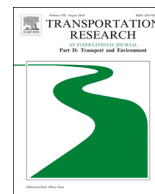


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Built environment and public bike usage for metro access: A comparison of neighborhoods in Beijing, Taipei, and Tokyo

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ABSTRACT

This article presents a transnational comparison study to clarify the difference in the associations of built environment with public bike usage in three cities in eastern Asia. This study sampled passengers entering or leaving metro stations in seven neighborhoods in Beijing, Taipei, and Tokyo for home-based work trips. Their mode choices of connecting travels between trip origins/destinations and metro stations were analyzed using logit and latent class models. Empirical evidence reveals that the associations of built environments with public bike usage of the study cities rarely accord with one other. Results are unable to support that empirical knowledge on the association of built environment with public bike usage is transferable among transnational cities despite their geographical and cultural proximity. Collecting local empirical knowledge on travel behavior is critical for developing bike-friendly built environments for a city.

1. Introduction

The success of the public bike system (PBS, also called bike-sharing system) launched in Lyon in 2005 started an explosive growth of global PBS services in the past decade. According to The Bike-sharing Blog (<http://bike-sharing.blogspot.tw/>), 1525 PBS programs worldwide operated almost 18.9 million public bikes by the end of 2017. PBS is an innovative transport solution, and PBS programs have sharply increased worldwide in the past decade, yet previous bicycle research provides limited knowledge to support PBS development. Additional PBS research will contribute to understanding the current system. Existing PBS studies predominantly involve general reviews of history and implementations (e.g., Fishman et al., 2013; O'Brien et al., 2014), user behaviors (e.g., Corcoran et al., 2014; Etienne and Latifa, 2014), repositioning bikes among rental stations (e.g., Caggiani and Ottomanelli, 2013; Dell'Amico et al., 2014), optimizing spatial distributions of rental stations (e.g., Lin and Yang, 2011; Lin et al., 2013), and determinants of PBS usage (e.g., Fishman et al., 2014; Tran et al., 2015).

Built environments are recognized as significant determinants of travel demand in theoretical research (e.g., Boarnet and Crane, 2001) and empirical studies (e.g., Ewing and Cervero, 2010). Clarifying the association of built environment with travel demand supports the development of travel demand management strategies for meeting local development goals via urban planning and design. Ascertaining the relationships between built environment and PBS usage is crucial to establishing a PBS-friendly environment.

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Owing to the importance of such relationships, studies exploring these topics have flourishingly appeared in the last years, and they are mostly aggregate analyses applying zonal average data around rental stations. El-Assi et al. (2017), Faghih-Imani and Eluru (2016a, b), Faghih-Imani et al. (2014), Faghih-Imani et al. (2017), Mateo-Babiano et al. (2016), Mattson and Godavarthy (2017), Rixey (2013), Tran et al. (2015), and Zhang et al. (2017) applied various statistical methods to analyze the associations of built environments with the arrivals and departures of PBS rental stations. Very few studies conduct disaggregate analysis using individual travelers as observations. Guo et al. (2017) applied questionnaire surveys and a three-point Likert scale to explore factors related to PBS usage and satisfaction. The aforementioned works reveal several environmental attributes that are significantly related to PBS usage in their study cities, and empirical evidence is gathered from either a single city (El-Assi et al., 2017; Faghih-Imani and Eluru, 2016a, b; Faghih-Imani et al. 2014; Guo et al., 2017; Mateo-Babiano et al., 2016; Mattson and Godavarthy, 2017; Tran et al., 2015; Zhang et al., 2017) or multiple cities in the same country (Faghih-Imani et al., 2017; Rixey, 2013). Prior research find that relationships between environment and travel demand are inconsistent among cities of different nations. For example, Mertens et al. (2017) found significant dissimilarities of built environment correlates of cycling for transport among cities located in five countries across Europe. However, the question of whether the empirical associations of built environments with PBS usage discovered in a city can be applied to other cities abroad has yet to be answered.

To fill the research gap on the extent of the similarity of the built environment correlates of PBS usage among transnational cities, the present research conducted a comparison study of three cities in Eastern Asia. The sample observations were obtained from work commuters entering or leaving the surveyed metro stations in Beijing, Taipei, and Tokyo. The transportation mode used by a respondent to travel between a metro station and his/her trip endpoint (origin or destination) and the built environment attributes around his/her trip endpoint and travel route were recorded and analyzed. Binary logit and latent class models were applied to analyze the sample data. The empirical results of the research not only present novel evidence to the study cities but also provide guidance for local administrations with regard to exercising caution when referring to empirical information obtained from studies conducted on foreign cities.

2. Method

2.1. Survey

Table 1 lists background information on the investigated PBSs. Beijing, Taipei, and Tokyo were selected as the study cities because of their geographical proximity (Fig. 1(a)), their similar cultural contexts (Zhang et al., 2005), and the concurrent formal launch of their PBSs (2012), which are all operating well at present. All the investigated PBSs belong to the so-called third-generation system (DeMaio, 2009), wherein users rent and return bikes at service stations by applying telecommunication technologies. Minimal differences exist in the pricing of the PBSs. Beijing's Municipal PBS charges a membership fee for deposit and provides an hour of free riding for each use (membership-based). Taipei's YouBike has free membership registration and charges a fee according to the duration of use (use-based). Tokyo Bike Share simultaneously applies membership- and use-based pricing.

The survey began in Taipei in January 2015 and ended in Beijing in May 2016. To control weather conditions, rainy days were excluded from the survey dates, and the average temperatures measured in the survey months ranged from 8 °C to 20 °C. To maintain a consistent trip purpose, the targeted participants involved passengers leaving or entering metro stations for home-based work trips. The Taipei PBS is a major metro transfer mode, and work-commuting is one of the major rental purposes. The survey of Thi

Table 1
Background information on the surveyed PBSs.

City	Beijing	Taipei	Tokyo
PBS ^a	Municipal PBS	YouBike	Tokyo Bike Share
Launch	June 16, 2012	August 1, 2012	November 21, 2012
Stations	538	196	180
Bikes	17,000	6406	1810
Pricing ^b	Membership-base	Use-based	Membership- and use-based simultaneously
Survey month	May 2016	January-February 2015	December 2015
Average temperature in the survey month ^c	20 °C	15 °C	8 °C
Survey District/metro station	Chaoyang/Chaoyangmen Liangmaqiao	Xinyi/Taipei 101 Taipei City Hall Yongchun Xiangshan	Koto/Toyosu
Population density of survey district ^d	8.3 10 ³ -residents per km ²	20.2 10 ³ -residents per km ²	12.2 10 ³ -residents per km ²
Number of effective responses	332	311	304
Number of PBS users among effective responses	123	157	61

^a Data year: 2013 for Beijing, 2015 for Taipei, 2016 for Tokyo; data sources: Bike-sharing Blog (<http://bike-sharing.blogspot.tw/>) for Beijing and Taipei, Docomo Bikeshare, Inc. for Tokyo.

^b Membership-based pricing charges a membership fee and provides a half or an hour of free riding for each use; use-based pricing charges a fee according to the duration of use and does not charge membership fee.

^c Data source: Official web site of Hong Kong Observatory.

^d Data year: 2014 for Beijing, 2017 for Taipei, 2015 for Tokyo.

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