado) to 81-years-old (Illinois)." Indeed, under this regimen, the time validity of licenses also is impacted, ranging from "1 year (Illinois for age 87 and older) to 5 years (Arizona, Colorado, and South Carolina)" (Molnar & Eby 2005).

Age-based testing is one of several strategies used to assess the driving ability of seniors as they age. According to research by Cobb & Coughlin (1997), there are three principal tools used to identify unsafe senior drivers: assessment or judgment of the driving examiner – the single most important control in all jurisdictions; screening of the person's driving record; and medical reporting. The "in-person" assessment of a senior driver by a driving examiner under the "age-based" testing regimen has resulted in a variety of benefits and disadvantages arising as a result of this strategy. Benefits of accelerated licensing periods (i.e., seniors renewing at shorter periods than adults younger than them) according to Levy (1995) can be described as:

- increasing the visibility of a policy to the target population;
- reducing the length of period before a problem is detected;
- increasing the likelihood of recognizing problems of individual applicants; and
- learning about the changes occurring to individuals over the years (Coley 2001).

On the other hand, disadvantages or disbenefits of an accelerated licensing regime according to Lange & McKnight (1996) can be described as:

- discouraging driving and associated activities by seniors;
- license revocation of drivers who fail the tests;
- self-regulatory termination of driving by those who fear that they cannot pass the test (these may be insecure but safe drivers); and
- withholding of pertinent health information with respect to personal driving ability - drivers may be afraid to mention certain symptoms, if they fear that acknowledging a specific ailment will jeopardize their right to drive (Walser 1991).

The gradual implementation by states of age-based testing of senior license holders is based on the premise that senior drivers pose a greater risk to themselves and other road users the older they become. Despite the supposed benefits of such a scenario, there have been a number of concerns expressed against unwarranted moves in this direction. First, “laws imposing requirements only upon those above a certain age may be discriminatory if they do not produce clear safety benefits; and second; in the absence of specific medical problems, age alone has not been shown to be associated with poorer driving performance” (TRB, quoted in Rock, 1998, p. 69). In light of these two statements, the implementation of age-based testing may precipitate driving cessation by those applicants who fail (on their initial attempt) or current drivers (with accident free driving histories) who choose not to renew their licenses for fear of failing.

Safe drivers who prematurely have to end their driving will suffer inordinately due to the frustration of adjusting their travel behavior to accommodate an unanticipated new mobility regime. This frustration is likely to be exacerbated if alternative transportation is limited or not available. Here arises a dichotomy, as; on the one hand, society may

precipitate driving cessation of senior drivers, while on the other the provision of alternative transportation modes are inadequate or nonexistent. Stamatiadis et al. (2003 p. 49) noted this concern where it was stated that "age-based license restrictions pose numerous society questions regarding the availability of travel alternatives for persons without drivers' licenses."

Several studies have found positive correlation between age-based licensure laws and safety with respect to senior drivers (Nelson et al. 1992; Levy 1995). Such a scenario may be achieved through reducing licensure rates of seniors, which possibly may contribute to an enhanced traffic safety environment. On the other hand, Rock (1998), using Illinois crash data, found a tenuous relationship between frequency of license renewal (for persons 81 years and above) and crash rate, thus producing negligible benefits of such a policy. Results from a study by Lange & McKnight (1996) also called into question "the ability of age-based renewal testing to yield significant reduction in proportions of unsafe drivers among the elderly."

In Walser (1991, p. 4),

> *…. an experiment conducted in Pennsylvania suggests that states need to monitor older drivers even more aggressively. It also indicates the tremendous social ramifications that would result if even present-day tests were used across-the-board. Between 1978 and 1985, licensing officials used a computer to randomly select 365,000 drivers over age 45 (the majority were over 65) and notified them that their licenses would not be renewed unless they came in for general physical and eye examinations. Of those who were examined, more than 77,000 subsequently had new restrictions added to their licenses. Almost as*

many -- some 72,000 -- chose not to come in for the exams, and their licenses expired as a result.

It is accepted that there is a link between chronological age and driving performance; however, "the probability of deteriorating performance increasing with increasing age, the presence of individual variation means that no specific chronological age can be singled out as an appropriate age at which a driver's license should automatically be denied" (Waller 1991, p. 502). Indeed, trying to weed out unsafe drivers according to age is a challenge in an environment where seniors are living longer, healthier, and more active lives. McKnight (2003) notes that few age-related declines in ability are susceptible to experimental variation. This is despite having the same "cause" (i.e., disease) and "effect" (i.e., the impact of the disease on driving ability) either of which may not be explicitly controlled for in some cases. This scenario is also confirmed by Messinger-Rapport & Rader (2000), who indicate that there is no single predictor of adverse driving events (which may be a precursor to driving cessation) that can be applied in the office (i.e., under experimentation).

2.9 Seniors Potential to be More Dependent on Outside Resources for Mobility

Contemporary socio-economic, demographic and cultural trends could lead one to anticipate that future seniors are more likely to live alone, less likely to have as many children in proximity, less likely to have siblings in proximity, and less likely to live in locations with quality transit and walkable destinations than prior generations. These conditions are the result of the number of trends that have been underway over the past several decades. This includes lower fertility rates, i.e., fewer siblings and children, high rates of divorce, and high immobility levels resulting in more frequent relocations away

from family and friends. Figures 2.6 and 2.7 present indicators from the Decennial Census and Survey of Income and Program Participation (SIPP) that provide insight into the "personal environment" of seniors.

Figure 2.6 indicates that between the years 1990 and 2000 (in the age cohorts illustrated), there were increases in the percentage of seniors whose living arrangements were described as "living alone." The increase in "living alone" status for all persons 65 and older approximated 2 percent; there was a 3 percent increase for persons 75 years and older. One might expect this trend to increase dramatically as the numbers of baby boomers, a generation accustomed to high mobility and divorce and noticeably fewer and more mobile offspring, increases. This may be particularly true for females, who tend to outlive males. In very practical terms, this means there may well be poor households where an individual who has ceased driving does not have other household members available to provide mobility.

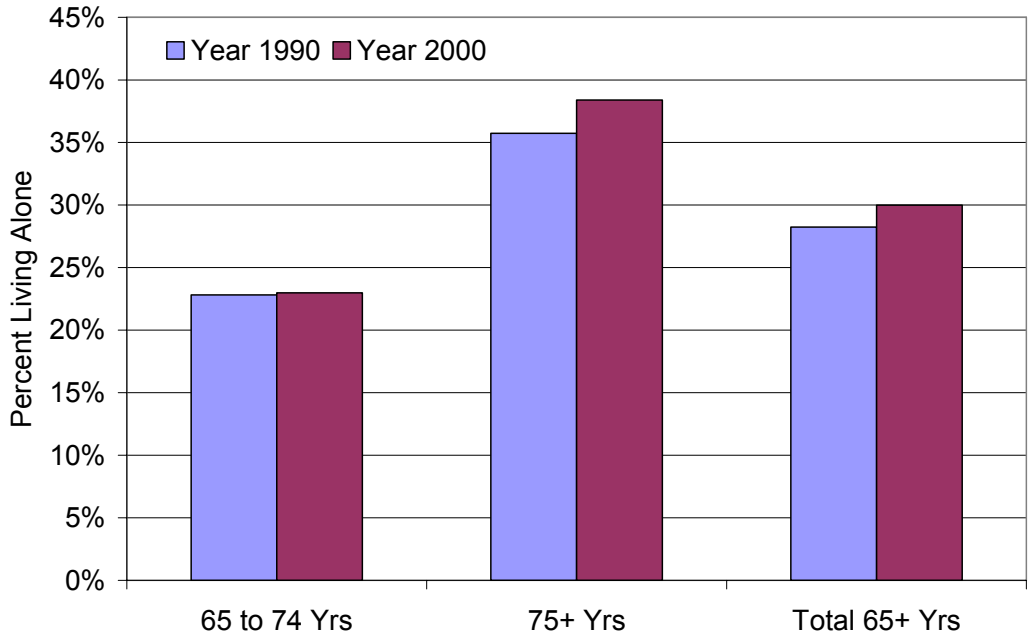

Figure 2.6 Living Arrangements of Adults 65 Years and Older 1990 and 2000
Sources: Fields & Casper (2001) and Goldstein & Damon (1993)

Exploring the need for personal assistance as one ages, Figure 2.7 illustrates the percent of seniors who needed assistance with activities in 1986 and 1991. It is evident from Figure 2.7 that the need for personal assistance with everyday activities (e.g., care, preparing meals, etc.,) increases with age. Hobbs & Damon (1996), reporting on data from the 1991 SIPP, noted that women 75 years and older were more likely to require more assistance than men, and elderly Hispanics or African Americans may require more personal assistance than Whites. This also includes assistance needed to get around outside of the home. This factor may be indicative that driving

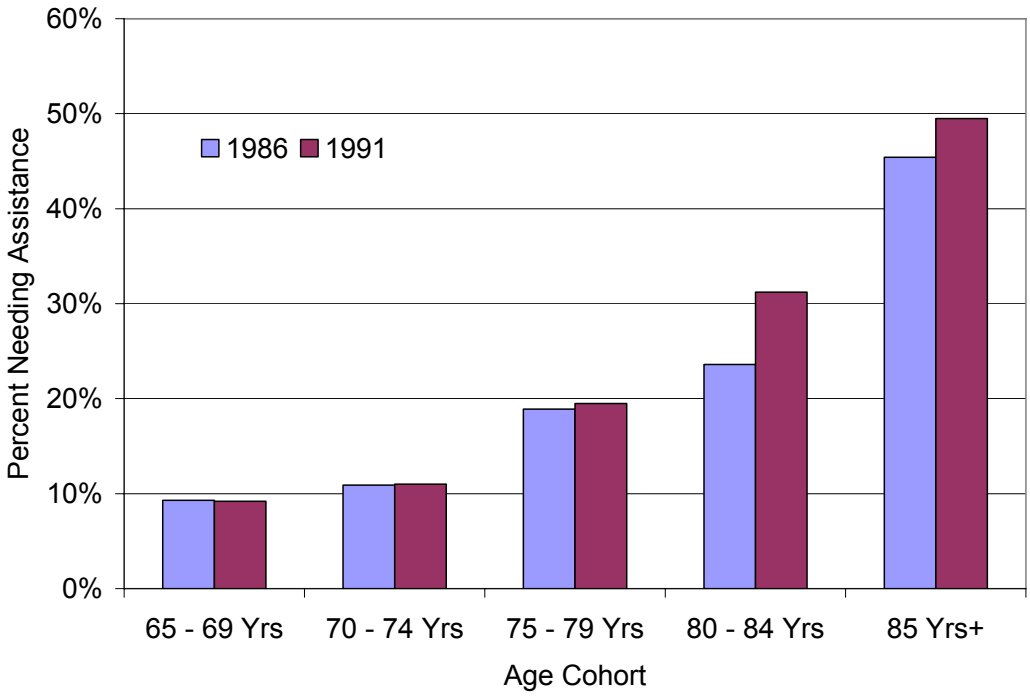

Figure 2.7 Persons Who Needed Assistance with Activities by Age
Source: Hobbs & Damon (1996) p. 3-18 & Harpine et al. (1990) p. 21

oneself may no longer be an option for the senior and they are thus dependent on others for transportation; the use of public transportation may be a challenge even if it is available for seniors in this predicament.

The combination of socio-demographic changes, societal and family structure changes is resulting in a situation where the next generation of seniors is less likely to have their mobility needs met in the same ways as prior generations. Indeed, future seniors are less likely to have familiarity with transit use and may be less likely to consider it. This potential scenario is confirmed by Kostyniuk & Shope (2003), where, in their study of 1,000 senior drivers (active and former) in Michigan, 60 percent of the respondents indicated that they had never used public transportation in their lives and, of those who had, the experience was acquired a long time ago. Simultaneously, auto travel on the ever more congested roads is likely to be higher risk for senior drivers. The collective impact of these changes is likely to complicate the already difficult challenges of meeting mobility needs for post-driving cessation seniors.

2.10 Household Composition and Driving Cessation

Persons living with a senior driver do have a role to play in the driving cessation process, despite the fact that some drivers who cease to drive have indicated that they made the decision themselves without outside influence. Household composition is, therefore, a factor in the driving cessation process. Kington et al. (1994, p. 1329), in a study of 2,429 respondents, found that "individuals who lived in households with more adults were less likely to drive." The research team went on further to note that this situation may have arisen because, where there are other adults in the household who are able to drive, those who can no longer drive choose to live or remain in such households. In a study of Public Use Microdata Sample (PUMS) from the 1980 Census of Population, Cutler & Coward (1992) were able to determine that the majority of elderly persons (77%) live in households where personal transportation was available. Nevertheless, Cutler &

Coward were not able to determine how many of these persons actually were drivers or passengers (as the census data collected did not permit this).

In a study by Taylor & Tripodes (2001, p. 521) it was found that "the composition of the household in which an elder lives also determines the transportation resources available … as the presence of a licensed driver in the home was the most important predictor of perceived mobility following driving loss." Waldorf's study (2001 p. 33) came to a similar conclusion where it was found that the "presence of an additional driver in the household is the single most important factor influencing whether older people intend to use alternative transportation modes."

2.11 Trends Influencing Senior Transit Use or Non-use

In arriving at an estimate of senior drivers and non-drivers (i.e., never driven and former drivers) that could form a potential market for transit agencies in future years, it is also necessary to identify trends that currently influence transit use or non-use by seniors. These trends may continue to develop in future years, in turn increasing or decreasing the potential of seniors to consider transit use as a viable transportation alternative to the Personally Operated Vehicle (POV). Burkhardt et al. (1998, pp. 4) during their study identified several notable trends affecting older people and their transportation choices. These trends can be listed as follows:

- Spatial Dispersion characteristics
- Aging in place
- Unequal income distribution
- The predominance of women
- Minority elders
- Urban/rural differences
- Changes in family structure
- Health status
- Retirement status

2.12 Trends Having Positive Potential on Senior Transit Use

Trends that may have a positive influence on transit use (i.e., increase the propensity to use transit) by seniors are presented.

2.12.1 Minority Elders

Acknowledging the impacts of race on driving cessation, Rosenbloom (2001) found, in a study of 1,000 volunteer drivers (current and former) in Tucson, AZ, that Hispanics (of any race) who made up 6.5 percent of the sample population comprised 12 percent of ceased drivers at follow up whereas African Americans were, on average, the youngest (69 years) to cease from driving of all racial groups surveyed. Future decades will bring gains to African American/Black and Hispanic ethnic groups with respect to their percentage makeup of the senior U.S. population. However, it is estimated that there will be a decline from 84% to 72% percent in the numbers of seniors classified as 'White Alone' of the total population between 2000 and 2030 (U.S. Census Bureau 2004). These estimated changes in the proportions of seniors according to their ethnic heritage may have a positive impact on future levels of transit use, as research has shown that minority populations have had a greater propensity to use transit than the majority non-Hispanic White population (Polzin & Chu 2005).

2.12.2 Number of Adult Children

The family characteristics of senior households are and will remain paramount in deriving an estimate of the number of seniors that may avail themselves to transit. As already stated, "the number one alternative to the car for older adults is not another mode: rather, it is riding with family members and friends" (Coughlin 2001, p. 3). If members belonging to this group are not available within the immediate locale of the

non-driving senior, opportunities may arise to consider transit as a out-of-home mobility option.

The Decennial Census does not provide information that enables detailed familial linkages (on a macro scale) to be determined, i.e., mother living with daughter, etc. Nevertheless, proxies in the form of fertility rates and the parent support ratio may provide insight. What we do know with respect to these proxies can be summarized as follows:

- Since the Baby Boom period (1946 to 1964), the general fertility rate (i.e., live births per 1,000 women ages 15 to 44 years) has fallen from a high of 118 in 1960 to 66 in 2000 (CDC, 2000), graphically displayed in Figure 2.8.
- The parent support ratio (i.e., "the number of people 85 and older per 100 people aged 50 to 64 years" [He et al. 2005, p. 26]) has been increasing over the recent decades, from 3.4 in 1960 to 10.1 in 2000 and is predicted to increase to 16.0 in 2030 (graphically displayed in Figure 2.8). What this rate implies, taking the year 2000 as an example, is that for every 10 persons ages 50 to 64 years there could be one oldest-old family member to attend to.

The parent support ratio is a socio-demographic concept and does not indicate that every family or individual will have an oldest-old family member to care for or, on the other hand, that an oldest-old member of the community will not have someone to assist with personal transportation (i.e., a driver) available. As the absolute number of persons ages 85 years or more increases relative to the shrinking numbers of adult children (i.e., persons ages 50 to 64 years who may provide assistance to the elder), so too does the parent support ratio increase. What this scenario suggests is that there may possibly

be a greater need for alternatives to POV transportation for the oldest-old in 2030 as the pool of drivers available (i.e., adult child of senior) will be reduced.

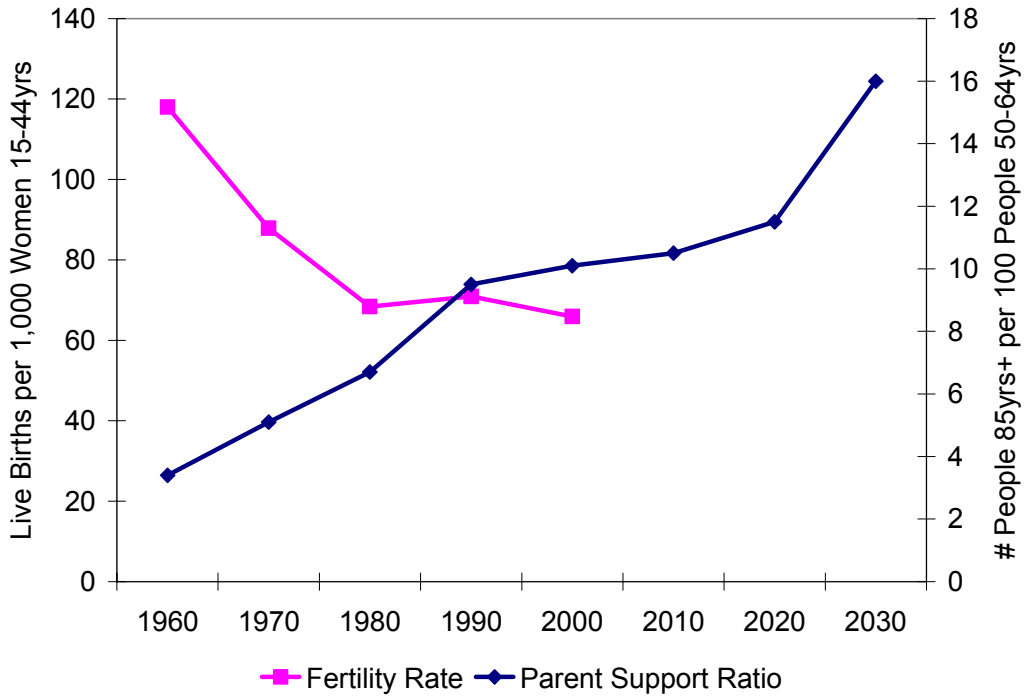

Figure 2.8 Fertility Rates and Parent Support Ratios 1960 to 2030
Source: CDC Table 1-1. Live Births, Birth Rates, and Fertility Rates, by Race: United States, 1909-94 & U.S. Census Bureau (2004) Projected Population of the United States, by Age and Sex: 2000 to 2050 (Detailed Table) U.S. Census Bureau, Population Division, Population Projections Branch

2.12.3 Physical Distance of Adult Children

Falling fertility rates have resulted in fewer children being born to women who live longer, increasing the probability that in future decades these fewer children (then adults) will have an older parent to look after. However, the effectiveness and sharing of parental care and responsibility by living adult children will in some cases be dependent on the spatial separation between the adult child/ren and their parent/s. What is known about parental/child relationships separated by physical distance, can be summarized as follows:

- “Distance is the strong predictor of assistance exchanges among family members that require a physical presence” (Rogerson et al. 1997, p. 122).
- “Daughters are more likely than sons to provide informal support to elderly parents and it is not family size but the presence [or spatial proximity] of a daughter that affects the level of parental help” (Spitze and Logan quoted in Rogerson et al. 1997, p. 124).
- “Having more children increases the likelihood that there will be at least one suitable child toward whom parents may expect to move closer” (Silverstein & Angelelli 1998, p. S158).
- The higher the educational level [of either party] the greater the spatial separation between them (Lin & Rogerson 1995).
- “Children with remarried parents are less likely to living within an hour of their parents” (Lawton et al. quoted in Lin & Rogerson 1995).

Lin & Rogerson’s study (1995) using data from the National Survey of Families and Households (NSFH) (conducted during the mid 1980’s) reported that 75 percent of elderly parents had an adult child living within 35 miles (Lin & Rogerson 1995, pp. 317). However, since the 1980’s there has been a dramatic structural change in the spatial distance between family members brought about by employment opportunities, increases in personal educational levels, mass transportation linkages, etc. In light of this scenario, in future decades with women having fewer children, there will be fewer children living nearby for whom aging parents can move towards, resulting in possibly an even greater propensity to age-in-place for those parents who choose not to move or relocate to assisted living/nursing home facilities. For non-driving community-dwelling

seniors in this situation, transit may have the potential to be considered as a viable transportation option.

2.12.4 Marital Status of Elderly Population

It is accepted that marital status can affect many facets of an individuals life, including longevity, health, income etc. (Lillard and Panis, quoted in He et al. 2005). Thus, as marital status may change during an individuals life, so too will their proclivity for travel. For example, an active and healthy senior, is likely to make more daily trips, perhaps to see friends and the family of each partner, than in the case of an active and healthy single senior. Such a scenario is evident from an analysis of NHTS trip data and presented in Table 2.1. Table 2.1 indicates that, in the case of the 2 person household (where at least one member is a senior), a daily trip rate of 3.68 can be compared to a one person senior household of 3.31.

Table 2.1 Daily Trip Frequency According to Household Size

Trip Category	All Households	One Person Household	Two Person Households
All Person Trips (billions)	407.3	33.1	108.4
Senior (65yrs +) Trips (billions)	41.0	10.2*	25.5*
Daily Trip Rate All Persons	4.03	4.03	4.07
Daily Trip Rate Seniors	3.42	3.31	3.68

*Note at least one person in Household is 65 years or more
Source: Author's analysis of NHTS (trip and person files) data

Research has indicated that, once the age of 65 years and above is reached, "divorce is relatively infrequent among the older population" (He et al. 2005). No one doubts the impact of divorce on the affected parties and families but with respect to seniors meeting their daily travel needs, there will also be an acute impact. That is, divorce may have a negative "impact on the amount of time and money that is exchanged later in life between adult children and their fathers, with less impact on their mothers" (Furstenberg

et al., quoted in He et al. 2005, p. 148). Thus, there is the potential that the "time" aspect may include the time available for transporting senior parent/s by their adult children. This scenario increases in complexity when one considers that the "victim"' of the divorce may be supported by the adult child/ren while the other parent is not. For non-victim seniors (of a divorce) in this situation, transit may have the potential to be considered as a viable transportation option.

2.12.5 Technology and Design

In recent decades, there has been increasing application of computers and technology to transit service and operations. Working alongside these applications Intelligent Transportation System technologies (ITS) also has played a role in enhancing transit service quality. Examples of technological innovations that may positively enhance transit use by seniors in the future as follows:

- Low floor vehicles

  Step-less entry into the vehicle, i.e., there is no need for the passenger to step-up or step-down to access/exit the vehicle. Vehicles are also accessible to persons in wheelchairs and passengers pushing baby strollers or grocery karts. Benefits of such an intervention include, ease and speed of access/exit from the vehicle for all passengers but notably those who may require extra assistance, e.g., seniors.

- Global Positioning Systems (GPS)

  A wireless navigation system that enables vehicles to be tracked and located. Thus, real time information as to vehicle location, speed and estimated time of arrival can be obtained and disseminated. A benefit arising from this technology in the form of accurate travel information for example, enables improved planning and execution of the trip by the passenger.

- Internet/Cell Phones

  Recent decades have seen the rapid application of internet and cell phones in the dissemination of transit service/trip information. Benefits from this form of technology can be experienced in the potential of "real time" transit information being obtained before, after and while on the trip. This enables a potential or an actual passenger to plan in advance a transit trip to meet their exact needs.

2.13 Factors Having Negative Potential on Senior Transit Use

Trends which can have a negative influence on transit use (i.e., decrease the propensity to use transit) by seniors are presented in the following paragraphs.

2.13.1 Life Expectancy and Health

Over recent decades, much progress has been made in the field of science, most notably medicine with its positive impacts on morbidity, disease progression and management and ultimately life expectancy. In fact, life expectancy at 65 years over the last 4 decades, (i.e., from 1960) has increased by 0.9 years per decade for males and females. Thus, persons ages 65 years in 2000 should experience a life expectancy of 81.2 years (males) and 84.3 years (females) (National Center for Health Statistics 2005, Table 27. p. 167). However, it is interesting to note that despite the equal gains in life expectancy for males and females ages 65 years, in recent decades greater inroads have been made in male life expectancy.

A more circumspect measure relating to personal health status which is of relevance to driving cessation, is the amount of time spent free of disability, referred to as "Active Life Expectancy." This is a period where activities of daily living (ADL) (i.e., personal maintenance tasks such as eating, getting in and out of bed, etc.,) can be performed without assistance (i.e., from a caregiver or an external prosthetic). Research

has shown that with the increasing onset of limitations in performing ADL this signals a change in driving capability for those seniors who do drive (Foley et al, 2002). Table 2.2 presents data on life-, active- and driving life expectancies.

Table 2.2 Life-, Active- and Driving-Life Expectancies by Age

	Life Expectancy*		Active Life Expectancy**		Driving Life Expectancy***	
Age	Males	Females	Males	Females	Male	Females
65	16.2	19.3	13.7	15.7	na	na
75	10.1	12.3	7.7	8.3	8.0	7.9
85	5.6	6.7	4.2	3.1	2.0	1.8

* as at 2000, National Center for Health Statistics, 2005, p. 167
** data from National Long Term Care Survey 1982 to 1994 in Manton & Land, 2000
*** data from Health Dynamics Among the Oldest Old Study 1993 to 1995 in Foley et al, 2002

It is evident from Table 2.2, that for both males and females there will be a period of life where driving themselves will not be possible. At age 65 years, for many seniors, health status does not interfere with their driving capability. Nevertheless, at the onset of the ninth decade of life, things begin to change. As can be seen at 75 years, men have a life expectancy of 10 further years, of which, eight will be spent in good health free from limitations in performing ADL. The active life and life expectancy data as presented in Table 2.2 is similar to the surviving and surviving and driving curves developed by Waldorf & Pitfield (to be discussed in the following chapter).

Driving capability is dependent on adequate vision, physical function and cognitive function all present at acceptable levels during the active life expectancy stage of life. Declines in any one of these factors coupled with limitations in the performance of ADL can often render seniors incapable of using transit. Indeed, in extreme cases, an escort (i.e., caregiver) may be necessary, having the potential to increase the challenge of using transit, as two persons are now involved instead of one. Improvements in medicine and health, may extend the active life expectancy period, enabling those who drive to continue driving for a few more years. This extension in driving history

benefiting mobile seniors may result in a decreased potential for them to consider transit as they near the end of their driving careers and when driving is ceased. These seniors may be too ill to consider transit as an option for out-of-home mobility. Indeed, if seniors are to move for health or other reasons, “parents are more likely to choose daughters than sons” (Silverstein & Angelelli 1998, p. S158), Such seniors seeking to maintain pre-cessation mobility levels or to reside in an environment where others can assist with transportation needs, transfer to become car passengers (their initial preference) rather than transit patrons.

2.13.2 Aging in the Suburbs

Research has shown that the majority of older people do not move (He & Schachter 2003, pp. 2) and this fact has contributed to the phenomenon “aging in place.” Frey (2003) determined that, of the age cohort 35 to 64 years, approximately 70 percent of residents of large metropolitan areas lived in the suburbs. Accepting that this same cohort has a greater propensity to move (i.e., employment relocation/opportunity, changing real estate needs, etc.,), it is predicted that the majority of moves in future decades by adults ages 35 years and older will be either intra-suburb or from suburbs to outside the metropolitan areas. In the typical suburb, with its less dense transit services, if such service densities remain unchanged in future years (or do not change to offer a real transportation alternative to seniors), it is unlikely to provide what seniors will consider transit as a viable alternative.

Gentrification of urban cores (precipitating suburban/rural to central city migration), often associated with transit rich environments, may continue during the intervening years. Nevertheless, it is predicted that young professionals, childless couples, and a small percentage of affluent seniors will be those who take up this trend.

For many seniors, the suburban or rural environment has been perceived as being more attractive for raising a family or establishing family roots. Once children are grown and leave their parents' home, for many seniors, remaining in the same house/home is usually their preferred choice. On the other hand, focus group participants who had reduced their driving indicated that they rarely traveled to/from and avoided travel through downtowns. Remembering how downtowns were in years gone by and their current state (i.e., parking, one-way streets, and traffic congestion) increased the aversion of some focus group participants of going near downtowns, let alone relocating to reside there.

Further insight gained from the focus group discussions, particularly relevant for the Sunbelt states, was that for some participants they would rather remain in a warm environment with limited out-of-home mobility (due to lack of transportation) than to relocate back to the Northeast/Midwest with its transit rich cities but also cold winters. The possible reasoning for this was that having limited transportation options in a Floridian winter but still being able to get out was better than having extensive transit services in the neighborhood but not being able to get out because of the cold and snow.

2.13.3 Technology

In recent decades, there has been increasing application of computers and technology to the operation of the POV. Working in tandem with these applications ITS has played a significant role in enhancing POV operations and efficiency. Examples of POV technological innovations which may negatively impact transit use in the future by seniors are as follows:

- Congestion Management Systems

  Systems that mitigate and manage traffic congestion, many of these systems are being deployed by many local authorities in the U.S. These systems (i.e., those that harness ITS technologies) aim to optimize vehicle mobility in congested traffic environments. A benefit arising from the implementation of these systems is seen in the optimization of vehicle delays enabling travel time savings to be realized.

- In-Vehicle Technologies

  Currently, there are available a variety of in-vehicle technologies available whose primary benefits are seen in enhancements in driving safety and comfort. Adaptive Cruise Control systems (ACC) maintain a preset driving speed simultaneously keeping a safe distance between a vehicle and the vehicle in front. Rear view video cameras mounted on the back bumper (coupled with sensors) enable the area immediately behind the car to be seen and an alarm to sound if an object gets too close to the car. This latter device is particularly useful in its potential reduction of reversing accidents by seniors who may have difficulty turning their head to gain a correct view of the area behind the vehicle. Increasing incidence of minor bumps and scratches on a vehicle are often tell-tale signs that the senior driver may be losing driving competency.

2.14 Transit Service Provision Planning

Understanding the travel behavior of seniors post-cessation of driving may contribute to informed planning and policy making to support the mobility of non-drivers in their communities. Transit providers should note that “the [transportation] needs of older citizens are predictable so accommodating them is possible” (Freund 2004, p. 114). In the coming decades, more and more seniors will have had the experience of driving and

the longer an individual drives, the more accustomed they become towards driving and, as noted earlier, the less likely they are to cease from driving even after diagnosis (of a condition that affects driving ability) and the greater risk they become to other road users (Adler et al. 1999).

Transit providers have to realize that, to increase the probability of seniors who having ceased from driving (especially those in the ninth decade of their lives) and who may consider and subsequently use transit, promotion of transit services as a viable transportation alternative must be affected during the driving reduction stage. Such a need is confirmed by Waldorf (2003, p. 198) who states that, "the provision of transit services needs to be complemented with programs ensuring that the elderly will actually use transit alternatives rather than choose immobility. It seems necessary that such programs reach the elderly early, well before they are forced to stop driving, so that there is sufficient time to learn about these alternatives, appreciate them as alternatives that can ensure an active life … and learn how to use these alternatives." In light of this potential scenario, transit providers are cautioned that the promotion of transit services to seniors after driving cessation is likely to yield limited results. Indeed, maintaining the interest of seniors in transit cannot be taken for granted by transit providers.

> *Public transit must assess the markets where its current strengths lie, consider what new markets exist or are evolving, evaluate how these new markets can best be served, and evaluate the areas where it is possible to strengthen the role of public transit. … [Transit] operators who do nothing to deal with the major changes in the travel patterns of most Americans … will see their ridership erode - and their public political support with it (Rosenbloom & Fielding 1998, p. 1).*

Policy change often takes many years, and transit agency reaction to it may follow. Informed planning decisions (based on research such as herein described) may enable transit providers to become increasingly adept (i.e., proactive) in meeting the mobility needs of seniors in the years ahead.

CHAPTER 3 – DATA AND METHODS

3.1 Introduction

As already noted in section 2.4, valid estimates of the numbers of senior drivers who may give up driving (i.e., creating a potential transit market) are a challenge to derive, as there is no direct method to determine whether the "bona fide" holder of a driver's license is a regular versus an intermittent driver or permanent non-driver. Even if a senior driver license holder is asked, "Do you drive?" some respondents may answer in the affirmative (i.e., pretend to drive when in fact they do not drive) in order to appear functional in their old age (Burkhardt et al, 1998, p. 24). Furthermore, as noted by Levy (1995, p. 461), "Not all drivers are legally licensed and not everyone who is licensed actually drives." This scenario is particularly pertinent to the senior population.

In 2001, it was noted that "the literature has not yet provided estimates of the current or future incidence of driving cessation" (Waldorf 2001, p. 23). However, a study of driving life expectancy data of seniors in the U.S. (1993 to 1995) by Foley and colleagues estimated that 600,000 persons 70 or older had stopped driving during the year of study (Foley et al. 2002). Recently, an estimate of 1 million license holders who retire from driving annually was made in 2005 (Staplin & Freund 2005). Despite these estimates, a contribution to permit an increased understanding of the current methodologies to estimate the future numbers of senior drivers who will be reducing their driving exposure or will have ceased altogether is still warranted. The challenge in deriving an appropriate methodology is also associated with understanding the future licensing rates of senior women coupled with their levels of driving exposure. (Burkhardt

et al. 1998) This synthesis of methodologies described herein aims to further close the gap in the development of a definitive methodology that is able to determine the numbers of seniors who reduce or cease from driving.

3.2 Methodological Approach

If the current status-quo of senior mobility is perpetuated into the future, transit operators will be faced with an "adapt or perish" quandary. To contribute to the refinement and understanding of a potential future senior transit market for transit providers, the methodology described will seek to determine the following:

- estimate the number of seniors at a specified future year;
- estimate the number of seniors holding driver's licenses at a specified future year;
- estimate the proportion of seniors who may have ceased from driving (i.e., who are driving intermittently or have permanently ceased to drive); and
- estimate the transit market share based on the use of transit by seniors who are either non-licensed or former drivers. Such an estimate may indicate a potential market for public transit as one of several transportation alternatives.

With an enhanced composite profile of the senior traveler, this research also aims to enable a clearer understanding of the market characteristics that transit agencies may be able to target in future decades and determine the nature of travel needs that senior travelers have, permitting transit providers to target their services accordingly. The research methodology proposed will try to determine if future generations of senior non-licensed and former-drivers may consider transit use as a viable mobility option (of several transportation alternatives) and identify the extent to which transit operators can

positively contribute to senior well-being through the provision, access to and use of their services.

3.3 Quantitative Methodology and Primary Data Sources

Investigation will be achieved primarily through quantitative (i.e., interrogation of datasets) analysis, followed by the presentation and discussion of results in Chapter 4. Quantitative research methods will involve the analysis of public datasets of travel behavior, senior population characteristics, and so on. An overview of a selection of publicly available datasets that enabled the creation of a senior profile through quantitative analysis is presented in this section.

3.3.1 National Household Travel Survey

The National Household Travel Survey (NHTS) is a dataset of long-distance and local travel behaviors by the American public. Collection of data for the NHTS is sponsored by Federal Highway Administration (FHWA), Bureau of Transportation Statistics (BTS) and the National Highway Traffic Safety Administration (NHTSA). The NHTS is recognized as the leading dataset in the U.S. providing detailed information on trip-making behavior. The most recent year for this cross sectional study was 2001; the survey has been conducted intermittently since 1969. Data items on individual trip making include mode of transportation used, duration of trip, distance and purpose of trip. In addition to person trip characteristics the NHTS also provides trip maker information relating to demographic, geographic, and socio-economic profiles.

3.3.2 Decennial Census

The Decennial Census is the authoritative census of the U.S. population conducted every 10 years. The latest census occurred in the year 2000; the status quo of the

current population and estimates of future populations are conducted on an ongoing basis. The Decennial Census provides a rich data resource on many macro-aspects of the general population, e.g. race, household characteristics, etc.

3.4 Quantitative Data Sources (Secondary)

An overview is given of other datasets that also contributed in the development of the senior profile, in particular, estimates of former drivers.

3.4.1 Health and Retirement Study

The Health and Retirement Study (HRS) is a longitudinal survey of a nationally representative sample of the senior population (51 years and older) in the U.S., which since 1996 has been conducted every two years. The main goal of the HRS is to "provide panel data that enable research and analysis in support of policies on retirement, health insurance, saving and economic well-being" (Rand Center for the Study of Aging 2006, p. 10). The study is funded by the National Institute on Aging (NIA) and provides data on senior health, income, assets, employment, retirement, insurance and family structure. The first HRS study was conducted in 1992, and the latest year in which data is publicly available is 2002.

3.5 National Versus State Level Analysis

The analysis presented here is at the national level. This is due to the nature of data required to derive future estimates and the focus of this study being at the macro rather than micro level. For the majority of factors described below, as at the time of writing, future estimates were only provided at a national level.

3.6 Base Year

To undertake a prediction of some future event establishing a base year is imperative. In this study, the base year is 2000/2001. There are several reasons for setting the year 2000/2001 as the base year:

- The year 2000 is the most recent year of the U.S. Decennial Census. This year also provided a platform for revised population projections of the U.S. Census Bureau, which have since been published in recent years.
- Within two years on either side of 2000/2001 (i.e., 1998 to 2002), a number of cross sectional and longitudinal surveys were conducted in the U.S. These surveys provide valuable descriptive information of the senior population at specific points in time, which will subsequently be incorporated into the methodology developed. Table 3.1 illustrates the year/s cross sectional/longitudinal surveys (of interest in this study) which were conducted with respect to the year 2000/2001.

Table 3.1 Dataset Year of Survey

DATASET	1998	1999	2000	2001	2002
Decennial Census			●		
Health and Retirement Study	●		●		●
National Household Survey				●	

3.7 Future Year

The year 2030 is taken to be the future year of estimate. Estimates of the number of seniors in the year 2030 have been generated by the U.S. Bureau of Census at both national and state levels. Table 3.2 presents national figures.

Table 3.2 2030 Population Estimates by Cohort (in '000s)

Cohort	2000 (Jul 1)	2030 (Jul 1)	Proportion of Total 2000 (%)	Proportion of Total 2030 (%)	% Year on Year increase from 2000
65 - 69 yrs	9,533	19,980	3.4	5.5	2.50
70 - 74 yrs	8,849	17,967	3.1	4.9	2.39
75 - 79 yrs	7,425	13,988	2.6	3.8	2.13
80 - 84 yrs	4,984	9,913	1.8	2.7	2.32
85yrs+	4,267	9,603	1.5	2.6	2.74
65yrs+	35,061	71,453	12.4	19.6	2.40
Total Population	282,125	363,584	100.0	100.0	0.85

Source: U.S. Interim Projections by Age, Sex, Race, and Hispanic Origin 2000 – 2050,
U.S. Census Bureau, Population Division, Population Projections Branch

The year 2030 is expected to have 10.4 percent of the U.S. population between 65 – 74 years old, currently the 2nd highest (behind 2029) sub-cohort proportion of any Decennial Census year projected by the U.S. Census Bureau of senior persons ages 65 – 74 (up to the year 2050 based on 2000 census projections). In addition, if the cohorts 65 to 74 years and 75 to 84 years are taken together, this also peaks (at 17 percent of the total population) in the year 2030. Figure 3.1 graphically presents information regarding projected proportions of the senior population and it becomes evident that, with each passing decade from 2000, persons aged 65 years and older will represent a greater proportion of the total U.S. population.

