



Research Paper

Do configurational attributes matter in context of urban parks? Park pathway configurational attributes and senior walking

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H I G H L I G H T S

- We measure park pathway configurational attributes based on space syntax theory.
- We explore relations between senior walking and pathway configurational attributes.
- High pathway integration value relates to more senior walking on the pathway.
- High pathway control value relates to more senior walking on the pathway.
- Pathways that do not connect with activity zones are used more by seniors.

A R T I C L E I N F O

Article history:

Received 30 April 2015

Received in revised form

10 December 2015

Accepted 16 December 2015

Available online 28 January 2016

Keywords:

Urban park

Pathway

Configuration

Space syntax

Senior walking

A B S T R A C T

Neighborhood urban parks are easily available settings for seniors to engage in walking. Park pathway characteristics can promote or limit senior walking. The present study examines how four objective measurements of pathway configurational characteristics relate to senior walking in two neighborhood parks in Beijing, China. In total, 75 pathway segments were included in the study. Senior walking behavior was measured through on-site observations, and sum of observed seniors on each pathway segment was the dependent variable. Space syntax approach was used to measure four park pathway configurational characteristics, i.e., average depth to gates, average depth to landmarks, control value, and global integration. In addition, three micro-level pathway characteristics were also included: pathway connection with activity zones, presence of shade, and lateral visibility. Regression analysis indicates that pathway global integration value (degree of syntactic accessibility) and control value (degree of control on accessing neighboring pathways) are positively associated with number of observed seniors on each pathway segment. Moreover, pathways without connection with activity zones are used more by seniors. In design practice, we can distribute preferred micro-level design characteristics, such as shade and benches along pathways with high global integration value and control value, in order to encourage senior walking.

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1. Introduction

Physical activity can improve people's health and well-being (DHHS, 2000; Nantel, Mathieu, & Prince, 2010). Among urban built environments, urban parks are important settings that encourage physical activity (Cohen et al., 2006; Giles-Corti et al., 2005; McCormack, Rock, Toohey, & Hignell, 2010). Previous research has extensively examined the associations between park

characteristics and physical activity at the neighborhood level (Baran et al., 2014; Giles-Corti et al., 2005; Stahle, 2010; Sugiyama & Ward Thompson, 2008), at the overall park level (Golnicnik, 2008; Kaczynski, Potwarka, & Saelens, 2008; McCormack et al., 2010; Ries et al., 2009), and at the activity zone level (Cohen et al., 2007; Floyd, Spengler, Maddock, Gobster, & Suau, 2008; Kaczynski et al., 2008; Shores & West, 2008). Extant research also indicates that activity facilities (e.g., path, open space, and playground) are more important than park amenities (e.g., restroom, bench, and drinking fountain) in supporting opportunities for physical activity (Kaczynski et al., 2008). Moreover, among activity facilities, trails and paths have the strongest relationship with park use for physical activity (Kaczynski & Henderson, 2007), such as running and

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walking (Kira, 2006; Reed et al., 2008). Kaczynski and his colleagues (2008) found that parks with paved trails are used 26 times more for physical activity than parks without paved trails. Another study indicated that the availability of walking surfaces or cycle paths is an important factor in influencing walking or cycling in parks (Corti, Donovan, & Holman, 1996). Cohen et al. (2007) found that parks with tracks appear to draw a large proportion of older individuals and called for further examination of the role of track facilities in attracting older people.

Walking is an easily accessible exercise practiced by people of nearly all ages throughout the world (Siegel, Brackbill, & Heath, 1995) and is one of the most popular leisure-time physical activities among U.S. adults (DHHS, 1996). Walking, which is identified as the most amendable physical activity (Saelens, Sallis, & Frank, 2003), can help reduce the rates of chronic disease (Lee & Buchner, 2008) and improve social confidence (Eyler, Brownson, Bacak, & Housemann, 2003). Walking can provide a low-cost and low-impact way to stay healthy (Cunningham, Michael, Farquhar, & Lapidus, 2005), especially for seniors, who are less active compared with other adults (Hagstromer, Troiano, Sjostrom, & Berrigan, 2010). Walking in the park, can be primarily categorized as walking for recreational (leisure) purposes (Ding, Sallis, Kerr, Lee, & Rosenberg, 2011). However, it can also be considered as utilitarian walking if the primary motivation is to reach a particular destination (Handy, 1996) within the park, such as a particular activity zone, to engage in an activity at that destination.

