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# Improving transfer feasibility for older travelers inside high-speed train station

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ABSTRACT

China is faced with a serve aging crisis, and the seniors' long-distance travel is becoming more challenging with the rapid development of high-speed trains. This paper studies the transfer feasibility for elderly passengers passing through specific barriers at high-speed train stations. Questionnaires were distributed at Beijing High-Speed Train Station, with 716 valid samples involved. This paper divides the transfer procedure into seven phases, and proposes various points of interest at each phase with different barriers. These points of barriers are categorized into three major different types: Serious AND Common, Serious BUT NOT Common, and Common BUT NOT Serious. The quantitative relationships between each point of barriers and old travelers' information have been explored using decision tree and binary logistics regression. As a conclusion, we suggest some recommendations for improving the transfer environment, long-distance mobility, as well as wellbeing of the older adults at high-speed train stations. To the best of our knowledge, we are the first to study the transfer feasibility at high speed train stations for seniors both qualitatively and quantitatively, especially dealing with the complicated transfer procedure.

## 1. Introduction

World Health Organization Reports (2015) predicts that the population of seniors in China (≥60 years old) will increase from 194 million by 2015 to 400 million by 2030, and this is equivalent to the total population of 15 European Union countries. The statistics shows that China is faced with an aging crisis, which is more severe than anywhere else in the world. These old adults tend to travel longer distances due to social, economic and cultural factors in China. For example, the young generation of the One-Child Policy migrates to big cities for work, and old people have to travel long distances to visit their children and grandchildren. Since China heavily replies on public transportation (e.g., bus and train) instead of private vehicles, it has built the world's largest high-speed train system to improve efficiency and experience of traveling around the country. This drives the rapid growth of the seniors' demand for long-distance mobility, and most trips have been completed by high-speed trains. Back to a few years ago, seniors in China travelled much less frequently for long distances and most of their transfers happened at traditional train stations. High-speed train stations are quite different from those traditional ones in terms of complicated transfer procedures, and large groups of old people have been suffering during their transfers. Such an increasing need of long-distance travel of the elderly people urges high-

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speed train stations to provide sufficient and opportune facilities as well as service throughout the transfer phases, which needs consider various personal, household, neighborhood, and trip characteristics (Kim and Ulfarsson, 2004). However, transferring at train stations, especially at high-speed train stations, has received few attentions so far.

The relevant body of literature is based on four streams of research: (1) short-distance travel, (2) long-distance travel, (3) transfers at train stations, and (4) seniors' travel behavior.

### 1.1. Short-distance travel

Research about short-distance (and also daily mobility) focuses on age-related deficiencies, such as changes in cognition, sensory function, physical abilities, and psychology. The deficiencies of different traveling modes are affected by various personal and built environment factors (Kim, 2011). Hess (2012) identified daily barriers by comparing actual walking distance and its estimation, which are between residential addresses and transit stops for older adults in metropolitan areas. He found out that with inferior pedestrian infrastructure (e.g., low walkability) not only the walking ability of seniors declines, but also their likelihood of giving up driving will decrease. This in turn requires more appropriate public transit modes to keep seniors mobile. Potential opportunities include higher frequency of bus routes, fare-free public transportation during off-peak time, and use of driverless cars (Mackett, 2015). Travel patterns also vary significantly among individuals who have different health conditions. Empirical research has suggested a positive correlation between general state of health and trip making (Ruopila and Suutama, 1997). Nordbakke's work (2013) showed the older adults' mobility could be sustained by alternative travel modes, including walking and public transportation. In addition, multiple travel modes are necessary to keep people connected with their social networks and Julien et al. (2015) suggested free or reduced-fare public tickets and amenities, and accessibility of services for the elderly. Nordbakke and Schwanen (2015) proposed that enhancing driving ability, shortening the distance to public transportation stations, and improving the connectivity between transfer stops and destinations are key points to raise the mobility and the well-being of seniors.

### 1.2. Long-distance travel

The major concentration of existing studies is on driving restrictions of older people, which are related to safety and driving abilities. Anstey et al. (2005) showed that long-distance driving and driving in unfamiliar environments may cause crashes and other dangerous driving behaviors. It was suggested that older drivers can use self-feedback to regulate their own driving abilities (Hassan et al., 2015). However, some seniors might overvalue their driving abilities while others perceive their driving abilities more negatively (Jouk et al., 2014). As a solution, driving training programs have been developed by taking advantage of driving simulators and other technologies (Cuenen et al., 2016), and in-vehicle navigation systems has been promoted (Emmerson et al., 2013). Although cars are the main mode for seniors to travel in the United States (Boschmann and Brady, 2013), a number of studies provided evidences that those who always rely on private vehicles are more likely to lose mobility and have difficulties with other modes of travel (Douissembekov et al., 2014; Mercado and Páez, 2009) Moreover, because of low percentages of older drivers in China, public transportation is much more commonly used for long-distance travel, and we discuss high-speed trains specifically in this paper.

### 1.3. Transfers at train station

Studies about transfer feasibilities in train stations generally focus on three aspects. The first one is the importance of accessibility and facilities surrounding train stations. Brons et al. (2009) found out that the accessibility to train stations is always the most important factor of one trip, and it impacts the overall satisfaction of this trip. Wang and Chen (2012) proposed a new practical location approach to increase the quality of public services around transfer hubs. Lin et al. (2014) measured the accessibility and transport connectivity to train stations based on walking distance and personal characteristics (e.g., gender, age, favored travel modes, and household income). The second aspect is the development of heuristic algorithms about dynamic train scheduling (Carey and Crawford, 2007; Törnquist and Persson, 2007). The third aspect focuses on improving the infrastructure and service of high-speed train stations, which include the use of high technology and re-engineering of track layouts (Edwards, 2013; Warrior et al., 2015) There is also a new trend that special groups (e.g., elderly, disabled and pregnant people) start receiving more and more attention (Sharma et al., 2013).

### 1.4. Seniors' travel behavior

Previous research has focused on the influences of elderly travel behavior from many perspectives, such as density, land usage and built environments. Böcker et al. (2017) conducted a study in the Greater Rotterdam area in Netherlands about the impacts of socio-demographic, health, trip, spatial and weather on seniors' mobility. Feng et al. (2013) found out that seniors in China who live together with their children and grandchildren tend to make much fewer trips and travel shorter distances than those who live alone. Such travel patterns of the elderly have been mainly determined by the unique social and cultural factors in China (Feng, 2017). Chudyk et al. (2015) studied the association between where older adults live and their travel behavior, and found out that the prevalence of these neighborhood destinations may encourage walking. Georggi and Pendyala (2001) identified that seniors and low-income people have made significantly fewer long-distance trips than others.