3.8 Driver Licensing Rates and Numbers of Drivers

Earlier, in section 2.7, the closing gap of licensure rates by gender (a phenomenon of the late 20th century) was discussed. Concomitant with successive waves of seniors in future decades, there will not only be a greater number of seniors but more of them will be licensed at levels never witnessed before in U.S. driver licensing history. In the year 2000, 92 percent of males over the age of 65 in the U.S. were licensed, compared to 68 percent of females, a difference of 24 percentage points (Office of

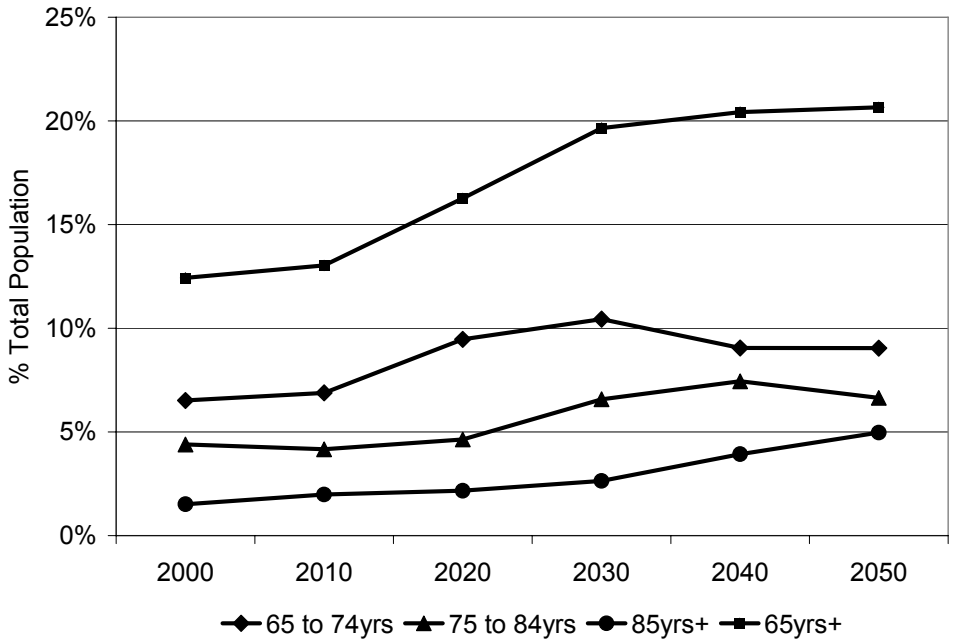

Figure 3.1 Senior Population Cohorts of Total Population 2000 – 2050
Source: U.S. Census Bureau (2004) U.S. Interim Projections by Age, Sex, Race, and Hispanic Origin 2000 - 2050, Population Division, Population Projections Branch

Highway Policy Information 2001; U.S. Census Bureau 2000). Nevertheless, how will the predicted licensing levels in 2030 be reflected in the actual numbers of licensed seniors? A first step to predicting licensing levels in 2030 is to revisit the licensing levels of persons ages 35 years+ in 2000, as depicted in Tables 3.3 and 3.4.

Table 3.3 Licensing Proportions (Males) in 2000

Population/ Licensed	35 – 39 yrs (65 – 69yrs in 2030)	40 – 44 yrs (70 – 74yrs in 2030)	45 – 49 yrs (75 – 79yrs in 2030)	50 – 54 yrs (80 – 84yrs in 2030)	55+ yrs (85+ yrs in 2030)
Population 2000*	11,276,704	11,168,659	9,955,867	8,706,148	26,170,474
# Licensed*	10,621,910	10,576,976	9,578,268	8,448,424	24,626,777
% Licensed*	94.19%	94.70%	96.21%	97.04%	94.10%

*Note: Figures are for cohorts in 2000.
Sources: Office of Highway Policy Information, 2001 & U.S. Census Bureau (2004) Projected Population of the United States, by Age and Sex: 2000 to 2050 (Detailed Table), Population Division, Population Projections Branch

Table 3.4 Licensing Proportions (Females) in 2000

Population/ Licensed	35 – 39 yrs (65 – 69yrs in 2030)	40 – 44 yrs (70 – 74yrs in 2030)	45 – 49 yrs (75 – 79yrs in 2030)	50 – 54 yrs (80 – 84yrs in 2030)	55+ yrs (85+ yrs in 2030)
Population 2000*	11,339,802	11,353,883	10,270,558	9,083,519	33,314,509
# Licensed*	10,437,549	10,516,251	9,575,363	8,419,527	25,374,152
% Licensed*	92.04%	92.62%	93.23%	92.69%	76.17%

*Note: Figures are for cohorts in 2000.
Sources: Office of Highway Policy Information, 2001 & U.S. Census Bureau (2004), Projected Population of the United States, by Age and Sex: 2000 to 2050 (Detailed Table) Population Division, Population Projections Branch

Tables 3.3 and 3.4 present predicted licensing levels for males and females, respectively, for the year 2030. These statistics were derived from population and licensing levels in the year 2000. Persons reaching "senior" status in 2030 (i.e., 65 years and older) would have been at least 35 years old in 2000. Thus, estimated licensing levels and populations in 2030 for persons between 35 to 39 years, 40 to 44 years etc., are presented in Tables 3.5 and 3.6 for males and females, respectively.

Table 3.5 Predicted Number of License Holders (Males) in 2030

Population/ Licensed	65 – 69yrs	70 – 74yrs	75 – 79yrs	80 – 84yrs	85+ yrs
Estimated Population 2030	9,473,104	8,280,824	6,159,657	4,089,194	3,339,937
Predicted % Licensed*	94.19%	94.70%	96.21%	97.04%	94.10%
Predicted # Licensed	8,923,038	7,842,130	5,926,038	3,968,144	3,142,927

* Note: Estimated percentages based on Table 3.3
Source: U.S. Census Bureau (2004) Projected Population of the United States, by Age and Sex: 2000 to 2050 (Detailed Table) Population Division, Population Projections Branch

Table 3.6 Predicted Number of License Holders (Females) in 2030

Population/ Licensed	65 – 69yrs	70 – 74yrs	75 – 79yrs	80 – 84yrs	85+ yrs
Estimated Population 2030	10,507,158	9,686,847	7,829,249	5,824,404	6,263,097
Predicted % Licensed*	92.04%	92.62%	93.23%	92.69%	76.17%
Predicted # Licensed	9,671,154	8,972,201	7,299,301	5,398,649	4,770,317

* Note: Estimated percentages based on Table 3.4
Source: U.S. Census Bureau (2004) Projected Population of the United States, by Age and Sex: 2000 to 2050 (Detailed Table) Population Division, Population Projections Branch

It is evident that gender licensing rates for these cohorts are similar (especially for the youngest-old), a development which has matured concomitantly with the greater participation of women in the economy/workforce. The cohort progression of licensing levels is illustrated in Table 3.7.

Table 3.7 Licensure Rates and Cohort Projections

Cohort/ Year	2000 % Licensed	2010 % Licensed	2020 % Licensed	2030 % Licensed
35 - 39yrs	M 94.2 F 92.0			
40 - 44yrs	M 94.7 F 92.6			
45 - 49yrs	M 96.2 F 93.2	M 94.2 F 92.0		
50 - 54yrs	M 97.0 F 92.7	M 94.7 F 92.6		
55 - 59yrs*	M 94.0 F 76.2	M 96.2 F 93.2	M 94.2 F 92.0	
60 - 64yrs		M 97.0 F 92.7	M 94.7 F 92.6	
65 – 69yrs		M 94.0 F 76.2	M 96.2 F 93.2	M 94.2 F 92.0
70 – 74yrs			M 97.0 F 92.7	M 94.7 F 92.6
75 – 79yrs			M 94.0 F 76.2	M 96.2 F 93.2
80 – 84yrs				M 97.0 F 92.7
85yrs+				M 94.0 F 76.2

* 55yrs+ in 2000

Applying the percentages presented in Tables 3.3 and 3.4 to the cohort population estimates for 2030, an estimate as to the numbers of licensed drivers can be developed. These estimates may be optimistic but as Burkhardt et al. (1998, p. 37) noted in deriving their projections of future drivers, “there is no set of number with a solid research foundation to estimate, with confidence, the levels of future driving of our oldest citizens.”

Despite this, a number of caveats can be made in the interpretation of the estimates, as follows:

- The figures represent only an estimate based on historical data relationships.
- It is assumed that non-licensed immigrants (35 years and older) coming to the U.S. over the next few decades will acquire licensing status similar to that of their respective age cohorts. Research has shown that acquiring a license is one of several demonstrable factors indicating assimilation into the American lifestyle enabling travel patterns similar to the U.S. born population (Myers, 1996).
- The estimated figures may not represent all senior persons licensed or driving in 2030. Nevertheless, for persons who were licensed in 2000 and will be alive in 2030, these estimates can be taken to represent seniors in 2030 who, at some earlier stage in their lives, were licensed and thus had the ability to drive at that point in time.
- Driver licenses may be personally held (i.e., for identification purposes), but the holder may not actually drive. As noted by Levy (1995, p. 461), “Not all drivers are legally licensed and not everyone who is licensed actually drives.”

The projections for 2030 of the future numbers of senior drivers by Burkhardt et al. (1998) representing their worst case scenario (i.e., equivalent equal licensing rates for men and women plus 5%t) are shown in Tables 3.8 and 3.9. These estimates are also compared with those derived in the present study (i.e., Tables 3.5 and 3.6).

Table 3.8 Comparison of Predicted Number of License Holders (Males) in 2030

Licensed	65 – 69yrs	70 – 74yrs	75 – 79yrs	80 – 84yrs	85yrs+
Predicted # Licensed	8,923,038	7,842,130	5,926,038	3,968,144	3,142,927
Predicted # Licensed*	9,670,034	8,295,252	5,703,061	3,229,855	1,783,165
Difference	7.72%	5.46%	-3.91%	-22.86%	-76.26%

* Burkhardt et al, 1998, Table 2-8, pp. 34

Table 3.9 Comparison of Predicted Number of License Holders (Females) in 2030

Licensed	65 – 69yrs	70 – 74yrs	75 – 79yrs	80 – 84yrs	85yrs+
Predicted # Licensed	9,671,154	8,972,201	7,299,301	5,398,649	4,770,317
Predicted # Licensed*	10,325,580	9,369,540	7,096,143	4,699,513	3,799,921
Difference	6.34%	4.24%	-2.86%	-14.88%	-25.54%

* Burkhardt et al, 1998, Table 2-8, pp. 34

As can be seen, differences between the estimates become wider with each advance in age cohort. Nevertheless, if all senior cohorts are combined, the resulting estimates are strikingly close (i.e., differences of -3.91% and -2.33% for males and females, respectively), an unintended result but nonetheless interesting. However, the largest differences are seen in estimates for the 85 years and older cohort. These differences may be due to Burkhardt et al. using licensing rates and population estimates from 1996, whereas this study uses licensing rates and revised population estimates (with significant changes to the “oldest old,” 85 year plus cohort) based on the 2000 census (published 2005).

Based on their projections in the number of drivers, Burkhardt et al. (1998) did noted the potentially significant increase in the number of senior licensed drivers as at the time of their study and the future. Using figures derived from this research, Tables 3.10 and 3.11 depict the change in the numbers of senior licensed drivers (males and females). Senior female licensed drivers, in particular, are responsible for the greatest percentage increases in each of the age cohorts identified. Despite the many

uncertainties of the future, Burkhardt et al. (1998, p. 38) stated that, "given the absence of significant change to societal patterns of personal mobility, particularly as they affect our eldest citizens, the number of older licensed drivers will at least double in the next 35 years." The estimates produced here confirm this statement.

Table 3.10 Numbers of License Holders (Males) in 2000 and 2030

Licensed	65 – 69yrs	70 – 74yrs	75 – 79yrs	80 – 84yrs	85yrs+
Actual # Licensed 2000	4,182,933	3,644,990	2,820,136	1,656,789	957,463
Predicted # Licensed*	8,923,038	7,842,130	5,926,038	3,968,144	3,142,927
Difference %	113.32%	115.15%	110.13%	139.51%	228.26%

* Note: Predicted # Licensed based on Table 3.5
Source: Office of Highway Policy Information

Table 3.11 Numbers of License Holders (Females) in 2000 and 2030

Licensed	65 – 69yrs	70 – 74yrs	75 – 79yrs	80 – 84yrs	85yrs+
Actual # Licensed 2000	4,202,950	3,822,570	3,091,013	1,854,278	1,092,687
Predicted # Licensed*	9,671,154	8,972,201	7,299,301	5,398,649	4,770,317
Difference %	130.10%	134.72%	136.15%	191.15%	336.57%

* Note: Predicted # Licensed based on Table 3.6
Source: Office of Highway Policy Information

3.9 Driving Cessation

Several methodologies have been put forward to estimate the number of persons transitioning to driving cessation. Interrogation of longitudinal and cross sectional datasets is one method; the use of multi-state life tables is another. In the case of multi-state life tables, using a synthetic cohort, transition probabilities are derived for each stage of driving, i.e., driving, reduced driving and stopped driving. "As such, the multi-state life table allows us to derive the proportion of older people in each driving status state at each age and the expected time to be spent in each state" (Waldorf & Pitfield,

2005 p. 79). Nevertheless, the same articles goes on to state that "data necessary to estimate the transition probabilities do not exist" (Waldorf & Pitfield 2005, p. 79).

3.9.1 Estimates of Driving Cessation - Wallace

Much has already been stated about the process of driving cessation (see previous chapter) but, as to a possible scenario in 2030, four methods are applied to estimates of licensed drivers in 2030. The first approach is that developed by Wallace (Eberhard 1996) using the 1993/1994 Assets and Health Dynamics Survey (AHEAD), incorporated into Wave #2 of the HRS dataset (see section 3.4.1). In this study, Wallace derived proportions of former drivers ages 70 years or more, presented in Table 3.12. Former drivers would be persons who declared themselves as drivers (i.e., not only licensed but driving) during earlier waves (i.e., Wave 1 in 1992) of the survey but at a later survey stage declared that they did no longer drive (identification of this progression is made possible through longitudinal surveys). Table 3.12 also indicates that, in all age cohorts, there are greater proportions of female former drivers than males as well as an exponential increase in these proportions as age increases.

Table 3.12 Proportion of Senior Former Drivers (Percent Stopped Driving)

Gender	70 - 74 yrs	75 - 79yrs	80 - 84 yrs	85yrs +
Male	10	14	21	43
Female	17	23	35	52

Source: Wallace (Eberhard, 1996)

Applying the percentages of former drivers as derived by Wallace (Table 3.12) to the estimates of seniors licensed to drive in 2030, it is possible to obtain an estimate as to

the number of former drivers at this future year. These estimates are presented in Table 3.13.

3.9.2 Estimates of Driving Cessation – Foley et al.

The second methodology used to derive numbers of former drivers is that developed by Foley et al. (2002) from research estimating the "Driving Life Expectancy" of seniors. Foley and colleagues interrogated 1993 and 1995 data from the AHEAD dataset. The sample analyzed (4,699 persons) consisted of persons ages 70 years and older. At the baseline (1993), respondents were asked if they were able to drive and had a car available. Again in 1995, to follow up, the same question was asked to those of the original sample who were still living. Weights were applied to the sample enabling national representation, to account for mortality, non-response and driver status (active driver or former driver). Interpreting the results on a national scale Foley et al. found that, over the two year period of follow-up, seven percent of the 13.7 million drivers (70 years and older) died and, of those who survived, nine percent (1.2 million) ceased driving. Thus, over one year, approximately 620,000 senior drivers aged 70 years and above (i.e., 428,232 males + 811,167 females / 2) transitioned to become former drivers. The results are presented in Tables 3.14 and 3.15.

Table 3.13 Predicted Drivers and Former Drivers 2030 (Based on Wallace (Eberhard, 1996))

	70 – 74yrs		75 – 79yrs		80 – 84yrs	
Licensed	Males	Females	Males	Females	Males	Females
Predicted # Licensed*	7,842,130	8,972,201	5,926,038	7,299,301	3,968,144	5,398,649
Predicted % Former Drivers**	10.0%	17.0%	14.0%	23.0%	21.0%	35.0%
# Predicted Former Drivers	784,213	1,525,274	829,645	1,678,839	833,310	1,889,527
Predicted Actual Drivers	7,057,917	7,446,926	5,096,392	5,620,462	3,134,834	3,509,122

*See Tables 3.7 & 3.8
**Wallace (see Eberhard, 1996)

	85+ yrs		Total	
Licensed	Males	Females	Males	Females
Predicted # Licensed*	3,142,927	4,770,317	20,879,238	26,440,468
Predicted % Former Drivers**	43.0%	52.0%	18.2%	28.6%
# Predicted Former Drivers	1,351,459	2,480,565	3,798,627	7,574,205
Predicted Actual Drivers	1,791,468	2,289,752	17,080,611	18,866,262

*See Tables 3.7 & 3.8
**Wallace (see Eberhard, 1996)

Table 3.14 Prevalence of Driving and Not Driving for Males (1993 – 1995)

Age Cohort	AHEAD Sample Size	Estimated # Drivers	U.S. Population*	% Drivers	% Stopped Driving	# Stopped Driving
70-74	1,017	2,969,000	3,372,000	88.0	2.9	86,101.0
75-79	683	2,036,000	2,431,000	84.4	6.2	126,232.0
80-84	443	1,081,000	1,385,000	78.1	11.2	121,072.0
85+	187	433,000	793,000	54.6	21.9	94,827.0
Total	2,330	6,519,000	7,981,000			428,232

Source: Foley et al. (2002)
*AHEAD weighted population of community-dwelling elderly persons

Table 3.15 Prevalence of Driving and Not Driving for Females (1993 – 1995)

Age Cohort	AHEAD Sample Size	Estimated # Drivers	U.S. Population*	% Drivers	% Stopped Driving	# Stopped Driving
70-74	1,077	3,288,000	4,710,000	69.8	5.9	193,992.0
75-79	726	2,196,000	3,633,000	60.4	11.0	241,560.0
80-84	412	1,212,000	2,707,000	44.8	19.3	233,916.0
85+	154	447,000	2,015,000	22.2	31.7	141,699.0
Total	2,369	7,143,000	13,065,000			811,167

Source: Foley et al. (2002)
*AHEAD weighted population of community-dwelling elderly persons

The former driver percentages (i.e., percent stopped driving), as indicated in Tables 3.14 and 3.15 are of importance here. They indicate the wide disparity between genders with respect to the prevalence of driving cessation, i.e., female drivers were more likely to cease from driving in all the age cohorts presented. In addition, the data indicate the exponential increase in the percentage of ceased drivers with increasing age. Accepting the two year cessation percentages indicated in Tables 3.14 and 3.15 and applying them to the estimates of seniors licensed to drive in 2030, it is possible to obtain a second estimate as to the number of former drivers in this future year. These estimates are presented in Table 3.16.

3.9.3 Estimates of Driving Cessation – Waldorf

A third method to estimate the numbers of former drivers is that developed by Waldorf (2001), who looked at anticipated mode choices following driving cessation. In the

Table 3.16 Predicted Drivers and Former Drivers 2030 (Based on Foley et al.)

Licensed	70 – 74yrs		75 – 79yrs		80 – 84yrs	
	Males	Females	Males	Females	Males	Females
Predicted # Licensed*	7,842,130	8,972,201	5,926,038	7,299,301	3,968,144	5,398,649
Predicted % Former Drivers**	2.9%	5.9%	6.2%	11.0%	11.2%	19.3%
# Predicted Former Drivers	227,422	529,360	367,414	802,923	444,432	1,041,939
Predicted Actual Drivers	7,614,708	8,442,841	5,558,624	6,496,378	3,523,712	4,356,710

Licensed	85+ yrs		Total	
	Males	Females	Males	Females
Predicted # Licensed*	3,142,927	4,770,317	20,879,239	26,440,468
Predicted % Former Drivers**	21.9%	31.7%	8.3%	14.7%
# Predicted Former Drivers	688,301	1,512,190	1,727,569	3,886,413
Predicted Actual Drivers	2,454,626	3,258,127	19,151,670	22,554,055

course of this study, Waldorf was also able to derive cessation estimates based on Eberhard's (1996) paper. These estimates were a synthesis of FHWA licensing rates and the prevalence of active drivers as derived from the 1993/1994 AHEAD study. Waldorf determined that the proportion of persons ceasing from driving can be represented by the equation:

$$p^* = \frac{p_{el} - p_{cd}}{p_{cl}} = 1 - \frac{p_{cd}}{p_{cl}}$$

where p^* represents persons who have stopped driving, p_{el} proportion ever licensed, p_{cl} proportion currently licensed, and p_{cd} proportion currently driving (i.e., active drivers).

Three driving cessation scenarios were further developed by Waldorf (see Appendix B); Scenario 1 represents the case where the proportion of persons ever licensed equaled the proportion currently licensed; Scenario 2 assumed universal licensing, that is p_{el} = 1; and Scenario 3 was the average of scenarios 1 and 2. It was found that this latter scenario (Scenario 3) gave a more realistic driving cessation estimate. Driver cessation probabilities from Scenario 3 are presented in Tables 3.17 and 3.18. Estimates from Scenario 3 are then applied to driver licensing estimates 2030 and results are presented in Table 3.19. Table 3.19 presents the estimated number of licensed drivers, driving cessation proportions (as determined by Waldorf 2001) and estimates of the number of actual versus ceased drivers in 2030.

Table 3.17 Driving Cessation Estimates for Older Persons in the USA (Males)***

Scenarios		70 – 74yrs	75 – 79yrs	80 – 84yrs	85yrs+
Base Case	*Proportion currently licensed, p_{cl}	0.94	0.91	0.87	0.75
	**Proportion currently driving, p_{cd}	0.88	0.85	0.77	0.54
Scenario 3	Proportion ever-licensed, $p_{el} = ½ (p_{cl} + 1)$	0.97	0.96	0.94	0.88
	Proportion stopped driving, p^*	0.09	0.11	0.18	0.38

Sources: * OHPI/FHWA, ** AHEAD, ***Eberhard 1996 in Waldorf 2001

Table 3.18 Driving Cessation Estimates for Older Persons in the USA (Females)***

Scenarios		70 – 74yrs	75 – 79yrs	80 – 84yrs	85yrs+
Base Case	*Proportion currently licensed, p_{cl}	0.74	0.64	0.49	0.26
	*Proportion currently driving, p_{cd}	0.70	0.60	0.44	0.22
Scenario 3	**Proportion ever-licensed, $pel = ½ (p_{cl} + 1)$	0.87	0.82	0.75	0.63
	Proportion stopped driving, p^*	0.20	0.27	0.41	0.65

Sources: * OHPI/FHWA, ** AHEAD, ***Eberhard 1996 in Waldorf 2001

3.9.4 Estimates of Driving Cessation – Waldorf and Pitfield

Another more recent methodology that has the potential to estimate the number of persons experiencing the driving cessation process is the use of multi-state life tables. Here, using a synthetic cohort, transition probabilities are derived for each stage of driving, i.e., driving, reduced driving and stopped/ceased driving. “As such, the multi-state life table allows us to derive, the proportion of older people in each driving status state at each age and the expected time to be spent in each state” (Waldorf & Pitfield 2005, p. 79). Nevertheless, the same article goes on to state that “the data necessary to estimate the transition probabilities do not exist.”

The Life Table approach to estimating the numbers of former drivers is an application developed by Waldorf & Pitfield (2005). A life table is defined as “a statistical table that follows a hypothetical cohort of 100,000 persons born at the same time as they progress through successive ages, with the cohort reduced from one age to the next

Table 3.19 Predicted Drivers and Former Drivers 2030 (Based on Waldorf)

	70 – 74yrs		75 – 79yrs		80 – 84yrs	
Licensed	Males	Females	Males	Females	Males	Females
Predicted # Licensed*	7,842,130	8,972,201	5,926,038	7,299,301	3,968,144	5,398,649
Predicted % Former Drivers**	9.0%	20.0%	11.0%	27.0%	18.0%	41.0%
# Predicted Former Drivers	705,792	1,794,440	651,864	1,970,811	714,266	2,213,446
Predicted Actual Drivers	7,136,338	7,177,761	5,274,174	5,328,490	3,253,878	3,185,203

	85+ yrs		Total	
Licensed	Males	Females	Males	Females
Predicted # Licensed*	3,142,927	4,770,317	20,879,239	26,440,468
Predicted % Former Drivers**	38.0%	65.00%	15.6%	34.3%
# Predicted Former Drivers	1,194,312	3,100,706	3,266,234	9,079,404
Predicted Actual Drivers	1,948,615	1,669,611	17,613,005	17,361,064

according to a set of death rates by age until all persons eventually die" (U.S. Census Bureau 1996). A life table thus defined is technically referred to as a "Period" Life Table (i.e., synthetic population) versus a "Cohort" Life table, which follows the life experience of an actual birth cohort. In addition, a life table can be "abridged" (i.e., data grouped by 5 or 10 year age intervals) or "complete" (i.e., data for individual years). Life tablesfor the U.S. are produced annually by the National Center for Health Statistics (NCHS) a unit of the Centers for Disease Control (CDC). The complete life table for males and females in 2000 (as published by the NCHS) is presented in Appendix C.

The creation of an abridged life table for persons 35 years and older (base year 2000) is described as follows. The year 2000 was set as the base year in this study with 2030 as the forecast year. As life tables for future years have not been published by the NCHS, life tables (male and female) for the year 2000 will form the platform to derive probabilities of survival to the year 2030. Life tables generated for the year 2000 are presented in Tables 3.20 and 3.21, for 35 year old males and females respectively. Appendix D presents the detailed methodology followed in the derivation of these life tables.

As the focus of the study is the year 2030, to derive the number of senior former drivers in this year it is necessary to determine the proportion of persons alive (S_x) at least 30 years post 2000 (i.e., the opposite of mortality probabilities). In other words having reached 35 years or more in 2000 what is the probability of reaching 65 years or more in 2030 (based on the 2000 life tables). In this particular case, the probability is derived by dividing the cumulative number of deaths between a cohort (i.e., x) and 30 years hence (i.e., $x+30$) by the number surviving to age x (i.e., l_x) in 2000, as given in the formula:

Table 3.20 Life Table for Males: United States 35yrs+, 2000*

Cohort	Population (l_x)	Prob' Dying (q_x)	Deaths (d_x)	Person Years Lived (L_x)	Person Years Lived Total (T_x)	Life Expectancy (e_x)
35 - 39yrs	100,000	0.010257	1,026	497,436	4,135,932	41.36
40 - 44yrs	98,974	0.015126	1,497	491,129	3,638,496	36.76
45 - 49yrs	97,477	0.022407	2,184	481,926	3,147,368	32.29
50 - 54yrs	95,293	0.031250	2,978	469,021	2,665,442	27.97
55 - 59yrs	92,315	0.047977	4,429	450,503	2,196,421	23.79
60 - 64yrs	87,886	0.073557	6,465	423,269	1,745,918	19.87
65 - 69yrs	81,422	0.111454	9,075	384,421	1,322,648	16.24
70 - 74yrs	72,347	0.168277	12,174	331,298	938,228	12.97
75 - 79yrs	60,172	0.248708	14,965	263,449	606,929	10.09
80 - 84yrs	45,207	0.367438	16,611	184,508	343,480	7.60
85 - 89yrs	28,596	0.534164	15,275	104,794	158,972	5.56
90 - 94yrs	13,321	0.720043	9,592	42,626	54,178	4.07
95 - 99yrs	3,729	0.880494	3,284	10,438	11,552	3.10
100yrs+	446	1.000000	446	1,114	1,114	2.50

* for detailed methodology used in deriving table see Appendix D

Table 3.21 Life Table for Females: United States 35yrs+, 2000*

Cohort	Population (l_x)	Prob' Dying (q_x)	Deaths (d_x)	Person Years Lived (L_x)	Person Years Lived Total (T_x)	Life Expectancy (e_x)
35 - 39yrs	100,000	0.005667	567	498,583	4,584,834	45.85
40 - 44yrs	99,433	0.008600	855	495,029	4,086,250	41.10
45 - 49yrs	98,578	0.012439	1,226	489,826	3,591,222	36.43
50 - 54yrs	97,352	0.018667	1,817	482,217	3,101,396	31.86
55 - 59yrs	95,535	0.029758	2,843	470,566	2,619,179	27.42
60 - 64yrs	92,692	0.047284	4,383	452,502	2,148,613	23.18
65 - 69yrs	88,309	0.073047	6,451	425,418	1,696,111	19.21
70 - 74yrs	81,858	0.110777	9,068	386,622	1,270,692	15.52
75 - 79yrs	72,790	0.171756	12,502	332,696	884,071	12.15
80 - 84yrs	60,288	0.270477	16,307	260,674	551,374	9.15
85 - 89yrs	43,982	0.424747	18,681	173,205	290,700	6.61
90 - 94yrs	25,301	0.632261	15,997	86,511	117,495	4.64
95 - 99yrs	9,304	0.833978	7,759	27,122	30,983	3.33
100yrs+	1,545	1.000000	1,545	3,862	3,862	2.50

* for detailed methodology used in deriving table see Appendix D

$$1 - \frac{\sum_{l_x}^{l_{x+30}} d_x}{l_x}$$

where, d_x cumulative number of deaths between year l_x and l_{x+30}, and l_x number of survivors at age x years. For example, the probability of a females ages 40 to 44 years in 2000 (n = 99,433 see Table 3.21) surviving 30 years to see their 70th to 74th year in 2030 (n = 81,858 see Table 3.21) is 0.823248., i.e., 82 percent of females ages 40 to 44 years in 2000 are estimated to live to see their 70th to 74th year in 2030 (based on 2000 life tables). The resulting survival probability estimates for males and females for the year 2030 are presented in Table 3.22.

Table 3.22 Male and Female Survivor Probabilities S_x (65 Years and Older)

		Males		Females	
Age 2000	Age 2030	Prob of Dying (q_x)	Prob of Surviving (S_x)	Prob of Dying (q_x)	Prob of Surviving (S_x)
35 - 39yrs	65 - 69yrs	0.185785	0.814215	0.116910	0.883090
40 - 44yrs	70 - 74yrs	0.269035	0.730965	0.176752	0.823248
45 - 49yrs	75 - 79yrs	0.382702	0.617298	0.261598	0.738402
50 - 54yrs	80 - 84yrs	0.525599	0.474401	0.380720	0.619280
55 - 59yrs	85 - 89yrs	0.690232	0.309768	0.539627	0.460373
60 - 64yrs	90 - 94yrs	0.848427	0.151573	0.727047	0.272953
65 - 69yrs	95 - 99yrs	0.954197	0.045803	0.894643	0.105357
70 - 74yrs	100yrs+	0.993840	0.006160	0.981130	0.018870

Waldorf & Pitfield (2005) also produced five-year (assumed) cessation probabilities for seniors. These cessation probabilities adhere to the following criteria, namely; increase with age and are greater for women than for men.[2] The cessation probabilities are presented in Table 3.23.

[2] Personal communication with Brigitte Waldorf

Table 3.23 Five-Year (Assumed) Cessation Probabilities for Seniors

Age Cohort	Men	Women
65 to 69	0.05	0.05
70 to 74	0.05	0.10
75 to 79	0.10	0.20
80 to 84	0.10	0.20
85 to 89	0.40	0.80
90 to 94	0.50	0.99
95+	1.00	1.00

Source: Waldorf & Pitfield (2005, p. 80)

The cessation probabilities are applied to the probability of dying (q_x) for each particular cohort, producing revised q^*_x. The "probability of dying forms the basis of the life table." (Arias 2002, p. 2) The revised probability of dying results in changes to life table calculations, subsequently producing new survival probabilities. Appendix E gives the detail surrounding the derivation of q^*_x, and S^*_x. Table 3.24 presents the probability of survival S_x to the year 2030 (derived from the regular life table) and the probability for surviving and actively driving S^*_x. The resulting probability curves are illustrated in Figures 3.2 and 3.3.

Table 3.24 Male and Female Survivor (S_x) and Surviving & Driving (S^*_x) Probabilities

		Males		Females	
Age 2000	Age 2030	Prob of Surviving (S_x)	Prob of Surviving & Driving (S^*_x)	Prob of Surviving (S_x)	Prob of Surviving & Driving (S^*_x)
35 - 39yrs	65 - 69yrs	0.814215	0.814215	0.883090	0.883090
40 - 44yrs	70 - 74yrs	0.730965	0.694417	0.823248	0.782086
45 - 49yrs	75 - 79yrs	0.617298	0.557111	0.738402	0.631333
50 - 54yrs	80 - 84yrs	0.474401	0.385332	0.619280	0.423588
55 - 59yrs	85 - 89yrs	0.309768	0.226448	0.460373	0.251916
60 - 64yrs	90 - 94yrs	0.151573	0.066482	0.272953	0.029872
65 - 69yrs	95 - 99yrs	0.045803	0.010045	0.105357	0.000115
70 - 74yrs	100yrs+	0.006160	0.000000	0.018870	0.000000

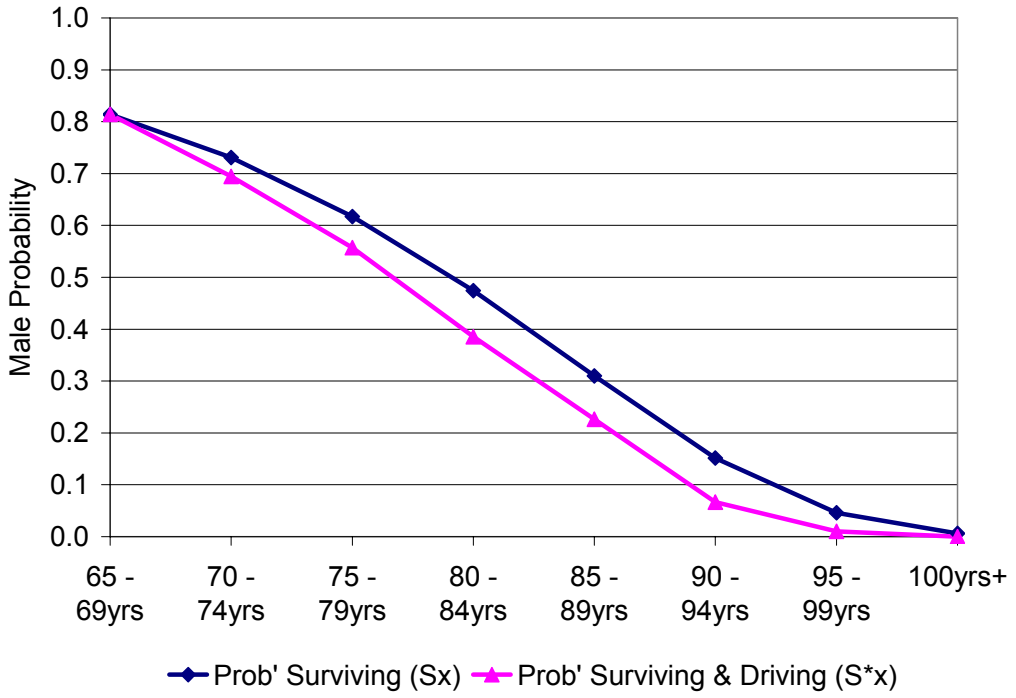

Figure 3.2 Survivor Curves S_x and S^*_x (Males)

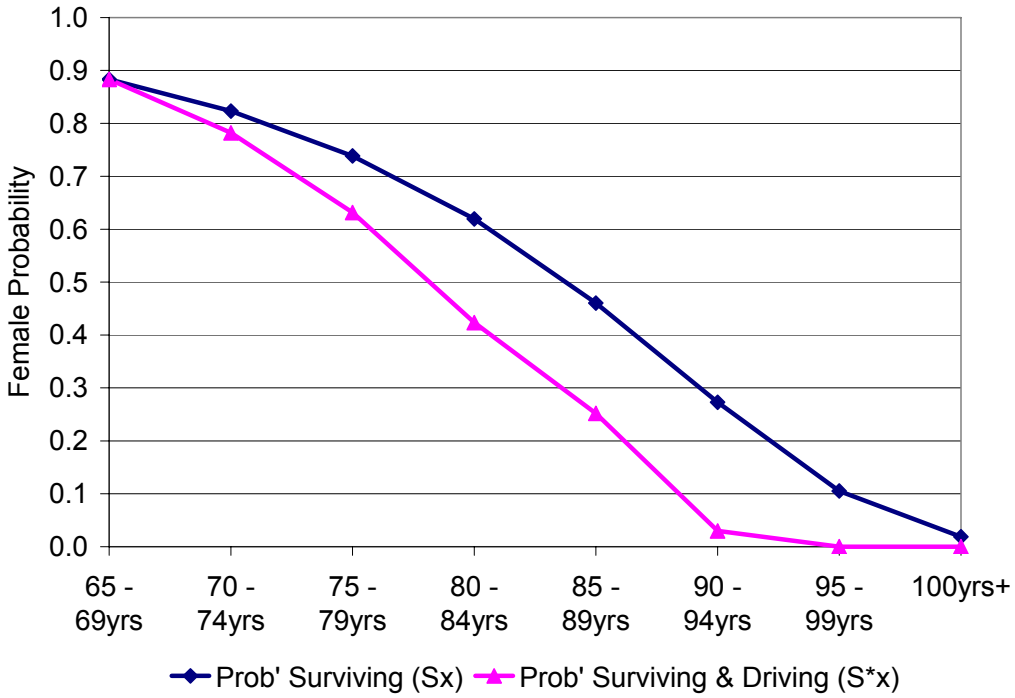

Figure 3.3 Survivor Curves S_x and S^*_x (Females)

Figures 3.2 and 3.3 indicate that for senior men ages 65 years or more in 2030, the median age (where p = 0.5) of survival S_x is 79 years, with a driving life expectancy S^*_x of 77 years. This is in comparison to the median life expectancy S_x for senior women in 2030 approximating 84 years with a corresponding S^*_x of 78 years.

The difference between the survivor probability curve (S_x) and the surviving and driving curve (S^*_x) at a specific probability represents the number of years during which a person is in need of assistance with transportation, i.e., they become former drivers and may seek alternative non-personally operated transportation modes.

The final stage in order to derive the numbers of persons transitioning to the former driver status according to Waldorf & Pitfield is calculated from the following formula (Waldorf & Pitfield 2005, p. 82):

$$_nN_x(t) = \frac{S_x - S^*_x}{S_x} {}_nP_x(t)$$

where $_nN_x(t)$ is the number of persons in need of non-personally operated automobile transportation, S_x survivor probability, S^*_x, driving life expectancy, and $_nP_x(t)$ is the size of the age cohort. Applying this method, the estimated numbers of males and females in need of non-automobile transportation in 2030 are presented in Tables 3.25 and 3.26. (Note: (1) the driver population figures are based on licensed driver proportions in 2000 (i.e., 30 years before the cohort in question, for example, the cohort 65 to 69 yrs in 2030 is based on the cohort 35 to 39 years in 2000, and (2) as survivor probabilities have been given to age 100+ the estimates of licensed drivers 85yrs+ have been re-calculated – see Appendix F for details)).

Table 3.25 Estimated Former Driver Population in 2030 (Males)

Cohort (Males)	S_x	S^*_x	Driver Population	# Ceased Driving ${}_nN_x(t)$
65 to 69yrs	0.8142	0.8142	8,923,038	0
70 to 74yrs	0.7310	0.6944	7,842,130	392,106
75 to 79yrs	0.6173	0.5571	5,926,038	577,789
80 to 84yrs	0.4744	0.3853	3,968,144	745,019
*85yrs+	0.3098	0.0000	3,234,826	1,337,218

* see Appendix F for recalculation of driver population 85yrs+

Table 3.26 Estimated Former Driver Population in 2030 (Females)

Cohort (Females)	S_x	S^*_x	Driver Population	# Ceased Driving ${}_nN_x(t)$
65 to 69yrs	0.8831	0.8831	9,671,154	0
70 to 74yrs	0.8232	0.7821	8,972,201	448,610
75 to 79yrs	0.7384	0.6313	7,299,301	1,058,399
80 to 84yrs	0.6193	0.4236	5,398,649	1,705,973
*85yrs+	0.4604	0.0000	5,506,872	3,644,796

* see Appendix F for recalculation of driver population 85yrs+

The ceased driving estimates presented in Tables 3.25 and 3.26 do illustrate the higher number of female former drivers when compared to males. The cohort 85 to 89 years witnesses a rise in the numbers of former drivers for both males and females. However, this is related to the steep change in the assumed cessation probabilities presented in Table 3.23. Overall, the figures indicate that in 2030 approximately 15 percent of the senior driving population (i.e., 65 years and older) will have transitioned to the former driver state and thus have need of other non-personally operated transportation modes.

3.10 Driving Cessation Caveats

Three primary caveats can be made in the interpretation of the driving cessation estimates developed, presented in the following sections.

3.10.1 Cumulative Cessation Rates Over Time

In section 2.4, it was noted that a recent estimate of the numbers of senior drivers who retire from driving annually approximated 1 million (Staplin & Freund 2005). However, from the four methods assessed in this chapter, the driving cessation estimates are to be taken as cumulative as at the year 2030. Indeed, it can be seen that, with each advance in age cohort, the proportion of former drivers increases. In other words, taking Wallace's estimates (see Table 3.13), in 2030, 10 percent of senior male drivers in the 70 to 74 year cohort will have retired from driving, as at 31 December (correspondingly 17 percent of senior female drivers), some of these would have been before 2030 and some during the same year. However, if former drivers from the 70 to 74 age cohort survive to the next cohort (75 – 79 years), they will be added to the numbers of former drivers in this cohort who were active drivers in their previous cohort. Thus, as age increases, there is an expansion in the proportion of former drivers of the number of total senior drivers with a specific age cohort.

