

A study of senior-friendly transportation services in Beijing

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Abstract

A study of senior-friendly transportation services in Beijing

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With the increasing population of the elders in China, many social challenges arise. To make travel easier for the elderly, new technology can be used to increase transportation services. This thesis will use successful cases around the world as examples and conclude with useful planning and design approaches to use in Beijing. Based on the successful cases, I created a survey to learn about the kind of technology and services that are preferred by seniors in Beijing.

The main focus of this thesis is on how to improve senior-friendly transportation services in Beijing. First, the literature review will introduce how emerging new services affect seniors' lifestyles, and the successful examples in other cities or countries. After this, it is necessary to learn what the elders' specific travel needs in Beijing are by collecting survey responses — and then answer how transportation agencies should implement mobility services for the elderly. Last, I make recommendations regarding how to fill the elderly care services gap through new technology.

The thesis is based on a mixed-research method. At first, I took the results from previous studies to identify senior-friendly transportation services. I included and analyzed successful examples and considered how to learn from these successes in Beijing. I created hypotheses of which kind

of services would be most helpful to the elders. After that, I used a survey to determine the elders' transportation preferences, understand their needs, and to rank the order of importance of the alternative services. I analyzed the survey results and based on the research, provided some suggestions about adding supporting facilities to public transportation systems, and some new technology, such as autonomous driving, as a future trend of senior-friendly transportation system. Additionally, door-to-door services for helping seniors travel in Beijing are highly desirable, and thus a community shuttle bus is an excellent service to consider.

University of Washington

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Introduction

In the past decade, global population entered a stage of aging. The number and proportion of older people have been increasing in almost every country. According to statistics provided by the World Population Prospects (2019), the world's population over 65 years old will occupy 16% of the whole population by 2050, which was 9% in 2019. Aging population brings social and economic problems which are severe challenges faced by governments in the 21st century. The challenges include housing, transportation, and senior care services.

In Beijing, the most common travel option for the elders with independent living ability is taking buses. For the elders who have diseases and need special care, most of them can hardly leave their home. The thesis aims to answer the question of what transportation services can better meet seniors' needs for travel. This thesis introduces the possible transportation services for the self-sufficiency elders around the world and whether can use similar transportation services in Beijing, China.

Many senior communities in China are built in suburban areas for better air quality and more affordable land prices. However, compared to the suburban area, cities have better medical systems and more consumer facilities, such as shopping malls, better restaurants, fitness areas, and hospitals. Many seniors still want to live in the city area. Additionally, since most young parents in Beijing have heavy work pressures and long working hours, many of them are not able to take care of their children on their own. Their parents move to Beijing from hometowns to help them take care of their children which has caused the number of elderly people in Beijing to increase. With a sharply increasing of elderly population, it is necessary to add and improve the

senior-friendly transportation services in Beijing. Although there are many public transit lines that can cover the whole urban area, most of the elders choose buses as their travel mode, while some inconvenient transportation services hinder their travel. For example, existing buses are too high for disabled elders to board. Moreover, complicated bus lines are not convenient for older people to navigate. I would like to figure out how to improve feasibility of transportation services to provide more transit modes options for the elders, such as car-sharing and private vehicles.

Nowadays, most elders can do some activities around their communities while others have slight difficulties in walking and can only stay at home. People with increasing health problems have limited social integration and need more assistance (Park et al., 2017). Living alone is associated with more functional limitations and worse physical and mental health, while social interaction with friends leads to better physical and mental health situations. The expansion of their activity range can also help to expand their circle of friends and improve their mental health. The importance of outdoor equipment for older people in public spaces or urban parks is cited in the literature (Levinger et al., 2018). Moreover, these facilities can meet the elders and young children's requirements at the same time. This literature highlights the importance of improving senior-transportation services. The purpose of this thesis is to look for solutions to make elders' daily travel convenient by improving transportation services and adding transit supporting facilities for them.

Literature Review

The literature review includes previous research about senior-friendly transportation services and technologies which can be implemented in Beijing. This section includes three major parts, one is about the definition of senior-friendly services, another is about new senior-friendly technologies, and the last part is about practical applications.

Definition of Senior-friendly Services

The population of elders is increasing in many countries. However, many countries are not fully prepared to become senior-friendly countries. For example, Detroit made a lot of effort to make the elders feel comfortable in the city (Bridgewater et al., 2011). Bridgewater (2011) proposed several standards to judge whether major cities are older-friendly cities, one of the criteria is the integrity level of the transportation system, which includes walkability level, the completeness of surrounding commercial facilities, availability to use regional transportation systems, door-to-door and escorted transportation services.

Transportation – New Technology

This part is going to provide information about what kind of transportation system is the most friendly to elders. First, with more and more middle-aged people having driver licenses, it is important to develop some smart technologies for aging people to ensure they can still drive without any restrictions when they get old. It is important to maintain their quality of life and self-esteem. Mann (2005) argues that although not allow the seniors to drive can affect their

living quality and self-esteem, it is dangerous to let the elders drive because age-related declines in visual and sensory abilities, cognition, and motor skills are decreasing. Meredith (2002) states a similar reason for why it is impossible to craft an approach to encourage the seniors to drive. With age increasing, physical, mental, and cognitive capacities are decreasing and some medications might affect body function. The effects of aging are different for different seniors, so it is hard to identify the effect of age on driving ability. However, as Mann said, restricting elders to drive will bring isolation, which can increase the riskiness of depression. Rosenbloom (2009) mentions that one of four U.S. drivers will be elders by 2030.

Since China is still developing, some situations in China are similar to the situations in the United States ten to twenty ago. Therefore, we can predict future development in China by analyzing the situation that happened in the United States before. In 2007, many people over 65 years old had a driver's license in the United States. As a result, those over 65 accounted for more than one in seven drivers on the United States roadways. By 2030, older drivers will account for as many as one of four U.S. drivers and substantially more in many rural and retirement communities (Sandra, 2009). Older people have become more and more reliant on the car as licensing rates have increased.

To solve the problem of seniors driving safety, some researchers have tried to use smart technology to enable older people to avoid isolation. William (2005) mentions the technology which can solve problems that appear with increases in age. The author mentions some technologies to provide senior-drivers' safety, such as In-Vehicle Technologies, Basic Collision Warning Systems, Navigation Technologies, Route Guidance Systems, and Automatic Collision Notification or Automatic Vehicle Location Sensors. In addition to these transportation

technologies, the government can also test the senior-drivers before allowing them to drive. Furthermore, elders can be educated on how to drive safely in different health situations.

William (2005) also mentions some other smart technologies that can improve disabled seniors' traveling experiences. For example, “smart wheelchairs” can prevent collisions. Additionally, the Architectural Barriers Act (1968) and the Americans with Disabilities Act (1990) formulate that public buildings and sidewalks are required to have ramps to make sure the seniors and people with disabilities can access. To help seniors with vision impairments, accessible pedestrian signals (APS) should provide audible or vibrotactile information to remind disabled pedestrians when the walk interval begins.

Bogren and Ketchel (1994) talk about providing solutions to make transportation more aging friendly. With the aging increase, older people will rely more on conventional public transit services. It provides some traveling methods, which includes traditional public transit, American Disability Act (ADA) paratransit services, and Community transit services. Along with the former article, smart technology is a great mode to be considered to develop public transit services. Bogren and Ketchel (1994) mention that transportation department started to use low-riding buses with an extendable step that comes from under the bus to lower the initial step height to convenience seniors' travel experiences. At the same time, smart cards can be used for bus fares which can automatically deduct the senior ticket fee.

Practical Application

Comparable services are used in King County, Washington. In the Seattle Department of Transportation report (2020), several senior-friendly transportation services are mentioned.

Senior Regional Reduced Fare Permit (RRFP) Pilot which provides reduced fares to senior people who are age 65 and above, disabled people, and Medicare cardholders on public transportation systems. Additionally, this policy allows people over 65 years old to take buses for free, which might make them hesitant to take other more expensive transportation modes. To help seniors be familiar with this service, Seattle Department of Transportation (SDOT) needs to provide field trip opportunities for seniors to show the routes they might often take.

Moreover, the report shows that 73% seniors use King County Metro bus, including Rapid Ride, while 26% take Sound Transit. The percentage is slightly higher after they signed up for their RRFP card. After enrollment, 85% seniors used their RRFP card. The people who do not use the RRFP card are mainly because of 3 reasons, which include do not know how to use the RRFP card, haven't needed RRFP card in the last 2 months, and an alternate mode is faster than transit. 84% seniors thought transit was already affordable or very affordable before they get RRFP card. 50% seniors spend \$0 --\$20/month on transit and 29% spend \$21 --\$40/month.

For the elders who like to walk, Bogren et al.(1994) introduce a transportation apparatus for street traffic safety. This kind of transportation apparatus can help with pedestrians crossing the street quickly and safely. It is a simple device which is a transportation car with strobes on both sides. The car will be arranged on the rail lying on the street to commute senior people and the people with disabilities.

Rosenbloom (2009) points out that transit operators are encouraged to provide more customized services and more directly linked residential concentrations for older people. The service needs to be provided during the time they want to travel and at the hours they need to travel which can be outside the traditional peak period and sometimes at night. These problems can be solved by

providing special services. To improve the community transport system, the author points out that the community can match volunteer drivers to older people needing transportation. In the article, the author says that the lack of sidewalks or a system of connected sidewalks will cause significant problems in the pedestrian environment. Furthermore, unsafe intersection crossings, crowded sidewalks, and cyclists on the sidewalk may bring danger to old pedestrians. The walking experiences can be improved by raising pavement markings, median islands, user-activated signal crossing devices, enhancing signals, and improving pedestrian crossings. The paper also mentions that encouraging the elders to move to denser urban areas and creating a walk-accessible community can improve the elders' travel experiences.

Sibal (2016) mentions a lot of alternative transportation modes in her article. She lists the challenges for public transportation, which include expensive costs, unavailability in all areas, untrained drivers, and the vehicles that may not be friendly to people who take wheelchairs. The following transit modes can be great alternatives. Government-sponsored affordable ride programs are less expensive than standard public transportation and some of them have door-to-door service. Volunteer driving services usually have little or no cost for rides, but since there are not enough volunteers, people always need to wait and make an appointment in advance.

Shuttles link the community with people's destinations, but it will take longer times than other transit modes. In the article, the author encourages ride-sharing which is more cost-effective than owning a car. The only concern is that the elders need to know how to use the ride-sharing app. If the elders can use the app, ride-sharing will be more convenient than other travel modes.

The City of Seattle has a series of initiatives to facilitate travel for older people. The Seattle Department of Transportation uses lift-equipped buses to make it convenient for senior

passengers to board. All of the buses have priority seats which are set on both sides of the aisle behind the driver, and extra handrails to help people to better keep balance. Additionally, King County provides training for the elders who feel using public transportation to be a challenge. Participants will travel with their instructors on public transportation until they think they can travel by themselves. Moreover, Volunteer Transportation is a transit mode that is similar to senior shuttles. The frequency of volunteer transportation will be once a week or once a month, which aims to connect the senior with important locations. On the report, it shows that SDOT provides \$36 vouchers per month to subsidize elderly travel (2020). However, in the 56 participants, only 2 have used up the entire \$36 vouchers, which means vouchers may not be a widely accepted mode to improve elders' travel experiences.

