The Relationship between Park Design and Seniors' Use of Green Spaces in X'ian, China

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Abstract
Urban parks can facilitate a healthy and active lifestyle among older adults by promoting their physical activities and social interactions. However, unless these parks meet the needs of this group, they may not be effectively utilized or contribute to seniors' well-being. We applied the concept of environmental affordances in an investigation of the relationship between urban parks' design characteristics and their use by older adults. Specifically, we developed a functional taxonomy of afforded park usage for senior visitors based on a methodology that combined interviews and behaviour mapping in three sites within an urban park in Xi'an, China. We identified four main categories of afforded park usage: individual physical activities, group physical activities, social interactions, and sitting and resting. These activities may be supported or constrained by particular design elements, other people and their behaviours, the park's physical accessibility, facilities and maintenance, and the park's atmosphere. In conclusion, we provide recommendations to facilitate urban planners and designers in creating more liveable green spaces for senior residents in urban areas.

Keywords: behaviour mapping; environmental affordance; seniors; urban green space; urban park

1. Introduction

Urban parks are essential resources, providing public green spaces that contribute to the health and well-being of residents by stimulating restorative experiences, physical activities, and social contact (e.g., Enssle and Kabisch, 2020; Kajosaari and Pasanen, 2021; Van den Berg et al., 2015). The health and well-being benefits of green spaces may be especially important for older adults, who are more dependent on available neighbourhood resources and more prone to health-related problems compared with younger residents (Cherrie et al., 2018). In China, increased life expectancy, reduced fertility, and the one-child family planning policy introduced in 1979 have led to a rapid increase in the proportion of seniors within the population (Liu et al., 2015). It is projected that citizens aged above 65 years will account for 26.9% of the population in 2050 compared with just 8.2% in 2010 (Zeng, 2012). This trend, combined with China's unprecedented urbanization rate, will inevitably lead to more people spending their later lives in urban areas. In the Chinese context, the traditional role of families in taking care of senior members has weakened, resulting in increasing numbers of "empty-nest" seniors who live independently (Liu et al., 2015). Given shrinking networks of seniors, it may be harder for seniors to obtain social support within their existing social networks. In most Chinese cities, urban parks are significant sites for senior residents' everyday practices, including developing activity-oriented friendships (Richaud, 2016). Proximity to parks and other green spaces has been associated with many health benefits for senior Chinese citizens, including reduced cognitive decline (Zhu et al., 2019) and lower mortality risk (Liu et al., 2020). However, because urban green spaces, such as parks, are scarce resources in most Chinese cities (Zhai & Baran, 2017), designers face the challenges of making the most efficient use of the limited available public green spaces in densely populated cities and of optimizing their values for the expanding older population. Previous studies have shown that parks' characteristics have significant effects on their uses for physical and other activities (Kaczynski & Henderson, 2007). Park characteristics associated with physical activities include their proximity to parks (Giles-Corti et al., 2005; Kaczynski & Henderson, 2007), size (Baran et al., 2014), amenities (Kaczynski, Potwarka, & Saelens, 2008), and available sports facilities (Lapham et al., 2016). Urban parks also support other pursuits, offering opportunities for rest, relaxation and social activities (Ward Thompson & Aspinall, 2011). Especially for vulnerable groups like seniors, green spaces are crucial for maintaining their subjective well-being (Xu, Nordin & Aini, 2022), meaningful life (Mmako, Courtney-Pratt & Marsh, 2020), and physical activity (Marini et al., 2022). In terms of the characteristics of urban green spaces, limited research has focused on the significance of green space characteristics for seniors'use behaviour. A study conducted in Japan found that seniors' physical activities were associated with their perceptions of green spaces and self-efficacy (Encho et al., 2023). However, practical expertise on how these park characteristics should be combined and spatially arranged in real settings is lacking (Nordh, Alalouch, & Hartig, 2011). Additionally, the dynamics of the relationships between users' characteristics and park settings require further investigation (McCormack, Rock, Toohey, & Hignell, 2010).

Few studies have applied a design perspective to develop an understanding of the relationship between park characteristics and park use in their own social-geographical settings. A study conducted in two urban parks in Beijing revealed connections between the design characteristics of the parks' pathways and seniors' walking behaviour (Zhai &

Baran, 2017). The findings of another study pointed to linkages between the types of urban green spaces and older adults' activities (Tan et. al., 2019). Based on the ecological perceptual psychology's theory of affordance, Sundevall and Jansson (2020) explored the multifunctionality of an urban park located in Southern Sweden to address the needs of seniors, children and adolescents through on-site interviews. To investigate how urban green space characteristics supported children's physical activities, a case study conducted in Beijing utilized behaviour mapping to document the spatial distribution of their physical activities (Tang & Woolley, 2023). Zhou et al. (2021) utilized on-site interviews and observations to discover how the assemblage of physical and social elements, as well as older people's performances contributed to a collective identity and a reciprocal relationship between older people and other park participants. However, associations between specific park characteristics and activities remain unclear. This study aimed to fill this gap through an investigation of the relationship between a park's characteristics and its usage by older adults. Given limited theorization in this research field, we applied Gibson's affordance theory (Gibson, 1979), and the application of the affordance theory to outdoor areas with regard to children's activities (Heft, 1988), to explore the characteristics of a park that are important and meaningful for senior visitors' use of the park. In the following sections, we first discuss the concept of affordance and its relevance to urban green space design and review previous studies that have examined the importance of parks and green spaces for seniors. We subsequently present the methods and results of a field-based study of an urban park in Xi'an, China, aimed at examining seniors' park uses in relation to the park's affordances.