3.10.2 Gender Differences in Cessation Rates

In an overwhelming number of studies, female cessation rates are higher for males in the same age cohort. Suggested reasons for the differences in cessation rates by gender have stated that it is partly due to the greater importance given to driving by elderly men when compared to women. On the other hand, for elderly women, having a living spouse who prefers to drive can relieve them from the necessity to drive. However, according to the study by Foley et al. (2002), the lack of correcting for the differing mortality rates between men and women biases cessation rates in favor of men. This error is evidenced when studies of senior former drivers do not assess those drivers who were actively driving at the point of their deaths, i.e., the cessation rate is based on

former drivers who survive after giving up driving. Thus, "when mortality risk is factored into the rates of cessation (more men will stop due to death than women over time), the risk of driving cessation is comparable and therefore results in similar driving life expectancies [i.e., cessation rates]."[3] This conclusion by Foley et al. (2002) is unique among studies of driving cessation as it goes against the trend of widely differing cessation rates by gender. To incorporate the reasoning by Foley et al. a sensitivity test (presented in Chapter 4) will be carried out where the derivation of transit market size will allow for female cessation rates that are equal to that of males.

3.10.3 Cessation Rates of the 65 to 69 Year Cohort

In three of the cessation estimate methods assessed, driving cessation rates for the 65 – 69 year cohort were not derived. This was not necessarily due to the lack of drivers in this age cohort transitioning to former driver status, but due to the use of the AHEAD dataset in the estimation of former drivers. As indicated in section 3.12, the AHEAD dataset only includes senior persons ages 70 years or more. Thus, it would not be possible using this dataset to derive cessation estimates for seniors younger than 70 years.

3.11 Derivation of Potential Transit Market Size

To estimate the potential transit market size in the forecast year of 2030, the approach to be followed is that of applying transit trip rates derived from the NHTS 2001 to the numbers of non-drivers (i.e., former drivers and persons who have never driven). However, before this is done, an understanding of elderly travel behavior is described.

[3] Personal communication with Daniel Foley

3.12 Travel Behavior of the Elderly

To better understand the short and long distance travel behavior of Americans, the Bureau of Transportation Statistics (BTS) of the U.S. Department of Transportation (USDOT), FHWA and NHTSA have intermittently, since 1969, collected detailed data on personal travel. The NPTS, as it was referred to in 1969, has been collected in 1977, 1983, 1990, 1995 and 2001. The 2001 survey was conducted over the period of March 2001 to May 2002 and covered all 50 states. The goal of the NHTS is to create a national inventory of daily and long distance travel. Such information is useful for policy makers and strategic planners in the course of defining the safety, quality, and efficiency of the U.S. transportation system.

The primary method of collecting data was via the Computer Aided Telephone Interview (CATI) from a sample of the non-institutionalized population. CATIs were facilitated using the Random Digit Dialing Method (RDD). The survey process included household interviews, in-person interviews, and odometer readings from personal motor vehicles. Interviewees and their respective trip-making behavior came from households/persons representing all socio-economic backgrounds, ethnic groups, and ages (including, for the first time, children ages 0 to 4 years old). Each respondent was asked to give details of all trips made (both local and long distance but not international) on a particular travel day.

Over 106,000 household interviews were conducted, and approximately 163,000 person interviews were completed. Of the 106,000 households interviewed, approximately 70,000 households provided usable information. In the case of person interviews, 161,000 were usable. The unweighted person response rate (in households where at least half of the adults completed the person interview) was approximately 60 percent for both the full sample and the national sample. The overall unweighted survey

response rate was 29 percent and 37 percent of the full sample and national sample, respectively. Refer to the 2001 National Household Travel Survey User's Guide (USDOT 2004) for more information on the survey and weight estimation methodology and response rates.

The 2001 NHTS dataset contains four separate files: household, person, vehicle and travel day trips. The household file contains information relating to each household, e.g., number of vehicles; the person file contains information relating to each person, e.g., age, race, etc.; the vehicle file contains information relating to the household vehicle(s), e.g., vehicle type; and the travel day trip file contains information detailing each trip made on the household's randomly-assigned travel day. Details (i.e., number of records) of each file and weighted sums are presented in Table 3.27.

Table 3.27 National Household Travel Survey 2001 Data File Statistics

Data File	Sample Size (# of records)	Weighted Sum
Household (unit = households)	69,817	107,365,346
Person (unit = persons)	160,758	277,203,235
Vehicle (unit = vehicles)	139,382	202,586,200
Travel day person trips (unit = trips)	642,292	407,262,485,207

Source: National Household Travel Survey 2001

3.13 Dataset Caveats

The following caveats are given in interpretation of the 2001 NHTS dataset.

3.13.1 Cross Sectional Versus Longitudinal Datasets

Despite data being collected over a number of years, the NHTS is not a longitudinal survey as the travel behaviors of the same persons have not been followed in each of the survey years. Thus, "within-person" change, i.e., how does each person change over time, and "inter-individual" change, i.e., what predicts differences among people in their changes, cannot be derived from analyses of NHTS datasets. Indeed, cross

sectional datasets over time compare different individuals at one point in time with another set of individuals at another point of time and try to draw individual inferences about change over time. Such shortcomings of cross sectional datasets (and the benefits of longitudinal research) are investigated further in Singer & Willett (2003).

3.13.2 Institutionalized Populations

According to the 2001 NHTS Users Guide, “An eligible household excludes telephones in motels, hotels, group quarters, such as nursing homes, prisons, barracks, convents or monasteries and any living quarters with 10 or more unrelated roommates” (USDOT, 2004 p. 1-7). Thus, transit behavior of seniors resident in such institutions cannot be presented in this discussion.

According to the 2000 Decennial Census, approximately 444,000 males ages 65 and over were institutionalized in 2000, compared to 1.2 million senior women. Of these figures, approximately 400,000 senior males resided in nursing homes compared to 1.1 million senior females. It is evident that for senior males and females, residing in nursing homes represented 90 percent and 96 percent, respectively, of the institutionalized populations. Figure 3.4 presents the proportions of institutionalized seniors of the total senior population.

3.13.3 Transportation Definitions

Two general transportation mode definitions are assessed in the following sections, POVs and transit. A total of 26 transportation modes are incorporated into the NHTS 2001. With respect to POV transportation, this is defined to include car, van, sport utility vehicle (SUV), pickup or other truck, recreational vehicle (RV), and motorcycle. Transit (public transportation)is defined as local public transit bus, commuter bus, city to city bus, commuter train, subway/elevated rail and street car/trolley.

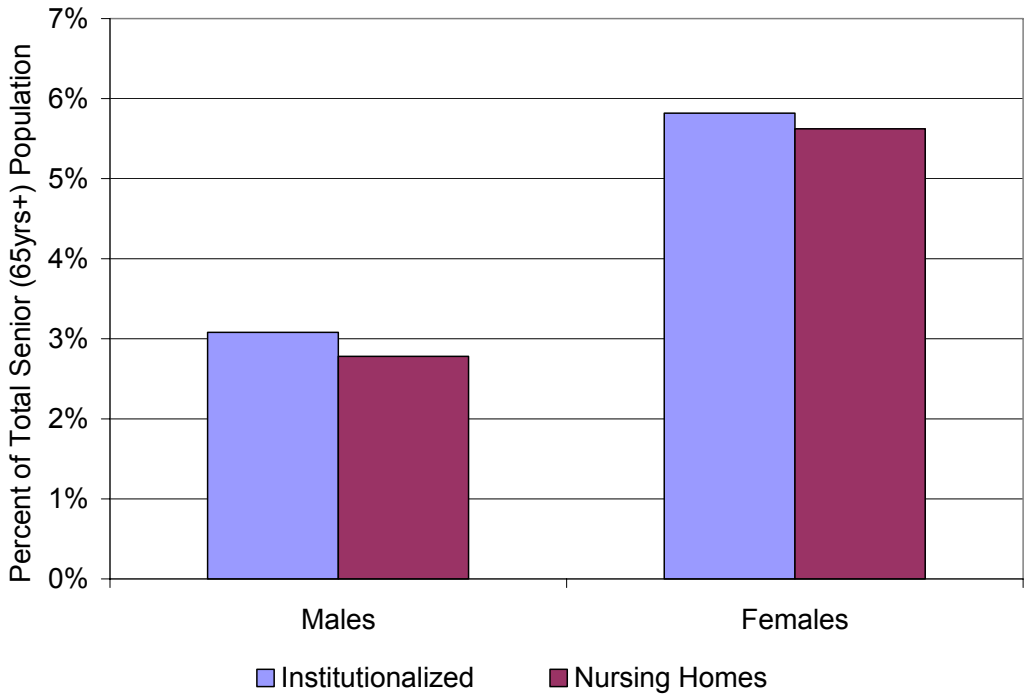

Figure 3.4 Percent of Senior Population Residing in Institutions 2000
Source: U.S. Census Bureau (2005)

3.13.4 Driving/Licensure Status[4]

Data in the NHTS 2001 indicate the driving status of the respondent rather than their driving licensure status. In executing the survey, the respondent is simply asked, "Are you a driver?" The answer can be either "Yes" or "No." Nothing is asked about whether the respondent holds a current driving license. Thus, if the respondent has an expired license but is still driving, they are recorded as a "driver." On the other hand, if a respondent has a current license but does not drive (i.e., due to a health impairment) they are a 'non-driver.'

[4] Based on email communication with Nancy McGuckin and Nanda Srinivasan 11/04/2006

3.13.5 Elderly Demographics

The U.S. population approximated 285,107,923 persons, according to Census estimates for the year 2001, of which of 35,329,850 (12%) were age 65 years or older. Population estimates for the same year computed from the NHTS survey (using the person file) approximated 277,203,235 persons, of which 32,884,068 (12%) were 65 years and older. Figure 3.5 illustrates Census and NHTS estimates of the population by age cohort in 2001 and the difference between the two estimates (with Census estimate as base). It is evident that, at the oldest-old age cohorts, the differences are significant, with NHTS estimates being approximately 35 percent less than the estimates derived from the Census for persons 85 years and older. This may be partially attributable to the

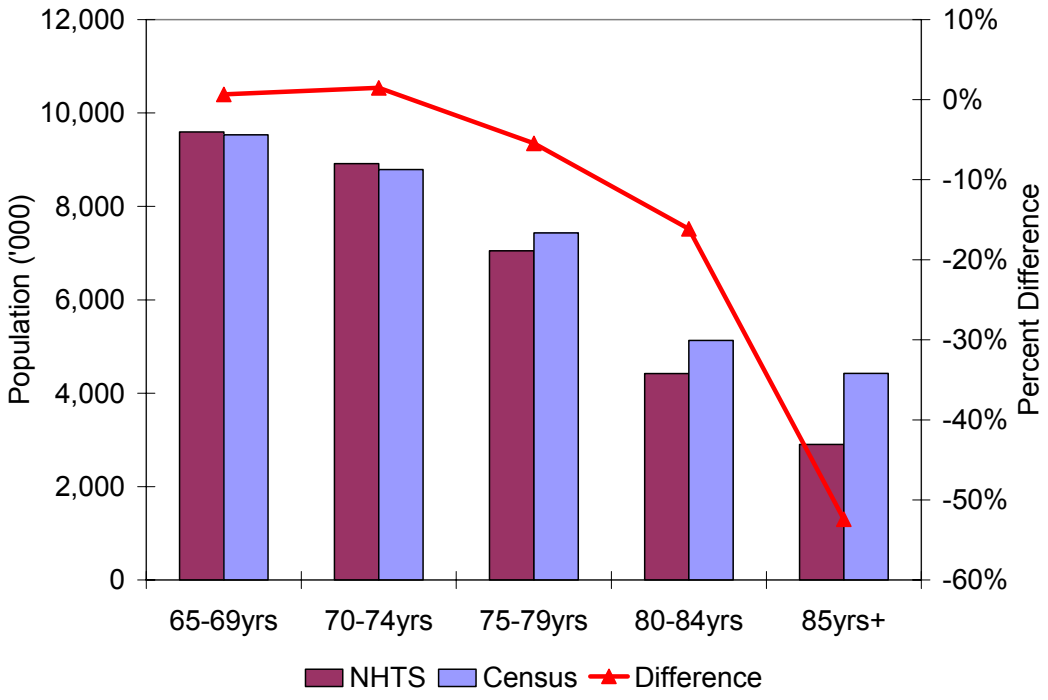

Figure 3.5 Population Estimates by Senior Age Cohort (Year 2001)
Sources: NHTS 2001 & U.S. Census Bureau (2004) Projected Population of the United States, by Age and Sex: 2000 to 2050 (Detailed Table) Population Division, Population Projections Branch

fact that NHTS does not include institutionalized persons (discussed earlier) in the database as well as to the sample size of the “oldest old” senior population.

3.14 Transit Trip Rates

As the focus of this research is deriving the future demand for transit, an understanding of daily transit use of the population is required. It is anticipated that these rates will be applied to the senior population in the year 2030 to estimate the transit market size. Thus, this section will look at transit trip use from a variety of perspectives. First, Market Assessment #1, the overall use of transit by seniors will be presented.

3.14.1 Transit Trip Rates – Market Assessment #1: General Population

Transit trip rates for the senior population (approximately 33 million persons) as derived from the NHTS 2001 are presented in Table 3.28. It is evident that daily transit trip rate is negligible for the senior population, when compared to the daily trip rate (all trips).

Table 3.28 Transit Trip Rates Market Assessment #1: General Population

Market Assessment #1	Trips	Population	Daily Trip Rate
2001 Total Trips 0 - 64yrs	366,272,055,294	244,319,167	4.11
2001 Total Trips 65yrs+	40,990,429,913	32,884,068	3.42
2001 Transit Trips 0 - 64yrs	6,149,312,016	244,319,167	0.07
2001 Transit Trips 65yrs+	503,068,683	32,884,068	0.04

Source: NHTS 2001 Person and Trip Files

3.14.2 Transit Trip Rates – Market Assessment #2: Urban/Rural Population

Table 3.29 presents data with respect to transit trip rates broken down by whether the trip maker was located in an urban versus rural location. According to the NHTS 2001, of the 6.6 billion trips made by transit, 6.5 billion trips (98%) were made in urban areas. This severe disparity possibly contributes to the zero daily transit trip rate for seniors as depicted in Table 3.29. Indeed, the lack of transit use by seniors residing in rural locations is primarily due to the non-availability of transit services in such areas.

Table 3.29 Transit Trip Rates Market Assessment #2: Urban/Rural Population*

Market Assessment #2	Trips Urban	Population	Daily Trip Rate	Trips Rural	Population	Daily Trip Rate
2001 Total Trips 0 - 64yrs	289,645,261,201	190,950,308	4.16	76,626,794,127	53,368,861	3.93
2001 Total Trips 65yrs+	32,434,626,485	25,622,499	3.47	8,555,803,425	7,261,571	3.23
2001 Transit Trips 0 - 64yrs	6,018,647,645	190,950,308	0.09	130,664,372	53,368,861	0.01
2001 Transit Trips 65yrs+	500,341,685	25,622,499	0.05	2,726,998	7,261,571	0.00

Table 3.30 Transit Trip Rates Market Assessment #3: Urban Driver/Non-Driver Population*

Market Assessment #3	Trips Active Driver	Population	Daily Trip Rate	Trips Non-Driver	Population	Daily Trip Rate
2001 Total Trips 0 - 64yrs	213,313,223,561	127,113,550	4.60	76,332,037,616	63,836,759	3.28
2001 Total Trips 65yrs+	29,216,362,781	19,892,925	4.02	3,218,263,711	5,729,575	1.54
2001 Transit Trips 0 - 64yrs	2,935,343,743	127,113,550	0.08	3,083,303,922	63,836,759	0.13
2001 Transit Trips 65yrs+	159,513,500	19,892,925	0.02	340,828,189	5,729,575	0.16

Table 3.31 Transit Trip Rates Market Assessment #4: Urban Non-Driving Population and Household Driver Availability*

Market Assessment #4	Trips Zero Drivers in Household	Population	Daily Trip Rate	Trips Driver in Household	Population	Daily Trip Rate
2001 Total Trips 0 - 64yrs	5,392,524,661	5,358,808	2.76	70,939,512,962	58,477,956	3.32
2001 Total Trips 65yrs+	1,343,355,866	2,348,859	1.57	1,874,907,841	3,380,717	1.52
2001 Transit Trips 0 - 64yrs	1,433,165,576	5,358,808	0.73	1,650,138,340	58,477,956	0.08
2001 Transit Trips 65yrs+	257,148,542	2,348,859	0.30	83,679,644	3,380,717	0.07

Table 3.32 Transit Trip Rates Market Assessment #5: Urban Non-Driving Population and Household Vehicle Availability*

Market Assessment #5	Trips Zero Vehicles in Household	Population	Daily Trip Rate	Trips Vehicle in Household	Population	Daily Trip Rate
2001 Total Trips 0 - 64yrs	7,658,773,577	7,436,026	2.82	68,673,264,049	56,400,733	3.34
2001 Total Trips 65yrs+	1,353,076,756	2,376,609	1.56	1,865,186,948	3,352,962	1.52
2001 Transit Trips 0 - 64yrs	1,801,485,576	7,436,026	0.66	1,281,818,344	56,400,733	0.06
2001 Transit Trips 65yrs+	284,969,789	2,376,609	0.33	55,858,397	3,352,962	0.05

* Tables 3.29 to 3.32 data source: NHTS 2001 Person and Trip Files

Thus, in light of the dominance of transit trip making in the urban areas, ongoing analysis of the NHTS with respect to senior travel behavior will focus on transit use in urban areas only.

3.14.3 Transit Trip Rates – Market Assessment #3: Urban Driver/Non-Driver Population

Table 3.30 presents data with respect to transit use according to the driving status of seniors residing in an urban area. Driver status is a significant factor contributing to the number of out-of-home trips made. Indeed, of the 25 million seniors residing in urban areas, approximately 20 million (78%) described themselves as “drivers” (i.e., actively driving) and had a daily trip rate significantly higher than those seniors who were not drivers.

3.14.4 Transit Trip Rates – Market Assessment #4 Urban Non-Driving Population and Household Driver Availability

Market Assessment #4 as presented in Table 3.31 presents trip rate data for seniors residing in households with or without a driver present in that household. It is evident that the lack of a driver in the household is a contributing factor to the percentage of transit trips made of all out-of-home trips.

3.14.5 Transit Trip Rates – Market Assessment #5 Urban Non-Driving Population and Household Vehicle Availability

Market Assessment #5 (as shown in Table 3.32) presents data on trip rates according to household vehicle availability. It is evident (in the majority of cases) that the lack of a vehicle for a non-driving senior has a greater impact on the daily trip rate than the lack of another household driver (compare Table 3.30).

3.14.6 Summary Trip Frequency Behavior

Summarizing the various trip rates contained in the scenarios above is shown in the form of a trip rate tree as indicated in Figure 3.6. As can be seen, senior non-drivers have a daily trip rate that is 50 percent less than senior drivers. Indeed, the highest trip rate for seniors is in respect of those seniors residing in urban areas who drive.

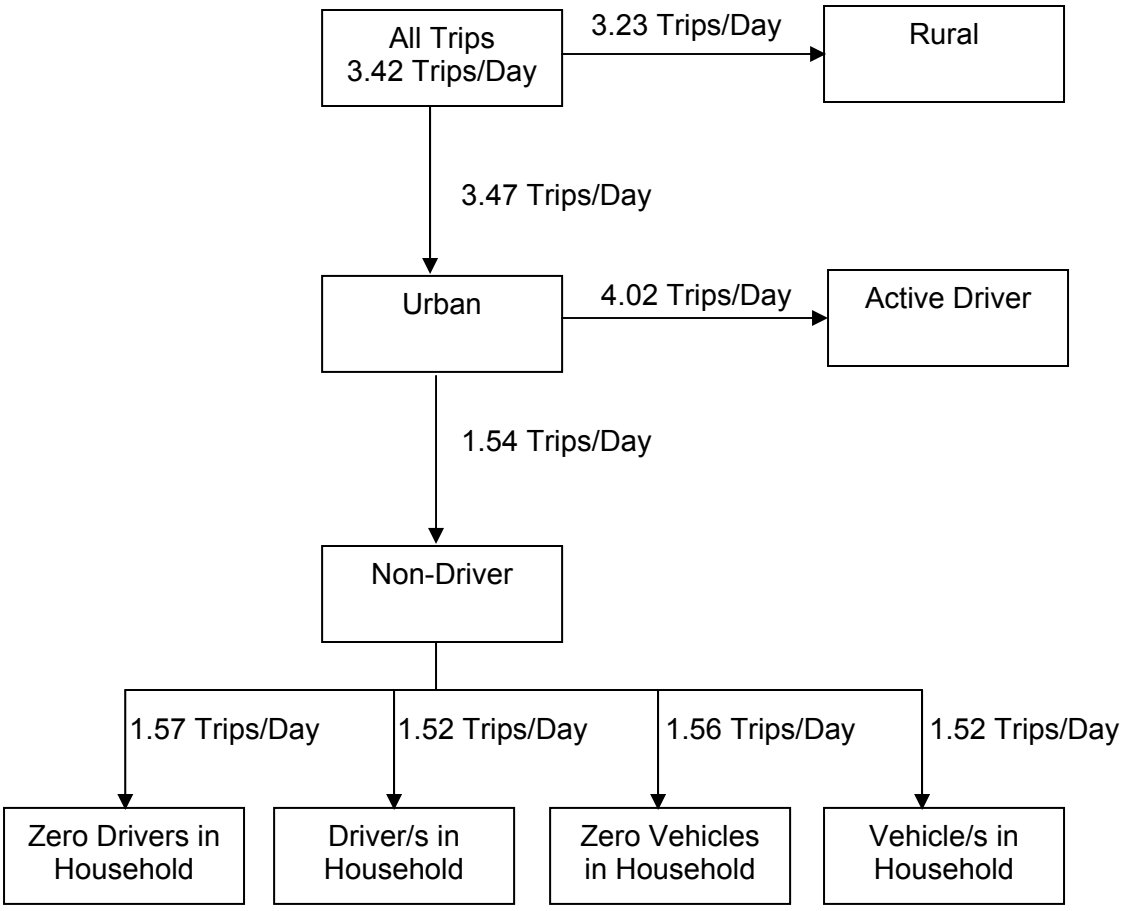

Figure 3.6 Senior Population Daily Trip Rate Tree
Source: Author's analysis of the NHTS 2001

CHAPTER 4 – RESULTS AND DISCUSSION

4.1 Introduction

Chapter 3 presented the methodology developed to estimate the number of former drivers in the year 2030. This current chapter will discuss the results of the estimation process by way of presenting:

- estimates of the senior population in 2030 according to their driving licensure status;
- estimates of current and former senior drivers in the year 2030; and
- estimates of transit market size in 2030 through the application of daily trip rates to the senior population according to their licensure and driving status.

Sensitivity tests will also be conducted with the estimates of current and former drivers in 2030. In addition, there will be a discussion of the active and former driver estimates taking note of factors that may influence the size of the future senior transit market, as discussed in Chapter 2.

4.2 Estimates of the Senior Driving Population in 2030

Estimates of the numbers of seniors according to their licensure status were reviewed in section 3.8. Tables 4.1 and 4.2 revisit these estimates by presenting the estimated numbers of licensed and unlicensed seniors in the year 2030.

Table 4.1 Estimated Senior Population by Licensure Status (Males) 2030

Population/ # Licensed	65 – 69yrs	70 – 74yrs	75 – 79yrs	80 – 84yrs	85+ yrs
Estimated Population 2030	9,473,104	8,280,824	6,159,657	4,089,194	3,339,937
Predicted # Licensed	8,923,038	7,842,130	5,926,038	3,968,144	3,142,927
Predicted # Unlicensed	550,066	438,694	233,619	121,050	197,010

* Note: Estimated percentages based on Table 3.3
Source: Projected Population of the United States, by Age and Sex: 2000 to 2050 (Detailed Table) U.S. Census Bureau, Population Division, Population Projections Branch

Table 4.2 Estimated Senior Population by Licensure Status (Females) 2030

Population/ # Licensed	65 – 69yrs	70 – 74yrs	75 – 79yrs	80 – 84yrs	85+ yrs
Estimated Population 2030	10,507,158	9,686,847	7,829,249	5,824,404	6,263,097
Predicted # Licensed	9,671,154	8,972,201	7,299,301	5,398,649	4,770,317
Predicted # Unlicensed	836,004	714,646	529,948	425,755	1,492,780

* Note: Estimated percentages based on Table 3.4
Source: Projected Population of the United States, by Age and Sex: 2000 to 2050 (Detailed Table) U.S. Census Bureau, Population Division, Population Projections Branch

Of the 31 million males in 2030, it is estimated that the overall licensing rate for this group will be approximately 95 percent, compared to 90 percent of the 41 million senior women.

4.3 Active and Former Drivers

The estimated numbers of seniors that may have ceased driving by 2030 or may be going through the driving cessation process during that year, according to the four different methods, are presented in Table 4.3 and displayed graphically in Figures 4.1 and 4.2. The estimates range from a conservative 5.6 million senior former drivers in 2030 (aged 70 years and older), as per the method developed by Foley et al. (2002), to a high of 12.3 million seniors applying Waldorf's (2001) method. Another observation arising from the

Table 4.3 Estimated Senior Former Driver Population 2030

	65 – 69yrs		70 – 74yrs		75 – 79yrs		80 – 84yrs	
	Males	Females	Males	Females	Males	Females	Males	Females
Predicted # Licensed	8,923,038	9,671,154	7,842,130	8,972,201	5,926,038	7,299,301	3,968,144	5,398,649
# Former Drivers Wallace	na	na	784,213	1,525,274	829,645	1,678,839	833,310	1,889,527
# Former Drivers Foley	na	na	227,422	529,360	367,414	802,923	444,432	1,041,939
# Former Drivers Waldorf	na	na	705,792	1,794,440	651,864	1,970,811	714,266	2,213,446
# Former Drivers Waldorf & Pitfield*	0	0	392,106	448,610	577,789	1,058,399	745,019	1,705,973

na = not assessed

* licensing rates for 85yrs+ recalculated (see Appendix F for details)

	85+ yrs		Total	
	Males	Females	Males	Females
Predicted # Licensed	3,142,927	4,770,317	29,802,277	36,111,622
# Former Drivers Wallace	1,351,459	2,480,565	3,798,627	7,574,205
# Former Drivers Foley	688,301	1,512,190	1,727,569	3,886,412
# Former Drivers Waldorf	1,194,312	3,100,706	3,266,234	9,079,403
# Former Drivers Waldorf & Pitfield*	1,337,218	3,644,796	3,052,132	6,857,778

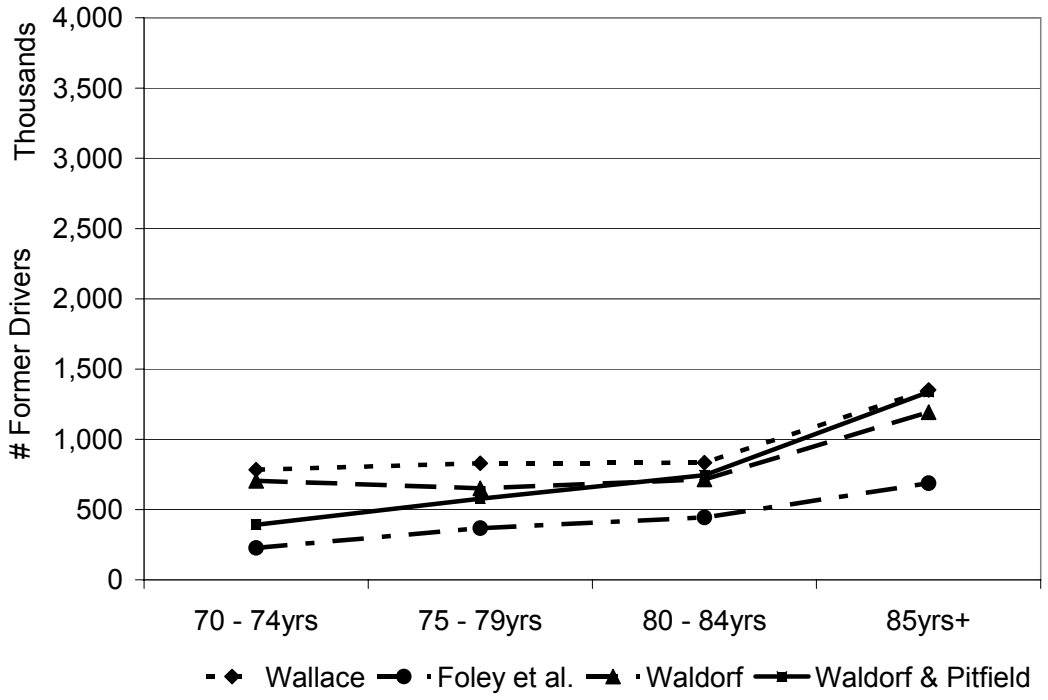

Figure 4.1 Estimated Male Former Drivers 2030

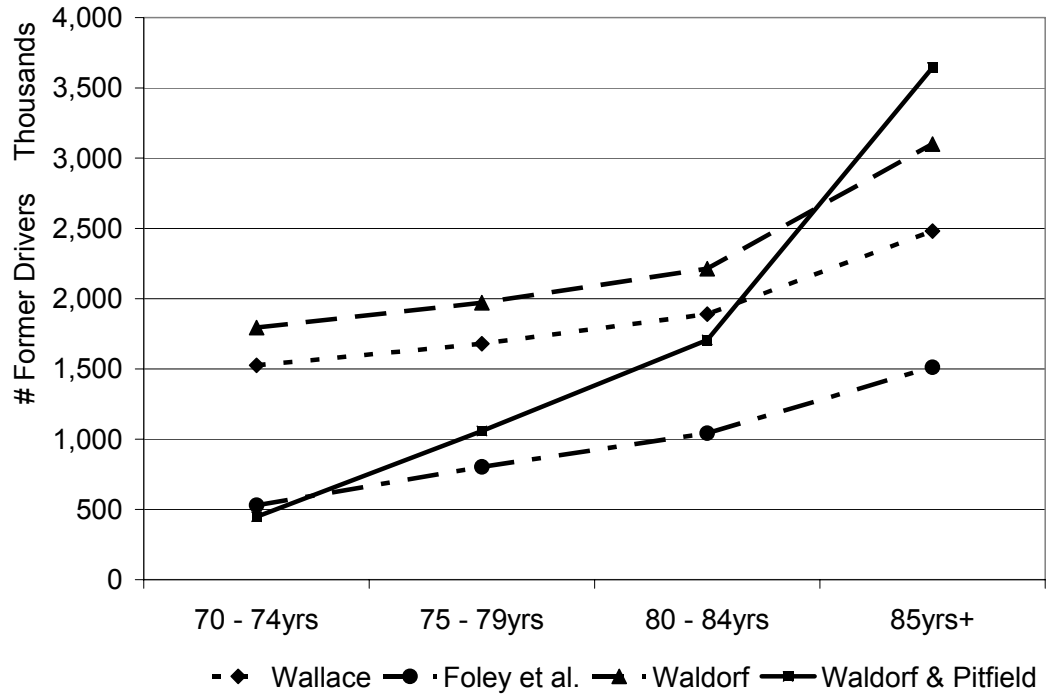

Figure 4.2 Estimated Female Former Drivers 2030

estimated driving cessation results is that an upward trend in the numbers of former drivers is evident for both males and females. Furthermore, the steepest rise or fall in cohort estimates for both genders is evident at 85 years and older. This result is supportive of evidence that suggests that during the ninth decade of life (colloquially referred to as the "Decade of Reckoning") there is a greater chance that personal health status will be compromised through chronic illness for example, impacting driving skills and capability[5].

In all age cohorts, the propensity to transition to become a former driver was greater for women than men (even when taking into account the four distinct estimation methods). Wallace's method produced the lowest overall average of 2 female former drivers (≥ 70 years) to every 1 male former driver (7.5 million / 3.7 million; see Table 4.3), when compared to 2.78 using Waldorf's (2001) method. These driving cessation ratios are significantly higher than the corresponding licensing ratio of 1.26 senior female drivers (≥ 70 years) for every 1 senior male driver in 2030. In addition, only one method, namely Waldorf & Pitfield (2005), estimated former drivers ages 65 to 69 years. It is accepted that many seniors in this age bracket continue to drive without any health or other problems impacting their driving capability. However, the lack of estimates for the senior population ages between 65 to 69 years using the other three methods (Wallace (Eberhard, 1996), Foley et al. 2002, and Waldorf, 2001) is due to the use of the AHEAD longitudinal dataset, which only includes persons 70 years and older in the sample.

In Spring 2005, Staplin & Freund estimated that 1 million senior drivers (70 years and older) ceased driving annually. Based on 2004 licensing data, at that time the senior driver licensed population (≥70yrs) approximated 20 million persons or, put another way, 8 out of 10 senior persons were licensed (population ≥70 years in 2004

[5] Personal communication with Daniel J Foley 05/12/06

approximated 26 million). From Staplin & Freund's estimates, approximately 1 in 20 senior drivers ages 70 years and older stopped driving in 2004/2005. Similarly, the estimates for 2030 indicate a former driver (≥ 70 years) ratio of between 1 in 8 (according to Foley et al. 2002) to 1 in 4 (Waldorf 2001). Overall, the four methods assessed in this study predict that in 2030, 12 to 26 percent of seniors (≥ 70 years) holding driver licenses may have ceased driving and be in need of non-personally operated transportation modes in order to maintain their mobility and activity levels pre-cessation.

Looking at the cessation estimates for persons in their ninth decade of life, there seems to be a greater clustering of estimates for males (around 1.2 million, in Figure 4.1) when compared to the wider disparity for females (ranging from a low of 1.5 million to 3.8 million, in Figure 4.2). Historically, the higher incidence of licensed male drivers has contributed to the gender disparity in former driver estimates. The extent of such disparities being perpetuated into the future (taking into account the closing gender gap in driver licensing), confirm the challenge of predicting the licensing and corresponding driving behavior of senior females in the future. Many of the relationships that have been developed to assess senior driving behavior and cessation are based on empirical/historical relationships which are unlikely to be repeated in the future due to the increasing incidence of licensed seniors.

There has never been a time where licensing rates of senior women have been similar to that of senior males (i.e., licensed in excess of 90 percent with a corresponding gender difference ≤ 5 percentage points). Nevertheless, this scenario is currently evident for persons aged 35 to 64 years (see Tables 3.3 and 3.4) and will impact senior age cohorts with each advancing decade post 2000. Burkhardt et al. (1998, p.28) noted in their study regarding predicting senior women driving behavior, "will they [women born

after 1950] exhibit the driving behavior of those women now in the 65 and above age group or will they drive more like they, themselves, did in their 20s and 30s?" Concomitantly, with respect to this study, will senior women in the coming decades cease driving as senior women do now [i.e., in 2005/2006] or follow closely the driving behavior and cessation patterns of senior males in that future year?

The far larger number of persons ages 65+ in future decades provides a larger group of licensed senior drivers, many of whom will deal with driving cessation sometime during their lives. The number of persons who will face driving cessation is expected to increase dramatically and in absolute terms provide a large group of individuals who will have to transition to alternative mobility options. Public policy may very well influence not only the size of the group that transitions but the public sector's response. Such a response may include proactive involvement in offering mobility choices through public venues and numerous additional pubic actions such as service coordination, education and counseling to former drivers. Figure 4.3 provides a summary of the estimated current and future driving status of the senior population. The large growth in seniors and licensure rates results in far more seniors who are expected to transition from driving but fewer unlicensed drivers.

4.4 Never Driven

In all cohorts in 2030, there will be those seniors who may have never acquired a driver's license (permitting them to drive legally) in their lifetimes. The actual numbers maybe small (taking note of the decreasing gender differences in licensing in recent decades; see section 2.7); nevertheless, this group must also be added to the numbers of former drivers. Tables 4.4 and 4.5 present the total number of persons that may seek

alternatives to the automobile in the year 2030, favorable (base) and worse case scenarios.

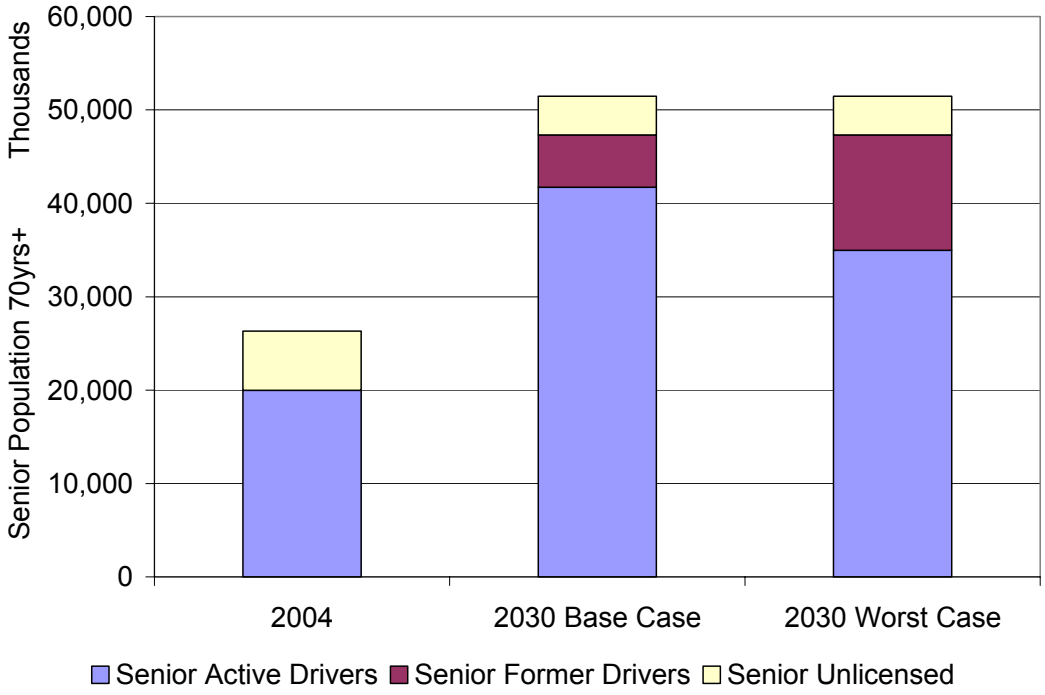

Figure 4.3 Estimated Current and Future Senior Drivers According to Driving Status (70 Years and Older)

4.5 Driving Cessation Favorable Versus Worse Case Analysis

In determining the transit market share attributable to seniors in the forecast year, it will be necessary to include those seniors who may be using transit for the first time (or after a long time since their pre-driving period) post cessation. In the subsequent analysis it is anticipated that the numbers of former senior drivers in future years will follow the favorable (base) case scenario as assessed by Foley et al. (2002). Assumptions governing this anticipated scenario in 2030 are as follows:

Table 4.4 Estimated Senior Former Driver Population 2030 (Favorable Case – Foley et al., 2002)

Cohort	65 – 69yrs		70 – 74yrs		75 – 79yrs		80 – 84yrs	
	Males	Females	Males	Females	Males	Females	Males	Females
Population	9,473,104	10,507,158	8,280,824	9,686,847	6,159,657	7,829,249	4,089,194	5,824,404
Predicted # Licensed	8,923,038	9,671,154	7,842,130	8,972,201	5,926,038	7,299,301	3,968,144	5,398,649
#Never Driven	550,066	836,004	438,694	714,646	233,619	529,948	121,050	425,755
#Former Drivers	0	0	227,422	529,360	367,414	802,923	444,432	1,041,939
#Total Non-Drivers	550,066	836,004	666,116	1,244,006	601,033	1,332,871	565,482	1,467,694
Non Drivers % of Cohort Population	5.81%	7.96%	8.04%	12.84%	9.76%	17.02%	13.83%	25.20%

Cohort	85+ yrs		Total	
	Males	Females	Males	Females
Population	3,339,937	6,263,097	31,342,716	40,110,755
Predicted # Licensed	3,142,927	4,770,317	29,802,277	36,111,622
#Never Driven	197,010	1,492,780	1,540,439	3,999,133
#Former Drivers	688,301	1,512,190	1,727,569	3,886,412
#Total Non-Drivers	885,311	3,004,970	3,268,008	7,885,545
Non Drivers % of Cohort Population	26.51%	47.98%	10.43%	19.66%

Table 4.5 Estimated Senior Former Driver Population 2030 (Worse Case – Waldorf, 2001)

Cohort	65 – 69yrs		70 – 74yrs		75 – 79yrs		80 – 84yrs	
	Males	Females	Males	Females	Males	Females	Males	Females
Population	9,473,104	10,507,158	8,280,824	9,686,847	6,159,657	7,829,249	4,089,194	5,824,404
Predicted # Licensed	8,923,038	9,671,154	7,842,130	8,972,201	5,926,038	7,299,301	3,968,144	5,398,649
#Never Driven	550,066	836,004	438,694	714,646	233,619	529,948	121,050	425,755
#Former Drivers	0	0	705,792	1,794,440	651,864	1,970,811	714,266	2,213,446
#Total Non-Drivers	550,066	836,004	1,144,486	2,509,086	885,483	2,500,759	835,316	2,639,201
Non Drivers % of Cohort Population	5.81%	7.96%	13.82%	25.90%	14.38%	31.94%	20.43%	45.31%

Cohort	85+ yrs		Total	
	Males	Females	Males	Females
Population	3,339,937	6,263,097	31,342,716	40,110,755
Predicted # Licensed	3,142,927	4,770,317	29,802,277	36,111,622
#Never Driven	197,010	1,492,780	1,540,439	3,999,133
#Former Drivers	1,194,312	3,100,706	3,266,234	9,079,403
#Total Non-Drivers	1,391,322	4,593,486	4,806,673	13,078,536
Non Drivers % of Cohort Population	41.66%	73.34%	15.34%	32.61%

- Licensing rates of seniors (for both males and females) in all likelihood will be above 90 percent, in particular for persons ages 64 to 84 years. Concomitantly, at these licensing proportions, it is also likely that males and females will have similar driving histories (i.e., length of time actively driving). Longer driving histories, leading to a increased familiarity with and competency of driving and a greater dependency on driving in meeting transportation needs, the incidence of cessation in all likelihood will be less than it is for seniors today (2006) and the incidence of transitioning to former driver status similar for both senior males and females. So the lower estimates of driving cessation using the method of Foley et al. (2002) is preferable.
- Life expectancy at birth has been increasing over recent decades, where, in 2003, life expectancy for males approximated 74.8 years and females 80.1 years (Arias 2006, p. 3). With respect to males, increased life expectancy in future years may result in more men living to report driving cessation rather than being omitted from the driving cessation equation due to their deaths while actively driving (see section 3.10.2). This needs to be coupled with senior females with driving habits similar to their male counterparts. Therefore, both of these factors have the potential to close the driving cessation gender gap, which also supports lower estimates of driving cessation as according to Foley et al. (2002).

