



Modeling the mobility choices of older people in a transit-oriented city: Policy insights

Linchuan Yang

Department of Real Estate and Construction, Faculty of Architecture, The University of Hong Kong, Hong Kong



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ABSTRACT

Hong Kong is a transit-oriented city with an extremely high public transportation share (approximately 90%). Additionally, in this city, the percentage of older people aged 60 or above is predicted to reach 38.0% in 2064. Thus, the provision of age-friendly public transportation is timely and enormously significant. Only with a better understanding of mobility behaviors of older people, it is possible to tailor transportation systems and optimize market strategies to cater to their actual needs and preferences. Based on the 2011 Travel Characteristic Survey data, this paper calibrates a mixed binary logit model and a conditional logit model to uncover older people's travel propensity, as well as destination and departure time choices. The findings include: (1) a host of socio-demographic variables and land-use attributes affect travel propensity; (2) owning an automobile and driving license are too weak to exert significant influence on travel propensity. This finding is in contrast with the conventional wisdom in car-dominant cities where car ownership and license-holding status are significant predictors of mobility; (3) there are random taste variations among respondents regarding travel propensity; and (4) time-constant destination and time-variant origin-destination pair characteristics influence older people's destination and departure time decisions. Based on the results, a few policy suggestions (e.g., reducing the actual and perceived costs associated with interchanges, time-varying public transport service) are discussed. We believe that these policy sights can act as a valuable reference to transportation planning which addresses the mobility of older people, especially in the metropolitan cities which provide similar public transport services.

1. Introduction

Population ageing is a common, notable and inevitable demographic trend virtually everywhere, particularly due to long life expectancy and low fertility rate. Hong Kong is no exception, evidenced by the second highest percentage of people aged 60 or above (21.7%) in Asia in 2015, only behind Japan which tops the world in this ranking (33.1%) (United Nations, 2015). The percentage of older people is predicted to reach 38.0% in 2064 (Census and Statistics Department, 2015).

Transportation is an indispensable dimension of urban sustainability, owing to its integral role in, and lasting impacts on economic, environmental, social and physical conditions. In an era of population aging, providing better transport which caters to older people's needs and preferences becomes of utmost importance. For older people, the availability of adequate transportation is a necessary condition of living independently in the community (Liu, Dijst, & Geertman, 2014; Whelan, Langford, Oxley, Koppel, & Charlton, 2006). Nonetheless, the impact of aging population on the transportation system is normally ignored by government officials and decision makers. Understandably,

older people have never been incorporated into the mainstream of thinking, planning, and policy (Buffel & Phillipson, 2016).

Transportation mobility refers to the ability to travel from one location to another in an independent and safe way, which typically decreases as people age (Rantakokko, Mänty, & Rantanen, 2013). It is a significant element in overall life satisfaction, essential for independence, good health, quality of life, well-being, and social integration, for older people (Banister & Bowling, 2004; Kim & Ulfarsson, 2004; Metz, 2000; Tacken, 1998). Improving the mobility of older people is an indispensable part of facilitating the development of a society. Indeed, in the last few decades, the Hong Kong government has made efforts to improve the mobility of city residents. In 2002, the vision of "Transport for All" was put forward to guide stakeholders in planning and designing transport services which suit all people, including the disabled, older people, and others in need, of which the intention is to make transport system more accessible to all by ensuring the provision of barrier-free access facilities such as fixed ramps and wheelchair aids (Wong, Szeto, Yang, Li, & Wong, 2018). In the same year, the concessionary fare scheme was initiated, the target beneficiaries of which are older people and eligible persons with disabilities.

E-mail addresses: u3003593@connect.hku.hk, yanglc0125@gmail.com.

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This scheme enables its target beneficiaries to travel on four designated public transport modes (railway, franchised bus, green minibus, and ferry) anytime at a concessionary fare of HK\$2 per trip. By and large, general transportation policies, though not necessarily targeted at older people, are beneficial to them. Unfortunately, to date, the needs and preferences of older people have not been considered adequately in planning, design, and implementation of transport policies. To the best of our knowledge, no transport policies have been proposed specifically for senior citizens so far.

Particularly with the goal of understanding and/or enhancing the mobility of older people, various studies have focused on their mobility patterns and behaviors in some advanced or emerging economies, the United States and Europe in particular (Broome, Worrall, Fleming, & Boldy, 2013; Colliá, Sharp, & Giesbrecht, 2003; Schmöcker, Quddus, Noland, & Bell, 2008). In most of the countries concerned (e.g., the United States, Canada, Australia, and New Zealand), automobile is the dominant transport mode, and few older people use public transport. In stark contrast with car-dominant cities, transit-oriented cities (e.g., Hong Kong, Curitiba, Tokyo, and Shanghai) have a dense and advanced network of public transportation and offer frequent, efficient, and reliable public transport services, which also has wide spatial and temporal coverages (Wong et al., 2018). Obviously, Hong Kong is an example of transit-oriented cities, evidenced by the fact that nearly 90% of people use public transport. Moreover, compared with young adults, older people use public transport services more often (Yang, 2016). There is no doubt that two widespread notions in most Western countries, namely, *life depends on driving* and *owning a private car is crucial in order to not be socially excluded* (Ozkazanc & Sonmez, 2017), are not applicable to transit-oriented cities such as Hong Kong. So are the transport policy measures suggested to car-dominant cities. In addition, mobility behaviors of the older people in Hong Kong largely remain uncovered by literature. Two exceptions are Szeto, Yang, Wong, Li, & Wong (2017), who have described older people's travel patterns and visualized the spatio-temporal travel dynamics, and Wong et al. (2018), who have interviewed hundreds of older residents regarding their travel decisions using designated modes of public transport to attend social activities in a few hypothetical games. Moreover, it is essential to establish statistical models to understand what critically shapes older people's mobility choices for targeted policy-making. Notwithstanding, very few studies have used modeling methodologies to analyze older people's travel behaviors and preferences in transit-oriented cities like Hong Kong.