1.1. Affordance and urban green space
The concept of an affordance was introduced by the psychologist, James J. Gibson (1977, 1979). Describing environmental perception as a process in which the values and meanings of things can be directly perceived, Gibson argues that "the affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill" (Gibson, 1979, p127).
Affordances refer to the functional significance of environments relating to the needs and abilities of individuals or groups. An affordance can be material; for example, a playground affords swinging, throwing, and a park affords peace and quiet (Heft, 1988). However, Gibson (1979) also affirmed that the most enriching and elaborate environmental affordances relate to the presence of other people and their behaviours. For example, a case study conducted in the UK revealed that social interactionability is one of the most meaningful affordances of neighbourhood parks for young people (Townshend & Roberts, 2013). In the late 1980s, the concept of affordances was introduced in the field of design. As suggested by Norman(1988) affordances can both be perceived and actual properties of objects that can be used, indicating these properties inform or suggest to the user the actions that can be performed with the object. One of the key debates surrounding the concept of affordances in relation to perception involves a complex interplay between how objects are designed and how they are understood or perceived by users. While some researchers attempt to distinguish between the concepts of affordances and perception (Tornvliet, 2003; McGrenere & Ho, 2000). Gibson, who originally introduced the concept of affordances in 1979, proposed a more integrated approach in which perception and affordances are

inherently linked users perceive an object by recognizing the possible actions (affordances) it offers. This perspective views affordances as opportunities for action that are inherently dependent on the perception capabilities of the observer, integrating the object's characteristics with the user's cognitive and physical abilities (Wagman & Carello, 2001). Here, affordances, which refer to enabling park use for seniors, provide a framework comprising three intertwined dimensions: seniors' perceptions and interests, a park's environmental characteristics, and its use by seniors, see the conceptual framework Diagram 1. Affordances provide a suitable framework for this study to explore seniors' perceptions and physical activities in urban green spaces. It allows us to investigate how the characteristics of green spaces can be spatially arranged to enhance their affordances. The practical application of the affordance concept to elicit individuals' responses to a park's design characteristics may contribute to contemporary green-space design by targeting specific groups. This approach necessitates an exploration of a park's characteristics, including the spatial configuration of physical elements, focusing on their arrangements in relation to each other rather than considering them independently.
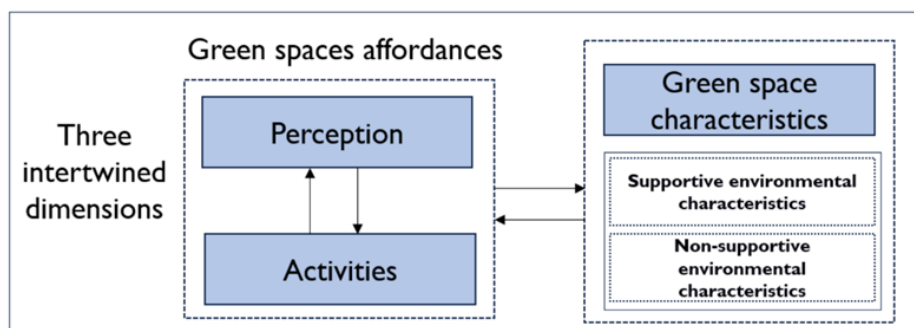

Diagram 1. The concept of affordances with three intertwined dimensions

Affordances offer a relational approach for the study of parks' characteristics and the uses that they prompt in seniors. Accordingly, action-based inputs can be compiled for use by design professionals, which could augment prevailing visual perception methods (see, e.g. Nordh & Østby, 2013). A visual perception method typically entails asking respondents to rate, sort, or describe static images, thus reducing the experiences of green space users to a passive contemplation of a visual stimulus in a context that is far removed from actual behaviour in, and use of, green space (Unt & Bell, 2014).

1.2. The present study
We aimed to expand the knowledge base on how an urban park may be designed and managed to meet seniors' needs relating to their park use. Accordingly, we explored the affordances of an urban park for seniors in Xi'an, China. As affordances emerge from users' interactions with a physical and social environment, we adopted a case study strategy, entailing multiple methods of data collection that enabled us to study park affordances in a real-life setting (Yin, 2003). We first conducted on-site interviews with senior visitors to the park, who described their daily experiences, behaviours, and perceived park qualities. We subsequently made systematic observations of these visitors using a behaviour mapping technique to verify and enhance the interview data.

2. Methods

2.1. Study Location

Data were collected in Xingqinggong Park, located in Xi'an, a city in Shaanxi Province, China. The city of Xi' an, located in the northwest of China, is home to approximately 8.6 million inhabitants, with one million people aged over 60 in 2014. Xi'an is an ancient city with a rich history. It is one of the most famous ancient capitals in Chinese history. With rapid urbanization, the population Xi'an is steadily increasing along with the proportion of older residents, which means more and more people will spend their later life in urban areas. As such, city planners and designers face the challenge of providing liveable spaces for a growing population while promoting active aging for seniors amidst ongoing urbanization. In this study, seniors were defined as individuals aged 55+ years. The promotion of healthy aging is a priority for the local municipality, and interventions to enhance physical activity are especially needed for seniors (Sun et al., 2015).

Xingqinggong Park was originally developed in 1958 on the site of the ruins of an imperial palace from the Tang Dynasty (Figure 1). Xingqinggong Park is one of the earliest public parks in Xi'an, situated within the old city town area. Surrounded by roads, bus lines and sidewalks, the park is easily accessible for seniors. The park is connected by roads and bus lines that make the park easily accessible for seniors. Residential neighbourhoods and two universities are adjacent to the park, including shops, restaurants and grocery stores. Furthermore, the park covers an area of 52 ha, with 10 ha comprising water bodies in the centre. The types of spaces are relatively varied in the park, such as paved open space where physical activities can take place, leisure spaces surrounded by nature plantings, walking paths, a lake with rich water plants and bird life. In terms of design characteristics, it includes both natural elements, such as trees, bushes, and flowerbeds, and artificial elements, such as squares, pavilions, and benches. All of the above criteria make the park a suitable site for conducting our fieldwork, as it is located in the city and easily accessible to older adults, with diverse range of design characteristics. The park is rectangular in shape, measuring approximately 800 m × 700 m, with four main entrances, one on each side of the park. In 2006, it became a publicly accessible park. Its popularity among senior visitors makes Xingqinggong Park a suitable location for this study.