4.6 Transit Use by Seniors - Evidence from the National Household Travel Survey 2001

Results from analysis of the NHTS 2001 are presented in this section. It is noted that public transportation (transit) may represent a transportation alternative for seniors, if certain conditions are met. National transportation mode choice statistics as derived from the NHTS are presented in Table 4.6. It is evident that the use of transit in 2001 for

Table 4.6 Daily Travel by Mode (Billion Trips in 2001) in U.S.A.

Mode	National		19-64yrs		65yrs+	
	# Trips	Percent	# Trips	Percent	# Trips	Percent
POV*	351.8	86.4%	236.0	89.4%	36.5	89.0%
TRANSIT**	6.7	1.6%	4.8	1.8%	0.5	1.2%
WALK	35.4	8.7%	19.9	7.5%	3.5	8.5%
BIKE	3.3	0.8%	1.2	0.5%	0.1	0.3%
OTHER	10.2	2.5%	2.2	0.9%	0.4	0.9%
TOTAL	407.3	100.0%	264.1	100.0%	41.0	100.0%

*POV Includes car, van, sport utility vehicle (SUV), pickup or other truck, recreational vehicle (RV), or motorcycle
**Transit includes local public transit bus, commuter bus, city to city bus, commuter train, subway/elevated rail and street car/trolley
Source: NHTS 2001 Trip File

persons ages 65 years and older represented only 1 - 2 percent of trips; traveling in POV travel was by far the overwhelming and preferred choice of transportation. Figure 4.4 presents percentage of trips made by transit by age cohort. Even though, in all senior age cohorts, transit trip use is minimal, overall there is an upward trend, particularly in the oldest-old cohorts. This upward trend may be due to widowhood (with its concomitant financial implications) and the increasing desire of seniors in the oldest-old age cohorts to remain mobile despite limitations brought on by socio-economics or age. The desire to remain mobile may lead seniors to experiment in using public transportation.

4.6.1 Gender and Transit Use

If gender is taken into account with respect to transit use by seniors, the following is evident as presented in Tables 4.7 and 4.8. Senior women make 1.7 percent of trips by transit compared to 0.7 percent of trips by senior men. In fact, for every 1 transit trip by a senior male, a corresponding 2.5 transit trips were made by senior women in 2001. The greater use of transit by senior women may be partly due to widowhood (and the unavailability of another person facilitate POV transportation) and lower licensure rates

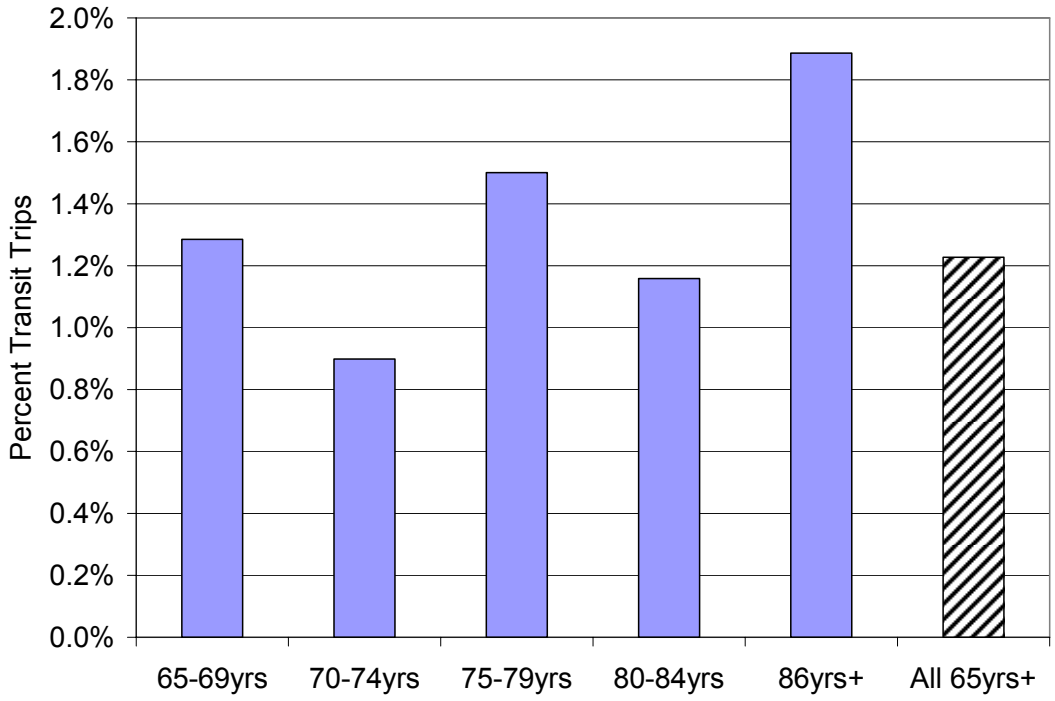

Figure 4.4 Percent Transit Trips by Senior Age Cohort (Year 2001)
Source: NHTS 2001 Trip File

for older females. Evidence supporting this conclusion is indicated through analysis of driving life expectancy versus life expectancy. As women live longer than men, they will have longer periods (after driving cessation) in need of alternatives to POV transportation.

Table 4.7 Modal Split for Daily Travel in U.S.A. (Billion of Trips Males Year 2001)

Mode	National	Percent	19-64yrs	Percent	65yrs+	Percent
POV*	171.3	86.4%	113.8	89.7%	17.6	90.3%
TRANSIT**	3.0	1.5%	2.1	1.7%	0.1	0.7%
WALK	16.5	8.3%	9.0	7.1%	1.5	7.7%
BIKE	2.2	1.1%	0.8	0.6%	0.1	0.5%
OTHER	5.3	2.7%	1.2	0.9%	0.2	0.8%
TOTAL	198.3	100.0%	127.0	100.0%	19.4	100.0%

Source: NHTS 2001 Trip File

Table 4.8 Modal Split for Daily Travel in U.S.A. (Billion of Trips Females Year 2001)

Mode	National	Percent	19-64yrs	Percent	65yrs+	Percent
POV*	180.4	86.4%	123.4	89.0%	18.9	87.9%
TRANSIT**	3.7	1.8%	2.7	2.0%	0.4	1.7%
WALK	18.9	9.0%	11.0	8.0%	2.0	9.3%
BIKE	1.1	0.5%	0.4	0.3%	0.0	0.2%
OTHER	4.8	2.3%	1.1	0.8%	0.2	1.0%
TOTAL	208.9	100.0%	138.7	100.0%	21.5	100.0%

Source: NHTS 2001 Trip File

Figure 4.5 graphically portrays senior transit use by age and gender. In all age cohorts, senior women utilize transit more than senior men. In fact, for senior women there is evidence of a strong positive correlation between transit use and age.

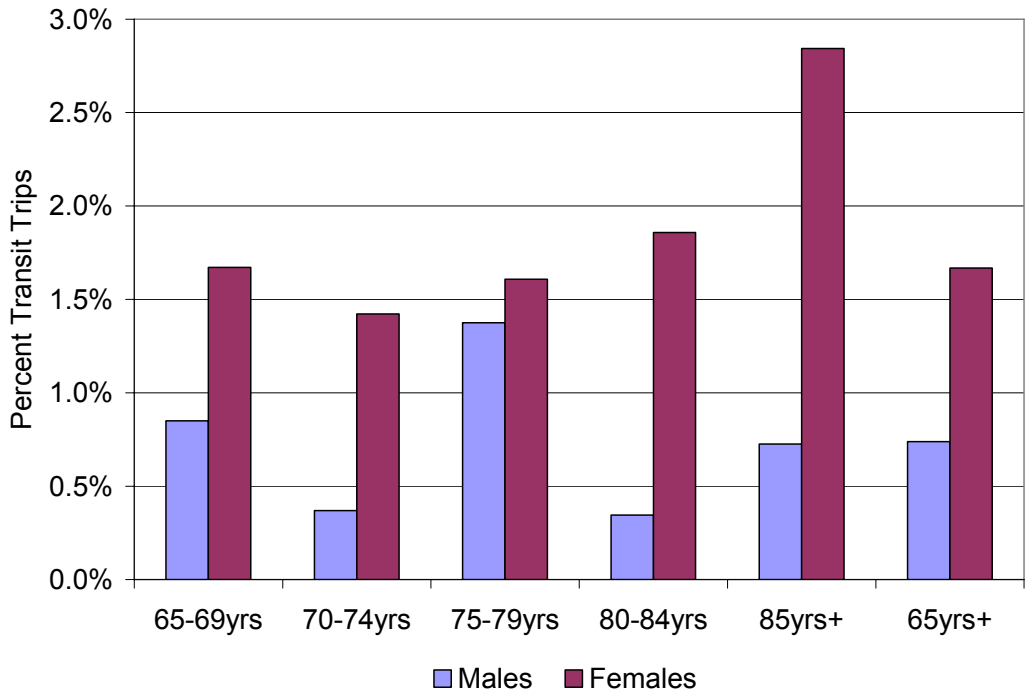

Figure 4.5 Percent Transit Trips by Senior Age Cohort and Gender (Year 2001)
Source: NHTS 2001 Trip File

4.6.2 Minorities and Transit Use

Chapter 2 discussed various factors that have positively influenced transit use (and may continue to in forthcoming decades), one of which was minority (ethnic) status. Figure 4.6 presents the proportion of all trips made by transit according to age cohort and ethnic status. It is evident that minorities in the age cohorts depicted in Figure 4.6 utilized transit to a higher extent (of all trips made) than whites. With respect to seniors, approximately 11 percent of trips made by Hispanic seniors were made by transit; this was double the proportion of the next closet ethnic group, that of African American/

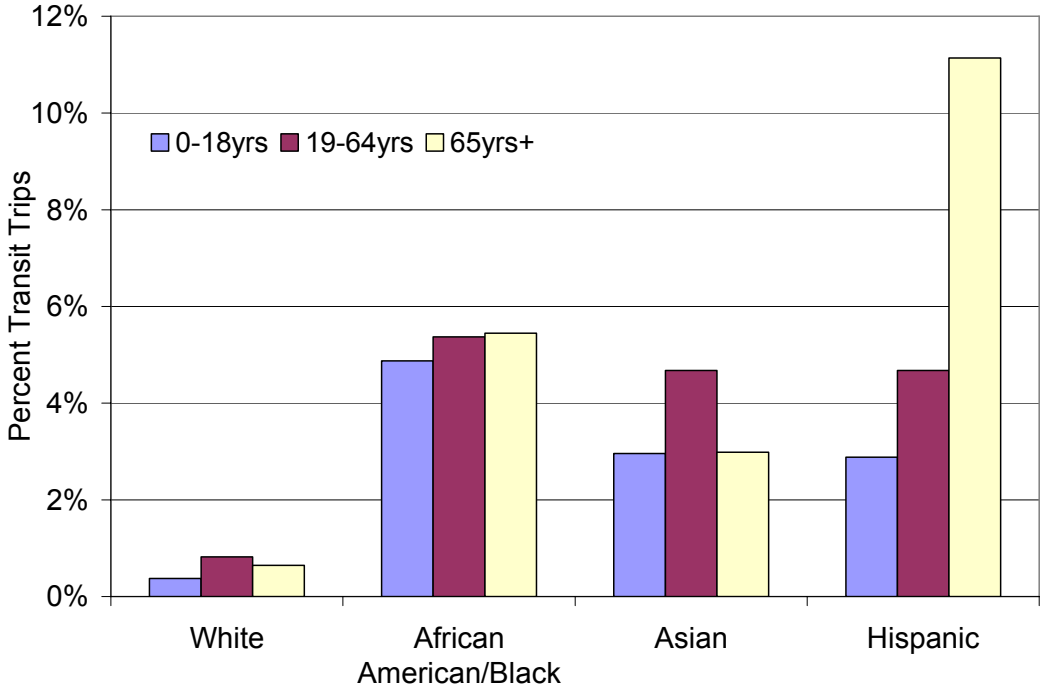

Figure 4.6 Percent Transit Trips by Senior Age Cohort and Ethnicity (Year 2001)
Source: NHTS 2001 Trip File

Black at 5 percent. A significant percentage of ethnic seniors reside in central cities, which, in many cases, have associated transit services. Residential location and socio-economics are major contributory factors to the higher utilization rate of transit by ethnic

seniors. With the ethnic proportion of the total U.S. population predicted to grow rapidly in future years, if current transit utilization trends are continued, this may have positive benefits for transit agencies through increased ridership levels.

4.6.3 Modal/Market Share by Age Cohort

An understanding of modal/market share by age cohort may enable a cursory determination of the market size for each mode, i.e., transit, with respect to the proportion of all trips made on each particular mode. Modal/market share can then be compared with the respective proportion of total trips and trips on a particular mode that each cohort represents. Through such a comparison, the level of dependency or non-dependency on a particular mode can be gauged. Such relationships are relevant in the current study, as changes in population proportions (e.g., the significant growth in the 65+ year cohort) will have corresponding impacts in modal shares. Figure 4.7 presents modal/market share proportions by age cohort for all trips made on a particular mode.

The mode/market share dominance of the 19 to 64 years cohort is evident in Figure 4.7, particularly for POV, transit and walking modes. Of the modes depicted in Figure 4.7, only for the bike mode did the 19 to 64 years age cohort not contribute to the majority of bike trips. Indeed, for POV and transit trips, the 19 to 64 years cohort contribution to these trips exceeded their population share (61 percent in 2001), noting that the senior population proportion in 2001 was estimated at 12 percent. For all the modes depicted in Figure 3.9, the senior contribution to the trips on each particular mode was less than their proportion of the population, only POV came in close at 10 percent.

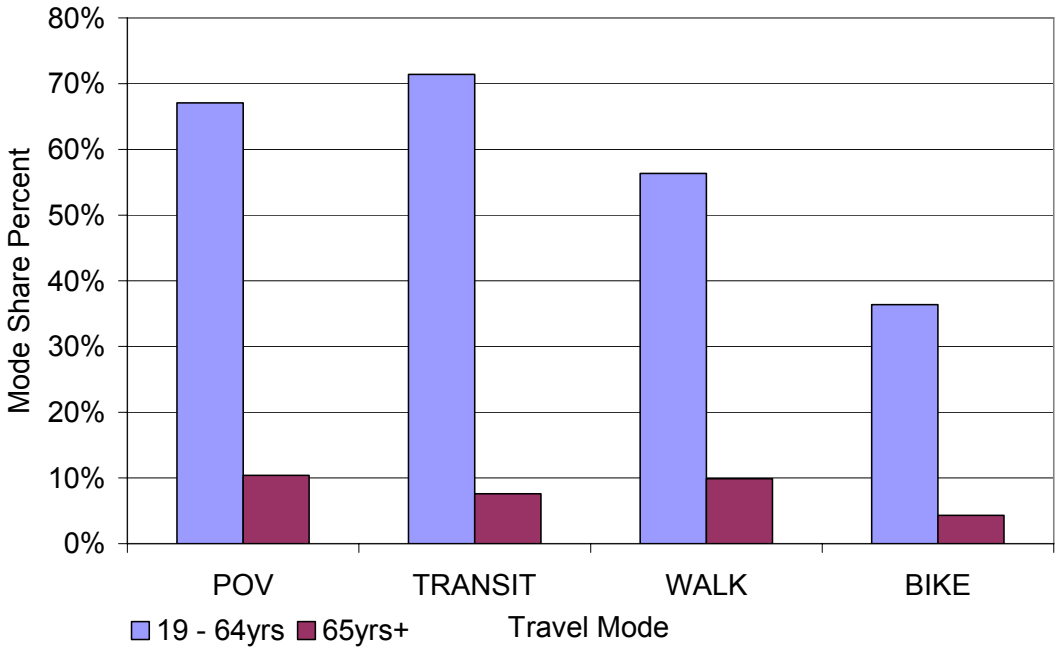

Figure 4.7 Mode/Market Share by Age Cohort
Source: NHTS 2001 Trip File

With respect to transit, the NHTS estimated that over 6 billion trips were made using transit in 2001. It is evident from Figure 4.7 that persons ages 65 years and older were responsible for 7.7 percent of transit mode share, approximately 5 percentage points less than their estimated proportion of 2001 total population. The dominance of transit use for work related trips has influenced the negatively disproportionate share of transit trips made by seniors. This result is to be expected as for the majority of seniors (many of whom are retired), the need for making the work trip is significantly reduced and when transit is used it is to fulfill other trip purposes (discussed further in section 4.6.6).

In Figure 4.8, this takes the mode/market share proportions as indicated in Figure 4.7 and categorizes them according to the urban and rural location of the respondent's household. With respect for POV transportation, the results are similar to those presented in Figure 4.7, i.e., approximately 10 percent of the POV trips in either an urban or rural category were made by seniors. However, in the case of transit, trips made by seniors made up 8 percent of the urban transit market share, compared to 2 percent of rural transit market. This difference is primarily due to the denser transit networks available in urban areas when compared to rural areas, resulting in a greater dependency in rural areas on POV transportation. With respect to the walking market

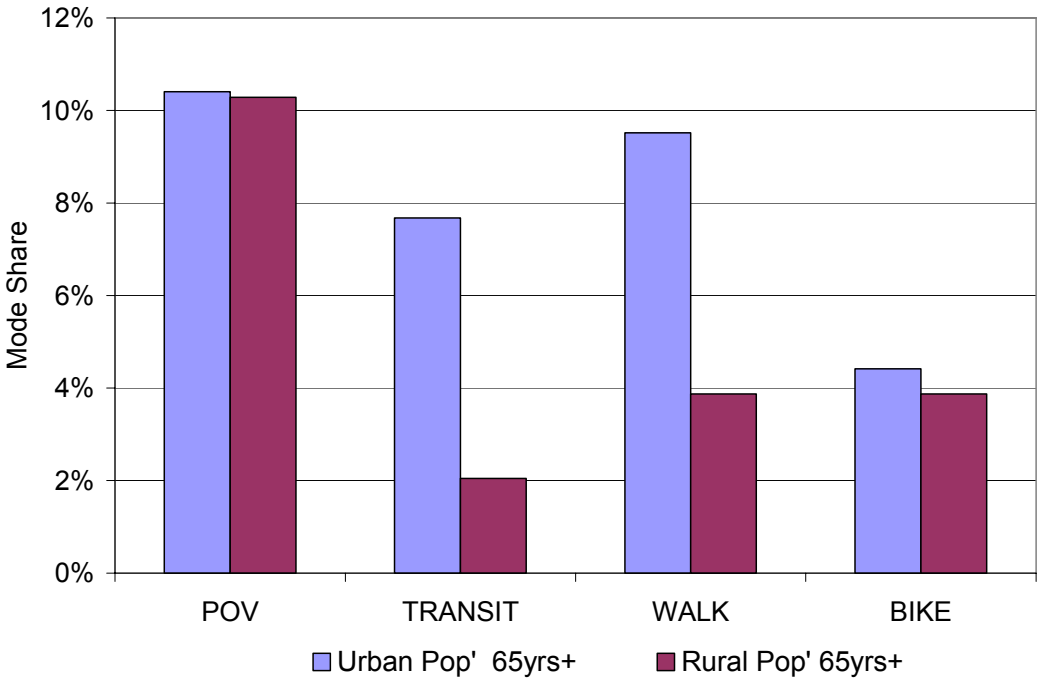

Figure 4.8 Urban and Rural Mode/Market Share by Age Cohort
Source: NHTS 2001 Trip File

share, walk trips by seniors accounted for 9 percent of the urban walk trips market share, compared to 4 percent in rural areas. Possible factors influencing the differential in this case may be related to the prevalence of sidewalks in urban areas which permit walking in a safer environment and the greater incidence of longer distances between destinations in rural areas (when compared to denser physical environments in urban areas), resulting in a decreased viability of walking as a transportation option for seniors.

4.6.4 Transit Trip Starting Time

Another aspect of senior travel behavior is the trip starting time, whether during the day or night of travel. Some senior drivers try to avoid traveling during peak periods, and after dark in evenings and at nights. Figure 4.9 presents start hour of transit trips by age cohort. It is evident from Figure 4.9 that senior transit users exhibit similar behaviors as senior drivers. In the case of senior transit users, the peak trip start hour (14 percent of transit trips) is at midday (12 noon) rising steeply from 8am. A secondary peak start hour (10 percent of transit trips) is also evident at 3pm. Both of these peak start hour periods are after (AM Peak) or before (PM Peak) of adults ages 19 to 64 years. As many seniors may be in retirement or in part time work, the need to travel in the AM or PM peak is significantly reduced and many senior activities are scheduled to avoid peak periods.

The concentration of senior transit trips during the off peak hours, (i.e., between the AM and PM peak periods) affords the senior less crowded transit services, enabling one to be seated on the journey but a potential downside of this scenario is that transit service frequency (buses per hour) may also be less. With a potential reduced service frequency and the desire to travel comfortably, the senior has a fixed travel window to complete their daily business. This in itself may limit seniors taking advantage of all

lifestyle opportunities (e.g., shopping or entertainment) in their communities or, on the other hand, discourage senior drivers who are in the process of driving reduction considering transit for non-essential trips.

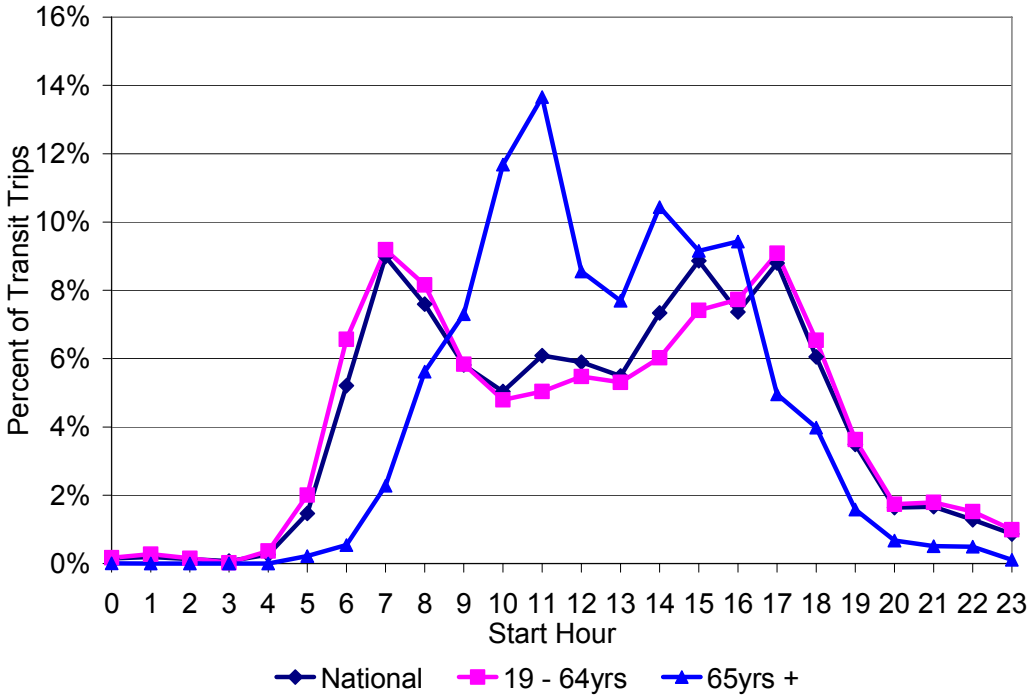

Figure 4.9 Distribution of Transit Trips by Start Hour
Source: NHTS 2001 Trip File

4.6.5 Transit Trip Starting Time by Age Cohort

Another variation of trip starting time is taking into account the proportion of the total number of transit trips made by each age cohort at a particular time. Figure 4.10 presents such information. It is evident that there is no start hour where seniors contribute to the majority transit trips. However, just as 11am represented the hour during which the highest proportion of daily transit trips made by seniors commenced (see Figure 4.9), so too, does 11am represent the hour where daily senior contribution to transit trips is at its highest (18%).

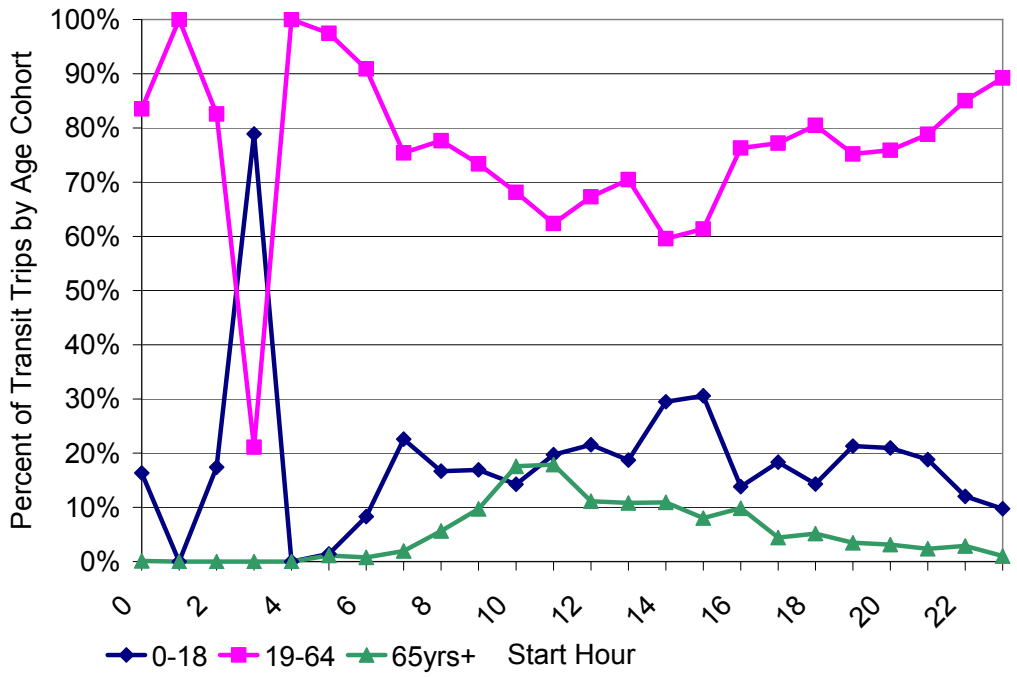

Figure 4.10 Transit Trip Starting Time by Age Cohort
Source: NHTS 2001 Trip File

4.6.6 Transit Trips and Trip Purpose

Given that 1.2 percent of all trips made by seniors in 2001 utilized transit services, what was the reason for initiating the trip? Table 4.9 presents proportion of transit and POV trips according to trip purpose in 2001. Several items of interest are revealed in the data as follows:

- Of the seniors who used transit in 2001, approximately 7 percent of their transit trips were work-related, whereas 5 percent of their POV trips were work-related. The higher percentage of work-related senior transit trips may be due to socio-economic factors, in that those seniors who used POVs may have been in a better financial position (as evidenced by owning or having immediate access to a car and therefore having less need to work) than those seniors who used transit services.

Table 4.9 Distribution of Trips by Trip Purpose, Travel Mode and Age Cohort

Trip Purpose	Transit			POV		
	National	19-64yrs	65yrs+	National	19-64yrs	65yrs+
Work Related	34.9%	45.8%	7.3%	17.8%	24.5%	4.7%
Education	11.8%	7.6%	2.3%	7.6%	3.8%	5.6%
Medical	5.4%	4.6%	11.5%	2.2%	2.0%	4.6%
Shopping	16.0%	13.7%	38.8%	21.7%	21.1%	31.6%
Social/Recreation	18.3%	15.3%	28.2%	25.8%	23.4%	27.3%
Family/Personal Business	10.8%	10.1%	11.3%	24.1%	24.5%	25.3%
Other	2.8%	2.9%	0.60%	0.8%	0.7%	1.0%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Source: NHTS 2001 Trip File

- Excluding work trip purposes, shopping trips represent the largest proportion of trips for both senior POV and transit users. For senior transit users, traveling during the off peak period while increasing the chances of being seated throughout the journey also permits a more amenable environment to be enjoyed when carrying groceries, etc. The high percentage of senior transit shopping trips may also be influenced by limited trip chaining possibilities when access to shopping malls, stores, etc., is dependent on transit service frequency. Thus, instead of visiting three stores during an afternoon, one has to visit one store on each of three days, i.e., one trip chain versus three round trips.
- The temporal flexibility of POV transportation for seniors is evident in the percentage of trips for family/personal business (25 percent) when compared to senior transit users at 11 percent. This difference may be due to the fact that such trips by POV can be done at anytime, e.g., evenings, specifically during periods where transit services may not be at their best and they may involve other family members with automobile availability. Transit service frequency may also be a factor in the 2 percent of senior transit trips for educational purposes. The attraction of any educational programs for seniors may be eroded if such programs are conducted

during the evenings, which for a number of transit properties is a period with limited transit services and lower service frequencies. Figure 4.11 is a variation of Figure 4.9 and indicates the temporal distribution of senior trip making by three modes. The temporal flexibility of POV transportation and walking (i.e., the peaks are not as pronounced as that of transit) is evident as well as a higher percentage of trips starting after 6pm when compared to transit users.

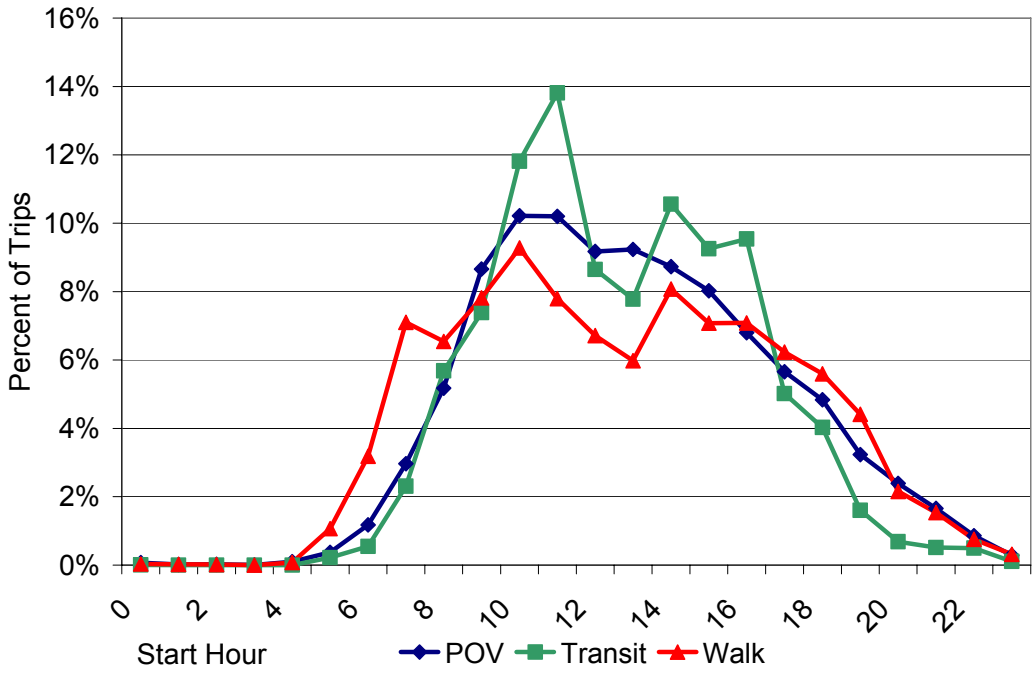

Figure 4.11 Distribution of POV, Transit and Walk Trips by Seniors by Start Hour

Source: NHTS 2001 Trip File

- Overall, the higher distribution of trip purpose proportions for senior transit users (e.g., 7.3% transit trips compared to 4.7% POV trips were related to work; see Table 4.9) may not be a reflection as to the actual number of trips. Senior POV drivers and passengers generally make a higher number of daily trips (see Figure 3.6) and this

will result in lower proportions of trip purposes even when the actual number of trips for a particular trip purpose are the same for transit and POV users.

4.6.7 Transit Trips by Day of Week

What day of the week are seniors most likely to use transit when compared to those seniors who utilize POVs? Figure 4.12 illustrates transportation mode used by day of week, of the 503 million transit trips made by seniors in 2001, the distribution of these trips according to day of week. Transit use by seniors peaks on Mondays; 20 percent of all senior transit trips in 2001 occur on this day. This may be due to engagement in part-time work or the weekly replenishment of groceries after the weekend. Given that weekend transit services are either non-existent or very limited for many transit systems, Monday affords the first opportunity to undertake out of home activities for many seniors, especially where a POV is not available.

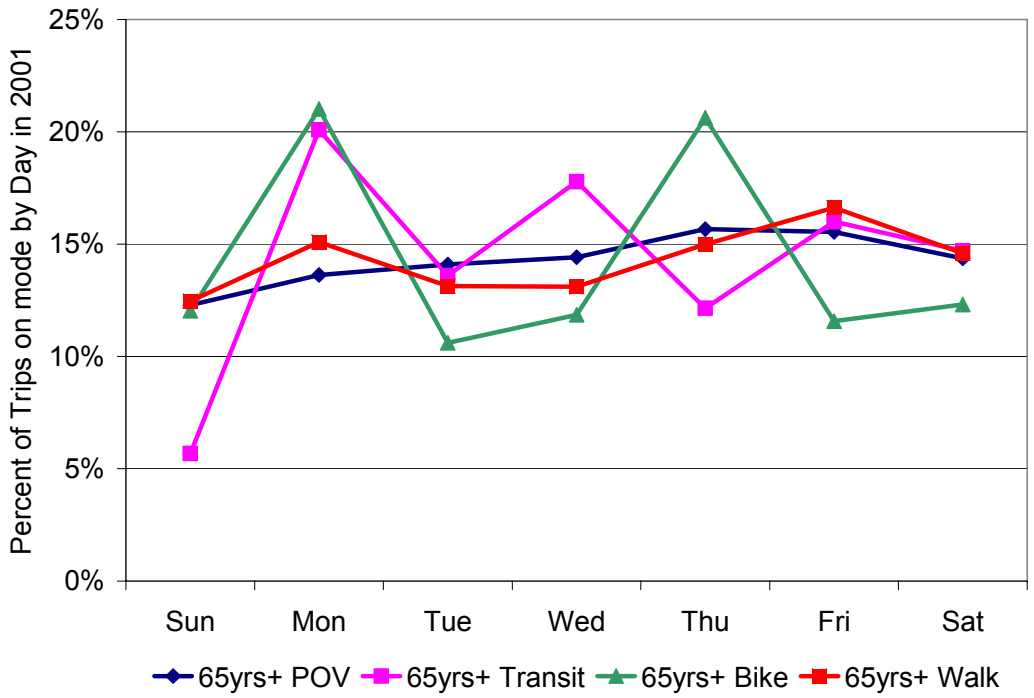

Figure 4.12 Daily Distribution of Transportation Mode Used by Seniors
Source: NHTS 2001 Trip File

4.6.8 Transit Trip Distance

Transit and POV trip distance statistics from the NHTS are shown in Tables 4.10 to 4.12. Overall, the distance traveled per person per day using all modes approximated 40 miles (Table 4.10). This is approximately 4 times the average trip distance (9.75 miles; see Table 4.10) multiplied by the daily trip rate of 4.03 (discussed in section 4.8). However, seniors traveled only 28 miles per day, approximately 40 percent less miles than adults ages 19 to 64 years. In all the three cases, below the average trip length and daily miles traveled for persons over 65 years is shorter than for adults ages 19 to 64 years. This can be expected since, for many seniors, the work commute is no longer a daily occurrence.

Table 4.10 Trip Distance Statistics NHTS 2001

All Modes	National	19 - 64yrs	65yrs+
Total Trip Distance (Miles)	3,972,748,489,512	2,843,388,838,494	336,511,612,527
Total # Trips	407,262,485,209	264,129,886,358	40,990,429,912
Average Trip Distance per Trip (Miles)	9.75	10.77	8.21
Total Trip Distance (Miles)	3,972,748,489,512	2,843,388,838,494	336,511,612,527
Total # Persons	277,203,235	163,938,182	32,884,069
Daily Person Miles Traveled	39.26	47.52	28.04

Source: NHTS 2001 Trip file

Table 4.11 POV Trip Distance Statistics NHTS 2001

Personally Operated Vehicle	National	19 - 64yrs	65yrs+
Total Trip Distance (Miles)	3,519,604,279,710	2,532,754,238,810	303,181,677,873
Total # Trips	351,755,038,139	236,005,474,405	36,498,220,003
Average Trip Distance per Trip (Miles)	10.01	10.73	8.31
Total Trip Distance (Miles)	3,519,604,279,710	2,532,754,238,810	303,181,677,873
Total # Persons	277,203,235	163,938,182	32,884,069
Daily Person Miles Traveled	34.79	42.33	25.26

Source: NHTS 2001 Trip file

Table 4.12 Transit Trip Distance Statistics NHTS 2001

Transit	National	19 - 64yrs	65yrs+
Total Trip Distance (Miles)	48,546,523,130	37,974,457,848	2,610,693,720
Total # Trips	6,652,380,692	4,751,577,270	503,068,683
Average Trip Distance per Trip (Miles)	7.30	7.99	5.19
Total Trip Distance (Miles)	48,546,523,130	37,974,457,848	2,610,693,720
Total # Persons	277,203,235	163,938,182	32,884,069
Daily Person Miles Traveled	0.48	0.63	0.22

Source: NHTS 2001 Trip file

Analyzing transit trip distance statistics, the average distance traveled per trip approximated 7 miles, 3 miles less than that of POV trips. The dominance of POV travel is evident in the daily person miles traveled, where transit approximated 0.48 miles per person per day, compared to 35 miles for the POV.

4.6.9 Transit Trip Travel Time

Transit and POV travel time statistics from the NHTS are shown in Tables 4.13 to 4.15. Overall, the average time spent per trip using all modes approximated 19.77 minutes (Table 4.13). In all the three cases below, the average travel time per trip for persons over 65 years is shorter than for adults ages 19 to 64 years. Again, as indicated earlier, this can be expected since for many seniors, the work commute is no longer a daily occurrence.

Table 4.13 Trip Travel Time Statistics NHTS 2001

All Modes	National	19 - 64yrs	65yrs+
Total Trip Minutes	7,889,770,409,416	5,294,932,701,740	785,129,947,267
# Trips	407,262,485,209	264,129,886,358	40,990,429,912
Average Trip Time per Trip	19.37	20.05	19.15
Total Trip Minutes	7,889,770,409,416	5,294,932,701,740	785,129,947,267
# Persons	277,203,235	163,938,182	32,884,069
Daily Person Trip Travel Time (Minutes)	77.98	88.49	65.41

Source: NHTS 2001 Trip file

Table 4.14 POV Travel Time Statistics NHTS 2001

Personally Operated Vehicle	National	19 - 64yrs	65yrs+
Total Trip Minutes	6,663,870,254,448	4,636,772,666,631	684,187,912,601
# Trips	351,755,038,139	236,005,474,405	36,498,220,003
Average Trip Time per Trip	18.94	19.65	18.75
Total Trip Minutes	6,663,870,254,448	4,636,772,666,631	684,187,912,601
# Persons	277,203,235	163,938,182	32,884,069
Daily Person Trip Travel Time (Minutes)	65.86	77.49	57.00

Source: NHTS 2001 Trip file

Table 4.15 Transit Travel Time Statistics NHTS 2001

TRANSIT	National	19 - 64yrs	65yrs+
Total Trip Minutes	277,814,513,561	207,177,962,535	16,844,961,620
# Trips	6,652,380,692	4,751,577,270	503,068,683
Average Trip Time per Trip	41.76	43.60	33.48
Total Trip Minutes	277,814,513,561	207,177,962,535	16,844,961,620
# Persons	277,203,235	163,938,182	32,884,069
Daily Person Trip Travel Time (Minutes)	2.75	3.46	1.40

Source: NHTS 2001 Trip file

4.6.10 Transit Travel and Medical Condition

It is acknowledged that “mobility is critical to well-being” (Coughlin & Lacombe 1997, p. 91) and, concomitantly, the level of personal mobility (out of the home) may be related to personal health status. To explore this issue, the NHTS has incorporated questions about medical condition and the ability/desire to undertake out of home travel. Figure 4.13 illustrates the proportion of seniors who have a medical condition that makes travel difficult. As can be seen, female gender and increasing age increases probability of a Medical condition that impacts mobility. Overall, 1 in 5 senior persons had a medical condition which impacted mobility outside of the home.

