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The Influence of Environmental Characteristics on the Outdoor Activities of the Elderly: A Case Study at Labor Square, Qingdao City, China

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ABSTRACT

The construction of age-friendly cities has emerged as a social development objective in response to the growing senior population. Outdoor activities can enhance the elderly's physical and psychological health, and an attractive outdoor setting can draw them in and encourage them to participate in more frequent and higher-quality outdoor activities. Nevertheless, research on the social and environmental traits of Chinese seniors in outdoor settings still needs to be done. To properly develop outdoor spaces in urban community parks, this study aims to investigate the outdoor activity preferences of senior citizens. Labor Square in Qingdao, China, was chosen as the research site because of its outdoor setting, and data were collected through the "System for Observing Play and Recreation in Communities" (SOPARC) to analyse the number and characteristics of age-friendly cities where older people live in different periods and different environmental areas. The findings indicate that older adults in Qingdao Labor Square love playing cards and square dancing. These two activities had the most significant number of participants during the survey. In addition, an excellent biological environment (more shrubs, shade trees, and pergolas with climbers) can encourage senior citizens to use the outdoors during the day, while open spaces are more alluring in the evening. This article investigates the outdoor activities that older people choose, as well as the characteristics of residential outdoor environments which offer a foundation for enhancing both the outdoor environment and senior health. These serve as a resource for designers.

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1. Introduction

The United Nations' 17 Sustainable Development Goals (SDGs) (2022) represent a comprehensive strategy to improve everyone's future. By 2030, the 17 Goals offer a roadmap for eradicating extreme poverty, lowering inequality, restoring the environment, guaranteeing access to justice, enhancing wellbeing, and forming the international alliances required for sustainable development. "Good health and wellbeing, ensuring healthy lives, and promoting wellbeing for all ages" is Goal 3 in this set of objectives. Goal 7 is

"Sustainable Cities and Communities: fostering inclusive, secure, resilient, and sustainable cities and communities."

"Age-friendly cities and communities" are still essential in international policy texts, so community environments are being focused on (Rudnicka et al., 2020; Yifan et al., 2020; Lui et al., 2009). Communities are essential to good ageing because they lower obstacles and promote health, as demonstrated by a recent pledge to expand the global network of age-friendly towns and communities within ten years. A well-maintained outdoor community space will increase senior citizens' quality of life.

1.1. Significance of an Age-Friendly Environment in Urban China

In 2020, about 264 million people aged 60 and above comprised 18.7% of the total population. The age group 60 and beyond grew by 5.44 percentage points compared to the findings of the sixth Chinese census in 2010 (NBSC, 2021). China is seeing a significant ageing of its population, with the largest number of older adults worldwide. The elderly become more reliant on their familiar living environment as their physical and cognitive abilities deteriorate, their social networks gradually disappear, and their psychological susceptibility increases. Therefore, their physical and emotional well-being correlates more directly with their immediate environment.

Furthermore, China is becoming a more urbanised nation. The rising urbanisation rate in China exposes older urban residents to environmental risks such as noise pollution, air pollution, and high temperatures, among other elements that compromise healthy living (Xu & Lyu, 2022).

Creating a robust physical health education program for the elderly will help them comprehend the value of exercise in an ageing society. Engaging in outdoor activities helps older people stay healthier and more physically active (Heng, 2024). Most elderly individuals engage in physical activity at or close to their homes (Chaudhury et al., 2016; Moran et al., 2014). Consequently, relying on their community to provide them with places for beneficial activities negatively impacted the elderly's physical and mental health in numerous ways.

1.2. The Importance of the Community Environment

A structure or area that humans make is known as the built environment (Clarke et al., 2008). Given that older people spend more time at home and in residential settings than people of other ages, the effects of the built environment on them must be considered (Clarke & Nieuwenhuijsen, 2009). Many academics have focused on creating a high-quality residential environment because of its profound effects on the physical and mental health of the elderly (Lu & Misni, 2023a; Lu & Misni, 2023b; Parker et al., 2004).