For volunteer transportation, I think it is doable if the volunteer frequency is once a month. Seattle Downtown Circulator Bus is a good example (2020). Seattle Downtown Circulator Bus provides free rides for low-income people. Compared to the regular buses, it has a relatively shorter fixed route (2020). This bus service aims to connect people with surrounding living facilities.

King County provides a Taxi Scrip program (2020) for low-income King County residents age 65 and over. People can have a 50 percent discount by using up to eight books of taxi scrip per month.

Seattle city also provides free senior shuttles, people who are age 55 years or older can call to schedule rides. It is allowed for same-day services which are based on a first-come, first-served rule. Similar to senior shuttles, the elders aged 55 or over and living within one of our neighborhood service areas can take the Hyde Shuttle. This service provides a convenient transit

chance for people who give up driving and have difficulty with taking buses. Similar to the senior shuttle, access transportation can take people to any public transportation stations after they paid \$1.75 per trip. People also need to make a schedule by phone to request this service.

For pedestrians' safety, Mayor Jenny A. Durkan (2019) announced to reduce speed limits to 25 miles per hour (mph) throughout Seattle and set more safety-enhanced traffic signals to create safer streets. However, it is hard for drivers to yield to pedestrians if some of them ignore the traffic signals and cross the streets whenever they want. In this situation, compared with adding traffic signals, safety education for both drivers and pedestrians is more important.

Research Method

To collect the survey data, I used the snowball method. I asked my friends to hand out the questionnaire to their relatives who are aged over 55. Then, I read each survey, and removed the invalid answers to ensure that all the questionnaires are valid. For the remaining valid questionnaires, I recorded how many people selected different options for each question, and then entered the number of data into the excel. I ranked the supporting facilities and services priority according to the percentage of people choosing different options from different ages. The minimum required number of participants was 100, 50% for each gender.

Research Hypothesis

To find the most suitable senior-friendly transportation services in Beijing, I list the following four hypotheses. The research aims to figure out which hypotheses are supported, and which corresponding transportation services can be applied to Beijing's transportation system.

Hypothesis 1: Supporting facilities are necessary to be added to encourage seniors to go outside, which includes supporting facilities on buses and the subways.

Hypothesis 2: Driving assistance facilities for improved safety will be needed.

Hypothesis 3: Applications on smartphones are necessary to be developed and training on these new applications is necessary for elders that may be unfamiliar with using smartphones.

Hypothesis 4: Car-sharing or ride-sharing can be the new popular transportation mode.

The research and analysis will help me to figure out how to improve transportation system convenience for elders. The final results can come from the following two aspects. First is the physical facilities aspect. By knowing the most needed supportive facilities, the government can improve targeted facilities by adding some services to improve seniors' travel experiences.

Second is the virtual supporting facilities aspect, which can include the applications for smartphones and automated or assisted driving systems. This thesis is trying to find solutions that can solve Beijing's specific situation. In other words, how to make travel more convenient for seniors and prove the elders' safety when they choose different travel modes.

Methodology

Based on the literature review, I have a general idea about what senior-friendly transportation services can be suitable for elders around the world. However, it is still necessary to conduct a survey because China has a different social background with other countries, a widely accepted transportation service in other countries may not be accepted in China. Furthermore, first-tier and second-tier cities may also have different needs. Conducting a survey can help us better understand what kind of transportation services will be better suited for the seniors in Beijing.

The selections for each question in the questionnaire will be created based on the information I learned from the literature review. From the survey, I collected transportation services preferences from seniors and considered about future development trends. The survey includes three parts:

1. Are there any services of public transportation system that are developed for seniors? (such as supporting facilities, community shuttle, etc.)
2. The preferences for people in the different age groups when they take public transportation (such as walking, biking, self-driving, ride-sharing, subway, bus, etc.).
3. Their willingness to use mobile apps to improve their travel experiences.

In general, I used mixed-research method for this thesis. I used a qualitative research method at the first step because the thesis needs to get general information about how to improve the senior-friendly transportation system.

The first step was learning the new technologies and senior transportation services that are applied in other countries by reading pervious researches and learning from existing cases. Based on these applied technologies and services, I provided different options in the survey to learn about seniors' preferences. Since China might be different because for cultural reasons, instead of including all the possible technologies and services in the survey, I chose some of them which can better fit the Chinese social environment. After that, I asked some of my friends who live in Beijing to deliver the survey to people over 55 years old of age and each of my friends found about 5 to 10 participants for me, so I needed to ask about 20 friends to help me to deliver the survey for an approximate sample size of 100. I used an online website (wenjuanxing.com) to create and deliver the survey.

The second step was using quantitative method to identify the most needed technologies and services in Beijing. After the participants filled out the survey, I downloaded the survey results and used Excel to calculate the percentage of how many people chose different options and got a general idea about their preferences. The following research focused on which services can be added and improved first. After I use qualitative research method to get the criteria, I used the quantitative research method to learn what are the most popular transit services to decide how to turn the transportation system into becoming a senior-friendly system. It is the only method to predict the requirements from survey results because there is not a fixed standard for the most convenient transportation services for elders from different age levels.

To better preform the analysis, I need to know the daily facilities requirements for seniors. I collected the following data results from the survey, which were the most frequently visited places and the supporting facilities development situation. I predicted the top three most

frequently visited places were parks, grocery stores, and hospitals. For daily transportation requirements, it is important to know if there is any supporting facility on public transportation and the user experiences of the elders. The elders' willingness to drive alone is also important to know from the survey. However, since private vehicles are just becoming popular in Beijing in the past few decades, many seniors may not have a chance to learn how to drive and know if they are willing to drive alone. Next, I collected the information about their willingness for taking public transportation, people from the different age groups may have different travel preferences. Therefore, I needed to analyze their requirements based on different age groups' preferences.

Some of the questions on the questionnaire can be created based on some specific Chinese social situations. Based on past experience, older people under the age of 70 may pay more attention to whether there are enough recreational facilities, such as parks, supermarkets, shopping malls, etc. One specific condition can be the difference in the parenting theory of young people in China. It is quite different from the parenting theory of young people in the United States. Instead of taking care of their children by themselves, some young people seek help from their parents to take care of their children. Therefore, the most frequently visited places for seniors should also include kindergartens and elementary schools.

Due to the different health situations, the elders under the age of 70 may have relatively higher requirements for the perfection of public transportation systems and surrounding recreational facilities. In contrast, older people over the age of 70 may be more willing to stay at home or just walk around their neighborhood instead of driving or taking public transportation to the far areas. For the surrounding facilities, people above 70 years old may be concerned about the level of

medical care in their neighborhood. However, this concern can be released if the housing association provide emergency services.

Goal of the Survey

The goal of this research project is to improve the convenience level of senior travel by understanding the travel characteristics and habits of the elderly and acceptable and preferable supporting facilities. In this part, I compared different travel modes chosen by seniors in different age periods, predicted what extra transportation modes and supporting facilities they need, and predicted the possibility of using mobile apps to convenient seniors' travel.

The survey is created by a sampling survey method. Overall, elderly people over 55 years old in Beijing are research subjects, a part of whom were selected for investigation and analysis. The characteristics of the participants were used to infer the overall senior people's transportation characteristics.

According to international regulations, people over 65 years old are determined to be senior people; the Chinese Protection of Rights and Interests of Old People Law stipulates that people over 60 years old are seniors. 65 years old is the age limit in this survey for two reasons. First, as the population life-span grows in China, the proportion of the elderly population is increasing. The retirement age of males is planning to extend to 65 years old, which means 65 year-old can be a more reasonable age division point. Secondly, with the continuous development of mobile communication equipment, people from 60 to 65 years old use smartphones more often. Since the second part of the survey aims to get information about whether apps can help to increase seniors' travel experiences, setting 65 years old as the age dividing line can be acceptable.

Survey Analysis

This section is going to introduce the survey. First, it is going to describe the survey sample. The second part will talk about the measure of senior-friendly transportation services. The last part is about the survey results.

To make the decision, the following questions will be considered in creating the survey. First, what are the ideal technology or services that should be easy to access and can meet as many requirements as possible? Second, what are the essential and necessary facilities that can be added to the vehicles efficiently? Third, what policies need to be added to support the uses of new services and technologies?

Sample Description

To better understand the seniors' travel behaviors and their attitudes towards new transportation technology, I created a survey to collect the analytic statistics information. This was an Internet non-distributed private survey that consists of 189 participants aged above 55 years old who were the family members of my friends in Beijing. I divided them by age.

I sent the survey through an online survey application and got an electronic report. The target sample size was 100. The survey received 196 responses with 189 effective responses. Since the age range is wide, the survey includes two kinds of target consumers, which are the people above 65 years of age and between 55 to 65 years of age. I analyzed the two groups separately, one is figuring out what kind of transportation services are necessary for the existing seniors, the other is trying to learn what is best for future seniors. I asked my friends to help the participants unfamiliar with technology to fill out the surveys. The survey was open for two weeks for the

participants to fill out. Since the questionnaire was distributed via the Internet during the Covid-19 period in China, I did not indicate that the participants should make choices under normal circumstances and this caused a few participants to choose unnormal choices. Therefore, the result may have a small deviation.

Age	55-65	Above 65	Total
Number	124	65	189
%	66%	34%	1
Gender			
Male	30%	46%	35%
Female	70%	54%	65%
Monthly transportation expense (yuan)			
0-50	22%	42%	29%
50-200	38%	40%	39%
200-500	16%	11%	14%
500-1000	19%	6%	14%
above 1000	6%	2%	4%

Table 1 Characteristics of the seniors ages above 55

Table 1 lists the characteristics of senior people in our sample. The ratio of men and women participating in the questionnaire was 7:13. There are more females that participated in this survey and more than half of the participants are 55 to 60 years old, which might influence the final result. More than half of the seniors spent 0 to 200 RMB (~30 USD) on transportation per month, only 4.23% participants spent more than 1000 RMB (~150 USD) per month on transportation (table 1).

In this questionnaire, 66% people are between 55-60 years old. 14% participants are aged 61-65, 12% participants are aged 66-70, 10% participants are aged 71-75, 5% participants are aged 76-80, and 8% participants are over 80 years old. More than half of the participants between the

ages of 55-60 may affect the results. Instead of learning what kind of senior-friendly transportation services are required for recent use, the results may be more suitable for analyzing how to develop future senior-friendly transportation services.

Compared with the elderly over 65 years old, the 55-65 years old seniors are willing to spend more on transportation. 42% seniors over 65 years old can accept travel expenses less than 50 RMB (~7 USD) per month, and 40% can accept cost 200 RMB (~30 USD) per month for transportation. Among the 55-65-year-old group, 22% can accept travel expenses of less than 50 RMB (~7 USD) per month, and 40% can accept 200 RMB (~30 USD) per month. Compared with only 19% people over the age of 65 can accept travel expenses of more than 200 RMB (above 30 USD). In 55-65 age group, 40% of them can accept to cost more than 200 RMB per month (above 30 USD) for their travel costs. I hypothesized the reason why most of the people can accept lower travel expenses is because most of them prefer traveling by foot. Furthermore, the Beijing Municipal Government provides a “Retirement Assistance Card” for elderly people over 60 years old, which allows them to ride the bus for free.