Figure 1. An aerial view of Xingqinggong Park, in Xi'an City, China, depicting the locations of three observational mapping sites.

2.2.   Research Design and Data collection

This research focuses on exploring the affordances of urban parks for seniors in a dense Chinese city centre by investigating seniors' perceptions, physical activities and their relationships with park characteristics. Therefore, this research used a combined research method including interviews and behaviour-mapping, which has been used in previous research (e.g. Kreutz, 2024). Data collections were conducted by the first author in the Xingqinggong Park. First, interviews were conducted, and additionally observations were implemented to supplement interview data by using paper-based behaviour-mapping, recording seniors' variety activities. Data collection took place during summer 2014 and October 2015, when outdoor activities were conducive. Interviews were conducted in July 2014. A total of 22 older visitors were interviewed (11 females and 11 males) aged 55–82 years. The participants were approached while they were resting in the park or engaged in individual or group activities. Ten of them indicated that they visited the park daily; ten visited the park several times in a week or month; and two had only visited the park a few times. The interviews were conducted on working days and weekends at different times of the day. We approached individuals indirectly, first joining in the activities of the older adults, for instance, dancing, playing badminton, and practicing Tai Chi. After an initial casual conversation, we requested visitors to participate in in-depth interviews and explained the use of the data. Notes and recordings were made during the interviews. A semi-structured interview strategy was used, with questions centring on three key topics: (1) daily park-use patterns (e.g., frequency and duration of visits and travel time); (2) physical and social park uses (e.g., physical activities, social interactions, and other meaningful uses); and (3) park characteristics that support or constrain? its use. Most of the interviews lasted 15–45 minutes. Interviews were concluded when no further information could be obtained. After conducting the interviews and analysing their content, we found that seniors may lack capabilities for associating a park's characteristics, and especially their spatial arrangements, with its affordances. Therefore, we conducted behaviour mapping to study the spatial relationship between the park's characteristics and seniors' park-use behaviour. The initial challenge of the observations was to select suitable locations for behaviour mapping. There are two criteria involving the selection process. Firstly, the observation sites should encompass a wide range of activities carried out by seniors.

Secondly, the sites should include typical spatial arrangements of park characteristics. Three sites in the park, with areas of 2000 m2 to 3000 m2, were chosen for the observations: the eastern part of the square at the south gate (S1), the exercise forest (S2), and the Changqing Pavilion (S3) (Figure 2). These sites represent three distinct types of park spaces: an open space, a half-open space, and an enclosed space. S1 is an open space with three connected paved squares and a corridor with green cover; S2 is a half-open space covered by large trees and including some exercise facilities (a badminton court) and paved exercise areas; and S3 is a small enclosed hill with a bamboo cover and a pavilion at the top.

We adapted the behaviour mapping approach developed by Goličnik and Ward Thompson (2010) and Unt and Bell (2014). We collected data in October 2015 on two working days and two weekend days. Three of these days were sunny and one was rainy. On each day, six rounds of observation were conducted: 6–8 am, 8–10 am, 10 am–12 pm, 12–2 pm, 2–4 pm, and 4–6 pm. A total of 24 observation rounds were conducted at each site. The temperatures on the observation days were appropriate for outdoor activities: 11–13 °C in the early morning, rising quickly to 21–22 °C in the middle of the day on the sunny days, and 14 °C on the rainy day. Each observation round entailed a systematic 10-minute walk through the site, scanning it visually and recording point data on site maps. The data were collected passively, avoiding any interactions with users. Seniors were identified through a combination of their appearances and mobility levels.

Figure 2. Views of the three behavior mapping sites: The eastern part of Nanmen Square (S1, upper left), the exercise forest (S2, upper right), and the Changqing Pavilion (S3, bottom) (photographs: first author).

2.3 Data analysis

We performed content analysis on the interview data to obtain categories for environmental features that were perceived as significant by seniors as well as affordances of the environmental characteristics responding to their needs. Combining these categories with behaviour mapping data, we developed a functional taxonomy of the seniors' park environment. We developed digital maps from the behaviour mapping data, using AutoCAD to summarize the field data. Following Goličnik and Ward Thompson (2010), we analysed the blocks of park observation data separately to discuss daily visits and daily composites for overall spatial pattern analysis.

In detail, the data were analysed in two steps. First, interview data were verbally transcribed and qualitatively analysed aiming to identify thematically functional uses of the urban park. The transcripts were coded to uncover themes related to affordances for seniors. Subsequently, sub-themes were considered, linked to main themes, and further connected to park characteristics. Second, these themes were then correlated with behaviour mapping data to understand how spatial arrangements either facilitates or constrains seniors' physical activities.


