SENIOR CITIZENS' ADAPTIVE STRATEGIES TO GET AROUND IN THEIR COMMUNITIES: A CASE STUDY OF YAO CITY, JAPAN

A Dissertation

by

AYA YOSHIKAWA

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2011

Major Subject: Geography

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ABSTRACT

Senior Citizens' Adaptive Strategies to Get Around in Their Communities:

A Case Study of Yao City, Japan. (December 2011)

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Chair of Advisory Committee: Dr. Robert S. Bednarz

This study investigated the relationship between seniors' travel behaviors and living environments and the ways they successfully adapt to the environments, using a sequential mixed method in which qualitative methods follow quantitative analyses. The data were collected from the members of social clubs who regularly visit a community center for the elderly in a mid-size city in Osaka prefecture, Japan. One hundred ninety three seniors participated in the questionnaire survey asking about their daily travel patterns, personal backgrounds, social relations, and environmental information. Twenty-one seniors shared their perceptions of the city and the ways in which they get around through face-to-face interviews, sketch mapping, and one-week travel diary.

The findings highlighted cultural and gender influences on seniors' mobility and the proactive nature of their travel behaviors. The participants were relatively healthy and active seniors who travel primarily by bicycle. The statistical analyses indicated that gender did not determine overall or average travel frequency but did identify factors related to high travel frequency. Living near a bus stop and the perception of going out more often than in the past predicted men's high travel frequency (going out every day),

while women's high travel frequency was predicted by travel modes (bicycling and walking), sidewalk safety, chores (grocery shopping), and social network (seeing friends and having fewer relatives).

Furthermore, the results of qualitative analyses revealed that seniors invented, modified, and applied various adaptive strategies to maintain or enhance their mobility. The positive perceptions of their communities such as favorable memories and beautiful scenery fostered seniors' familiarity and sense of belonging. Seniors used and modified social and environment resources to ensure travel safety. In addition, changes in senior's life stages and travel means manifested gender differences in their adaptive strategies. Men tended to focus on maintaining good health to keep their driver's license, representing their social role as a provider, while women's adaptations related to adjustment to widowhood and travel safety.

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CHAPTER I

INTRODUCTION

The primary purpose of this research is to explore the relationship between the travel behaviors of community-dwelling senior citizens and their living environments. Getting around in a community can become challenging as one ages with decreasing stamina, visual acuity and strength. Modes of transportation become limited due to driving cessation. Nevertheless, mobility is an extremely critical issue in maintaining one's autonomy and quality of life. Despite the growing number of aging population worldwide, older adults' travel behaviors have been understudied and are mostly limited to the investigation of the correlation between travel patterns and environmental factors. Little attention has been paid to the local context constructed from both physical and social environments (Wahl and Lang 2006).

This research aims to fill the gap and further extend the questions of 'what' to 'how' senior citizens engage with the outdoor environment in a particular community setting, a mid-size city in Osaka prefecture in Japan. By combining quantitative data presenting the general pattern of the senior citizens' travel behaviors and qualitative data offering further explanation of the way they get around in the community, this research provides relevant information to the community and to transportation planners to promote supportive environments which could increase mobility and life quality of senior citizens.

This dissertation follows the style of *The Professional Geographer*.

World Population Aging and Japan

Population aging is a conspicuous demographic phenomenon today. With the decrease in fertility and the increase in life expectancy that has occurred, the number of people falling into the elderly category (60 years of age or older) is growing by 2.6 percent each year. On the other hand, the annual growth rate of the world population is only 1.2 percent (United Nations 2009). Regionally speaking, more developed regions (MDR) have and will have a larger proportion of adults above the age of 60 than less developed regions (LDR) although the absolute number of older adults in LDR is larger than those of MDR. This trend, which is projected to continue at least until 2050, requires most countries to prepare for a graying society. Japan has one of the fastest aging populations in the world. The country has the highest life expectancy with 86.4 years for women and 79.6 years for men, and the largest proportion of people aged 65 years and over, 22.7 percent (Statistics Bureau Japan 2011).

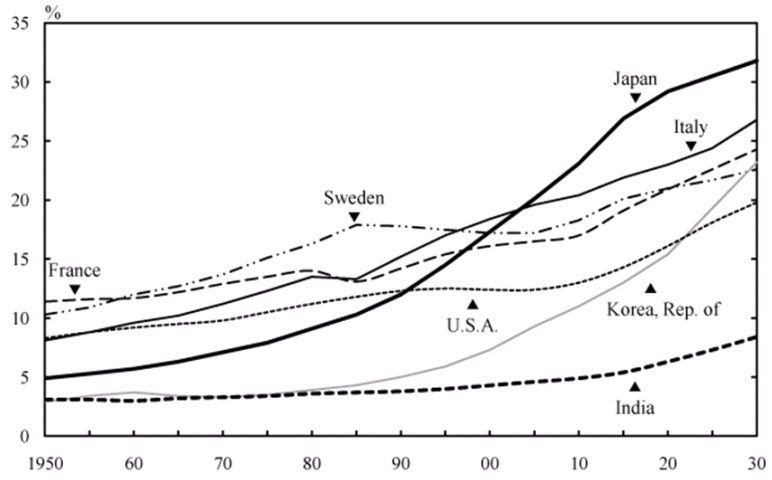

Figure 1 *Proportion of Elderly Population by Country, aged 65 years and over. Source: Statistic Bureau Japan (2011).*

Moreover, the country has a higher rate of population aging than those of Western European countries or the U.S.A. (Figure 1). The proportion of Japanese people aged 65 and over is projected to reach over 30 percent in 2025 (Ministry of Health Labor and Welfare Japan 2000). In Japan, the increase in aging has been more profound in the major metropolitan areas of Tokyo, Osaka, and Nagoya than any other regions since year 2000 (Ministry of Health Labor and Welfare Japan 2000). This is because the first baby boomers, who were born immediately after WWII, migrated into those areas for education and job opportunities during the years of high economic growth, and the actual 'aging in place' has taken place since then. Considering the growing aging population in urban environments, the ways senior citizens experience and perceive urban surroundings should be further investigated to promote supportive urban environments for the growing number of senior citizens.

Benefits of Out-of-Home Activities and Active Aging

A number of studies from multiple disciplines highlight the impact of living environments on older adults' health outcomes. Specifically, a growing number of studies in medical sciences and public health suggest significant benefits of active engagement in out-of-home activities on senior citizens' physical and psychological functioning and maintaining social networks (e.g., Abbott et al. 2004; Kweon, Sullivan, and Wiley 1998; Weuve et al. 2004; Yaffe et al. 2001; Sugiyama and Thompson 2007).

Regularly taking long walks was found to be associated with the prevention of cognitive decline (Yaffe et al. 2001), the improvement of cognitive performance (Weuve et al. 2004), and the low risk of dementia (Abbott et al. 2004). Exposure to sunlight prevents not only insomnia, which is a common problem in older adults (Hood, Bruck, and Kennedy 2004), but also vitamin D deficiency which can disturb bone metabolism and cause the development of hypertension (Holick 2002). Furthermore, morning rather than evening light reduces depression (Ulrich and Zimring 2004) and agitation among older adults with dementia (Lovell, Ancoli-Israel, and Gevirtz 1995). In terms of subjective well-being, a study examining behaviors of older adults living in a public housing development revealed that green public space is related to better life satisfaction as well as an increase in older adults' social interactions and their sense of belonging (Kweon, Sullivan, and Wiley 1998).

The findings of those studies suggest the potential benefits of actively engaging outdoor environments in late life. The significant influences of various environmental factors are highlighted through the concept of active aging which the World Health Organization (WHO) (2002) defines as "the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age." The concept incorporates the major determinants of active aging (Figure 2). Culture and gender are two key components which affect all of the other determinants: health and social services, physical environment, and behavioral, personal, social, and economic determinants. It implies that understanding the context of surrounding environments shaped by culture and gender is indispensable (World Health Organization 2002).

Figure 2 *The determinants of Active Ageing. Source: Word Health Organization (2002).*

More specifically, culture is the key component which shapes individual behaviors as well as socio-economic and physical settings. Thus, the studies investigating a wide variety of determinants in specific contexts are needed to provide insight into understanding and promoting active aging.

With this regard, World Health Organization launched Age-Friendly Environments Programme to develop a guideline for promoting active aging (World Health Organization 2007). The guideline, which was derived from the research findings of 35 cities around the world, introduces wide varieties of domains determining seniors' mobility - from social aspects such as social inclusion and physical environments such as outdoor space and transportation to the dissemination of communication network and information. Thus, the issues of senior citizens' living environments have received a particular attention to address mobility concerns.

Mobility

Mobility can be defined and measured in various ways depending on the focus of the specific study. There are three main foci: (1) the speed and success of performance (Ettinger 1994); (2) the ability to practice activities of daily living (ADLs), which are measured by "basic self-care tasks such as eating, bathing, toileting, walking, or dressing," (Cavanaugh and Blanchard-Fields 2005); (3) the ability to conduct activities of instrumental daily living (AIDLs), which are "actions that entail some intellectual competence and planning" (Cavanaugh and Blanchard-Fields 2005). These measures are useful for simply evaluating one's physical movement or performance.

In large scale environments such as neighborhoods, however, the nature of travel such as frequency, distance, and area over which one typically travels (May, Nayak, and Isaacs 1985) and the modes of travel represent better indicators of mobility because they reflect not only physical but also socio-cultural factors. In fact, a number of studies indicate that the distance and area over which an individual typically travels are strongly associated with the individual's level of income, education (Golant 1984; Tahara, Arai, and Kawaguchi 1996), gender (Collia, Sharp, and Giesbrecht 2003), and residential environment (Mitani 1997; Osugi 1987; Carp 1980).

Studies of Travel Behaviors in Japan

At regional or national levels, travel patterns in Japan have been predominantly examined based on trip surveys conducted in major metropolitan areas like Tokyo, Osaka, and Nagoya every ten years (Ministry of Health Labor and Welfare Japan 2000).

Also, some governmental offices such as the Cabinet Office conduct regular surveys of elderly people's views on daily living (2009). The large-scale trip surveys ask randomly sampled participants to provide information about origins, destinations, purposes and means of their daily trips. The results of these surveys provide information about the volume and flow of trips made in a particular metropolitan area. The opinion surveys, on the other hand, specifically target about 3000 randomly selected senior citizens who are 65 years old or older. It offers detailed information on travel behavior: the frequency of travel, transportation modes, purposes, and barriers encountered when traveling (Cabinet Office Japan 2000, 2005, 2010a).

The results of those surveys are valuable for gaining a big picture of senior citizens' travel patterns. However, the context of community settings, older adults' perceptions of neighborhood and specific strategies they employ to participate in out-of-home activities are not well described or understood. In order to better understand how senior citizens get around their communities, this study examines the relationship between their travel behaviors and their social and physical environments as well as their perception of neighborhoods. The data were collected by questionnaire survey, travel diary, sketch mapping and interviews with the elderly who regularly visit the Yao Welfare Center for the Elderly in Osaka, Japan.

Organization of Dissertation

Chapter II provides a literature review of major theoretical frameworks in environmental gerontology and the empirical evidence of senior citizens' travel

behaviors in Japan and the United States. In addition, the chapter introduces the concept of and previous research about cognitive mapping, a method implemented in this study to gain participants' perceptions of their environments.

Chapter III introduces this study's specific research questions and methodology to investigate older adults' travel behaviors. The general travel patterns of the senior citizens are examined using statistical analysis. In addition, perceptions of their community environments and the way in which they get around are qualitatively analyzed to gain insight into their travel behaviors. The study site, Yao City, and the data collection site, Yao Welfare Center for the Elderly (YWCE), are described in detail.

Chapter IV provides the results of the quantitative analysis obtained from a semi-structured questionnaire survey. The results include both simple descriptive statistics which introduce participants' profile, and bivariate and multivariate statistics which examine possible explanatory factors on the participants' travel behaviors.

Chapter V presents the results of the qualitative analysis using observation of sketch mapping, one-week travel diary, and interviews. Moreover, the participants' perceptions of the community environments are explored to investigate the specific strategies used in their daily travel.

Chapter VI is devoted to the discussion which synthesizes both the quantitative and qualitative results to explain senior citizens' travel behaviors. The discussion also takes the local context into account. In addition, the results are summarized with their implications on public policy with regard to research in senior citizens' outdoor mobility and community and transportation for an aging society.

CHAPTER II

LITERATURE REVIEW

The objective of this chapter is to provide a review of literature to indicate the research gaps that will be explored in this study. To address mobility issues of senior citizens, this chapter discusses three major themes: 1) the theoretical framework of aging in an environment, 2) the empirical evidence of factors related to senior citizens' out-of-home mobility, and 3) the concept of cognitive mapping and its use for understanding one's perception of a city. The chapter provides the rationale for exploring the relationship between senior citizens, neighborhoods and perceptions of their environments needs.

Theoretical Frameworks of Older Adults and Environments

In historic environmental gerontology, older adults were initially conceptualized as vulnerable agents whose adaptation is determined by their declining competences and demanding environments. The most influential theoretical frameworks in environmental gerontology are the environment docility hypothesis (Lawton and Simon 1968) and the ecological model of aging, which is also known as the competence-press model (Lawton and Nahemow 1973). The fundamental nature of both frameworks is explained by the simple ecological equation (Lewin 1935):

$$B = f(P, E)$$

As shown in the equation, a person's behavior (B) is a function of both a person (P) and surroundings (E).

In the environment docility hypothesis (Lawton and Simon 1968), older persons with lower competence perceive the environment as more challenging. The hypothesis was derived from the findings of a study examining the establishment of social relations in a nursing home. The physical environment, specifically the distance between older adults' residences was found to be related to the development of social networking. In other words, the longer the distance between their residences, the less chance they established social relations. Importantly, the results were most dramatic among frail older adults. Based on the hypothesis, Lawton and Nahemow (1973) introduced the competence-press model which depicts older adults' adaptive outcome determined by balance between persons' competences such as one's health condition, sensor functioning and ego strength, and environmental demands (Figure 3).

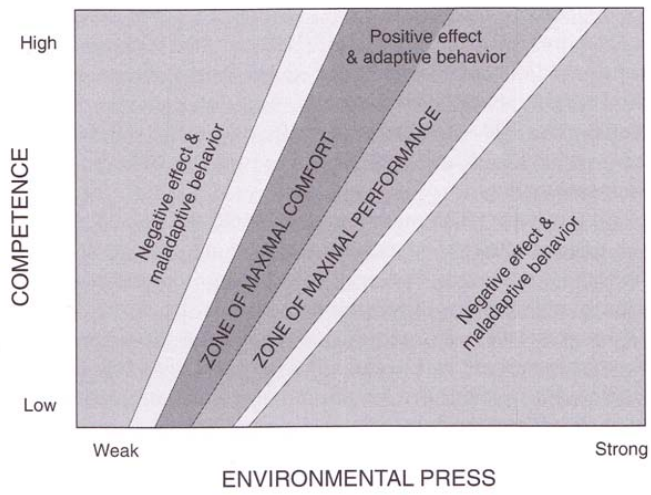

Figure 3 *Ecological Model of Aging. Source: Adapted from Lawton and Nahemow (1973).*

According to the model, some excess environmental demand over competence is desirable for older adults to get motivated (Nahemow 2000). The original ecological frameworks which explain adaptive outcomes in frail older adults who reside in an institutional setting, have been modified by incorporating a broader conceptualization of older adults' profile in living environments: homes, assisted livings and communities. By acknowledging the drawback of the environmental docility hypothesis, the superimposing nature of environments over persons, Lawton (1982) incorporates the notion of transaction, the interactive relationship between a person and his/her environment into the Lewin's ecological equation (1935):

$$B = f(P, E, P \times E)$$

This equation introduces an interactive process (P ×E) which entails an individual personality and environmental cognition into the original equation (Lawton 1982). The interaction term accounts for the significant impact of how a person perceives and responds to the environment.

As Lawton pointed out through the significance of the interactive process in human behaviors, the connotations of certain elements in the surroundings depend on reception and interpretation by human agents. In this regard, Gibson introduced the notion of affordance in the ecological approach. Affordances are attributes which environments 'offer' us (Gibson 1979). When we explore environments, certain functional properties of environments are perceived by humans. The meanings of functional properties, affordance, differ among various organisms. For instance, a study of environmental perception among older adults in assisted living facilities revealed that

greenways, overhead shelters, and sitting areas are the top three preferred built elements in outdoor environments (Rodiek 2006). Those top three elements can be understood from a perspective of Gibson's affordances. Greenways offer older adults reduced traffic congestion and fresh air. They represent the functional properties which offer the space for physical activity. Overhead shelters provide shade from direct sunlight. Sitting areas provide supportive environments to those older adults who are physically challenged. Thus, the concept of affordances is essential to understanding spatial behaviors of elderly people.

The active nature of older adults was addressed through the environmental proactivity hypothesis (Lawton 1989). The hypothesis posits "the greater the competence of the person, the more likely the person's needs and preferences will be successfully exercised to search the environment for resources to satisfy the needs (Lawton 1989, p16)." In Lawton's framework, there are two types of environmental resources: those already provided (externally generated) and those created by individuals. Examples include not only external environmental modifications such as amenities in a local setting and the formation of social relations but also internally modified or organized resources such as the formation of environmental information also known as cognitive maps (Lawton 1989). Cognitive maps are mental constructs created by the processes of acquisition, accumulation, remembrance, and representation of spatial environments. They have been studied to explore the dynamic information of individuals' knowledge about places and their attitudes and meanings (Downs and Stea 1973; Moore and Golledge 1976; Kitchin 1994). The notion of proactivity proposed by Lawton (1989)

implies the process of modifying one's environmental information for one's convenience in everyday life. Thus, the evolution of ecological frameworks recognizes that healthy older adults are not necessarily passive but active agents who modify or utilize personal and environmental resources as well as cognitive representations of their surroundings to better adapt to their environments.

Despite the growing interest in senior citizens' environments, older adults' behaviors at larger scales, especially in community settings, are not fully understood. One major critique of studies of older adults' environments is that theoretical perspectives are mostly developed in the domain of either physical environments or social environments, and the knowledge of older adults' environment in the physical context and social context has developed independently (Wahl and Lang 2003, 2006). In these studies, the physical environment is defined as a spatial and material domain. These studies deal with the impacts of physical and spatial aspects of the home and community environments on aging and accompanying behaviors (Wahl and Lang 2003). On the other hand, the social environment is defined as a domain which includes relations with other people. Examples include social networks and the regulation of social relations in late life (Wahl and Lang 2003). Specifically, ecological frameworks such as Lawton's, which were originally developed to explain older adults' adaptation in small-scale environments such as nursing homes, predominantly emphasized the significance of physical aspects of environments but put little emphasis on social aspects (Wahl and Lang 2003).

According to Wahl and Lang (2003, 2006), the lack of theoretical perspectives that integrate physical and social contexts is problematic since both aspects are not only dynamic but also intertwined and essential for understanding older adults' environment. In this regard, the recent attempts to develop more heuristic frameworks integrating personal and socio-physical environmental factors are particularly vital when studies take place at large scale environments such as community and neighborhood settings where both social and cultural contexts play a critical role in affecting behaviors (i.e.,Mollenkopf et al. 2005; Mollenkopf et al. 2006; Wahl and Lang 2003; Lord and Luxembourg 2006). Daily travel occurs in a geographical space or place which is defined as "an amalgam of social, cultural, historic, political, economic and physical features, […] [and it] make[s] up the meaningful context of human life (Cutchin 2005)." To better understand daily experiences of older adults, it is imperative to examine various contextual settings and highlight similarities and differences that correlate with outdoor mobility in older adults.

One of the attempts to bridge physical and social contexts to conceptualize older adults' behaviors in a living environment is Social-Physical Place Over Time, SPOT (Wahl and Lang 2003, 2006). SPOT introduces three different aspects of older adults' environments: place, social impact, and dynamism. The concept of place is critical since place is where "every aging person's day-to-day behavior is embedded within given physical and spatial surroundings" (Wahl and Lang 2003, p. 17). Place represents a socially constructed physical environment which does not have a static but a dynamic nature. By acknowledging those critical elements of both physical and social

environments, SPOT posits changes in the significance of three dimensions: 1) stimulation and activation, 2) safety and familiarity, and 3) continuity and preservation of meaning. The last two domains, safety and familiarity, and continuity and preservation of meaning, become more significant while stimulation and activation becomes less important as we get old. The framework also proposes shifts in environmental significance, that is, the increased significance of social environments rather than physical environments as we age.

Another conceptual framework which highlights both social and physical environments is MOBILATE, Enhancing Outdoor Mobility in Late Life-Personal Coping, Environmental Resources, and Technical Support, which was introduced in a large-scale interdisciplinary project investigating the different travel patterns in older adults in five European countries, Finland, Germany, Hungary, Italy, and Netherlands (Mollenkopf et al. 2004; Mollenkopf et al. 2005; Mollenkopf et al. 2006). It suggests that older adults' mobility, a contributor to quality of life, is determined by three resources: personal resources such as health and psychological factors, socio-economic resources such as income and education, and structural or environmental resources such as infrastructure, social networks and residential characteristics (Figure 4). Similarly, in a study specifically investigating older adults who lost their driver's license, Lord and Luxembourg (2006) propose a conceptual framework which depicts the way these individuals adapt to their environments over time.

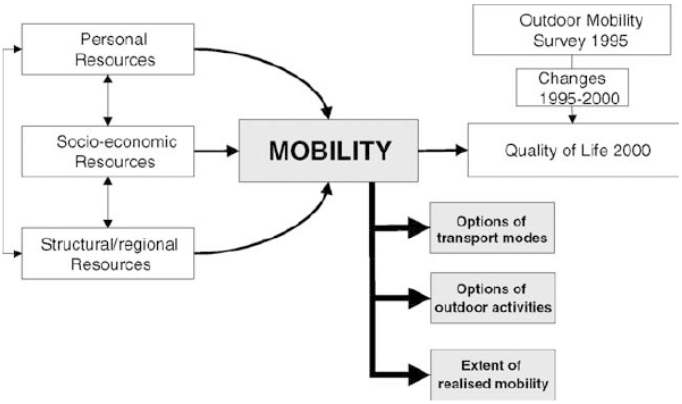

Figure 4 *The MOBILATE mode of outdoor mobility. Source: Mollenkopf et al. (2004).*

In this study, the influence of subjective views on both physical and social environments is emphasized. The older adults' adaptive behaviors, their interaction with their environments, is explained by both the subjective domain, which consists of one's physical and social representations and needs, and the objective domain, which contains environmental demands on individuals' autonomy and available resources. Specifically, mobility practices, social relations, and residential situations are three dimensions which reciprocally determine adaptive outcomes in older adults. This framework, which aims to conceptualize the loss of driver's license in late life, helps researchers to identify specific adaptive behaviors of older adults by stressing the significance of older adults' subjective views.

A similar approach was adopted by Rowles (1978, 1983), a social geographer who studied geographical experiences of older people. Based on ethnographic and

autographic qualitative studies of five community-dwelling seniors in a rural Appalachian town, Rowles (1978) not only illustrated the shrinkage of seniors' space but also conceptualized four major domains of environmental experiences: activity, orientation, feelings, and fantasy. As activity space becomes smaller with age, subjective meanings of places become profound. These schemas that have been developed over time help seniors orient themselves. More importantly, specific episodic memories enrich seniors' surroundings and strengthen their emotional attachment and sense of belonging.

Furthermore, Rowles (1983) also conceptualized their subjective space and place in general, and specifically introduced the concept of insideness. He argued that older adults consider themselves embedded agents in their surroundings characterized by three attributes: physical, social, and autobiographical insidenesses. The specific routes they used to reach certain destinations are examples of physical insideness whereas the social relations of support network established by old people fall under the attribute of social insideness. His work contributed to the existing gerontology literature by introducing a third attribute: personal history in place. The autobiographical insideness derives from older adults' idiosyncratic memories attached to particular places, and these often represent their sense of belonging to their communities. This suggests that the context of older adults' surroundings is critical for understanding their geographical experience.

These conceptual frameworks suggest that senior citizens' mobility is determined not only by personal, social and environmental factors but also by their perceptions of safety as well as familiarity, while aging in place. The SOC (selection, optimization, and

compensation) (Baltes and Baltes 1990; Baltes, Lindenberger, and Staudinger 2006) has recently gained attention as a valuable conceptual model to highlight older adults' mobility adaptations (Rush, Watts, and Stanbury 2011; Siren and Hakamies-Blomqvist 2009). The conceptual framework introduces three adaptive processes to achieve one's goals: selection, optimization, and compensation. To better adapt to environments, individuals 1) choose or re-focus on certain goals because of already existing limited resources (selection), 2) invent or enhance certain means to accomplish goals (optimization), and 3) replace one's means with alternative resources (compensation). The selection processes can be made according to 'elective' or 'loss-based' levels (Baltes, Lindenberger, and Staudinger 2006). An elective selection reflects one's preference while a loss-based selection results from a decrease in resources. This model serves well to conceptualize proactive nature of seniors (Cavanaugh and Blanchard-Fields 2011).

Thus, older adults in living environments were initially conceived of as vulnerable but later as proactive agents. To further investigate the proactive nature of older adults, researchers recently developed more heuristic conceptual frameworks which aim to integrate physical and social environments. SPOT (Wahl and Lang 2003 2006) proposes three meanings of environments in late life by stressing the significance of the concept of place. The MOBILATE model (Mollenkopf 2005; Mollenkopf et al. 2006) and the framework of mobility (Lord and Luxembourg 2006), also emphasize the necessity of examining both physical and social environments. Moreover, Lord's and Luxembourg's framework of mobility (2006) and Rowles' conceptualization of

insideness (1983) address senior citizens' subjective views of living environments and their impacts on travel behaviors. The conceptual model of selection, optimization, and compensation (Baltes and Baltes 1990; Baltes, Lindenberger, and Staudinger 2006) which could allow researchers to examine the processes of behavioral and perceptual adaptations has been conceived as a promising framework to further explore the proactive nature of mobility among senior citizens. This study aims to examine the essential domains referred to in those conceptual frameworks by exploring older adults' mobility in personal, social and physical contexts.

Empirical Evidence of Senior Citizens' Travel Patterns

The research of older adults' travel behaviors, especially by Japanese geographers in the 1980s, initially concerned older adults who reside in remotely located areas but eventually included seniors living in large cities using a travel survey (Chubachi 1998). The Japanese research literature suggests that travel patterns of older adults were explained by both personal factors (i.e., age, gender, educational background, length of residence) and environmental factors (i.e., rural vs. urban, availability of public transportation, etc.).

Personal Factors

Age has been found to be a critical factor related to travel patterns (Cabinet Office Japan 2009; Chubachi 1998; Takeda 1995; Murata et al. 2006). In a study of older adults' travel patterns in Kyoto, which utilized Person Trip Survey of Kyoto-Osaka-

Kobe area conducted in 1990, Chubachi (1998) found that non-working women aged 65 or older are less likely to travel every day (60.1. percent) than non-working women younger than 65 years (34.4 percent) in Kyoto city. However, shopping trips made by non-working elderly women who regularly traveled were not necessarily shorter than those of their younger counterparts. Using the same data source, Takeda (1995) also found people aged 60 or older and people aged 18 or younger made fewer trips in the northern area of Kyoto city, a region of mixed residential and farming areas. In terms of the variability of trip frequency among older adults, a recent national opinion survey showed that the proportion of older adults who traveled every day steadily declines with age (Cabinet Office Japan 2009). A study of a rural town to investigate factors related to life space among elderly people also revealed that older age was associated with a smaller life space often characterized by homebound life space rather than neighborhood or unlimited life space (Murata et al. 2006). All of the findings indicate that as people become older, they make fewer trips over a smaller geographical area.

Education and occupation also seem to affect travel patterns in older adults. In a study examining the travel areas of middle-aged and older adults in Koshigaya city, a suburban region of the Tokyo metropolitan area, Tahara, Arai and Kawaguchi (1996) found that participants who had higher levels of education and engaged in white collar jobs traveled farther, specifically to the Tokyo metropolitan region. In discussing the relationship between these two variables, the authors speculated that working experience in the Tokyo metropolitan area represented an important factor affecting their travel patterns.

The results of the same study also imply that familiarity also affects travel patterns (Tahara, Arai, and Kawaguchi 1996). Older adults who were born outside Koshigaya city were more likely to travel Tokyo than those who were born in Koshigaya city. The authors argue that the newcomers were more likely to make these trips because of social networks they had previously established in Tokyo.

Other research found gender to be a factor affecting the travel patterns of older adults. In a survey study conducted at a senior citizens' club in the suburb Akiba-cho in Yokohama city, Senda found (1993) older men traveled longer distances than older women; however, older women traveled more frequently than older men, especially after retirement. Similarly, a study of a small town in Gifu prefecture (Ishikawa et al. 2006) revealed that men left their homes significantly more often than women. A study of travel behaviors in older adults who reside in a depopulated village also showed the same pattern: men travels more frequently than women (Mitani 1997). In addition to these results, research revealed that differences in transportation modes typically used by men and women had an impact. Men were more likely to drive cars and motorcycles while women walked or used buses. Another rural study which explored the geographical extent of daily travel also revealed that women had more limited life spaces than men (Murata et al. 2006). The reasons behind these gender differences may include that the majority of men establish their social networks at work, which often include people who live in distant neighborhoods and the availability of transportation such as the ownership of a private vehicle and possession of a driver’s license.

Health status is also a key factor that determines one's mobility. Seniors' life spaces were found to be related to their physical and psychological well-being (Murata et al. 2006). Older adults who were diagnosed with stroke, heart disease, arthritis, eye disease, ADL limitations, and those with lower self-rated health had smaller life space than those who were free from have these health conditions. Moreover, low levels of psychological well-being measured, "ikigai," which represents meaningfulness of living was also related to smaller life space. In a study of a small city in Gifu prefecture (Ishikawa et al. 2006), elderly men who had physical pain and depressive symptoms were less likely to go out, and elderly women who had arthritis were also more likely to stay at home. Based on these findings, it seems safe to conclude that poor physical and psychological conditions affect travel behaviors of older adults.