Measures of Senior-friendly Transportation Services

I focused on four domains of transportation hardship: transportation modes, transportation services, road supporting facilities, and supporting apps.

1. Modes of transportation: not enough choices of travel modes. The existing travel modes cannot help seniors easily reach their frequent places.
2. Transportation services: lack of services for seniors who are not able to travel alone and need help from others/volunteers.

3. Road supporting facilities: there are no supporting facilities for the elderly on the sidewalks.
4. Supporting applications: there is no mobile application that specifically solves the problem of elderly travel.

There are 25 questions in this questionnaire, the first 10 questions are about travel behaviors and the other questions are about their willingness to use new technology to convenience their travel experiences and their basic personal information.

Findings

From the report, we learned that most of the seniors would choose to travel on foot or by bus. It shows that 74.07% participants choose to walk and 65.61% participants choose to travel by bus. The third way to travel is to take their children's vehicles, but the percentage is much lower than walking and taking buses. Only 31.22% elderly choose this travel mode. Since most of the participants in this questionnaire come from middle-class families in Beijing, we can rule out that the elderly not choosing this travel modes because their children do not have a car. I speculate that travel by children's vehicles is not popular because their children are too busy to travel with their parents every day. The fourth and fifth modes are self-driving and travel by subway. For those who always drive, 77% of them are between 55-60 years old, and 15% are between 61-65 years old. 65% participants who chose to travel by subway are between 55-60 years old, and 12% are between 61-65 years old.

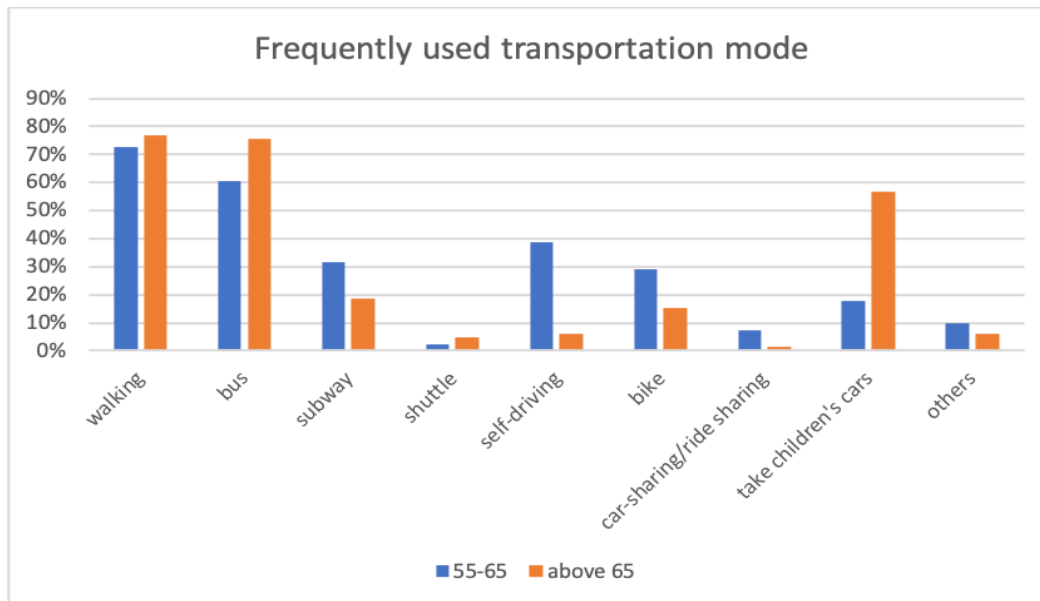


Figure 1 Transportation options

Among the 55-65 year-old group, walking (73%) and taking buses (60%) are the most popular travel modes, as well. Unlike the overall results, 39% participants chose to travel by self-driving and 31% participants chose to travel by subway. Taking children's cars dropped from third to sixth. It can be speculated that with 55-65 year-old senior people age increasing, the demand of self-driving will gradually increase. Senior-friendly transportation services should not only focus on how to meet the needs of the current elderly population, but also should consider how to provide the services that may be needed in the future.

Among the elderly over 65 years old, 57% of them ranked taking the children's car as the top three travel options. With age increasing, more and more elderly people will choose to take their children's cars to travel. It might be because of the following two reasons. One is that other transportation modes are difficult for them to reach. In other words, their physical condition does not allow them to travel alone. The other reason is that the elderly are not willing to travel because of physical decline, but their children want to take them out to keep them mentally

healthy. For the first reason, promoting people to use car-sharing and adding community shuttle can be considered as a solution. However, these two travel modes have not been widely accepted yet. Most of the seniors are unfamiliar with car-sharing and the community shuttle are rarely provided by the community in China. From the result, when planning to provide additional senior-friendly transportation services, it is fundamental to distinguish the different needs of people from different age groups and add different services according to their specific requirements.

Frequently used transportation mode									
	walking	bus	subway	shuttle	self-driving	bike	car-sharing/ride sharing	take children's cars	others
55-65	73%	60%	31%	2%	39%	29%	7%	18%	10%
above 65	77%	75%	18%	5%	6%	15%	2%	57%	6%
Total	74%	66%	27%	3%	28%	24%	5%	31%	8%

Table 2 Transportation options

For the ranking of favorite travel modes, no matter what age group they are in, the elderly's favorite travel mode is walking, which is similar to the first question. Most of the seniors prefer to travel by walking, and the second preference mode is taking buses. The score of traveling by children's cars is slightly higher (3.26) than self-driving (2.91). Supermarket shuttle or community shuttle ranked the least likely traveled mode with a score of 0.69 (full score is 10).

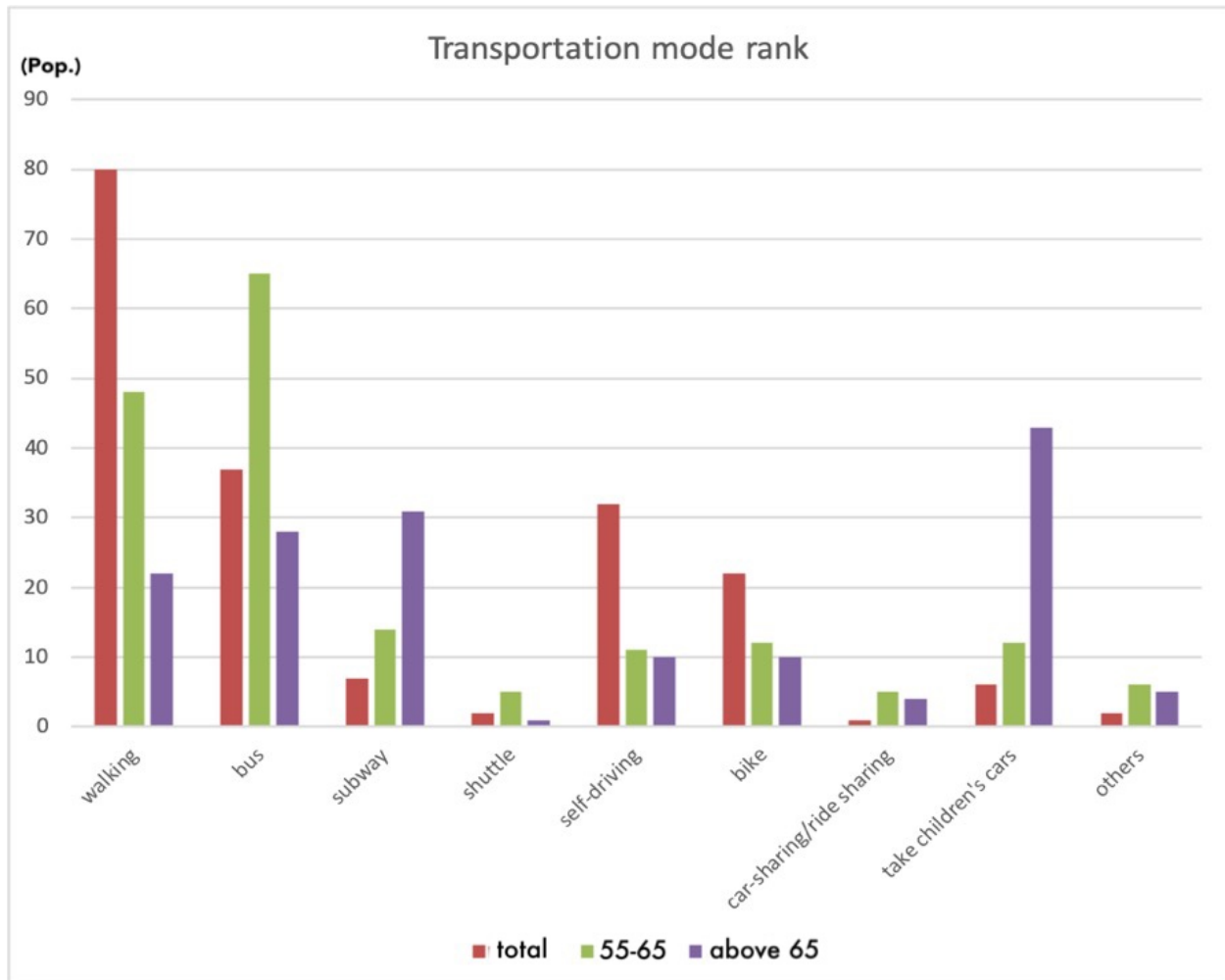


Figure 2 Transportation options ranking

For the elderly who prefer to go out on foot, they think that the most convenient way is not using any supporting facilities no matter what age group they are in. Using crutches is slightly more convenient than using wheelchairs. I speculate that this may be because the barrier-free facilities in Beijing have not been fully constructed, and many places are inaccessible by wheelchairs.



Figure 3 Walking convenient level ranking

For the elderly who did not rank travel on foot as the top choices, 37 elderly people (20%) were because many motor vehicles on the road would not avoid pedestrians, and 27 elderly people (14%) chose the sidewalks were uneven which might cause fall.

For the 55-65 year-olds who are unwilling to walk, 23% participants stated that motor vehicles on the road would not yield pedestrians, and 18% participants stated that the uneven sidewalk can cause fall. For the people who aged over 65 years old, 12% elderly people chose not to travel often because motor vehicles on the road would not yield pedestrians, and 8% seniors over 65 year-old are because the uneven sidewalk would cause fall. Therefore, in addition to the elderly who prefer to stay at home, most of the elderly over 65 years old think there is no problem to walk outside. However, this does not mean that we can ignore the construction of barrier-free facilities. I speculate that because of the shortage of barrier-free facilities, many elderly people who have difficulty in walking refuse to go out. I do not think the result of this question brings

great reference value to Beijing’s actual need to add senior-friendly transportation services. This question needs to be addressed deeply in the future research.