3. Results

3.1. Interview outcomes

During the interviews, seniors were asked to describe the environmental characteristics that contribute to the park's qualities based on their user experiences. Five main categories of characteristics were identified: design elements, people, physical accessibility, facilities and maintenance, and atmosphere. Within each category, up to five distinct positive and negative characteristics were identified. Design elements were the most frequently mentioned characteristics, especially "trees," "lake," "soft soil," and "paved ground." The appearance of "other people and their activities" and of "grouped participants" was the second most frequently mentioned category of positive characteristics, especially by active users who engaged in group activities. The interviewees also expressed appreciation of the "physical accessibility" of Xingqinggong Park in terms of its size, proximity, and location. Park "facilities and maintenance," comprising benches, toilets, exercise facilities, park maintenance, and shops, were also frequently mentioned as being important park qualities. Finally, seniors acknowledged quiet and coolness as important features that contributed to the park's "atmosphere." Most of the dimensions that positively contributed to the perceived park quality also included characteristics that seniors disliked in their visiting experience. "Facilities and maintenance" and "atmosphere" were the most frequently mentioned categories associated with negative characteristics. In the former category, the inadequate quantity and quality of benches, exercise facilities, and pavilions were mentioned most often. Disruptive weather conditions, such as hot weather, rain, and darkness were most frequently reported as negative features relating to the park's atmosphere. Other people could also induce negative experiences through conflicts in (group) use, areas being "too crowded," and smoking. For the design features category, the only negative characteristic was an obstructed view. Natural features were not associated with negative characteristics. The interviewees did not spontaneously identify any negative characteristics for physical accessibility, indicating that the size, location, and proximity of the park were perceived as adequate.

3.2. Behaviour mapping

Figure 3 depicts composite mappings of the seniors' behaviours at the three observation sites. Accordingly, three distinct types of spaces were identified: moving, ornamental, and gathering spaces. Moving spaces mainly comprised roads and pathways. They afforded the most common activity: walking. Ornamental spaces were characterized by a combination of green elements, such as trees, bushes, flowers, and grass. Although large sections of these spaces were inaccessible because of fences and bushes, the presence of these natural elements made ornamental spaces optimal sites for activities such as Tai Chi and Kung Fu. For example, as shown in Figure 3, the northeastern corner of S3, which is surrounded by trees and bamboo, provides a quiet, natural environment for such practices. Gathering places mostly comprised open spaces that provided opportunities for physical activities and social interactions. Most physical activities were practiced here. In S1 (Figure 3), paved opens spaces enabled senior visitors to engage in Xingjiang and Latin dancing as well as aerobics. The exercise facilities in S2 afforded physical activities, such as light-intensity exercise, badminton games, and gymnastics. In addition to the active uses of the park, passive uses, such as sitting, standing, and talking mostly occurred in gathering spaces.
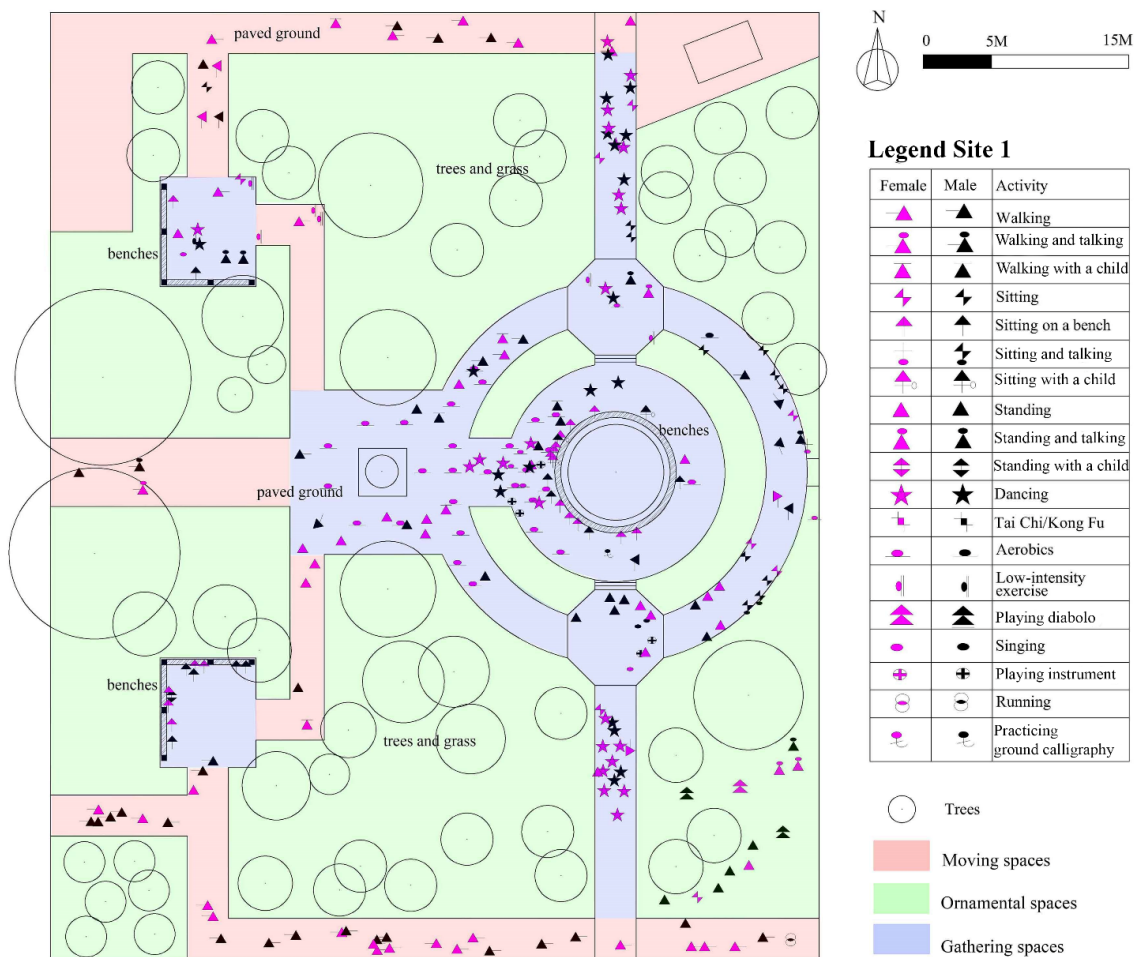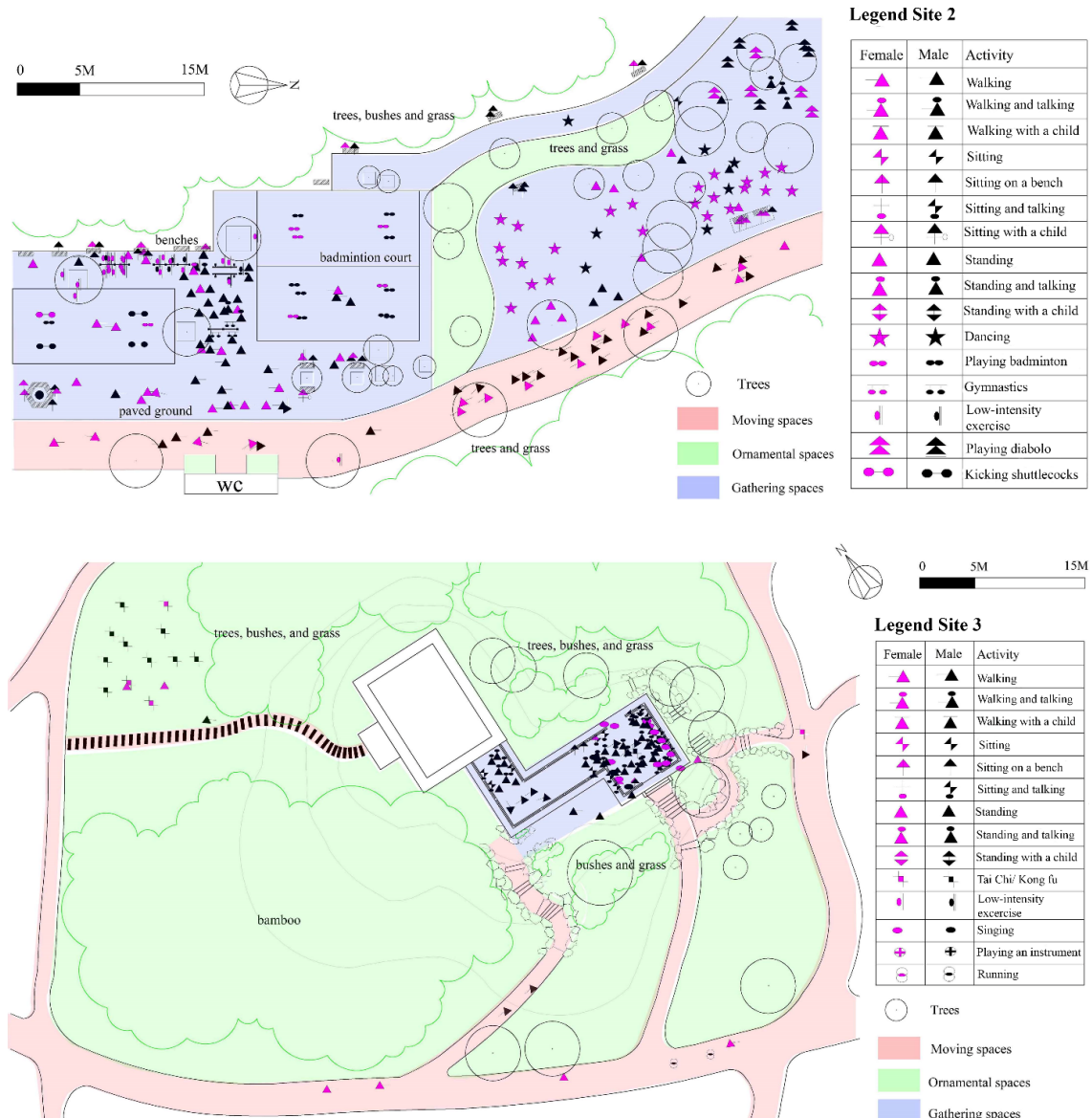
Figure 3. Composite maps of observation sites (S1, S2, and S3).