In China, healthy senior citizens who retire at age 60 have a strong affinity for outdoor activities. The elderly in urban areas do not choose to spend their entire lives at home because they are aware of the health benefits of outdoor activities (Ismail et al., 2022). Hence, they engage in a variety of activities here and adore the community's outdoor setting. For this reason, the community's outside space is crucial to the elderly.

1.3. Activities and Natural Environment Preferences of the Elderly

Close interaction with ecological places, such as natural vegetation, significantly impacts the well-being of older people, according to growing evidence (Fei et al., 2023; Gong et al., 2014; Lee & Maheswaran, 2011). This may be because older people are more likely to be physically active due to their increased exposure to green spaces, which purify the environment. Suitable green spaces also offer secure areas for low-intensity activities, such as walking, for the elderly (Zhai & Baran, 2017; Sugiyama et al., 2008; Giles-Corti et al., 2005). Studies have indicated that increasing the number of trees planted within 400 meters of community settings can increase outdoor activity engagement among older adults. Elderly people who experience sleep loss may also benefit from green ecological settings (Stangierska et al., 2023; Wenjie et al., 2019; Grigsby-Toussaint et al., 2015).

Based on the theory, this study used the residential outdoor environments of Qingdao as an example to observe the activities and behaviours of the elderly to shed light on the relationship between these activities and the ecological environment's features, offer design recommendations for the development of age-friendly cities, and enhance the ecological, psychological, and physical space necessary for the elderly to live in a natural setting.

2. Methodology

2.1 Study Sites

Labor Square is the outdoor environment of Shuiqinggou residential areas in Qingdao, Shandong Province, China. Qingdao is one of the coastal cities in eastern China. It is in the northern-temperate East Asian monsoon region, which has a warm-temperate monsoon climate. The climate characteristics are very suitable for outdoor activities. The residential outdoor environment is located in Qingdao City's north district, bordering the residential area to the east, Siliu South Road to the west, Huaiyang Road to the south, and Kaiping Road to the north. Since 2005, the park has covered an area of 21,000 square metres. The outdoor environment of the Shuiqinggou residential area was chosen because it has a relatively large population density and a large elderly population, so it is of great significance to create a better outdoor space. About 30,000 people live in the old and new residential communities within a 10-minute walk of Labor Square, and the elderly population is about 6,000. There are about four or five hundred older people who entertain themselves here every day. Therefore, the outdoor environment should be designed better for the elderly.

2.2 Residential Outdoor Environment

Because Labor Square is relatively large, it is divided into three different spaces according to its environmental characteristics (Figure 1). Space A is mainly a large square, supplemented by green space; Space B is in the central area with various facilities, such as sculptures, corridors, etc.; and Space C is dominated by tree arrays, combining corridors and sports fields. At different times, the density of use among the elderly differs in each area. Due to the different environmental characteristics of the three spaces, the activities of the elderly on weekdays are also very different.