Environmental Factors

The latest Japanese national opinion survey (Cabinet Office Japan 2009) revealed that older adults in rural areas go out less than those in more populated areas. The influence of gender on mobility becomes profound especially in rural areas. Studies of older adults' travel patterns in a mountain village Togochi-cho in Hiroshima revealed that men traveled as much or slightly more often than women overall (Osugi 1987). The pattern is most pronounced for those who reside far from the city center where the majority of commercial facilities are located. In the district located close to the city center, the pattern was reversed: women traveled more often than men. The study does not provide data concerning the mode of travel by gender; nevertheless, it is true that in

Japan men are more likely to possess a driver's license than women. Also, the availability of a personal vehicle has a significant impact on daily travel patterns, especially in rural areas where public transportation is limited.

In fact, a recent national opinion survey revealed that the most common means of travel for men was driving a car and for women was walking (Cabinet Office Japan 2005). Similarly, a study of elderly people in a depopulated mountain village Muzuho-cho in Chugoku Mountains (Mitani 1997) found the dominant form of travel for men was car or motorcycle and bus or walking for women. Thus, gender and availability of personal vehicles are often related and have a significant impact on older adults' mobility, especially in rural areas.

Moreover, individuals' living arrangements also seem to have some impact on travel patterns. In a study of a mountain village, Osugi (1987) found that older adults living with others shopped less often than those who lived alone or with a spouse. This effect was more prominent for men than women. The older men who lived with others traveled infrequently for shopping. A study of Kyoto city (Chubachi 1998) produced similar results and found that non-working older women who lived with children had a lower travel frequency than the non-working women who lived alone.

The difference in travel patterns between rural and urban areas could be explained by the issue of accessibility. Accessibility has been found to be a critical factor that determines older adults' daily travel. For example, older adults in rural areas who had limited accessibility to transportation and services traveled less often than those who lived in more densely populated areas (Mitani 1997; Osugi 1987). Osugi (1987) and

Mitani (1997) examined the differences in travel patterns for shopping and seeing a doctor between older adults who reside near village centers and those who live in peripheral areas in Hiroshima and Shimane prefectures, respectively.

Both of the studies indicated that the older adults who reside far from the village center traveled less often than those who lived near the center. Moreover, the former heavily relied on buses whereas the latter traveled on foot. There is a clear distinction between bus users and non-bus users in mountain villages: the inconvenient and infrequent bus schedule results in specific weekly rhythms which regulate older adults' activity and travel time (Osugi 1987). Not only in mountain village areas but also in suburban environments, differences in travel patterns were found. In the city of Kyoto, a lower rate of travel was observed in the city's peripheral areas than in the city center (Chubachi 1998). These studies revealed limited travel means, resulting from different environments that significantly restricted older adults' daily activity space and time.

Social networks are another environmental factor which encourages older adults to go out and participate in various activities. The older adults who had fewer social relations measured by availability of casual and reliable friends were found to have smaller life spaces than those who had more social relations (Murata et al. 2006). In a study of a small city, having friends and social groups was found to be a factor related to frequent travel to visit acquaintances among men (Ishikawa et al. 2006). A similar pattern involved in maintaining social networks was found in a study of senior citizens living in suburbs of the Tokyo metropolitan area (Senda 1993, Tahara et al. 1996). The results of both studies reveal that elderly males who are likely to maintain work-related

social networks, travel longer distances than women whose friends tend to reside in their neighborhoods.

Japanese empirical evidence highlights complex travel behaviors influenced by both personal and environmental factors. These studies which aim to investigate the relationship between travel behaviors and various environmental and social factors are mostly based on quantitative analyses. Only a few studies specifically look at older adults' perceptions of neighborhoods. Senda's mixed study (1993) which employed a qualitative analysis revealed the relationship between the participants' life history changes in their life space and social networks. Matsumoto (2004) examined "stopping-by" episodes to evaluate types of places where older adults visit, the action they make, and the people they encountered. Despite the indication of factors related to older adults' mobility, little is known about how older adults perceive neighborhoods and stay active by utilizing resources in a particular community setting. To better understand the experience of daily travel among older adults, qualitative analyses which explore the ways various personal and environmental factors interact need to be more conducted.

Empirical Evidence in the United States

Studies in the United States also show that mobility factors such as age, gender, education, and city structure influence mobility in older adults. The 2001 national household travel survey revealed that older adults were less mobile than younger adults in terms of trip frequency, distance, and duration (Collia, Sharp, and Giesbrecht 2003). More specifically, older women are the least mobile among the groups among all of the

groups. In a study of older adults' nighttime activity in Evanston, Illinois, Golant (1984) found that those who were better educated and had more access to an automobile went out more often than those who were less educated and without an automobile.

An environmental factor, city structure, was also found to influence older adults' mobility. A comparative study of senior citizens' mobility in San Francisco and San Antonio indicates the impact of transportation mode on travel behaviors (Carp 1980). Older adults in San Francisco, who primarily traveled on foot or by bus, went out more often than those in San Antonio, where the major mode of travel was by car. Similar results were found in the study of physical activity in older females who lived alone in urban and suburban Portland neighborhoods (Patterson and Chapman 2004). The older women who lived alone in urban neighborhoods walked more frequently than those who lived alone in suburban neighborhoods although the frequency of walks for recreational purposes did not differ in the urban and suburban areas. The results imply that walker-friendly environments and accessibility to major services in urban areas contributed to frequent walks.

The recent studies about older adults' out-of-home mobility in the United States have been mostly examined from a perspective of physical activity. Physical activity (PA) is defined as "any bodily movement produced by skeletal muscles that results in energy expenditure (Caspersen, Powell, and Christenson 1985 p126) "PAs involve not only exercise but also various other activities such as work-related and household activities. Specifically, walking has been a major focus of the recent PA studies of older

adults (e.g., King et al. 2005; Lockett, Willis, and Edwards 2005; Michael et al. 2006; Nagel et al. 2008; Strath, Isaacs, and Greenwald 2007; Tucker-Seeley et al. 2009).

> Walkability is the extent to which the built environment supports and encourages walking by providing for pedestrian comfort and safety, connecting people with varied destinations within a reasonable amount of time and effort, and offering visual interest in journeys throughout the network (Southworth 2005).

Recent studies show that safety is a major issue that influences older adults' walking frequency. For instance, a low level of perceived neighborhood safety (Tucker-Seeley et al. 2009) and high traffic volume (Lockett, Willis, and Edwards 2005; Michael et al. 2006; Strath, Isaacs, and Greenwald 2007; Nagel et al. 2008) were found to be the factors which hinder walking in older adults. Moreover, missing infrastructure or amenities such as sidewalks, crosswalks, and bike paths (Nagel et al. 2008) and benches and washrooms (Lockett, Willis, and Edwards 2005) were also negatively associated with the frequency of walks by older adults.

Another important factor related to the frequency of walking in older adults is accessibility to major services (e.g., Shigematsu et al. 2009; King et al. 2005; Li et al. 2008; Nagel et al. 2008; Patterson and Chapman 2004). A study of age-related differences in the relationship between PA and perceived environments in Seattle indicated that the frequency of (non-recreational) walking in adults aged 66 years and older was positively associated with higher levels of mixed land use and proximity to recreational facilities (Shigematsu et al. 2009). Similarly, in a study of Caucasian woman aged 50 to 65 who lived in Pittsburgh, Pennsylvania (King et al. 2005), the level of PA measured with a pedometer was associated with the neighborhood's walkability,

accessibilities to parks (defined as living within a 20-minute walk from home to a park) and the presence of commercial establishments such as departments, discount or hardware stores.

Other studies evaluating the relationship between built environments and walking activities in Portland, Oregon, also show that walking is associated with higher levels of mixed-use development (Li et al. 2008), larger numbers of commercial services in neighborhoods (Nagel at el. 2008), accessibility to a grocery stores and the number of services available within 1 miles from home (Patterson and Chapman 2004). Thus, accessibility to major services represents a key factor which promotes older adults' daily walks.

In addition, social environments such as social cohesion were found to influence older adults' PAs (Fisher et al. 2004; King et al. 2005). In a study in Portland, Oregon, a social cohesion indicator was derived from a subjective evaluation consisting of five questions about social relationships of the existence of neighborhoods (Fisher et al. 2004). The researchers found that a higher level of social cohesion was associated with more frequent walks. Similarly, a study in Denver, Colorado, indicated that the degree of social cohesion measured by a five-item scales was positively related to the PA level and a more positive perception of neighborhood safety (King et al. 2005). These studies underscore that a sense of belonging in older adults' neighborhoods is a critical factor which affects walking behaviors in older adults.

Similar to the Japanese empirical studies, seniors' perceptions of outdoor environments and mobility adaptation in North America and Europe have also been

understudied (i.e., Lockett, Willis, and Edwards 2005; Lord and Luxembourg 2006; Rowles 1978, 1983; Rush, Watts, and Stanbury 2011; Siren and Hakamies-Blomqvist 2009). The major focuses of those studies are the investigation of one's shrinking place perception, the meanings of a community, and safety and risk perceptions. Only a few studies focus on seniors' mobility adaptations (i.e., Rush, Watts, and Stanbury 2011). Based on the selective, optimization, and compensation model (Baltes and Baltes 1990, Baltes et al, 2006), Rush and her colleagues (2011) found that fifteen community-dwelling seniors used optimization strategies more often than selection and compensation strategies.

Thus, research literature in both Japan and the United States point out the effects of both personal (e.g., gender, education) and environmental (e.g., urban/rural, city structure, perception of safety) factors on daily trips by older adults. The results of the Japanese studies, which depended primarily on trip surveys and census data, provided information about overall travel patterns and possible explanatory factors of mobility. However, the impacts of neighborhood perceptions on daily trips and adaptive travel strategies have not been studied adequately. This study aims to fill that gap by exploring community-dwelling older adults' travel behaviors and neighborhood perceptions in a specific environmental context.

Using Cognitive Mapping for Understanding Perceptions of a City

Cognitive maps, mental representations of space, have been studied as a way to explore how people remember environments since Tolman (1948) introduced the

concept by observing rats' shortcut behaviors. The most significant work which resulted in mental representations of urban environments is Lynch's *The Image of the City* (1960). In the study of people's perceptions of Boston, Jersey City, and Los Angeles, Lynch studied the sketch maps drawn by the residents and identified five urban elements which influence perceptions of a city: path, edge, node, landmark, and district. The 'imageability' of cityscapes is a crucial element that can increase positive values such as emotional satisfaction and the depth which enhances everyday experience. Lynch's work has been so influential that the classification of urban elements has become the foundation for today's research of urban cognitive mapping. The concept of cognitive mapping and studies examining the relationship between cognitive maps and travel behaviors in urban environments are discussed in this section to highlight a rationale for the use of the sketch mapping method in this study.

Theoretical Framework of Cognitive Mapping

Cognitive maps, mental constructs accompanied by the process of acquisition, accumulation, remembrance, and representation of spatial environments, have been studied to explore the dynamic information regarding people's knowledge about places and their attitudes and meanings (Downs and Stea 1973; Moore and Golledge 1976; Kitchin 1994). The research findings have contributed to an understanding of the development of spatial concepts (Piaget and Inhelder 1967) in childhood and the evolution of cognitive representation over time (e.g., Siegel and White 1975; Golledge 1978). Furthermore, analysis of mental maps has been used to identify various factors

which influence cognitive map formation such as gender, socioeconomic status, mobility, travel means, etc. (e.g., Appleyard 1970; Orleans 1973; Van Vliet 1983).

A key theoretical construct which conceptualizes the formation and structure of one's cognitive representation in a large scale environment is anchor-point theory (Golledge 1978). This theory of environmental learning emphasizes the role of major landmarks, focal points that develop urban cognition from the stage of 'skeletal node-path relations,' a primitive formation of networks established between important places such as home and work place, to the stage of spillover effect, the spread of the network to space surrounding those major nodes (Golledge 1978). Typically nodes are hierarchically organized according to frequency of travel and the road network connecting those nodes. Spatial information is hierarchically organized for efficiency. People consciously or unconsciously use landmarks significant to them to best organize their spatial knowledge and perform everyday tasks. This theory suggests that the form of environmental images varies depending on one's spatial experiences in everyday life.

Influential Factors on Cognitive Representations

A number of cognitive map studies have indicated that our mental representations are influenced by both personal and environmental factors. It has been revealed that social class, ethnicity, gender, etc., affect cognitive maps (Orleans 1973; Goodchild 1974; Karan, Bladen, and Singh 1980; Van Vliet 1983; Orleans and Schmidt 1972). Sketch maps drawn by higher income white participants were more spatially extensive, detailed, and accurate than those drawn by the lower income minorities.

Gender was also found to be a factor that influences the cognitive representations of living spaces (Appleyard 1970; Orleans and Schmidt 1972; Van Vliet 1983). In a study of Venezuelan cities, Appleyard (1970) found that female subjects' sketch-maps were less accurate than male subjects'. Contrarily, a study in Los Angeles revealed that the housewives drew more detailed representations of the city than their husbands (Orleans and Schmidt 1972). A study of neighborhood images by school children found that girls drew significantly smaller cognitive maps of neighborhoods than boys (Van Vliet 1983). The findings of those studies imply that differences in the extent and accuracy of cognitive representations may result from travel experiences related to gender.

Environmental attributes also contribute to the development of cognitive representations. Direct influences—how far and how often individuals move around—have been examined by explaining the relationship between the amount of effort to reach a destination and one's cognitive representation. Topological barriers, uphill and downhill paths (Okabe, Aoki, and Hamamoto 1986; Hanyu and Itsukushima 1995) and stairways (Hanyu and Itsukushima 1995), can have an effect on estimated distance. The perceived effort to climb hills and stairways led subjects to overestimate the distance significantly while the estimations of flat paths did not show the same results.

The modes of travel in a city also have an impact on the development of cognitive maps. A sketch-map study conducted in Venezuelan cities revealed that the cognitive maps drawn by car and bus travelers were distinctively different (Appleyard 1970). Those of the bus travelers were fragmented and sequential whereas those of the car travelers were more spatially organized. The findings revealed that the ways

individuals interact with environments are critical in developing their mental representation of urban environments.

Gibson's ecological approach (1979) provides an insight into strategies people use to update environmental cognition. The research results emphasize the significant impact of the interaction between organisms and perceived environments on wayfinding behaviors. The framework suggests that active rather than passive exploration in environments is essential to effective spatial orientation. The notions of efference and afference are critical to understand the significant effect of active forms of locomotion on spatial learning and orientation. Efference and afference are both the processes of transmitting nerve impulses between the central nervous system and sensory organs (Rieser and Pick 2007). Yet, the direction of functional processes in efference and afference differ. In the efferent processes, impulses are transmitted from the central nervous system to sensory organs whereas the afferent processes move in the opposite direction: impulses are transmitted from sensory organs to the central nervous system. In other words, efference represents the 'exiting' processes of impulses and afference refers to the 'entering' processes of impulses (Rieser and Pick 2007).

All forms of locomotion involve the acquisition of afferent information by taking nerve impulses from sensory organs to the central nervous system (Rieser and Pick 2007). In this way, we constantly perceive environmental information while we are moving in any form of locomotion, walking, biking, and riding a bus or a car. However, the forms of locomotion significantly affect the efferent processes, the transmission of impulses from the central nervous system to sensory organs. Only active forms of

locomotion can successfully generate the efferent information, which is essential to navigation (Rieser and Pick 2007). Active locomotion involves self-produced movement such as walking, biking, and skating. On the other hand, the passive forms of locomotion such as traveling by car or by bus, do not involve self-produced movement. The intermediate forms of locomotion are the ones which maintain self-produced locomotion without the direct bodily movement in environments such as driving a car and navigating a plane. Only the active forms of locomotion contribute to learning the correlation between the efferent and afferent information, that is, the relationship between actions and specific environmental consequences (Rieser and Pick 2007).

A study of school children's neighborhood perceptions revealed the influence of passive or positive travel experiences on their cognitive representations. (Hart 1981) found that the sketch maps drawn by children who rode a school bus were fragmented while those drawn by children who traveled on foot or by bike were more accurate. Based on theory about the forms of locomotion introduced by Rieser and Rick (2007), the children traveled on foot or by bike actively engage in the environments learned not only the correlation of efference and visual flows but also the details of environmental information through active attention to affordances, the attributes attached to environments which offer specific meanings in their neighborhoods.

The research findings concerning active and passive forms of locomotion offer some interesting insights into older adults' spatial learning and behaviors. Empirical evidence suggests that older adults who regularly walk or bike are likely to learn their environment in detail and navigate efficiently. It is reasonable to hypothesize that older

adults who engage in active forms of locomotion develop detailed and information-rich cognitive maps of their neighborhoods. On the other hand, those who engage in passive forms of locomotion such as traveling by a car as a non-driver or riding in a bus, can be expected to develop the cognitive maps that might be geographically extensive but not detailed. Since these individuals learn environments passively without the necessity of navigating themselves, a limited number of affordances would be obtained and developed in their cognitive maps.

Cognitive Mapping Research on Older Adults' Outdoor Environments

Research on older adults' cognitive maps, predominantly comprised of psychometric and experimental studies, has received little attention, and only a few of the studies have examined the scenarios reflecting the real world environments (Kirasic 2000). Furthermore, those studies focus on the subjects' ability to learn about new environments. The few studies examining the cognition of real-world environments reveal a correlation between the size of seniors' neighborhood images and the relative extent of their activity space (Regnier 1981).

The findings of these studies also imply that older adults' spatial memories can be influenced by familiarity and contextual information. For example, a study of spatial performance conducted in supermarkets indicates the positive effect of familiarity on spatial performance among older adults (Kirasic 1991). The spatial performance of 20 college female students and 20 elderly women (average 71 years old) was assessed based on cognitive tests of a scene recognition task, a distance-ranking task, a route-execution

task, and a map-placement task in addition to orientation and route-execution tasks conducted in both familiar and unfamiliar supermarkets. The young adults had better scores on the tests than the older adults. However, the performance of elderly subjects was better in the familiar than in the unfamiliar supermarket, whereas that of college students did not significantly differ between the familiar and unfamiliar environments. The findings indicate that the impact of familiarity on spatial memory is more significant for older adults than for young adults.

Moreover, a study examining performance on array reconstructions highlights the effect of contextual information attached to landmarks on spatial memory (Cherry, Park, and Donaldson 1993). In the study, the younger women outperformed the older women on the recall test of landmarks. The contextual cues attached to landmarks representing household objects such as scissors and mousetraps, however, improved the older women's spatial memory, while the younger women did not significantly benefit from the contextual information. The findings suggest older adults are more likely to remember landmark locations efficiently when contextual information is provided.

Specific characteristics of the landmarks remembered by older adults were analyzed in a study examining recall performance and location memory (Evans et al. 1984). Seventy two young adults (M=32) and 47 older adults (M=71) participated in the study of a neighborhood of Orange, California. The younger subjects recalled significantly more buildings with better accuracy compared to the older adults. The specific characteristics of the buildings remembered by the older adults were associated with high intensity use, symbolic significance, greater surrounding natural landscape,

having direct access from streets, and possessing a unique architectural style. Although the study lacks an investigation of frequency and pattern of the participants' neighborhood use, the findings imply the significance of familiarity and place context on older adults' maintaining cognitive representations. The relatively few studies about older adults' spatial memory of real world environments reveal the inferiority of older adults' memory and the significant influence of familiarity and place contexts on their performance. The contexts or meanings of place remembered by older adults should be studied to help researchers better understand their spatial behaviors and experience in their neighborhoods.

Cognitive Maps and Schemas

Cognitive mapping studies have been criticized for failing to incorporate the social meanings of environments into the analyses. For instance, the studies have often overlooked the affective components of cognitive maps, which reflect one's decision-making or action (Lee 2003). There are only a few studies that examine place preference and its relationship to spatial knowledge (Kitchin and Blades 2002). A study which examined the inclusion and exclusion of liked and disliked places in subjects' sketch-maps revealed that the majority of the subjects excluded disliked places (Seibert and Anooshian 1993). Furthermore, it was revealed that the older adults included liked places and excluded disliked places significantly more than other age groups: first graders, fifth graders, and college students. The findings suggest that a strong impact of place preference on cognitive representations in older people.

Another critique of cognitive mapping research is the limited nature of interpretations made by researchers. Because spatial behaviors are often evoked by affective responses to the environment, schemas need to be further explored (Tuan 1975; Lee 2003). Schemas are organized prior knowledge that facilitate top-down cognitive processes critical to decision-making (Fiske and Taylor 1991). Lee (2003) proposes the concept of socio-spatial schemas which emphasize the integration of social and physical environments. Since environment is a social construction, physical settings and social meanings of physical structures are inseparable. Senior citizens' outdoor perception of, and spatial behaviors in, neighborhoods can be better understood using the concept of socio-spatial schemas. The social or cultural meanings of spatial elements drawn in sketch-mappings can be further explored to better understand their living environment.

Outdoor settings have most frequently been analyzed based on secondary sources such as census data and field audits to assess characteristics of environments. Because those data are explicitly identified by researchers beforehand, the findings can be useful to apply to environmental design. However, the data do not reveal the idiosyncratic nature of environmental cognition. These studies assume that people perceive the environmental features uniformly (Sugiyama and Thompson 2005). Sketch-mapping is advantageous not only to elicit the idiosyncratic saliency of environments but also to facilitate interviews to further understand the meanings of participants' spatial representations and experience. Since schemas are necessarily limited to image-like or map-like representations (Tuan 1975; Lee 2003), analyses of both sketch-maps and

verbal descriptions of the maps could be beneficial to further understanding both social and physical environments in seniors' daily travel.

CHAPTER III

METHODOLOGY

This chapter describes research questions and methodologies for this study. The main purpose of this study is to investigate 1) travel patterns of senior citizens and the possible explanatory factors related to the travel patterns and 2) the way in which seniors interact with social and physical environments to better understand their coping strategies in their daily trips. To examine these questions, the study implements both quantitative and qualitative analyses. To address the first question, data collected through a questionnaire survey is analyzed quantitatively. For the second question, analyses of interviews, sketch-mappings, and one-week travel diaries were conducted to reveal the participants' travel experience and perception of the city. The chapter also includes descriptions of the study sites. The following research questions guide the study.

Research Questions

1. What are the characteristics of senior citizens' travel patterns? What factors are associated with their travel behaviors?

Based on the Japanese research literature, both environmental (the location of residence and living arrangements) and personal (age, gender, and travel means) factors help determine the frequency of daily trips. Specifically, proximity to the city center or major commercial districts, being married, younger, male, and driving were found to be positively associated with frequency of daily trips. This study attempts to apply

empirical results to understand the behavior of relatively active senior citizens living in an urban environment.

2. How do active senior citizens get around in the community? What impact do personal and environmental factors have on these questions?

As reviewed in the previous chapter, the Japanese research literature predominantly investigates the association of older adults' travel behavior with various personal and environmental factors. A few studies pay particular attention to the way seniors interact with and perceive outdoor environments (e.g., Matsumoto 2004). These studies offer insights into older adults' strategies for getting around their communities and the impact of community perceptions. The next section introduces the research design of this study.

Research Design

This study employs a sequential mixed method in which qualitative methods follow quantitative analyses. This method is suitable for conducting a detailed exploration of research questions through interviews with select individuals after conducting a survey to examine general characteristics of a sample (Creswell 2009). The results of a semi-structured questionnaire survey are quantitatively analyzed, then the research questions are further explained and elaborated with the combination of interviews, observation of a sketch mapping task, and a one-week travel diary. The flow of data collection is shown in Figure 5. Triangulation, a research design that analyzes various types of data relating to the same research problems, is implemented in this study to allow the researcher to refine and complement unresolved issues of quantitative

methods with the findings of qualitative methods (Creswell and Clark 2007; Patton 1990). Within the framework of a qualitative approach, this study employed a case study design. The design is suited for in-depth descriptions and analysis of a case or multiple cases bounded by specific time or place (Creswell and Clark 2007). The present study fit well with the design because it aimed to explore how community-dwelling seniors perceive and get around in their communities. Multiple cases of their travel behaviors were analyzed within the specific geographic boundary of Yao city. The next section provides a description of the study area, Yao city and the Yao Welfare Center for the Elderly (YWCE).

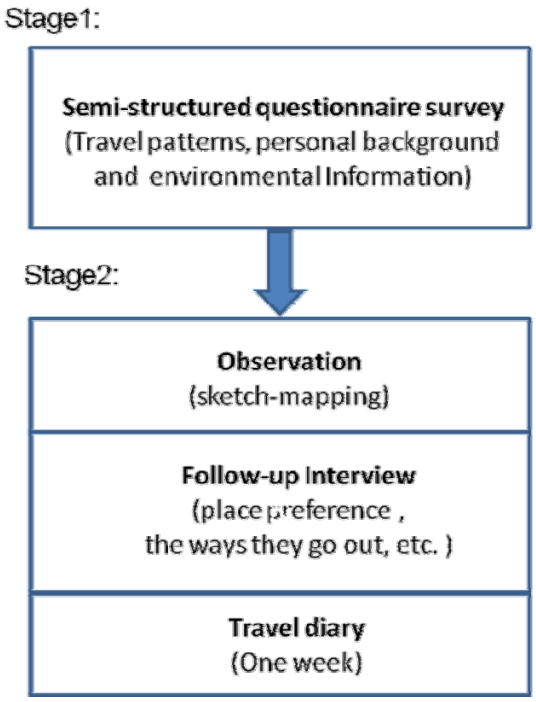

Figure 5 *Flow of data collection*

Study Area

The data were collected at the Yao Welfare Center for the Elderly (YWC) in Osaka prefecture, Japan. Yao is a mid-size city with population of about 273,000, located in southeastern Osaka (Yao City Health and Welfare Division 2006). The city area is about 4.4 miles in south-north direction and 5.6 miles wide (Yao City Policy Planning Division 2010). Most of the city is built on plains except for the eastern section which is set in the hills with designated quasi-national parks such as Mount Takayasu and Mount Shigi in less than 1,600 feet (Figure 6).

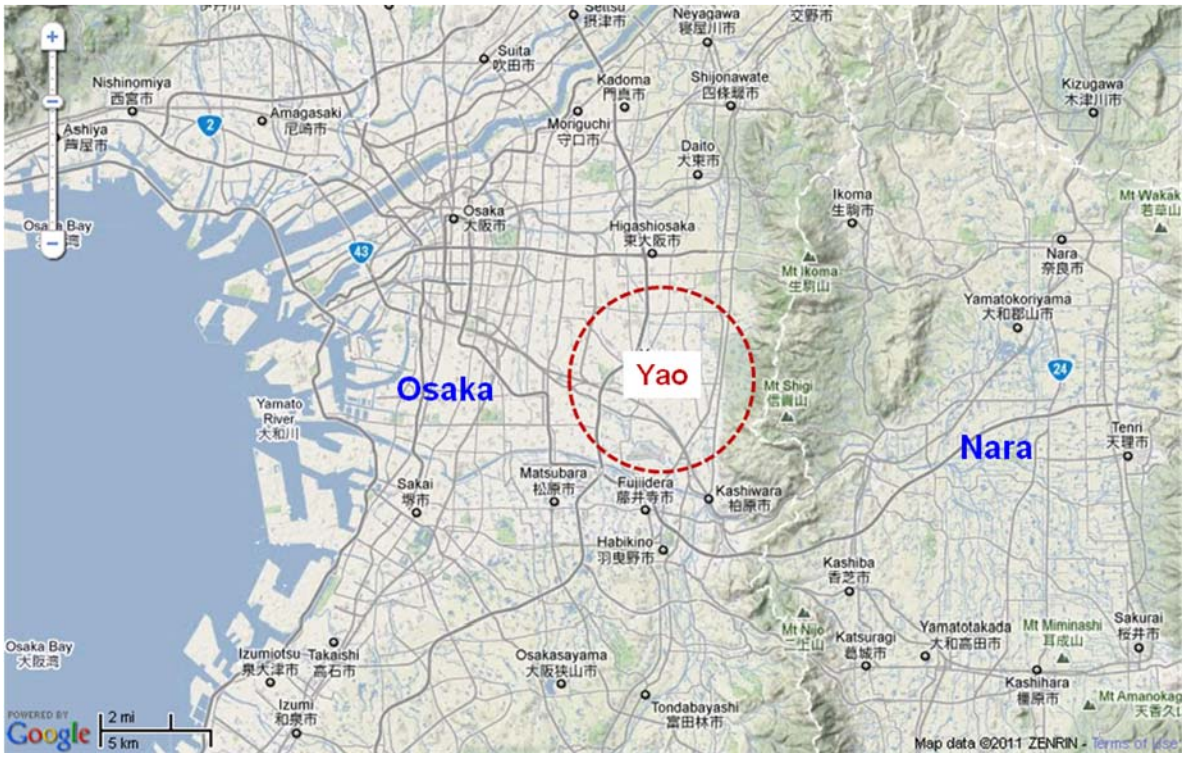

Figure 6 *Relative location of Yao city (Source: GoogleMap.)*

With the rapid economic boom in 1950s, Yao, whose major industry bases are small businesses in manufacturing and wholesale, had attracted migrants between 1955

and 1980 (Yao City Policy Planning Division 2010). The city has approximately 271,000 and has experienced a low or negative population growth since 1980s. In 2006, the proportion of population aged 65 or older in the city was approximately 20 percent in 2006 (Yao City Health and Welfare Division 2006), comparable to the national average of 23.1 percent in 2010 (Statistics Bureau Japan 2011). The city offers citizens with diverse travel means: walking, bicycling, motorcycle or car traveling, taking a bus, and train. The city offers a good access to the city of Osaka with two major rail lines running across the city. Biking is the most widely used travel means in Yao (Yao City Policy Planning Division 2010), and this makes the city unique in that residents can get around easily and affordably.