Reasons for walking is not a top choice				
	Motor vehicles on the road never avoid pedestrians	The uneven sidewalk is too dangerous	other	I ranked “walking” in the top 3
55-65	23%	18%	22%	63%
above 65	12%	8%	17%	63%
total	20%	14%	20%	63%

Table 3 Walking convenient level ranking

From the survey results, it is clear that regardless of the participants’ age, traffic lights, crosswalks, and bright lights, are the options they think will enhance their walking experiences. In general, 78% participants believed that traffic lights and crosswalks could enhance their walking experiences, and 69% participants believe that bright lights can enhance their walking experiences. Straight (2003) mentions the significance of walking. More than a transportation mode to reach destinations, walking is a physical activity for people to promote their health. A comfortable and safe walking environment can improve their experiences. In this situation, similar to survey result, Straight thinks installing sidewalks and traffic lights with motion sensors can improve people’s walking experiences by increasing the safety of crossing intersections. For the sidewalk ramps, only 37% seniors think this is necessary to improve their walking experiences. We can infer that most elderly people who need wheelchairs and crutches are not willing to walk outside due to the under-developed disabilities facilities. For the elderly who do not need supporting facilities, the sidewalk ramp may has little use. From this perspective, Beijing government can consider to vigorously develop the Disabilities Act to ensure that disabled seniors can travel smoothly and conveniently.

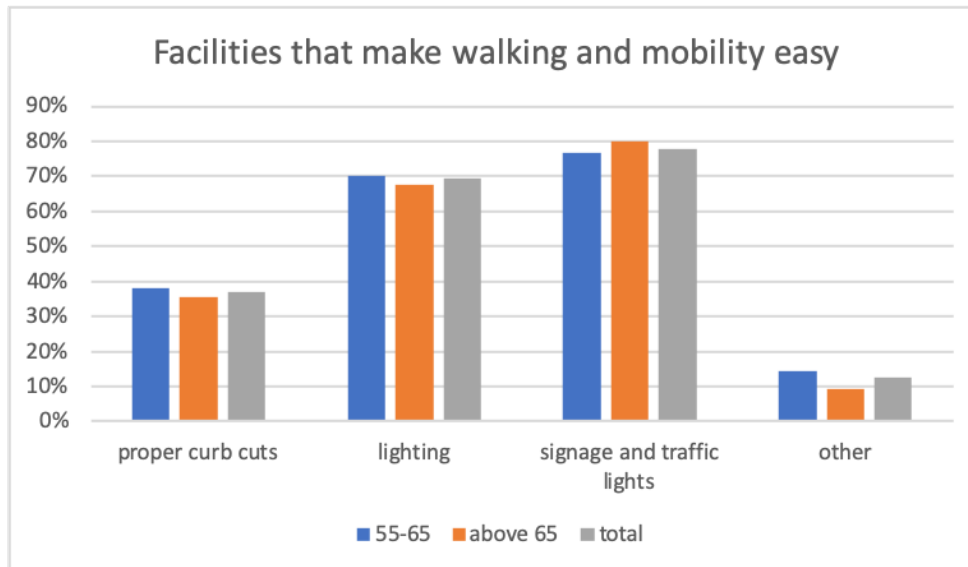


Figure 4 Rank of walking experiences upgrade

	proper curb cuts	lighting	signage and traffic lights	other
55-65	38%	70%	77%	15%
above 65	35%	68%	80%	9%
total	37%	69%	78%	13%

Table 4 Rank of walking experiences upgrade

The report “Measures to Support Voluntary Retirement From Driving in Japanese Older People: Driving Is Not Just a Means of Transportation” (2012) points out that senior driving can provide a sense of identity as a member of society and bring a little pleasure in their social life. However, most of the seniors did not travel by self-driving is because of the following reasons. First, 38% participants do not have a car, and 36% of them do not have driver’s licenses, and 25% elderly believe that driving alone is dangerous. Only 23% of them would rank self-driving as the top three travel modes. However, 31% participants from the 55-65 age group rank self-driving as the primary travel mode. There are various reasons for the 55-65 age group didn’t rank self-driving as the primary travel mode, such as not having a car (28%), not having a driver’s license (20%) ,

and concern of safety (23%). More than half (57%) of people over the age of 65 think that having a car is too expensive, and 66% participants over 65-year-old did not choose self-driving because they do not know how to drive.

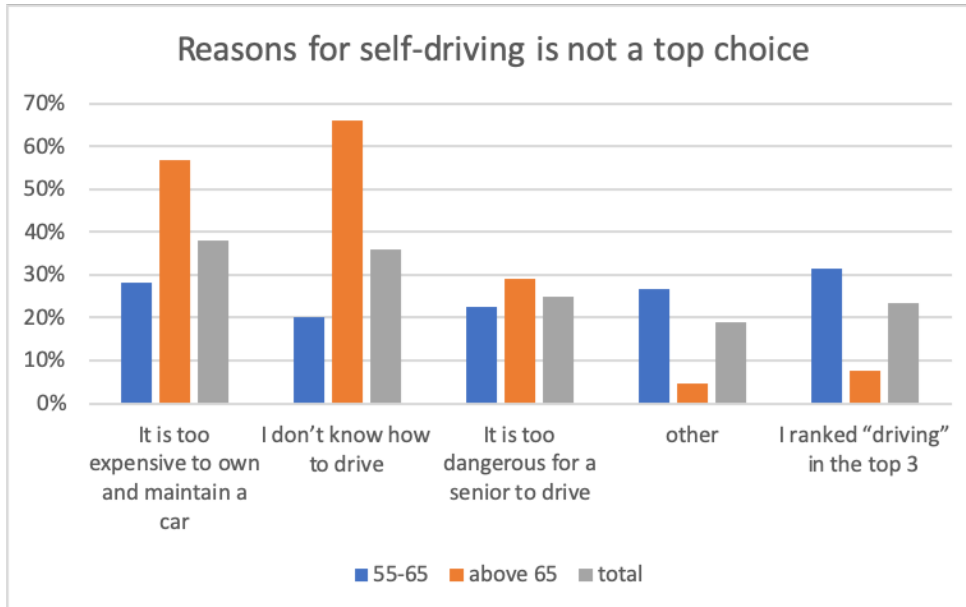


Figure 5 Reasons for not driving frequently

Reasons for self-driving is not a top choice					
	It is too expensive to own and maintain a car	I don't know how to drive	It is too dangerous for a senior to drive	other	I ranked "driving" in the top 3
55-65	28%	20%	23%	27%	31%
above 65	57%	66%	29%	5%	8%
total	38%	36%	25%	19%	23%

Table 5 Reasons for not driving frequently

Among the age-group between 55-65, nearly half of the people (49%) think that too many people on buses made them reluctant to take the bus. However, there is only 18% elderly over the age of 65 do not rank bus travel as the top three favorite travel modes for the same reason. It might be because 55 to 65-year-old middle-class seniors have more alternative travel options. They preferred to choose a more convenient and comfortable way to travel. There are 40% elderly in

the 55-65 age-group choose to travel by bus frequently. It might be because the bus can provide a more convenient ride experience.

Compared with the participants from the 55-65 age group, getting on and off the bus is more challenging for people over the age of 65. No matter in which age group, only a small number of people think that there are too many bus stops to remember (55 to 65-year old: 13%; above 65-year old: 15%), and sometimes they miss the station that they plan to get off.

To solve the problem of remembering and missing stations, some mapping applications provide solutions. For example, the “Bus Assist System-Listening to Bus App,” which is developed by Huatu Technology (华途科技) allows people to set automatic reminders for buses arrival. When the bus passes through each stop of the line, the site’s Bluetooth tag will trigger this application (Listening to Bus App) to notice users what is the current bus station. For the target station, users will get a strongly notification.

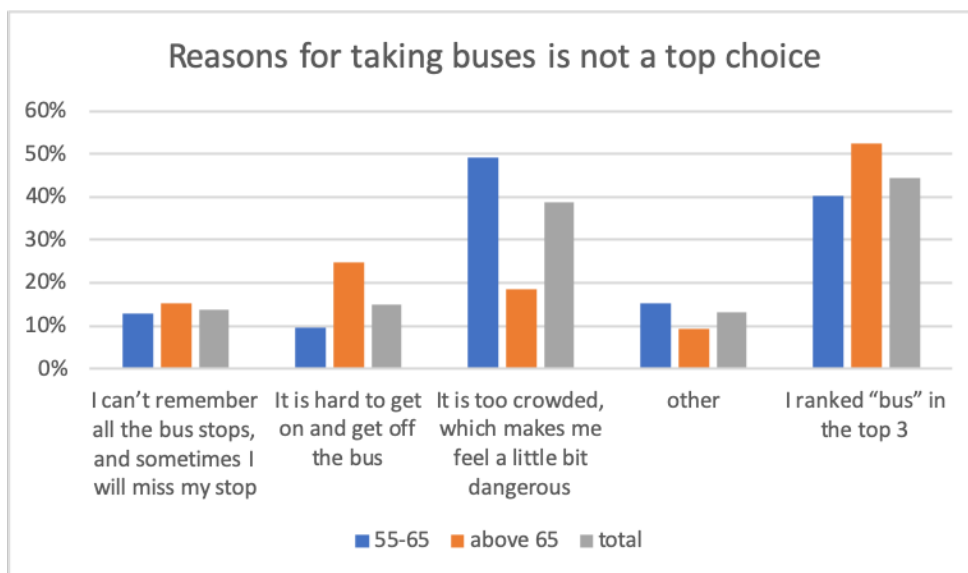


Figure 6 Reasons for not taking buses frequently

Reasons for taking buses is not a top choice					
	I can't remember all the bus stops, and sometimes I will miss my stop	It is hard to get on and get off the bus	It is too crowded, which makes me feel a little bit dangerous	other	I ranked "bus" in the top 3
55-65	13%	10%	49%	15%	40%
above 65	15%	25%	18%	9%	52%
total	14%	15%	39%	13%	44%

Table 6 Reasons for not taking buses frequently

Among the overall participants, more than half of the elderly (54%) do not choose to take the subway because the subway stations are far away from them. 21% participants often take the subway to travel. In 55-65 age-group, 27% will choose to take the subway frequently while 11% people over 65-year-old will take the subway frequently. From this, we can speculate that after the 55-65 year-old group retires in the future, more and more elderly will travel by subway. In general, 25% elderly chose not to travel on the subway for other reasons. It includes subway is not necessary, not used to taking the subway, subway security was troublesome, public transportation and other transportation modes were more convenient, excessive subway lines in a single station made transfer inconvenient, and lack of elevators in some of the subway stations would be more inconvenience. There are some proposals to improve subway services. For example, for the inconvenient transfer, mark the subway transfer direction with a striking sign might help. For those subway stations without elevators, add disability facilities or elevators to assist the disabled seniors up and down the stairs can be considered. However, the specific solution needs to be discussed in more detail in the forthcoming research.