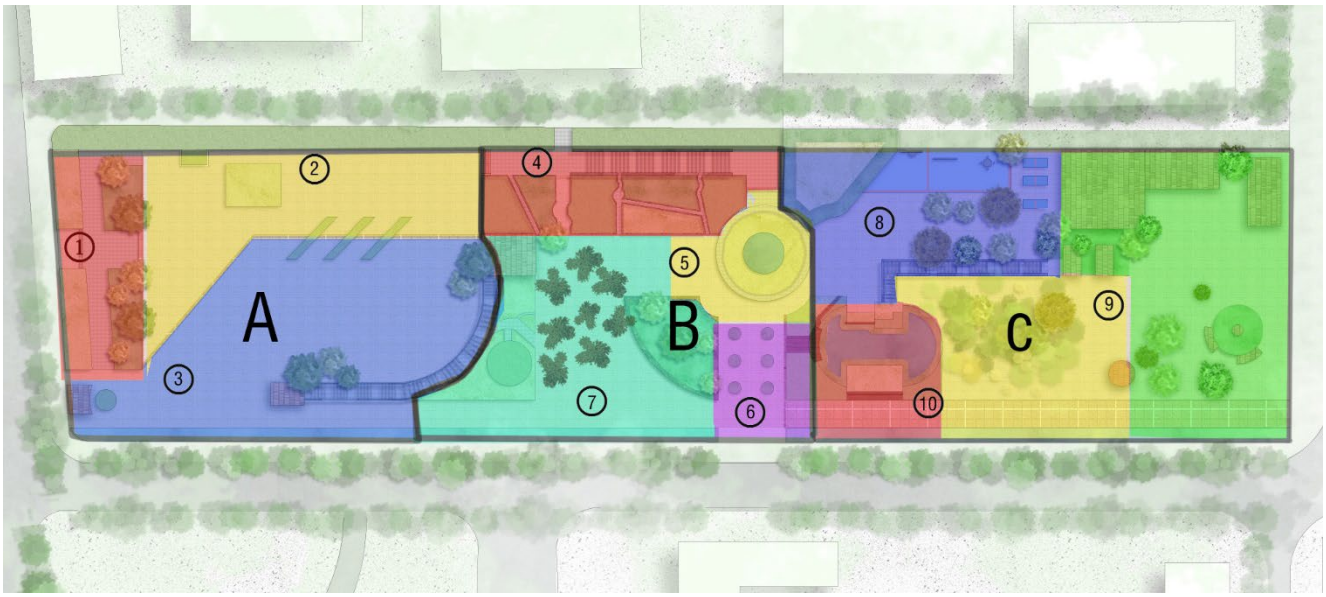

Figure 1. Three Spaces Distribution of Labor Square, A, B and C and Ten Zones with Different Environmental Characteristics

2.3 Description of Study Area System for Observing Play and Recreation in Communities (SOPARC)

Conducting systematic observational research in outdoor areas is difficult due to the lack of objective measures to assess visitor behaviours and features. The dynamic movement of park users poses additional obstacles to accurately estimating the physical activity of older users (Marquet et al., 2019; Umstattd Meyer et al., 2020). Since its inception in 2006 (McKenzie et al., 2016), SOPARC has addressed these issues.

SOPARC is an approved method for direct observation used in parks and recreational settings to evaluate physical activity levels and related human and environmental factors. Quick-timed by SOPARC is meant to document the locations and users of physical activities. SOPARC has proven to be a dependable and efficient technique that is frequently used to characterise park utilisation. Researchers have been able to measure the behaviour of large groups while also gaining a better knowledge of the setting in which physical activity occurs because of the creation of SOPARC and its quick adoption. It was created to enable evaluation beyond self-reported physical activity and individual measurement (Marquet et al., 2019; Umstattd Meyer et al., 2020). The present investigation employed SOPARC to examine the correlation between the environmental attributes of outdoor spaces and the activity aspects of older adults.

The study divided the day into five segments. The early morning (5.50–7.30), morning (8.30–10.30), noon (11.30–11.30), afternoon (14.30–16.30), and evening (17.30–19.30) sessions lasted roughly two hours each. Every activity area was observed for a week, every day from Sunday to Saturday. To maximise the accuracy of the data, repeated observations and records were performed in early fall (October 2022) during favourable weather. Area numbers, activities, gender, and roles were recorded based on preliminary data analysis. Everyone's activity was coded as one of three options: sedentary, moderate, or vigorous. Separate scans were made for females and males. The researcher recorded the number of activities using pen and paper. The summary counts described the number of participants by gender, activity modes and levels, apparent age, and race/ethnicity groupings. The instrument permitted for comparisons of physical activity levels between different settings or within the same setting over different periods of time.

The intensity of physical activity was expressed as the amount of energy expended and calculated based on previously validated assessments of energy expenditure for each activity level (Ainsworth et al., 2000). Although estimates can be expressed in calories expended—for example, Kcal/kg/min—a more straightforward metric called METs (or metabolic equivalent) has been developed. One MET is equal to the energy spent by a person at complete rest. One MET-hour is the amount of energy expended at rest for an hour. Based on measures of energy expenditure, sedentary behaviour is roughly the equivalent of 1.5 METs, moderate physical activity is 3 METs, and vigorous activity is 6 METs. In this study, the activities in the park were divided into three categories and 22 subcategories. The first category was

Moderate, second was Vigorous, and third was Sedentary (Table 1).