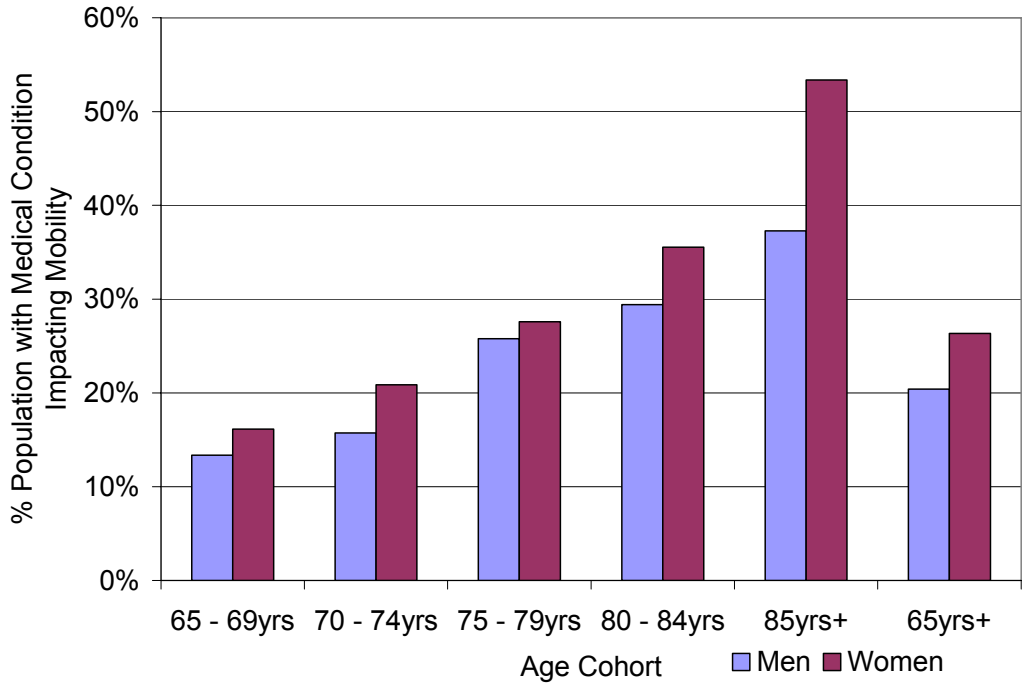

Figure 4.13 Medical Condition Impacting Out-of-Home Mobility
Source: NHTS 2001 Person file

4.7 Households and Senior Households

Understanding the household characteristics of the senior population is paramount in deriving an estimate of the number of seniors that may avail themselves to transit. Research has indicated that "the number one alternative to the car for older adults is not another mode: rather, it is riding with family members and friends" (Coughlin 2001, p. 3). In addition if there is a POV available in a household, along with a licensed driver the desire for senior members to use transit in such a household will be limited. Analysis of the NHTS 2001 Household and Trip files will form the basis of the discussion in this section.

Table 4.16 presents data with respect to household size and the proportion of these households with at least one person 65 years and older. Observations from Table 4.16 are as follows: Overall, of the 107 million households, 27 million households

Table 4.16 Household Size and Senior Members

Household Size	All Households	Percent of Households	# Households with ≥1P 65yrs+	Percent of Households with ≥1P 65yrs+
One Person	27,717,611	25.82%	10,868,162	39.21%
Two Persons	35,032,433	32.63%	11,603,291	33.12%
Three Persons	17,748,759	16.53%	2,403,898	13.54%
Four Persons	16,203,074	15.09%	958,630	5.92%
Five Persons	7,110,655	6.62%	538,870	7.58%
Six Persons	2,342,229	2.18%	212,433	9.07%
Seven Persons	703,645	0.66%	64,868	9.22%
Eight Persons	274,333	0.26%	59,645	21.74%
Nine Persons	111,794	0.10%	4,321	3.87%
10 Persons	68,331	0.06%	4,683	6.85%
11 Persons	46,447	0.04%	0	0.00%
12 Persons	5,014	0.00%	0	0.00%
14 Persons	1,021	0.00%	0	0.00%
Total	107,365,346		26,718,801	24.89%

Source: NHTS 2001 Household file

(approximately 25%) had at least one senior member present in 2001. Thirty two percent of all households comprised 2 persons, followed by the 1 person household at 26 percent. Alternatively, of those households where at least one member was 65 years and older, approximately 33 percent of such households were two person households.

4.7.1 Household Population Caveat

Analysis of the household file enables each member of a household to be counted, whether or not they were the respondent to the NHTS survey, as each individual in the household is identified in the household record. Identification of each household individual is not possible using the trip file (as some household members may not have made any trips on travel day). Two population figures result from the differing approaches; these are shown in Appendix G. From the household file, an overall population estimate is 274.8 million compared to 277.2 million from the person file. The

reason for this difference is the weighting used with respect to the person and household files of the NHTS. The population calculated from the person file will use weights based at the person level, whereas the population calculated from the household file will use weights at the household level.

With respect to the senior population, the estimate from the household file approximated 35,638,862 persons (presented in Table 4.17), slightly more than that of the person file (32,884,069; see Table 4.10). Using population figures from the household file may cause slight differences in resulting trip rate analyses when compared to using population figures from the person file. Thus, for the sake of consistency with published NHTS analyses for trip rate calculations, population figures from the person file will be used.

Table 4.17 Senior Population According to Household Size

Household Size	# Seniors	Percent
One Person	10,853,719	30.52%
Two Persons	18,925,455	53.21%
Three Persons	3,423,086	9.62%
Four Persons	1,273,414	3.58%
Five Persons	638,599	1.80%
Six Persons	279,030	0.78%
Seven Persons	90,906	0.26%
Eight Persons	73,952	0.21%
Nine Persons	4,549	0.01%
10 Persons	4,900	0.01%
11 Persons	0	0.00%
12 Persons	0	0.00%
14 Persons	0	0.00%
Total	35,567,610	100.00%

Source: NHTS 2001 Household file

4.7.2 Driver or Vehicle Availability by Household Size

Analyzing the 27 million households where one or more seniors were present, Table 4.18 presents data relating to these households and the non-availability of an automobile. Table 4.19 presents data relating to the same households according to the non-availability of a driver. From these tables it is evident there is a greater incidence of households without vehicles than that of drivers. Indeed, in the case of senior households the lack of a vehicle may be due to the disposal of a vehicle after driving cessation while still retaining individual licensure status. The cost of maintaining a vehicle (e.g., insurance and general repair), while not driving it can be prohibitive to persons on a fixed income such as a pension.

Table 4.18 Households and Senior Households Vehicle Availability

	All Households			Senior Households*		
Household Size	# Households	# Households with Zero Vehicles	%	# Households	# Households with Zero Vehicles	%
One Person	27,717,609	5,081,729	18.3%	10,868,162	2,839,954	26.1%
Two Persons	35,032,430	1,701,179	4.9%	11,603,291	525,955	4.5%
Three Persons	17,748,759	709,657	4.0%	2,403,898	118,782	4.9%
Four Persons	16,203,076	731,058	4.5%	958,629	87,297	9.1%
Five Persons	71,10,655	322,301	4.5%	538,870	22,673	4.2%
Six Persons	23,42,228	106,430	4.5%	212,433	8,708	4.1%
Seven Persons	703,646	50,826	7.2%	64,868	3,412	5.3%
Eight Persons	274,333	11,709	4.3%	59,644	1,406	2.4%
Nine Persons	111,793	691	0.6%	4,321	0	0.0%
10 Persons	68,331	0	0.0%	4,683	0	0.0%
Total Households	107,312,860	8,715,580	8.1%	26,718,799	3,608,187	13.5%

* Senior household were at least 1 member is ≥ 65 years
Source: NHTS 2001 Household file

Table 4.19 Households and Senior Households Driver Availability

Household Size	All Households			Senior Households*		
	# Households	# Households with Zero Drivers	%	# Households	# Households with Zero Drivers	%
One Person	27,717,611	3,991,239	14.4%	10,868,163	2,535,235	23.3%
Two Persons	35,032,433	901,901	2.6%	11,603,292	384,965	3.3%
Three Persons	17,748,759	340,074	1.9%	2,403,898	74,820	3.1%
Four Persons	16,203,075	362,330	2.2%	958,630	46,343	4.8%
Five Persons	7,110,655	147,253	2.1%	538,870	2,185	0.4%
Six Persons	2,342,230	52,364	2.2%	212,433	7,517	3.5%
Seven Persons	703,645	28,527	4.1%	64,868	0	0.0%
Eight Persons	274,332	9,913	3.6%	59,645	0	0.0%
Nine Persons	111,794	154	0.1%	4,321	0	0.0%
10 Persons	68,332	0	0.00%	4,683	0	0.0%
Total Households	107,312,866	5,833,755	5.4%	26,718,803	3,051,065	11.4%

* Senior household were at least 1 member is ≥ 65 years
Source: NHTS 2001 Household file

With respect to one person households (the household composition for 30 percent of the senior population), 1 in 4 of such senior households do not have a vehicle available. The incidence of seniors being members in households with zero vehicles or zero drivers decreases with increasing household size. Table 4.20 presents results of the numbers of seniors residing in households with zero vehicles or zero drivers. It is evident that approximately 12 percent of the senior population lived in households where there were zero vehicles, compared to 10 percent of the senior population residing in households where there were zero drivers. These estimates have the potential to indicate those seniors that may be amenable to alternative modes away from the POV.

As stated previously, the incidence of seniors living in a household with zero vehicles is greater than that of households with zero drivers, and this is reflected in the actual numbers of seniors in these categories. Estimates from the NHTS 2001 indicate that approximately 4 million seniors lived in households with zero vehicles, representing 12 percent of the total senior population.

Table 4.20 Senior Population in Zero Vehicles or Zero Drivers Available Households

Household Size	Senior Population in Zero Vehicle Households	Senior Population in Zero Driver Households
One Person	2,839,954	2,535,235
Two Persons	779,286	609,632
Three Persons	134,492	85,988
Four Persons	110,781	50,437
Five Persons	22,673	2,185
Six Persons	8,708	7,517
Seven Persons	3,412	0
Eight Persons	1,406	0
Nine Persons	0	0
10 Persons	0	0
Total	3,900,712	3,290,994
% of Senior Population	11.9%	10.0%

Source: NHTS 2001 Person file

4.7.3 Households and Seniors Only Households

As indicated earlier, it is possible from the household file to determine the actual numbers of persons ages 65 and older within each household. As the focus of this research is on the senior individual, it is necessary to separate out households where all members are seniors from households where 1 or more members are seniors. Analysis of the NHTS 2001 (household file) indicated that the maximum number of senior persons in any household equaled 4; however, approximately 84 percent of seniors lived in 1 or 2 person households. Table 4.21 presents summary seniors only households statistics.

Table 4.21 Household Size Where All Members are Seniors

Household Size	1 person ≥ 65yrs	2 persons ≥ 65yrs	3 persons ≥ 65yrs	4 persons ≥ 65yrs	Total
1 person	10,868,162 (39.2%)				27,717,611
2 persons		7,348,150 (21.0%)			35,032,432
3 persons			90,541 (<1%)		17,748,760
4 persons				5,416 (<1%)	16,203,075

Figures in parenthesis represent the proportion of 100% senior households of all households in respective size.
Source: NHTS Household file

4.8 Trip Frequency Behavior

Evidence from the 2001 NHTS indicated that adults 19 to 64 make on average 30 percent more trips per day than adults ages 65 years and older. Table 4.22 indicates the daily person trip rates, where the overall daily trip rate approximated 4 trips per day compared to seniors with 3 trips per day. Table 4.23 presents trip frequency behavior according to gender and age cohort.

Table 4.22 Daily Average Number of Trips

Cohort	# Trips	# Persons	Average Daily Person Trips
0 – 18yrs	96,193,114,892	75,944,038	3.47
19 - 64yrs	264,129,886,354	163,938,182	4.41
65yrs+	40,990,429,912	32,884,068	3.42
All	407,262,485,206	277,203,237	4.03

Source: National Household Travel Survey 2001(Person and Trip Files)

Table 4.23 Daily Average Number of Trips by Gender and Age Cohort

Cohort	Gender	# Trips	# Persons	Average Daily Person Trips
0 - 18yrs	Male	49,403,291,332	38,958,298	3.47
	Female	46,789,823,560	36,985,740	3.47
19 - 64yrs	Male	126,951,752,613	80,519,476	4.32
	Female	137,178,133,741	83,418,706	4.51
65yrs+	Male	19,446,977,255	13,898,970	3.83
	Female	21,543,452,657	18,985,098	3.11
Total		407,262,485,206	277,203,237	4.03

Source: National Household Travel Survey 2001(Person and Trip Files)

In Table 4.23, it is evident that with each cohort progression the gender difference in the number of daily trips made increases. The higher daily trip rate for females in the 19 – 64 year cohort is possibility due to homemaking, child rearing and out of home work responsibilities that a growing proportion of women undertake. The notable gender difference in the 65 year plus cohort (3.82 versus 3.11 daily trips for males and females respectively) may be due a continuation of out-of-home activities, e.g., part-time

employment, post-retirement due to active driving status (for males in particular), the lack of a vehicle in the household or the health status of the individual.

4.9 Transit Market Share Results – Market Assessment #1

Market Assessment #1 as initially presented in section 3.21.1 represents transit use by the total senior population. Summarizing transit use facts from the 2001 NHTS it is known that:

- 503 million transit trips were made by seniors (1.2 percent of all trips made by seniors).
- Persons ages 65 years and older represented 12 percent of total population.
- Transit trips made by seniors accounted for 7 percent of the transit market.

Deriving an estimate of the transit market share in 2030, the following is assumed:

- Total number of trips and transit trips for the entire population in 2030 is based on the daily trip and transit trip rates for the total population in 2001 (as derived from the NHTS 2001) multiplied by the population estimates for 2030.
- Transit trip rates by age cohort and gender for the senior population derived from the 2001 NHTS are applied to the year 2030. Thus, seniors in 2030 are assumed to display similar transit use behaviors as evident in the NHTS 2001.
- As transit use by seniors (as a percentage of all trips) has been gradually decreasing with each NHTS survey, the application of 2001 NHTS trip rates may represent a stabilization or an overestimation of transit use by seniors when applied to future years.

- The derived transit market size is only an estimation; however, inferences may be gained by way of the magnitude of any resulting change that may assist in the strategic planning of future transit services for seniors by transportation providers.

Table 4.24 presents estimates of the transit market share of seniors in the base and forecast years (see Appendix H for detailed calculations). Estimates indicate that the number of transit trips for seniors is set to double by the year 2030, when compared to those made in 2001. With this doubling of transit trips by seniors, it can also be seen that the market share attributable to seniors will also increase, from 8 percent to 13 percent.

Table 4.24 Senior Transit Market Share Assessment #1*

Trip/Population Cohort	2001	2030
Total Trips 0 - 64yrs	366,272,055,294	437,949,301,366
Total Trips 65yrs+	40,990,429,913	89,067,705,829
Transit Trips 0 - 64yrs	6,149,312,016	7,352,695,523
Transit Trips 65yrs+	503,068,683	1,093,113,040
0 - 64yr population	244,319,167	292,130,964
65yrs+ population	32,884,068	71,453,471
Senior Transit %	7.56%	12.94%

* see Appendix H for detailed calculations

4.10 Transit Market Share Results – Market Assessment #2

In Market Assessment #2, senior transit trip making is broken down into urban and rural categories (see Appendix H for detailed calculations). In section 3.14.2 it was evident that 98 percent of transit trips took place in the urban environment. Indeed, of the 503 millions transit trips made by seniors in 2001, 99 percent were made in an urban area. In deriving an estimate of the transit market share in 2030 according to an urban/rural split the following is assumed:

- The urban/rural population split for persons ages 65 years and older in 2030 will be similar to that prevailing in year 2000. According to 2000 Decennial Census data, 26.8m persons 65 years and older (77%) lived in metropolitan areas and the balance, i.e., 23 percent lived outside metropolitan areas (in the rural areas) (He et al. 2005, p. 138). NHTS data estimated the urban/rural split of the senior population at similar proportions, 78 percent urban and 22 percent rural.
- According to the NHTS 2001 an Urban Area is defined as a, "built up area surrounding a central core (or central city), with a population density of at least 1,000 persons per square mile." (U.S. Department of Transportation, Appendix E, 2004) A rural area is therefore taken to be an area with a density less than 1,000 persons per square mile.
- Research has shown that most older people do not move, (He & Schachter 2003, p. 2), and this fact has contributed to the phenomenon "aging in place." The concept of aging in place is defined as "not having to move from one's present residence in order to secure necessary support services in response to changing need" (Seniorresource.com, 2006). Thus, it is assumed that in the majority of cases (and the preferred choice of), persons ages 35 years and older in 2000, if alive in 2030, will be in a similar residential setting (urban/suburban/rural) as they were in 2000. Frey (2003, p. 6), notes that, "roughly 70 percent of all 35 – 54 year olds in large metro areas lived in the suburbs."
- Total number of trips and transit trips for the urban/rural population in 2030 is based on the daily trip and transit trip rates for the urban/rural population in 2001 (as derived from the NHTS 2001) multiplied by the population estimates for 2030.

- Transit trip rates by age cohort and gender for the senior population derived from the 2001 NHTS are applied to the year 2030. Thus, seniors in 2030 are assumed to display similar transit use behaviors as evident in the NHTS 2001.

Tables 4.25 and 4.26 present estimates of the transit market share of seniors in the base and forecast years. In the year 2001, senior transit users residing in urban areas were responsible for 8 percent of the transit market (see Figure 4.8). In 2030, this proportion of transit market share according to the methodology developed in this research project is estimated to increase to 13 percent. However, given the dominance of transit trips undertaken in urban areas, the positive 2 percentage point change in market share for seniors in rural areas between 2001 and 2030 in Table 4.8 may be a plausible estimate, assuming rural transit service patterns do not change significantly in future decades.

Table 4.25 Senior Transit Market Share Assessment #2 (Year 2001)*

Trip/Population Cohort	Urban	Rural	Total
Total Trips 0 - 64yrs	289,645,261,201	76,626,794,127	366,272,055,328
Total Trips 65yrs+	32,434,626,485	8,555,803,425	40,990,429,910
Transit Trips 0 - 64yrs	6,018,647,645	130,664,372	6,149,312,017
Transit Trips 65yrs+	500,341,685	2,726,998	503,068,683
0 - 64yr population	190,950,308	53,368,861	244,319,169
65yrs+ population	25,622,499	7,261,571	32,884,070
Senior Transit %	7.68%	2.04%	7.56%

* see Appendix H for detailed calculations

Table 4.26 Senior Transit Market Share Assessment #2 (Year 2030)*

Trip/Population Cohort	Urban	Rural	Total
Total Trips 0 - 64yrs	341,204,210,139	96,471,304,201	437,675,514,340
Total Trips 65yrs+	69,646,848,852	19,363,389,264	89,010,238,116
Transit Trips 0 - 64yrs	7,090,010,405	164,503,324	7,254,513,730
Transit Trips 65yrs+	1,074,383,321	6,171,708	1,080,555,029
0 - 64yr population	224,940,842	67,190,122	292,130,964
65yrs+ population	55,019,173	16,434,298	71,453,471
Senior Transit %	13.16%	3.62%	12.96%

* see Appendix H for detailed calculations

Again, estimates indicate that the number of urban transit trips for seniors are set to double by the year 2030, when compared to those made in 2001. With this doubling of urban transit trips by seniors, it can also be seen that the market share attributable to seniors will also increase from 8 percent to 13 percent.

4.11 Transit Market Share Results – Market Assessment #3

Market Assessment #3 takes the urban seniors and categorizes them according to their driving status (see Appendix H for detailed calculations). In deriving transit use estimates for 2030 in this market assessment, estimates of former drivers will also be incorporated. At this juncture in the analysis of the NHTS 2001, of the 32 million trips made by seniors in urban areas, 29 million were made by senior drivers and 3 million by senior non-drivers. However, the following is also assumed in deriving estimates for Market Assessment #3:

- Drivers are persons ages 15 years and above. Correspondingly, non-drivers are persons ages 0 to 14 years, non-licensed adults ages 15 years and above, and adult licensed but non-active drivers.
- Only seniors residing in an urban area, according to the NHTS 2001, are considered. Thus, in this market assessment, of the 26 million urban seniors, 20 millions are drivers (78%) and 6 millions (22%) non-drivers.
- Estimates of future drivers and non-drivers (year 2030) ages 15 to 64 years are determined by the average licensing proportions of this age cohort between the years 2000 and 2004. Analysis reveals that 87 percent of males and 85 percent of females (15 to 64 years) were, on average, licensed for this period. However, a licensing proportion of 85 percent for both males and females will be used in this market assessment analysis.

- Estimates of future drivers and non-drivers (year 2030) in senior age cohorts will follow the proportions as developed by Foley et al. (2002) in section 3.12.2 (and presented in Table 3.15). For example, in 2030, estimates indicated that 66 million of the 71 million seniors (65 years+) will be licensed. However, 6 million will be former drivers and 6 million never licensed; thus, a total of 12 million will represent the non-driving senior population.
- The total numbers of trips and transit trips for the urban senior population in 2030 are based on the daily trip and transit trip rates for population of senior drivers and non-drivers in 2001 (as derived from the NHTS 2001) multiplied by the population estimates for 2030.
- Transit trip rates by age cohort and gender for the senior population derived from the 2001 NHTS are applied to the year 2030. Thus, seniors in 2030 are assumed to display similar transit use behaviors as evident in the NHTS 2001.

Tables 4.27 and 4.28 present estimates of the transit market share of seniors in the base and forecast years. In the year 2001, non-driving seniors residing in urban areas had a 13 percent transit market share, when compared to their driving counterparts with 4 percent. Estimates of licensure status for seniors (see section 3.8) have indicated that

Table 4.27 Senior Transit Market Share Assessment #3 (Year 2001)*

Trip/Population Cohort	Active Driver	Non-Driver	Total
Total Trips 0 - 64yrs	213,313,223,561	76,332,037,616	289,645,261,177
Total Trips 65yrs+	29,216,362,781	3,218,263,711	32,434,626,492
Transit Trips 0 - 64yrs	2,935,343,743	3,083,303,922	6,018,647,665
Transit Trips 65yrs+	159,513,500	340,828,189	500,341,689
0 - 64yr population	127,113,550	63,836,759	190,950,309
65yrs+ population	19,892,925	5,729,575	25,622,500
Senior Transit %	5.15%	9.95%	7.68%

* see Appendix H for detailed calculations

Table 4.28 Senior Transit Market Share Assessment #3 (Year 2030)*

Trip/Population Cohort	Active Driver	Non-Driver	Total
Total Trips 0 - 64yrs	242,216,674,504	96,380,904,381	338,597,578,885
Total Trips 65yrs+	68,191,259,289	4,824,328,925	73,015,588,215
Transit Trips 0 - 64yrs	3,333,076,066	3,893,144,082	7,226,220,147
Transit Trips 65yrs+	372,305,975	510,917,513	883,223,488
0 - 64yr population	144,337,144	80,603,699	224,940,842
65yrs+ population	46,430,270	8,588,903	55,019,173
Senior Transit %	10.05%	11.60%	10.89%

* see Appendix H for detailed calculations

over 90 percent of the young old will have been licensed at some stage in their lives; these anticipated high licensure rates for seniors in the forthcoming decades may have contributed to the marginal estimated increase in transit market share for senior non-drivers in the year 2030 of 2 percent when compared to active drivers of 4 percent (even when taking into account the addition of senior former drivers to the non-driving population), as presented in Table 4.28. It can also be noted that, in 2001, senior non-drivers were 22 percent of the senior urban population: this proportion in 2030 is estimated to decrease to 15 percent.

4.12 Transit Market Share Results – Market Assessment #4

Market Assessments #4 and #5 take the urban non-driving seniors and categorizes them by availability of drivers or vehicles in their households (see Appendix H for detailed calculations). The primary reason for focusing on seniors in this particular category is that the lack of a drivers' license or a household vehicle is a strong predictor of transit use particularly in an urban environment (ICF Consulting 2006). One only has to look at the transit market share estimates for Market Assessments #4 and #5 to gauge the greater contribution to transit market share by non-driving seniors or those without household vehicles at their disposal.

In Market assessment #4 which focuses on the availability of a driver in the household, for those non-driving seniors living alone, of course, there will not be another driver in the household. However for other non-driving seniors living in households of more than one person, other persons in the household holding driving status may be in a position to facilitate out-of-home mobility for these non-driving seniors. Market Assessment #4 attempts to ascertain the significance of non-driving seniors residing in households with no other driving adults and their propensity to use transit.

In deriving transit use estimates for 2030 in this market assessment, estimates of former drivers will also be incorporated. At this juncture in the NHTS, of the 32 million trips made by seniors, 29 million were made by urban senior drivers and 3 million by urban senior non-drivers (see Table 4.27). However, the following is also assumed in deriving estimates for Market Assessment #4:

- Drivers are persons ages 15 years and above. Correspondingly non-drivers are persons ages 0 to 14 years, non-licensed adults ages 15 years, and adult licensed but non-active drivers.
- Only non-driving seniors in an urban area according to the NHTS 2001 are considered in Market Assessment #4. Thus, in this market assessment of the 5.7 million urban non-driving seniors (see Table 4.27), 2.3 million reside in households were there are zero drivers and 3.3 million reside in households where a driver is present. Table 4.29 presents this information.

Table 4.29 Urban Non-Driver Respondent According to Household Driver Availability (Year 2001)

	Zero Drivers in Household		Driver in Household	
Driver/Non-Driver Household Split	Population	Percent	Population	Percent
0 - 64yr population*	5,358,808	8.4%	58,477,956	91.6%
65yrs+ population*	2,348,859	41.0%	3,380,717	59.0%

*Urban non-drivers
Source: NHTS 2001 Person File

- With each passing decade into the future, it is likely that there will be higher proportions of persons in adult age cohorts that will be licensed. Thus, estimates of the proportions of non-drivers residing in households with drivers or zero drivers will also change from the 2001. In 2001, according to the NHTS, approximately 33 percent of non-drivers (0 – 64 years) and 22 percent of senior non-drivers resided in driver or zero driver available households, as indicated in Table 4.29. With higher percentages of licensed persons in 2030, the predicted proportions of persons residing in driver and zero driver available households are contained in Table 4.30.

Table 4.30 Urban Non-Drivers According to Household Driver Availability (Year 2030)**

	Zero Drivers in Household		Driver in Household	
Driver/Non-Driver Household Split	Population	Percent	Population	Percent
0 - 64yr population*	4,030,185	5.0%	76,573,514	95.0%
65yrs+ population*	639,914	15.0%	3,626,177	85.0%

*Urban non-drivers
** See Table H.XX Annexure H

- The total numbers of trips and transit trips for the urban non-driving senior population in 2030 are based on the daily trip and transit trip rates for the population of urban senior non-drivers in 2001 (as derived from the NHTS 2001) multiplied by the population estimates for 2030.
- Transit trip rates by age cohort and gender for the senior non-driving population derived from the 2001 NHTS are applied to the year 2030. Thus, seniors in 2030 are assumed to display similar transit use behaviors as evident in the NHTS 2001.

Tables 4.31 and 4.32 present estimates of the transit market share of seniors in the base and forecast years. In the year 2001, non-driving seniors residing in zero driver households had a 15 percent transit market share, when compared to non-driving

counterparts residing in homes where a driver is present with 7 percent. Estimates for 2030 indicate that senior non-drivers in zero driver households will decrease by 3 percentage points to account for only 12 percent of the transit market share. This is a plausible result given the higher proportions of persons licensed to drive in 2030 and the increasing likelihood that a higher proportion of seniors will be living in a household with a driver available.

Table 4.31 Senior Transit Market Share Assessment #4 (Year 2001)*

Trip/Population Cohort	Zero Driver in Household	Driver in Household	Total
Total Trips 0 - 64yrs	5,392,524,661	70,939,512,962	76,332,037,623
Total Trips 65yrs+	1,343,355,866	1,874,907,841	3,218,263,707
Transit Trips 0 - 64yrs	1,433,165,576	1,650,138,340	3,083,303,916
Transit Trips 65yrs+	257,148,542	83,679,644	340,828,186
0 - 64yr population	5,358,808	58,477,956	63,836,764
65yrs+ population	2,348,859	3,380,717	5,729,576
Senior Transit %	15.21%	4.83%	9.95%

* see Appendix H for detailed calculations

Table 4.32 Senior Transit Market Share Assessment #4 (Year 2030)*

Trip/Population Cohort	Zero Driver in Household	Driver in Household	Total
Total Trips 0 - 64yrs	4,055,542,140	92,891,204,607	96,946,746,747
Total Trips 65yrs	736,822,839	4,048,813,055	4,785,635,894
Transit Trips 0 - 64yrs	1,077,837,145	2,160,761,073	3,238,598,219
Transit Trips 65yrs+	141,044,472	180,703,941	321,748,412
0 - 64yr population	4,030,185	76,573,514	80,603,699
65yrs+ population	1,288,335	7,300,567	8,588,903
Senior Transit %	11.57%	7.72%	9.04%

*see Appendix H for detailed calculations

4.13 Transit Market Share Results – Market Assessment #5

Market Assessment #5 is similar to Market Assessment #4 but looks at the availability of vehicles in households of senior non-driving respondents (see Appendix H for detailed calculations). Market Assessment #5 attempts to ascertain the significance of non-driving seniors residing in households with or without vehicles and their propensity to use transit. In deriving transit use estimates for 2030 in this market assessment,

estimates of former drivers will also be incorporated. However, the following is also assumed in deriving estimates for Market Assessment #5:

- Drivers are persons ages 15 years and above. Correspondingly, non-drivers are persons ages 0 to 14 years, non-licensed adults ages 15 years, and adult licensed but non-active drivers.
- Only non-driving seniors in an urban area according to the NHTS 2001 are considered in Market Assessment #4. Thus, in this market assessment, of the 5.7 millions urban non-driving seniors, 2.3 million reside in households where there are zero vehicles and 3.3 million reside in households where at least one vehicle is available. Table 4.33 presents this information.

Table 4.33 Urban Non-Driver Respondent According to Household Vehicle Availability (Year 2001)

	Zero Vehicles in Household		Vehicle in Household	
Driver/Non-Driver Household Split	Population	Percent	Population	Percent
0 - 64yr population*	7,436,029	11.6%	56,400,734	88.4%
65yrs+ population*	2,376,609	41.5%	3,352,962	58.5%

*Urban non-drivers
Source: NHTS 2001 Person File

- With each passing decade into the future, it is likely that there will be higher proportions of persons in adult age cohorts that will be licensed. Thus, estimates of the proportions of non-drivers residing in households with drivers or zero drivers will also change from the 2001. Accepting that there will always be licensed persons who do not have access to a vehicle in their household, 2030 estimates for the availability of at least one vehicle in a household will be 5 percentage points less than those shown in Table 4.30. Estimated proportions are presented in Table 4.34.

Table 4.34 Urban Non-Drivers According to Household Vehicle Availability (Year 2030)**

Driver/Non-Driver Household Split	Zero Drivers in Household		Driver in Household	
	Population	Percent	Population	Percent
0 - 64yr population*	8,060,370	10.0%	72,543,329	90.0%
65yrs+ population*	853,218	20.0%	3,412,873	80.0%

*Urban non-drivers
** See Table H.XX Annexure H

- The total numbers of trips and transit trips for the urban non-driving senior population in 2030 are based on the daily trip and transit trip rates for the population of urban senior non-drivers in 2001 (as derived from the NHTS 2001) multiplied by the population estimates for 2030.
- Transit trip rates by age cohort and gender for the senior non-driving population derived from the 2001 NHTS are applied to the year 2030. Thus, seniors in 2030, are assumed to display similar transit use behaviors as evident in the NHTS 2001.

Tables 4.35 and 4.36 present estimates of the transit market share of seniors in the base and forecast years. In the year 2001, non-driving seniors residing in zero vehicle households accounted for 14 percent of the transit market share, when compared to non-driving counterparts residing in homes where a vehicle was present, with 4 percent. Estimates for 2030, indicate that senior non-drivers in zero driver households will decrease by 4 percentage points to only account for 10 percent of the transit market share.

Table 4.35 Senior Transit Market Share Assessment #5 (Year 2001)*

Trip/Population Cohort	Zero Driver in HH	Driver in HH	Total
Total Trips 0 - 64yrs	7,658,773,577	68,673,264,049	76,332,037,626
Total Trips 65yrs+	1,353,076,756	1,865,186,948	3,218,263,704
Transit Trips 0 - 64yrs	1,801,485,576	1,281,818,344	3,083,303,920
Transit Trips 65yrs+	284,969,789	55,858,397	340,828,186
0 - 64yr population	7,436,026	56,400,733	63,836,759
65yrs+ population	2,376,609	3,352,962	5,729,571
Senior Transit %	13.66%	4.18%	9.95%

*see Appendix H for detailed calculations

Table 4.36 Senior Transit Market Share Assessment #5 (Year 2030)*

Trip/Population Cohort	Zero Driver in HH	Driver in HH	Total
Total Trips 0 - 64yrs	6,297,295,305	21,657,271,087	27,954,566,392
Total Trips 65yrs	2,028,327,218	2,789,063,655	4,817,390,873
Transit Trips 0 - 64yrs	1,877,939,934	1,096,558,934	2,974,498,867
Transit Trips 65yrs+	427,183,438	83,734,427	510,917,865
0 - 64yr population	9,389,123	71,214,575	80,603,699
65yrs+ population	3,562,651	5,026,252	8,588,903
Senior Transit %	18.53%	7.09%	14.66%

*see Appendix H for detailed calculations

Three of the five market analyses indicated an increase in transit market share attributable to seniors between the base year 2000/2001 and the forecast year 2030. Market analyses 4 and 5 indicated a decrease in transit market share. In these latter analyses, higher licensure proportions of seniors, coupled with higher levels of active driving and/or vehicle access, eroded predicted transit market size, even with the doubling in the absolute numbers of seniors during this period.

4.14 Market Share Sensitivity Analyses

Three sensitivity tests were performed on Market Analysis #4 to illustrate potential changes in transit market share when licensing or cessation rates are equal between genders. For example, if driving cessation rates between males and females equalize coupled with longer driving histories, there is likely to be further change in the transit market share due to seniors as indicated in Table 4.32. The three tests performed were:

- Driving licensure rates equal between genders (female licensure rates equal that of males);
- Cessation rates (according to Foley et al. 2002) equal between genders (female cessation rates equal that of males); and
- Driving licensure and cessation rates equal between genders.

Results of these sensitivity analyses are contained in Tables 4.37 to 4.39 (and Appendix J presents calculations in the derivations of these tests). The assumptions with respect to Market Analysis #4 (see section 4.12) also apply in these tests.

Table 4.37 Senior Transit Market Share Market Assessment #4 Gender Licensing Equal (Year 2030)*

Trip/Population Cohort	Zero Driver in Household	Driver in Household	Total
Total Trips 0 - 64yrs	4,055,542,140	92,891,204,607	96,946,746,747
Total Trips 65yrs	631,488,778	3,470,006,456	4,101,495,234
Transit Trips 0 - 64yrs	1,077,837,145	2,160,761,073	3,238,598,219
Transit Trips 65yrs+	120,881,162	154,871,028	275,752,190
0 - 64yr population	4,030,185	76,573,514	80,603,699
65yrs+ population**	1,104,159	6,256,899	7,361,058
Senior Transit %	10.08%	6.69%	7.85%

*Compare with Table 4.31
**Female licensing rates equal to males see Appendix J for detailed calculations

Table 4.38 Senior Transit Market Share Market Assessment #4 Gender Cessation Rates Equal (Year 2030)*

Trip/Population Cohort	Zero Driver in Household	Driver in Household	Total
Total Trips 0 - 64yrs	4,055,542,140	92,891,204,607	96,946,746,747
Total Trips 65yrs	636,130,839	3,495,514,403	4,131,645,242
Transit Trips 0 - 64yrs	1,077,837,145	2,160,761,073	3,238,598,219
Transit Trips 65yrs+	121,769,757	156,009,482	277,779,239
0 - 64yr population	4,030,185	76,573,514	80,603,699
65yrs+ population**	1,112,275	6,302,894	7,415,169
Senior Transit %	10.15%	6.73%	7.90%

*Compare with Table 4.31
**Female cessation rates equal to males see Appendix J for detailed calculations

Table 4.39 Senior Transit Market Share Market Assessment #4 Gender Licensing and Cessation Rates Equal (Year 2030)*

Trip/Population Cohort	Zero Driver in Household	Driver in Household	Total
Total Trips 0 - 64yrs	4,055,542,140	92,891,204,607	96,946,746,747
Total Trips 65yrs	521,032,477	2,863,053,349	3,384,085,826
Transit Trips 0 - 64yrs	1,077,837,145	2,160,761,073	3,238,598,219
Transit Trips 65yrs+	99,737,341	127,781,899	227,519,240
0 - 64yr population	4,030,185	76,573,514	80,603,699
65yrs+ population**	911,026	5,162,479	6,073,505
Senior Transit %	8.47%	5.58%	6.56%

*Compare with Table 4. 31
**Female licensing and cessation rates equal to males see Appendix J for detailed calculations

4.15 Market Assessment Summary

The five different market assessments gave an indication as to a probable change in transit market share attributable to senior trip makers in 2030 (assuming 2001 trip rates). Table 4.40 summarizes the market assessment results, of seniors residing in urban areas who may have a greater propensity to use transit i.e., those who are non- or former drivers and live in households with zero drivers or vehicles. Table 4.40 also indicates the percentage point change in transit market share attributable to seniors in the categories described, between the base year 2000/2001 and the forecast year 2030.

Table 4.40 Overall Market Assessment Results

Market Assessment	Base Year 2000/2001	Forecast Year 2030	Percentage Point Change
Market Assessment #1: All Seniors	7.56%	12.94%	5.38
Market Assessment #2: Senior Transit Market – Urban	7.56%	12.96%	5.40
Market Assessment #3: Senior Transit Market - Urban Non-Driver Status	7.68%	10.89%	3.21
Market Assessment #4: Senior Transit Market - Urban Non-Driver & Zero Driver Availability	9.95%	9.04%	-0.91
Market Assessment #5: Senior Transit Market - Urban Non-Driver & Zero Vehicle Availability	9.95%	8.17%	-1.78

The three sensitivity tests performed representing hypothetical scenarios provided additional insight into potential transit market changes. Equalization of cessation or licensure rates (or both) between males and females may result in negative changes in future transit market shares attributable to seniors.

4.16 Seniors Perceptions and Experiences with Transit

To complement the the market analyses with respect to the potential future use of transit by seniors, qualitative methodology was employed to elicit views of seniors on

their perceptions and experiences of transit. The subsequent sections present the results of the focus group discussions.

4.16.1 Focus Group Methodology

Five focus group discussions, including one pilot session, were conducted with seniors 55 years and older in Hillsborough County at senior centers located in urban, semi-urban and semi-rural areas of the county. This strategy increased the potential that a diversity of individuals would participate, reflecting the senior population makeup of the county. The focus groups were conducted in late January and early February 2006. Participants were recruited with the help of the County Aging Services Department through advertising the focus group discussions at senior centers under their jurisdiction. For more details on the format of and overall findings from the focus group discussions sessions, the reader is referred to Polzin & Page (2006).

Each focus group discussion lasted no more than 90 minutes. Two researchers from the University of South Florida (USF) Center for Urban Transportation Research (CUTR) were present at each session, a moderator and an observer. The format at each focus group session included a welcome and introduction with an explanation of focus group participant rights, discussion, and questionnaire completion, followed by closure and thanks. A questionnaire was designed to provide socio-demographic information as well as further probe issues raised in the discussions in order to undertake quantitative analysis. Two types of questionnaires were given, one for former drivers (i.e., those who had permanently stopped driving) and another for current drivers (i.e., those who had reduced their driving exposure). Each of these questionnaires is presented in Appendix K. Each focus group discussion was digitally recorded and transcribed afterward. The discussion transcripts as well as results from participant

surveys were combined to create a holistic perspective of senior issues and concerns about and their potential use of public transportation as one of several transportation alternatives during and after the process of driving retirement.

