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Gated university campus and its implications for socio-spatial inequality: Evidence from students' accessibility to local public transport

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1. Introduction

Rapid urbanization has led to a massive transformation of urban space in China, spatially and socially. The spatial and social inequities in urban services, as a dimension of urban sustainability, have been of growing concern to both academics and policy makers (Feitelson, 2002). For example, previous decades have witnessed a remarkable shift from effective transport to equal access in the urban transport planning process, of which two of the most important aspects are transport equity and transport–related social exclusion (Kaplan, Popoks, Prato, & Ceder, 2014). It has been widely accepted that an important goal of sustainable urban transport is to provide equal access to necessary services to social groups that lack private transport (Holzer, Quigley, & Raphael, 2003; Ricciardi, Xia, & Currie, 2015). It is concluded that lack of access to any specific services will reduce their expected opportunities, and this will accordingly lead to deprivation, social exclusion, and a decreasing quality of life (El-Geneidy et al., 2015; Jin, Cheng, Lu, Huang, & Cao, 2015; Lucas, 2012; Wan & Su, 2017). However, due to the unavailability of high-resolution data, few studies have been conducted that explore specific groups' travel needs in Chinese cities, where a dramatic rate of urbanization is precipitating challenges of sustainability about transport-induced equity issues.

Meanwhile, higher education in China has been growing much faster than ever before, along with an explosive increase of university students' population. The total population of university students (undergraduate and post-graduate) has increased by 840% from 1997 to 2016. For example, there are 26, 252, 968 undergraduate students and 1,911,406 postgraduate students in total who enrolled with about 2560 Chinese universities in 2016 (MOE, 2016a, b). But, these figures in 1997 were only 3,174,326 and 176,353 for undergraduate and post-graduate students respectively (MOE, 2005a, b, c). The lifestyles and travel demand of these university students have shown remarkable disparities with those in Western countries. In China, a majority of students are required to reside within university campuses (Zhong, Zhao, Zou, & Mason, 2018), which are walled as a non-production work unit and gated community inherited from the Soviet tradition (He, 2013).

Public transport is essential for citizens' daily activities, and university students do need public transport services as well. Unlike other social groups and university students in Western countries, Chinese university students, as a unique social group, only rely on public transport systems due to limited incomes and transport choices. This paper aims to explore the social and spatial inequalities in relation to university students' access to public transport and analyze its implications for gated university campuses' planning and governance by using high-resolution spatial data and GIS (Geographical Information System) methods. Wuhan in Central China, which has the third largest group of university students in China, is taken as our case study. The remainder of this paper is organized into six sections. Section Two reviews relevant literature on social and spatial inequalities in public transport accessibility and studies about gated university campuses. Section Three introduces the study area, its student population and data collection briefly. Section Four explains the methodology of measuring spatial accessibility to public transport services used for this case study. Section Five presents the analytical results and explores the disparities in accessibility to public transport and evaluates its findings. Further discussions, implications and possible further research are recommended in addition to general conclusions in Section Six.

2. Literature review: socio-spatial inequality in public transport accessibility and university campus

2.1. Public transport accessibility and socio-spatial inequality

Accessibility can be defined as the ease to reach the destinations from a given location (Farrington, 2007), and it was defined as the "transport good" (Martens, 2012). Accessibility is a fundamental concept associated with social equity in geographical and urban studies (Di Ciommo & Shiftan, 2017). While transport "goods and bads" are often unevenly distributed, which means some social groups are more

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disadvantaged than others are (Lucas & Jones, 2012), the even distribution of public transport resources and its socio-spatial effects have been one of the key concerns in the field of public transport planning. According to Litman (2002), there are two kinds of equity in public transport, that is, horizontal and vertical equity. By this framework, the horizontal equity means providing public transport services to individuals or groups without considering their ability, while the vertical equity considers the abilities and needs of specific groups when distributing public transport services. Recent studies have paid more attention to vertical equity because the "social transit" perspective based on the latter, rather than the "mass transit" perspective based on the former, considers various population destinies in a city (Foth, Manaugh, & El-Geneidy, 2013) and prioritizes the special needs of those groups without private transport (Delbosc & Currie, 2011). However, a specific definition of equity is hard to determine and may lead to vague goals (Martens, Golub, & Robinson, 2012). Thereby, one solution is to minimize the creation of inequity and inequality of opportunity (Dawkins, 2016; Ogryczak, 2007).