Table 1. Activities for Elderly in Three Categories and 22 Sub-categories

Category	Sub-categories of Activities
Moderate (4)	1-Walk the dog, 2-Roam, 3-Walk back and forth, and 4-Take care of children
Vigorous (13)	1-Exercise, 2-Tai Chi, 3-Play badminton,4-Play Ping-Pong, 5-Play Kong-gu, 6-Jump rope, 7-Play Basketball,8-Kick the Shuttlecock, 9-Square dancing, 10-Play volleyball, 11-Social dance, 12-Martial arts, and 13-Others
Sedentary (5)	1-Watch and sit, 2-Play cards,3-Play chess, 4-Music, and 5-Chat

Origin2018 software was used to sort all the recorded data, SPSS26 for chi-square detection, and ArcGIS 10.7 for analysis and result generation. Physical activity was analysed using descriptive statistics, and the relationship between behaviour zones and the frequency counts of physical activity was examined using a two-way chi-squared test with SPSS 26 ($\chi 2 = 236.718$, $p < 0.001$), which showed a medium effect size (Cramér's $V = 0.357$). This is because older people's activities vary depending on their surroundings.

3. Results

3.1 Description of Study Area System for Observing Play and Recreation in Communities (SOPARC)

SOPARC was used to calculate the number of elderly activities in each period, as listed in Table 2. Vigorous exercise was about 161, which is the most active. Meanwhile, the number of people who were sedentary was about 88. Relatively few were moderately active--just 61. Depending on the physical condition of the elderly, they are very willing to participate in outdoor exercise activities rather than just sitting and watching.

Figure 2 shows how the utilisation of space varies in different periods. While Space C, represented by the green area, had the highest utilisation rate of the periods, Space A had the highest utilisation rate at night, in the afternoon, and in the evening. Spaces A and C users were more than 200 people, and the utilisation rate was relatively high.

Table 2. Statistics on the Number of Elderly People in Different Time Periods and Spaces

Space/Time	5:30-7.30	8:30-10:30	11:30-13:00	14:30-16:30	17:30-19:30	Sum
• Space A	14	24	11	30	208	287
• Space B	30	24	8	42	24	128
• Space C	85	62	26	224	116	513
• Sum	129	110	45	296	348	928

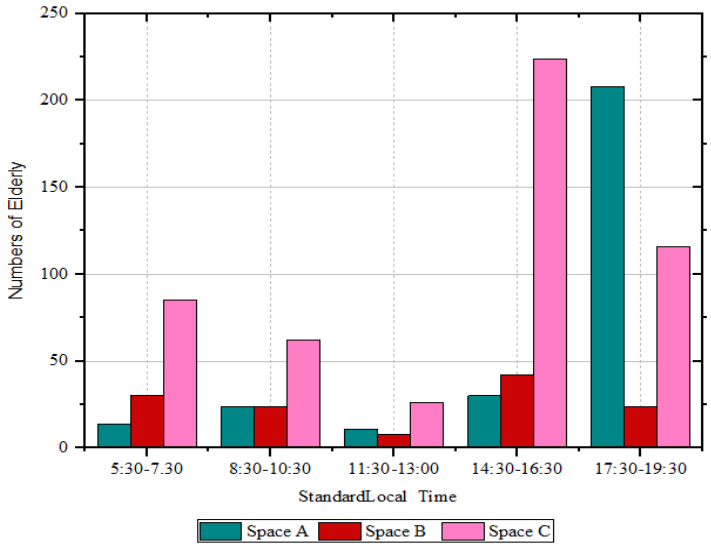

Figure 2. Statistics in Different Periods and Spaces

3.2 Result Analysis of Space A

Space A has a square as the dominant environmental feature, surrounded by some trees or shrubs. According to the observation, the number of seats in this position was relatively small, and the comfort level was low. Combined with the behaviour mapping data in Table 3, it revealed a low usage rate.