4.16.2 Factors Initiating Use of Public Transportation

Discussion of factors that would influence focus group participants to include public transportation as a transportation option elicited a variety of responses. Responses are summarized as follows.

- Cost

  Many focus group participants indicated that if there were a cost for use of public transportation it would have to be free or affordable. There was some debate about any cost charged being determined by one's income, but it had to be a fair price and have minimal impact on one's pocketbook. Another cost that may influence the use of public transportation is the cost of a parking ticket. One focus group participant stated that he used the bus to go downtown on personal business to avoid getting a ticket.

- Accessibility

  Being able to access services closer to one's home and delivery and pickup closer to the destination were cited as factors that could induce use of public transportation. Door-to-door service was the preferred option. If one had to drive to access public transportation, this would detract from using public transportation altogether for the trip in question. Continuing with the accessibility theme, a focus group participant noted that, not only is the distance to the access point, (bus stop) important, but the environment at that point also contributed to her current non-use of local transit services. She stated that, "the stops are so far away, you can't get to those. I am a

mile away from the first, from the nearest stop which is about right at a bar where the drunks are hanging out." The non-availability of public transportation near one's home was another factor that discourages considering this mode as a viable transportation alternative for the majority of focus group participants.

- Destinations Served

  Public transportation services serving the destination of interest was another factor that may induce use of the service by the focus group participants. Having access to public events, theme parks (e.g., Busch Gardens), or areas of natural beauty was another issue raised by some focus group participants. They wanted to visit these places but were limited by physical ability, cost of transportation (having to take a taxi), and lack of information about public transportation access to these places.

- Level of Family Involvement

  The strength of familial relationships has an impact on the use of public transportation. The transportation needs of several focus group participants were met entirely by family members or friends. On the other hand, striving to lessen the inconvenience to family members/friends while at the same time maintaining self dignity and independence when asking for rides was another factor influencing some focus group members to consider and even use transit.

- Past Experiences with Public Transportation

  Focus group participants who had lived part of their lives in a transit rich environment, e.g., New York City, had allowed these past experiences to determine their perception of public transportation in their current location. In all cases, comparing transportation services in a city such as New York to those provided in their current location would not be a fair comparison. These past experiences relegated fixed route services provided in their current location to be described by

such negative terms as “really, really bad,” “no good” or “terrible.” The extent of the dislike of local public transportation services could be seen in the faces of several focus group participants as they discussed their use or non-use of public transportation.

- Travel Time and Service Frequency

  Several focus group participants noted the long travel times (the actual line haul trip plus the waiting times at either end of the journey) and low frequency of buses as a deterrent to using public transportation. A frequency of one bus every 15 – 20 minutes was cited by a focus group participant as having a positive impact on their potential use of public transportation. Focus group participants who had used paratransit also were concerned with the travel time window that was either too long (i.e., waiting for service to arrive) or too short (i.e., not enough time to get to the service when at your door).

Figure 4.14 presents results to the question, “What one factor, if changed, would make public transit an option for you to use today?” It is evident that cost (i.e., free or low cost public transit services) and accessibility (i.e., closer to my home and easier to get on or off) are the two highest ranked factors to the 36 focus group participants who answered this question (eight declined). Four participants indicated that, despite any improvements of public transportation services, they still would not use it. The perceived lack of personal safety has been cited as a factor seniors mention as a reason to avoid using transit. None of the focus group participants indicated that crime on local public transit services detracted from them using it or that improving the personal safety environment on local transportation might induce them to use it.

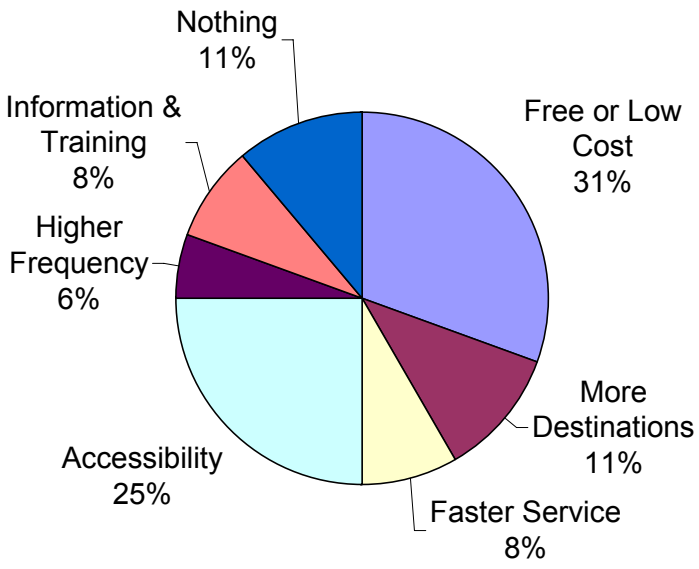

Figure 4.14 Factors Enhancing Potential Use of Public Transportation

4.16.3 Concerns about Using Public Transit

Focus group participants were asked to indicate their primary concern about using public transit. Responses (37) are presented in Figure 4.15. Service area (i.e., public transit does not go where I want to go) was the foremost factor giving rise to concern, followed by transit information (i.e., lack of information about public transit). These two factors are interrelated as the lack of knowledge about the public transit options in an area may be due to a lack of information about public transit in general. More information and training about using public transit may increase consideration of its use by seniors.

- Transit Information

  For many focus group participants, the lack of information about transit services served as a factor in its non-use. Indeed, as to the limited knowledge of the local transit services, consensus reached among focus group participants indicated that this was “partly because we don’t have to use it yet.” This response indicates that

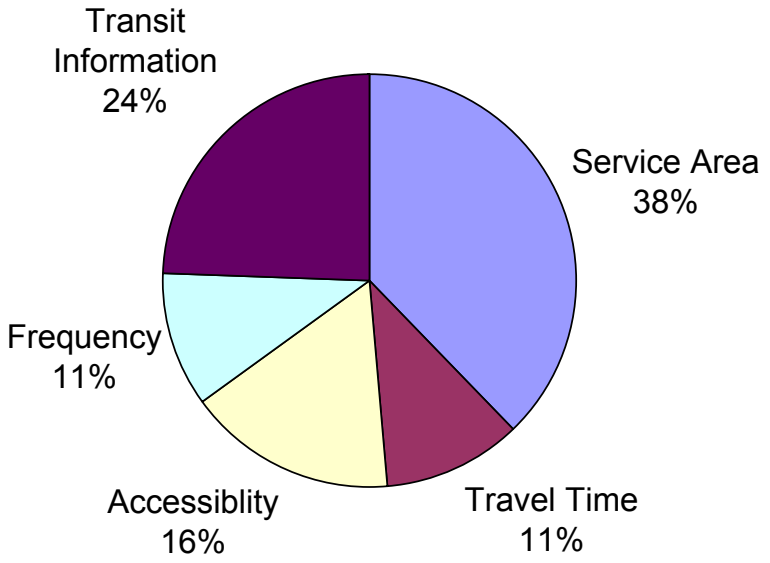

Figure 4.15 Factors Influencing Concerns About Using Public Transit

interest in transit services is partly due to having to use it, if one does not need to use transit, there is no need to why find out about what benefits it can offer. The non-interest in the local transit services was further confirmed by a participant who stated that, "I don't bother finding out [about transit services] where it [the transit service] does go here, because we know it doesn't go our way, so we didn't bother with the other."

- Service Area

  For focus group members situated in semi-rural areas of Hillsborough County, transit services and coverage were limited and often associated with long travel times to complete a round trip. An experience shared by a focus group member related her frustration at the long travel times and the circuitous routing of the bus while traveling only a few miles to a large shopping mall from her semi-rural home. It was pointed out to focus group members that fixed route transit service, adhere to a pre-

designated route and only served stops along that route. However, focus group participants who lived a few blocks away from a particular stop perceived that they were not directly served (i.e., on their street) by the local transit service, despite the fact that the nearest bus stop was only few blocks from where they lived. Thus, the use of any local transit services was dismissed. Adjusting the local fixed route transit service to meet all rider demands would possibly result in a circuitous routing with commensurate lengthening in travel times, decreasing its attractiveness to potential riders.

- Service Accessibility

  Some focus group participants realized that transit service was available in their area, but accessing the service was a challenge. For many it was too far away to walk, requiring transportation to get to the bus stop. Furthermore, if transportation were available to take them to the bus stop, why not use the transportation service for the whole trip instead of transferring to transit? This latter reasoning was particularly evident in the case of seniors using park and ride facilities. Some focus group participants who used park and ride facilities preferred smaller venues close to where they lived, rather than using the regular (i.e., large) facilities situated at some distance from their home. Given the propensity of seniors to travel during the off-peak periods, arriving during such a time may involve additional time being spent finding a parking space. This factor unique to park and ride facilities may have the potential to lessen future transit use for seniors who may still be driving but would consider using transit if the conditions were favorable.

4.16.4 Viability of Using Public Transit in the Future

Focus group participants were asked “Do you think that public transit is a viable option for you to use today?” Overall results presented in Table 2.3 (n = 42) indicated a 50:50 split, with 21 focus group participants indicating “yes” and 21 “no.” Breaking down these results by driver type (i.e., former and current drivers), the responses are shown in Table 4.41.

Table 4.41 Viability of Future Consideration of Public Transportation as a Transportation Alternative

Driving Status	Yes	No	Total
Current Drivers	11 (26%)	15 (36%)	26
Former Drivers	10 (24%)	6 (14%)	16
Total	21 (50%)	21 (50%)	42

The results contained in Table 4.41 indicate that, among current drivers, 15 (60%) of the 26 focus group participants who responded felt that public transportation is not a viable transportation option for them. This result may have been influenced by their non- or limited use, non-availability or negative perceptions held about public transportation. A similar percentage (62%) of former drivers (10 out of 16) responded positively. Possible factors contributing to this result may have been that this group had investigated transportation options as former drivers and having had recent experience with using public transportation, coupled with a change of attitude towards this mode arising from their experience.

It can be noted that interpretation of the viability of public transportation by focus group participants in meeting their transportation needs may not, in reality, result in the actual use of this mode. Focus group participants may require a variety of interventions to be in place in order for them to use public transportation, some of which may be economically unviable for a transportation provider to implement for the market being

served. However, despite the inconclusive result, focus group participants did indicate a variety of factors that would influence them to consider transit as a mobility option.

CHAPTER 5 – CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This concluding chapter provides an overview of the research undertaken and explores the potential implications of the research. Through analysis of a variety of market assessments, it has become clearer how the number of active and former drivers affect the transit market in the future. However, transit agencies cannot be assured that a burgeoning transit market can be guaranteed with the maturing of the baby boom generation, given the dynamic nature of senior travel behavior and preferences, especially post driving cessation. Lessons that can be learned from this research are discussed in the following sections.

5.2 Transit Market Size

In 2001 seniors accounted for 33 million persons and comprised 8 percent of transit market share, according to the NHTS 2001 (Table 4.24). Estimated results from this research indicate that this market may increase to 71 million persons responsible for 13 percent of transit market share in 2030 (Table 4.24; assumes trip rates of seniors in 2030 are similar to those in 2001). Despite this increase, it is evident that a doubling of the senior population does not lead to a doubling in the size of the associated market share in 2030. Indeed, transit agencies should take note that, with the increasing proportions of licensed seniors in forthcoming decades, and seniors living in better health and possibly at higher levels of financial wealth, there will be a greater likelihood that the actual use levels of transit (transit mode share) by seniors may actually decline.

Indeed, the increase in licensure rates will offset the potential growth in the non-driving senior transit market. Transit will continue to provide service to more driving seniors (choice transit users); however, this is a more challenging market for tranit.

To test the stability of the estimates derived, the sensitivity tests (contained in Tables 4.37 to 4.39) also confirmed the negative relationship between increasing licensure/cessation rates and transit market share. The resulting shrinkage in transit mode share in future decades is confirmed in another study that modeled the aging population and transit ridership. This study found that "an increased older population depresses regular transit ridership (especially for buses) while increasing paratransit use" (ICF Consulting 2006, p. 39). However, determining the magnitude of the senior transit market is complicated by inadequate estimates of the numbers of former drivers and the accessibility to and quality of transportation alternatives available to this group post-cessation.

5.3 Driving Transition and Subsequent Transportation Options

Despite the increases in active life expectancy, for many seniors it is inevitable that, at some stage in their driving career, there will come a point where driving will be a challenge and the option is taken to retire from driving. What options will be available in 2030 for seniors at this juncture in their driving lives? Furthermore, what proportions of the seniors who have retired from driving will transition to the various transportation alternatives.

Figure 5.1 presents eight different choices in how seniors in 2030 may facilitate their out-of-home mobility in 2030. Each transportation alternative offers different levels of service quality, and the availability of transit does not make the transportation choice of the senior any easier nor ease the transition from an active driver to former driver.

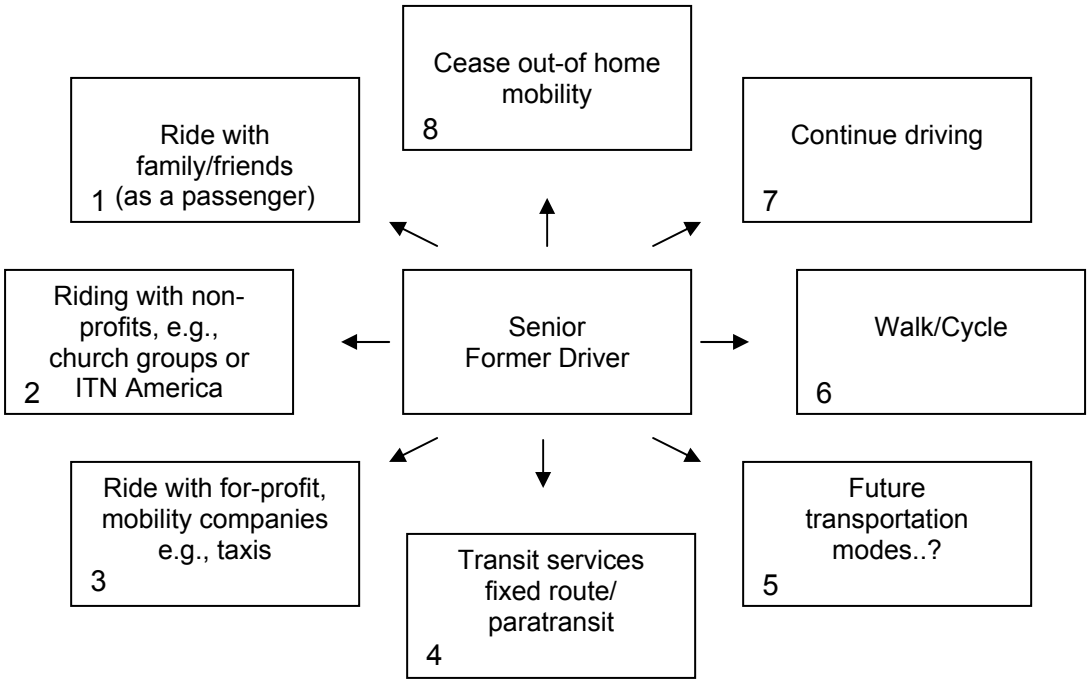

Figure 5.1 Post Cessation Transportation Options

The presumption that seniors after driving cessation place a high value on transit availability and thus become transit patrons is incorrect. The availability of transit at a level not meeting a senior's transportation need may prolong the driving career of a senior who wants to avoid using a service that does not meet their needs. Increasing numbers of post-driving seniors will not translate into increasing numbers of transit users, if the current status of transit services perpetuates into the future.

The first transportation choice for many seniors post-driving cessation is riding with family or friends. However, as discussed in Chapter 2, falling fertility rates in recent decades may result in a situation where, for some seniors in 2030, there may not be an available adult child to facilitate their transportation needs. For some seniors, will non-profit transportation service providers step in to meet the challenge, and will this option be dependent on group membership or some other predetermined qualification, that, if

not met may disqualify seniors from using provided transportation services? Will there be a time in future decades where transit could be perceived on a similar service quality level as riding with friends/family or a non-profit transportation organization? With the introduction of new transportation modes in the future, the relative preference of options depicted in Figure 5.1 may be upset again, and one does not know how transit will be ranked in the new order of transportation choices.

5.4 Migration and Seniors

The extent of migration pre- and post-retirement will impact the magnitude of transit market estimates. For many seniors who plan their retirement location during their middle age years, the issue of the prevailing transportation environment at the new location is not explicitly considered as a pull-factor. Indeed, it may be taken for granted or overlooked by the retiree. It is evident that, for the majority of factors mentioned by seniors precipitating migration, accessibility to the POV enables the benefits sought from such a migration to be realized. After the onset of driving cessation, some seniors may contemplate another move to a location that offers a range of transportation alternatives in addition to the POV. However, the extent of transit availability is one of several competing factors that may influence relocation as observed from focus group discussions.

In this study, focus group participants were asked whether they would relocate so as to be near adequate transit services or closer to an adult child who could meet their transportation needs. For the majority of participants relocating to be closer to an adult child or to an area with adequate transit services, if such an area were situated in the Northeast or Midwest, relocation was not an option. Responses ranged from these regions being “too cold,” which would impact expenditure on heating bills (and on a fixed

income, this could prove a challenge to meet every month) and the “convenience of living in Florida” in terms of affordability. For other participants, they would only consider such a move after the death of a spouse/partner. The prospect of having to relocate placed a number of focus group participants in a quandary, on whether to stay in an area with limited transportation options or move to an area better served by transit. In numerous instances in locations like Florida, one can observe adult children relocating to be nearer to aging parents.

Depending on the availability of adult children, close friends, or the desire to relocate, the desire to stay put was so strong that one focus group participant indicated that she would consider moving into an assisted living community in the surrounding area rather than relocate to the Northeast or Midwest. Many assisted living communities provide transportation, which meet the transportation needs of their residents. However, seniors who consider a move to such a community in all likelihood would be lost to the fixed-route transit market. For some focus group participants, it was preferable to remain in a warmer climate with limited mobility rather than relocate to an environment with many mobility choices but limited access due to inclement weather.

5.5 Senior Conducive Transportation Environments

Extension of the driving cessation process through continued self-initiated restrictions on driving behavior may prolong the driving experience of the senior to the detriment of using alternative transportation modes. Another aspect of the driving cessation process, is induced migration in order to continue driving in a conducive environment. Seniors in the driving cessation process may perceive that relocating to the exurbs (the extreme edges of the urban form) in preference to the central city with its associated transit services may offer relief from heavily congested suburban/urban traffic environments.

The exurbs may offer a traffic environment that enables continued POV operation for the senior. However, the exurbs are even less transit friendly than the suburbs. Adequately serving the exurbs has been a challenge for many transit agencies, with the associated low population densities and greater distances between origins and destinations. However, when seniors in the exurbs do retire from driving, they may find themselves in an acute situation, as they may be further from family/friends (perhaps located in the suburbs necessitating longer trips to meet the travel needs) or be outside the service area of local transportation providers. In such a situation, meeting daily transportation needs may become prohibitively expensive, both in terms of cost and physical energy required, such that seniors may quickly find themselves isolated and disadvantaged.

It is accepted that relocating to the exurbs may be partly due to affordability of homes in these areas. This may create an additional challenge for the senior who has the opportunity to relocate. Seniors may relocate to transit rich areas (downtowns) but may be challenge by housing affordability, or they may relocate to peripheral areas with affordable housing but limited (or non-existent) transit services. However, as noted above, once driving retirement begins, transportation for seniors in the exurbs may become very expensive. Greater distances to travel will undoubtedly cost more in fares and travel time and with a possible inconvenience to friends/family who have to provide the trips.

5.6 Working Seniors

Recent reports (AARP 2005) have indicated the increasing numbers of seniors working post-retirement. Reasons for this development are seniors like what they do and want to keep doing it for as long as they can maintaining the value of savings and pensions, held

and ensuring adequate social security and/or health insurance benefits post-retirement. The increasing numbers of seniors working past retirement age may offer a unique opportunity to transit agencies. Agencies may be able to rise to the challenge of meeting this need through the provision of tailored transit services as well as enhancing the role of transit as a transportation alternative. However, any potential expansion in the transit market arising from working seniors is dependent on the numbers of seniors who make the work commute trip versus telecommuting.

5.7 Meeting Transportation Needs Through Public Versus Private Provision

Many seniors in the driving cessation process would prefer to make the decision to stop driving themselves. However, family involvement can and does play a role in determining when the senior should stop driving. Future decades will bring an increase in the dependency ratio (discussed in Chapter 2), which, in turn, may result in seniors having to look outside their immediate family to meet their transportation needs. In both of these cases, one pressing question is the extent to which non-driver transportation needs will be met through public versus private initiatives?

If there is family involvement in the driving cessation process, for this involvement to be complete, it may be preferable that the family also take the responsibility to meet the transportation needs of the former driver during and after the transition period. For some families, this may not create a challenge. However, will family members be able to meet all the transportation demands of the senior? For some seniors, the perception of being an inconvenience to family members (through asking for a ride) may take a greater toll on their psyche than in a situation where an alternative transportation provider, e.g., taxi driver, is used. To reduce family involvement post-cessation, will the senior relocate to a transit rich area to depend on public service

provision of transportation? Seniors of tomorrow may feel that, since they have contributed over many years (by way of taxes) for their retirement, part of the retirement phase of their lives is access to adequate transportation services. Now that they have reached retirement, many feel "entitled" to public transportation services.

5.8 Implications for Senior Mobility Providers

With the predicted doubling of the senior population in 2030 based on 2000 projections, what implications will this have for senior mobility providers?

5.8.1 Financial

In many jurisdictions, seniors travel at reduce fares, often subsidized through taxes and other local authority revenue streams. With 8 percent of the 2001 transit market share attributable to seniors predicted to rise to 13 percent in 2030, transit providers will be challenged to accommodate a possibly increased proportion of reduced fare paying passengers while at the same time manage cost and service levels to maintain operational efficiency. The importance of the cost to use transit was confirmed in Figure 4.14, where free or low cost/fare was the most important factor influencing transit use by the focus group participants.

The financial implications not only influence getting seniors to use transit but how they travel when they do use it. Seniors will expect to be able to access/exit a vehicle close to their home and will expect entering into/alighting from a vehicle to be relatively easy and safe. When riding the vehicle, seniors will also expect that a seat is available and, if assistance is required, e.g. lifting shopping bags, it is given by trained staff personnel. To meet any or all of these requirements, there will be a cost attached. If transit providers do not meet the minimum standards of senior expectations with respect to transit use, seniors may chose alternatives other than ransit.

Working seniors may imply wealthier seniors who are in a greater position to finance the travel choices they make. Many transit agencies subsidize senior fares, reducing the potential of farebox revenue meeting operating costs. However, wealthier seniors in the future may be able to contribute to transit travel through payment of a minimal charge. For those seniors who need to ride for free, subsidized fares can still be provided based on need rather than age. A positive implication of seniors directly contributing to transit services is that such contributions could be used for service enhancements, which, in turn, may attract more seniors to use transit services.

5.8.2 Operations

The travel behavior profile of seniors presented in section 3.18 indicated that the majority of seniors travel during the off-peak periods (primarily between 11am and 3pm). This is a period where, for some transit operators, service frequency is scaled down from peak periods. Greater numbers of seniors traveling during off-peak periods may necessitate a revision of service frequencies during this time to meet senior demand. The prospect of a "transfer" on a trip often discourages seniors from using transit services; however, the increased numbers of seniors may create a market where direct routes during off-peak periods may be resumed. Maintaining social activity into the evening hours is another aspect of senior lifestyle that is important. Similarly, there may well be a need for transit properties to revisit evening schedules in order to stimulate and maintain demand. One benefit arising from increased off-peak operations is an increase in vehicle and bus operator utilization efficiency.

Seniors may also influence the schedule speed of vehicles if they impact the stop dwell time by needing extra time to board the vehicle, pay fares or take a seat to avoid

the risk of falling when the vehicle accelerates. This could have a cumulative impact on service cost and speed in locations with high concentrations of senior travelers.

5.8.3 Infrastructure

As indicated above, seniors have and will continue to have expectations of travel by transit (and former drivers may expect transit services to be operated "on-demand" as their POV). However, to capitalize on those seniors that may be contemplating transit use and retain the seniors who are already using transit, changes in transit infrastructure will have to keep pace with these expectations. Innovations such as low floor buses, (enabling easy entry/exit from the vehicle) accessible and safe bus shelters (protecting persons from the elements), speaking buses (bus location and route information are made audible) and obtaining information about services is simple, accurate and clear. These are but a few of infrastructure innovations, some of which incorporate ITS, that should be considered by transit agencies to make using transit by seniors (and everybody) easy. Nevertheless, such innovations must be well promoted directly to seniors in order to remedy any negative perceptions that seniors may have acquired over the years about transit use.

5.9 The Next Steps

The estimates produced in this study paint one of several scenarios that may occur in the year 2030. Indeed, this research on transit use viability among older drivers after losing driving privileges resulted in:

- Licensed seniors (though not all active drivers) in the forecast year is estimated to be 92 percent of the total senior population (Table 4.4). Licensing proportion differences between genders will decrease in future years.

- An estimated 16 percent of the senior population may be classified as never-driven or former drivers in the year 2030 (Table 4.4), although driving cessation rates differ by methodological approach used as well as by gender.
- Driving cessation does not result in an automatic transition to transit. For many seniors (never licensed and former driver), ridesharing is the preferred choice for out-of-home mobility. For transit to become a viable option for seniors (at least for consideration), services need to be free or low cost, accessible and serve a variety of destinations (Figure 4.14).

How can the observed results from this research have practical applicability? A number of initiatives are presented as follows.

- Policy development

  Measures will need to be in place to accommodate the growing number of seniors who will have a diverse array of transportation needs to be satisfied in forthcoming decades. Seniors in 2030, the current baby boom generation of today, will have higher expectations of transit services, if such services are to be seen as a viable transportation alternative. Policy initiatives that can be put in place to enable a realization of this can include:

  - rewarding transit operators (through financial incentives) who provide services where seniors contribute in excess of a predetermined percentage (10 percent perhaps) of the total transit ridership
  - rewarding seniors who make a certain percentage of weekly trips by fixed route transit (discount shopping vouchers, free transit trip tickets)

- enabling legislation that would permit a greater involvement of transit agencies in rideshare programs; in this case, transit agencies would not only own/manage buses but also car fleets.
- enhancing lifelong learning standards that could encourage computer literacy of seniors through the provision of computer and internet access in each and every home to aid in getting transit information.

- Operational planning

  With respect to operational planning by transit agencies, a proactive approach will need to be maintained in order to meet the transportation demands of seniors in future decades. There will have to be a rebalancing of transit service provision, which currently is focused on servicing the AM and PM peak periods to improve service provision in the off-peak periods. Indeed, policy will have to be developed that will encourage a mindset change surrounding the provision of premium transit services to full fare passengers (commuters) to accepting that all passengers of whatever fare class represent a market that can be nurtured, developed and maximized for operational benefit.

5.10 Study Limitations

While undertaking this research a number of study limitations were identified. The use of empirical relationships to derive cessation rates for future senior populations was biased in favor of male drivers (males over 65 are licensed and drive to a much greater degree than their female counterparts), and incorporated wide differences in gender licensing rates. This will not be the case in future decades, as there will not only be a greater number of seniors but more senior females in particular will be licensed at levels never witnessed before in U.S. driver licensing history. Until this point is reached,

cessation methodologies used to forecast senior former drivers may tend to overestimate the actual numbers of seniors that may be in the process of ceasing to drive.

The focus group participants shared views specific of their driving and transit use experience within Florida, the state that many of them had spent most of their senior years. As such, some of the views presented may not be applicable to seniors residing in other parts of the U.S. However, many of the views expressed, were similar to those expressed in numerous published reports on senior mobility challenges during and post driving cessation. As part of the qualitative research, it was not possible to solicit the views and experiences of housebound seniors. Such views may have provided additional insights into mobility challenges faced by seniors who are relatively immobile not due to health impairments but to lack of the safety net of family or friends that could assist them in meeting their transportation needs.

Another limitation of this research effort was the inability to explicitly discern the size of the population that goes through the driving cessation process and the mobility alternatives available to this group at various stages of the process. Indeed, this deficiency is also related to the lack of not being able to determine transition probabilities during the driving cessation process.

5.11 Future Research Needs

An improved estimation in the numbers of former drivers will be dependent on ascertaining the rate of cessation according to gender. This research identified two approaches to derive such estimates; one approach (Foley et al. 2002) involved including active drivers at the point of their deaths in the cessation calculation, the other excluded such drivers and included only those who have ceased driving and survive to

tell about it (the majority of research efforts). Foley et al. (2002) acknowledged the differing cessation rates between males and females and also noted the differing mortality rates between males and females. During their study, the male mortality rate was 89 deaths per 1,000 drivers compared to 55 deaths per 1,000 female drivers. Similarly, the cessation rate was 63 per 1,000 male drivers compared to 112 per 1,000 female drivers. Incorporating these mortality and cessation risks resulted in similar cessation rates as well as driving life expectancies for males and females. Additional research is needed to validate the two approaches as to their appropriateness and accuracy in estimating the numbers of former drivers.

Further work on deriving transition probabilities in the driving cessation process may yield a better understanding of the transitions during the driving cessation process and subsequent estimates of former drivers. Existing longitudinal datasets, e.g. HRS, may offer a potential resource that could be used to derive such probabilities. There is a need for more collaborative research on senior mobility between transportation engineers/planners and gerontology professionals. Through such collaborative efforts, each discipline may complement the other with additional insights into the mobility challenges facing seniors, thereby enabling a wider application and appreciation of ongoing research.

Many seniors continue to drive up until the ninth decade of their lives[6] (i.e., 80 years and above) and it is during this period (commencing at retirement) of driving transition that marketing and communicating transit services directly to seniors may yield results, as some trips may be amenable to alternatives to the automobile. Research has inferred, that once a senior stops driving due to visual, physical, or cognitive decline, these same impairments that impact activities of daily living make them unlikely to

[6] Personal communication with Daniel Foley M.S. (May 2006)

consider transit as a viable transportation option (Burkhardt et al. 2002). Additional research is needed as to what factors enable seniors to consider and subsequently use transit for a proportion of their trips while they still have the option to drive.

During 2006, increased ridership on mass transit systems across the U.S. was spurred by rising gasoline prices. Transit agencies are determined to capitalize on this development and retain drivers who had transitioned to their services (*USA Today*, 10/2/2006). In turn, increasing congestion or high fuel costs may be factors that influence seniors to consider using transit. However, the extent to which these factors influence senior travel behavior is another aspect of needed research that requires clarification.

5.12 Recommendations

Recommendations emanating from the research effort can be summarized as follows:

- Transit service providers must engage in effective transit information awareness campaigns, such as workshops, through personally interacting with potential senior riders. It is not only the availability of information but gaining an understanding how transit can meet their transportation needs and actually using the information provided that can transition seniors into becoming potential transit riders. Transit is not a first choice transportation option for many seniors. However, to increase the chances of senior active drivers considering using transit pre- and post-driving cessation, there will be a need to inform and train them during the driving reduction phase of their lives. Part of this marketing effort by transit providers will be to engage generational marketing strategies that target a generation rather than an age cohort.

- Servicing suburban areas has been a perennial challenge for a number of transit service providers engaged in providing fixed route services. For any service to be used by seniors, accessibility in terms of getting to the access point must be balanced against the cost of providing and sustaining the service. Senior demands on accessing transit services, preferred traveling times, and their destinations of interest should be ascertained by transit properties if envisioned transit services are to have a positive impact on meeting the transportation needs of seniors.
- For many transit providers, servicing the work trip forms the majority of transit operations. However, there needs to be marketing promotion and demonstration that transit services can be used to facilitate non-work trip purposes. The driving cessation process that many seniors, will face may present opportunities to engage in this type of promotion, so that when permanent cessation is reached, former drivers may consider the transition to transit a viable option (for some trips) and not fear the end of driving as the end of their personal mobility.
- If transit service is not a viable option for seniors, transit service providers should identify and possibly partner with alternative modes to the POV. One such alternative is the Independent Transportation Network (ITNAmerica), a non-profit transportation service for seniors headquartered in Portland, Maine. This transportation service is based on volunteer drivers of POVs assisting non-driving seniors in meeting their transportation needs. The service is not free to the user; however, the cost is based on per mile driven charge, and payment can be made by cash or through transportation credits (operated like a savings account where charges are deducted as the service is used).

- Development of driving cessation management policies should not be seen as accelerating the prospect of license non-renewal but rather enabling senior drivers to better cope with the cessation process through the effective management of it. The implementation of driving cessation management programs offers an opportunity to increase awareness of transportation alternatives to seniors as they manage the driving cessation process. Transit as an alternative to the POV should not be seen as a mode of last resort but a viable option in a basket of alternatives.

5.13 Conclusions

The ability to drive is, for many people, highly correlated to their level of enjoyment of life, and this is particularly pertinent to retirees who aim to enjoy their twilight years to the maximum extent possible. Indeed, mobility in recent years has reached unprecedented levels such that seniors are experiencing "longer, happier, fuller lives than their counterparts today and certainly than the elderly of just a few decades ago" (Rosenbloom 2004, p. 3). The senior transit market assessment indicate a modest growth in transit market attributable to seniors and the focus group sessions elicited confirmation of the inextricable link between personal well-being and mobility. The limited use made of existing transit services by seniors today is influenced by the ability to drive, level of service accessibility and frequency, and a general non-interest in transit services; for the majority of seniors, transit does not meet their transportation needs at a level and flexibility that is found with POV transportation.

This research highlights the importance of understanding the process of driving cessation, and the transportation needs of seniors at the present time has become increasingly pertinent, warranting additional research as there are currently several issues that continue to directly impact levels of senior mobility. In recent decades, there

has been evidence of decreasing family size, fewer adult children per senior adult, greater spatial separation of seniors between their adult children, and seniors preferring to “age in place.” All these factors significantly affect the evolving role of the family versus institutional support in meeting senior needs. Will the family remain the primary “safety net” for seniors in future decades? Indeed, the potential reluctance of senior and former drivers to utilize alternative non-automobile transportation modes, e.g., fixed route transit, has been partly influenced by negative perceptions and a non-interest of transit services developed over a number of years. Noting these negative perceptions of public transportation, the elderly may feel that after driving for many years, “they deserve [and will expect] better” (Shope 2003, p. 58). Transit providers have extensive work to do to change the perceptions of transit service provision and subsequently encourage the use of such services by senior populations in forthcoming generations if transit is to become a viable transportation alternative for those seniors ceasing to drive.

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APPENDICES

Appendix A List of Acronyms

Table A.1 List of Acronyms

AAA	American Automobile Association
ACC	Adaptive Cruise Control Systems
ADL	Activities of Daily Living
AHEAD	Assets and Health dynamics Among the Oldest Old
BTS	Bureau of Transportation Statistics
CATI	Computer-Aided Telephone Interview
CDC	Centers for Disease Control
CUTR	Center for Urban Transportation Research
FHWA	Federal Highway Administration
GPS	Global Positioning Systems
HRS	Health and Retirement Study
ITNAmerica	Independent Transportation Network America
ITS	Intelligent Transportation System
NCHS	National Center for Health Statistics
NHTS	National Household Travel Survey
NHTSA	National Highway Traffic Safety Administration
NIA	National Institute of Aging
NPTS	Nationwide Personal Travel Survey
NSFH	National Survey of Families and Households
OHPI	Office of Highway Policy Information
POV	Personally-Operated Motor Vehicle
PUMS	Public Use Microdata Sample

Appendix A (Continued)

RDD	Random Digit Dialing
RV	Recreational Vehicle
SIPP	Survey of Income and Program Participation
SUV	Sport Utility Vehicle
TRB	Transportation Research Board
TRIS	Transportation Research Information Services
USDOT	U.S. Department of Transportation
USF	University of South Florida

Appendix B Driving Cessation Estimates for Older Males and Females Waldorf (2001)

Table B.1 Driving Cessation Estimates (Males) Waldorf (2001)

Scenario		70 – 74yrs	75 – 79yrs	80 – 84yrs	85yrs+
Base Case	Proportion currently licensed*, p_{cl}	0.94	0.91	0.87	0.75
	Proportion currently driving**, p_{cd}	0.88	0.85	0.77	0.54
Scenario 1	Proportion ever-licensed, $p_{el} = p_{cl}$	0.94	0.91	0.87	0.75
	Proportion stopped driving, p^*	0.06	0.07	0.11	0.28

Scenario		70 – 74yrs	75 – 79yrs	80 – 84yrs	85yrs+
Base Case	Proportion currently licensed*, p_{cl}	0.94	0.91	0.87	0.75
	Proportion currently driving**, p_{cd}	0.88	0.85	0.77	0.54
Scenario 2	Proportion ever-licensed, $p_{el} = 1$	1.00	1.00	1.00	1.00
	Proportion stopped driving, p^*	0.12	0.15	0.23	0.46

Scenario		70 – 74yrs	75 – 79yrs	80 – 84yrs	85yrs+
Base Case	Proportion currently licensed*, p_{cl}	0.94	0.91	0.87	0.75
	Proportion currently driving**, p_{cd}	0.88	0.85	0.77	0.54
Scenario 3	Proportion ever-licensed, $p_{el} = ½ (pcl + 1)$	0.97	0.96	0.94	0.88
	Proportion stopped driving, p^*	0.09	0.11	0.18	0.38

* OHPI/FHWA
** AHEAD

Appendix B (Continued)

Table B.2 Driving Cessation Estimates (Females) Waldorf (2001)

Scenario		70 – 74yrs	75 – 79yrs	80 – 84yrs	85yrs+
Base Case	Proportion currently licensed*, p_{cl}	0.74	0.64	0.49	0.26
	Proportion currently driving**, p_{cd}	0.70	0.60	0.44	0.22
Scenario 1	Proportion ever-licensed, $p_{el} = p_{cl}$	0.94	0.91	0.87	0.75
	Proportion stopped driving, p^*	0.26	0.34	0.49	0.71

Scenario		70 – 74yrs	75 – 79yrs	80 – 84yrs	85yrs+
Base Case	Proportion currently licensed*, p_{cl}	0.74	0.64	0.49	0.26
	Proportion currently driving**, p_{cd}	0.70	0.60	0.44	0.22
Scenario 2	Proportion ever-licensed, $p_{el} = 1$	1.00	1.00	1.00	1.00
	Proportion stopped driving, p^*	0.30	0.40	0.56	0.78

Scenario		70 – 74yrs	75 – 79yrs	80 – 84yrs	85yrs+
Base Case	Proportion currently licensed*, p_{cl}	0.74	0.64	0.49	0.26
	Proportion currently driving**, p_{cd}	0.70	0.60	0.44	0.22
Scenario 3	Proportion ever-licensed, $p_{el} = ½ (pcl + 1)$	0.87	0.82	0.75	0.63
	Proportion stopped driving, p^*	0.20	0.27	0.41	0.65

* OHPI/FHWA
** AHEAD

Appendix C Complete Life Tables 2000 (Source: National Center for Health Statistics, 2002)