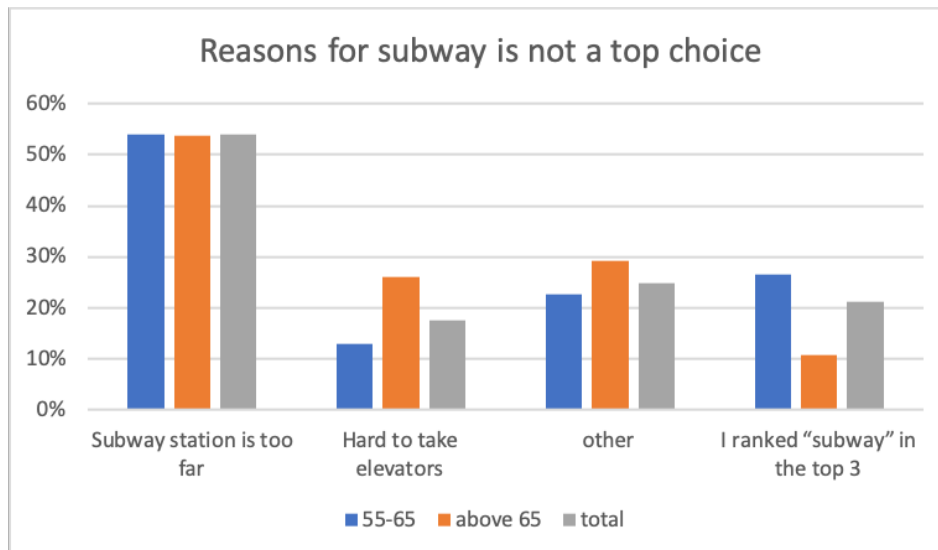


Figure 7 Reasons for not taking subway frequently

Reasons for subway is not a top choice				
	Subway station is too far	Hard to take elevators	other	I ranked "subway" in the top 3
55-65	54%	13%	23%	27%
above 65	54%	26%	29%	11%
total	54%	17%	25%	21%

Table 7 Reasons for not taking subway frequently

Regardless of the participants' age group, the shuttle bus is the last favored travel mode among all travel options. As it shown in the chart above, 69% participants did not choose shuttle to travel because their communities did not provide this kind of service. 27% thought that the shuttle could not send them to the destinations. In the 55-65 age group, 23% of them thought that shuttle bus could not reach their destinations. Furthermore, for the participants over 65-year-old, 35% of them had the same reason. It can be speculated that people over 65-year-old may need visit hospitals more frequently, clinics, and other places were not included in shuttle bus routes. In general, 12% participants thought shuttle bus schedule was not suitable. In the 55-65 age group, 9% seniors chose the same reason, while 18% elderly who over 65-year-old, chose this reason. This phenomenon is inconsistent with the prediction. If the elderly over 65 have a more

flexible schedule, a smaller percentage of people should choose this option. The possible reason for this could be concluded as the elderly have multiple choices to arrive destinations, and shuttle bus did not have an outstanding advantage, which was uncompetitive. In summary, for the communities that provide shuttle buses, the route and departure time of the shuttle bus is an issue that needs to be discussed deeply in the future.

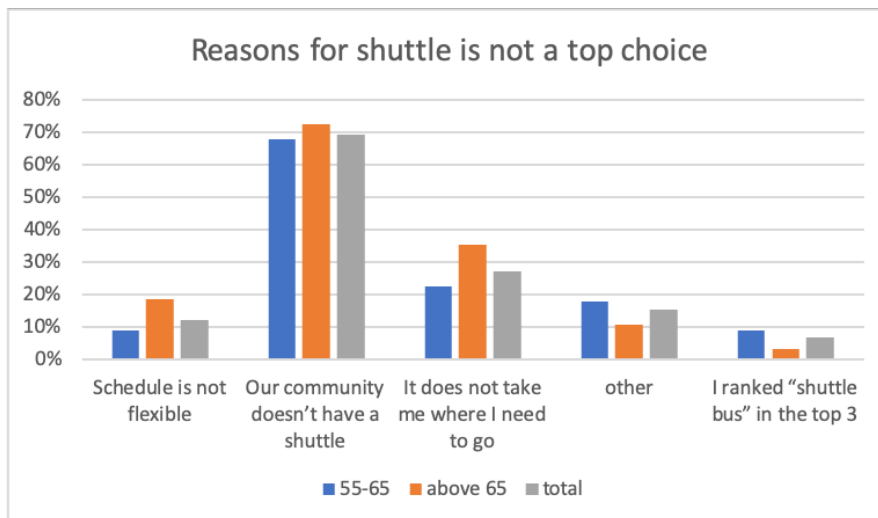


Figure 8 Reasons for not taking shuttle frequently

Reasons for shuttle is not a top choice					
	Schedule is not flexible	Our community doesn't have a shuttle	It does not take me where I need to go	other	I ranked "shuttle bus" in the top 3
55-65	9%	68%	23%	18%	9%
above 65	18%	72%	35%	11%	3%
total	12%	69%	27%	15%	7%

Table 8 Reasons for not taking shuttle frequently

Among 189 participants, only 19 ranked travel by car-sharing as a higher position, 14 of them were between 55-60 years old, four were between 61-65 years old, and only one participant's age at 71-75 years old. 24% participants in the 55-65 age group do not rank car-sharing as the top three choices because they do not know how to use car-sharing apps. Among the seniors over 65,

74% did not choose car-sharing for the same reason. Among the 55-65-year-old seniors, 40% think that the ride is too expensive, while the people over 65 years old, 29% do not choose car-sharing as the primary travel mode for the same reason. Overall, people did not choose car-sharing as the primary travel mode for the same reason. Overall, people did not choose car-sharing because they do not know how to call a rider (41%), or this kind of travel mode is too expensive (37%). 28% the participants chose not to choose car-sharing for other reasons. Most of them felt that ride-sharing had a low safety factor or would feel embarrassed to ride with strangers. Similar to the survey result, in Straight's (2003) opinion, car-sharing can be embarrassing experiences. In Straight's (2000) article, some seniors express that it is embarrassing to share a confined space with strangers because it degrades independence and dignity. People of different ages have very different choices on this issue might be because the elderly over 65 are not skilled in using smartphones, which makes them not familiar with car-sharing. Since it is not clear why people in different ages hold on various opinions, whether to promote car-sharing and how to promote it will require follow-up in-depth research.

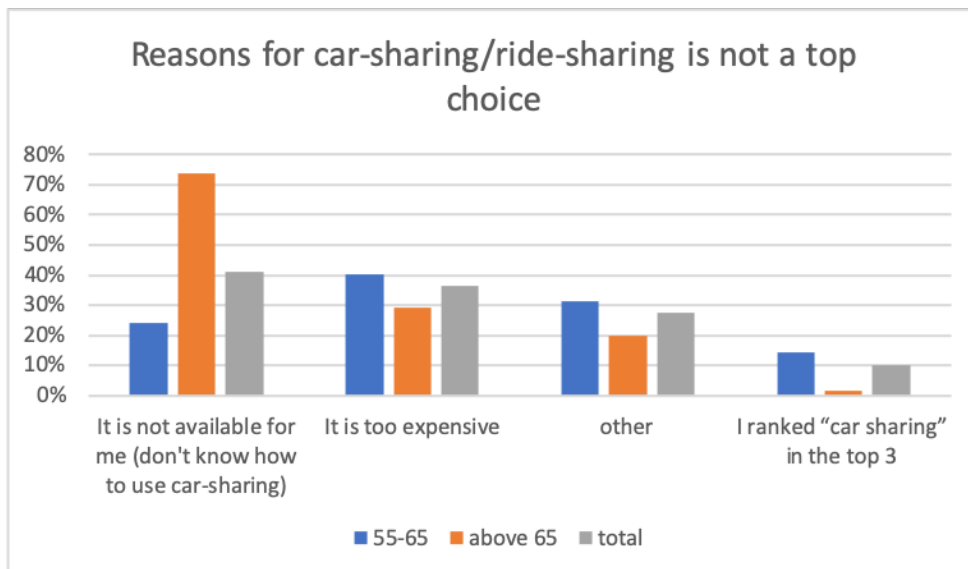


Figure 9 Reasons for not taking ride-sharing frequently

Reasons for car-sharing/ride-sharing is not a top choice				
	It is not available for me (don't know how to use car-sharing)	It is too expensive	other	I ranked "car sharing" in the top 3
55-65	24%	40%	31%	15%
above 65	74%	29%	20%	2%
total	41%	37%	28%	10%

Table 9 Reasons for not taking ride-sharing frequently

The top two most frequently visited the places are supermarkets (6.29) and parks (5.78). There are 68 seniors rated the park as the most frequented place, and 70 seniors ranked the supermarket as the most frequently visited place. The third to sixth ranked places are shopping malls (3.29), hospitals/clinics (2.99), banks (2.7), and schools (for picking up their grandchildren) (2.46). Entertainment venues (such as table cards rooms or tea houses) are places that the elderly were less frequent visits. Most seniors spend about 30 minutes from home to supermarkets, while about 5% elderly spend more than an hour to supermarkets. About 1/2 of seniors go to parks in less than 30 minutes, almost 1/4 of the elderly will spend 1-2 hours to go to parks. Among the people who filled out the questionnaire, 20% of them will spend more than 1 hour to go to the mall, and the remaining 80% participants will go to the mall for about 20-30 minutes. More than 90% elderly spend less than 1 hour from home to hospitals or banks. Among the 189 interviewees, grandchildren's pick-up ranks from first to eighth almost averagely. The number of people in each ranking accounts for about 10% of the total amount. The average time spent on picking-up grandchildren is less than 30 minutes. It can be seen that most participants can reach the place they frequently visit within an hour, which means the supporting facilities around the neighborhood are relatively complete in Beijing. This also simplifies the route planning of the community shuttle and public transportation.