Space A was relatively low at noon, with only 11 users. During the morning and afternoon, the number of users increased to around thirty. However, in the evening, the number of older adults participating in square dancing activities had surged, with more than 200 older adults using the space, and the space density had increased.

Table 3. Behaviour Mapping Data at Different Times in Space A

	Space/Time	5:30-7.30	8:30-10:30	11:30-13:00	14:30-16:30	17:30-19:30	Sum
• Moderate	• Walk the dog	0	2	0	0	4	6
	• Roam	2	4	3	5	10	24
	• Walk back and forth	0	0	0	1	0	1
	• Take care of children	0	4	0	4	10	18
• Vigorous	• Exercise	4	2	0	0	0	6
	• Tai chi	8	0	0	0	0	8
	• Square dancing	0	0	0	0	134	134
• Sedentary	• Watch	0	6	4	6	30	46
	• Music	0	0	0	6	0	6
	• Chat	0	6	4	8	20	38
• Sum		14	24	11	30	208	287

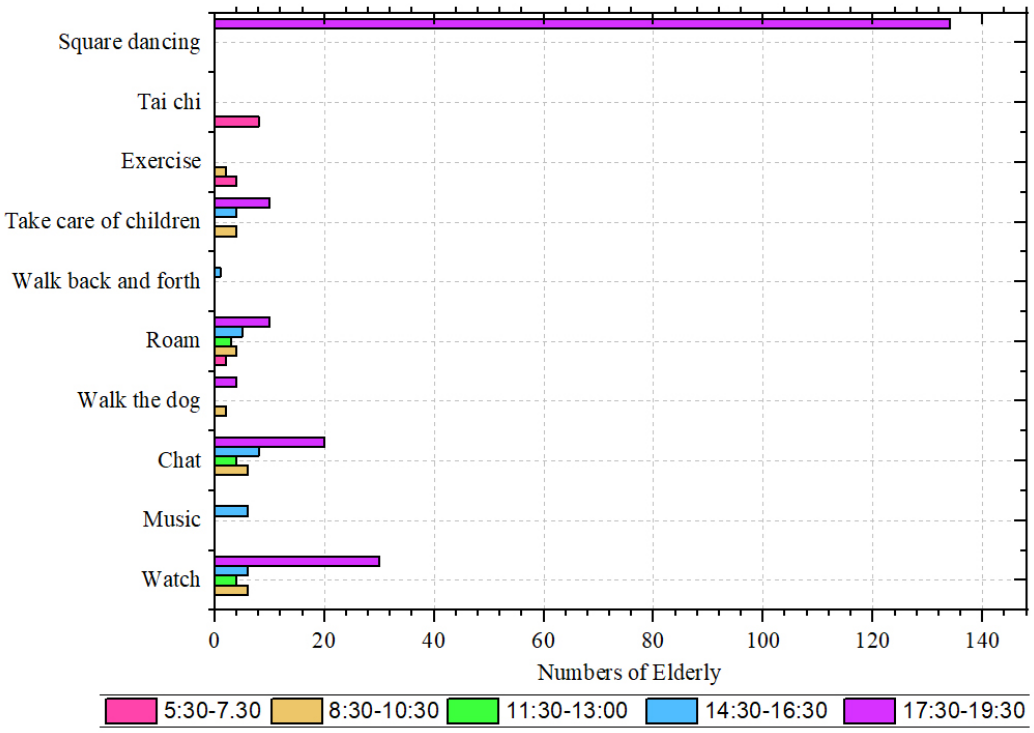

Figure 3. Behaviour Mapping Data at Different Times in Space A

Based on Figure 3, nighttime was the most frequently used. In the shrubs around Space A, many elderly people are watching and chatting. The square in the central area is most used by people in the evening, and the steps between the two squares become a resting place for people to enjoy the view. There is a stage set up on the east side. Figures 4 and 5 are the scenes of the square in different periods. Although they are instantaneous records, we can also see the square being used.