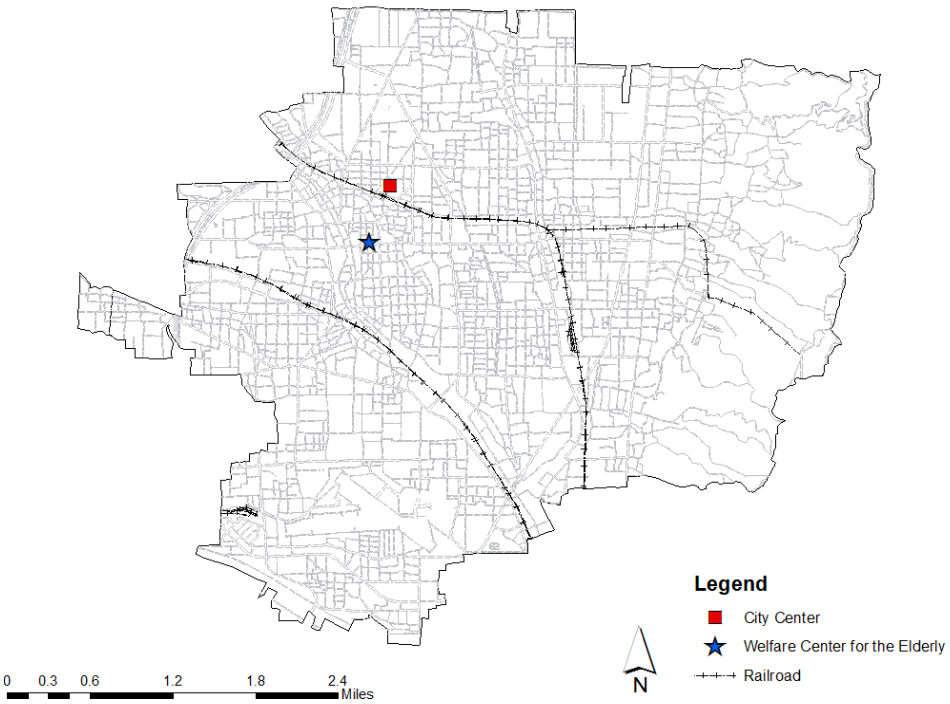

***Figure** 7 Map of Yao city*

Figure 8 *Yao city welfare center for the elderly*

The YWCE, located in the city center, is a major gathering place for senior citizens and offers various activities organized by 17 clubs (Figure 7). Approximately 1,800 seniors are enrolled, all of them more than 60 years old. The pilot study, conducted in June 2008, suggested that bicycles are considered a convenient means of transportation among the senior members, although those who are older and more frequently walk expressed concern about the safety of cycling. In the pilot-study interviews, the researcher found that seniors held distinctively different perceptions of neighborhoods and used various strategies to get around in the city to studying their travel needs (Figure 8).

The rationale for selecting this particular setting, the YWCE, is both theoretical and practical. The primary aims of this study are to identify possible personal and socio-physical environmental factors affecting senior citizens' daily travels and to examine how those factors interact by exploring their coping strategies. To achieve these goals, the study targeted relatively healthy community-dwelling seniors who might have some difficulties but were able to move around on their own. Yao city, a mid-size city that is compact offers various travel options, is suitable not only to examine the ways in which older adults select particular travel means but also to explore how the mode of travel affects seniors' perceptions of their living environments.

The YWCE was identified because it attracts relatively physically and socially active older adults in the city enabling this researcher to discover the coping strategies used to get around in the community. The site was also selected for a practical reason. The researcher was born in the city and had lived there for five years. Therefore, some familiarity with the city and the local population enabled the researcher to more easily gain access to the local site for data collection. The next section describes the data collection process.

Data Collection

Stage 1: Quantitative Analyses

The researcher collected data in two phases: a survey questionnaire and an interview accompanied with the sketch-mapping task at the YWCE. In June 2009, during scheduled social meetings, the researcher introduced the study and asked senior

members to participate in the project, yielding a sample of convenience. To provide information of the research, the researcher distributed flyers that described the purpose of the study and what participants were expected to do with the cooperation of the director of YWCE and the leaders of social clubs.

The researcher developed a semi-structured questionnaire in Japanese composed of three major components: information about participants' travel pattern, personal data, and neighborhood information including information about both social and built environments (Appendix A). The questionnaire also served to provide the researcher with permission to contact the participants for the second phase of this study: the follow-up interviews. Those who agreed to participate provided their phone numbers in a space provided. A copy of the study description and the consent form were attached to each questionnaire. The researcher distributed approximately 400 copies of the questionnaires to senior citizens who initially showed interest in the study. One hundred ninety-three (approximately 40 percent of the copies distributed) senior citizens agreed to participate in the study and returned the forms. The Institutional Review Board at Texas A&M University approved the survey as well as the scripts for the interviews. The following section describes the variables included in the questionnaire instrument. The complete questionnaire from is available as Appendix B.

Travel Behaviors

The first section of the questionnaire collected information about participants' travel behaviors. The participants were asked about travel frequency ("How often do you

leave your residence per week?"), primary mode of travel, frequency of grocery shopping per week, and changes in perceived travel frequency over time. The question concerning seniors' daily travel frequency asked the participants to choose one of four responses: Almost every day, 4-5 days in a week, 2-3 days in a week, and almost none. To compare current travel frequency to that of the past, seniors were asked to respond "yes" or "no" to the statement: "I currently travel more often than I did in the past." The question aims to examine whether participants have more opportunities to make leisure trips after retirement with availability of free time and/or financial affordability as well as how aging might have affected travel behaviors.

Personal Factors

Age and gender data were collected to examine if these factors have any influence on seniors' travel behaviors as the literature suggests. Location of residence represents a good measure of accessibility to the city center. To protect participants' privacy, the participants were asked to provide a generalized location of their home address, the name and number of city district without block and building numbers (i.e., 2 Marunouchi). The researcher mapped the locations of the participants' residences and calculated Euclidian distance between the residence locations and the city center, Kintetsu Yao Station, using Geographic Information Systems. Length of residences in years, and the social clubs for which they were registered at the YWCE were also recorded. Participants were also asked if they possessed a driver's license. It is expected that participants who hold a driving license will be more likely to travel frequently.

The survey also contained questions that inquire about perceived health, the date of most recent medical attention, and type of facility at which the medical procedure was performed. The study employed a subjective health evaluation because self-rated health has been found to be a reliable predictive indicator of mortality in a number of studies (Mossey and Shapiro 1982). A longitudinal study examining the relationship between self-rated health and mortality revealed that the association between risk of death and poor self-rated health was greater than the between risk of death and objective poor health status. The results imply older adults' perceived health is related to their lifestyle and behaviors. In this study, it was expected that those perceiving poor health are likely to travel less frequently. Since the registered members of the YXCE are relatively healthy and active, few participants were expected to have significant physical disabilities. Therefore, only the basic information about seniors' health conditions was collected.

Data about marital status, living arrangements, current work status, and former occupation were also gathered because the findings of previous studies have suggested that these factors impact older adults' travel behaviors. For example, living arrangement was likely to affect trip frequency – studies found that seniors who lived with their children traveled less frequently (Osugi 1987, Chubachi 1998). In terms of income status, individuals' working experience, specifically the occupation in which they were employed, was used to gain some insight into economic status. Asking about income level was avoided in this survey because in Japan it is considered too personal. Instead, participants were asked about their current job status and their past occupation. The

question about past occupations was open-ended, allowing the respondent to describe his or her own job type. The researcher later assigned each job described into one of nine major occupation groups identified by Japanese Statistics Bureau. These were later regrouped into three categories: 1) professional/executive jobs, 2) clerical/ sales/service/other jobs, and 3) part-time/unemployed.

The literature suggests that personality type is another factor that is likely to influence travel behaviors. A previous study of senior citizens' nighttime activities in the United States revealed that those who had stimulus-seeking personalities went out more frequently at night (Golant 1984). This study employed Gosling and his associates' (2003) Ten Item Personality Measure (TIPM) to explore the relationship between particular personality traits and travel behaviors. TIPM is a simplified version of Costa and McCrea's (1992) five-factor model of personality traits: extraversion, agreeableness, conscientiousness, emotional stability, and openness to experience. It was expected that those who are extraverted and open to experience were likely to travel more often than seniors who have higher scores for the traits of agreeableness, conscientiousness, and emotional stability.

Environmental Factors

Factors associated with seniors' living environments consist of elements from both the physical and social domains. Information about the physical environment such as the existence of a sidewalk, a bus stop, and a grocery store as well as perception of sidewalk, traffic, and lighting safety were collected. In addition to personal factors noted

above, it was expected that older adults who lived in the neighborhoods with sufficient travel support and various services were more likely to travel. Seniors' perceptions of the safety of their neighborhoods, especially with respect to traffic, a sidewalk, crime, and lighting, were assessed using a 4-point Likert scale. A recent study that qualitatively examined older women's mobility in Canada indicated that concerns about encountering beggars and gangs of teenagers influenced women's level of mobility (Finlayson and Kaufert 2002). It was expected that a fear of crime would hinder the travel opportunities of older adults, especially women. The perception of a low level of safety was expected to affect both men's and women's travel behavior. In addition to gathering information about the physical environment, the questionnaire also collected information about social factors: the number of relatives and friends in the city and the frequency of contact with them.

Data analysis was conducted using descriptive statistics, bivariate analyses, and logistic regressions. The general characteristics of the participant's travel patterns, socio-demographics and social and physical surroundings were examined through descriptive statistics. Since the data were not randomly sampled, the study employed a non-parametric test, Spearman's correlation tests. Then, each variable was tested for its bivariate correlation to examine the association, if any, between those variables. In addition, the association of categorical data was examined by cross tabulation.

The findings from the descriptive statistics indicated that a majority of the participants ate healthy and go out every day regardless of older age and longer distance between home and YWCE. Thus, the findings brought other questions to be understood

the senior's active travel behaviors: In what way or how they go out almost every day? Which characteristics explain the active travel behaviors? How the characteristics differ from those of the seniors who do not travel so often?

The researcher identified logistic regression analysis as the best method to examine the research questions because it analyzes relationship between binary dependent variables and multiple independent variables. Specifically, the researcher collapsed the four levels of travel frequency into two: going out every day (HighTravel Freq) or not going out every day (Non-HighTravel Freq). Unlike linear regression analysis, the logistic regression analysis does not require assumption of normality in data and can predict the probability of the occurring event, going out every day (Sweet and Grace-Martin 2003). Moreover, the analysis allows researcher to identify the likelihood of occurring an event (going out every day) according to independent variables.

The advantages of using logistic regression are the abilities to deal with both numeric and categorical variables and to estimate likelihood of that an event occurs (Sweet and Grace-Martin 2003). Thus, the researcher found logistic regression analysis best suitable to analyze the questionnaire survey containing both numerical (e.g., age, number of friends, personality measure) and categorical data (e.g., four likart-scale of safety perception, current job status-working/not working, and living arrangement categories).

To answer the first research questions, the effect of independent variables on the high level of travel frequency, the researcher conducted bivariate logistic regression to identify the relationship between individual variables and travel frequency. The

researcher also developed multiple logistic regression models to determine relative contributions of the factors which characterize highly active travel behaviors of the total, male, and female participants. The findings of those statistical analyses are presented in Chapter IV. The next section provides a description of interviews, the sketch-mapping procedure and the production of a one-week travel diary.

Stage 2: Qualitative Analyses

As Lawton's proactivity (1989) suggests, relatively healthy seniors are more likely to devise and apply unique methods to meet their needs. By sampling the active seniors from different demographic groups and living environments, the researcher aimed to identify both externally provided and personally created resources (Lawton 1989) and investigate behavioral and psychological adaptive strategies to meet their needs.

In addition to providing more information concerning unresolved issues raised by first research questions, the second research question, how active senior citizens get around in the community, was explored by interviewing the seniors about perceptions of the city and the ways they travel daily. The researcher believed that purely quantitative methods did fully satisfy the purposes of this study, and additional description and processes of participants' travel behaviors through qualitative methods would enrich analyses and interpretation. Moreover, use of multiple data sources ensures not only the validity of the analysis but also adds depth to the study (Gibbs 2007). Therefore, the study employed multiple data sources: face-to-face interviews, observation of sketch

mapping tasks, and one-week travel diaries. Within the framework of a qualitative approach, this study employed a case study design. A case study design is suited to description and analyses of multiple cases such as an event and activity, bounded by time or place (Creswell and Clark 2007). In this study travel behaviors of the community-dwelling seniors were explored (activities) within a specific boundary of a place - Yao city.

The Research Sample

Of the 193 participants who answered the survey questions, 51 (26.4 percent) seniors agreed to participate in the follow-up interview including four with missing contact phone numbers. The researcher conducted purposive sampling (Creswell and Clark 2007) based on the participants' gender, age, the distance of from the city center. The sampling aims to select individuals from groups that might share similar perspectives (Creswell and Clark 2007). The statistical results revealed both gender differences and high travel frequency of the seniors regardless of age and distance traveled, which were often cited as important variables in previous studies.

Criteria were chosen to obtain participant subsamples with individuals who are roughly similar: gender (male, female), age (60-73, 74-87) and the distance between the YWCE and the participants' residence (less than 0.9 miles, more than 0.9 miles). Since the mean and median of the participants' age were both 73 years old (SD=6), the age younger and older than 73 was applied to group the participants. Similarly, the mean and median of distance between YWCE and their residences were 0.9 miles and 0.8 miles,

respectively. Since its standard deviation is large (932), the median, the distance of 0.9 miles was used to divide the group. The findings of the questionnaire survey indicated uneven patterns in travel means (74 percent of the participant used bicycles as their primary travel means) and the forth criteria based on mode was not applied. Table 1 summarizes overview of the participants' profile based on the sampling criteria.

Table 1 *Sampling grid of with three independent variables*

Gender	Men				Women			
Age (years old)	≤ 73		>74		≤ 73		>74	
Distance (miles)	≤ 0.9	>0.9	≤ 0.9	>0.9	≤ 0.9	>0.9	≤ 0.9	>0.9
Number of participants	2	2	3	3	3	3	3	2

The researcher originally contacted 33 seniors based on the criteria and availability of response calls. Twelve seniors declined to be interviewed due to an emergency (e.g., illness of spouse), loss of interest in the study, lack of time for the participation, etc. One of the seniors who agreed to participate in the interview cancelled the meeting due to sickness. Twenty one seniors agreed to participate in the follow-up interviews. The face-to-face interviews were conducted in a room at the YWCE that was usually used for social activities. In each session, only the researcher and the participant (in some cases accompanied by the participant's spouse) were in the room to minimize distractions. At the beginning of the session, the researcher described the study and briefly explained what the participant was expected to do. Consent forms were provided to the participants to read and sign.

Observation of Sketch-mapping

The interview sessions were initiated with the sketch mapping task. Previous research studies have incorporated a cognitive mapping technique to investigate participants' spatial knowledge by counting the number of spatial features remembered (e.g., Evans et al. 1984; Cherry, Park, and Donaldson 1993), and distance comparison (e.g., Okabe, Aoki, and Hamamoto 1986; Hanyu and Itsukushima 1995), and identifying types of cognitive representations (e.g., Appleyard 1970; Golledge 1978; Hart 1981). More recently, interdisciplinary studies incorporating cognitive maps have tried to understand the connotation of sketch maps rather than to evaluate the sketcher's spatial knowledge (e.g., Hume, Salmon, and Ball 2005). Researchers strive not only to comprehend the meanings of features drawn but also to identify the implication of how participants' perceptions identified by drawing a map are related to their behaviors. This study intends to investigate the perception and meaning of older adults' daily travel by specifically asking them about the way they travel from their home to YWCE. Instead of evaluating their spatial knowledge, the study focused on specific travel behaviors to better understand how they get around in the city. In this way, participants can virtually travel and describe their daily routes during the drawing session.

The interview sessions started with a sketch-mapping task by asking the participants "Would you describe how you get to the senior center from your home by drawing a map? I would like you to include any familiar landmarks to better understand which route you use." The participants were allowed to spend as much time as they wanted and to draw the map in whatever way they chose. During the map drawing

session, the researcher encouraged the participants to verbally describe the elements drawn to better grasp the meaning of particular landmarks along the route and to understand how and why they got around. The verbal descriptions were qualitatively analyzed to explore participants' travel experience. By combining the sketch mapping task with a think-aloud procedure, the researcher hoped to compensate for a drawback of sketch mapping, the influence of drawing skills on the ability of participants to produce a map about their perceptions and the types of strategies they used to get around the city. Most participants completed the task within 20 minutes.

The sketch mapping processes were video-recorded using a video camera. The previous work which analyzed college students' drawing strategies of living environments indicated the advantages videotaping provided when analyzing the drawing strategies of students who sketch mapped (Lee and Bednarz 2005). The results of that study suggest that videotaping enables the researchers to not only extract precise map information but also to capture the sequence of steps performed by the participants along with their verbal descriptions. This information provides a much richer understanding of the sketcher's strategies and thought process than an examination of the sketch maps alone. To analyze sketch maps, the researcher first visually examined the processes of sketch mapping in videos, and then listed the geographic features drawn or verbally descriptions in order to examine the ways the participants make a decision to take particular routes and strategies.

Interviews

Following the sketch-mapping, interviews were conducted. The interviews were guided by a script and asked the participants about familiar places, liked and disliked places, satisfactions and dissatisfactions with their daily travel, travel experience in the past, etc. The complete interview script is available as Appendix C. The order of the topics and the way in which questions were asked were modified according to the direction of conversation. Other relevant questions were asked depending on the contexts of the participants' descriptions about the sketch-map and their response to the questions. The researcher paid particular attention to how participants perceived various outdoor environments and the people they encountered and how they interacted with them. During the interviews the entire conversations were audio-recorded using a voice recorder.

The conversations were analyzed mostly to investigate the second research question, coping strategies employed by seniors to get around their communities. After having transcribed the whole interview for each participant, the researcher coded statements based on personal, social and physical resources to interpret how those resources were utilized to support their travel behaviors. The researcher also developed new themes to add further dimensions to mobility of the elderly.

One-week travel diary

At the end of the interviews, the researcher asked the participants to keep a diary of their travel patterns for one week. The participants were asked to record date, time,

destination, mode of transportation, purpose, and companion, if any, for each trip (See Appendix D). The diary format was adapted and modified from the form used for the MOBILATE project (Mollenkopf et al. 2005). The main purpose of the travel diary was to collect information that would provide insights into participants' travel patterns and strategies to navigate communities. The participants were also encouraged to provide comments about trips they made. They were asked to mail back the diaries to the researcher after they were completed in stamped envelopes provided by the researcher.

The results were summarized and analyzed along with the respective interviews to examine their travel patterns. The diary contains not only the information of travel means, destinations, and purposes but also the information of approximate time spent for out-of-home activities, travel time by a trip, and frequency of multi-purpose trips, etc. The total distance the seniors travel per week was also calculated using a measurement tool of Mapion (http//www.Mapion.com). This allows the researcher to estimate rough activity distance for each participant. In addition to distance measurement, the diary contained the information of time for each trip. Not only did the researcher calculate total hours they spend per day or week, but also calculated trip ratios, the ratio of time spent for travel to the entire time spent for out-of-home activities. The trip ratio is a good way to understand how long a senior spent their trip. The longer they spent travel time relative to the entire time spend for out-of-home activities, the lesser access they have to reach certain destinations. The quantitative data of the questionnaire survey and the qualitative data of interviews, sketch mapping, and a travel diary were linked to confirm

uncertainties from the quantitative data and enrich the nature of the senior citizens' travel behaviors.

Validity and Reliability

The quality of qualitative research is usually determined by issues of trustworthiness: validity and reliability (Bloomberg and Volpe 2008). To maximize validity -legitimate analyses which present accuracy of the interested phenomena- the study implemented triangulation of the data (Creswell and Clark 2007). To support credibility of the study, this study employed multiple sources (evidence): a semi-structured survey questionnaire, observations of sketch-mapping tasks, face-to-face interviews, and one-week travel diary. To enhance reliability of the study, the consistency of data collection, coding, and interpretation (Boyatzis 1998), the researcher provided detailed information on processes of data collection, coding, and analyses. Due to time and cost constraints, this study did not incorporate a double coding, the method which makes sure the consistency of coding and interpretations with another researcher.

Limitations of the Study

The study does have some limiting conditions. First, senior citizens' travel behaviors were analyzed based on a restricted research sample. Although the study focuses on non-institutionalized older adults living in a city, data were collected at single site, YWCE. It is expected that the participants share similar characteristics, which are relatively good health and outgoing; therefore, only limited generalization can be drawn

from the study. The researcher added specific contexts such as participants' demographic and historic backgrounds to avoid overgeneralization.

Second, the restricted time duration for the interview was not satisfactory on its own to obtain information rich enough for comprehensive interpretation. Therefore, the qualitative results were compared with and complimented by other data sources: a questionnaire survey, a sketch-mapping task, and a travel diary.

Summary

This chapter introduced the research questions and the methods for empirical analysis of the data. This study aimed to discover what factors influence senior citizens' daily travel and relative contributions of those variables. Based on hypotheses and the research literature, it was expected that both personal and environmental factors would affect older adults' travel patterns. Descriptive statistics, bivariate analyses, and logistic regressions were conducted based on the data obtained through the survey questionnaire. To further analyze the results and gain additional insights, this study incorporated a research design using multiple data sources, triangulation. In addition to the results of one-week travel diary, the researcher conducted face-to-face interviews to better understand how they travel in their respective communities by implementing the sketch-mapping task, which aims to facilitate the descriptions of their travel experiences. The next two chapters provide the results of both quantitative and qualitative analyses.

CHAPTER IV

RESULTS: QUANTITATIVE ANALYSES

This chapter presents the findings of quantitative analyses to address the first research question, what are the characteristics of travel patterns and possible explanatory factors related to senior citizens' travel behaviors. The data were obtained from a questionnaire survey. To introduce general characteristics of the participants, the first section provides a set of descriptive statistics. This section includes the results of bivariate analyses, correlations, Mann-Whitney U tests and chi-square analyses, which identify potential associations between two variables. Second, to explore possible explanatory factors, logistic regressions were conducted. The section discusses not only the significance of independent variables in general but also the differences in the possible explanatory variables.

Participants and Travel Behaviors

Table 2 presents an overview of the participants' characteristics. A majority of the participants (57.0 percent) were female, and the youngest and oldest participants were 60 and 87 years old, respectively. The mean and median of the participants' age are both 73, and the largest age group, 70 to 79 years old, represents 56 percent of the participants. Approximately 93 percent of the participants have lived in Yao city for more than 30 years, and this implies that participants have a relatively high degree of familiarity with their respective communities.

Table 2 *Participants' characteristics*

Gender	**n**	**%**
Men	80	41.5
Women	111	57
Missing data	2	1

	Men		**Women**	
	n	**%**	**n**	**%**
Age (years old)				
60-69	12	14.8	39	35.4
70-79	52	64.8	56	50.4
>80	16	20	14	12.6
Missing data				4 (2.1[a])
Length of residence (years)				
2-29	5	6	9	8.1
30-59	58	72	79	71.1
60-87	17	20.9	21	18.9
Missing data				3(1.6[a])

[a]Percentage of total participants

The geographical distribution of participants' residence is shown in Figure 9. Two major railroads run across Yao city in west-east direction. As the map shows, the participants' residences are widely scattered across the city area. The city's commercial and business establishments are located around the Kintetsu Yao station. The Yao Welfare Center for the Elderly, YWCE, is located approximately 0.3 miles southwest of the station, which provides easy access. Distance, the Euclidean distance between participants' residences and the city center (Appendix F for variable definitions), varied from 0.07 miles to 3.01 miles. The mean and median distances are 1.07 miles and 0.93 miles, respectively. The distribution of Distance is shown in Figure 10. Most of the participants reside within 2 miles of the city center, although a few of the participants travel over 3 miles to attend social activities at the YWCE.

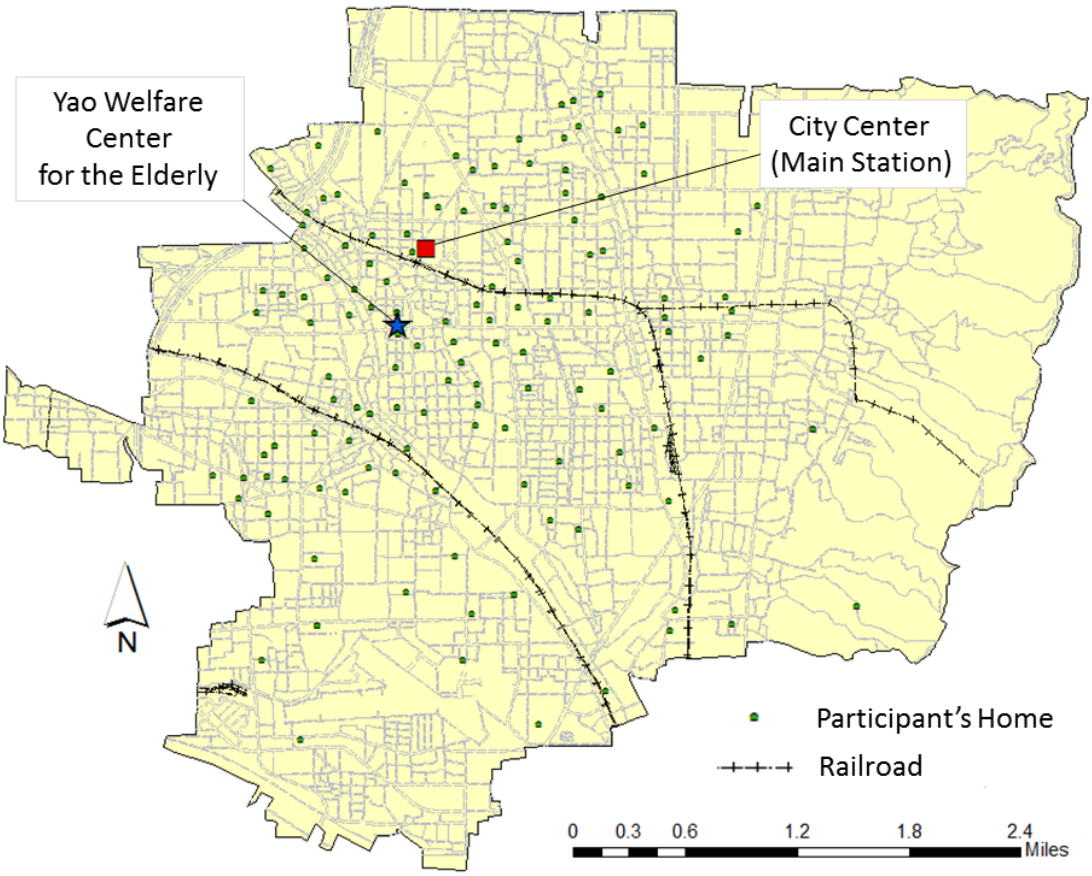

Figure 9 *Participants' home locations*

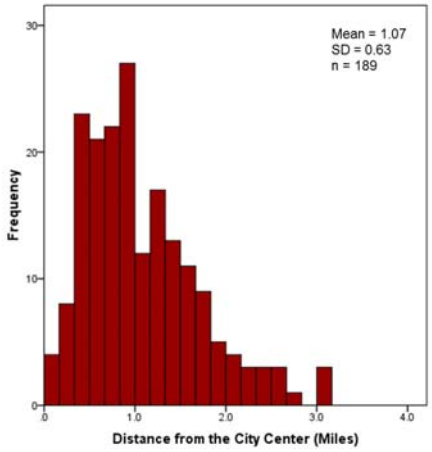

Figure 10 *Distributions of distance from the city center*

Figure 11 shows the travel frequency pattern. More than half of the participants (52.4 percent) reported they leave the house almost every day. An additional 30 percent leave the house at least four to five days per week. Only 17 percent stated they leave their house three or fewer days per week. These figures are similar to the findings from another survey of elderly people's views on housing and living environments (Cabinet Office Japan 2010b). In that study's opinion survey, 66 percent of the adults 60 years old or older answered they leave the house almost every day, and additional 16 percent answered they go out four to five days a week (Cabinet Office Japan 2010b). Thus, more than 80 percent of the older adults in both this study and the opinion survey reported they leave the house at least four to five days per week.