For the elderly people in North America and Europe, car driving has been one of their most important travel modes (Szeto, Yang, Wong, Li, & Wong, 2017). However, the travel mode choice of elderly people in China is quite different from these countries. The study on the elderly people's accessibility has been well publicized for their unavailable access to services by car (Wong, Szeto, Yang, Li, & Wong, 2018). A travel behavior survey conducted by Hu, Wang, and Wang (2013) reveals that 48.52% of the elder people travel as pedestrians and 43.38% as public transport users, while only 0.99% choose car driving. This is mainly the result of the limited ownership of car driving licenses among the elderly population in China. The age limit for car driving license application is 70, and the car driving license owner at the age of 70 and above is also required to submit a health report annually (MPS, 2016). Alternatively, public transport provides them with a reliable mean of daily trips (Ikram, Hu, & Wang, 2015). Traditionally, as a non-car group that always suffers from transport-related social exclusion, the elderly people's residential locales are also described as "transport disadvantaged" (Engels & Liu, 2011; Ricciardi, Xia, 2015). In many aspects, the university students in China share a similar position of their accessibility concern as elderly people. Most students, as unemployed even partially, have no sufficient income to buy, maintain and own a private car or frequently travel by taxi. As with elderly people, the student group has to rely on public transport systems for regular off-campus activities (Cao, 2008; Qi & Lu, 2016). Thereby, the access to public transport is crucial for all non-car drivers, both elderly people and university students. To analyze social inequality, elderly people's accessibility is used as an appropriate benchmark to compare them with university students.

2.2. Students' life in gated university campus

The "Soviet Model" university system was formed in the middle of 1950s (Liu, 2017b) when a number of university campuses were built with walls and gates, and spatially segregated from urban public space as a kind of non-production work units (Tang, Tomba, & Breitung, 2011). The "Soviet Model" reflects a traditional combination of the gated community and the work unit in Chinese campuses, where accommodation and other resources in the campus were mostly provided as a kind of welfare for university students. In contrast to the commercialization process of "studentification" in the UK (Smith, 2009), Chinese universities still keep running the model after the housing policy's marketization reform in the 1990s (Logan, Fang, & Zhang, 2010) by providing accommodation to their students at a much lower price than renting a room from the market as rural migrants are doing. The central or provincial governments, who fund all of these public universities, play a vital role in their operation and internal governance (Liu, 2017b). In addition to public universities, provincial governments also govern private colleges although they have been given greater autonomy than the public universities (MOE, 2007). In this context, the conception of governing means that universities and colleges in China are spatially independent of other organizations. Other types of gated community in China have led to the spatial segregation between the inside and the society outside (Deng, 2017; Wu, Cheng, Chen, Hammel, & Wu, 2014), however, the relevant work on gated campus still lacks quantitative evidence regarding its spatial and social effects.

Although such gated university campuses, as non-production work units, remain existing spatially with housing provision as well as walls and gates (Qian, 2014; Xu & Yang, 2009), a dramatic transformation in the era of post-reform is undergoing in two ways. Firstly, the daily activities and social lives of the residents are not directly controlled and separated from the outer urban area. Many services formerly offered by the work unit are now provided through services from increasingly growing commercial markets (He, 2013). Those services are located across the whole city and beyond the capacities and scales of those work units, especially in the era of globalization. Secondly, the relationship and interactions between the university and the city are also changing globally and locally. Universities are increasingly engaged with urban and community development (Liu, 2017a, pp. 1–24), particularly in the aspects of creative city and innovation as the basis of scientific research and higher education and professional training (Smith, 2016). They are not only 'in' the city but also 'of' the city (Bender, 1998). There are several dimensions of roles and effects for universities to engage in the city (Fernández-Esquinas & Pinto, 2014): universities are not only amenities and attractions in urban life but also customers of local businesses. Considering that public transport is essential for citizens' daily activities, students need public transport services for accessing those activities which are not located in their gated campuses, or when the services in the campus could not meet their demand and satisfaction. Yet gated campuses are deemed as self-organized communities, and previous works have mostly neglected two aspects: firstly, students' accessibility to their destinations by traveling out from their residential location within a campus, and secondly, transport connection between those and outer urban areas.

Local urban planning cannot regulate the land allocation and spatial arrangement within a university campus, because these public universities are administered by either Ministry of Education or provincial governments, rather than municipal governments (Wang & Vallance, 2015). What all the local municipality and planning organizations can do is to provide public transport services around campuses, but it is still unknown whether such provision has sufficiently met students' needs. Therefore, it is necessary to examine the gated university campus and its socio-spatial implications from the aspect of public transport accessibility in the context of China.

3. Study area and data sets

3.1. Study area

Wuhan, as the capital of Hubei province, is situated in Central China and at the middle reaches of Yangtze River (Wuhan City Government, 2011) (Fig. 1). The Yangtze River and its longest tributary, the Han River, flowing through the city, have divided it into three parts: Wuchang, Hankou, and Hanyang.

The resident population of Wuhan Municipality is 10, 607, 700 in 2015 (WBS, 2016a, pp. 13–34), of which 956,705 are university students who are attending the higher education in 79 universities and colleges (WBS, 2016b, pp. 371–410). As the university students occupy 9.02% of its total population, Wuhan has had the highest proportion of university student population in China. Thereby, Wuhan is a representative of a university city.

All the higher-education institutions include 8 national universities administered by Ministry of Education, 14 provincial colleges and universities, 9 private colleges, 15 independent private colleges, and 33 higher vocational colleges administered by the provincial government.

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