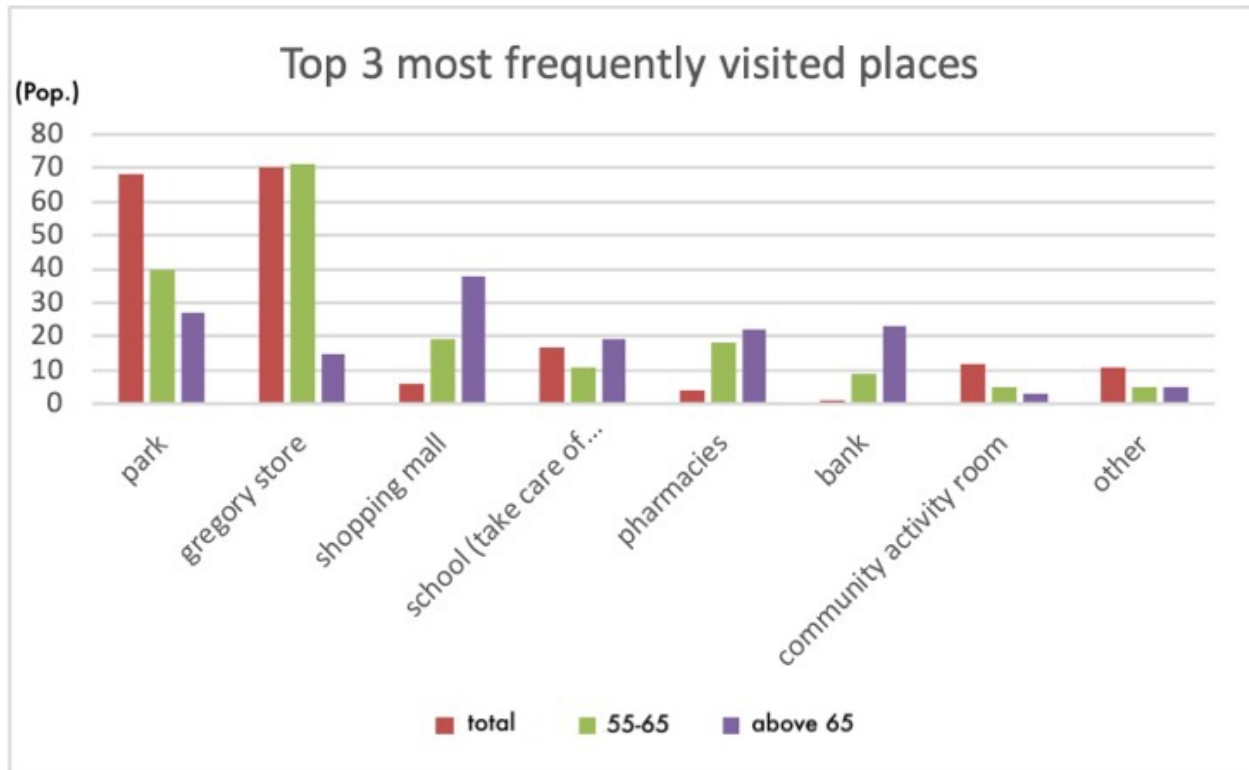


Figure 10 Frequently visited places ranking

Whether the elderly under 60 who is still working or has retired, more than half of the participants will choose to travel in the morning (8 am to 11 am). Surprisingly, 71% participants over the age of 65 chose to travel from 8 am to 11 am, in which the percentage is higher than the portion of the 55-65 years old who decide to travel in the same period. Among all participants, people who choose to travel after 6 pm account for only 10% of the total number of participants. 14% seniors from 55-65-year-old traveled after 6 o'clock. For people over 65-year-old, 2% will choose to travel after 6 o'clock. Among 189 participants, nine seniors are not traveling. From the results, we can conclude that the travel time of the elderly is relatively concentrated, which can be an essential evidence to schedule a time for the shuttle bus.

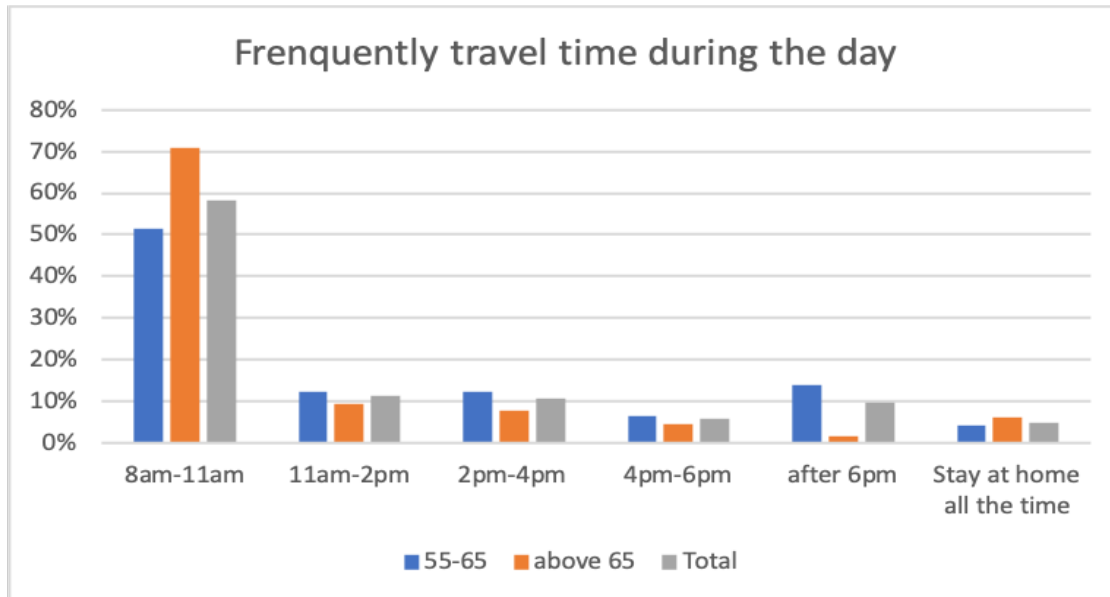


Figure 11 Travel time overall result

Frequently travel time during the day			
	55-65	above 65	Total
8am-11am	52%	71%	58%
11am-2pm	12%	9%	11%
2pm-4pm	12%	8%	11%
4pm-6pm	6%	5%	6%
after 6pm	14%	2%	10%
Stay at home all the time	4%	6%	5%

Table 10 Travel time result

Questions 13 to 19 aim to know what new-type senior-friendly transportation services can effectively increase the mobility of elderly. 88% the elderly usually use mobile phones, and most of the elderly who do not often use smartphones are over 70 years old. In the 55-65 age group, up to 98% are smartphone users, while 71% participants are smartphone users for people aged above 65.

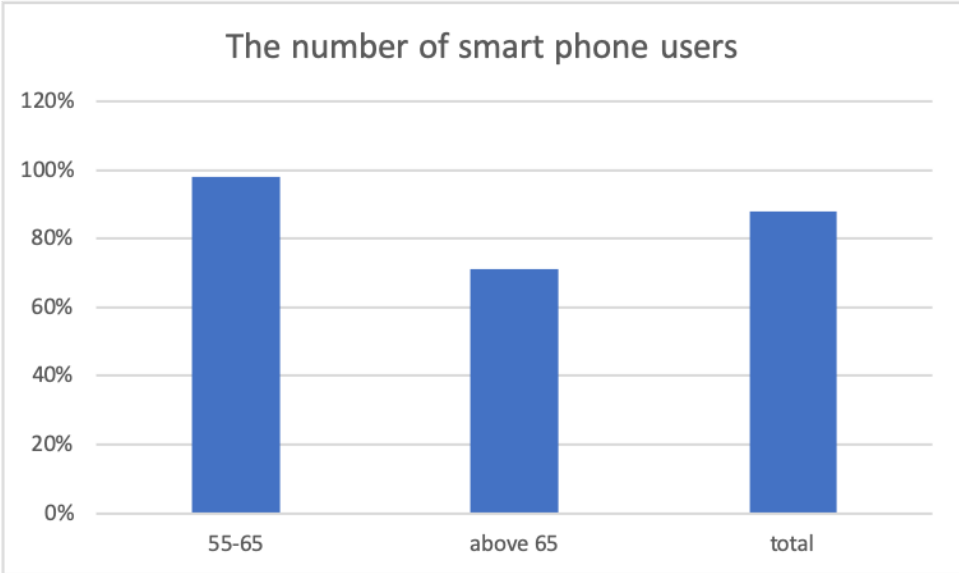


Figure 12 Percentage of smartphone users in their age group

The number of smart phone users	
55-65	98%
above 65	71%
total	88%

Table 11 Percentage of smartphone users in their age group

Among those elderly who often use smartphones, more than half of the elders (63%) often use the mapping Apps on their mobile phones (such as Baidu map or Gaode map). Among the participants in the 55-65 age group, 79% are willing to use wayfinding apps, while 52% are willing to use wayfinding apps for people aged above 65. Those who were reluctant to use the navigation app is that wayfinding apps cannot improve their transportation experiences. In general, nearly half of the elderly who regularly use smartphones open the apps on their phones every day. In the group of 55-65-year-old, the proportion of people who open apps every day is 49%, and in the group of people over 65, the proportion of people who open apps every day is 39%.

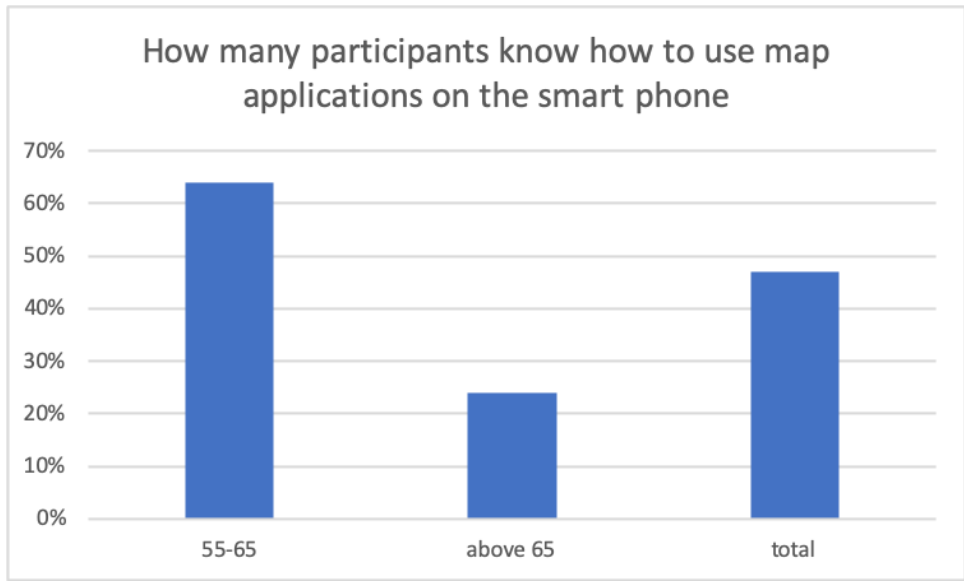


Figure 13 Willingness to use wayfinding apps

How many participants know how to use map applications on the smart phone	
55-65	64%
above 65	24%
total	47%

Table 12 Willingness to use wayfinding apps

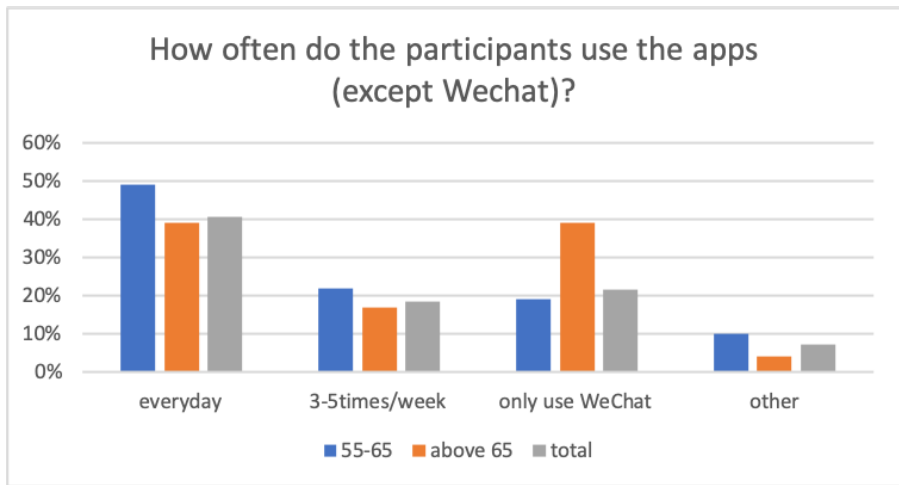


Figure 14 Frequency of using smartphone

How often do the participants use the apps (except Wechat)?				
	everyday	3-5times/week	only use WeChat	other
55-65	49%	22%	19%	10%
above 65	39%	17%	39%	4%
total	41%	19%	22%	7%

Table 13 Frequency of using smartphone

For some infrequently used apps, 40% participants in the 55-65 age group thought these apps could not improve their living quality. There are 23% elderly who are over 65 years old chose the same reason. Among participants aged 55-65, 22% of them gave up using apps because they did not know how to use them, and 43% participants over 65 chose the same reason. Overall, only 16% elderly could not read because of the words were too small.