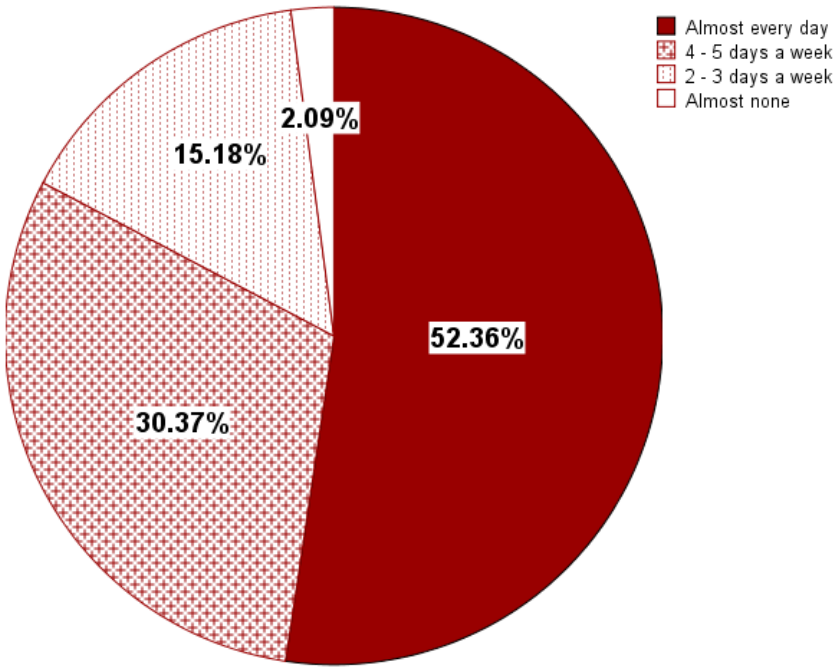

Figure 11 *Travel frequency*

A number of studies indicated that age is an important factor that affects travel behaviors. As people age, research finds that limited means of transportation and physical incapability hinder older persons' mobility. Figure 12 shows the participants' travel frequency by age categories. The seniors who are between 80 and 89 years old are less likely to go out every day than younger seniors; however, the current study finds that this does not necessarily mean that they have a sedentary lifestyle. The seniors in the oldest age group go out two to five days per week on average. In fact, even though they may not go out every day, at least 45 percent of the seniors between 80 and 89 years of age go out two to five days a week. With the exception of those who mostly stay at home, the seniors in the oldest age group (80-89) have similar travel frequency to the younger seniors (60-69 and 72-79).

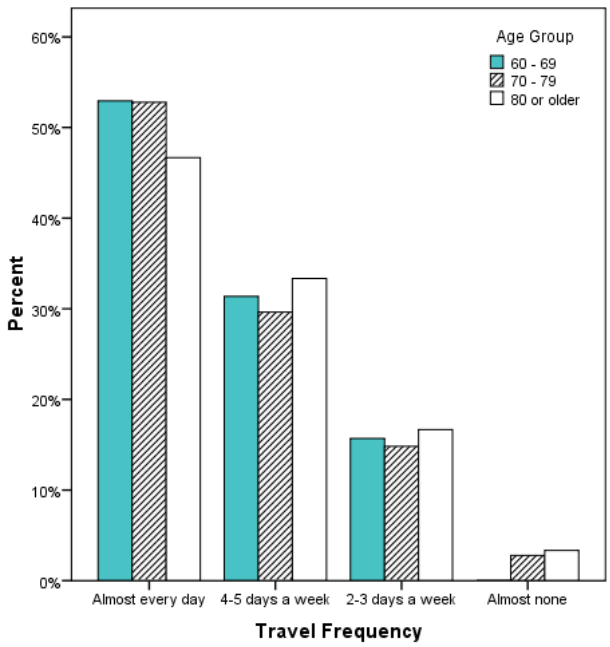

Figure 12 *Travel frequency by age group*

Despite the conventional notion that age is a critical factor related to not only TF but also to the choice of travel modes (TM), the results of this study showed that age does not necessarily affect how often seniors travel. In terms of travel modes, the participants who belong to the older age categories (e.g., 76-79 and 80-83 years) were more likely to choose train as main travel mode compared with those in the younger age categories. However, most of the oldest seniors, those 80 years old or older, travel by bicycle and on foot as much as their younger counterparts (Figure 13). The findings indicate that the participants of this study were healthy seniors who stay active by walking and biking to make trips in the city.

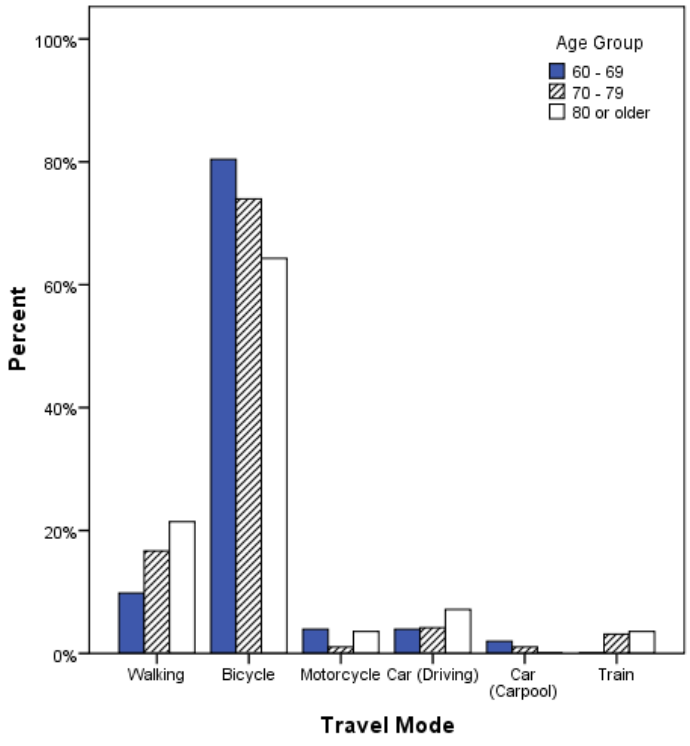

Figure 13 *Travel modes by age group*

Gender Comparisons

Gender has been also cited as a common factor that explains differential travel patterns. In this study, it was found that nearly 80 percent of both the men and women bike to get around the community. Gender differences are greater for walking, driving and train (Figure 14). While the walking is the second most popular travel modes for both genders, the female participants were more likely to walk than the male participants.

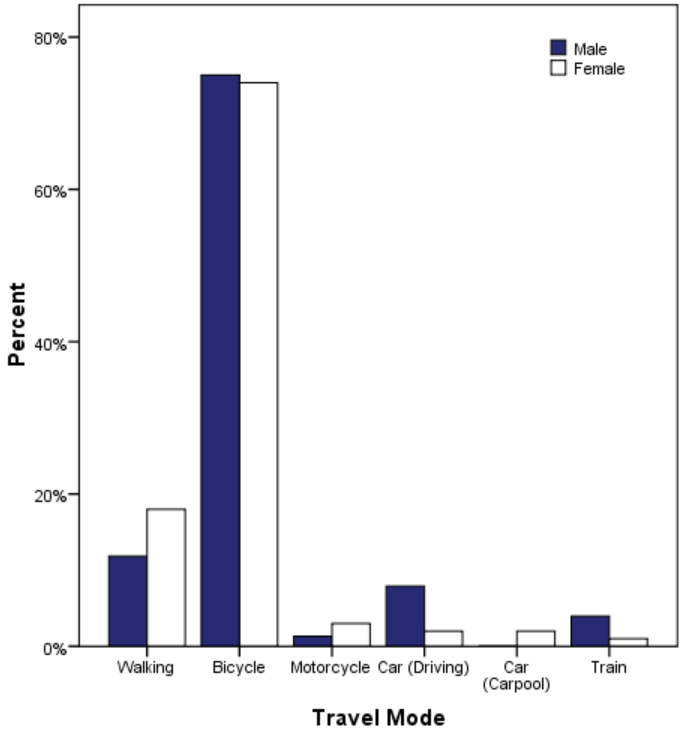

Figure 14 *Primary travel mode by gender*

To statistically analyze gender differences, the researcher conducted Mann-Whitney U tests (Table 3) for numerical variables and Chi-square tests (Table 4) for categorical variables. The Mann-Whitney U test is a non-parametric test to compare the

mean of two groups (Pallant 2010). The researcher conducted the non-parametric test over an independent sample t-test because the assumption of normality was violated in these data. The results indicate that specific out-of-home activities, accessibility, and social behaviors differ significantly by gender (Table 3). On average, the male participants (median = 74 years old) were significantly older than the female participants (median = 71 years old, $p<0.05$).

Table 3 *Comparisons of demographic and behavioral characteristics by gender (Mann-Whitney U tests)*

	1 Male (n=80)	**2 Female (n=110)**	**p**	**U**	**Z**	**r**	**Effect***
Age	74	71	**0.02**	3520	-2.27	-0.16	medium
Year of Residence	-	-	0.72	-	-	-	-
Distance from CBD	-	-	0.63	-	-	-	-
Frequency of grocery shopping per week	1	4	**0.00**	1271	-8.26	-0.6	large
Time spent at a grocery store in minutes	12.5	30	**0.00**	1811	-5.70	-0.43	medium
Personality							
Extraversion	-	-	0.31	-	-	-	-
Agreeableness	-	-	0.50	-	-	-	-
Conscientiousness	-	-	0.95	-	-	-	-
Emotional stability	-	-	0.15	-	-	-	-
Openness to experiences	-	-	0.51	-	-	-	-
Travel time to a nearby grocery store in minutes	5	6	**0.01**	2996	-2.74	-0.2	medium
Number of relatives	-	-	0.67	-	-	-	-
Number of friends	-	-	0.26	-	-	-	-
Frequency of seeing relatives per month	1	1.5	**0.05**	2197	-1.94	-0.16	medium
Frequency of seeing friends per month	2	4	**0.00**	2630	-3.12	-0.24	medium

* Effect value criteria (Cohen 1988)
0.1: Small effect, 0.3: Medium effect, 0.5: Large effect

Specifically, the female participants go shopping more frequently (4 days vs. 1 day per week, $p<0.00$) and spend a longer time at a store, TimeGS (30 minutes vs. 13

minutes, p<0.00) than their male counterparts. In addition, the women see relatives (1.5 times vs. 1 time a month, p=0.05) and friends (2 times vs. 4 times per month, p<0.00) more frequently than the men.

The effect size shown in the last column, the standard measure ranging from zero to one, indicates the strength of observed effect (Field 2005). The results of this study (Table 4) show that frequency of grocery shopping (FreqGS) has the strongest gender effect.

Table 4 *Comparisons of demographic and behavioral characteristics by gender (Chi-square tests)*

	Coding	Chi square	Sig	Phi*
Travel frequency	1 = going out every day, 2 = Others	0.00	1.00	-
Travel mode	1 = walking & biking, 2 = Others	0.75	0.38	-
Driver's license	1 = Yes, 2 = No	68.70	**0.00**	0.63
Perceived travel	1= More often than in the past, 2 = Not 1	0.00	1.00	-
Perceived health	1 = Excellent, 2 = Good, 3 = Fair, 4 = Not good	0.27	0.97	-
Marital status	1 = Married, 2 = Not married	22.00	**0.00**	0.36
Living arrangement	1 = Living alone, 2= Not living alone	18.33	**0.00**	-0.32
Current job status	1= Working 2 = Not working	0.00	1.00	-
Past job	1= Worked, 2 = Never worked/housekeeping	14.65	**0.00**	0.31
Sidewalk nearby	1 = Yes, 2 = No	1.80	0.18	-
Bus stop nearby	1 = Yes, 2 = No	1.70	0.19	-
Grocery store nearby	1 = Yes, 2 = No	Fisher's**	0.38	-
Safety perception	1 = Safe, 2 = Unsafe	0.42	0.52	-
Road safety	1 = Safe, 2 = Unsafe	0.01	0.93	-
Sidewalk safety	1 = Safe, 2 = Unsafe	0.35	0.55	-
Public safety	1 = Safe, 2 = Unsafe	2.41	0.12	-
Lighting safety	1 = Safe, 2 = Unsafe	0.02	0.90	-

* p<0.00

** Fisher's Exact Test applied, 1 cell (25.0%) have expected count less than 5

The women go out for grocery shopping more frequently than the men (effect value = -0.6). Despite the women's high travel frequency (HighTravel F), they spend a

longer time at a store, TimeGS (30 minutes vs. 13 minutes, $p<0.00$) and travel a longer travel time to get to a nearby grocery store, TTimeGS (6 minutes vs. 5 minutes, $p<0.05$). Other factors such as Distance, personality, numbers of relatives (NumR) and friends (NumF) were not significantly different by gender.

In addition to these differences, the results of chi-square tests indicate that the male and female participants significantly differ in the possession of a driver's license (DL), and in their marital status, living arrangement, and past job status (Table 3). Specifically, the men tend to possess a driver's license (75 % vs.13 %, $p < 0.00$), be married (90 % vs. 61 %, $p < 0.00$), live with someone (6 % vs. 33 %, $p <0.00$), and have a full-time job in the past (100 % vs. 58%, $p < 0.00$) more often than the women. On the other hand, other factors such as travel behaviors (TF, TM, TravelEx), perceived health, current job status, accessibility (presence of sidewalks, a bus stop, and a nearby grocery store) and safety perception do not significantly differ by gender. A Phi value ranging from zero to one reveals the magnitude of associations between two variables (Field 2005). Among the four variables, it was found that gender has the strongest effect on DL.

The findings of both Mann-Whitney U and Chi-square tests revealed that TF and TM do not significantly differ by gender although the women go out for grocery shopping, spend more time for shopping, and meet relatives (FreqR) and friends (FreqF) more often than the men. The DL is significantly higher for the men than the women even though the male seniors do not necessarily choose to drive a car. Men's living environments were also found to be significantly different from the women's: the male

seniors are more likely to be married, not to live alone, and to have had a full-time job than the women. Although the men and women share similar levels of TF and TM, the purposes of travel and the living environments are significantly different by gender.

Other Characteristics of Participants

To gain further insights into characteristics of the participants, Spearman's correlations (Appendix H, I, and J) and chi-square analyses (Appendix K) were conducted. Personality traits are correlated with age in this study: age is negatively associated with extraverted personality for both the men ($r = -0.22$, $p<0.05$) and women ($r=-0.21$, $p< 0.05$). Furthermore, the results revealed that the older men are emotionally more stable ($r=0.26$, $p<0.05$), while the older women are more agreeable ($r=0.24$, $p<0.01$).

Some personality traits were also related to social and behavioral factors. The extraverted women tend to have high travel frequency ($r=0.23$, $p<0.05$) and frequency of grocery shopping ($r=0.33$, $p<0.01$). Moreover, the women who are more open to experience spend a longer travel time to get a nearby grocery store ($r=0.20$, $p<0.05$), and see their relatives ($r=-0.20$, $p<0.05$) less frequently. Personality is inadequately correlated to male behaviors. The more agreeable male seniors do fewer friends ($p=-0.25$, $p<0.05$). Overall, the women's outgoing natures are strongly related to their active going out behaviors.

Accessibility factors, travel time and distance, are also associated with some behavioral factors. The older women spend a longer time (TTimeGS) to get a nearby

grocery store while their male counterparts do not follow this pattern. Instead, the male participants' TTimeGS is positively correlated with their Distance. This could be interpreted that older age is little influence on TTimeGS since the male seniors are more likely to own a driver's license and drive a car, while the women are more strongly influenced by age meaning it challenging for daily travel with no driver's license. In fact, the correlation results for age and travel time to get a nearby grocery store indicates that the older women spend a longer travel to get a nearby grocery store ($r=0.21$, $p<0.05$) while the older men do not. The social behaviors, frequency of seeing relatives and friends were also found to be correlated to travel time to get a nearby grocery store.

Specifically both the men ($r=-0.21$, $p<0.05$) and women ($r=-0.18$, $p<0.05$) who spend a longer time to get a nearby grocery store tend to meet their friends less frequently. These findings imply that accessibility to stores, in terms of time and distance, is somehow related to social factors. Distance is also correlated to the travel behaviors of men and women differently. The women who reside far from the city center see their friends less frequently ($r=-0.26$, $p<0.01$), while the men who live farther from city center spend a longer travel time to get a nearby store ($r=0.19$, $p<0.05$). One interpretation is that differential impact of longer distance on out-of-home activities exists by gender. The distance accessibility has more influence on social behaviors for women while it has more on a shopping behavior for men.

The frequency patterns of grocery shopping also differ for males and females. A fairly strong correlation ($r=0.69$, $p<0.01$) was found between frequency of grocery shopping and time spent at a grocery store only among the men. This indicates that

frequent male grocery shoppers tend to spend longer time spent at a grocery store. The women's frequency of grocery shopping is not related to time spent at a store but to frequency of seeing friends ($r=0.24$, $p<0.05$). The reason for this result could be that unlike the male seniors, the frequent female grocery shoppers do not necessarily spend a longer time at a grocery store and rather spend more time for other activities such as meeting friends.

The correlation matrixes of categorical ordinal data (Appendix K) indicate that a relation between perception factors and travel behaviors exists. The women who feel that the neighborhood is safer perceive better health ($r=0.17$, $p<0.05$). In addition the women perceive sidewalks safer travel more frequently ($r=0.22$, $p<0.01$), while their male counterparts do not show the same pattern. In fact, safety perception was not associated with men's travel frequency. The findings imply that women's safety perception (i.e., sidewalk) is significantly related to their travel frequency while it has little effect on the male seniors; travel frequency.

The gender comparisons revealed that there are differential characteristics of travel frequency, social activities, and safety perception for males and females. Travel time, an accessibility measure which represents more accurate physical demand than distance, is related to age for women but not for men. Older females spend a longer time to get a nearby grocery store. Moreover, Distance was a correlated factor with meeting friends for the women. Safety perception of neighborhood (i.e., sidewalk safety) is also related to travel frequency for women. Considering similar levels of travel frequency and types of travel modes between the men and the women, it is worthwhile to further

examine factors which determine their travel behaviors. The next section specifically looks at the explanatory factors of HighTravel F by gender.

Factors of High Travel Frequency

To investigate factors determining seniors' HighTravel F, this study employed logistic regression. The researcher chose this method rather than multiple linear regression because logistic regression enables one to predict the odds of an event occurrence, which is defined by a categorical variable (Sweet and Grace-Martin 2003). Multiple regressions require a numerical outcome variable with assumption of normality, the normal distribution of data. Specifically, this study employed binary logistic regression since the outcome variable is dichotomous: the seniors who go out almost every day a week or not. Using this type of analysis, the researcher was able to identify only the factors predicting the odds of occurring HighTravel F.

Logistic regression can incorporate both categorical and continuous independent variables with no assumptions of normality. However, the method assumes no outliers and independence, that is, no correlations (multicollinearity) among independent variables. If multicollinearity exists, it biases the goodness of fit of the regression model (Pallant 2010). To identify whether the assumptions are violated, the researcher examined histograms, boxplots and calculated descriptive statistics to investigate the difference between mean and the 5 percent trimmed mean for the presence of outliers (Pallant 2010). The extreme values observed in some independent variables (e.g., NumR and NumF) were kept in the analyses since the researcher identified them as genuine

data. In the course of developing logistic regression models, the researcher ran collinearity diagnostics among the model's independent variables. All the independent variables in the analyses had no significant correlations (Pallant 2010).

Bivariate Logistics Regression

Before building logistic regression models, the researcher conducted bivariate logistic regression analysis to identity the absolute significance of each independent variable on the outcome variable (Appendix L and M). Five out of 35 independent variables were statistically significant in predicting HighTravel F for the total sample ($p<0.1$): bicycle as a TM, FreqGS, perceiving more frequent travel than the past (TravelEx), NumR, and FreqF. The strength of relationship between HighTravel F and each independent variable was obtained using the odds ratio. Unlike in linear regression, in which the strength of the relationship is identified based on regression coefficients, the odds ratio best provides an intuitive interpretation for logistic regression analysis (Sweet and Grace-Martin 2003). The odds ratio tells us the likelihood of change in an outcome for each one-unit increased in a dependent variable (Tabachnick and Fidell 2007).

Appendix L summarizes the results of bivariate logistic regressions for all participants (n=191). In this analysis, the researcher examined the relationships between the seniors' HighTravel F and the independent variables listed. In other words, each independent variable was tested to determine if it accounts for HighTravel F, going out almost every day. Four out of the 35 independent variables were found to be explanatory

factor of HighTravel F ($p<0.5$). The odds ratios with more than 1 represent the positive impact of predictors on the outcome variable. Specifically, HighTravel F was found to be predicted by biking as a TM ($p=0.04$, OR =2.04), FreqGS ($p=0.02$, OR=1.18), TravelEx ($p=0.02$, OR=2.55), and FreqF ($p=0.00$, OR=1.09).

The values for each variable the odd ratios indicate how strongly those valuables impact HighTravel F. Compared to the seniors who do not go out every day, those who go out every day were two times more likely to travel by bicycle, 1.2 times more likely to go out for shopping, 2.5 times more likely to have TravelEx, and 1.1 times more likely FreqF (Appendix L). Over all, TravelEx and bicycling are the most significant predictors of HighTravel F. The results are understandable since bicycling is the most popular travels mode in Yao city. It provides the seniors with a convenient and affordable mobility. The change of TravelEx does not offer rich explanation. In the next chapter which discusses the qualitative analysis, the issue of travel perception, how the perception can explain HighTravel F is explored. The other predictors, FreqGS and FreqF have been cited in previous studies as major purposes of going out. Thus the results of this study suggest the reasons of going out frequently to complete a task of grocery shopping and maintain social network.

There are distinctive gender differences in factors predicting HighTravel F (Appendix M). The male participants' HighTravel F is accounted for TravelEx (OR =3.64, $p<0.05$) and the availability of a bus stop nearby (OR=3.01, $p<0.05$,). This means that the men who go out every day were approximately four times more likely to have TravelEx than the male seniors who do not go out every day. Also, they were three times

more likely to reside near a bus stop than their counterparts. On the other hand, the female participants' HighTravel F was found to be predicted by different independent variables. Female travel frequency was determined by a bicycle or walking as a TM (OR=3.64, p<0.05), bicycle as a TM (OR=3.23, p<0.00,), FreqGS (OR=1.65, p<0.00,), TravelEx (OR=1.94, p<0.10), NumR (OR=0.99, p<0.10), FreqF (OR=1.14, p<0.00) and perception of sidewalk safety (OR=3.16, p<0.05). For instance, the female participants who went out every day were approximately four times as likely to bike or walk as those who did not go out every day. It is understandable that the perception of sidewalk safety factor showed the significant explanatory power for the female travelers who travel almost every day. Perceiving sidewalks as safer contributes to women's travel behaviors, which are characterized by walking and biking as major travel modes. Unlike the results for the male participants, the women's HighTravel F is explained by both social factors (i.e., NumR and FreqF) and safety factors (i.e., sidewalk safety).

Multivariate Logistics Regression

To better understand relative contributions of the independent variables by gender, three models of multivariate logistic regression were constructed: one to model HighTravel F of all the participants (n=191), a second and third to predict the male participants (n=80) and the female participants (n=111). The independent variables with statistical significance (p<0.1) in the previous bivariate logistic regression were entered into each analysis (Table 5). The existence of multicollinearity, a high correlation between predictor variables, is a problematic for logistic regression modeling(Field

2005). The researcher examined tolerance values and variance inflation factors (VIF) to test multicollinearity. Specifically, the tolerance values less than 0.1 and VIF greater than 10 represent serious problem of multicollinearity. Based on these criterion values, the researcher confirmed no existence of multicollinearity.

Table 5 *Variables entered in multiple logistic regression models*

	Variables entered
Model 1: Total participants	1. Bicycle as a primary travel mode 2. Frequency of grocery shopping 3. Going out more frequently than in the past 4. Number of relatives in the city 5. Frequency of seeing friends
Model 2: Male participants	1. Going out more frequently than in the past 2. Availability of a bus stop nearby
Model 3: Female participants	1. Walking/bicycle as a primary travel mode 2. Bicycle as a primary travel mode 3. Frequency of grocery shopping 4. Going out more frequently than in the past 5. Number of relatives in the city 6. Frequency of seeing friends 7. Perception of sidewalk safety

In this analysis, a backward regression method was implemented to select significant contributing variables since this method allows researcher to eliminate weakest contributors and maximize the contributing power of other significant variables (George and Mallery 2006).

Model Predicting High Travel Frequency for Total Participants

The backward method identified four variables which predict the likelihood of the participants who went out almost every day. Due to missing data, 143 cases (74

percent of total cases) were entered to build the model. Two steps were required to eliminate the weakest contributor, bicycle as a TM, to develop the best model (Table 5). The model containing the four predictors was statistically significant (χ^2 =19.3, p<0.00). The model explained approximately 17 percent (Nagelkerke R Squared) of the variance in TF.

Table 6 *Variables selected for the model predicting high travel frequency*

	B	S.E.	Wald	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
						Lower	Upper
Frequency of grocery shopping	0.16	0.09	3.47	0.06	1.18	0.99	1.40
Perception of travel experience	0.89	0.37	5.81	0.02	2.43	1.18	5.02
Number of relatives in the city	-0.04	0.03	2.65	0.10	0.96	0.91	1.01
Frequency of seeing friends	0.06	0.03	3.74	0.05	1.07	1.00	1.14
Constant	-0.82	0.41	3.99	0.05	0.44		

Removed variable: Bicycle as a primary travel mode, perception of travel experience, perception of sidewalk safety
χ^2 =19.269, p=0.001
Nagelkerke R Square = 0.169

Table 6 shows individual contributions of independent variables in predicting HighTravel F. B represents logistic regression coefficient, which are less intuitive than regular linear regression coefficient, indicate 'the influence of a one-unit change in the independent variable on the log-odds of the dependent variable' (Sweet and Grace-Martin 2003). Negative or positive B value tells critical information, whether the predictor and the outcome variable, HighTravel F, have a negative or positive relationship. Except NumR, all the other predictors have positive relationship with HghTravel F. For instance, the more often seniors grocery shop, the more likely they are

to travel almost every day. The results of Wald test are presented with significance levels. All the predictors which had significant level of 0.1 or greater 1 presented in this table.

The most important information of logistic regression is OR shown in Ex(B). A variable with an OR <1 indicates the less likely a participant report going out almost every day. TravelEx was found to be the most influential factor with OR of 2.4. FreqGS (OR=1.18) and FreqF (OR=1.07) are next most influential variables. In brief, the model indicates that the participants who go out almost every day were more than two times more likely to have TravelEx, slightly more likely to grocery shop and see more friends, and slightly less likely to see relatives (Exp (B) = 0.96).

Model Predicting High Travel Frequency for Male Participants

Due to missing data, 75 cases (94 percent of the male participants) were entered in the model to predict men's HighTravel F. The previous bivariate logistic analyses identified only two variables with statistical significance ($p<0.1$). For this model (Table 7), the researcher selected the full model rather than the model with backward method since the full model has a larger explained variability than the counterpart with Nagelkerke R Square (0.17, $p<0.01$ vs. 0.13 $p<0.01$).

Table 7 *Variables of the equation model predicting high travel frequency for men*

	B	S.E.	Wald	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
						Lower	Upper
Perception of travel experience	1.19	0.50	5.62	0.02	3.27	1.23	8.70
Availability of a bus stop nearby	0.89	0.56	2.58	0.11	2.45	0.82	7.24
Constant	-0.72	0.36	4.05	0.04	0.49		

χ^2 =10.024, p=0.007
Nagelkerke R-Square = 0.167

Similar to the model for the total participants, TravelEx and the presence of a nearby bus stop were found to be the influential predictors with ORs of 3.27 and 2.45, respectively. Specifically, the men who go out almost every day are at least three times likely to have TravelEx and two times more likely to live near a bus stop than the men who do not go out every day.

Model Predicting High Travel Frequency for Female Participants

Due to missing data, 80 cases (72 percent of total cases) were entered in this analysis. As shown in Table 8, After four steps of the variable elimination process, three of the six variables were selected to predict HighTravel F (χ^2 =26.4, p=0.00). Thirty-eight percent of the dependent variable may be accounted by the selected predictor variables. FreqGS is the most influential predictor of HighTravel F with OR of 2.1 (p<0.00).

Table 8 *Variables of the equation model predicting high travel frequency for women*

	B	S.E.	Wald	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
						Lower	Upper
Frequency of grocery shopping	0.74	0.22	11.65	0.00	2.10	1.37	3.22
Number of relatives in the city	-0.09	0.04	4.80	0.03	0.91	0.84	0.99
Frequency of seeing friends	0.14	0.06	5.18	0.02	1.15	1.02	1.29
Constant	-3.21	1.05	9.34	0.00	0.04		

Removed variable: Bicycle as a primary travel mode, Bicycle or walking as a primary travel mode, χ^2 =26.355, p=0.000
Nagelkerke R-Square = 0.377

The next strongest predictor is FreqF (OR=1.15, p<0.05). Similar to the model of the total participants' HighTravel F, NumR negatively contributes to HighTravel F (B=-

0.09, OR=0.91, $p<0.05$). The model results can be interpreted as for each one accounted unit difference in NumR, females are 0.91 times as likely to go out every day, having FreqGS and FreqF in the model.

The results of the multivariate logistic regression analyses indicate differences in contributing factors by gender. The female participants' HighTravel F is explained by frequency of grocery shopping and social networks (relatives and friends) whereas none of these factors was found to be influential for the male participants' HighTravel F. The gender differences imply that the women's HighTravel F is determined by the specific travel purposes (FreqGS, FreqR, and FreqF) while the men's is determined by perception of going out frequency and a specific type of accessibility (presence of a bus stop).

This chapter presented the results of statistical analyses obtained from the questionnaire survey. The participants are active seniors: a majority of seniors go out almost every day and bicycling is the most popular travel mode among all age groups. Unlike the results of previous research, older age and longer distance were not found to be critical factors determining TF. Furthermore, there are distinctive gender differences in DL, living arrangement and marital status as well as FreqGS, FreqR and FreqF while there is no significant difference in TF and TM by gender. The accessibility in terms of travel time and distance showed a stronger relation to women's characteristics and travel behaviors than those of men. Older women travel longer distance to get to a nearby grocery store while men do not follow this pattern. The longer distance between the

women's home and the city center, the less frequently they see their friends. The accessibility factors had little relation to men's characteristics and travel behaviors.

The second half of this chapter was devoted to examining possible contributing factors to HighTravel F. By creating a binary outcome variable based on the magnitude of TF (almost go out every day vs. others), bivariate logistic analyses found different contributing factors of TF by gender. Operational and social factors (FreqGS and FreqF) were the most important in determining the everyday travel behavior of the women. TravelEx and availability of a nearby bus stop were found to be critical in determining the men's HighTravel F. Thus, the results of bivariate and multivariate logistic analyses highlighted the complex nature of travel behaviors by gender. The next chapter provides analysis of the second research question of this study, how active senior citizens get around in the community and what impact personal and environmental factors have on their behavior.