Figure 4. Morning (left) and Noon (right) in Space A

Figure 5. Afternoon (left) and Evening (right) in Space A

3.3 Result Analysis of Space B

Space B is a sculpture-centred space surrounded by a promenade, a small array of trees, and a pool of water. According to the observations, Space B's comfort level was higher than Space A's. The behaviour mapping also revealed that the space's corridors and tree array are more comfortable and offer more rest areas. Space B was used evenly throughout the day.

According to the behaviour mapping data in Table 4, it was found that in Space B, the number of users in other periods except noon was similar, controlling around 20-40 people. The relatively small scale of the environmental facilities in Space B explains this. Observing the site revealed a constant presence of people, albeit insignificant number. For example, people pass by in the corridor, sit down, and chat intermittently. Especially in the morning and afternoon, many older adults rest and chat here.

The tree array position is another example. When the sun is shining, many elderly people rest here. In the evening, they will choose to dance in the ballroom in twos and threes.

Table 4. Behaviour Mapping Data at Different Times in Space B

	Space/Time	5:30-7.30	8:30-10:30	11:30-13:00	14:30-16:30	17:30-19:30	Sum
• Moderate	• Walk the dog	5	0	0	0	0	5
	• Roam	3	0	2	4	0	9
	• Walk back and forth	1	0	0	0	0	1
	• Take care of children	0	3	0	0	0	3
• Vigorous	• Exercise	4	0	0	0	0	4
	• Tai chi	5	1	0	0	0	6
	• Play badminton	6	0	0	0	0	6
	• Square dancing	0	0	0	10	12	22
	• Social dance	0	0	0	0	8	8
• Sedentary	• Watch	0	6	3	13	0	22
	• Play cards	0	0	0	6	0	6
	• Play Chinese chess	0	0	0	2	0	2
	• Chat	6	14	3	7	4	34
• Sum		30	24	8	42	24	128