The mappings reveal a spatial pattern within the gathering spaces of connected spaces with buffer areas. Groups of older park users attempted to maintain some distance from both the spatial boundaries and other groups. As shown in Figure 4, participants in group activities stayed at least two meters away from physical boundaries. In addition, different types of buffer areas between groups were evident. The group kicking shuttlecocks remained around six meters away from the badminton group, with an ornamental space functioning as a buffer between the badminton group and the dancing group toward the eastern side. Trees served as a potential natural buffer between two dancing groups and a diabolo-playing group. When there were more participants in the group activities, a rope was tied between trees to demarcate the buffer area between the two dancing groups and the diabolo-playing group (Figure 5).
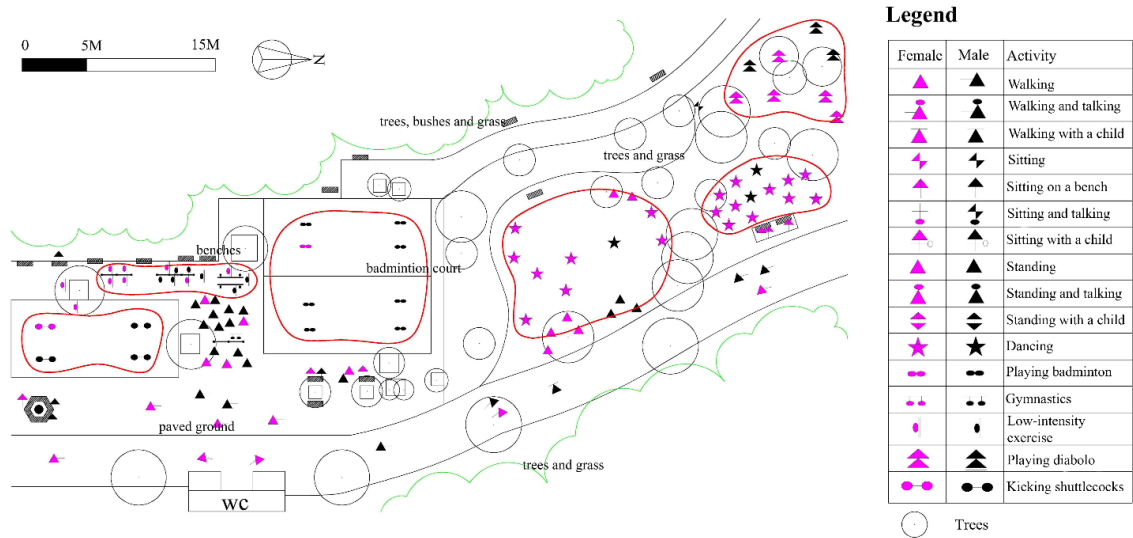
Figure 4. S2 users on Monday, October 12, 2015 at 9:30 am. This morning was a sunny, and there was a slight breeze.