CHAPTER V

RESULTS: QUALITATIVE ANALYSES

This chapter presents the findings of qualitative analyses to address the second research question: how do active senior citizens get around in the community. The chapter also introduces personal, social, and environmental factors identified in the interviews not only to confirm the statistical findings but also to highlight additional factors related to the seniors' mobility. It was hoped that exploring the ways seniors travel and perceive their personal, social and environment settings would provide insight about how seniors remain active regardless of age, health, and travel distance, major obstacles to mobility in late life.

The researcher used multiple sources — a face-to-face interview, sketch mapping, and one week travel diary — from 21 participants, a subset of questionnaire survey participants who were purposefully selected based on gender, age, and the distance from their residence to the city center. Interview transcripts were first coded and to explore personal, social, and built-environmental factors. The researcher also conducted a second coding that specifically focuses on the seniors' adaptive travel strategies and perceptions of the city based on the model of selection, optimization, and compensation (Baltes and Baltes 1990; Baltes, Lindenberger, and Staudinger 2006). In short, the findings from the coding, process and visual descriptions of sketch mapping, and one-week travel diary revealed that seniors proactively invent and practice

behavioral and psychological adaptations to overcome personal, social, and environmental concerns.

Characteristic of Interview Participants

Twenty one seniors, 11 women and 10 men, participated in the second stage of the study consisting of face-to-face interviews, sketch mapping tasks, and keeping a one-week travel diary (one participant did not return her travel diary). The details of the sampling process based on gender, age, and distance between home and the city center, are provided in Chapter III. The mean and median of age and the distance are 73 and 74, and 1.4 miles and 1.2 miles, respectively (Table 9).

Table 9 *Summary of interview participants*

	Pseudonym	Age	Gender	Distance from the city center* (miles)	Major travel modes**	Living arrangement
1	Koeda	63	Female	3.4	Bicycle, train	With spouse
2	Yamada	68	Female	1.6	Electric bicycle	Alone
3	Kitano	69	Female	1.7	Bicycle, walk	With spouse and son
4	Kawamura	71	Female	0.6	Bicycle, walk	With spouse
5	Toyota	72	Female	0.6	Bicycle, walk	With son
6	Kawasaki	73	Female	0.7	Bicycle, walk	Alone
7	Nakano	74	Female	1.2	Bicycle	With spouse
8	Nishikawa	75	Female	0.5	Bicycle, carpool	With daughter
9	Aoyama	75	Female	0.6	Walk	Alone
10	Okura	78	Female	2.7	Electric bicycle, train	Alone
11	Mizuno	77	Female	0.6	Motorcycle, bicycle	Alone
12	Tani	64	Male	1.6	Bicycle, drive car	With spouse
13	Fuji	66	Male	0.6	Bicycle, walk	With spouse
14	Okuno	70	Male	0.6	Walk, carpool	Alone
15	Uemura	73	Male	2.6	Bicycle, walk	With spouse
16	Sekikawa	74	Male	0.5	Bicycle, drive car	With spouse
17	Sakai	75	Male	1.6	Bicycle, drive car	With spouse
18	Maeda	75	Male	2	Bicycle, drive car	With son and son's family
19	Taramae	79	Male	0.4	Walk, bicycle	With spouse
20	Kuwata	83	Male	3	Bicycle, walk	With spouse
21	Kijima	87	Male	3.5	Bicycle	With spouse

* Based on the most often used route (not based on the Euclidean distance)
**Listed in order of priority

As indicated in Table 9, the participants travel by a variety of means. Bicycling is the most common way to travel followed by walking and driving a car. Driving a car was only reported by half of the male participants. Furthermore, only one of 11 female seniors ever held a driver's license while eight out of 10 male seniors did. Somewhat unexpectedly, the distance between participants' homes and the city center is not necessarily related to travel mode.

In other words, the distance of seniors' residence from the city center does not imply a sedentary lifestyle and car use (Figure 15). About half of the female participants live alone while only one of the males does so.

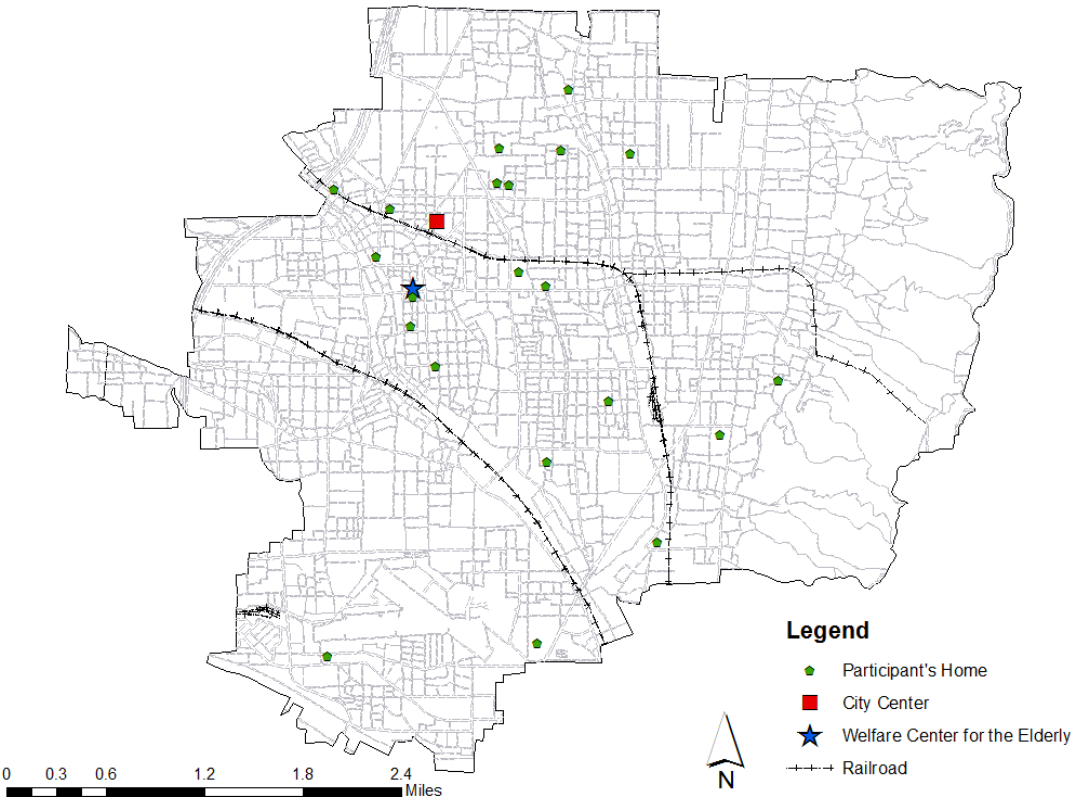

Figure 15 *Location of participants' residence and major travel modes*

An analysis of the one-week travel diaries reveal that the participants can be characterized as very active seniors (Appendix N). The average number of trips made by the seniors per day was 3.3, ranging from two to seven trips. The latest person trip survey conducted by Keihanshin Transport Planning Council (2000) showed that the average number of trips made by adults 65 years old or older per day was only 1.6. Thus, the participants of this study made trips twice as often as those of the person trip survey. Hence, the participants of this study who are active members of YWCE, represent the more active group of the population.

Factors Related to Seniors' Travel Behaviors

The first research question of this study is to identify explanatory factors related to the seniors' travel behaviors. The bivariate logistic regression analyses in the previous chapter revealed differential explanatory factors for their high travel frequency by gender. Specifically, the male seniors who perceive they go out more often than in the past and have a bus stop in their neighborhoods were more likely to go out every day. On the other hand, the women who walk or ride a bicycle, go out for grocery shopping often, have more relatives, see friends often, and perceive sidewalks safer, were more likely to go out every day. The bivariate logistic regression analyses aimed to identify factors determining a specific outcome variable, high-frequency travel (going out almost every day). The qualitative analysis captured a more comprehensive picture of the seniors' travel behaviors, not necessarily limited to explanation of the high-frequency

travel. The researcher identified various personal, social, and environmental factors related to the seniors' travel behaviors (Table 10).

Table 10 *Factors related to travel behaviors identified in interviews*

Factor	Constraint	Resource
Personal	Poor health	Outgoing personality/characters
	Loss of spouse and financial constraint	Relatives and familiarity
	Giving up driving	Bicycle
Social	Loss/lack of social network	Social and cultural event
	Poor public safety - crime	Community service and education
Built/natural environment	Unsafe traffic/street conditions	Physical structures
	Poor accessibility	Accessibility of basic services
	Inconvenient public transportation	Beautiful scenery
	Heat, rain, and hilly topography	

Personal Factors - Constraints

Poor Health

"As we age, we feel the same distance is longer. You may not imagine it though."
- A seventy-one year old woman who regularly bikes to YWCE

Decline of physical competence is the most critical issue that affects the decision of seniors to leave their house and how or when to go out. The researcher identified that respiratory problems, hypertension, leg problems, and weakening eye sight resulting from cataracts were major health concerns commonly shared by the participants. The impact of a decline in stamina and strength significantly influenced the perception of seniors' physical surroundings.

Three of the 11 female participants had eyesight problems such as floaters and cataracts. Those visual problems restricted their out-of-home activities. One seventy-five year old widow, Nishikawa, has suffered from high blood pressure for ten years since her husband passed away, and three years ago she started to develop early onset cataracts. Because she lives in the city center, she benefits from accessibility. It takes her no more than five minutes to bike to YWCE. This is illustrated by her sketch map which is compact (approximately 0.4 miles in radius) and contains rich information about nearby temples, a shrine, and shopping places (Figure 16). She has a daughter who lives with her and drives her to a large shopping mall near the station. Her one-week travel diary recorded the fewest journeys per week and the shortest total travel distance among the 21 participants (Appendix N).

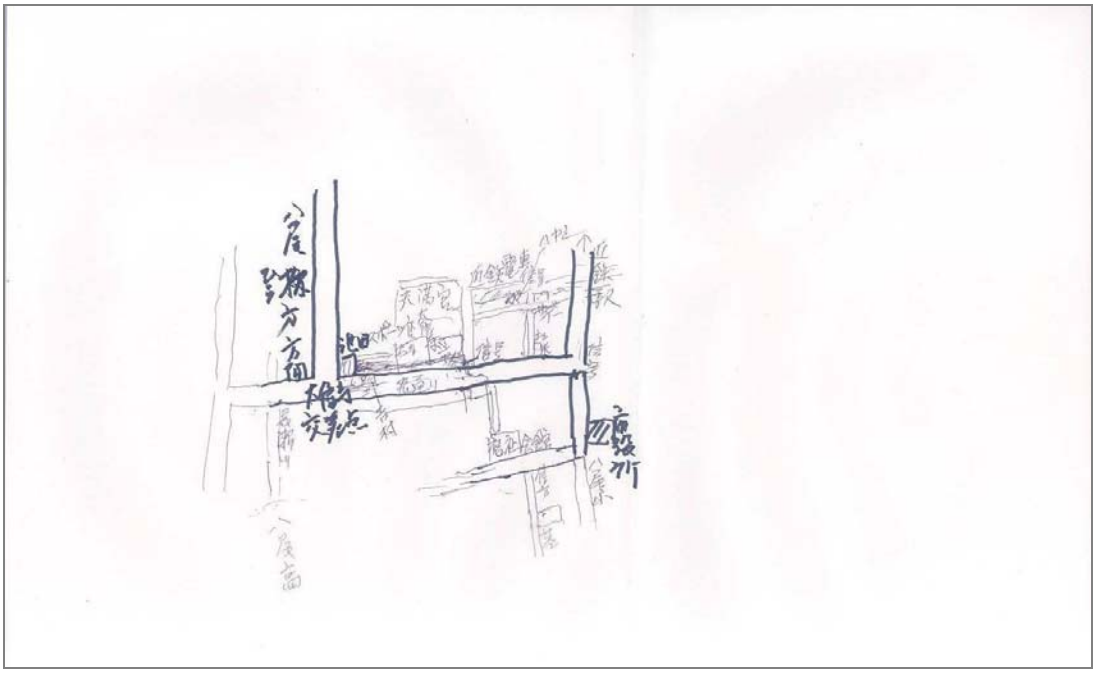

Figure 16 *Sketch map of a senior biker who resides in the city center*

The case of Sekikawa, who had lung surgery in his 20's, exemplifies how health has an impact on the choice of travel means.

> I obtained a driver's license at age of 19 or 18 years old. Then I had had this respiratory problem for 10 years. Even now I feel it is difficult to breathe while talking with you. I have a physical disability certificate since the extirpative surgery. Except driving a car, biking is my only the travel means to get around in the city. I have a trouble with walking.

The case of Mizuno, a seventy-seven year old single woman, exemplifies how the sedentary life style has negative impact on health. She experienced a sudden change in her health condition right after retirement, requiring her to leave her house to take part in the Karaoke club at YWCE and attend an evening class at high school.

> Before coming to YWCE [for Karaoke], I had basically stayed at home doing nothing after retirement. Then I suddenly lost my voice and was not able to speak. That's the reason why I started Karaoke here. Just for using my voice. That's for good health. And attending evening class at high school too.

Those stories indicate that poor health and mobility difficulties can be interrelated and influential on travel behaviors of senior citizens resulted in a positive and negative direction.

Loss of Spouse and Financial Constraints

Loss of a spouse is the most depressing and stressful event and profoundly impacts seniors' mobility. Aoyama, a seventy-five year old senior, has no nearby relatives but two grown-up sons who currently reside outside the city. After many years of caring for her sick husband, she had little contact with neighbors. It took her seven

years to recover from grief of her husband's death. "I felt lost and did not know how to spend time for myself. And I realized that freedom and loneliness come together. I had felt lonely so long, but I finally came to the realization that I am free now. My time is now only for myself (smile)." After long grief period, she eventually has begun to set a daily schedule to go out for social activities because she thinks it will keep her healthy, and it will be best for her two sons. Four out of the 21 senior citizens who have lived in widowhood expressed that there was some period of time when they found it difficult to leave their homes due to depression. Eventually they overcome the grief of their spouses' death and started to participate in social events at YWCE.

The other critical issue related to living alone is the financial constraint. Being single and living alone increased the chance that seniors had limited financial resources. For instance, the fares of public transportation (bus and train) and medical expenses were found to be a major issue restricting seniors' mobility. Mizuno has lived alone for over 47 years and has had no contact with her children since her divorce. Her major concern is her medical expenses. She intentionally limits seeing a doctor for a regular check-up. Admitting the possible negative health outcomes of this behavior, she relies on her informal remedy, engaging in a regular exercise to stay healthy as much as possible.

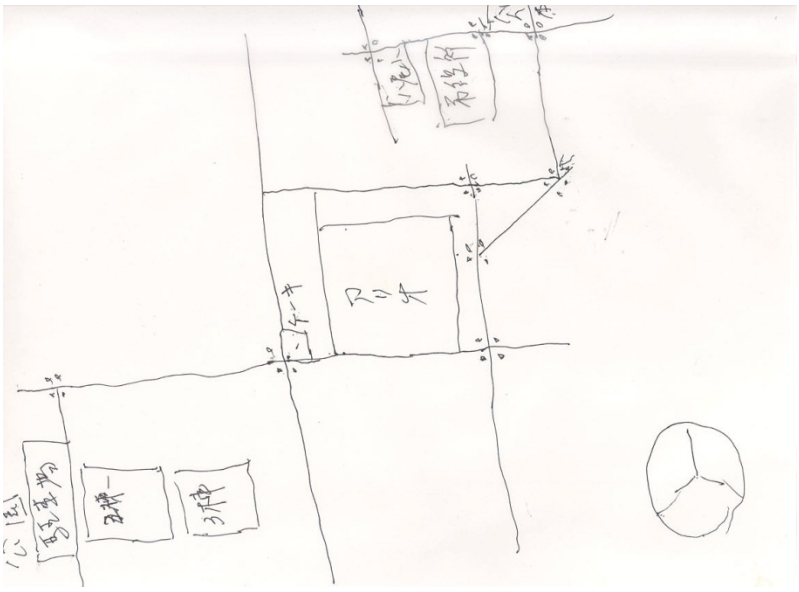

Figure 17 *A sketch map of a former chauffeur which contains rich traffic information*

Giving Up Driving

Since the bicycle is the most popular travel means for Yao citizens to get around in the city, many seniors have adapted and become used to bicycling from early adulthood. Therefore, lack of a driver's license is not the most detrimental factor which profoundly restricts mobility. Rather, giving up a driving license was the most frequently discussed concerns among male seniors. For male senior drivers, being able to travel by a car means more than just mobility, or moving from one place to another, it means empowerment. Okuno, a former chauffeur, introduced a rich and keen spatial memory of driving environments. His sketch map and verbal descriptions contain rich traffic and street information such as the location of traffic lights and one-way streets (Figure 17). They revealed the ways he organizes and conveys spatial information to execute his tasks efficiently and safely. Okuno gave up driving a car because his wife passed away

six months ago. “My wife passed away and it is not necessary for me to drive a car. Riding a bicycle is good enough to get around in the city. Besides, it is expensive to keep the space in a garage.”

The male seniors explicitly expressed how intimidating it is to take the driving exam for license renewal because of slowed reflexes and declining dynamic vision. In Japan the drivers aged 70 years old or older are mandated to renew their license every three years. The test of motor performances for renewal of a driver’s license has become a stressful event for many senior drivers. Taramae, a 79 year old senior who lives with a spouse, enjoys golfing with his friends three times a month. He usually offers his friends a ride for golfing outings. His concern is about how he can maintain physical health and prepare well enough for the performance tests to have his driver’s license renewed.

> Well, I do not think my driving skills are deteriorating. My wife sitting next to me often carps at me saying ‘almost bumping it.’ I am trying not to drive so often because my wife asks me to do so. I do not think that I have slower reflexes, but I have to admit there have been some occasions when I almost had a car accident. I drive carefully by checking both ways. I have no problem driving forward, but I have to admit some problems turning right and left as well as reversing. It does not mean I cannot drive, but I drive with extra caution.

Taramae regularly participates in traffic safety seminars offered by the police department. He articulated his concern of giving up driving by saying “If I have to give up driving next year (at age 80), it becomes necessary for me to ask a friend for a ride or take a taxi for golfing. It means I can golf only once a month.” Thus, the loss of a driver’s license not only restricts seniors’ mobility but also has a negative impact on maintaining their social network.

Personal Factors – Resources

Personality / Character

The findings of quantitative analysis did not reveal statistically significant relationship between personality traits and travel frequency. Nevertheless, seniors who identified themselves as being laid-back, free-spirited, and seeking fun, tended to demonstrate a strong propensity to go out to see friends and meet new people. Yamada, who has been a widow for seven years, described herself saying, "I like to meet people. It is fun. It just rejuvenates me. I would identify myself as rather yang (light) than yin (shadow)." Among the 21 seniors, she had the highest scores on the personality traits of extraversion (5 out of 7) and openness to experience (5 out of 7) recorded on the questionnaire survey.

The story of Mizuno, the oldest student who attends evening high school shows how her character of self-reliance and outgoing personality shapes her active travel behavior. "I am so laid-back and like to try everything I can get into. I am different from others of my age." To attend the evening classes, she travels 3.5 miles four days a week. She shared a significant episode that demonstrated her strong and independent characters.

> One day on the way back home from the evening class, I happened to have my motorcycle stalled. It was raining, a freezing day in February. I did not ask an instructor for a lift and did not call my relatives in the city. I just walked home by wheeling my bike. It was already the midnight when I got my home.

During the conversation, she showed mixed emotions of both embarrassment and a sense of pride for being independent. Mizuno was only the senior who rides a motorcycle to attend high school evening classes in this study. She thinks that a motorcycle is the most

convenient travel means because it gives her independence and flexibility to overcome a long travel distance. She was graduating in the year when she was interviewed. She said that she was thinking about switching from motorcycling to bicycling after graduation.

Having a sense of freedom and self-control tends to increase active engagement in out-of-home activities. All the female participants stressed that they do not want to rely on meal delivery services because it would lessen their opportunities to go grocery shopping and select foods to their tastes. The preference to travel a longer distance was exemplified by Kawamura's comment, "We have some stores nearby, but I usually travel a longer distance for fresh fish twice a week." Goal seeking activities, reflecting independent character, are significantly related to seniors' active travel behaviors.

Relatives and Familiarity

Having a close relative, especially a spouse, is also a valuable resource for seniors. It is especially true for those with no access to a car or bus, and when carrying groceries becomes challenging. Walking or biking for grocery shopping with a spouse is a definite advantage which helps to minimize physical constraints according to Fuji, who has been sick for four years. Furthermore, the results of the travel diary (Appendix N) indicate that higher percent of trips made with someone was found among male seniors than female seniors (average 24.3 percent vs. 9.9 percent). The male seniors responded that they made trips mostly with a spouse while the female seniors did not necessarily follow that pattern. This implies that a male senior who accompanies with his spouse might be functioning as a provider who offers a ride or helps his spouse carry groceries.

Regarding personal surroundings, having familiarity with their local environments is advantageous for maintaining seniors' sense of belonging as well as security. All of the participants have lived in the city more than 30 years: many of them born and grew up there. Place familiarity and knowing how to get to destinations helps seniors feel comfortable and safe during their travels. As the Lawton's proactivity theory (1989) posits, the more competent seniors are, the more they can successfully modify environmental resources. This capability enables seniors to undertake their travel experience with confidence. The participants' creative adaptive behaviors were revealed in their idiosyncratic sketch maps along with the detailed verbal descriptions they provided.

Koeda is a bicyclist who resides 3.4 miles south of the city center. She introduced the descriptions of her travel route by drawing short cuts to the city center. "I don't use the main street to get to Ario (the main shopping mall). I have been in the city almost for 40 years. I know the routes to get there." Familiarity with the urban area helps a senior feel safe when traveling around in the city. Participant, Kijima, grew up in Yao city and has lived for 87 years. "What do I like most about the city? I know lots of places and have a large circle of acquaintances. I have relatives on both sides of the family in the city." Kijima looks forward to going out regularly to see his relatives who live in the city.

Their perception of the urban environment, which has developed over a long time, also influences seniors' travel behaviors. Rowles (1978) who studied the community perceptions of five senior citizens in rural Appalachia introduced three subjective

domains of geographic space (place): physical, social, and autobiographical insideness. While physical and social insidenesses represent physical and socio-cultural settings in general, a place attached via idiosyncratic life experiences has a strong impact on perception and behavior of the elderly. The findings of this study confirmed earlier research concerning autobiographical insideness.

Toyota, who lost her husband in a traffic accident, shared her traumatic memory of the place where the accident occurred, a street corner near her house. She was hesitant to draw a sketch map during the entire interview session and mostly provided the researcher with verbal descriptions about familiar places. When asked about disliked places in the city, she responded

> (Long pause). I lost my husband in a traffic accident. My son and I never want to visit the street. He was hit by a truck on the way home from his farm. It is only 300 feet away from my workplace. So there is no way to avoid that I will pass the place on my way to work. I lost him too suddenly and did not know what to do. I am alone. How can I live alone? I know we age and pass away eventually, but it is too sudden. I knew I had to overcome it, but it is not easy to move on. My two sons thought I could not get over it. They thought I might end up being bedridden.

It took three years for her to overcome the grief of the traumatic incident, and finally she has begun to go out for the Karaoke club of YWCE. She still avoids passing the street where the tragedy occurred.

Kijima provides another example of autobiographical insideness. Kijima was born and grew up and lived in the city for his entire life. His rich and vivid autobiographic memories of places in the city were clearly manifested in his sketch map. His drawing contained a place which existed during World War II, which he further

described and enriched with stories of the large air base (the shaded areas in Figure 18) and hangar sheds that once existed there.

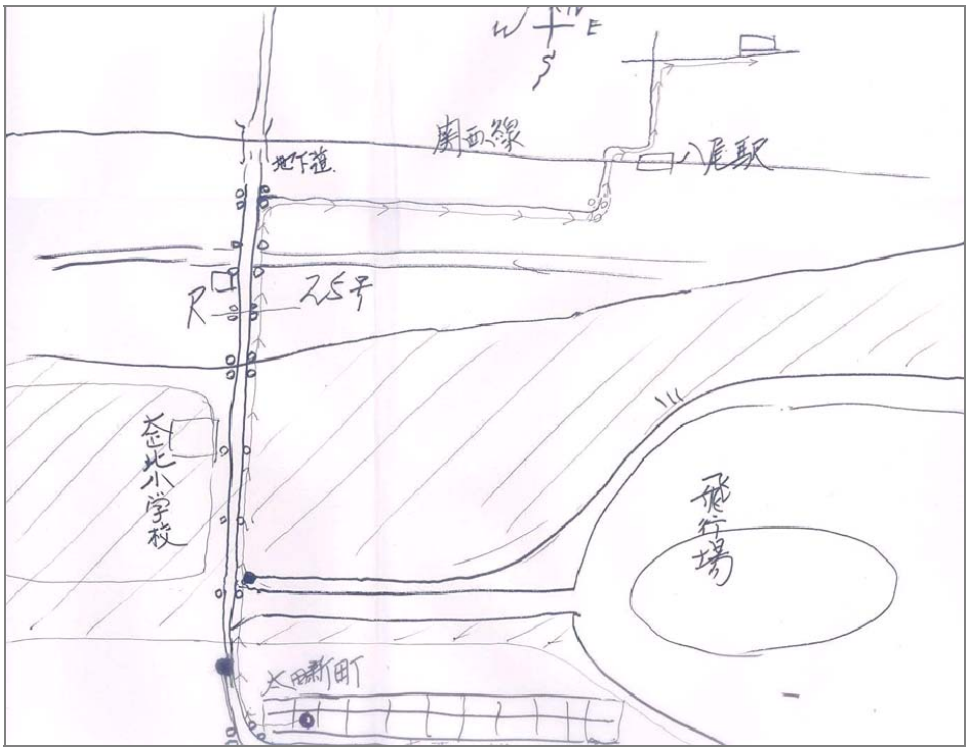

Figure 18 *Sketch map containing autobiographical information*

Kijima's excitement and pride while he reflected his place memories during wartime as a factory owner who has lived near the air base, imply his strong sense of belonging to the city. This factor is likely to encourage him to keep going out in, what are for him, familiar and memorable surroundings.

Figure 19 *A bicycle rental store near the main station*

Bicycle

Bicycling is the most popular travel means in Yao city. A person trip survey revealed that the proportion of the general population (not necessarily the elderly) using bicycles and motorcycles is larger (35 percent) than that (25 percent) of Osaka prefecture (Yao City Traffic Division 2006). There are a number of bicycle stations and rental stores in the city center (Figure 19). Especially for senior citizens, a bicycle is an essential travel means to accomplish independent living because it is most affordable and accessible. As a daily physical activity, bicycling is a low impact mean to maintain physical strength and flexibility which affect seniors' physical health.

The seniors who experience a decline in stamina, strength and weakening of the knees, find walking more challenging and unpleasant and often choose to ride a bicycle instead. Moreover, some seniors find riding a bicycle rather than walking contributed to continuity of activities and independence because of "convenience." Toyota, a bicycler who has been a widow for ten years, pointed out that it is "convenient" to have a bicycle to carry groceries herself.

> I know walking to a store is better for health, but I usually find myself ending up with buying and carrying too much cheap stuff. One day I walked for grocery shopping and hurt my right shoulder carrying big stuff. It is nothing like I cannot carry groceries. But since then, I ride a bicycle to grocery stores so that I can put the stuff in the bicycle basket.

Two female seniors living far from the city center ride electric bicycles. A seventy-six year old widow, Okura, who resides in the eastern hilly area uses en electric bicycle to overcome time, distance, and the topographical barriers. She used to ride a motorcycle, but she switched to an electrical bicycle three years ago. This is mostly because she thinks that renewing the motorcycle license is too costly and a hassle. She spends 40 minutes on a trip to participate in the Bumper Pool club at YWCE. To minimize a time constraint, she takes a short cut and creates multi-purpose trips by which she is able to stop by an orthopedic clinic, various social clubs, and grocery stores.

Social Factors – Constraints

Loss of Social Network

Loss of formerly established social network restricts seniors' mobility especially after retirement. After retirement, they go through a major lifestyle change, from work-based to home-based activities. This was particularly apparent for male participants as indicated by the statistical results of gender comparison for past job experience (worked as a full-time worker or not), but it also is reflected in the qualitative findings. Uemura, a former business person who retired six years ago, described how he adapted to the circumstances influenced by change in his social role after retirement. He feels detached from his old colleagues at workplace.

> Since retirement, my subordinates no longer contact me at all. It is so distant although we used to golf together, but not anymore. The way young people think today is so different from that of our generation - we had much respect for seniors.

Unlike many female seniors who have already established close relationship with neighbors, male seniors who had spent most of the day at their workplace often experience a different social constraint. In fact, a few female participants pointed out concerns that if their spouse at home stays all day after retirement, it would be harmful for their spouses' health.

Public Safety - Crime

One of the most often mentioned negative perceptions by the citizens of Yao city is public safety, especially, the relatively large number of thefts (Yao Police Station 2010). According to crime statistics, Yao had at least 111 snatch and grab incidents in

2010. The concern about public safety was exemplified by seniors' comments such as, "You know, unfortunately Yao is known for snatching incidents (Taramae)." To avoid being robbed, seniors employ various strategies. For instance, they do not leave their property in a bicycle basket, carry a bag on their shoulder, or keep much cash on themselves. Okura who resides in the eastern hill area regularly travels a long distance to go shopping in the city center. To ensure public safety, she goes out only in the daytime and chooses specific routes to take. When she happens to come home late, she avoids taking a street along the Tamagushi River, which is deserted in the evening. Thus, the seniors develop and employ various strategies to prevent themselves from becoming a victim of theft.