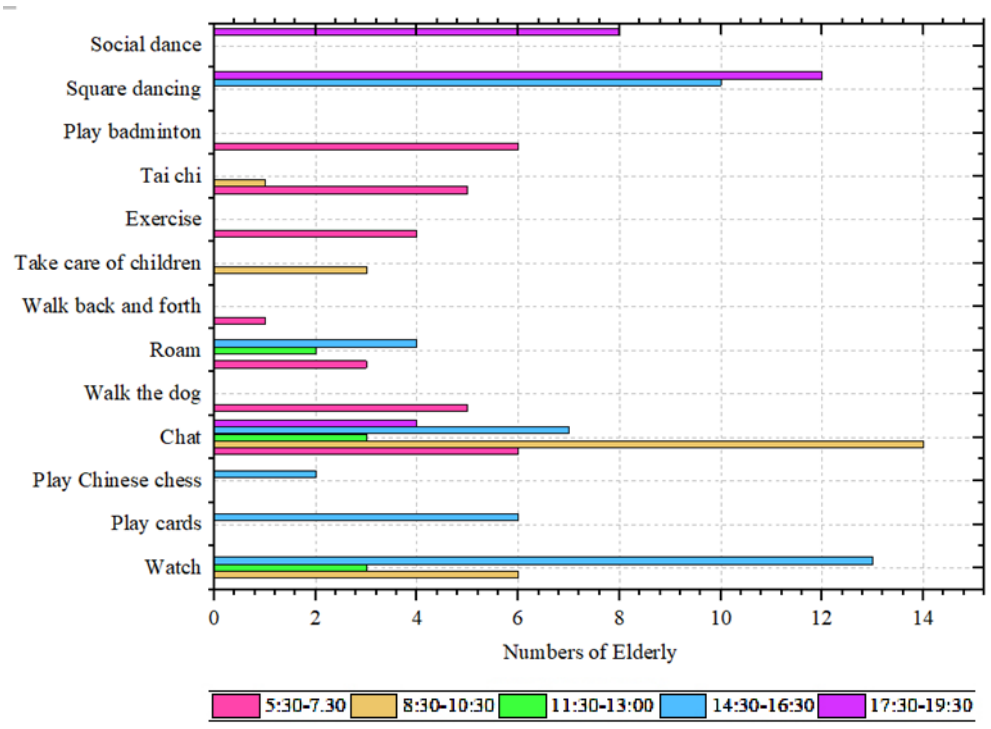

Figure 6. Behaviour Mapping Data of Different Times in Space B

Figure 7. Early Morning (left) and Morning (right) in Space B

Figure 8. Noon (left) and Afternoon (right) in Space B

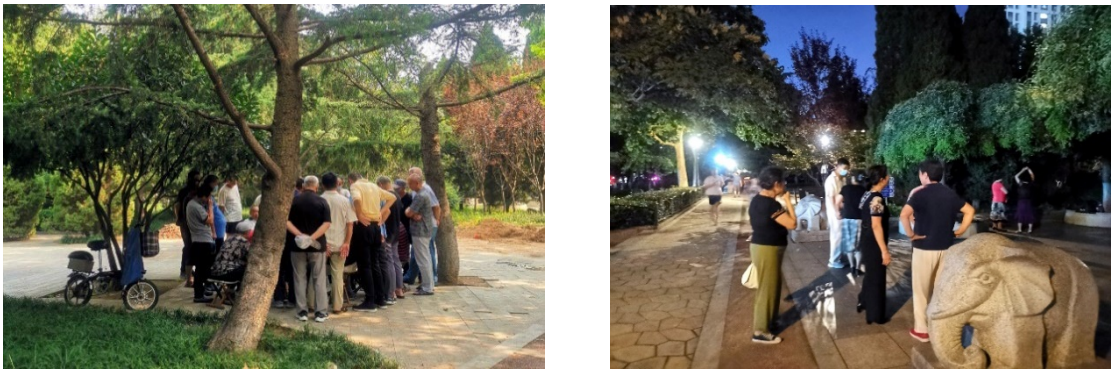

Figure 9. Afternoon (left) and Evening(right) in Space B

In the corridor of Space B, many older adults are watching and chatting. The tree array is a place to watch, chat, and dance. In the same space, sedentary activity was the most active, followed by vigorous activity, and moderate activity the least. However, the difference was insignificant in Figure 6, which shows that the elderly exercise in the early morning. In the morning, they will choose a seat with shade to bask in the sun. They will also choose a shaded and ventilated place to chat and play cards in the afternoon. In the evening, more people choose open spaces for dancing and other activities. The requirements for ecological factors would be higher during the day, while those for space would be higher at night (Figures 7-9).

3.4 Result Analysis of Space C

The environment of Space C includes a sports field, tree array, pond, and corridor. Sports venues include table tennis venues, fitness facility venues, basketball courts, etc. The tree array is tall, the site is flat, and the number of users was relatively large daily from morning to night. The reservoir boasts numerous fresh features that enhance the overall environment. People can be seen observing fish and flowers at various times. Compared with the corridor in Space B, corridor C is highly utilised. This corridor is in the centre, separating the sports field from the tree array. Many people like to observe the scenery here; not only to see the crowd, but also to see the scene of playing cards under the tree array, so the utilisation rate of this corridor was relatively high.

When combined with the behaviour mapping data presented in Table 5 and Figure 10, it is evident that the number of users at noon and in the morning was relatively small. Space C had the most significant number of people in the afternoon. Many elderly people ride electric bikes and walk there to meet and play cards from noon to evening. Even at 7 or 8 p.m., the shady tree-array and corridor

environments still attract many people. There were about 90 people there early in the morning, many of whom were exercising. Obviously, Space C had a higher number of users (Figures 11-14).