Figure 5. Ropes tied between trees to reinforce buffer areas between group activities (photographs: first author).

Seniors' passive uses of the park, namely standing, sitting, and watching, revealed an "edge effect" pattern in which the edges of woods, clearings and other public spaces were preferred gathering places because they provided a combination of privacy and visibility (De Jonge, 1967; Gehl, 2011). Two types of edge effects were evident. As Figure 6 shows, sitting and standing behaviours were prevalent along the physical

boundaries of the green corridor to the east of the red rectangle. The physical edges may have provided seniors with psychological comfort, as their backs were shielded. Another type of "edge effect" was evident with active park use. As shown in the red rectangle in Figure 8, a singing group attracted seniors who stood or sat around the group.
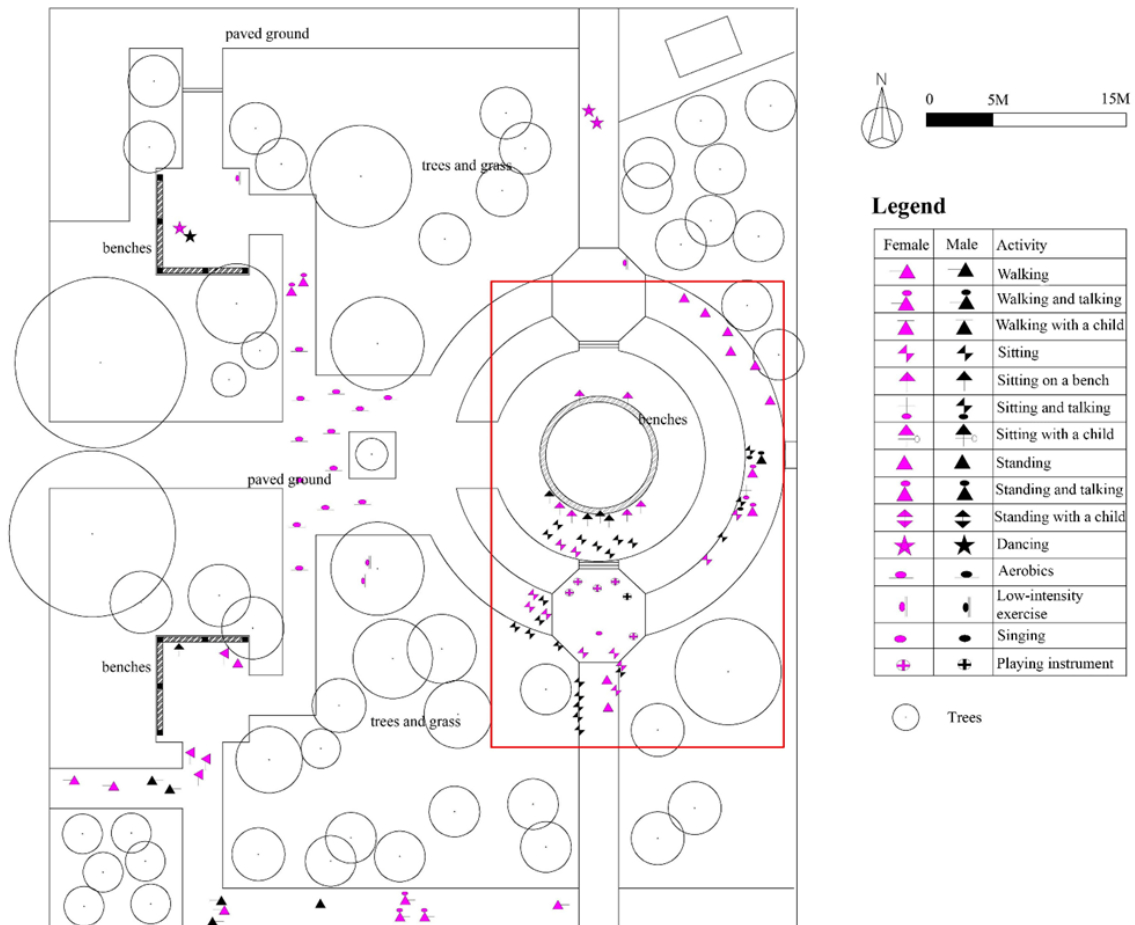

Figure 6. PI users on Sunday, October 11, 2015 at 9:00 am. This was a sunny morning, and there was a slight breeze.

3.3. Afforded usages

Four main categories of afforded park usage were identified from interviews and observations: individual physical activities, group physical activities, social interactions, and sitting and resting. The quotes derived from interviews reveal their main characteristics (Table 1).

Table 1. Overview of afforded park activities for seniors with supporting and non-supporting environmental characteristics.