Table C.1 Life Table for Males: United States, 2000

Age	Probability of dying between ages x to $x+1$	Number surviving to age x	Number dying between ages x to $x+1$	Person-years lived between ages x to $x+1$	Total number of person-years lived above age x	Expectation of life at age x
	q_x	l_x	d_x	L_x	T_x	e_x
0–1	0.007592	100,000	759	99,333	7,413,931	74.1
1–2	0.000567	99,241	56	99,213	7,314,597	73.7
2–3	0.000385	99,184	38	99,165	7,215,385	72.7
3–4	0.000285	99,146	28	99,132	7,116,219	71.8
4–5	0.000217	99,118	22	99,107	7,017,087	70.8
5–6	0.000209	99,096	21	99,086	6,917,980	69.8
6–7	0.000199	99,076	20	99,066	6,818,894	68.8
7–8	0.000189	99,056	19	99,047	6,719,828	67.8
8–9	0.000171	99,037	17	99,029	6,620,781	66.9
9–10	0.000147	99,020	15	99,013	6,521,752	65.9
10–11	0.000128	99,006	13	98,999	6,422,739	64.9
11–12	0.000135	98,993	13	98,986	6,323,740	63.9
12–13	0.000193	98,980	19	98,970	6,224,753	62.9
13–14	0.000314	98,961	31	98,945	6,125,783	61.9
14–15	0.000479	98,930	47	98,906	6,026,838	60.9
15–16	0.000660	98,882	65	98,850	5,927,932	59.9
16–17	0.000828	98,817	82	98,776	5,829,082	59.0
17–18	0.000977	98,735	96	98,687	5,730,306	58.0
18–19	0.001097	98,639	108	98,585	5,631,620	57.1
19–20	0.001194	98,531	118	98,472	5,533,035	56.2
20–21	0.001295	98,413	127	98,349	5,434,563	55.2
21–22	0.001396	98,285	137	98,217	5,336,214	54.3
22–23	0.001463	98,148	144	98,076	5,237,997	53.4
23–24	0.001483	98,005	145	97,932	5,139,921	52.4
24–25	0.001467	97,859	144	97,787	5,041,989	51.5
25–26	0.001438	97,716	141	97,645	4,944,201	50.6
26–27	0.001416	97,575	138	97,506	4,846,556	49.7
27–28	0.001402	97,437	137	97,369	4,749,050	48.7
28–29	0.001407	97,300	137	97,232	4,651,681	47.8
29–30	0.001429	97,164	139	97,094	4,554,449	46.9
30–31	0.001456	97,025	141	96,954	4,457,355	45.9
31–32	0.001491	96,883	144	96,811	4,360,401	45.0
32–33	0.001546	96,739	150	96,664	4,263,590	44.1
33–34	0.001625	96,589	157	96,511	4,166,926	43.1
34–35	0.001723	96,432	166	96,349	4,070,415	42.2
35–36	0.001828	96,266	176	96,178	3,974,065	41.3
36–37	0.001940	96,090	186	95,997	3,877,887	40.4
37–38	0.002070	95,904	199	95,805	3,781,890	39.4
38–39	0.002222	95,705	213	95,599	3,686,086	38.5
39–40	0.002396	95,493	229	95,378	3,590,487	37.6
40–41	0.002581	95,264	246	95,141	3,495,109	36.7
41–42	0.002777	95,018	264	94,886	3,399,968	35.8
42–43	0.003001	94,754	284	94,612	3,305,082	34.9
43–44	0.003262	94,470	308	94,316	3,210,470	34.0
44–45	0.003561	94,161	335	93,994	3,116,155	33.1
45–46	0.003902	93,826	366	93,643	3,022,161	32.2
46–47	0.004270	93,460	399	93,261	2,928,518	31.3
47–48	0.004643	93,061	432	92,845	2,835,257	30.5
48–49	0.004996	92,629	463	92,397	2,742,412	29.6
49–50	0.005334	92,166	492	91,920	2,650,015	28.8
50–51	0.005687	91,674	521	91,414	2,558,094	27.9
51–52	0.006083	91,153	555	90,876	2,466,681	27.1
52–53	0.006529	90,599	592	90,303	2,375,805	26.2
53–54	0.007052	90,007	635	89,690	2,285,502	25.4
54–55	0.007668	89,372	685	89,030	2,195,812	24.6
55–56	0.008389	88,687	744	88,315	2,106,783	23.8
56–57	0.009199	87,943	809	87,539	2,018,468	23.0
57–58	0.010081	87,134	878	86,695	1,930,929	22.2
58–59	0.011001	86,256	949	85,781	1,844,234	21.4
59–60	0.011964	85,307	1,021	84,796	1,758,453	20.6
60–61	0.013033	84,286	1,099	83,737	1,673,656	19.9
61–62	0.014248	83,188	1,185	82,595	1,589,920	19.1
62–63	0.015558	82,002	1,276	81,364	1,507,325	18.4
63–64	0.016947	80,727	1,368	80,043	1,425,960	17.7
64–65	0.018420	79,359	1,462	78,628	1,345,918	17.0
65–66	0.019939	77,897	1,553	77,120	1,267,290	16.3
66–67	0.021588	76,344	1,648	75,520	1,190,170	15.6

Appendix C (Continued)

Table C.1 (Continued)

Age	Probability of dying between ages x to $x+1$	Number surviving to age x	Number dying between ages x to $x+1$	Person-years lived between ages x to $x+1$	Total number of person-years lived above age x	Expectation of life at age x
	q_x	l_x	d_x	L_x	T_x	e_x
67–68	0.023499	74,695	1,755	73,818	1,114,650	14.9
68–69	0.025743	72,940	1,878	72,001	1,040,832	14.3
69–70	0.028251	71,063	2,008	70,059	968,831	13.6
70–71	0.030827	69,055	2,129	67,991	898,772	13.0
71–72	0.033436	66,926	2,238	65,807	830,782	12.4
72–73	0.036262	64,688	2,346	63,516	764,974	11.8
73–74	0.039394	62,343	2,456	61,115	701,459	11.3
74–75	0.042837	59,887	2,565	58,604	640,344	10.7
75–76	0.046467	57,321	2,664	55,990	581,740	10.1
76–77	0.050241	54,658	2,746	53,285	525,751	9.6
77–78	0.054397	51,912	2,824	50,500	472,466	9.1
78–79	0.059174	49,088	2,905	47,636	421,966	8.6
79–80	0.064770	46,183	2,991	44,688	374,330	8.1
80–81	0.071426	43,192	3,085	41,649	329,643	7.6
81–82	0.079067	40,107	3,171	38,521	287,993	7.2
82–83	0.087465	36,936	3,231	35,320	249,472	6.8
83–84	0.096142	33,705	3,240	32,085	214,152	6.4
84–85	0.105041	30,465	3,200	28,865	182,067	6.0
85–86	0.114901	27,265	3,133	25,698	153,202	5.6
86–87	0.125348	24,132	3,025	22,619	127,504	5.3
87–88	0.136374	21,107	2,878	19,668	104,884	5.0
88–89	0.147968	18,229	2,697	16,880	85,217	4.7
89–90	0.160114	15,531	2,487	14,288	68,337	4.4
90–91	0.172788	13,045	2,254	11,918	54,049	4.1
91–92	0.185960	10,791	2,007	9,787	42,131	3.9
92–93	0.199595	8,784	1,753	7,907	32,344	3.7
93–94	0.213650	7,031	1,502	6,280	24,436	3.5
94–95	0.228076	5,529	1,261	4,898	18,157	3.3
95–96	0.242816	4,268	1,036	3,750	13,259	3.1
96–97	0.257810	3,231	833	2,815	9,509	2.9
97–98	0.272989	2,398	655	2,071	6,694	2.8
98–99	0.288279	1,744	503	1,492	4,623	2.7
99–100	0.303602	1,241	377	1,053	3,131	2.5
100 years and over	1.00000	864	864	2,078	2,078	2.4

Appendix C (Continued)

Table C.2 Life Table for Females: United States, 2000

Age	Probability of dying between ages x to $x+1$	Number surviving to age x	Number dying between ages x to $x+1$	Person-years lived between ages x to $x+1$	Total number of person-years lived above age x	Expectation of life at age x
	q_x	l_x	d_x	L_x	T_x	e_x
0–1	0.006235	100,000	624	99,454	7,947,581	79.5
1–2	0.000465	99,376	46	99,353	7,848,126	79.0
2–3	0.000308	99,330	31	99,315	7,748,773	78.0
3–4	0.000199	99,300	20	99,290	7,649,458	77.0
4–5	0.000187	99,280	19	99,271	7,550,168	76.0
5–6	0.000167	99,261	17	99,253	7,450,897	75.1
6–7	0.000154	99,245	15	99,237	7,351,644	74.1
7–8	0.000144	99,229	14	99,222	7,252,407	73.1
8–9	0.000135	99,215	13	99,208	7,153,185	72.1
9–10	0.000126	99,202	13	99,195	7,053,977	71.1
10–11	0.000121	99,189	12	99,183	6,954,781	70.1
11–12	0.000125	99,177	12	99,171	6,855,598	69.1
12–13	0.000147	99,165	15	99,158	6,756,427	68.1
13–14	0.000190	99,150	19	99,141	6,657,269	67.1
14–15	0.000247	99,132	24	99,119	6,558,128	66.2
15–16	0.000312	99,107	31	99,092	6,459,009	65.2
16–17	0.000373	99,076	37	99,058	6,359,917	64.2
17–18	0.000419	99,039	42	99,018	6,260,860	63.2
18–19	0.000444	98,998	44	98,976	6,161,841	62.2
19–20	0.000453	98,954	45	98,931	6,062,866	61.3
20–21	0.000460	98,909	45	98,886	5,963,935	60.3
21–22	0.000471	98,863	47	98,840	5,865,048	59.3
22–23	0.000482	98,817	48	98,793	5,766,208	58.4
23–24	0.000493	98,769	49	98,745	5,667,415	57.4
24–25	0.000505	98,720	50	98,696	5,568,671	56.4
25–26	0.000520	98,671	51	98,645	5,469,975	55.4
26–27	0.000539	98,619	53	98,593	5,371,330	54.5
27–28	0.000560	98,566	55	98,538	5,272,738	53.5
28–29	0.000586	98,511	58	98,482	5,174,199	52.5
29–30	0.000616	98,453	61	98,423	5,075,717	51.6
30–31	0.000650	98,392	64	98,360	4,977,294	50.6
31–32	0.000690	98,329	68	98,295	4,878,934	49.6
32–33	0.000743	98,261	73	98,224	4,780,639	48.7
33–34	0.000810	98,188	80	98,148	4,682,415	47.7
34–35	0.000887	98,108	87	98,065	4,584,267	46.7
35–36	0.000967	98,021	95	97,974	4,486,203	45.8
36–37	0.001048	97,926	103	97,875	4,388,229	44.8
37–38	0.001138	97,824	111	97,768	4,290,354	43.9
38–39	0.001238	97,712	121	97,652	4,192,586	42.9
39–40	0.001348	97,591	132	97,526	4,094,935	42.0
40–41	0.001467	97,460	143	97,388	3,997,409	41.0
41–42	0.001590	97,317	155	97,239	3,900,021	40.1
42–43	0.001718	97,162	167	97,079	3,802,781	39.1
43–44	0.001849	96,995	179	96,905	3,705,703	38.2
44–45	0.001991	96,816	193	96,719	3,608,797	37.3
45–46	0.002149	96,623	208	96,519	3,512,078	36.3
46–47	0.002326	96,415	224	96,303	3,415,559	35.4
47–48	0.002527	96,191	243	96,069	3,319,256	34.5
48–49	0.002749	95,948	264	95,816	3,223,186	33.6
49–50	0.002990	95,684	286	95,541	3,127,370	32.7
50–51	0.003253	95,398	310	95,243	3,031,829	31.8
51–52	0.003538	95,088	336	94,919	2,936,586	30.9
52–53	0.003847	94,751	364	94,569	2,841,667	30.0
53–54	0.004188	94,387	395	94,189	2,747,098	29.1
54–55	0.004577	93,991	430	93,776	2,652,909	28.2
55–56	0.005031	93,561	471	93,326	2,559,132	27.4
56–57	0.005550	93,091	517	92,832	2,465,806	26.5
57–58	0.006120	92,574	567	92,291	2,372,974	25.6
58–59	0.006723	92,007	619	91,698	2,280,684	24.8
59–60	0.007364	91,389	673	91,052	2,188,986	24.0
60–61	0.008087	90,716	734	90,349	2,097,933	23.1
61–62	0.008910	89,982	802	89,581	2,007,584	22.3
62–63	0.009787	89,180	873	88,744	1,918,003	21.5
63–64	0.010700	88,308	945	87,835	1,829,259	20.7
64–65	0.011655	87,363	1,018	86,854	1,741,424	19.9
65–66	0.012667	86,344	1,094	85,798	1,654,571	19.2
66–67	0.013782	85,251	1,175	84,663	1,568,773	18.4

Appendix C (Continued)

Table C.2 (Continued)

Age	Probability of dying between ages x to $x+1$	Number surviving to age x	Number dying between ages x to $x+1$	Person-years lived between ages x to $x+1$	Total number of person-years lived above age x	Expectation of life at age x
	q_x	l_x	d_x	L_x	T_x	e_x
67–68	0.015033	84,076	1,264	83,444	1,484,110	17.7
68–69	0.016446	82,812	1,362	82,131	1,400,666	16.9
69–70	0.018005	81,450	1,467	80,717	1,318,535	16.2
70–71	0.019605	79,983	1,568	79,199	1,237,819	15.5
71–72	0.021296	78,415	1,670	77,580	1,158,619	14.8
72–73	0.023255	76,745	1,785	75,853	1,081,039	14.1
73–74	0.025571	74,961	1,917	74,002	1,005,186	13.4
74–75	0.028212	73,044	2,061	72,013	931,184	12.7
75–76	0.031018	70,983	2,202	69,882	859,171	12.1
76–77	0.033947	68,781	2,335	67,614	789,288	11.5
77–78	0.037214	66,446	2,473	65,210	721,675	10.9
78–79	0.041000	63,974	2,623	62,662	656,465	10.3
79–80	0.045434	61,351	2,787	59,957	593,803	9.7
80–81	0.050468	58,563	2,956	57,085	533,846	9.1
81–82	0.056134	55,608	3,121	54,047	476,760	8.6
82–83	0.062698	52,486	3,291	50,841	422,713	8.1
83–84	0.070208	49,195	3,454	47,468	371,873	7.6
84–85	0.078624	45,741	3,596	43,943	324,404	7.1
85–86	0.087179	42,145	3,674	40,308	280,461	6.7
86–87	0.096372	38,471	3,708	36,617	240,153	6.2
87–88	0.106211	34,763	3,692	32,917	203,536	5.9
88–89	0.116702	31,071	3,626	29,258	170,618	5.5
89–90	0.127841	27,445	3,509	25,691	141,360	5.2
90–91	0.139619	23,936	3,342	22,266	115,669	4.8
91–92	0.152021	20,595	3,131	19,029	93,404	4.5
92–93	0.165023	17,464	2,882	16,023	74,375	4.3
93–94	0.178596	14,582	2,604	13,280	58,352	4.0
94–95	0.192701	11,978	2,308	10,824	45,072	3.8
95–96	0.207290	9,669	2,004	8,667	34,249	3.5
96–97	0.222310	7,665	1,704	6,813	25,582	3.3
97–98	0.237696	5,961	1,417	5,253	18,768	3.1
98–99	0.253378	4,544	1,151	3,968	13,516	3.0
99–100	0.269278	3,393	914	2,936	9,547	2.8
100 years and over	1.00000	2,479	2,479	6,611	6,611	2.7

Appendix D Calculation of Life Tables for Persons Ages 35 and Older (Base Year 2000)

A life table is defined as "a statistical table that follows a hypothetical cohort of 100,000 persons born at the same time as they progress through successive ages, with the cohort reduced from one age to the next according to a set of death rates by age until all persons eventually die" (U.S. Census Bureau, 1996). A life table thus defined is technically referred to as a "Period" Life Table (synthetic population) versus a "Cohort" Life table, which follows the life experience of an actual birth cohort. In addition, a life table can be "abridged" (data grouped by 5 or 10 year age intervals) or "complete" (i.e., data for individual years). Life tables for the U.S. are produced annually by the National Center for Health Statistics (NCHS) a unit of the Centers for Disease Control (CDC). The creation of an abridged life table for persons 35 years and older (base year 2000) is described as follows.

The construction of the life table will follow the methodology as provided for by the CDC (Anderson 1999). The foundation of any life table is to derive the probability of dying (the opposite of which is the probability of surviving), as the "probability of dying forms the basis of the life table: all subsequent columns are derived from it." (Arias, 2002 p.2) To determine the probability of dying (q_x), estimates of the incidence of death at each respective age grouping are obtained. Table D.1 illustrates observed death rates in the year 2000 for males and females respectively.

Appendix D (Continued)

Table D.1 Male and Female Death Rates Year 2000

Year 2000	Population		Deaths		Deaths per Capita	
	Males	Females	Males	Females	Males	Females
35 - 39yrs	11,276,704	11,339,802	23,252	12,888	0.002062	0.001137
40 - 44yrs	11,168,659	11,353,883	34,045	19,613	0.003048	0.001727
45 - 49yrs	9,955,867	10,270,558	45,121	25,711	0.004532	0.002503
50 - 54yrs	8,706,148	9,083,519	55,277	34,232	0.006349	0.003769
55 - 59yrs	6,553,094	7,005,933	64,425	42,326	0.009831	0.006041
60 - 64yrs	5,165,683	5,699,026	78,896	55,199	0.015273	0.009686
65 - 69yrs	4,402,844	5,131,111	103,935	77,804	0.023606	0.015163
70 - 74yrs	3,904,321	4,945,625	143,473	115,997	0.036747	0.023454
75 - 79yrs	3,051,227	4,374,151	173,327	164,373	0.056806	0.037578
80 - 84yrs	1,853,795	3,130,873	166,892	195,853	0.090027	0.062555
85 - 89yrs	884,151	1,918,650	128,877	206,936	0.145764	0.107855
90 - 94yrs	286,369	837,415	64,439	154,844	0.225021	0.184907
95 - 99yrs	58,970	231,005	18,552	66,089	0.314601	0.286093
100yrs+	10,020	40,720	2,874	15,560	0.286826	0.382122
Total	67,277,852	75,362,271	1,103,385	1,187,425	0.016400	0.015756

Sources: Projected Population of the United States, by Age and Sex: 2000 to 2050 (Detailed Table) U.S. Census Bureau, Population Division, Population Projections Branch http://www.census.gov/ipc/www/usinterimproj/usproj2000-2050.xls GMWK I Total deaths for each cause by 5-year age groups, United States, 1999-2003. National Center for Health Statistics. http://www.cdc.gov/nchs/data/dvs/wktbli.pdf

According to the CDC guideline, q_x, is determined by the following:

$$q_x = \frac{d_x}{l_x + \frac{1}{2} d_x} \qquad (1)$$

where d_x number of deaths occurring between age x and $x+1$, and l_x is the life table population at risk of dying between ages x and $x+1$. Formula (1) assumes that the age intervals are 1 year of age in length. Additionally, the formula cannot be used on the last line, however, as death is certain, the probability of dying at 100yrs+ is given as 1. As an abridged life table is being created formula (1) has to be adjusted to reflect the groupings of the years in 5 year intervals, indicated in formula (2) and the results are presented in Table D.2.

Appendix D (Continued)

$$q_x = \left[\frac{d_x}{l_x + \frac{5}{2} d_x} \right] * 5 \qquad (2)$$

Table D.2 Male and Female Probabilities of Dying (q_x) Year 2000

Year 2000	Population (l_x)		Deaths (d_x)		Probability of Dying (q_x)	
	Males	Females	Males	Females	Males	Females
35 - 39yrs	11,276,704	11,339,802	23,252	12,888	0.010257	0.005667
40 - 44yrs	11,168,659	11,353,883	34,045	19,613	0.015126	0.008600
45 - 49yrs	9,955,867	10,270,558	45,121	25,711	0.022407	0.012439
50 - 54yrs	8,706,148	9,083,519	55,277	34,232	0.031250	0.018667
55 - 59yrs	6,553,094	7,005,933	64,425	42,326	0.047977	0.029758
60 - 64yrs	5,165,683	5,699,026	78,896	55,199	0.073557	0.047284
65 - 69yrs	4,402,844	5,131,111	103,935	77,804	0.111454	0.073047
70 - 74yrs	3,904,321	4,945,625	143,473	115,997	0.168277	0.110777
75 - 79yrs	3,051,227	4,374,151	173,327	164,373	0.248708	0.171756
80 - 84yrs	1,853,795	3,130,873	166,892	195,853	0.367438	0.270477
85 - 89yrs	884,151	1,918,650	128,877	206,936	0.534164	0.424747
90 - 94yrs	286,369	837,415	64,439	154,844	0.720043	0.632261
95 - 99yrs	58,970	231,005	18,552	66,089	0.880494	0.833978
100yrs+	10,020	40,720	2,874	15,560	1.000000	1.000000

To determine the numbers of persons dying in a particular cohort, it follows that with an initial synthetic male population ages 35 to 39 years of 100,000, 1,026 of this cohort will not see their 40th birthday (i.e., 100,000 x 0.010257 (for (q_x) see Table D.2)). Thus, 98,974 will enter the second age interval, namely 40 to 44 years. The process is continued applying the respective q_x for each cohort.

The Person Years lived, L_x is determined by the following formula:

$$L_x = l_x - \frac{1}{2} d_x \qquad (3)$$

where, l_x is the life table population at risk of dying between ages x and $x+1$, and

Appendix D (Continued)

d_x number of deaths occurring between age x and $x+1$. Again as we are preparing an abridged life table the formula is adjusted to reflect the 5 year groupings as indicated in formula 4.

$$L_x = 5 * \left[l_x - \frac{1}{2} d_x \right] \qquad (4)$$

If all the persons in a cohort (l_x) had lived to progress to the next cohort ($l_x + 1$), the maximum number of person years lived would be 5 years multiplied by l_x. Unfortunately, this is not the case (as deaths at all ages is inevitable), and to take account of those persons who died at sometime in their respective cohort, we assume that each made it half-way through the age interval (indicated by $\frac{1}{2} d_x$). Total person years lived (T_x) represents the total number of person-years that would be lived after the beginning of the age interval x to $x+1$ by the synthetic life table cohort and indicated by the following formula.

$$T_x = \sum_{t=0}^{\infty} L_{x+t} \qquad (5)$$

In other words, for the initial 100,000 males ages 35 to 39 years, T_x = 4,135,932 (i.e., the cumulative sum of all L_x for each cohort). For the next cohort (40 to 44 years), T_x = 3,638,496 (which is 4,135,932 less L_x for the cohort 35 to 39 years). The process is continued deducting the respective L_x for each cohort.

Appendix D (Continued)

Life expectancy (e_x) for a cohort is determined by the following formula:

$$e_x = \frac{T_x}{l_x} \qquad (6)$$

where, T_x represents the total number of person-years that would be lived after the beginning of the age interval x to $x+1$, and l_x is the life table population at risk of dying between ages x and $x+1$.

The resulting period/abridged life tables for males and females respectively are presented in Tables D.3 and D.4.

Table D.3 Life Table for Males: United States 35yrs+, 2000

Cohort	Population (l_x)	Probability of Dying (q_x)	Deaths (d_x)	Person Years Lived (L_x)	Person Years Lived Total (T_x)	Life Expectancy (e_x)
35 - 39yrs	100,000	0.010257	1,026	497,436	4,135,932	41.36
40 - 44yrs	98,974	0.015126	1,497	491,129	3,638,496	36.76
45 - 49yrs	97,477	0.022407	2,184	481,926	3,147,368	32.29
50 - 54yrs	95,293	0.031250	2,978	469,021	2,665,442	27.97
55 - 59yrs	92,315	0.047977	4,429	450,503	2,196,421	23.79
60 - 64yrs	87,886	0.073557	6,465	423,269	1,745,918	19.87
65 - 69yrs	81,422	0.111454	9,075	384,421	1,322,648	16.24
70 - 74yrs	72,347	0.168277	12,174	331,298	938,228	12.97
75 - 79yrs	60,172	0.248708	14,965	263,449	606,929	10.09
80 - 84yrs	45,207	0.367438	16,611	184,508	343,480	7.60
85 - 89yrs	28,596	0.534164	15,275	104,794	158,972	5.56
90 - 94yrs	13,321	0.720043	9,592	42,626	54,178	4.07
95 - 99yrs	3,729	0.880494	3,284	10,438	11,552	3.10
100yrs+	446	1.000000	446	1,114	1,114	2.50

Appendix D (Continued)

Table D.4 Life Table for Females: United States 35yrs+, 2000

Cohort	Population (l_x)	Probability of Dying (q_x)	Deaths (d_x)	Person Years Lived (L_x)	Person Years Lived Total (T_x)	Life Expectancy (e_x)
35 - 39yrs	100,000	0.005667	567	498,583	4,584,834	45.85
40 - 44yrs	99,433	0.008600	855	495,029	4,086,250	41.10
45 - 49yrs	98,578	0.012439	1,226	489,826	3,591,222	36.43
50 - 54yrs	97,352	0.018667	1,817	482,217	3,101,396	31.86
55 - 59yrs	95,535	0.029758	2,843	470,566	2,619,179	27.42
60 - 64yrs	92,692	0.047284	4,383	452,502	2,148,613	23.18
65 - 69yrs	88,309	0.073047	6,451	425,418	1,696,111	19.21
70 - 74yrs	81,858	0.110777	9,068	386,622	1,270,692	15.52
75 - 79yrs	72,790	0.171756	12,502	332,696	884,071	12.15
80 - 84yrs	60,288	0.270477	16,307	260,674	551,374	9.15
85 - 89yrs	43,982	0.424747	18,681	173,205	290,700	6.61
90 - 94yrs	25,301	0.632261	15,997	86,511	117,495	4.64
95 - 99yrs	9,304	0.833978	7,759	27,122	30,983	3.33
100yrs+	1,545	1.000000	1,545	3,862	3,862	2.50

Appendix E Calculation of Survivor Curves S_x and S^*_x for Persons Ages 35 and Older (Base Year 2000)

Calculation of survivor curves for the year 2030, males and females respectively, is a continuation of the life table process. The life tables generated in this study are presented in Tables E.1 and E.2.

Table E.1 Abridged Life Table for Males: United States 35yrs+, 2000

Cohort	Population (l_x)	Probability of Dying (q_x)	Deaths (d_x)	Person Years Lived (L_x)	Person Years Lived Total (T_x)	Life Expectancy (e_x)
35 - 39yrs	100,000	0.010257	1,026	497,436	4,135,932	41.36
40 - 44yrs	98,974	0.015126	1,497	491,129	3,638,496	36.76
45 - 49yrs	97,477	0.022407	2,184	481,926	3,147,368	32.29
50 - 54yrs	95,293	0.031250	2,978	469,021	2,665,442	27.97
55 - 59yrs	92,315	0.047977	4,429	450,503	2,196,421	23.79
60 - 64yrs	87,886	0.073557	6,465	423,269	1,745,918	19.87
65 - 69yrs	81,422	0.111454	9,075	384,421	1,322,648	16.24
70 - 74yrs	72,347	0.168277	12,174	331,298	938,228	12.97
75 - 79yrs	60,172	0.248708	14,965	263,449	606,929	10.09
80 - 84yrs	45,207	0.367438	16,611	184,508	343,480	7.60
85 - 89yrs	28,596	0.534164	15,275	104,794	158,972	5.56
90 - 94yrs	13,321	0.720043	9,592	42,626	54,178	4.07
95 - 99yrs	3,729	0.880494	3,284	10,438	11,552	3.10
100yrs+	446	1.000000	446	1,114	1,114	2.50

Appendix E (Continued)

Table E.2 Abridged Life Table for Females: United States 35yrs+, 2000

Cohort	Population (l_x)	Probability of Dying (q_x)	Deaths (d_x)	Person Years Lived (L_x)	Person Years Lived Total (T_x)	Life Expectancy (e_x)
35 - 39yrs	100,000	0.005667	567	498,583	4,584,834	45.85
40 - 44yrs	99,433	0.008600	855	495,029	4,086,250	41.10
45 - 49yrs	98,578	0.012439	1,226	489,826	3,591,222	36.43
50 - 54yrs	97,352	0.018667	1,817	482,217	3,101,396	31.86
55 - 59yrs	95,535	0.029758	2,843	470,566	2,619,179	27.42
60 - 64yrs	92,692	0.047284	4,383	452,502	2,148,613	23.18
65 - 69yrs	88,309	0.073047	6,451	425,418	1,696,111	19.21
70 - 74yrs	81,858	0.110777	9,068	386,622	1,270,692	15.52
75 - 79yrs	72,790	0.171756	12,502	332,696	884,071	12.15
80 - 84yrs	60,288	0.270477	16,307	260,674	551,374	9.15
85 - 89yrs	43,982	0.424747	18,681	173,205	290,700	6.61
90 - 94yrs	25,301	0.632261	15,997	86,511	117,495	4.64
95 - 99yrs	9,304	0.833978	7,759	27,122	30,983	3.33
100yrs+	1,545	1.000000	1,545	3,862	3,862	2.50

Calculation of S_x is a straight forward division of cohort l_x by a cohort 30 years later l_{x+30}, (i.e., the proportion of cohort l_x surviving 30 years later l_{x+30}). For example, it is assumed that the male cohort 40 to 44 years in 2000 will become the cohort 70 to 74 years in 2030. In this case l_x in 2000 approximated 98,974 persons and in 2030, l_{x+30} approximated 72,347 persons. Thus 26,627 persons of the original cohort died at some time during the intervening years, leaving 72,347 persons (or 73 percent) who will reach at least their 70th birthday in 2030. The resulting survivor probabilities S_x are presented in Tables E.3 and E.4.

Appendix E (Continued)

Table E.3 Survival Probabilities S_x for Males: United States 35yrs+, 2030

Cohort	l_x (yr 2000)	Cohort	l_{x+30} (yr 2030)	$S_x = \frac{l_x}{l_{x+30}}$
35 - 39yrs	100,000	65 - 69yrs	81,422	0.814215
40 - 44yrs	98,974	70 - 74yrs	72,347	0.730965
45 - 49yrs	97,477	75 - 79yrs	60,172	0.617298
50 - 54yrs	95,293	80 - 84yrs	45,207	0.474401
55 - 59yrs	92,315	85 - 89yrs	28,596	0.309768
60 - 64yrs	87,886	90 - 94yrs	13,321	0.151573
65 - 69yrs	81,422	95 - 99yrs	3,729	0.045803
70 - 74yrs	72,347	100yrs+	446	0.006160

Table E.4 Survival Probabilities S_x for Females: United States 35yrs+, 2030

Cohort	l_x (yr 2000)	Cohort	l_{x+30} (yr 2030)	$S_x = \frac{l_x}{l_{x+30}}$
35 - 39yrs	100,000	65 - 69yrs	88,309	0.883090
40 - 44yrs	99,433	70 - 74yrs	81,858	0.823248
45 - 49yrs	98,578	75 - 79yrs	72,790	0.738402
50 - 54yrs	97,352	80 - 84yrs	60,288	0.619280
55 - 59yrs	95,535	85 - 89yrs	43,982	0.460373
60 - 64yrs	92,692	90 - 94yrs	25,301	0.272953
65 - 69yrs	88,309	95 - 99yrs	9,304	0.105357
70 - 74yrs	81,858	100yrs+	1,545	0.018870

Surviving and driving probabilities take into account the preponderance of driving cessation. In order to derive revised S_x, (i.e., S^*_x), the driving cessation probabilities are applied to the probability of dying (q_x) to generate revised l_x, which is the life table population at risk of dying between ages x and $x+1$. The following formula7 is used to apply the cessation probabilities:

$$q^*_x = q_x + cp * (1 - q_x) \qquad (1)$$

[7] Personal communication with Dr. B. Waldorf

Appendix E (Continued)

where q^*_x adjusted probability of dying taking into account cessation probability, q_x probability of dying and cp cessation probability. This formula derives the probability of dying or surviving and driving. The revised l_x are presented in Tables E,5 and E.6 for males and females respectively.

Table E.5 Revised Male Population at Risk of Dying l_x : United States 35yrs+, 2000

Cohort	Probability of Dying (q_x)	Cessation Probability (cp)	Revised Probability of Dying (q^*_x)	Revised Population (l_x)
35 - 39yrs	0.010257	0.000000	0.010257	100,000
40 - 44yrs	0.015126	0.000000	0.015126	98,974
45 - 49yrs	0.022407	0.000000	0.022407	97,477
50 - 54yrs	0.031250	0.000000	0.031250	95,293
55 - 59yrs	0.047977	0.000000	0.047977	92,315
60 - 64yrs	0.073557	0.000000	0.073557	87,886
65 - 69yrs	0.111454	0.050000	0.155881	81,422
70 - 74yrs	0.168277	0.050000	0.209863	68,729
75 - 79yrs	0.248708	0.100000	0.323837	54,306
80 - 84yrs	0.367438	0.100000	0.430694	36,719
85 - 89yrs	0.534164	0.400000	0.720498	20,905
90 - 94yrs	0.720043	0.500000	0.860021	5,843
95 - 99yrs	0.880494	1.000000	1.000000	818
100yrs+	1.000000	1.000000	1.000000	0

Appendix E (Continued)

Table E.6 Revised Female Population at Risk of Dying l_x: United States 35yrs+, 2000

Cohort	Probability of Dying (q_x)	Cessation Probability (cp)	Revised Probability of Dying (q^*_x)	Revised Population (l_x)
35 - 39yrs	0.005667	0.000000	0.005667	100,000
40 - 44yrs	0.008600	0.000000	0.008600	99,433
45 - 49yrs	0.012439	0.000000	0.012439	98,578
50 - 54yrs	0.018667	0.000000	0.018667	97,352
55 - 59yrs	0.029758	0.000000	0.029758	95,535
60 - 64yrs	0.047284	0.000000	0.047284	92,692
65 - 69yrs	0.073047	0.050000	0.119395	88,309
70 - 74yrs	0.110777	0.100000	0.199699	77,765
75 - 79yrs	0.171756	0.200000	0.337404	62,236
80 - 84yrs	0.270477	0.200000	0.416382	41,237
85 - 89yrs	0.424747	0.800000	0.884949	24,067
90 - 94yrs	0.632261	0.990000	0.996323	2,769
95 - 99yrs	0.833978	1.000000	1.000000	10
100yrs+	1.000000	1.000000	1.000000	0

As before calculation of S^*_x is a straight forward division of cohort l_x by a cohort 30 years later l_{x+30}. The resulting survivor probabilities S^*_x are presented in Tables E.7 and E.8.

Table E.7 Survival Probabilities S^*_x for Males: United States 35yrs+, 2030

Cohort	l_x (yr 2000)	Cohort	l_{x+30} (yr 2030)	$S^*_x = \frac{l_x}{l_{x+30}}$
35 - 39yrs	100,000	65 - 69yrs	81,422	0.814215
40 - 44yrs	98,974	70 - 74yrs	68,729	0.694417
45 - 49yrs	97,477	75 - 79yrs	54,306	0.557111
50 - 54yrs	95,293	80 - 84yrs	36,719	0.385332
55 - 59yrs	92,315	85 - 89yrs	20,905	0.226448
60 - 64yrs	87,886	90 - 94yrs	5,843	0.066482
65 - 69yrs	81,422	95 - 99yrs	818	0.010045
70 - 74yrs	68,729	100yrs+	0	0.000000

Appendix E (Continued)

Table E.8 Survival Probabilities S^*_x for Females: United States 35yrs+, 2030

Cohort	l_x (yr 2000)	Cohort	l_{x+30} (yr 2030)	$S^*_x = \frac{l_x}{l_{x+30}}$
35 - 39yrs	100,000	65 - 69yrs	88,309	0.883090
40 - 44yrs	99,433	70 - 74yrs	77,765	0.782086
45 - 49yrs	98,578	75 - 79yrs	62,236	0.631333
50 - 54yrs	97,352	80 - 84yrs	41,237	0.423588
55 - 59yrs	95,535	85 - 89yrs	24,067	0.251916
60 - 64yrs	92,692	90 - 94yrs	2,769	0.029872
65 - 69yrs	88,309	95 - 99yrs	10	0.000115
70 - 74yrs	77,765	100yrs+	0	0.000000

Appendix F Recalculation of Licensing Proportions for Persons Ages 85 and Older in 2030 (Base Year 2000)

In complying with the age groupings originally established in this study, persons ages 85+ years in 2030 would have been ages 55+ years in 2000. Table F.1 revisits the population and licensing data for this cohort. However, amalgamating all persons 55+ years in 2000 would hide important licensing proportions for persons ages 85 years or more which might have an impact on the licensing patterns of the "oldest-old" grouping in 2030. It is therefore prudent to disaggregate the cohort 55+ years in 2000 to smaller grouping where data permits.

Table F.1 Population and Licensing Statistics for the 85year+ Cohort

Population Licensed	Year 2000 (Actual)		Year 2030 (Estimated)	
	Males	Females	Males	Females
Population	26,170,474	33,314,509	3,339,937	6,263,097
Licensed	24,626,777	25,374,152	3,142,927	4,770,317
Licensed proportion (%)	94.10%	76.17%	94.10%	76.17%

Sources: Office of Highway Policy Information, 2001 & Projected Population of the United States, by Age and Sex: 2000 to 2050 (Detailed Table) U.S. Census Bureau, Population Division, Population Projections Branch

In the year 2000, the Office of Highway Policy Information (OHPI) provided licensing data for several cohorts (grouped in 5 year intervals) above 55 years, persons ages 85+ years were grouped together as the last cohort. Assuming that the majority of seniors will die before their 100th birthday, it is possible with the year 2000 OHPI and census data to derive licensing proportions for persons ages 65 to 100 years in 2030. In this case, the last cohort in 2000 that will be of interest here, will be those ages 70 to 75 years. The licensing proportions of persons 55 years and older in 2000 grouped by 5 year intervals are presented in Tables F.2 and F.3, males and females, respectively.

Appendix F (Continued)

Table F.2 Licensing Proportions of Senior Males Ages 55+ years in 2000

Cohort	Population	Licensed Population	Licensed Proportion
55-59	6,553,094	6,394,207	97.58%
60-64	5,165,683	4,970,258	96.22%
65-69	4,402,844	4,182,933	95.01%
70-74	3,904,321	3,644,990	93.36%
75-79	3,051,227	2,820,136	92.43%
80-84	1,853,795	1,656,789	89.37%
85yrs+	1,239,510	957,463	77.25%
Total	26,170,474	24,626,777	94.10%

Source: Office of Highway Policy Information, 2001 & Projected Population of the United States, by Age and Sex: 2000 to 2050 (Detailed Table) U.S. Census Bureau, Population Division, Population Projections Branch

Table F.3 Licensing Proportions of Senior Females Ages 55+ years in 2000

Cohort	Population	Licensed Population	Licensed Proportion
55-59	7,005,933	6,366,285	90.87%
60-64	5,699,026	4,944,370	86.76%
65-69	5,131,111	4,202,950	81.91%
70-74	4,945,625	3,822,570	77.29%
75-79	4,374,151	3,091,013	70.67%
80-84	3,130,873	1,854,278	59.23%
85yrs+	3,027,790	1,092,687	36.09%
Total	33,314,509	25,374,152	76.17%

Office of Highway Policy Information, 2001 & Projected Population of the United States, by Age and Sex: 2000 to 2050 (Detailed Table) U.S. Census Bureau, Population Division, Population Projections Branch

Following the same methodology as presented in the main report to determine future cohorts of licensed persons, seniors reaching 85 years and older in 2030, would have been 55 years and older in 2000. Tables F.4 and F.5 present estimated numbers of licensed seniors (85+ years) for the year 2030.

Table F.4 Licensing Proportions of Senior Males Ages 85+ years in 2030

Cohort 2000	Licensed Prop' 2000	Cohort 2030	Population	Licensed Population
55-59	97.58%	85-89	2,044,641	1,995,066
60-64	96.22%	90-94	884,129	850,681
65-69	95.01%	95-99	316,977	301,145
70-74	93.36%	100+	94,190	87,934
Total			3,339,937	3,234,826

Appendix F (Continued)

Table F.5 Licensing Proportions of Senior Females Ages 85+ years in 2030

Cohort 2000	Licensed 2000	Cohort 2030	Population	Licensed Population
55-59	90.87%	85-89	3,405,952	3,094,986
60-64	86.76%	90-94	1,767,244	1,533,228
65-69	81.91%	95-99	784,822	642,856
70-74	77.29%	100+	305,079	235,801
Total			6,263,097	5,506,872

As can be seen in Tables F.4 and F.5, the senior population figures remain the same but the difference is seen in the licensure numbers. When all persons ages 55+ years were grouped together, the estimated number of licensed approximated 3,142,927 males and 4,770,317 females representing 94.1% and 76.2% of the male and female populations in 2030. Disaggregating the cohort of persons ages 55+ years, the resulting numbers of licensed increases to 3,234,826 males and 5,506,872 females respectively. The largest difference between the aggregated and disaggregated licensed populations is seen in the number of senior females licensed, a 15 percent increase, compared to 3 percent for males.

An important caveat needs to be noted in the interpretation of the licensed persons ages 85+ years, as stated earlier (see section 3.11), it is assumed that non-licensed immigrants coming to the U.S. over the next few decades will acquire licensing status similar to that of their respective age cohorts. However, such licensing behavior may be plausible for persons 35 to 55 years during the intervening period, but those persons of older years less so. A person of 55 years and never driven, who immigrated to the U.S. post-2000 and still alive in 2030 is less likely to learn to drive in their senior years, moreso, if they immigrated to join family members who are able to meet the immigrant's transportation needs. Thus, the revised figures may be an overestimation (i.e., worse case scenario), only time will tell.