Social Factors – Resources

Cultural and Social Events

Social gathering or cultural events are major resources for seniors to establish and maintain social networks. Annual events, such as a summer festival in August and a cultural event in November, create opportunities for them to actively engage in out-of-home activities. Many seniors prepare to participate in the cultural events as dancers, singers, and performers. For instance, Taramae, who is a former instructor of folk music, looks forward to performing at the annual cultural festival. He and his wife attend performance lessons and folk music events on weekends.

Okuno has just started to develop a social network by attending a cooking class since his wife passed away six months before. He attends a male-only class to learn how

to cook because he had rarely had cooked for himself. Initially he did not have any excitement about attending the class. However, he started to make male friends in class and maintain his social network, and this has become a reason for him to continue attending the class.

Besides formal social gatherings, neighborhood networks create opportunities to go out and meet other people especially for senior women. They regularly meet for lunch and dinners and to go on an excursions once in a while. Most of the female participants have developed close ties with neighbors over time and do not want to move away from their communities. Some of them even stressed that their neighbors are more important than their families. Aoyama, a 75 year old widow, had a hard time establishing a neighborhood network because she had to take care of her sick husband as soon as they moved in. After the death of her husband, she began to participate in community services, such as neighborhood clean-ups in order to establish a social network.

Community Service and Education

Other activities such as volunteering and education enhance seniors' independence and autonomy. An active involvement in volunteer activities was found to be critical, especially for retired male seniors. Four out of the ten male participants, all of whom all had a driver's license, expressed their satisfaction from volunteering. Uemura volunteers to give rides to the physically challenged almost every day. Not only does it frame his daily schedule but it also empowers him to assume the role of provider.

Volunteering, thus, represents a social opportunity which encourages seniors to go out and get involved in their communities.

Despite the reported importance of active involvement in community services by, the results of the bivariate logistic regression did not reveal a strong statistical relationship between travel frequency and social factors such as the number of friends or the frequency of seeing friends explained the mobility pattern of male seniors. However, the analysis of one week travel diaries indicate that many of male participants had large social purpose ratios (the proportion of the trips made for social activities relative to total trips) compared to the female seniors (See Appendix N). A possible interpretation is that the questionnaire survey did not elicit reporting of social factors such as participation of community services and volunteer activities. The findings of the qualitative analysis highlight not only the gender difference in engaging in social activities but also possible problems in the questionnaire survey.

Similar to participate in community and volunteer services, education enhances seniors' self-esteem and keeps them remain actively involved in out-of-home activities. For Mizuno, a 77 year old woman, attending evening high school classes has given her an opportunity to restructure her schedule after retirement (Figure 20). She expressed feelings of fulfillment and excitement, "I enjoy every moment of my second life."

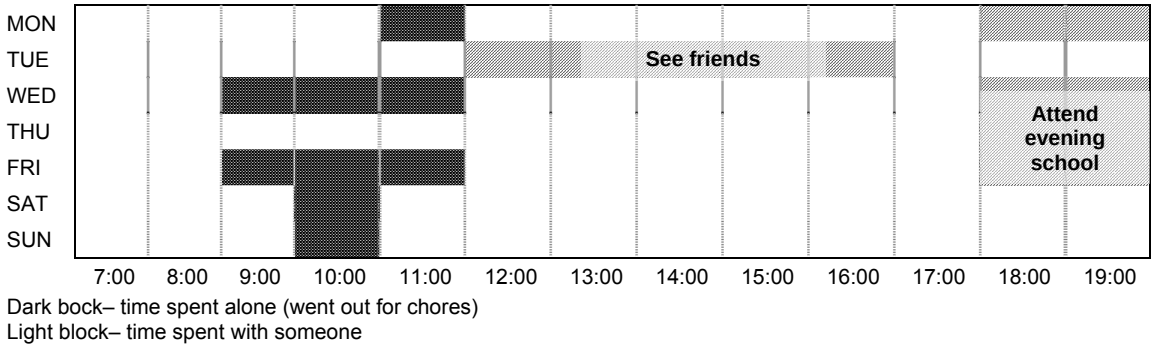

Figure 20 *A senior student's temporal aspects of out-of-home activities*

She plans her week according to the evening class schedule: she arranges her time to do chores in the morning and homework in the afternoon. Mizuno's story also illustrates how senior citizen can overcome a major physical barrier, a long travel distance. To attend the evening class she travels 3.5 miles by motorcycle four days a week.

Built/Natural environments - Constraints

Street conditions

One of the most commonly discussed built environment elements that restrict the seniors' mobility was street conditions. In fact, the city's attitude survey indicated that almost to 60 percent of the citizens thought that streets were unsafe for older adults and the physically challenged (Yao City Policy Planning Division 2010). One reason for this might be that the city has preserved at least 33 temples and shrines (Yao City Buildings and City Planning Division 2006) with along the surrounding narrow and winding streets (Figure 21).

Some seniors who regularly visit a temple and shrine find taking the nearby streets unsafe because the narrow and winding old streets block the visibility of pedestrians and bicyclers. In addition, the old streets have no lane for bikers and pedestrians. Some seniors mentioned that their reason for using specific streets is the presence of sidewalks. To avoid the risk of colliding with them, the seniors pay particular attention to passing pedestrians and bikers. When they pass by an older senior, especially they tend not to ring their bell but to warn by saying “excuse me.”

Figure 21 *Narrow and winding old streets with no sidewalk*

They explained that calling out with soft voice worked better because it does not make older seniors with hearing problems upset and startled. In this way, they develop a strategy not only to minimize the risk of traffic accident but also to avoid the hostility of traffic hassles. As discussed in the previous chapter, the findings of the logistic regression analyses indicated that the perception of sidewalk safety was a significant factor predicting the women's mobility.

Figure 22 *A sidewalk with bike lane in front of YWCE*

Several related issues were mentioned by the female seniors. They find biking on narrow streets extremely unsafe even with the presence of sidewalks (Figure 22). During

the fieldwork in summer, the researcher witnessed many female bicyclers who attached a parasol to their bicycles. During the interview session, a couple of the female seniors mentioned that they decided to take off the parasol despite of strong sunlight because it makes it unsafe for them to pass by oncoming pedestrians and bicyclers. Thus, some female seniors adapt to the inconvenient traffic situation by modifying their property.

Poor Accessibility

Seniors who live far from the city center deal with poor accessibility in various ways. Okura, a widow who lives alone 2.7 miles from the city center, expressed is concerned about the future when she becomes too frail to ride an electric bicycle to the city.

> I have poor access to the station and grocery stores. My concern is the time when I get sick in bed. I would have to rely on someone. I don't think I will be able to make a trip alone when that happens. I live too far away from the city center.

Furthermore, she discussed another challenging factor affecting her daily travel: hilly topography in her neighborhood.

> I am fairly healthy. You know, this point on the big street (pointing to it on the map) is hilly. I mean it is extremely hilly. Most bicyclers have to walk there with their bikes. I used to ride a motorcycle in the past and did not even feel it so challenging until I switched to an electric bicycle. I have to ride a bicycle in the lowest gear of three levels to go up the hill.

Okura also pays attention to the way she uses the battery of her electric bicycle. Knowing that she uses quite a large amount of battery power to go up the hill on the way home from YWCE, she regularly checks the amount of battery remained to save the power to assure that she can get up the hill.

Another senior bicycler, Kijima, is the oldest participant (87 years old) in this study. Among the 21 participants, he travels the longest distance (3.5 miles) and spends 40 minutes to reach YWCE. He has developed unique strategies to get around in the city. As a bicycler, he strategically selects the streets with bike lanes.

> This route is a main street where buses run. It's not good to ride a bicycle on this street. Buses are running. This is a short cut to YWCE, a short cut. It is shorter but busses and personal vehicles are all running on this one street. This is an old street. Also it is the shortest street to YWCE, but there are no specific lanes for car drivers, bicyclers, and pedestrians. It is way too dangerous. That's why I take another route. But this main street is much shorter to YWCE. I cannot take that (main) street. I just can't.

Kijima chooses another street to ensure traffic safety regardless of the longer distance he has to travel. He also described that he takes the routes with fewer traffic lights to avoid frequent stops for red lights. His route descriptions indicate that traffic safety is critical, yet he creates and employs unique strategies to make his daily trips pleasant as much as possible.

Inconvenient Public Transportation

The city's bus system is generally perceived of with little use due to expensive fares and a long travel times. Yao has five bus lines operated by the private sector; however, most of the participants choose not to take the bus because of they could not afford the bus fare. A senior discount is not available and a one-way ride costs at least 290 yen (approximately $3.8). The seniors strongly expressed their desire for more affordable public transportation. A community bus, which had once been operated by the city (beginning in 2000), was terminated in 2008 due to municipal financial constraints.

Kijima, the oldest senior bicycler, commented, “I know we have a bus running close to YWCE, but it costs 290 yen for one-way. It is not cheap. We also have to walk from a nearby bus stop to YWCE.” Many participants pointed out walking is more physically challenging than bicycling due to weakening knees. This is clearly the reason why Kijima chooses not take a bus. However, for some seniors who have no alternative way to travel other than walking, access to a public transit is essential. Aoyama whose only travel means is walking said that the city’s bus system is necessary especially for seeing her hospitalized friend. “My friend has been in the hospital which is located far away from my home. I have to take a bus to see her. I know the fare is expensive, but I have no choice. If I get sick, I cannot help relying on public transportation too.” For seniors whose only travel means is walking, public transportation is only the way to maintain independent mobility. A seventy-three year old bicycler, Kawasaki, shares the story of her senior neighbor, who has a problem going out by herself.

> I know an elderly neighbor who is 80 years old and cannot walk a long distance. For those who can ride a bicycle, there is no big problem. But for those who cannot, a long distance walk is unbearable. The only way they can go out is to ride a bus, but it is way too expensive. The older seniors have to take a bus anyway. But it is a burden for those getting old who have to rely on this expensive option. I really want somebody to take care of this problem.

Thus, many seniors are concerned about their future when they become too frail to ride a bicycle. Mobility is not necessarily limited to their physical capability to move from one place to another. It is also determined by affordability to of travel options. The findings highlight the necessity of affordable and accessible public transit systems in Yao city.

Heat, Rain and Hilly Topography

Weather conditions also hinder older adults' ability to make daily trips. For the seniors who travel by bicycle, motorcycle or on foot, rain is the most unpleasant natural factor that threatens travel safety. On a rainy day seniors sometimes choose to stay at home while others develop strategies to go out for basic chores like shopping. For instance, instead of putting up an umbrella while riding a bicycle, senior citizens wear a raincoat with a hood for a safety reason. Uemura, a male bicycler who lives near Yamamoto Station, which is the first stop from Yao Station, takes a train to get YWCE to minimize the risk of a traffic accident. However, only seniors who live near a bus and train station can benefit from public transportation.

Koeda, a female bicycler who lives far from the city center and travels more than 3 miles from her home to YWCE, once had a traffic accident and fell down on a rainy day.

> While I was carrying a lot of groceries and riding a bicycle in the rain, I slipped and fell down. I got a bruise on my hip. Since then I fear a rainy weather most. Often I am in rush and fear to bump into a person who puts up an umbrella. I am so afraid that my children eventually tell me to stop riding a bicycle for safety. At worst I might end up with riding a three-wheeled cycles or giving up bicycling.

Thus, these episodes indicate that rain becomes an obstacle especially for the seniors who live far from the city center and travel a long distance by bicycle. The long distance along with rainy weather has a profound negative impact on seniors' mobility.

Built/Natural Environments - Resources

Physical structures

Gibson (1979) introduced the notion of affordance, which posits that a place or an environment 'offers' certain meanings which differ among various organisms (individuals). The findings of this study confirmed the existence of affordance in seniors' urban environments: their verbal descriptions and sketch maps revealed that there are unique multiple functions and meanings of a particular environment in the city.

One good example is an old commercial avenue called Family Road, which is located in the western section of the Kintetsu Rail Station (Figure 23). The commercial avenue had been a major shopping place until the main station was relocated to the east along the railroad.

Figure 23 *Family road with arcade*

For many seniors in Yao city, the commercial avenue had been a major gathering place. Today many stores on the avenue are closed due to the relocation of the main station. Although it had been a shopping avenue, the arcade today offers seniors a different function, a physical structure which protects them from rain and sunlight. A couple of seniors described that they travel through the arcade not for shopping but for protection from heat in summer time. Thus, Family Road has changed its meaning or function from a shopping place to a protective structure.

Today Ario and Seibu are the two most popular shopping destinations in the city (Figure 24). Annexed to the main station, Seibu is an older structure than Ario, a new shopping mall established a couple years ago.

Figure 24 *Seibu – a shopping center annexed to the main station*

Seibu and Ario which are connected with a covered skywalk provide citizens with an easy and safe access to the main station. The large complex provides seniors with multiple functions and meanings: affordable entertainment, informal exercise and social gathering spaces, and a protective structure. The seniors described Ario as a place where they look forward to going to movies. The cinema complex in Ario attracts senior citizens by offering senior discounts. The large indoor space with benches in Ario also creates space for informal walking and social gathering. Most importantly, the two shopping buildings connected with the covered skywalks provide a safe indoor space they can use to reach the main station by protecting seniors from unpleasant and unsafe weather conditions: rain, wind, and heat.

> I found going through Ito Yokado (Ario) very convenient. For instance, when I come from the station, I walk across the land bridge and pass though Seibu and Ito Yokado to reach the northernmost exit. Just crossing the street from the exit takes me to my housing complex. It is especially convenient when we have a cold or rainy day. I know it is devastating for the owners of Family Road to lose their businesses though. – A seventy-five year old widow, Aoyama

Thus, the seniors do not necessarily perceive Seibu and Ario as shopping places but rather an environment which provides multiple functions: entertainment, exercise, socialization, and refuge.

Accessibility to Basic Services

Easy access to shopping places was the most often mentioned advantage to residing in Yao city. Eighty six percent of the participants (18 out of the 21 seniors) expressed their satisfaction with not only easy shopping access but also varieties of

shopping options. Seniors can easily bike or walk to nearby convenience stores and grocery shops. Moreover, some seniors stated that they go out for shopping because it is a physical activity that promotes their health. Toyota, a 72 year old widow, regularly goes out in order to engage in social and physical activities. She stressed that "I go out for shopping every day. Going shopping by bicycle means exercise to me." Her story implies that easy access to stores prevents seniors from becoming depressed and sedentary, especially after the loss of a spouse.

Beautiful Scenery

Although heat, rain and hilly topography may hinder seniors' mobility, some other natural environments create an opportunity for seniors to go out. Almost half of the senior participants mentioned that they like to go out to see the beautiful scenery when trees bloom along Tamagushi River. The cherry blossoms grove along Tamagushi River where have been a major sightseeing spot attracting people across the city. The residents along the river started to plant cherry trees about 45 years ago and now there are 1,000 cherry trees that blossom for over 3.1 mile along the river (Yao City 2011). The seniors look forward to riding a bicycle on the river trail and seeing cherry blossoms every April. Seniors also pointed out other scenic places that were favorite places to visit for stroll and biking such as hydrangea and amaryllis planted along streets. These examples are consistent with the findings from a study that examined perceptions of outdoor held by older adults in assisted living facilities (Rodiek 2006). In that study, greenway, fresh air,

and flowers were found as the top three natural elements which represent the reasons for seniors to go out.

The findings of the qualitative analyses highlighted some factors affecting seniors' travel behaviors in the context of Yao city. The notions of proactivity (Lawton 1989), autobiographical insideness (Rowles 1983) and affordance (Gibson 1979) are all confirmed by the qualitative analysis. The researcher identified several proactive travel behaviors employed by seniors: they utilize their internal (mental representations) and external resources (e.g., a raincoat, electric bicycle, and the old commercial avenue for heat protection) to maintain mobility. As noted by Rowles (1983) and Gibson (1979), some places can represent multiple meanings and hidden functions for seniors.

Adaptive Strategies of Mobility

The first half of this chapter was devoted to describing and analyzing the personal, social, and environmental factors related to senior citizens' travel behaviors in the specific context of Yao city. The findings revealed that aging in place is a complex phenomenon affected by various local environmental factors. As Lawton's proactivity hypothesis (Lawton 1989) posits, it was found that the seniors participated in this study were active agents who utilize internal and external resources to adapt to their environments.

The last section of this chapter explored the ways they adapt to their surroundings based on the conceptual framework of selection, compensation, and optimization (SOC). The model argues that humans thrived by adapting to their

environments to successfully achieve their own goals regardless of limited resources available to them. Research incorporating the SOC theory into seniors' outdoor mobility has been limited with a few empirical studies (Rush, Watts, and Stanbury 2011; Siren and Hakamies-Blomqvist 2009). The research applied SOC not only to examine seniors' proactive behaviors but also to highlight types of adaptations they made in the specific local context based on selection, optimization, and compensation domains. In this study, the seniors' fundamental goal was defined as being able to safely reach places they like to do basic chores and participate in informal and formal activities such as shopping, seeing friends, visiting a clinic, etc. The adaptive strategies found in the qualitative analyses are summarized in Table 11. The strategies presented here have been mostly discussed in the previous section along with the analysis of personal, social, and environmental factors.

Table 11 *Summary of adaptive strategies based on the SOC model*

Adaptive domain		Strategy
Optimization	Health promotion	Walking/bicycling as exercise, social gathering, volunteering and services
	Safety enhancement	Collision prevention, street selection, safety education, theft prevention
	Travel plan	Scheduling, mental maps, multipurpose trip
Compensation	Human	Family and relative assistance, alternate human service
	Environmental	Change of travel modes, protective built-environments
Selection	Behavioral	From family to neighbors/friends, from work-based to community networks
	Psychological	Adjusting perceptions of environments

Optimization

The researcher found that seniors enhance their mobility by inventing and practicing strategies of health promotion, safety enhancement, and travel planning. To maintain and promote health, seniors walk or ride a bicycle instead of taking a bus or driving a car. In fact, many seniors take a walk or ride a bicycle not because they have no other means to travel but because they thrive on maintaining or improving their health.

> I go to Karaoke at least once a week. I believe walking and vocalizing are good means to fight aging. – Kuwata, an 83 year old male senior

> You know, I am afraid of having a car accident, just think about what if I have a car accident. I never had one though. Riding a bicycle is safer. Besides, it is good for health. Riding a bicycle becomes exercise for the leg muscle. – Okura, a widow who rides an electric bicycle

> I am getting weak with age. I need to do exercise for my health. I walk for exercise. – Taramae, a 79 year old senior driver

Another strategy employed by seniors to maintain health is to actively engage in social activities and to visit with friends at YWCE. Most of the seniors participate in multiple social clubs and lessons. Fuji, who has been sick for four and half years, stressed the positive impact on his health of his regular visits to YWCE to participate in the Bumper Pool club. By adjusting his routine to the club schedule, he and his friends can get together regularly, which they think is beneficial to their health.

> The day feels long if I stay home. I feel sluggish staying at home, and often debate if I should come here [YWCE] or not. But it is weird that I feel much better meeting my club friends. My friends also have the same experience.

More specifically, some seniors stressed the importance of having a conversation in person. Sekikawa, a 74 year old senior who is actively involved in neighborhood gatherings, explained his idea of having a conversation in person.

> After retirement, many people just stay at home and just watch TV. That's really bad. There is no real conversation. It is no good being surrounded by high-tech machine. I think that talking in person improves our mental speed and prevents us from getting dementia. I go out for that reason.

Participating in volunteer activities and community services were also found as adaptive strategies to have emotionally satisfying experiences. Koeda, a member of theater companies of YWCE, currently volunteers in visiting a home for the elderly. She expressed her excitement by saying "I love volunteering in visiting nursing homes and seeing their enjoyment on our performance. I used to be a bank worker, but now I am in theater companies. I think it is my second life." Other seniors expressed similar satisfying feelings on volunteering. In fact, volunteer activities were found to have positive impact on physical and psychological health (Morrow-Howell et al. 2003).

As already discussed above, to safely get around in the city, cyclists pay a special attention to older senior cyclers and pedestrians by calling out and selecting streets with sidewalks. Senior car drivers attend safety seminars to avoid having a car accident and to maintain a good driving record for their license renewal. For theft prevention, seniors are cautious about not leaving their belongings in a bicycle basket, not carrying a bag on their shoulder, and not having much cash in their purses.

Seniors also proactively invent and implement travel plans to enhance safe mobility. As discussed in the previous section, seniors organize their time based on their mode of travel in addition to using their internal resources and cognitive representations

of urban environments. The weekly schedule of Mizuno, who attends evening high school, is a good example of how seniors reframe their time according to their travel modes (in her case, motorcycle) and out-of-home activities. Kijima, an 87 year old senior cycler, successfully overcomes the long travel distance (3.5 miles) from the city center by developing his mental maps that contain necessary geographical information about streets which bike lanes and traffic lights and vehicle volume. Seniors invent and implement adaptive strategies to enhance mobility and safety.

Analyses of the one-week travel diaries revealed that women made multipurpose trips more frequently than men (Appendix N). Specifically, nine of the 20 participants made multipurpose journeys which comprised more than 50 percent of their total journeys. Sixty seven percent of the seniors who often made multipurpose journeys (6 out of 9 seniors) were women. Purposes or destinations of multipurpose journeys for the women were mostly shopping related while those of the three male seniors who often made multipurpose trips were giving a ride to a social gathering. Except for the case of Sakai, a male senior whose spouse has been sick, chore-related multipurpose journeys were not common for the male multipurpose travelers. One interpretation of the results is that multipurpose trips are made for different purposes based on gender: efficiency of getting chores done for women and providing of a ride to social networks for men.

Compensation

The adaptive strategies related to replacement of resources were grouped into two themes: human and environmental. Seniors who have no driver's license rely on

spouse for rides. This was often mentioned along with how they compensated for their physical decline by accompanying their spouse for grocery shopping. An example of alternative human related resources was introduced by Aoyama, a widow who lives in a housing complex occupied by many single seniors. She expressed how lucky and helpful it is for her to have a mobile produce vendor which visits the housing complex once a week.

> The produce vendor visits us every week although another senior and I are the only customers in our housing complex. We buy only big vegetables like cabbages and Nappa cabbages from the vendor. They are much too heavy to carry myself. I do not want to drag a rolling grocery bag. – Aoyama

She usually walks to a nearby grocery store to purchase most produce, but her strategy is to use an alternative resource to compensate for her physical limitation to carry big heavy produce.

Seniors substitute environmental resources to gain mobility as well: the temporary or permanent change of travel mode and the use of protective physical structures from unpleasant weather. Temporary changes of travel modes are most frequently made by seniors who live near a bus stop or a train station. Rain was identified as the most unpleasant travel weather condition by the participants. On a rainy day, Uemura, a regular cyclist who lives near a train station, takes train to reach the city center for traffic safety reasons. Due to physical constraint of long travel distance, Yamada and Okura, permanently chose to ride electric bicycles. The technical aid enables the women to travel a long distance to attend social gatherings at YWCE. Ario, the shopping complex attached to the main station, is a good example of how seniors use physical structures to protect themselves from rain, heat, and wind. Thus, seniors apply

various strategies that compensate for limiting or undesirable surroundings with various human and environmental resources.

Selection

Due to the limitation or decline of personal, social, and environmental resources, seniors refocus on their goals through behavioral and psychological adaptations based on the change of life stages in their lives. For instance, male seniors often experience a loss of their work-related social network after retirement. By refocusing their networking from work-based to community-based, they maintain a reason to go out. Another good example is refocusing from family to neighbor-related activities after the loss of spouse. Those examples show the shift of behavioral focus as an essential adaptive strategy resulting from a decline of resources.

Psychological shift was also found among seniors who changed their travel means. With limited travel means, seniors usually experience shrinking activity space. Seniors psychologically refocused their goals from a large geographical space to a smaller geographical space, the vicinity of their homes. They start to pay more attention to the immediate surroundings to seek stimulation and sense of belonging. Aoyama, a 75 year old single woman who lives in the city center, recently gave up riding a bicycle for safety reasons. After switching her travel means from bicycling to walking, her perception of neighborhoods has changed.

> I started to notice more shops along the streets by walking. I enjoy seeing those stores. When I was young, the purpose of making a trip was doing chores. So I only focused on moving fast to get to the destinations. Now I have time available

> for myself and feel no necessity to be in a hurry. It is rather better for me to spend more time walking for health.

Thus, Aoyama established proactive psychological and behavioral adaptations and turned the inconvenience of walking into positive experience. Based on the findings, seniors' mobility adaptations are positioned in Figure 25.

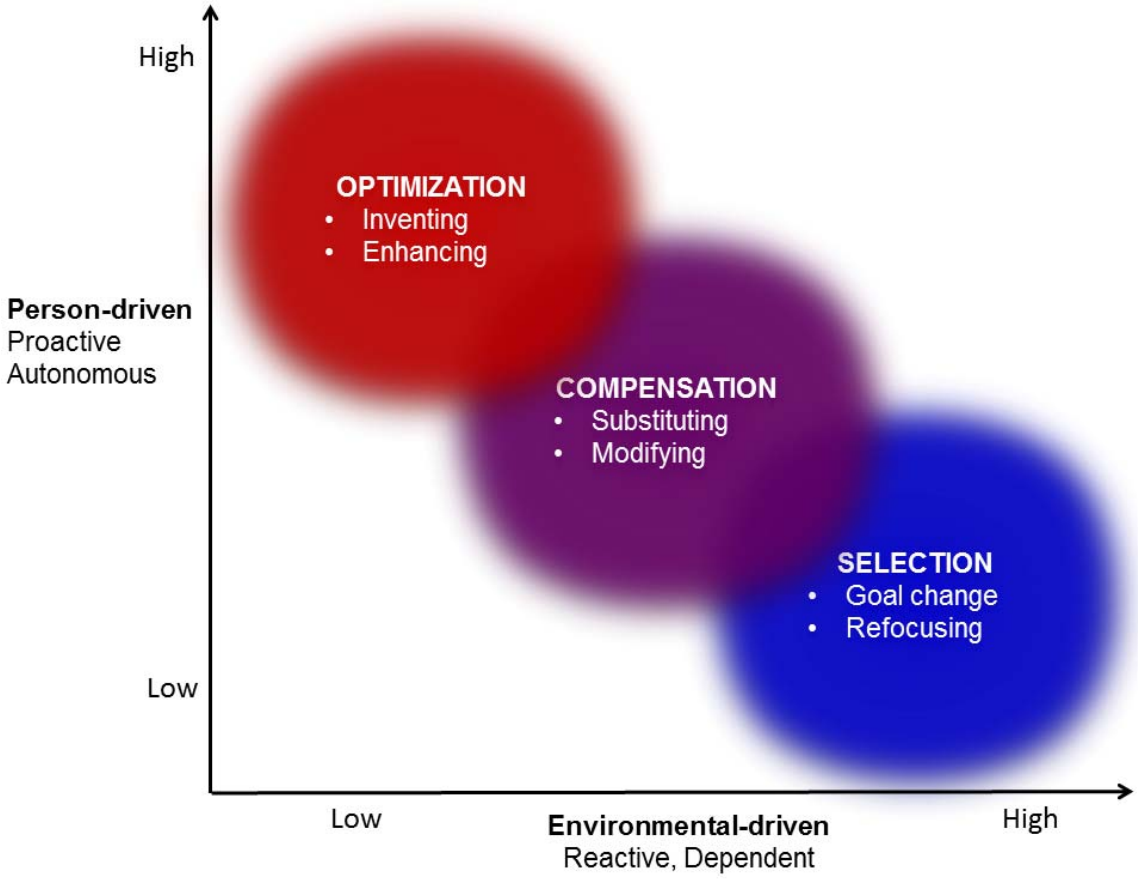

Figure 25 *SOC of seniors' mobility adaptation*

Optimization, the process involving invention and enhancement for goal attainment, is placed in the domain of person-driven strategies because seniors are

conceived of as independent and autonomous individuals who invent and practice proactive strategies. Selection was placed in the least human-driven domain. These adaptation strategies are least autonomous and are driven by changing one's goals or shifting one's pertaining to a part of their goals imposed only strong environmental challenges. Therefore, these adaptations are reactive rather than proactive.

Compensation is placed somewhere between optimization and selection in the person-environment driven spectrum. In this domain, adaptations are made by modifying and replacing resources. Seniors have some independence to utilize or alter resources yet are less autonomous since adaptations mainly relied on external resources (environments). More importantly, the three domains are not mutually exclusive but overlap each other. This implies that strategies might not always be exclusively categorized into a single domain.

This chapter discussed explanatory factors of the seniors' travel behaviors based on the qualitative analyses of face-to-face interviews, sketch mapping, and one-week travel diaries. The findings emphasized the complex nature of mobility which is understood to be a process embedded in the fabric of personal, social and environmental factors. The researcher discovered that senior citizens are not necessarily reactive but often proactive act by to an event or an environment. They develop and employ unique strategies to overcome personal, social, and built environmental barriers. The findings also confirmed that seniors recognize and utilize environmental information as described by Lawton's proactivity (1989). Seniors also develop cognitive representations of the city with their own life experiences, autobiographical insideness (Rowles 1983).

Furthermore, the analysis found that certain places offer multiple meanings and functions to senior citizens, a result that aligns with Gibson's affordance theory (1979).

The last section of this chapter presented the seniors' adaptive strategies regarding to use and change of travel means. The findings indicated that elderly mobility is not static phenomenon. It involves processes through which seniors invent and practice psychological and behavioral adaptations. The findings suggest that mobility in late life should be understood by including a time dimension. Different life stages, such as changes in health conditions, family composition, and a social role, shape the way seniors perceive the city and adapt to the new events or environments. The findings also revealed how seniors adapt to changes in travel modes. The senior citizens demonstrated their strategic psychological and behavioral adaptations to maintain an active lifestyle. The last chapter synthesizes the findings of quantitative and qualitative analyses to discuss implications of elderly mobility along with health in late life, research and methodological issues, and policy implications for community and transportation planning.