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Main category	Afforded usage	Supportive environmental characteristics	Non-supportive environmental characteristics
1. Individual physical activity	Walking/Running	"Paved ground," "trees," "size of park"	"Raining," "hot weather"
	Aerobics	"Trees"	"Smoking"
	Sketching	"Other people and their activities," "trees," "other natural elements"	
	Low-intensity exercise /gymnastics	"Exercise facilities," "trees"	"Not enough exercise facilities," "raining"
	Ground calligraphy	"Lake," "paved ground," "proximity"	"Hot weather"
2. Group physical activity	Tai Chi/Kung Fu	"Soft soil," "trees," "quiet environment,"	"Too crowded"
	Singing	"Grouped participants," "connected spaces with buffer area"	"Conflicts in (group) use"
	Dancing/aerobics	"Grouped participants," "paved-ground," "connected spaces with buffer area"	
	Badminton-playing/ shuttlecock-kicking/diabolo-playing	"Grouped participants," "exercise facilities," "connected spaces with buffer area"	"Not enough exercise facilities," "raining," "hot weather"
3. Social interactions	Direct social interactions	"Grouped participants," "benches,"	"Conflicts in (group) use," "lack of pavilions and other places to shelter"
	Passive watching	"Other people and their activities," "benches," "edge effects"	"Darkness at dusk"
4. Sitting and resting	Sitting and resting	"Benches," "trees," edge effects	"Lack of benches and the lack of diverse styles"

Restoration	"Quiet environment," "benches," "trees," "other natural elements"	"Too crowded," "obstructed view"

3.3.1. Individual physical activities

Various types of individual physical activities are performed in Xingqinggong Park, such as walking, aerobics, sketching, low-intensity exercises, and ground calligraphy (see Figure 7). Seniors who were interviewed favoured individual activities because these activities are flexible and easy to practice. For example, a 78-year-old woman described her aerobic practice as follows:

When there are dancing groups or other people here, I will go to other places. For me, it is all fine. I just practice aerobics [by] myself and have fun. I can do it whenever I want. I don't like to join them [group activities] [because] they have time limitations.… I bring a music player with me to practice aerobics anywhere I want.

Individual physical activities are influenced by the presence of favourable environmental features. For example, places with trees that offer shade are the best venues for aerobics and walking activities because they provide protection against the heat in summer. Disruptions of individual physical activity are mainly caused by factors such as hot weather, insufficient exercise facilities, and smoking.

Figure 7. Examples of individual activities: aerobic practice (left) and ground calligraphy (right) (photographs: first author).

3.3.2. Group physical activities

We observed seniors engaged in diverse group activities, such as dancing, singing, Tai Chi, and playing badminton in Xingqinggong Park (see Figure 8). Small and large group activities were distinguishable in terms of their requirements relating to particular environmental features.

Small group activities required relatively little support obtained through environmental factors, such as space and facilities. Participants adapted easily to the lack of space and facilities. When a 55-year-old badminton player found that the only available badminton court was already occupied by other players, he and his partner chose to play badminton in a nearby paved area. He stated: "There are public badminton courts over

there, but they are already being used by people who came earlier. This [badminton court] is a public facility, and there are not enough of them." When the environment did not support their activities, individuals tended to search for alternative options, such as playing badminton on the square without a net and court.

Large groups' activities usually required a place in the park that was constantly available for their performance. It was important for the group to find a place that accommodated their activities. For example, one interviewee, who was over 55 years old, observed that soft soil, trees, and a quiet environment are conducive to Tai Chi activities. Apart from physical park features, most group participants stated that the other participants are important to them. As a 65-year-old singer commented, "I have invitations from several singing groups because the instrument players prefer playing with me. I can give my song collection book to them, and they can choose and practice any song from the book."

When the environmental features do not meet the needs of bigger groups, this may lead to tension among the various groups, as pointed out by an interviewee:

There used to be another singing group over there (and a singing group opposite the present group). The two of them clashed with each other, and tension increased between them, which resulted in conflict and confrontation. Finally, one of the groups left for another park.

Figure 8. Examples of group activities: dancing practice (left) and Tai Chi practice (right) (photographs: first author).

3.3.3. Social interactions
Seniors usually engaged in direct social interactions while participating in group activities. For example, greetings and short chats among participants in group activities were frequently observed. More intimate relationships of friendship could develop among individuals sharing the same interests and remaining in regular contact with each other. Seniors used the term "small circle" with reference to intimate relationships forged among members of these groups. For example, a 60-year-old man stated: "We have a small circle, a group of friends who also like calligraphy, reading, and drawing." Places that afford sitting and resting opportunities, such as benches, may stimulate social interactions during activity breaks.

Apart from direct social interactions, indirect social interactions, like passive watching, were also valued by seniors (see Figure 9). A woman over 70 years old described her

experience as follows: "I don't talk with other people; I just walk around the park alone. Well, actually, when I watch other people and their activities in the park, I also get a feeling of interaction." In turn, the participants in the activity were also pleased that they were being watched. When an elderly man drew a picture of a dancer, the dancer was very pleased and even asked for a copy of the picture.

3.3.4. Sitting and resting

Most interviewees indicated that they sit or rest in the park when taking a break from activities: "Usually I take a walk around the lake and then have a rest" (a woman aged 70+ years), and "I will take a rest during exercise; too much strenuous exercise is also not good for elderly people" (a woman aged over 70+ years). Benches, the pavilion, and other environmental characteristics provide sitting opportunities, inviting seniors to sit and rest. However, when these opportunities are not available, seniors may either choose not to stay, or they may seek alternatives, such as carrying a small folding chair, as pointed out by an 82-year-old man. The design and quality of benches was also of concern to seniors. In general, participants indicated that benches should be comfortable, enabling them to sit for extended periods of time and facilitating the act of rising. The seating locations should also be attractive and inviting. Figure 9 reveals that popular sitting places for older people entail a combination of expansive tree shade and back-shielding locations. Additionally, the performance of group activities in a central area attracts people to sit and watch.