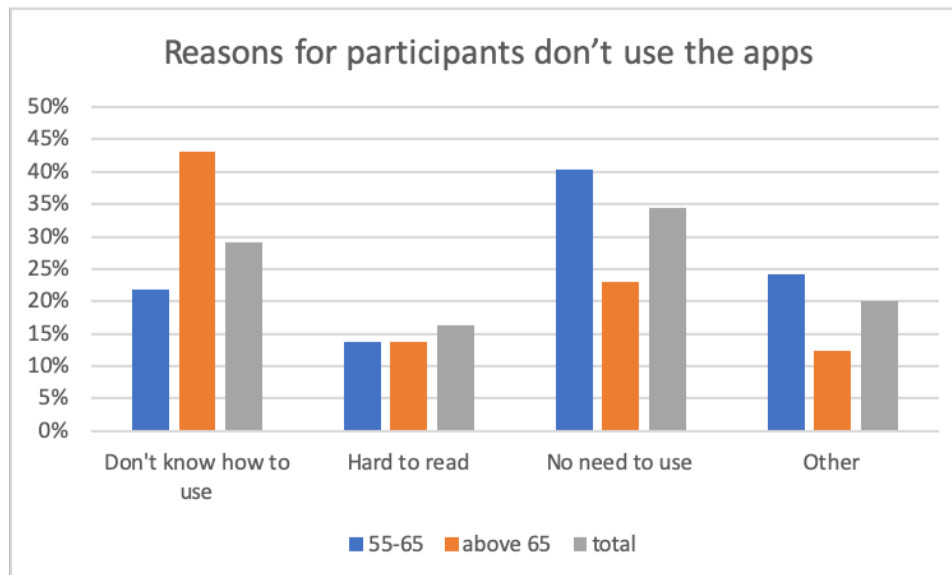


Figure 15 Reasons for not using apps frequently

Reasons for participants don't use the apps				
	Don't know how to use	Hard to read	No need to use	Other
55-65	22%	14%	40%	24%
above 65	43%	14%	23%	12%
total	29%	16%	34%	20%

Table 14 Reasons for not using apps frequently

Compared with the elderly over the age of 65 (60%), the elderly aged from 55 to 65 are more willing to learn to use new apps (81%).

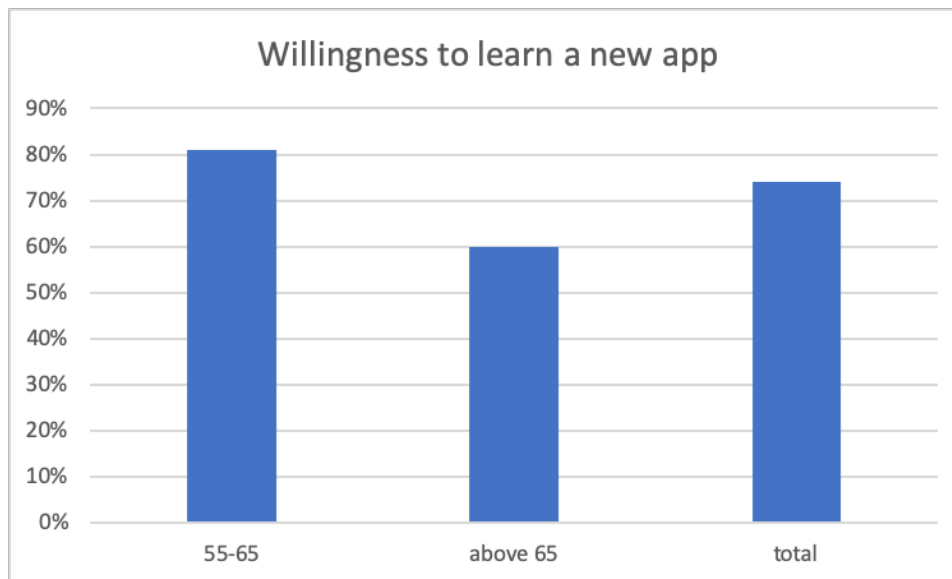


Figure 16 Willingness to learn a new app

Willingness to learn a new app	
55-65	81%
above 65	60%
total	74%

Table 15 Willingness to learn a new app

Among participants aged from 55 to 65, only 44% of them were willing to try car-sharing.

Among participants aged 65 and above, 29% of them were willing to try this transportation

mode. This shows that car-sharing may not be consistent with Chinese culture, so there are specific difficulties in implementation.

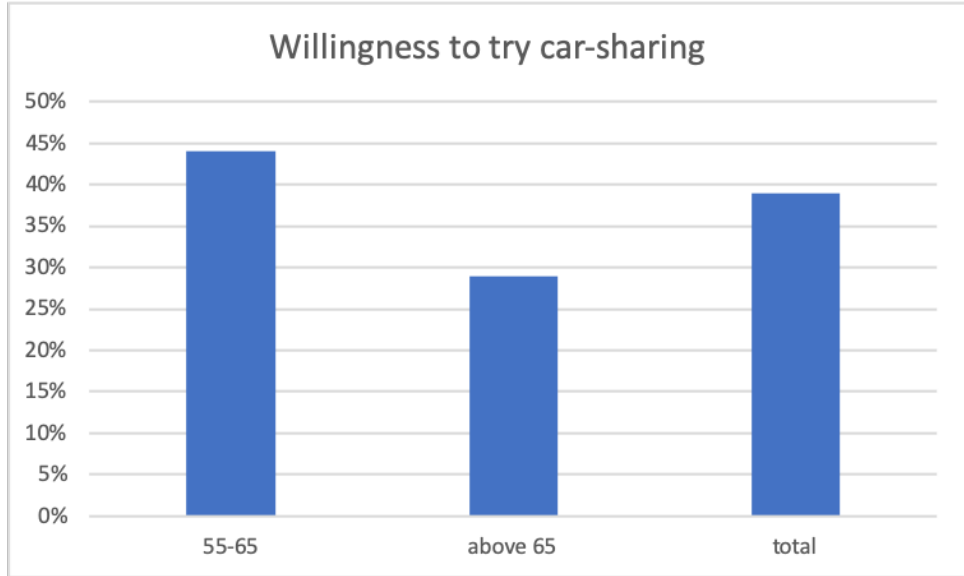


Figure 17 Willingness to try ride-sharing

Willingness to try car-sharing	
55-65	44%
above 65	29%
total	39%

Table 16 Willingness to try ride-sharing

In summary, here are the most relevant results for deciding solutions.

For travel modes:

- Most of the participants choose to travel on foot or by bus.
 - The elderly over 65 years old, 57% chose to take the children's car to travel as the top three travel choices.
- Not to use any supporting facilities is the most convenient travel mode for the elderly who prefer to go out on foot.

- People thought traffic lights, crosswalks, and bright lights could enhance their walking experience.
- 54% elderly do not choose to take the subway because the subway stations are far away from them.
- Participants did not take a shuttle bus frequently because most of the communities do not provide this kind of service.
- In the 189 participants, only 19 ranked travel by car-sharing as the top three travel modes.

For destination and travel time:

- The top two most frequently visit the places are supermarkets and parks.
- Most participants can reach the place they frequently visit within an hour.
- Most of the participants choose to travel from 8 am to 11 am.

For mobile apps:

- 88% elderly usually use mobile phones.
 - Among those elderly who often use smartphones, 63% of them often use the mapping Apps.
- Less than half of the participants were willing to try car-sharing.

Based on the survey results, the first hypothesis is partly rejected for now. People prefer to go outside without any supporting facilities. For the disabled seniors, they preferred to stay at home.

For buses and subways, adding supporting facilities are necessary. The second hypothesis is supported by survey results. With the time developing, more and more seniors will prefer to travel by driving. However, with visual and sensory abilities decreasing, let the elders driving will cause dangerous. Therefore, hypothesis 2, driving assistance facilities for improved safety will be needed, is supported. The third hypothesis is supported by survey results. Applications on

smartphones are necessary to be developed since most of the seniors are willing to use applications on smartphones. The fourth hypothesis is rejected by survey results. Car-sharing or ride-sharing cannot be the new popular transportation mode. Due to the high cost and embarrassed experiences, many of the seniors were not willing to choose car-sharing or ride-sharing.

Solutions

The goals of this survey is convenience seniors' travel experiences in Beijing by understanding their travel preferences and habits and knowing their accepted and preferred supporting facilities.

Specifically, I was interested in achieving the following goals in this survey. The first goal was to understand what additional transportation services and supporting facilities they needed most.

The second goal was trying to predict the possibility of using mobile apps to help the elderly travel in the future. Based on the observations, I inferred that people over 65-year-old and those aged from 55 to 65-year-old may have different travel preferences. Therefore, I divided all participants into two age groups. Based on the analysis of the elderly over 65 years old, finding out what transportation assistance facilities are the most needed for the elderly over 65 year-old. Based on the analysis of the main elderly population in the future (55-65 year-old), predicting which transportation modes and services can solve their travel problems when they are getting older.

Survey results showed that walking was still the most important mode of travel for all ages. The participants indicated that once they need supporting facilities, they become unwilling to go out.

It is because the accessibility facilities in Beijing have not been fully constructed, the disabled seniors cannot get a good travel experience. It was fundamental to learn relevant experiences from other countries and focus on adding more accessibility facilities in Beijing. After this, the government can encourage the elderly with different levels of physical abilities to go out and collect their feedback to improve accessibility facilities. Based on survey results, adding pedestrian crossings and traffic lights at every intersection, and strengthening the awareness of vehicle drivers to yield pedestrians can effectively improve pedestrian travel experiences.

As people from the 55-65 age get older, the demand for safe senior-driving will gradually increase. Straight (2003) mentioned that many seniors from the United States have the cultured pervasive dependence on cars, driving restrictions can isolate mobility for older people and will limit their activity scopes. However, with the aging growing, their ability to drive safely is decreasing. Therefore, it is important to set some public policies to avoid concerns about older driver safety. For example, in the United States, the seniors whose driving capability is impaired are not allowed to keep a driver's license. Furthermore, the US Department of Transportation Federal Highway Administration revised the guidelines for road and highway design to avoid some of the common safety challenges such as intersections and poor signage that will bring danger to senior drivers (Straight, 2003).

There are two main problems faced by the seniors taking buses. One is that there are too many people on the buses which will cause people to stagger on the bus and fall. The other is that buses do not have any equipment to help the elderly or disabled people to get on and off the buses. For the first problem, it is highly recommended that elders change their travel schedules to avoid taking buses with the commuters at same time period. For the second question, the Beijing

Municipal Government should install supporting facilities on the bus to help the seniors experience a more convenient ride. In the literature review, it mentioned that King County has lift-equipped buses for senior passengers boarding, which the Beijing government may be able to replicate.