CHAPTER VI

CONCLUSION

The purpose of this study was to examine the patterns and explanatory factors of senior citizens' travel behaviors and adaptive strategies to get around in their communities. Japan is the first country in the world facing seriously pressing issues of aging. Most previous research has been studied senior citizens' mobility based on national or regional travel surveys, and little attention has been paid to how seniors perceive their surroundings and adapt to their environments to remain active. To fill the research gap, this study explored the travel behaviors of seniors in a specific context by analyzing multiple sources: a questionnaire survey, face-to-face interviews, sketch mapping, and a one-week travel diary. One hundred ninety three seniors at YWCE in the city of Yao, Japan participated in a questionnaire survey, and 21 of the seniors - purposely selected based on age, gender, and travel distance - shared their perceptions of the city and the ways they get around in their communities.

Findings revealed that senior citizens' mobility was explained by multiple factors: personal, social, and environmental. The results of statistical analyses identified some similarities across genders: both men and women travel frequently and primarily by bicycle. However, explanatory factors of travel behaviors differed depending on gender. The results of qualitative analyses further revealed the proactive nature of seniors who invent, modify, and apply various adaptions to maintain their mobility. As the World Health Organization (2002) pointed out in research about the major

determinants of active aging, this study confirmed that culture and gender play major roles in explaining seniors' travel behaviors. This chapter summarizes and integrates the findings of quantitative and qualitative analyses to better comprehend mobility issues in late life and seniors' capacity to adapt. The chapter also introduces contributions and limitations of this study in addition to future implications for a wide range of fields: public health, environmental gerontology, community and transportation planning.

A Summary of Findings

This research aimed to explore seniors' travel behaviors from a broad framework consisting of personal, social, and environmental factors. To explore this complex phenomenon, two major research questions were formulated: 1) What are the characteristics of seniors' travel behaviors and what factors explain them? and 2) How do seniors adapt to their surroundings to get around in the city? The study employed a sequential mixed research design starting with quantitative analyses followed by qualitative analyses. The results of bivariate analyses, correlations, Mann-Whitney U tests, chi-square analyses, and logistic regressions helped to reveal explanatory factors that accounted for high travel frequency (going out almost every day a week) in addition to characteristics of the senior citizens related to their travel patterns.

Overall the participants were healthy individuals who primarily travel by bicycle. A number of empirical studies have pointed out that major factors restricting seniors' mobility are increasing age, female gender, lack of a driver's license, lower economic status, long travel distance and poor health. However, the statistical results of this study

did not identify age, gender, primary travel mode or distance from the city center from home as factors related to travel frequency. Instead, gender differences were related to participants' characteristics: living arrangement, grocery shopping behaviors, possession of a driver's license, past job status, and marital status. Specifically, when compared to men, women are more likely to be single, to live alone, and lack a driver's license. Also, women go grocery shopping more often, spend a longer time for traveling and shopping, and see relatives and friends more often than men.

The results of the logistic regressions also revealed gender differences in the factors that predict high travel frequency. Men who go out almost every day were more likely to live near a bus stop. These individuals also perceive that their travel frequency is greater than it had been in the past. These two variables were not identified as factors that predict women's high travel frequency. Since a similar proportion of men and women had a bus stop nearby (70 percent for men vs. 78 percent for women), the reason for the difference might be related to male seniors' ability to afford bus fare and their past job experience. The results also showed that the reason men perceived that they were going out more frequently than in the past was because every male participants had worked before. On the other hand, 19 percent of the female participants had not worked. Because men spent almost all day at their workplace before retirement, they felt they were going out more often after retirement. Therefore, it was a life style change after retirement that allowed men to go out more frequently for non-work purposes than in the past.

In contrast, the women who went out every day were more likely to travel by bicycle or on foot and go grocery shopping. They also had fewer relatives, and saw friends more often. Moreover, they perceived that sidewalks in their neighborhoods were safe. Since the majority of women did not possess a driver's license (87 percent for women vs. 25 percent for men), cycling and walking were factors that predicted their high travel frequency. Because cycling and walking were the most common modes of transportation, it is not surprising that sidewalk safety was also found as a factor predicting women's high travel frequency. The other findings highlight gender influences. Female's travel frequency was affected by women's need to do chores (e.g., grocery shopping) to support their family. Another gender-based factor was social networking—women are more likely to maintain a social network by visiting friends. Having fewer relatives in the city led to higher travel frequencies among women, possibly because women had more time to go out since they did not have to take care of relatives.

The findings from the quantitative analyses which introduced cultural and gender influence on travel frequency, raised specific questions about seniors' travel behaviors: what factors explain of why men and women travel frequently. Men and women did not significantly differ in travel frequency and self-rated health. Instead, they differed in other personal characteristics (i.e., living arrangement, possessing a driver's license, and marital status). In addition, the factors predicting high travel frequency differed. The results of qualitative analyses helped in the explanation of adaptive strategies and identified additional factors affecting seniors' mobility. The sketch maps and verbal

descriptions revealed that familiarity and memories of a particular place foster a sense of belonging or bring memories of positive travel experiences. Seniors shared idiosyncratic cognitive representations of the city with their life histories and travel experiences, which Rowles (1983) termed "autobiographical insideness." The positive perceptions of their communities, such as favorable memories and beautiful scenery became reasons for going out.

Furthermore, the qualitative analyses revealed concrete examples of adaptive strategies. As Lawton's environmental proactivity hypothesis (1989) posits, relatively healthy seniors utilized external (environmental) and internal (e.g., mental maps) resources to adapt to urban environments. In the context of Yao, seniors utilized shopping malls connected by a skywalk and the arcade of the old commercial street to protect themselves from rain, wind, and heat. Likewise, the mall served as "affordance (Gibson 1979)" for social gathering in a sheltered space. Seniors also developed and modified environmental information to ensure travel safety by traveling on carefully selected streets with sidewalks. Many of the seniors' adaptive strategies, which were grouped based on the model of selectivity, optimization, and compensation (Baltes and Baltes 1990; Baltes, Lindenberger, and Staudinger 2006) were observed in the domain of optimization which reflects seniors' proactive and autonomous adaptations: invention, enhancement, and implementation of strategies.

Changes in senior's roles and travel means manifested gender differences in their adaptive strategies. Men implemented mobility adaptations to stay healthy and to maintain their social role as a provider. They maintained their autonomy by volunteering

or providing services in their communities. It becomes especially critical after retirement, because this life-cycle change requires men to refocus their social network from the workplace to their neighborhoods. For many male seniors, offering a ride to another means not only helping with travel but continuing their role as a provider. The renewal of a driver's license is a major concern among male seniors; they regularly exercise to maintain their reflexes and/or attend accident prevention seminars. Women's adaptive strategies are mostly related to adjustment to widowhood and effort to enhance their travel safety. The change of a role from a care giver to a widow necessitates psychological adjustments for women. Since female seniors are more likely to live alone after the loss of spouse compared to men, they actively seek social networks comprised of neighbors, social club members, and friends. To maintain a healthy and independent life, they pay particularly attention to travel safety. They invent and implement these strategies to compensate for their limited stamina to minimize risk of having a traffic accident: They might ride an electric bicycle, select streets with sidewalks, and make multi-purpose trips to complete chores for example.

This study introduced multidimensional factors for seniors' travel behaviors and examples of adaptive strategies in a specific context, a mid-size city of Japan. The findings imply that relatively healthy community-dwelling seniors can remain active by applying external and internal resources in an environment which offers easy access, multiple transportation modes, and opportunities of social activities. Gender did not determine travel frequency but did explain factors related to high travel frequency. The findings strongly imply that mobility is more than the ability to move from one place to

another. It is also the manifestation of social role association with life stages: it is reflection of cultural, social, and personal identity.

Contributions and Limitations of Study

The contributions of this study are twofold: theoretical and methodological. The review literature pointed out the lack of studies that explore context-specific socio-physical environments for older adults (Wahl and Lang 2003, 2006). To fill the gap, this study explored both the explanatory and specific processes of seniors' travel behaviors in a particular community setting. For example, the primary travel modes used by senior citizens differ distinctively between Japan and the United States (Cabinet Office Japan 2010b). Seventy eight percent of total trips made by American seniors are by driving while 47 percent and 46 percent of total trips made by Japanese seniors are by driving a car and walking, respectively (Cabinet Office Japan 2010b). Only 2 percent of the total trips made by American seniors are made by public transportation (Rosenbloom 2004). Thus, the impact of driving cessation on mobility is more profound for American seniors than for Japanese seniors. Context specific studies should be conducted to help community planners and policy makers identify specific issues and develop programs which promote active aging in various socio-cultural environments.

The research also examined the adaptability of seniors based on the selection, optimization, and compensation model (Baltes and Baltes 1990; Baltes, Lindenberger, and Staudinger 2006). Seniors' mobility adaptation is a relatively new and understudied topic. This study illustrated mobility adaptations to better understand how various

personal, social, and environmental factors are interrelated. The concrete examples of mobility adaptations enabled the researcher to conceptualize types of strategies based on seniors' autonomy and proactivity.

This study also provided a methodological contribution. The use of a mixed method allowed the researcher to gain a more complete picture of travel behaviors. The statistical results were useful not only to understand the general characteristics of seniors but also to identify gender differences in explanatory factors of high travel frequency. In addition, data collected through the questionnaire survey allowed for purposeful sampling for further investigation about how participants get around in their communities. The findings of qualitative analyses also helped the researcher identify insufficiencies of the questionnaire survey. For instance, male seniors' high travel frequency was not sufficiently explained by variables incorporated in the questionnaire. This occurred because the questionnaire did not ask seniors about some social activities such as participation in community services, volunteer activities, and organized sport activities. Information about these social activities were only discovered from interviews with male seniors. By integrating quantitative and qualitative analyses, statistical findings were further verified and enabled deeper, more comprehensive interpretation.

The analyses of sketch mapping in this study suggested that there is a potential for using sketch mapping with verbal descriptions as a tool to study travel behaviors. Previous research, for the most part, employed cognitive maps to investigate subjects' memory of environments, which is influenced by personal factors such as social class, ethnicity, familiarity, and gender (i.e., Orleans 1973; Orleans and Schmidt 1972;

Goodchild 1974; Karan, Bladen, and Singh 1980; Van Vliet 1983) and environmental attributes such as urban structure and topography (i.e., Lynch 1960; Zannaras 1976; Okabe, Aoki, and Hamamoto 1986; Hanyu and Itsukushima 1995). However, the impact of travel modes on cognitive maps has been understudied. Few empirical studies indicated that people who use active travel modes such as walking, biking, and driving have more accurate geographic information than those who use a passive travel mode, public transportation (Mondschein, Blumenberg, and Taylor 2010; Hart 1981).

This study implemented sketch mapping not to evaluate seniors' accuracy of spatial memory but to explore the ways they travel in urban environments for better understanding their adaptive strategies. The study demonstrated the use of sketch mapping with verbal descriptions not only compensates for a participant's lack of drawing skills but also reveal specific mobility strategies they employed. By examining the way participants drew and traced the routes they travel, the researcher was able to gain insights about how they travel in addition to specific environmental information they pay attention and the reasons why they like or dislike traveling to specific places. The researchers was also able to explore seniors' socio-cultural schema, specifically, their idiosyncratic perception of the city using the sketch mapping method. Seniors' verbal descriptions of their life histories along with their sketch maps explored the role of autobiographical insideness (Rowles 1983) and benefits of affordance (Gibson 1979) in their lives. Thus, use of sketch mapping contributed to the confirmation of the concepts. The use of sketch mapping with verbal descriptions should be further explored

as a useful tool to investigate how people engage their environments and to identify specific policies for supportive transportation and community planning.

In addition, one-week travel diary helped the researcher collect additional information. For example, multipurpose trips were mostly observed in women's diaries and the purposes of those trips were typically a combination of chores and social purpose trips. Thus, the diaries revealed additional adaptive strategy they used to accomplish their objectives efficiently. As Matsumoto (2004) noted, a destination itself does not offer a full picture, purposes needs to be further examined especially when studying retired older adults, who have different travel patterns and reasons. Thus, the main contribution of this study is the enhancement of quantitative analyses using various qualitative methods and sources to conduct an in-depth case study of community mobility in older adults.

Despite the implementation of a triangulation design and the use of multiple resources to enrich the analyses, this study has limitations. First, the analyses were based on the data collected only from seniors, who were members of social clubs at YWCE. The focus of this study was to investigate the ways that healthy community-dwelling seniors stay active in their communities. It is expected that senior members of YWCE who are socially and physically active may not necessarily represent average community-dwelling seniors in the city. According to the director of Yao Welfare Center for the Elderly, approximately 10 percent of seniors living in Yao City register as a member of YWCE. It is, therefore, important not to generalize and represent them as typical community-dwelling seniors in Yao city.

In addition, this study explored the mobility and adaptive behaviors of senior citizens who live in a city. It should be pointed out that the ways seniors travel and adapt to their surroundings differ significantly from those living in rural areas. Rowles' work, *Prisoner of Space* (1978), stresses seniors' shrinkage of their activity space. For example, in remote isolated rural areas, topographical barriers, the lack of public transportation, and limited shopping and social opportunities restrict seniors' mobility. In fact, the mobility of seniors who live in Japanese rural areas was restricted in terms of activity space as well as travel distance (Mitani 1997; Osugi 1987). In this regards, seniors who live in Yao city benefit from environmental resources that enhance their environmental proactivity (Lawton 1989). One of reasons why seniors in Yao city succeed in utilizing internal resources (i.e., mental maps) might be the availability of supportive external physical and social resources. To enhance seniors' proactivity as well as sense of belonging, environmental (both physical and social) resources should be encouraged.

Second, the data were collected during a summer season. Considering the seasonal impact on seniors' mobility behaviors, the study was not able to fully incorporate the impact of a winter season on mobility and social interaction. Moreover, the questionnaire survey did not ask for detailed information about seniors' economic status. As described in the methodology section, requesting participants to reveal their income or financial details would be culturally insensitive. To minimize the drop-out rate that could occur because of unpleasant questions, such as economic status, the researcher instead asked seniors about their former job status and types. The lack of

precise data about income may be one reason why economic factors were not more significant in the statistical analyses. The issues of financial constraints were only captured in the face-to-face interviews (i.e., unaffordability of bus fare). Finally, coding was completed by only a single researcher due to budget and time constraints. Acknowledging the benefits of multiple coders to gain greater reliability, transcripts of interviews and coding classification were reviewed multiple times by the same researcher. The transcripts and coding were also compared to other resources (i.e., questionnaire survey, one-week travel diary, and sketch maps) to decrease the chance of misinterpretation.

Future Implications

The findings of this study can be benefitted to various behavioral and social science fields examining senior citizens and their environments such as public health, environmental gerontology, and community and transportation planning. In public health, the association of physical activities and health outcomes among older adults has been explained by various demographic and environmental factors. The results of this study bring attention to the impact of travel modes on health. This study found that sketch maps drawn by healthy seniors who make frequent trips by bicycle and on foot were geographically small yet filled with rich and detailed information. This implies a link between self-produced daily travel such as bicycling and walking and their health outcome. Walking and bicycling require seniors actively seek and gather essential information to accomplish satisfying and safe trips. Compared to the seniors use passive

forms of locomotion such as traveling by car or by bus, the seniors who regularly travel by bicycle and on foot constantly use the process of afference, nerve impulses transmitted from sensory organs to the central nervous system (Rieser and Pick 2007). The findings imply that regular and intensive use of the nervous systems to acquire travel information for navigation contributes to both physical and cognitive health of senior citizens. In public health research, it would be beneficial to pay more attention to the impact of daily travel on seniors' health since from the perspective of preventive care.

Researchers in environmental gerontology should benefit from the results of this case study. Despite the recent attempts to develop more heuristic frameworks integrating personal and socio-physical environmental factors (i.e., Mollenkopf et al. 2006; Mollenkopf et al. 2005; Wahl and Lang 2006, 2003; Lord and Luxembourg 2006), the review of literature pointed out the insufficient studies incorporating local context constructed from physical and social environments to better understand seniors' mobility (Wahl and Lang 2003, 2006). This study filled the gap by examining a specific cultural and geographic context. The findings of this study demonstrated and highlighted the significance of cultural and gender influences on the conceptualization of seniors' mobility. The replication of case studies in various contexts is desirable to further investigate similarities and differences in seniors' travel behaviors.

Furthermore, this study provides community and transportation planners with insights to design of supportive environments which could enhance mobility and life quality of senior citizens. The findings indicated that healthy community-dwelling

seniors are proactive individuals which invent, coordinate and implement various sets of adaptive strategies in the specific context. This implies that not only safety but also autonomy are essential component for seniors to stay active and healthy in their communities. Successful aging (Rowe and Kahn 1998) depends on not only the absence of disease and disability but also subjective well-being known as life-satisfaction.

The findings of this study indicated that seniors travel to seek satisfying experiences as well as health promotion. Having a sense of belonging and accomplishment and remaining an autonomous individual as a care giver or a service provider in their communities are essential parts of life-satisfaction. To enhance seniors' sense of belonging and accomplishments, creating accessible social, cultural, recreational, health promotion, and volunteer programs is helpful. Furthermore, providing seniors with multiple options of travel means is desirable to maintain independence and autonomy. As active aging framework (World Health Organization 2002) suggests, culture and gender should be taken into account when creating appropriate policies in the specific cultural and geographical contexts.

This study demonstrated the complex nature of senior citizens' travel behaviors. Although seniors' mobility is defined by personal, social, and physical environmental factors, it is also maintained and enhanced with various psychological and behavioral adaptations invented by senior citizens. Both internal and external resources are utilized to execute the adaptations. Furthermore, seniors' mobility is reflected by changes in life stages (e.g., living arrangement and work status) as well as travel means accompanied

with aging. The mobility issues of senior citizens should be approached from broad sets of heuristic, contextual, and life span perspectives.

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APPENDIX A
Question items of questionnaire survey

Question item		Measurement
Travel pattern	Travel frequency	almost every day, 4-5 days a week, 2-3 days a week, almost none
	Travel mode	walking, bicycle, motorcycle, bus, car as a driver, car as a passenger, train, others
	Driver license	have one, do not have one, had one before but no longer, never had one before
	Travel experience	currently travel more often than in the past (Y or N)
	Frequency of grocery shopping	times per week
	Time spent on grocery shopping	minutes
Personal information	Age	years old
	Gender	male, female
	Marital status	married, never married, separated (widowed), separated (divorced)
	Address	the name of city district and number
	Club(s) registered	name of club(s)
	Length of residence in the city	years
	Work status	retired, have a full-time job, have a part-time job, never worked
	Former occupation type	company employee, self-owned business, never worked
	Job description	open-ended, occupation name (i.e., engineer, nurse)
	Perceived health	subjective evaluation of one's healtha (excellent, good, fair, poor)
	Condition of medical attention	recently medical attention (last 6 months, about a year ago, more than a year ago)
	Place to get the medical attention	at home, seeing a community doctor, hospitalized, other
	Personality traits	Ten Item Personality Measureb (7 point scale)
Environmental information	Sidewalk availability	presence of sidewalks in neighborhoods (yes or no)
	Transportation accessibility	presence of a bus stop in neighborhoods (yes or no)
	Shopping accessibility	presence of a grocery store in neighborhoods (yes or no)
	Travel mean for grocery shopping	walking, bicycle, motorcycle, bus, car as a driver, car as a passenger, train, other
	Time to the nearest store	minutes to get the nearest grocery store
	Living arrangement	alone, with spouse w/o children, with children w/o spouse, with children and spouse, with someone who is not spouse and child
	Number of relatives in the city	persons
	Number of friends in the city	persons
	Frequency of seeing relatives	times per month
	Frequency of seeing friends	times per month
	Perception of neighborhood safety	very safe, fairly safe, unsafe, very unsafe
	Perception of traffic safety	very safe, fairly safe, unsafe, very unsafe
	Perception of sidewalk safety	very safe, fairly safe, unsafe, very unsafe
	Perception of public safety	very safe, fairly safe, unsafe, very unsafe
	Perception of lighting safety	very safe, fairly safe, unsafe, very unsafe
	Other mobility problems	open-ended

[a]Mossey and Shapiro (1982)
[b]Gosling et al. (2003)

APPENDIX B
Questionnaire survey

ID#:

Daily Travel Survey

Your name _____

Date _____

THANK YOU so much for helping with the survey!!

Your opinions will provide a better understanding of the travel experiences of senior citizens in your community.

Your opinions will be kept CONFIDENTIAL.

APPENDIX B – Contd.

Please make a CHECK MARK (√) for your answer.

There are no right or wrong answers.

THANK YOU !!!

1. **You are a:**

   ___ Man

   ___ Woman

2. **How old are you (OR what year were you born?)** _____

3. **How long have you lived in Yao city?** _____ Years

4. **Where do you live? Please provide city district name and numbers.**

   District name _____, _____Chyome _____ Banchi

5. **At the Yao Welfare Center for the Elderly, in which club(s) do you participate?**

   _____

6. **How often do you leave your residence in a week (seven days)?**

   ___ Almost every day

   ___ 4-5 days in a week

   ___ 2- 3 days in a week

   ___ Almost none

APPENDIX B – Contd.

7. What is the <u>MAIN</u> way you <u>USUALLY</u> get around in Yao City? Choose <u>ONE</u>.

___ Walking

___ Bicycle

___ Motorcycle

___ Bus

___ Car as a driver

___ Car as a passenger

___ Train

___ Others _____

8. Are there <u>ADDITIONAL</u> ways you <u>SOMETIMES</u> get around in the city?

___ Walking

___ Bicycle

___ Motorcycle

___ Bus

___ Car as a driver

___ Car as a passenger

___ Train

___ Others _____

9. I usually go grocery shopping _____ time(s) for a week.

10. I usually spend _____ minutes on grocery shopping.

11. I:

___ Have a driver's license

___ Do not have a driver's license, but <u>HAD</u> one before

___ Do not have a driver's license and <u>NEVER</u> had one before

APPENDIX B – Contd.

12. I currently travel MORE often than in the past.

___ Yes

___ No

13. For your age would you say, in general, your health is:

___ Excellent

___ Good

___ Fair

___ Poor

14. How recently have you received medical attention?

___ Last 6 months

___ About a year ago

___ Over a year ago

15. <u>WHERE</u> did you receive medical attention?

___ At home

___ Seeing a community doctor

___ Hospitalized

___ Other _____

16. I am :

___ Married

___ Never married

___ Separated (widowed)

___ Separated (divorced

APPENDIX B – Contd.

17. What is your current status of living arrangement?

___ Living alone

___ Living with spouse with NO children

___ Living with children with NO spouse

___ Living with children AND spouse

___ Living with someone who is NOT spouse or child

18. Do you live in a retirement community or institution (nursing home)?

___ Yes

___ No

19. What is your <u>CURRENT</u> work status?

___ **Retired**

___ **Not retired and have a FULL-time job**

___ **Not retired and have a PART-time job**

___ **Never worked**

20. How do you identify your <u>FORMER</u> occupation?

___ **Company employee,**

___ **Self-owned business**

___ **Full-time homemaker**

___ **Never worked**

21. What was your former occupation? (examples; engineer, nurse, etc.)

_____

APPENDIX B – Contd.

"Now about your personality"

Please make a CHECK MARK (√) for your answer.

There are no right or wrong answers.

An example: I see myself as sympathetic, warm.

Please insert a check mark (√) above the arrow to indicate the extent which you agree or disagree with that statement.

Disagree Strongly ← √ → Agree Strongly

Make a check mark!

This example indicates that the response is slightly closer to "Agree Strongly" for the statement (I see myself as sympathetic, warm).

You see yourself as ...

22. Extraverted, enthusiastic.

Disagree Strongly ← → Agree Strongly

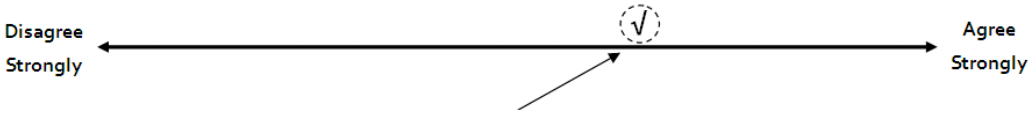
23. Critical, quarrelsome.

Disagree Strongly ← → Agree Strongly

APPENDIX B – Contd.

An example: I see myself as <u>sympathetic, warm</u>.

Please insert a check mark (√) above the arrow to indicate the extent which you agree or disagree with that statement.



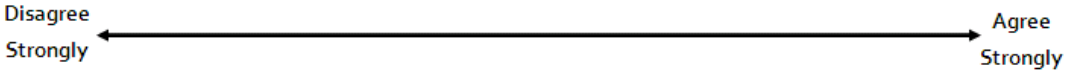
Make a check mark!

This example indicates that the response is slightly closer to "Agree Strongly" for the statement (I see myself as sympathetic, warm).

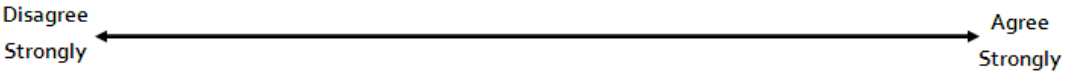
You see yourself as ...

24. Dependable, self-disciplined.

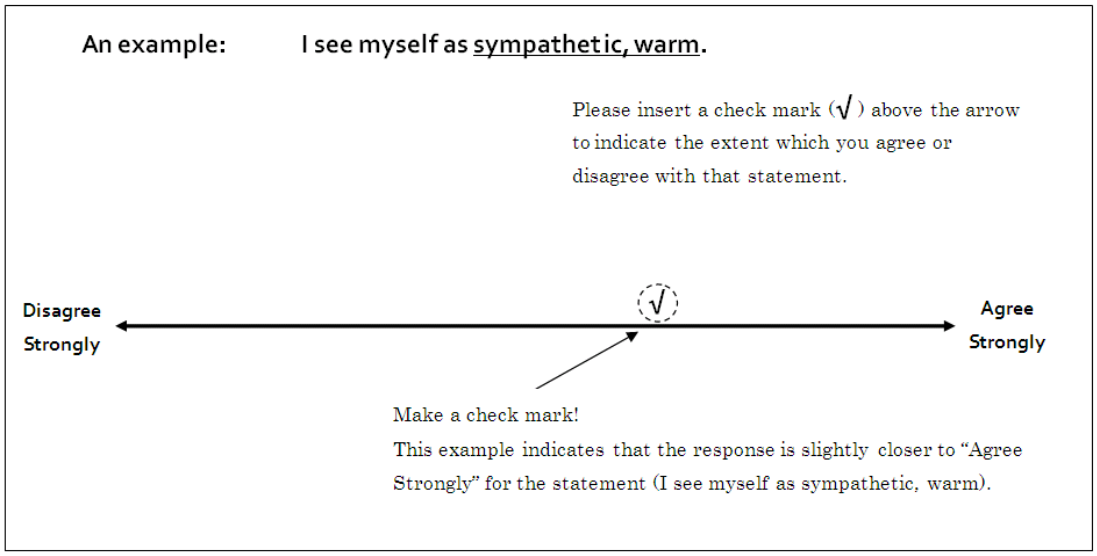
25. Anxious, easily upset.



26. Open to new experiences, complex.



APPENDIX B – Contd.



You see yourself as ...

27. **Reserved, quiet.**

Disagree Strongly ⟷ Agree Strongly

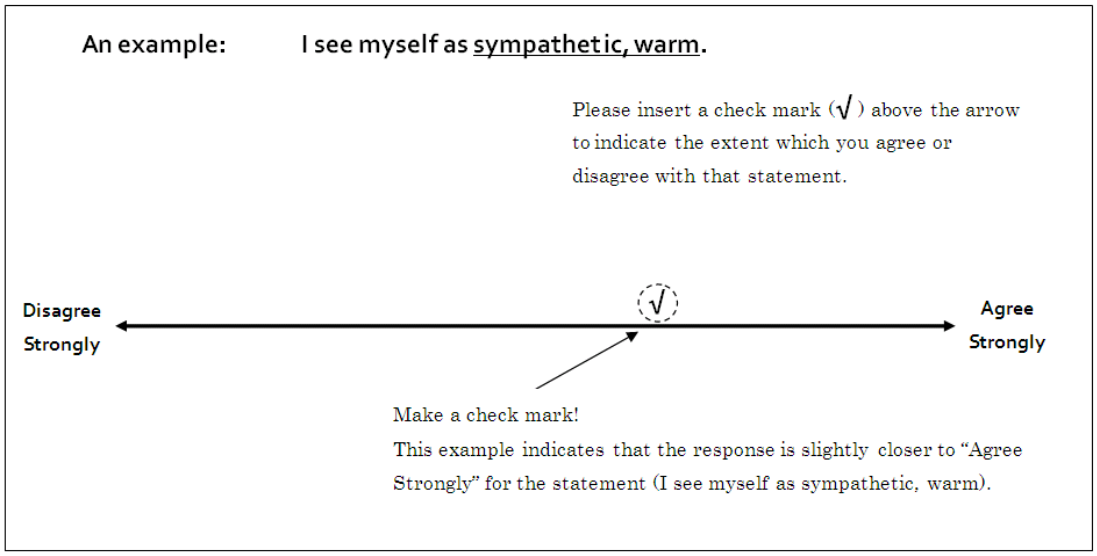
28. **Sympathetic, warm.**

Disagree Strongly ⟷ Agree Strongly

29. **Disorganized, careless.**

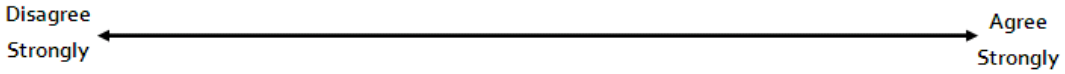
Disagree Strongly ⟷ Agree Strongly

APPENDIX B – Contd.