Figure 9. Examples of sitting and resting places: a sitting place with trees and edges (left) and a sitting place with an expansive view (right) (photographs: first author).

4. Discussion and conclusion

In this study, we explored the interconnections between activities that an urban park affords to seniors and its environmental characteristics. On-site interviews held in Xingqinggong Park in the city of Xi'an revealed five categories of park characteristics that may contribute positively or negatively to the affordances provided by the park to older adults: design elements, people, physical accessibility, facilities and maintenance, and atmosphere. This finding is in line with previous findings, indicating that what people can do in outdoor environments is leading in how the environment is perceived and categorized (Hadavi, Kaplan, & Hunter, 2015).

We identified three types of spaces used through behavioural mapping: moving, ornamental, and gathering spaces. Buffer areas formed through demarcations of a certain distance, a line of trees, or a section of ornamental space were found to play an important role in separating groups, which is consistent with findings from the UK (Goličnik & Ward Thompson, 2010). The buffer areas were not only intended to separate the group spaces but they also enabled different groups to observe each other easily. This spatial usage pattern, which provided opportunities for people to see, hear, and interact socially with each other, accords with Gehl's (2011) self-reinforcing process, wherein "something happens because something happens." Another pattern of spatial usage comprised "edge effects" that have previously been demonstrated in urban green spaces (e.g., Goličnik & Ward Thompson, 2010; Unt & Bell, 2014). We frequently observed people sitting or standing at the edges of squares and roads. Older people commonly demonstrate an attachment to "edges," which provide psychological comfort by shielding their backs and a vantage point for observation.

We found that the simultaneous presence and mutual positionality of multiple types of spaces, and their corresponding characteristics, provided affordances for older visitors that met their needs. A balanced design offers a range of usage options, some of which visitors may not expect. This resonates with the findings of Sundevall & Jansson (2020) in Sweden, highlighting the significance of seniors' valuing liveliness, connection with nature, social spaces, and a variety of activities.

Four main categories of usage afforded by the park were identified: individual physical activities, group physical activities, social interactions, and sitting and resting. Group activities promote direct social interactions that could facilitate the formation of "small circles" of senior participants who develop close friendships. Passive observers are attracted by active park-use behaviours, while active participants may gain a sense of gratification from being watched. This reciprocal attraction between active and passive senior participants supports the view that "behaviour affords behaviour" in affordance theory (Gibson, 1979, p. 135).

The ability of seniors to provide narratives of factors hindering or enabling their experiences of an urban park that were analysed in combination with behaviour mapping data were key strengths of this study. A limitation of the study was that our data did not include interactions between seniors and other park users. It is possible that the seniors' park-use behaviours were partly influenced by the physical presence or behaviours of individuals belonging to other age groups. A case study conducted in two Chinese cities involving four parks revealed that seniors play a significant role in influencing other park users' activities and in managing therapeutic areas, thus contributing to the formation of collective identity among park participants (Zhou et al., 2021). This also reflects a place-making process that makes urban green spaces meaningful places for both seniors and other participants. Therefore, we recommend that future investigations of park affordances should include all age groups. Secondly, the current study focused exclusively on seniors who actually visited the urban park. We excluded any information about seniors who choose not to visit urban green spaces. Because the benefits of green spaces for visitors' well-being have been well documented, future studies could investigate how seniors could be encouraged to visit urban parks, thereby promoting healthy aging. For instance, Encho et al. (2023) discovered that enhancing the perception of green spaces can promote visits and engagement in physical activities among seniors with low self-efficacy.

In light of our findings, we present some action-based inputs to facilitate design professionals in creating attractive park environments for seniors. Such an environment should be a place with sub-spaces catering to distinct functions that allow freedom of choice during a park visit. In line with the local context, a park designed for seniors' use should contain environmental features that support multiple activities and behaviours, such as large trees for enjoying shade in the heat of summer, benches for sitting, and courts for playing badminton. It may be practical to begin by arranging environmental elements that potentially support several affordances. This arrangement will increase use opportunities for a particular sub-space.

The three types of spaces—moving, ornamental, and gathering spaces—should be carefully balanced in relation to each other. Gathering spaces are connected with moving spaces and are embedded in ornamental spaces. Ornamental spaces with trees, bushes, flowers, or grass help to create a setting for quiet and restorative environments. However, a high proportion of inaccessible ornamental spaces will result in the shrinkage of gathering spaces.

A strategy for facilitating and stimulating maximal group-use behaviour could entail combining gathering spaces and connected spaces with buffers. Green elements, such a line of trees or bushes, or a patch of grass, may serve as "soft" buffers that not only divide large gathering spaces into small connected spaces but also offer groups of users an opportunity to "see and be seen." In addition, there should be sitting opportunities within gathering spaces so that active seniors can rest in these spaces, and passive observers can easily combine resting and observing.

We recommend that policy-makers, concerned with the quality of life in cities, enhance the amount of available green space, while simultaneously ensuring the application of good design principles, especially carefully arranging the characteristics of green spaces to facilitate affordances for seniors. This integration of research findings with design principles can also be regarded as evidence-base design (Brown & Corry, 2011). These principles will enable green spaces to accommodate maximum numbers of people and preferences by including different sub-spaces, favouring the designation of use spaces over moving and ornamental spaces, and making the best use of limited urban spaces and financial resources. This study's findings indicate that a lack of available social support within local communities (Liu et al., 2015) may be partially compensated for by social interactions enabled by park affordances.

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