Some elderly people under the age of 65 often choose the subway as a travel mode and reported some problems that need to be improved in the future. For example, some subway lines were built many years ago (such as Line 1 and Line 2), so there is no elevator. Although most stations are equipped with supporting facilities on the stairs to help people with disabilities go up and down the stairs, there is no guidance for how to use this supporting facility and few people know how to use it. Additionally, there are too many subway lines in Beijing which makes the transfer instructions confusing. This can cause people to get lost in the subway stations. For the first problem, it can be a good idea to add instructions on the side of the supporting facilities to guide passengers. For the second difficulty, a clearer sign should be considered, such as highlighting the areas that may be misunderstood.

From the survey, the shuttle bus is not a popular transportation mode in Beijing. Seattle Downtown Circulator Bus, which mentioned in the literature review, can be an excellent example to be used in Beijing's senior-friendly transportation system. Like I mentioned above, the facilities around each community in Beijing can meet most of the needs of nearby residents. Table 13 shows that the travel time of the seniors at different age groups is relatively uniform. Therefore, the shuttle bus route planning can be relatively simple.

From the current results, the car-sharing will not be the leading travel mode for the seniors. One is because it costs a lot, and the other is that it is embarrassing to stay with strangers in a small

enclosed space. As mentioned in the previous article, whether to promote car-sharing requires a more detailed investigation, so car-sharing is not an ideal way for the elderly to travel in the current situation.

For travel time, no matter how old they are, whether or not they are retired, travel time for 55% participants concentrated from 8am to 11am. Most of the elderly traveled by walking or taking bus from this time period, while some other elderly people chose to take subway, self-driving, or take their children's vehicles for traveling. Since the travel time of commuters is mostly concentrated in this period, it is necessary to promote cross-peak travel in Beijing to avoid the congestion.

The survey shows that most elderly people can reach their destinations within an hour, which includes grocery stores, parks, hospitals, and banks. This indicates that the living facilities in most parts of Beijing are fully equipped.

For knowing their accepted and preferred supporting facilities , in addition to the equipment installed on the road, maybe mobile apps can provide convenience for the elderly's life, as well. As mentioned in the literature review, although there already have some portable devices that can improve the travel experience and safety factor of the seniors, it is uncertain whether the seniors are willing to use these devices. I am trying to find out what stops them from using these supporting apps. According to the first assumption, most of the seniors from the 55-65 age group often use smartphones, who are more likely to accept new apps in the future. However, since most of the elderly over 65 are not very familiar with smartphones, the possibility of using new apps to improve their travel experiences is relatively slight. Survey results are consistent with predictions. However, it is essential to point out that many participants who are willing to learn

to use new apps do not have any physical disability. Their answers might vary due to their current physical condition, which does not mean that they will make the same choice when they need supporting equipment for their traveling. From my observation, most elders who need supporting equipment prefer to stay at home. Levinger et al. (2018) indicate that seniors' isolation hurts their mental health. As a result, it is necessary to develop new portable assistive devices to improve the travel experiences of seniors with physical problems. From the survey, we can see that more than half of the people over 65 are no longer willing to learn new apps, which might be because the new app operation is complicated. In my opinion, it might be worthwhile to try if an app is set up by their children according to the seniors' travel requirements, and the seniors can open the app and use it when they need to.

Limitations

The current study has some limitations that need to consider when interpreting the results and should be addressed in further research.

Since more than half of the participants are in the 55-60 age group, the study results may be affected by this uneven age distribution. To be as accurate as possible, I divided the participants into two age ranges: the 55-65-year-old age group and over 65-year-old age group. Based on this division, I calculated the percentage of the number of people who selected each option to the total number of people in their age group. Then I compared the percentages of each option from different age groups to get a more accurate result.

Besides, I used the sampling survey method to get the data, which means a sample should be randomly selected from the population for investigation, and the target group is the seniors of the

middle-class in Beijing. However, this survey is distributed to the elderly by their grandchildren or children, who are friends of the researcher. Therefore, concentrated the sample in a specific income group, and the living areas of participants may concentrate on a few particular areas, which may lead to reduced sample richness.

Furthermore, the elderly may have few experiences with road assist facilities and senior-aid mobile apps. Due to the lack of disability services in Beijing, many elderly choose to stay at home when they need to rely on wheelchairs to travel. The elderly who travel frequently are generally flexible in legs and feet, so it is also difficult to express opinions about disability services, which will impact the survey result.

Conclusion

As Bridgewater mentioned in his paper, Beijing can promote senior-friendly transportation services in many aspects to better meet the requirements of the older-friendly city. From a senior-friendly transportation perspective, the walkability level, the completeness of surrounding commercial facilities, availability to use regional transportation systems, door-to-door, and escorted transportation services are the criteria to critic whether a city is a senior-friendly city.

From the above research, Beijing has a high walkability level for healthy seniors. However, due to the incomplete support facilities on the sidewalk, many disabled seniors cannot travel by themselves. The regional transportation systems are well-developed in Beijing; people can access almost anywhere by bus. Although the subway can also be the right choice for traveling, the bus system is convenient and can be extended in almost all directions. The seniors take buses more frequently than subways.

The surrounding commercial facilities are well-equipped in Beijing. From the survey response, no matter what travel modes they use, most of them can arrive at their destinations for less than one hour.

Door-to-door transportation services can be concluded as community shuttle bus services. By reading the survey result, most of the communities in Beijing do not have this kind of service. As I mentioned in the survey analysis, the most important part is creating the schedule and route of the shuttle bus, which needs more future researches.

In the United States, transportation services are advanced. For example, the seniors in Seattle can schedule a time with volunteers and go to some places that may difficult to access by themselves. However, as far as the research I did, this service never appears in Beijing, which might be because of the following reasons.

First, the United States and China have different cultural backgrounds. Chinese culture regards blood-related people as a whole. Children have an inescapable responsibility to take care of their parents, and the seniors also responded to help their children and release their living stress by taking care of their grandchildren. In this situation, many new immigrants' parents move to Beijing to take care of their grandchildren, which increases the population of elders at the same time. Most of the middle-class families in Beijing have private cars, so most of the elderly who cannot travel by themselves will ask their children to take them. People in the United States pay more attention to independence than people in China. Many elderly do not live in the same city as their children, which increases the difficulty of traveling by their children's vehicles. As a result, it is essential to have volunteers who can help them go where they want to go at a particular time.

Second, the population densities are different. In Beijing, seniors' density is much higher than in the United States, which makes it hard for them to have enough volunteers to take care of each senior. However, from another perspective, since many seniors can ask help from their children, the actual number of people who need volunteers' help may not be too huge to be handled.

Therefore, I think it is worthwhile to encourage each community to provide volunteer services.

In the future, more and more elders will depend on traveling by self-driving. It is essential to develop smart technology to ensure seniors traveling safety. Although most of the seniors over 65-year-old are not familiar with using applications on smartphones, develop traveling supporting applications can be helpful for people from 55-year-old to 65-year-old.

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APPENDIX 1.0 – Survey

For the multiple choice, please choose all that apply.

1. What transportation mode do you frequently use?

- a. Walk
- b. Bus
- c. Subway
- d. Retail shopping bus services
- e. Private car (drive)
- f. Bike
- g. Car-sharing
- h. Travel by children's cars
- i. Others: _____

2. Please rank the your choices from Q1

- a. Walk
- b. Bus
- c. Subway
- d. Retail shopping bus services
- e. Private car (drive)
- f. Bike

- g. Car-sharing
 - h. Travel by children's cars
 - i. Others: _____
3. If you rank "walking" into the top 3, what convenience level do you think about this travel mode?
- a. Are sidewalks and streets accessible using a cane? _____
 - b. Are sidewalks and streets accessible using a walker? _____
 - c. Are sidewalks and streets accessible using a wheelchair? _____
4. If you ranked walking behind, what caused you to don't like walking?
- a. Motor vehicles on the road never avoid pedestrians
 - b. The uneven sidewalk is easy to be dangerous
 - c. Others
 - d. I rank "walking" in top 3
5. Which one make walking and mobility easy?
- a. proper curb cuts
 - b. lighting
 - c. signage and traffic lights

- d. other: _____
6. If you ranked driving behind, what caused you to don't like walking?
- a. I don't know how to drive
 - b. It is so dangerous for the senior
 - c. Other: _____
7. If you ranked bus behind, what caused you to don't like walking?
- a. I can't remember all the bus stops, and sometimes I will miss my stop
 - b. It is hard to get on and get off the bus
 - c. It is too crowded, which makes me feel a little bit dangerous
 - d. Other: _____
8. If you ranked subway behind, what caused you to don't like walking?
- a. Subway station is too far
 - b. Hard to take elevators
 - c. Not convenience
 - d. Other: _____
9. If you ranked shuttle bus behind, what caused you to don't like walking?
- a. Schedule is not flexible
 - b. Our community doesn't have shuttle
 - c. Cannot access my target place

d. Other: _____

10. If you ranked car-sharing behind, what caused you to don't like walking?

- a. Schedule is not flexible
- b. Our community doesn't have shuttle
- c. Cannot access my target place
- d. Other: _____

11. What is your most frequently visit places? Please rank them. How long it takes you to the place, please fill out the blank. (create a fixed route bus line for each neighborhood to connect their home and most frequently visit places)

- a. Parks _____ mins
- b. Gregory store _____ mins
- c. Shopping mall _____ mins
- d. Schools (take care grandchildren) _____ mins
- e. Pharmacies _____ mins
- f. Bank _____ mins
- g. Community activity room _____ mins
- h. Others: _____ mins

12. When do you usually choose to travel during the day?

- a. 8-11 am
- b. 11-2 pm
- c. 2-4 pm
- d. 4 pm – 6 pm
- e. After 6 pm

Solution hypothesis:

1. Do you have a smart phone?
 - a. Yes
 - b. No

2. Do you know how to use map applications on smart phone?
 - a. Yes (question 3)
 - b. No (question 4)

3. If a wayfinding app exist, will you use? Why or why not
 - a. Yes
 - b. No
 - c. Explain: _____

4. How often do you use the apps (except Wechat)?
 - a. Almost everyday
 - b. 3 -5 / week
 - c. Never use other apps except Wechat
 - d. Other: _____

5. Why don't you use the apps on your smart phones?
 - a. I don't know how to use them
 - b. I can't read (unreadable for the senior people)
 - c. No necessary for me
 - d. Other: _____

6. Are you willing to learn how to use app on smart phone?
 - a. Yes (question 6)
 - b. No

7. Do you want to try car-sharing (another app)?
 - a. Yes
 - b. No

8. What is the monthly travel expense you can accept?
 - a. Below 50 RMB (0 to 7 USD)

- b. Below 200 RMB (0 to 30 USD)
- c. 200 – 500 RMB (30 – 70 USD)
- d. 500 – 1000 RMB (70 – 140 USD)
- e. 1000 RMB and above (140 USD and above)

9. What is your gender?

- a. Man
- b. Woman

10. What is your Age?

- a. 55-60
- b. 62-65
- c. 66-70
- d. 71-75
- e. 76-80
- f. 81-85