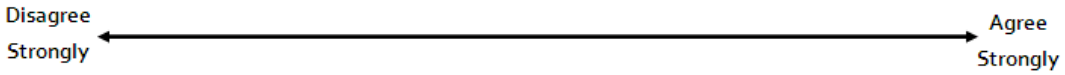


You see yourself as ...

30. Calm, emotionally stable.



31. Conventional, uncreative.



APPENDIX B – Contd.

"Now about your <u>NEIGHBORHOOD</u>"

Please make a CHECK MARK (√) for your answer.

32. Do you have sidewalks in your neighborhood?

___ Yes

___ No

33. Do you have a bus stop in your neighborhood?

___ Yes (If Yes, how long does it takes to get there on foot? _____ minutes)

___ No

34. Can you reach a grocery store in your neighborhood?

___ Yes

___ No

35. How do you USUALLY go to the grocery store?

___ Walking

___ Bicycle

___ Motorcycle

___ Bus

___ Car as a driver

___ Car as a passenger

___ Train

___ Others _____

APPENDIX B – Contd.

36. How long does it take to get the grocery store? _____ minutes

37. How many (not living together) relatives and friends do you have in Yao city?

Relatives _____ **Friends** _____

38. How often do you see your relatives and friends?

Relatives: _____ **a month** **Friends:** _____ **a month**

39. How safe is your neighborhood?

___ Very safe

___ Fairly safe

___ Unsafe

___ Very unsafe

40. In your neighborhood, how safe is:

Traffic ___ Very safe, ___ Fairly safe, ___ Unsafe, ___ Very unsafe

Sidewalks ___ Very safe, ___ Fairly safe, ___ Unsafe, ___ Very unsafe

Crime ___ Very safe, ___ Fairly safe, ___ Unsafe, ___ Very unsafe

Lightning ___ Very safe, ___ Fairly safe, ___ Unsafe, ___ Very unsafe

APPENDIX B – Contd.

41. Are there any other problems to get around in the city? (please describe):

( )

THANK YOU so much for participating in the survey!!

The researcher would like to learn more about your travel experience and perceptions of Yao city.

May I contact you to talk with you in person for interviews?

___ Yes

___ No

If yes,

Please provide your phone number to schedule for the interviews.

Your phone number:

Please specify the convenient time(s) I can reach you to make an appointment.

___ Weekday morning

___ Weekday afternoon

___ Weekend morning

___ Weekend afternoon

Thank you for your corporation.

Looking forward to seeing you soon!

APPENDIX C
Interview script

1. Would you describe how you get to the senior center from your home by drawing a map? I would like you to include any familiar landmarks to better understand which routes you use.

2. Can you describe the other places you go in the city from your home or from the senior center by drawing another map?

3. Describe which places you like to go to and tell me why you like these places.

4. Describe what is satisfying about your daily travel?

5. Describe any part of your daily travel that is a problem to you?

6. Describe any places you dislike going past or by in your travels around the community. Would you describe what you dislike about these places?

7. Describe any alternative ways for you to access goods and services (example-groceries, medical care) other than traveling to get these on your own? (Examples-home delivery services, family members or/and friends provide transportation – If used, how often?)

8. Describe your previous travel experiences? How have you changed the way you travel in the city such as means of travel and routes in the last 10 years? 5 years? year?

9. Describe how do you feel about traveling in the city? Have your feelings changed in the last year? 5 years? 10 years?

10. Think of someone you know who used to come to the senior center but has stopped coming over the past 6 months. What reason might have kept that person from coming? What might have helped him or her continue to come to the senior center?

ID#:

Travel Diary

Name

Dates __/____—____/

Thank you for your participation!

This is the one-week travel diary to record when, where, with whom, and how for you traveled. The purpose is to better understand scopes of travel environments and times by studying detailed information of trips you make.

Please use one page for a trip (NOT one page for a day).

An example: Ms. A went out twice, in the morning and in the afternoon, on July 15th. She attended a social meeting at the Yao Welfare Center for the Elderly in the morning. After the meeting, she went out for a coffee with her friends on the way back home. In the afternoon, she went out for grocery shopping. Note that in this case, total two trips were made a day and her records go over two pages. (See page 1 and 2).

Please send this booklet in the provided envelope stamped by mail after completing your one-week travel diary.

For any questions and concerns regarding the travel diary, please free to contact the researcher.

Aya Yoshikawa
Phone: 0000-00-0000, Email: 000@0000

Example 1: Ms. A attended a social meeting at YWCE and went out for coffee with her friends on the way to

Please fill out the form every one trip. (One trip – process in which you leave at and return to home)

Date: July 15	**1st trip**
Departure time (Circle am or pm) **(am) pm 9:10**	**Weather（Circle one or more）:** **Sunny (Occasionally cloudy) Rainy Others（ ）**

	How did you go by?								Where (e.g. Ario)	purpose (e.g. shopping)	Travel alone? y/n If no, provide with whom (i.e. friends, daughter)	Time for each travel (minutes)
	Walk	Bicycle	motorcycle	Car (Driver)	Car (Carpool)	bus	train	other				
1st		○							YWCE	Social meeting	Y	15
2nd		○							Seibu	Coffee	N, with friends	5
3rd		○							Home	Coming home	Y	15
4th												
5th												

Note that the last stop should be your home.

Arrival time (Circle am or pm): am (pm) 12: 20

Circle one about travel safety: Safe fair (Unsafe) Very unsafe

If any, please provide comments and concerns regarding the trip you made

(On the way to my home I almost bump into a pedestrian.)

Example 2: Ms. A went out for shopping with her daughter who drives a car.

Please fill out the form every one trip. (One trip – process in which you leave at and return to home)

Date: July 15	**2nd trip**
Departure time (Circle am or pm) **am (pm) 4:15**	**Weather（Circle one or more）:** **Sunny (Occasionally cloudy) Rainy Others（ ）**

	How did you go by?								**Where (e.g. Ario)**	**purpose (e.g. shopping)**	**Travel alone? y/n If no, provide with whom (i.e. friends, daughter)**	**Time for each travel (minutes)**
	Walk	**Bicycle**	**motorcycle**	**Car (Driver)**	**Car (Carpool)**	**bus**	**train**	**other**				
1st					◯				**Ario**	**Shopping**	**N, daughter**	**10**
2nd					◯				**Home**	**Coming home**	**N, daughter**	**10**
3rd												
4th												
5th												

Note that the last stop should be your home.

Arrival time (Circle am or (pm): am pm 5: 50

Circle one about travel safety: Safe (fair) Unsafe Very unsafe

If any, please provide comments and concerns regarding the trip you made

(None)

Now start to record your trips!

Please fill out the form every one trip. (One trip – process in which you leave at and return to home)

Date:	**st trip**
Departure time (Circle am or pm) **am pm :**	**Weather（Circle one or more）:** **Sunny Occasionally cloudy Rainy Others（ ）**

	How did you go by?								Where (e.g. Ario)	purpose (e.g. shopping)	Travel alone? y/n If no, provide with whom (i.e. friends, daughter)	Time for each travel (minutes)
	Walk	Bicycle	motorcycle	Car (Driver)	Car (Carpool)	bus	train	other				
1st												
2nd												
3rd												
4th												
5th												

Arrival time (Circle am or pm): am pm :

Circle one about travel safety: Safe fair Unsafe Very unsafe

If any, please provide comments and concerns regarding the trip you made

( )

Please check your name on the cover and mail back this form in the provided envelope stamped.

Thank you for your cooperation!

APPENDIX E
Chi-square tests

Gender	Driver's license		p	Phi	Odds
	Yes	No	0.00	0.63	20.3
Male	81.9	18.3			
Female	18.1	81.7			
	Marital status		p	Phi	Odds
	Married	Not married	0.00	0.36	6.67
Male	54.1	15.1			
Female	45.9	84.9			
	Living arrangement		p	Phi	Odds
	Living alone	Not Living alone	0.00	-0.32	0.12
Male	12.2	50.3			
Female	87.8	49.7			

Travel Frequency	Perceived travel experience		p	Value	Odds
	Go out more often	Go out less often	0.03	0.22	2.55
Almost every day	64.7	41.8			
Not every day	35.3	58.2			

Driver's license	Marital status		p	Phi	Odds
	Married	Not married	0.01	0.19	2.54
Have one	46.5	25.5			
Don't have one	53.5	74.5			
	Living arrangement		p	Phi	Odds
	Living alone	Not living alone	0.01	-0.20	0.32
Have one	21.1	44.8			
Don't have one	78.9	55.2			
	Current working status			p	Cramer's V	Odds
	Retired	Working	Never Worked	0.00	0.26	—
Have one	44.9	43.8	8.0			
Don't have one	55.1	56.2	92.0			

Marital status	Living arrangement		p	Phi	Odds
	Living alone	Not living alone	0.01	-0.74	0.01
Married	7.3	88.4			
Not married	92.7	11.6			
	Current working status			p	Cramer's V	Odds
	Retired	Working	Never Worked	0.06	0.17	—
Married	70.3	93.8	61.3			
Not married	29.7	6.2	38.7			

*The numbers represent proportions (%) actually observed in the categories.

APPENDIX F
Variable definitions and abbreviations

Variable	Abbreviation	Definition
Travel frequency	TF	Frequency to leave the house
Travel mode	TM	Primary means of travel
High travel frequency	HighTravel F	The highest travel frequency (going out almost every day a week)
Distance from the city center	Distance	Euclidean distance between one's residence and the city center
Ownership of a driver's license	DL	Currently possessing a driver's license
Perception of travel experience	TravelEx	Perception of going out more often than in the past
Frequency of grocery shopping	FreqGS	Number of times to go grocery shopping a week
Time spent on a grocery shopping	TimeGS	Duration of time to spend at a grocery store in minutes
Travel time to a nearby grocery store	TTimeGS	Travel time to get a nearby grocery store in minutes
Number of relatives	NumR	Number of relatives in the city
Number of friends	NumF	Number of friends in the city
Frequency of seeing relatives	FreqR	Times to see relatives per month
Frequency of seeing friends	FreqF	Times to see friends per month

APPENDIX G
Crosstabulations of selected variables

		Ownership of a driver's license		
		1 YES	2 NO	Total
Male	Count	59	20	79
	% within gender	74.7%	25.3%	100.0%
	% within driver's license	81.9%	18.3%	43.6%
	% of Total	32.6%	11.0%	43.6%
Female	Count	13	89	102
	% within gender	12.7%	87.3%	100.0%
	% within driver's license	18.1%	81.7%	56.4%
	% of Total	7.2%	49.2%	56.4%
Total	Count	72	109	181
	% within gender	39.8%	60.2%	100.0%
	% within driver's license	100.0%	100.0%	100.0%
	% of Total	39.8%	60.2%	100.0%

		Living alone		
		1 YES	2 NO	Total
Male	Count	5	75	80
	% within gender	6.2%	93.8%	100.0%
	% within living alone	11.9%	50.3%	41.9%
	% of Total	2.6%	39.3%	41.9%
Female	Count	37	74	111
	% within gender	33.3%	66.7%	100.0%
	% within living alone	88.1%	49.7%	58.1%
	% of Total	19.4%	38.7%	58.1%
Total	Count	42	149	191
	% within gender	22.0%	78.0%	100.0%
	% within living alone	100.0%	100.0%	100.0%
	% of Total	22.0%	78.0%	100.0%

		Married		
		1 YES	2 NO	Total
Male	Count	72	8	80
	% within gender	90.0%	10.0%	100.0%
	% within married	54.1%	15.1%	43.0%
	% of Total	38.7%	4.3%	43.0%
Female	Count	61	45	106
	% within gender	57.5%	42.5%	100.0%
	% within married	45.9%	84.9%	57.0%
	% of Total	32.8%	24.2%	57.0%
Total	Count	133	53	186
	% within gender	71.5%	28.5%	100.0%
	% within married	100.0%	100.0%	100.0%
	% of Total	71.5%	28.5%	100.0%

		Worked before*		
		1 YES	2 NO	Total
Male	Count	78	0	78
	% within gender	100.0%	0.0%	100.0%
	% within worked before	49.1%	0.0%	43.8%
	% of Total	43.8%	0.0%	43.8%
Female	Count	81	19	100
	% within gender	81.0%	19.0%	100.0%
	% within worked before	50.9%	100.0%	56.2%
	% of Total	45.5%	10.7%	56.2%
Total	Count	159	19	178
	% within gender	89.3%	10.7%	100.0%
	% within worked before	100.0%	100.0%	100.0%
	% of Total	89.3%	10.7%	100.0%

APPENDIX H
Spearman's correlation coefficients – total (n =189)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Age[a]	–															
2. Years of residence[a]	0.22**	–														
3. Distance from the city center	-0.06	0.04	–													
4. Frequency of grocery shopping	-0.17*	-0.01	-0.07	–												
5. Time spent at a grocery store[b]	-0.15*	-0.08	-0.04	0.43**	–											
6. Personality - Extraversion	-0.21**	0	0.01	0.12	0.07	–										
7. Personality - Agreeableness	0.20**	-0.08	-0.08	0.06	0.06	-0.08	–									
8. Personality - Conscientiousness	-0.01	0.18**	0.06	0.09	0.03	0.33**	0.14*	–								
9. Personality - Emotional Stability	0.16*	0.01	0.09	-0.01	0	0.01	0.51**	0.20**	–							
10. Personality - Openness to Experiences	0.06	0.12	0.02	0.07	0	0.25**	0.07	0.35**	0.1	–						
11. Time to the nearest bus stop[b]	-0.12	-0.15*	0.04	0.06	-0.08	0.12	0.1	-0.04	0.09	-0.05	–					
12. Time to the nearest grocery store[b]	0.15*	0.06	0.16*	0.06	0.07	0.03	0.01	0.04	0.14*	0.15*	0.23**	–				
13. Number of relatives in the city[b]	0.13*	0.16*	0.11	0.07	0.03	0.14*	-0.09	-0.07	0.04	-0.09	0.02	0.06	–			
14. Number of friends in the city[b]	0.01	0.14*	0.11	0.1	-0.06	0.24**	-0.12	0.12	-0.04	-0.01	0.09	-0.03	0.22**	–		
15. Frequency of seeing relatives[b]	-0.1	0.13	-0.01	0.1	0.14*	-0.01	0	-0.03	-0.05	-0.16*	0.11	0.02	0.15*	0.13	–	
16. Frequency of seeing friends[b]	-0.15*	0.11	-0.08	0.18**	0.13*	0.15*	-0.05	0.13*	-0.02	0.01	-0.08	-0.1	-0.12	0.36**	0.42**	–

**Correlation is significant at the 0.01 level (1-tailed).
*Correlation is significant at the 0.05 level (1-tailed).

APPENDIX I
Spearman's correlation coefficients – men (n =80)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Age[a]	–															
2. Years of residence[a]	0.12	–														
3. Distance from the city center	0.07	0.02	–													
4. Frequency of grocery shopping	0	-0.15	-0.06	–												
5. Time spent at a grocery store[b]	-0.01	-0.11	0.07	0.69**	–											
6. Personality - Extraversion	-0.22*	0.01	0.03	0.06	0.13	–										
7. Personality - Agreeableness	0.14	0	-0.11	0.08	0.08	-0.04	–									
8. Personality - Conscientiousness	0.03	0.27*	0.02	0.16	0.23*	0.29**	0.08	–								
9. Personality - Emotional Stability	0.26*	0.07	-0.02	-0.12	0.02	-0.04	0.40**	0.19*	–							
10. Personality - Openness to Experiences	-0.01	0.27**	-0.12	0.09	0.07	0.22*	0.07	0.47**	0.04	–						
11. Time to the nearest bus stop[b]	0.01	-0.06	0.14	-0.15	-0.13	0.23	-0.03	0.02	0.02	-0.11	–					
12. Time to the nearest grocery store[b]	0.15	-0.07	0.19*	-0.12	0	0.06	0.03	0.06	0.33**	0.05	0.31*	–				
13. Number of relatives in the city[b]	0.16	0.08	-0.02	-0.03	0.04	0.03	-0.01	-0.13	0.08	-0.20*	0.04	0.16	–			
14. Number of friends in the city[b]	-0.1	0.24*	0.17	-0.15	-0.27*	0.17	-0.25*	0.08	-0.1	-0.04	0.14	-0.08	0.30**	–		
15. Frequency of seeing relatives[b]	-0.12	0.07	0.01	0.07	0.04	0.05	0.03	-0.06	-0.15	-0.15	0.11	-0.07	0.39**	0.25*	–	
16. Frequency of seeing friends[b]	-0.14	0.15	0.12	0.12	-0.03	0.16	-0.03	0.20*	-0.19	-0.04	-0.11	-0.21*	-0.06	0.52**	0.42**	–

**Correlation is significant at the 0.01 level (1-tailed).
*Correlation is significant at the 0.05 level (1-tailed).

APPENDIX J
Spearman's correlation coefficients – women (n =109)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Age[a]	–															
2. Years of residence[a]	0.28**	–														
3. Distance from the city center	-0.15	0.06	–													
4. Frequency of grocery shopping	-0.13	0.13	-0.05	–												
5. Time spent at a grocery store[b]	-0.09	-0.07	-0.14	0.04	–											
6. Personality - Extraversion	-0.21*	-0.01	0	0.12	-0.1	–										
7. Personality - Agreeableness	0.24**	-0.15	-0.06	0.02	-0.01	-0.12	–									
8. Personality - Conscientiousness	-0.05	0.12	0.09	0.1	-0.09	0.34**	0.15	–								
9. Personality - Emotional Stability	0.11	-0.04	0.14	-0.1	-0.1	0.02	0.59**	0.19*	–							
10. Personality - Openness to Experiences	0.11	0.01	0.14	0.03	-0.04	0.27**	0.05	0.28**	0.13	–						
11. Time to the nearest bus stop[b]	-0.17	-0.18	-0.03	0.14	-0.13	0.06	0.18	-0.07	0.14	-0.01	–					
12. Time to the nearest grocery store[b]	0.21*	0.15	0.15	-0.1	-0.07	-0.02	-0.05	0.02	-0.04	0.20*	0.18	–				
13. Number of relatives in the city[b]	0.12	0.21*	0.21*	0.12	0.01	0.23*	-0.14	-0.03	0.01	-0.01	0	-0.05	–			
14. Number of friends in the city[b]	0.16	0.06	0.09	0.24*	0.01	0.33**	0.01	0.15	0	0	0.07	-0.02	0.17	–		
15. Frequency of seeing relatives[b]	-0.05	0.14	-0.04	-0.06	0.13	-0.12	-0.06	-0.07	-0.02	-0.20*	0.12	0.01	-0.04	0.03	–	
16. Frequency of seeing friends[b]	-0.08	0.06	-0.26**	-0.05	0.06	0.05	-0.11	0.04	-0.01	0	-0.07	-0.18*	-0.19*	0.18*	0.40**	–

**Correlation is significant at the 0.01 level (1-tailed).
*Correlation is significant at the 0.05 level (1-tailed).

APPENDIX K
Spearman's correlation coefficients- ordinal data

Total (n =190)

	1	2	3	4	5	6	7	8
1. Travel frequency	—							
2. Perceived health	0.08	—						
3. The latest clinic visit	0.00	-.16*	—					
4. Perception of safety - general	-0.03	0.12	0.03	—				
5. Perception of traffic safety	0.03	0.09	0.02	0.48**	—			
6. Perception of sidewalk safety	0.09	0.10	0.07	0.42**	0.60**	—		
7. Perception of public safety	0.02	0.13*	0.02	0.50**	0.41**	0.42**	—	
8. Perception of lightning safety	-0.05	0.16*	0.06	0.43**	0.40**	0.41**	0.52**	—

* 0.05 level (1-tailed) **0.01 level (1-tailed)

Men (n=80)

	1	2	3	4	5	6	7	8
1. Travel frequency	—							
2. Perceived health	0.07	—						
3. The latest clinic visit	-0.10	-0.34*	—					
4. Perception of safety - general	-0.12	0.05	-0.05	—				
5. Perception of traffic safety	-0.05	0.09	-0.02	0.43**	—			
6. Perception of sidewalk safety	-0.12	0.02	0.00	0.32**	0.59*	—		
7. Perception of public safety	-0.08	0.16	-0.13	0.47**	0.32*	0.37*	—	
8. Perception of lightning safety	-0.06	0.20*	-0.04	0.42**	0.42*	0.31*	0.43**	—

* 0.05 level (1-tailed) **0.01 level (1-tailed)

Women (N=110)

	1	2	3	4	5	6	7	8
1. Travel frequency	—							
2. Perceived health	0.07	—						
3. The latest clinic visit	0.07	-0.04	—					
4. Perception of safety - general	0.04	0.17*	0.05	—				
5. Perception of traffic safety	0.11	0.13	0.06	0.52**	—			
6. Perception of sidewalk safety	0.22*	0.16	0.10	0.46**	0.63**	—		
7. Perception of public safety	0.11	0.15	0.12	0.52**	0.44**	0.44**	—	
8. Perception of lightning safety	-0.03	0.14	0.13	0.43**	0.40**	0.47**	0.59**	—

*0.05 level (1-tailed) **0.01 level (1-tailed)

APPENDIX L
Bivariate logistic regressions, total (n=191)

Independent variables	Coding scheme or individual observed variables	Sig	Odds ratio
Gender	0=female, 1=male	0.9	1.03
Age	years old	0.2	0.97
Length of residence	number of years	0.6	1.00
Distance between home and the city center	kilometers from the city center	0.8	1.00
The most often used travel mode (Walk or Bicycle vs.	0=others, 1=walk & bicycle	0.3	1.63
The most often used travel mode (Bicycle vs. Others)	0=others, 1=bicycle	0.0	2.04
The most often used travel mode (Walk vs. Others)	0=others, 1=walk	0.1	0.44
Frequency of going grocery shopping	times a week	0.0	1.18
Time spent in store for grocery shopping	minutes spent at a grocery store	0.1	0.99
Ownership of a driver's license	0=no, 1=yes	0.7	1.09
More frequently going out than in the past	0=no, 1=yes	0.0	2.55
Perceived health	0=poor, 1=other (excellent, good, fair)	0.9	0.94
Recent visit to a doctor	0=within 6 months, 1=more than 6	0.9	1.00
Marital Status	0=not married, 1=married	0.6	0.86
Living arrangement	0=living alone, 1=not living alone	0.2	0.64
Current work status	0=not working, 1=working	0.8	0.90
Past job	0=never worked, 1=worked	0.2	1.80
Personality - Extraversion	number of scale 1-7	0.2	1.18
Personality - Agreeableness	number of scale 1-7	0.6	1.06
Personality - Conscientiousness	number of scale 1-7	0.5	1.09
Personality - Emotional Stability	number of scale 1-7	0.6	1.05
Personality - Openness to Experiences	number of scale 1-7	0.2	1.20

APPENDIX L – Contd.

Independent variables	Coding scheme or individual observed variables	Sig	Odds ratio
Availability of sidewalk	0=no, 1=yes	0.29	1.52
Availability of bus stop	0=no, 1=yes	0.11	1.73
Availability of convenience store	0=no, 1=yes	0.88	1.11
Time to get the nearest store	number of minutes to get the store	0.95	1.00
Number of relatives in the city	persons	0.10	0.96
Number of friends in the city	persons	0.21	1.02
Frequency of seeing relatives in the city	times a month	0.31	1.03
Frequency of seeing friends in the city	times a month	0.00	1.09
Perceived safety of neighborhood (Safe vs. Unsafe)	0= unsafe, very unsafe, 1=very safe, safe	0.56	0.65
Perceived traffic safety (Safe vs. Unsafe)	0= unsafe, very unsafe, 1=very safe, safe	0.44	0.74
Perceived sidewalk safety (Safe vs. Unsafe)	0= unsafe, very unsafe, 1=very safe, safe	0.16	1.95
Perceived crime safety (Safe vs. Unsafe)	0= unsafe, very unsafe, 1=very safe, safe	0.61	1.34
Perceived lighting safety (Safe vs. Unsafe)	0= unsafe, very unsafe, 1=very safe, safe	0.94	0.96

APPENDIX M
Bivariate logistic regressions by gender

Independent variables	men (n=80)		women (n=111)	
	Sig	Odds ratio	Sig	Odds ratio
Age	0.51	0.97	0.28	0.97
Length of residence	0.55	0.99	0.75	1.00
Distance between home and the city center	0.66	1.17	0.46	0.80
The most often used travel mode (Walk or Bicycle vs. Others)	0.34	0.52	0.02	3.64
The most often used travel mode (Bicycle vs. Others)	0.23	0.53	0.00	3.23
The most often used travel mode (Walk vs. Others)	0.61	1.44	0.25	1.83
Frequency of going grocery shopping	0.72	1.05	0.00	1.65
Time spent in store for grocery shopping	0.17	0.98	0.24	0.99
Ownership of a driver's license	0.75	0.85	0.46	1.56
More frequently going out than in the past	0.01	3.64	0.09	1.94
Perceived health	0.62	0.67	0.49	1.67
Recent visit to a doctor	0.33	0.62	0.48	0.74
Marital Status	0.88	1.12	0.63	0.83
Living arrangement	0.73	1.39	0.23	1.63
Current work status	0.83	0.84	0.64	1.38
Past job	0.73	1.39	0.21	0.62
Personality - Extraversion	0.20	1.34	0.67	1.08
Personality - Agreeableness	0.38	1.23	0.83	0.96
Personality - Conscientiousness	0.12	1.49	0.85	0.97
Personality - Emotional Stability	0.77	1.07	0.80	1.04
Personality - Openness to Experiences	0.46	1.20	0.31	1.19
Availability of sidewalk	0.29	1.79	0.49	1.48
Availability of bus stop	0.03	3.01	0.93	0.96
Availability of convenience store	0.94	1.11	0.64	1.44
Time to get the nearest store	0.52	1.04	0.65	0.98
Number of relatives in the city	0.72	0.99	0.06	0.99
Number of friends in the city	0.18	1.03	0.51	1.01
Frequency of seeing relatives in the city	0.98	1.00	0.57	1.02
Frequency of seeing friends in the city	0.28	1.05	0.00	1.14
Perceived safety of neighborhood (Safe vs. Unsafe)	0.11	1.54	0.95	0.94
Perceived traffic safety (Safe vs. Unsafe)	0.33	1.80	0.98	0.98
Perceived sidewalk safety (Safe vs. Unsafe)	0.80	1.23	0.05	3.16
Perceived crime safety (Safe vs. Unsafe)	0.96	0.93	0.40	0.56
Perceived lighting safety (Safe vs. Unsafe)	0.62	0.67	0.53	1.60

APPENDIX N
Summary of travel diary

	Pseudonym	Gender	# of days left the house a week	# of journeys[a] a week	Average # of journeys a day	# of trips[b] a week	Average # of trips a day	# of multiporpose journey a week	% of multiporpose journey to total journeys	% of trips with someone	Social purpose ratio[c]	Total distance traveled (mile)	Travel modes used[d]
1	Koeda	Female	6	9	1.29	32	4.57	5	55.6	21.9	0.31	36.5	Bicycle, walk, train
2	Yamada	Female	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3	Kitano	Female	3	6	0.86	14	2.00	2	33.3	0.0	0.00	5.9	Bicycle
4	Kawamura	Female	7	12	1.71	28	4.00	7	58.3	0.0	0.44	81.2	Bicycle, walk, train
5	Toyota	Female	6	7	1.17	18	2.57	4	57.1	0.0	0.33	16.4	Bicycle
6	Kawasaki	Female	6	8	1.14	20	2.86	4	50.0	30.0	0.25	9.3	Bicycle, walk
7	Nakano	Female	7	8	1.14	21	3.00	3	37.5	38.1	0.50	10.9	Bicycle, bus, walk
8	Nishikawa	Female	6	6	0.86	14	2.00	2	33.3	0.0	0.38	3.4	Bicycle
9	Aoyama	Female	7	11	1.57	29	4.14	4	36.4	3.4	0.29	11.8	Walk
10	Okura	Female	6	6	0.86	18	2.57	4	66.7	5.6	0.50	34.11	Electric bicycle, train
11	Mizuno	Female	7	11	1.57	31	4.43	6	54.5	0.0	0.32	38.9	Motorcycle, bicycle
12	Tani	Male	7	9	1.29	27	3.86	6	66.7	25.9	0.61	77.2	Bicycle, drive car, train, bus
13	Fuji	Male	7	12	1.71	26	3.71	1	8.3	38.5	0.57	8.3	Bicycle
14	Okuno	Male	6	8	1.14	21	3.00	2	25.0	33.3	0.77	37.7	Walk, bicycle, carpool, train
15	Uemura	Male	7	7	1.00	17	2.43	2	28.6	5.9	0.60	52.4	Bicycle, walk, train,
16	Sekikawa	Male	5	7	1.00	17	2.43	1	14.3	52.9	0.56	61.34	Bicycle, drive car, walk
17	Sakai	Male	7	12	1.71	49	7.00	9	75.0	20.4	0.33	129.3	Bicycle, walk, drive car
18	Maeda	Male	7	10	1.43	21	3.00	1	10.0	0.0	0.64	24.2	Bicycle, drive car
19	Taramae	Male	6	6	0.86	14	2.00	2	33.3	42.9	0.75	174.3	Drive car, walk
20	Kuwata	Male	7	7	1.00	27	3.86	7	100.0	7.4	0.53	75.4	Bicycle, walk, train
21	Kijima	Male	7	9	1.29	19	2.71	1	11.1	15.8	0.50	9.1	Bicycle

[a]Journey - a travel which consists of successive stops from leaving the house to returning to the house

[b]Trip - a travel of segment between one place to another

[c]The proportion of the trips made for social activities relative to the all trips

[d]Listed in order of frequency during the travel diary week

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