Mobility behaviors can be investigated from a host of aspects (Li, Yang, Shen, & Wu, 2018), including travel choice (trip generation), destination choice (trip distribution), departure time choice, and mode choice (modal split). In particular, we focus on travel propensity (whether to travel) and destination and departure time choices (where and when to travel) here, both of which can effectively predict older people's future travel demands. Yet, our understanding of them still remains descriptive for the most part (e.g., Szeto et al., 2017), and tools to project their future travel demands are missing (Páez, Scott, Potoglou, Kanaroglou, & Newbold, 2007; Stern, 1993).

To address these issues, based on the 2011 Travel Characteristic Survey (TCS 2011) data as well as local GIS data, this study develops two discrete choice models to uncover the underlying behavior mechanism of older people's mobility behaviors in Hong Kong. The motivation of this paper is not only knowledge building, but also tentatively providing insights for policy intervention. As such, a few policy implications are discussed then.

The key objective of improving the existing public transport services for older people is not to get the final 10% (non-transit user group) into public transport modes (Wong et al., 2018). Instead, our research objectives are how to provide more age-friendly public transport services and enhance the mobility of older people to make more trips. The contributions of this paper include: 1) *filling the research gap, adding a case study of mobility of older people in a transit-oriented city*; 2)

determining the importance of variables that influence older people's mobility choices and uncovering the underlying behavior mechanisms; 3) *discussing several public transportation policy measures for enhancing the mobility of older people*.

The remainder of the paper is structured as follows. The ensuing section (Section 2) reviews the literature on older people travel behavior. Section 3 briefly introduces the TCS 2011 data. Section 4 describes the modeling methodologies. Section 5 presents the modeling results. Section 6 discussed policy insights while Section 7 provides conclusions and limitations.

2. Related literature

A substantial body of scholarly literature has uncovered older people's mobility patterns, most of which has been carried out in car-dominant countries. Colliá et al. (2003) present that in the United States, personal vehicle is the dominant travel mode of older people, constituting 89.3% of daily and long-distance trips, and state that public transportation is very unpopular (1.2%). They indicate that other than return-home journeys, social and recreation account for the highest percentage of daily trips (19.4%), followed by shopping (18.3%) and family/personal business (17.5%). Newbold, Scott, Spinney, Kanaroglou, and Páez (2005) state that in Canada, automobile is the most popular option for older people while public transport is ranked least. They also suggest that the greatest proportion of trips are taken for goods or services (23.7%), followed by entertainment (11.7%). Rosenbloom and Morris (1998) demonstrate that in Australia, automobile accounts for 73% of trips while public transportation constitutes only 5%. Based on a large travel survey data, Zhang, Mao, Liu, Chen, and Guo (2007) observe that in Beijing, China, older people travel mostly on foot (58.3%), followed by cycling (18.3%) and public transportation (14.1%), and report that the proportion of car trips is 1.58%. They also report that shopping trips account for the greatest share of trips (48.8%), followed by entertainment and fitness trips (28.1%).

Travel patterns of older people are markedly different in differing contexts. A variety of studies have devoted to comparing travel patterns of older people in different settings using either parametric modeling or non-parametric methods. Buehler and Nobis (2010) employ logit models to analyze car use in the United States and German and demonstrate that older Americans use private car more than their counterparts in German while controlling for a host of socioeconomic, demographic characteristics and spatial development patterns. They present that a possible explanation is different transportation policies in both countries. Hu, Wang, and Wang (2013) directly compare the aggregate data of older people's travel patterns across different countries (China, the United States, England, and the Netherlands), and suggest that a possible explanation for low car share in China was low driving license ownership. Yet, the direct comparison has been often challenged since this method implies ignorance of other characteristics (e.g., income, place of residence) that might have affected the outcome variable.

A few studies have compared the difference of travel characteristics between older people and young adults. Zhang et al. (2007) report that trip rates are significantly lower in the older group: the daily trip rate of young adults and older people is 2.34 and 2.03, respectively. Somenahalli and Shipton (2013) note that older people are less likely to make trips and take a long-duration travel due to loss of mobility.

Travel patterns of older people have been found to change over time. Rosenbloom (2001) reveals that in some countries like the United States, Australia, and Britain, older people nowadays are more likely to own driving licenses, take more trips, drive more but use less public transportation, compared to their counterparts a decade ago. The author further proposes a multitude of policy suggestions such as age-friendly public transportation, and improved vehicles/roads. Rosenbloom (2004) focuses on the mobility needs of older Americans

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