Appendix G Population Estimates (2001) Derived from the NHTS Person and Household Files

Table G.1 NHTS Population Estimates (2001)

Cohort	# of Persons (Person File)	# of Persons (Household File)
Refused	4,576	4,572
Don't Know	1,655,483	1,409,219
Not Ascertained	2,776,545	2,494,438
0 - 4yrs	19,626,322	19,367,504
5 - 9yrs	20,180,735	20,253,848
11 - 14yrs	20,964,036	20,369,433
15 - 19yrs	18,135,667	17,199,613
20 - 24yrs	16,851,866	15,063,338
25 - 29yrs	18,637,298	16,471,331
30 - 34yrs	22,190,864	19,052,234
35 - 39yrs	20,858,385	19,978,465
40 - 44yrs	22,723,877	21,256,029
45 - 49yrs	18,236,634	20,698,123
50 - 54yrs	17,349,015	18,958,851
55 - 59yrs	13,091,630	13,974,639
60 - 64yrs	11,036,234	11,649,376
64 - 69yrs	9,595,850	10,193,810
70 - 74yrs	8,917,873	9,500,593
75 - 79yrs	7,048,667	7,626,033
80 - 84yrs	4,419,024	4,951,975
85yrs+	2,902,654	3,295,199
Total	277,203,235	274,828,376
Persons ≥ 65 years	32,884,069	35,567,610
% Persons ≥ 65 years	11.86%	12.94%

Appendix H Transit Market Share Assessments – Detailed Calculations

Table H.1 Market Assessment #1

Line	Martket Analysis #1 - All Seniors	
1	2001 Total Trips 0 - 64yrs	366,272,055,294
2	2001 Total Trips 65yrs+	40,990,429,913
3	2001 Transit Trips 0 - 64yrs	6,149,312,016
4	2001 Transit Trips 65yrs+	503,068,683
5	2001 0 - 64yr pop	244,319,167
6	2001 65yrs+ pop	32,884,068
7	2001 Senior Transit %	7.56%
8	Daily Trip Rate 0 - 64yrs	4.11
9	Daily Trip Rate 65yrs+	3.42
10	Daily Transit Trip Rate 65yrs+	0.07
11	Daily Transit Trip Rate 0 - 64yrs	0.04
12	2030 Total Trips 0 - 64yrs	437,949,301,366
13	2030 Total Trips 65yrs	89,067,705,829
14	2030 Transit Trips 0 - 64yrs	7,352,695,523
15	2030 Transit Trips 65yrs+	1,093,113,040
16	2030 0 - 64yr pop	292,130,964
17	2030 65yrs+ pop	71,453,471
18	2030 Senior Transit %	12.94%

Line	Explanation
1	Total number of trips 0 - 64yrs (NHTS 2001)
2	Total number of trips 65yrs+ (NHTS 2001)
3	Total number of transit trips 0 - 64yrs (NHTS 2001)
4	Total number of transit trips 65yrs+ (NHTS 2001)
5	0 - 64yr population (NHTS 2001)
6	65yrs+ population (NHTS 2001)
7	Senior transit trip market share (line 4 / (line 3 + line 4)
8	Daily trip rate 0 - 64yrs
9	Daily trip rate 65yrs+
10	Daily transit trip rate 0 - 64yrs
11	Daily transit trip rate 65yrs+
12	Estimated trips (0 - 64yrs) 2030 = (line 16 * line 8 * 365)
13	Estimated trips (65yrs+) 2030 = (line 17 * line 9 * 365)
14	Estimated transit trips (0 - 64yrs) 2030 = (line 16 * line 10 * 365)
15	Estimated transit trips (65yrs+) 2030 = (line 17 * line 11 * 365)
16	Estimated population ages 0 - 64 years (census)
17	Estimated population ages 65 years+ (census)
18	Senior transit trip market share (line 15 / (line 14 + line 15)

Appendix H (Continued)

Table H.2 Market Assessment #2

Line	Market Assessment #2 - Seniors Urban/ Rural	Urban	Rural	Total
1	2001 Total Trips 0 - 64yrs	289,645,261,201	76,626,794,127	366,272,055,328
2	2001 Total Trips 65yrs+	32,434,626,485	8,555,803,425	40,990,429,910
3	2001 Transit Trips 0 - 64yrs	6,018,647,645	130,664,372	6,149,312,017
4	2001 Transit Trips 65yrs+	500,341,685	2,726,998	503,068,683
5	2001 0 - 64yr pop	190,950,308	53,368,861	244,319,169
6	2001 65yrs+ pop	25,622,499	7,261,571	32,884,070
7	2001 Senior Transit %	7.68%	2.04%	7.56%
8	Daily Trip Rate 0 - 64yrs	4.16	3.93	4.11
9	Daily Trip Rate 65yrs+	3.47	3.23	3.42
10	Daily Transit Trip Rate 65yrs+	0.09	0.01	0.07
11	Daily Transit Trip Rate 0 - 64yrs	0.05	0.00	0.04
12	2030 Total Trips 0 - 64yrs	341,204,210,139	96,471,304,201	437,675,514,340
13	2030 Total Trips 65yrs	69,646,848,852	19,363,389,264	89,010,238,116
14	2030 Transit Trips 0 - 64yrs	7,090,010,405	164,503,324	7,254,513,730
15	2030 Transit Trips 65yrs+	1,074,383,321	6,171,708	1,080,555,029
16	2030 0 - 64yr pop	224,940,842	67,190,122	292,130,964
17	2030 65yrs+ pop	55,019,173	16,434,298	71,453,471
18	2030 Senior Transit %	13.16%	3.62%	12.96%

Urban/Rural split: 77% and 23%

Line explanation see Table H.1

Appendix H (Continued)

Table H.3 Market Assessment #3

Line	Market Assessment #3 - Urban Seniors and Driving Status	Active Driver	Non & Former Driver	Total
1	2001 Total Trips 0 - 64yrs	213,313,223,561	76,332,037,616	289,645,261,177
2	2001 Total Trips 65yrs+	29,216,362,781	3,218,263,711	32,434,626,492
3	2001 Transit Trips 0 - 64yrs	2,935,343,743	3,083,303,922	6,018,647,665
4	2001 Transit Trips 65yrs+	159,513,500	340,828,189	500,341,689
5	2001 0 - 64yr pop	127,113,550	63,836,759	190,950,309
6	2001 65yrs+ pop	19,892,925	5,729,575	25,622,500
7	2001 Senior Transit %	5.15%	9.95%	7.68%
8	Daily Trip Rate 0 - 64yrs	4.60	3.28	4.16
9	Daily Trip Rate 65yrs+	4.02	1.54	3.47
10	Daily Transit Trip Rate 65yrs+	0.06	0.13	0.09
11	Daily Transit Trip Rate 0 - 64yrs	0.02	0.16	0.05
12	2030 Total Trips 0 - 64yrs	242,216,674,504	96,380,904,381	338,597,578,885
13	2030 Total Trips 65yrs	68,191,259,289	4,824,328,925	73,015,588,215
14	2030 Transit Trips 0 - 64yrs	3,333,076,066	3,893,144,082	7,226,220,147
15	2030 Transit Trips 65yrs+	372,305,975	510,917,513	883,223,488
16	2030 0 - 64yr pop	144,337,144	80,603,699	224,940,842
17	2030 65yrs+ pop	46,430,270	8,588,903	55,019,173
18	2030 Senior Transit %	10.05%	11.60%	10.89%

Line explanation see Table H.1

Appendix H (Continued)

Table H.4 Market Assessment #3 Senior Active, Former and Non-Drivers

Cohort	65-69yrs		70-74yrs		75-79yrs	
Gender	Men	Women	Men	Women	Men	Women
Population (Year 2030)	9,473,104	10,507,158	8,280,824	9,686,847	6,159,657	7,829,249
Licensing Rate	0.942	0.920	0.947	0.926	0.962	0.932
# Licensed	8,922,717	9,670,788	7,841,940	8,971,958	5,926,206	7,299,209
# Non Licensed	550,387	836,370	438,884	714,889	233,451	530,040
Cessation Rate (Foley et al. 2002)	0.00	0.00	0.03	0.06	0.06	0.11
Estimate # Former Drivers	0	0	227,416	529,346	367,425	802,913
Total # Non Drivers	550,387	836,370	666,300	1,244,235	600,876	1,332,953

Urban 2030 (0.77 * Totals)	65-69yrs		70-74yrs		75-79yrs	
Gender	Men	Women	Men	Women	Men	Women
Population	7,294,290	8,090,512	6,376,234	7,458,872	4,742,936	6,028,522
Active drivers	6,870,492	7,446,507	5,863,184	6,500,811	4,280,262	5,002,148
NonDrivers	423,798	644,005	513,051	958,061	462,674	1,026,374
Total	7,294,290	8,090,512	6,376,234	7,458,872	4,742,936	6,028,522

Cohort	80-84yrs		85yrs+		Total 65yrs+	
Gender	Men	Women	Men	Women		
Population (Year 2030)	4,089,194	5,824,404	3,339,937	6,263,097	71,453,471	
Licensing Rate	0.970	0.927	0.941	0.762		
# Licensed	3,968,154	5,398,640	3,142,881	4,770,601	65,913,093	
# Non Licensed	121,040	425,764	197,056	1,492,496	5,540,378	
Cessation Rate (Foley et al. 2002)	0.11	0.19	0.22	0.32		
Estimate # Former Drivers	444,433	1,041,938	688,291	1,512,281	5,614,042	
Total # Non Drivers	565,473	1,467,701	885,347	3,004,777	11,154,419	

Urban 2030 (0.77 * Totals)	80-84yrs		85yrs+		Total 65yrs+	
Gender	Men	Women	Men	Women		
Population	3,148,679	4,484,791	2,571,751	4,822,585	55,019,173	
Active drivers	2,713,265	3,354,661	1,890,034	2,508,907	46,430,270	
NonDrivers	435,414	1,130,130	681,717	2,313,678	8,588,903	
Total	3,148,679	4,484,791	2,571,751	4,822,585	55,019,173	

Appendix H (Continued)

Table H.5 Market Assessment #3 2030 Population Estimates

Population Estimates		Active Drivers (@ 85%)**	Never Driven (@ 15%)	Former Drivers	Total Non-Drivers	Total
0 - 14 Population 2030*	71,600,569					
Urban	55,132,438		55,132,438	0	55,132,438	55,132,438
Rural	16,468,131	na	na	na	na	
15-64 Population 2030	220,530,395					
Urban (77 percent)	169,808,404	144,337,144	25,471,261	0	25,471,261	169,808,404
Rural (23 percent)	50,721,991	na	na	na	na	
Senior Population 65yrs+	71,453,471					
Urban (77 percent)	55,019,173	46,430,270	4,266,091	4,322,812	8,588,903	55,019,173
Rural (23 percent)	16,434,298	na	na	na	na	
Total Population	363,584,435	190,767,413	84,869,790	4,322,812	89,192,602	279,960,015
Total Population (Urban) 279,960,015 persons						
*Driving Age 15yrs						
**Senior active and former drivers as in Table H.4						

Appendix H (Continued)

Table H.6 Market Assessment #4 Urban Non-Driving Seniors According to Household Driver Availability Status

Line	Scenario #4 - Urban Non-Driving Seniors	Zero Driver in Household	Driver in Household	Total
1	2001 Total Trips 0 - 64yrs	5,392,524,661	70,939,512,962	76,332,037,623
2	2001 Total Trips 65yrs+	1,343,355,866	1,874,907,841	3,218,263,707
3	2001 Transit Trips 0 - 64yrs	1,433,165,576	1,650,138,340	3,083,303,916
4	2001 Transit Trips 65yrs+	257,148,542	83,679,644	340,828,186
5	2001 0 - 64yr pop	5,358,808	58,477,956	63,836,764
6	2001 65yrs+ pop	2,348,859	3,380,717	5,729,576
7	2001 Senior Transit %	15.21%	4.83%	9.95%
8	Daily Trip Rate 0 - 64yrs	2.76	3.32	3.28
9	Daily Trip Rate 65yrs+	1.57	1.52	1.54
10	Daily Transit Trip Rate 65yrs+	0.73	0.08	0.13
11	Daily Transit Trip Rate 0 - 64yrs	0.30	0.07	0.16
12	2030 Total Trips 0 - 64yrs	4,055,542,140	92,891,204,607	96,946,746,747
13	2030 Total Trips 65yrs	736,822,839	4,048,813,055	4,785,635,894
14	2030 Transit Trips 0 - 64yrs	1,077,837,145	2,160,761,073	3,238,598,219
15	2030 Transit Trips 65yrs+	141,044,472	180,703,941	321,748,412
16	2030 0 - 64yr pop	4,030,185	76,573,514	80,603,699
17	2030 65yrs+ pop	1,288,335	7,300,567	8,588,903
18	2030 Senior Transit %	11.57%	7.72%	9.04%

Line explanation see Table H.1

Appendix H (Continued)

Table H.7 Market Assessment #4 2030 Population Estimates

Population Estimates		Never Driven (@ 15%)	Former Drivers	Total Non-Drivers	Zero Driver in HH	Driver in HH
0 - 14 Population 2030*	71,600,569					
Urban	55,132,438	55,132,438	0	55,132,438	2,756,622	52,375,816
Rural	16,468,131	na	na	na		
15-64 Population 2030	220,530,395					
Urban (77 percent)	169,808,404	25,471,261	0	25,471,261	1,273,563	24,197,698
Rural (23 percent)	50,721,991	na	na	na		
Senior Population 65yrs+***	71,453,471					
Urban (77 percent)	55,019,173	4,266,091	4,322,812	8,588,903	1,288,335	7,300,567
Rural (23 percent)	16,434,298	na	na	na		
Total Population	363,584,435	84,869,790	4,322,812	89,192,602		
Total Population (Urban)	279,960,015					
*Driving Age 15yrs		Household Split	Zero Driver in HH	Driver in HH		
**Active and former drivers as in Table H.4		2001 0 - 64yr pop	5.0%	95.0%		
		2001 65yrs+ pop	15.0%	85.0%		

Appendix H (Continued)

Table H.8 Market Assessment #5 Urban Non-Driving Seniors According to Household Vehicle Availability Status

Line	Scenario #5 - Urban Non-Driving Seniors	Zero Vehicle in Household	Vehicle in Household	Total
1	2001 Total Trips 0 - 64yrs	7,658,773,577	68,673,264,049	76,332,037,626
2	2001 Total Trips 65yrs+	1,353,076,756	1,865,186,948	3,218,263,704
3	2001 Transit Trips 0 - 64yrs	1,801,485,576	1,281,818,344	3,083,303,920
4	2001 Transit Trips 65yrs+	284,969,789	55,858,397	340,828,186
5	2001 0 - 64yr pop	7,436,026	56,400,733	63,836,759
6	2001 65yrs+ pop	2,376,609	3,352,962	5,729,571
7	2001 Senior Transit %	13.66%	4.18%	9.95%
8	Daily Trip Rate 0 - 64yrs	2.82	3.34	3.28
9	Daily Trip Rate 65yrs+	1.56	1.52	1.54
10	Daily Transit Trip Rate 65yrs+	0.66	0.06	0.13
11	Daily Transit Trip Rate 0 - 64yrs	0.33	0.05	0.16
12	2030 Total Trips 0 - 64yrs	8,301,819,792	88,328,411,955	96,630,231,747
13	2030 Total Trips 65yrs	977,985,426	3,822,270,462	4,800,255,888
14	2030 Transit Trips 0 - 64yrs	1,952,741,971	1,648,690,801	3,601,432,772
15	2030 Transit Trips 65yrs+	205,972,277	114,468,901	320,441,178
16	2030 0 - 64yr pop	8,060,370	72,543,329	80,603,699
17	2030 65yrs+ pop	1,717,781	6,871,122	8,588,903
18	2030 Senior Transit %	9.54%	6.49%	8.17%

Line explanation see Table H.1

Appendix H (Continued)

Table H.9 Market Assessment #5 2030 Population Estimates

Population Estimates		Never Driven (@ 15%)	Former Drivers	Total Non-Drivers	Zero Vehilce in Household	Vehicle in Household
0 - 14 Population 2030*	71,600,569					
Urban	55,132,438	55,132,438	0	55,132,438	0	0
Rural	16,468,131	na	na	na		
15-64 Population 2030	220,530,395					
Urban (77 percent)	169,808,404	25,471,261	0	25,471,261	0	0
Rural (23 percent)	50,721,991	na	na	na		
Senior Population 65yrs+***	71,453,471					
Urban (77 percent)	55,019,173	4,266,091	4,322,812	8,588,903	1,717,781	6,871,122
Rural (23 percent)	16,434,298	na	na	na		
Total Population	363,584,435	84,869,790	4,322,812	89,192,602		
Total Population (Urban)	279,960,015					
*Driving Age 15yrs		Household Split	Zero Vehicle in HH	Vehicle in HH		
**Active and former drivers as in Table H.4		2001 0 - 64yr pop	10.00%	90.00%		
		2001 65yrs+ pop	20.00%	80.00%		

Appendix J Transit Market Share Assessments - Sensitivity Tests

Table J.1 Market Assessment #4 (Sensitivity Test #1 – Trip Rates Male & Female Licensing Proportions Equal)

Line	Scenario #4 - Urban Non-Driving Seniors	Zero Driver in HH	Driver in HH	Total
1	2001 Total Trips 0 - 64yrs	5,392,524,661	70,939,512,962	76,332,037,623
2	2001 Total Trips 65yrs+	1,343,355,866	1,874,907,841	3,218,263,707
3	2001 Transit Trips 0 - 64yrs	1,433,165,576	1,650,138,340	3,083,303,916
4	2001 Transit Trips 65yrs+	257,148,542	83,679,644	340,828,186
5	2001 0 - 64yr pop	5,358,808	58,477,956	63,836,764
6	2001 65yrs+ pop	2,348,859	3,380,717	5,729,576
7	2001 Senior Transit %	15.21%	4.83%	9.95%
8	Daily Trip Rate 0 - 64yrs	2.76	3.32	3.28
9	Daily Trip Rate 65yrs+	1.57	1.52	1.54
10	Daily Transit Trip Rate 65yrs+	0.73	0.08	0.13
11	Daily Transit Trip Rate 0 - 64yrs	0.30	0.07	0.16
12	2030 Total Trips 0 - 64yrs	4,055,542,140	92,891,204,607	96,946,746,747
13	2030 Total Trips 65yrs	631,488,778	3,470,006,456	4,101,495,234
14	2030 Transit Trips 0 - 64yrs	1,077,837,145	2,160,761,073	3,238,598,219
15	2030 Transit Trips 65yrs+	120,881,162	154,871,028	275,752,190
16	2030 0 - 64yr pop	4,030,185	76,573,514	80,603,699
17	2030 65yrs+ pop	1,104,159	6,256,899	7,361,058
18	2030 Senior Transit %	10.08%	6.69%	7.85%

Line explanation see Table H.1

Appendix J (Continued)

Table J.2 Market Assessment #4 (Sensitivity Test #1– Male & Female Licensing Proportions Equal)

Cohort	65-69yrs		70-74yrs		75-79yrs	
Gender	Men	Women	Men	Women	Men	Women
Population	9,473,104	10,507,158	8,280,824	9,686,847	6,159,657	7,829,249
Licensing Rate	0.942	0.942	0.947	0.947	0.962	0.962
# Licensed	8,922,717	9,896,692	7,841,940	9,173,444	5,926,206	7,532,520
# Non Licensed	550,387	610,466	438,884	513,403	233,451	296,729
Cessation Rate	0.00	0.00	0.03	0.06	0.06	0.11
Estimate # Former Drivers	0	0	227,416	541,233	367,425	828,577
Total # Non Drivers	550,387	610,466	666,300	1,054,636	600,876	1,125,306
Urban 2030 (0.77 * Totals)						
Gender	Men	Women	Men	Women	Men	Women
Population	7,294,290	8,090,512	6,376,234	7,458,872	4,742,936	6,028,522
Active drivers	6,870,492	7,620,453	5,863,184	6,646,802	4,280,262	5,162,036
NonDrivers	423,798	470,059	513,051	812,070	462,674	866,485
Total	7,294,290	8,090,512	6,376,234	7,458,872	4,742,936	6,028,522

Cohort	80-84yrs		85yrs+		Total 65yrs+	
Gender	Men	Women	Men	Women		
Population	4,089,194	5,824,404	3,339,937	6,263,097	71,453,471	
Licensing Rate	0.970	0.970	0.941	0.941		
# Licensed	3,968,154	5,652,002	3,142,881	5,893,574	67,950,130	
# Non Licensed	121,040	172,402	197,056	369,523	3,503,341	
Cessation Rate	0.11	0.19	0.22	0.32		
Estimate # Former Drivers	444,433	1,090,836	688,291	1,868,263	6,056,475	
Total # Non Drivers	565,473	1,263,239	885,347	2,237,786	9,559,816	
Urban 2030 (0.77 * Totals)						
Gender	Men	Women	Men	Women		
Population	3,148,679	4,484,791	2,571,751	4,822,585	55,019,173	
Active drivers	2,713,265	3,512,097	1,890,034	3,099,490	47,658,115	
NonDrivers	435,414	972,694	681,717	1,723,095	7,361,058	
Total	3,148,679	4,484,791	2,571,751	4,822,585	55,019,173	

Appendix J (Continued)

Table J.3 Market Assessment #4 Population Estimates (Sensitivity Test #1 – Drivers Male & Female Licensing Proportions Equal)

Population Estimates		**Never Driven (@ 15%)**	**Former Drivers**	**Total Non-Drivers**	**Zero Driver in HH**	**Driver in HH**
0 - 14 Population 2030*	71,600,569					
Urban	55,132,438	55,132,438	0	55,132,438	2,756,622	52,375,816
Rural	16,468,131	na	na	na		
15-64 Population 2030	220,530,395					
Urban (77 percent)	169,808,404	25,471,261	0	25,471,261	1,273,563	24,197,698
Rural (23 percent)	50,721,991	na	na	na		
Senior Population 65yrs+* **	71,453,471					
Urban (77 percent)	55,019,173	2,697,572	4,663,486	7,361,058	1,104,159	6,256,899
Rural (23 percent)	16,434,298	na	na	na		
Total Population	**363,584,435**	**83,301,271**	**4,663,486**	**87,964,757**		
Total Population (Urban)	279,960,015					
*Driving Age 15yrs		Household Split	**Zero Driver in HH**	**Driver in HH**		
**Active and former drivers as in Table J.2		2001 0 - 64yr pop	5.00%	95.00%		
		2001 65yrs+ pop	15.00%	85.00%		

Appendix J (Continued)

Table J.4 Market Assessment #4 (Sensitivity Test #2 – Trip Rates Male & Female Cessation Rates Equal)

Line	Scenario #4 - Urban Non-Driving Seniors	Zero Driver in HH	Driver in HH	Total
1	2001 Total Trips 0 - 64yrs	5,392,524,661	70,939,512,962	76,332,037,623
2	2001 Total Trips 65yrs+	1,343,355,866	1,874,907,841	3,218,263,707
3	2001 Transit Trips 0 - 64yrs	1,433,165,576	1,650,138,340	3,083,303,916
4	2001 Transit Trips 65yrs+	257,148,542	83,679,644	340,828,186
5	2001 0 - 64yr pop	5,358,808	58,477,956	63,836,764
6	2001 65yrs+ pop	2,348,859	3,380,717	5,729,576
7	2001 Senior Transit %	15.21%	4.83%	9.95%
8	Daily Trip Rate 0 - 64yrs	2.76	3.32	3.28
9	Daily Trip Rate 65yrs+	1.57	1.52	1.54
10	Daily Transit Trip Rate 65yrs+	0.73	0.08	0.13
11	Daily Transit Trip Rate 0 - 64yrs	0.30	0.07	0.16
12	2030 Total Trips 0 - 64yrs	4,055,542,140	92,891,204,607	96,946,746,747
13	2030 Total Trips 65yrs	636,130,839	3,495,514,403	4,131,645,242
14	2030 Transit Trips 0 - 64yrs	1,077,837,145	2,160,761,073	3,238,598,219
15	2030 Transit Trips 65yrs+	121,769,757	156,009,482	277,779,239
16	2030 0 - 64yr pop	4,030,185	76,573,514	80,603,699
17	2030 65yrs+ pop	1,112,275	6,302,894	7,415,169
18	2030 Senior Transit %	10.15%	6.73%	7.90%

*Driving Age 15yrs

**Active and former drivers as in Table J.2

Appendix J (Continued)

Table J.5 Market Assessment #4 (Sensitivity Test #2 – Male & Female Cessation Rates Equal)

Cohort	65-69yrs		70-74yrs		75-79yrs	
Gender	Men	Women	Men	Women	Men	Women
Population	9,473,104	10,507,158	8,280,824	9,686,847	6,159,657	7,829,249
Licensing Rate	0.942	0.920	0.947	0.926	0.962	0.932
# Licensed	8,922,717	9,670,788	7,841,940	8,971,958	5,926,206	7,299,209
# Non Licensed	550,387	836,370	438,884	714,889	233,451	530,040
Cessation Rate	0.00	0.00	0.03	0.03	0.06	0.06
Estimate # Former Drivers	0	0	227,416	260,187	367,425	452,551
Total # Non Drivers	550,387	836,370	666,300	975,076	600,876	982,591

Urban 2030 (0.77 * Totals)						
Gender	Men	Women	Men	Women	Men	Women
Population	7,294,290	8,090,512	6,376,234	7,458,872	4,742,936	6,028,522
Active drivers	6,870,492	7,446,507	5,863,184	6,708,064	4,280,262	5,271,927
NonDrivers	423,798	644,005	513,051	750,809	462,674	756,595
Total	7,294,290	8,090,512	6,376,234	7,458,872	4,742,936	6,028,522

Cohort	80-84yrs		85yrs+		Total 65yrs+
Gender	Men	Women	Men	Women	
Population	4,089,194	5,824,404	3,339,937	6,263,097	19,516,632
Licensing Rate	0.970	0.927	0.941	0.762	
# Licensed	3,968,154	5,398,640	3,142,881	4,770,601	17,280,276
# Non Licensed	121,040	425,764	197,056	1,492,496	2,236,356
Cessation Rate	0.11	0.11	0.22	0.22	
Estimate # Former Drivers	444,433	604,648	688,291	1,044,762	2,782,133
Total # Non Drivers	565,473	1,030,412	885,347	2,537,258	5,018,490

Urban 2030 (0.77 * Totals)					
Gender	Men	Women	Men	Women	
Population	3,148,679	4,484,791	2,571,751	4,822,585	15,027,807
Active drivers	2,713,265	3,691,374	1,890,034	2,868,896	11,163,570
NonDrivers	435,414	793,417	681,717	1,953,688	3,864,237
Total	3,148,679	4,484,791	2,571,751	4,822,585	15,027,807

Appendix J (Continued)

Table J.6 Market Assessment #4 (Sensitivity Test #2 – Drivers Male & Female Cessation Rates Equal)

Population Estimates		Never Driven (@ 15%)	Former Drivers	Total Non-Drivers	Zero Driver in Household	Driver in Household
0 - 14 Population 2030*	71,600,569					
Urban	55,132,438	55,132,438	0	55,132,438	2,756,622	52,375,816
Rural	16,468,131	na	na	na		
15-64 Population 2030	220,530,395					
Urban (77 percent)	169,808,404	25,471,261	0	25,471,261	1,273,563	24,197,698
Rural (23 percent)	50,721,991	na	na	na		
Senior Population 65yrs+***	71,453,471					
Urban (77 percent)	55,019,173	4,266,091	3,149,078	7,415,169	1,112,275	6,302,894
Rural (23 percent)	16,434,298	na	na	na		
Total Population	363,584,435	84,869,790	3,149,078	88,018,868		
Total Population (Urban)	279,960,015					
*Driving Age 15yrs		Household Split	Zero Driver in HH	Driver in HH		
**Active and former drivers as in Table J.5		2001 0 - 64yr pop	5.00%	95.00%		
		2001 65yrs+ pop	15.00%	85.00%		

Appendix J (Continued)

Table J.7 Market Assessment #4 (Sensitivity Test #3 – Trip Rates Male & Female Licensing and Cessation Rates Equal)

Line	Scenario #4 - Urban Non-Driving Seniors	Zero Driver in HH	Driver in HH	Total
1	2001 Total Trips 0 - 64yrs	5,392,524,661	70,939,512,962	76,332,037,623
2	2001 Total Trips 65yrs+	1,343,355,866	1,874,907,841	3,218,263,707
3	2001 Transit Trips 0 - 64yrs	1,433,165,576	1,650,138,340	3,083,303,916
4	2001 Transit Trips 65yrs+	257,148,542	83,679,644	340,828,186
5	2001 0 - 64yr pop	5,358,808	58,477,956	63,836,764
6	2001 65yrs+ pop	2,348,859	3,380,717	5,729,576
7	2001 Senior Transit %	15.21%	4.83%	9.95%
8	Daily Trip Rate 0 - 64yrs	2.76	3.32	3.28
9	Daily Trip Rate 65yrs+	1.57	1.52	1.54
10	Daily Transit Trip Rate 65yrs+	0.73	0.08	0.13
11	Daily Transit Trip Rate 0 - 64yrs	0.30	0.07	0.16
12	2030 Total Trips 0 - 64yrs	4,055,542,140	92,891,204,607	96,946,746,747
13	2030 Total Trips 65yrs	631,488,778	3,470,006,456	4,101,495,234
14	2030 Transit Trips 0 - 64yrs	1,077,837,145	2,160,761,073	3,238,598,219
15	2030 Transit Trips 65yrs+	120,881,162	154,871,028	275,752,190
16	2030 0 - 64yr pop	4,030,185	76,573,514	80,603,699
17	2030 65yrs+ pop	1,104,159	6,256,899	7,361,058
18	2030 Senior Transit %	10.08%	6.69%	7.85%

Line explanation see Table H.1

Appendix J (Continued)

Table J.8 Market Assessment #4 (Sensitivity Test #3 Male & Female Licensing and Cessation Rates Equal)

Cohort	65-69yrs		70-74yrs		75-79yrs	
Gender	Men	Women	Men	Women	Men	Women
Population	9,473,104	10,507,158	8,280,824	9,686,847	6,159,657	7,829,249
Licensing Rate	0.942	0.942	0.947	0.947	0.962	0.962
# Licensed	8,922,717	9,896,692	7,841,940	9,173,444	5,926,206	7,532,520
# Non Licensed	550,387	610,466	438,884	513,403	233,451	296,729
Cessation Rate	0.00	0.00	0.03	0.03	0.06	0.06
Estimate # Former Drivers	0	0	227,416	266,030	367,425	467,016
Total # Non Drivers	550,387	610,466	666,300	779,433	600,876	763,745
Urban 2030 (0.77 * Totals)						
Gender	Men	Women	Men	Women	Men	Women
Population	7,294,290	8,090,512	6,376,234	7,458,872	4,742,936	6,028,522
Active drivers	6,870,492	7,620,453	5,863,184	6,858,709	4,280,262	5,440,438
NonDrivers	423,798	470,059	513,051	600,163	462,674	588,084
Total	7,294,290	8,090,512	6,376,234	7,458,872	4,742,936	6,028,522

Cohort	80-84yrs		85yrs+		Total 65yrs+	
Gender	Men	Women	Men	Women		
Population	4,089,194	5,824,404	3,339,937	6,263,097	19,516,632	
Licensing Rate	0.970	0.970	0.941	0.941		
# Licensed	3,968,154	5,652,002	3,142,881	5,893,574	18,656,610	
# Non Licensed	121,040	172,402	197,056	369,523	860,022	
Cessation Rate	0.11	0.11	0.22	0.22		
Estimate # Former Drivers	444,433	633,024	688,291	1,290,693	3,056,441	
Total # Non Drivers	565,473	805,427	885,347	1,660,215	3,916,463	
Urban 2030 (0.77 * Totals)						
Gender	Men	Women	Men	Women		
Population	3,148,679	4,484,791	2,571,751	4,822,585	15,027,807	
Active drivers	2,713,265	3,864,613	1,890,034	3,544,219	12,012,130	
NonDrivers	435,414	620,178	681,717	1,278,366	3,015,676	
Total	3,148,679	4,484,791	2,571,751	4,822,585	15,027,807	

Appendix J (Continued)

Table J.9 Market Assessment #4 (Sensitivity Test #3 Drivers Male & Female Licensing and Cessation Rates Equal)

Population Estimates		Never Driven (@ 15%)	Former Drivers	Total Non-Drivers	Zero Driver in Household	Driver in Household
0 - 14 Population 2030*	71,600,569					
Urban	55,132,438	55,132,438	0	55,132,438	2,756,622	52,375,816
Rural	16,468,131	na	na	na		
15-64 Population 2030	220,530,395					
Urban (77 percent)	169,808,404	25,471,261	0	25,471,261	1,273,563	24,197,698
Rural (23 percent)	50,721,991	na	na	na		
Senior Population 65yrs+***	71,453,471					
Urban (77 percent)	55,019,173	2,697,572	3,375,933	6,073,505	911,026	5,162,479
Rural (23 percent)	16,434,298	na	na	na		
Total Population	363,584,435	83,301,271	3,375,933	86,677,204		
Total Population (Urban)	279,960,015					
*Driving Age 15yrs		Household Split	Zero Driver in HH	Driver in HH		
**Active and former drivers as in Table J.8		2001 0 - 64yr pop	5.00%	95.00%		
		2001 65yrs+ pop	15.00%	85.00%		

Appendix K Focus Group Questionnaire – Current Drivers

TRANSIT USE VIABILITY OF SENIORS LOSING DRIVING PRIVILEGES
(Persons who have reduced their driving exposure)

This study is about senior travel behavior, how do you get from home to the grocery store, or pharmacy and back home again? We will ask you questions about how you travel locally. We don't require your name and will not be selling you anything and your responses will remain confidential.

Questions about your driving status

1. How many years have you driven to date?
□ more than 40 years
□ 21 to 40 years
□ 6 to 20 years
□ 1 to 5 years

2. Do you hold a valid driver's license issued by any state in the U.S.?
□ Yes (go to question 3)
□ No (go to question 4)

3. In which year will your current driver's license expire?
□ 2006
□ 2007 to 2008
□ 2009 to 2010
□ 2011 or later

4. Are you currently driving a car for at least one trip per week?
□ Yes
□ No

Questions about transportation

5. Which transportation mode do you currently use for the majority of your local trips? (check one response only)
□ Drive myself (in a personally operated vehicle)
□ Car passenger (where someone else is driving)
□ Public transit (i.e., Hartline Bus, Sunshine Line, Trolley)
□ Other …….

6. What one factor gives you concern about using public transit? (check one response only)
□ Being worried about the expense of using public transit
□ Public transit does not go where I want to go
□ Public transit takes too long to get to where I want to go
□ Getting to and traveling on public transit is difficult
□ Public transit is not available when I need to travel
□ Being worried about crime on public transit
□ Lack of information about public transit

Appendix K (Continued)

7. What one factor if changed would make public transit an option for you to use today? (check one response only)

□ Free or low cost public transit services
□ Many more destinations (i.e., it goes to where I want to go)
□ Faster service (i.e., takes a short time to where I want to go)
□ Accessibility (i.e., closer to my home and easier to get on or off)
□ Higher frequency of services
□ Visible personal safety and security measures, e.g. transit police
□ More information and training about using public transit
□ Nothing – I still would not use public transit despite improvements

Questions about you and your household

8. Total number of persons in your household (including yourself)? .....

9. Total number of persons with driver's licenses in your household (including yourself)? .....

10. Total number of vehicles in your household .....

11. Who normally drives the car in your household?

□ Yourself
□ Spouse/partner/significant other
□ Someone else (other than spouse/partner/significant other)
□ Not driven at all

12. Who would be your first choice in assisting you with transportation if you needed it? (check one only)

□ Spouse/significant other
□ Adult children
□ Other relative (e.g., son-in-law or grandchild related to you)
□ Friend/neighbor/volunteer (unrelated to you)
□ Caretaker/Hired-help (not a taxi)
□ No one else

Questions about You

13. Gender

□ Male
□ Female

14. Are you?

□ Between 55 years and 64 years of age
□ Between 65 years and 74 years of age
□ Between 75 years and 84 years of age
□ Above 85 years of age

Appendix K (Continued)

15. What is your race or ethnic heritage?
□ White non-Hispanic
□ African American/Black non-Hispanic
□ Hispanic of any Race
□ Other

16. Which of the following best describes your annual household income in 2005?
□ Up to $30,000
□ Over $30,000

17. If you had to relocate to another residential location this year how important would access to public transit be to you? (check one response only)
□ Extremely important
□ Important
□ Somewhat important
□ Unimportant
□ Irrelevant/no importance

18. In the past 12 months have you considered that you may have to stop driving at some time in the future?
□ Yes
□ No

19. Do you think that public transit (i.e., Hartline Bus, Sunshine Line, Trolley) is a viable transportation alternative for you to use today?
□ Yes
□ No

There is a possibility that we would like to follow up later this year on your travel experiences, would this be OK with you?

□ Yes
□ No

Name ……

Contact Number …….

Thank you!!!

Appendix L Focus Group Questionnaire – Former and Non-Drivers

TRANSIT USE VIABILITY OF SENIORS LOSING DRIVING PRIVILEGES
(Persons who have permanently stopped driving)

This study is about senior travel behavior, how do you get from home to the grocery store, or pharmacy and back home again? We will ask you questions about how you travel locally. We don't require your name and will not be selling you anything and your responses will remain confidential.

Questions about your driving status

1. How many years had you driven at the time when you stopped?
□ more than 40 years
□ 21 to 40 years
□ 6 to 20 years
□ 1 to 5 years

2. Do you hold a valid driver's license issued by any state in the U.S.?
□ Yes (go to question 3)
□ No (go to question 4)

3. In which year will your current driver's license expire?
□ 2006
□ 2007 to 2008
□ 2009 to 2010
□ 2011 or later

Questions about when you permanently stopped driving

4. Which year did you stop driving?
□ 1989 or before
□ between 1990 and 1999
□ between 2000 and 2002
□ between 2003 and 2005

5. Which was the primary factor that influenced you to stop driving? (check one response only)
□ License revoked
□ Health reasons
□ Financial reasons
□ Personal discomfort with driving
□ Family pressure
□ Other ……

Appendix L (Continued)

6. Since the time that you stopped driving till now have you used public transit (e.g., Hartline Bus, Sunshine Line, Trolley) for any local trip, i.e., from your home to the grocery store or doctor?

□ Yes
□ No

Questions about transportation

7. Which transportation mode do you currently use for the majority of your local trips? (check one response only)

□ Car passenger (where someone else is driving)
□ Public transit (i.e., Hartline Bus, Sunshine Line, Trolley)
□ Walk
□ Other ……..

8. What one factor gives you concern about using public transit? (check one response only)

□ Being worried about the expense of using public transit
□ Public transit does not go where I want to go
□ Public transit takes too long to get to where I want to go
□ Getting to and traveling on public transit is difficult
□ Public transit is not available when I need to travel
□ Being worried about crime on public transit
□ Lack of information about public transit

9. What one factor *if changed* would make public transit an option for you to use today? (check one response only)

□ Free or low cost public transit services
□ Many more destinations (i.e., it goes to where I want to go)
□ Faster service (i.e., takes a short time to where I want to go)
□ Accessibility (i.e., closer to my home and easier to get on or off)
□ Higher frequency of services
□ Visible personal safety and security measures, e.g. transit police
□ More information and training about using public transit
□ Nothing – I still would not use public transit despite improvements

Questions about you and your household

10. Total number of persons in your household (including yourself)? .....

11. Total number of persons with driver's licenses in your household (including yourself)? .....

12. Total number of vehicles in your household

Appendix L (Continued)

13. Who normally drives the car (the majority of the time) in your household? (check one response only)
□ Spouse/partner/significant other
□ Someone else (other than spouse/partner/significant other)
□ Not driven at all
□ A car is not available in my household to drive

14. Who would be your first choice in assisting you with transportation if you needed it? (check one response only)
□ Spouse/significant other
□ Adult children
□ Other relative (e.g., son-in-law or grandchild related to you)
□ Friend/neighbor/volunteer (unrelated to you)
□ Caretaker/Hired-help (not a taxi)
□ No one else

Questions about You

15. Gender
□ Male
□ Female

16. Are you?
□ Between 55 years and 64 years of age
□ Between 65 years and 74 years of age
□ Between 75 years and 84 years of age
□ Above 85 years of age

17. What is your race or ethnic heritage?
□ White non-Hispanic
□ African American/Black non-Hispanic
□ Hispanic of any Race
□ Other

18. Which of the following best describes your annual household income in 2005?
□ Up to $30,000
□ Over $30,000

19. If you had to relocate to another residential location this year how important would access to public transit be to you? (check one response only)
□ Extremely important
□ Important
□ Somewhat important
□ Unimportant
□ Irrelevant/no importance

Appendix L (Continued)

20. Do you think that public transit (e.g., Hartline Bus, Sunshine Line, Trolley) is a viable transportation alternative for you to use today?

□ Yes
□ No

There is a possibility that we would like to follow up later this year on your travel experiences, would this be OK with you?

□ Yes
□ No

Name ……

Contact Number …….

Thank you!!!

ABOUT THE AUTHOR

Oliver A. Page received a Bachelor of Science (Honors-*magna cum laude*) in Maritime Studies (International Transport Option) from the University of Wales (UK) in 1985; a Master of Science in Transportation Planning and Engineering from the University of Southampton (UK) in 1989; and a Certificate in Logistics Management from Rand Afrikaans University in South Africa in 2000. He has over 15 years of professional and academic experience in transportation planning and engineering, working for private, local/state, and international agencies in Europe, North America and Southern Africa. Throughout his professional and academic careers, he has published in peer-reviewed journals, presented at numerous professional meetings, and won several awards. Mr. Page has a passion for encouraging high school students to consider transportation as a 'hot' career option.