Pathways are paramount in structuring a park setting (Nijhuis, 2011), because they facilitate park use and park experience through walking. Inevitably, understanding the associations between pathway characteristics and walking has practical implications for park planning and design. Although park pathways are found to have an important correlation with walking and other types of physical activities (Kaczynski & Henderson, 2007; Kaczynski et al., 2008; Reed et al., 2008), a limited number of studies have examined the associations between specific pathway characteristics and walking behavior (Cohen et al., 2007; Kaczynski et al., 2008; Reed et al., 2008). These limited studies that examined walking mainly addressed the discrete micro-level design characteristics of pathways, such as presence of benches or shading (Lu, 2010) and pathway length (Joseph & Zimring, 2007). Existing research suggests that in the context of the urban environment, destinations such as grocery stores, malls, and restaurants may encourage walking behavior among seniors (Chudyk et al., 2015). Accessibility to shops, aesthetics of places, and roads with little traffic can also encourage elders' walking (Van Cauwenberg et al., 2012). However, to author's knowledge, no study has examined how relational pathway configurational attributes relate to walking in the context of urban parks.

The literature acknowledges that human experience has spatial dimensions, thus suggesting that certain spatial configurations benefit the outdoor environment experience (Thwaites & Simkins, 2007). Space syntax theory provides valuable tools for examining the configurational characteristics of the environment and their potential influences on people's activity. Space syntax theory has been widely used to examine the urban environment and people's movement (Baran, Rodríguez, & Khattak, 2008; Ozbil, Peponis, & Stone, 2011; Ozer & Kubat, 2007). This body of research suggests that the configuration of the urban grid itself is believed to be the main generator of movement patterns (Hillier & Iida, 2005; Hillier et al., 1993). Empirical research indicates that configurational measurements of the urban environment are correlated with the number of leisure walking trips (Baran et al., 2008), pedestrian movement rates (Hillier et al., 1993; Ozer & Kubat, 2007), and route choice (Chang, 2002). Koohsari, Kaczynski, Giles-Corti, and Karakiewicz (2013) recently utilized the space syntax approach to quantify the access to public open spaces.

Similarly, they proposed the application of space syntax theory in the study of public open spaces and physical activity in general (Koohsari, Kaczynski, McCormack, & Sugiyama, 2014). At small geographic scale, space syntax theory has been utilized to examine walking behavior in buildings, residential communities, and environments around subway stations (Baran et al., 2008; Lee, Lee, Son, & Joo, 2013; Ortega-Andeane, Jimenez-Rosas, Mercado-Domenech, & Estrada-Rodriguez, 2005; Zhang, Zhuang, & Dai, 2012). However, few studies have used space syntax theory to examine walking behavior in the context of urban parks. Although urban parks are settings in the urban environment, their configurational structure are similar to that of a building because of their limited entry points and defined boundary. The space syntax approach provides additional opportunities to examine the configurational attributes of park pathways and their role in structuring walking in parks.

To address the aforementioned gaps, this study applies space syntax theory to measure the configurational attributes of urban park pathways and explores how these attributes may relate to senior walking behavior. The spatial distribution of seniors walking in urban parks is investigated, with a specific focus on how park pathway configurational attributes relate to senior walking behavior, by controlling for the presence of activity zone, degree of shade, and lateral visibility. On the basis of space syntax theory, four objective measurements are utilized to measure configurational attributes of park pathways, and on-site observations are used to measure senior walking behavior. The four pathway configurational attributes are average depth to gates, average depth to landmarks, control value, and global integration value. Pathways that are close to gates, are close to landmarks, have high global integration value and have high control value are assumed to be used more by seniors. The variables of average depth to gates and average depth to landmarks measure pathway configurational attributes in relation to a particular item/space, and related findings could provide direct insights to designers when they design park settings around park gates and landmarks. The variables of control value and global integration measure pathway configurational attributes in the whole system. Thus, these two variables could help designers understand the influence and accessibility of each pathway in the system, and predict the usage intensity of each pathway. The study is conducted in two neighborhood parks in Beijing, China. The findings of this study are helpful in predicting the spatial distribution of seniors when they walk in parks and thus provide implications for park design practice. Space syntax theory presents valuable tools and convenient software to measure the configurational attributes of environments, and it has been applied in various types of design practices (Dursun, 2007; Mahmoud, 2011). By utilizing related software, park pathway configurational attributes could be calculated easily for various pathway network schemas. If designers combine senior's preferred discrete micro-level design characteristics of pathways (e.g., even pavement, presence of shade, and presence of benches) with pathways with certain configurational attributes that are highly likely to be used by seniors, park environments become supportive of senior walking behavior. In addition, this study provides an approach to examine the configurational attributes of urban parks, which could be applied in future studies and design practice.

2. Space syntax theory and methodology

Space syntax theory was mainly introduced by Hillier and Hanson (1984) in their book *The Social Logic of Space*. Rooted in graph theory and the idea of urban morphology, space syntax theory objectively describes and measures the configurational

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