Table 5. Behaviour Mapping Data at Different Times in Space C

	Space/Time	5:30-7.30	8:30-10:30	11:30-13:00	14:30-16:30	17:30-19:30	Sum
• Moderate	• Walk the dog	2	0	0	3	4	9
	• Roam	5	0	4	10	4	23
	• Walk back and forth	0	0	0	0	2	2
	• Take care of children	2	0	0	2	0	4
• Vigorous	• Exercise	6	0	0	4	4	14
	• Tai chi	7	0	0	0	0	7
	• Play badminton	2	0	0	0	0	2
	• Play ping-pong	8	6	0	8	6	28
	• Play Konggu	1	0	0	0	0	1
	• Jump rope	1	0	0	0	0	1
	• Play basketball	5	0	0	0	4	9
	• Kick the shuttlecock	12	0	0	0	0	12
	• Square dancing	23	0	0	0	15	38
	• Play volleyball	5	0	0	0	0	5
• Sedentary	• Watch	6	16	6	70	10	108
	• Play cards	0	30	12	117	60	219
	• Play Chinese chess	0	4	0	0	4	8
	• Music	1	0	0	0	0	1
	• Chat	4	6	4	10	7	31
• Sum		90	62	26	224	120	522

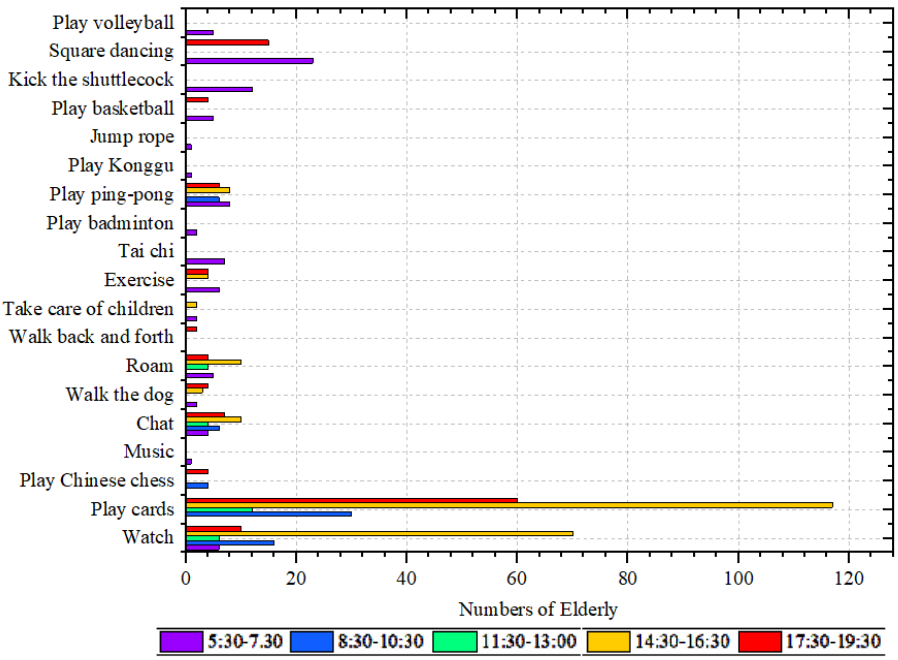

Figure 10. Behaviour Mapping Data of Different Times in Space C

Figure 11. Early Morning in Space C

Figure 12. Morning (left) and Noon (right) in Space C

Figure 13. Afternoon in Space C


Figure 14. Evening (left) and Night (right) in Space C

4. Discussion

A public open space is defined as an open piece of land, both green and hard, to which public access exists (Koohsari et al., 2015). Semi-public spaces are open to some people outside the regular constituency and have some features of a public institution (Orhan, 2022; Valente, 2020). Semi-private space is between semi-public and private space, which has certain sharing and privacy, similar to the combination of semi-public and private space (Gehl, 2011). These spaces provide venues for recreational activities, improve the well-being of those participating, and increase their sense of belonging (Wash et al., 2022).

Table 6. Analysis of Landscape Characteristics of Different Zones in Labor Square

	Zone Characteristics	Environmental Characteristics	Environmental Attribute	Activity Analysis
Zone A-1	A narrow space enclosed by a hedge	Shrubs and trees semi-enclosed; Narrow and long space	semi-privacy	Watching, sitting, and chatting were the main activities, and the distribution of activities was scattered. Activities are evenly distributed in all time periods.
Zone A-2	Open Spaces, including squares and plants	Hard paved ground, the terrain is 0.5 meters higher than Zone3; Coniferous trees in local areas	Public openness	Watching, square dancing, and other activities that are distributed in dots or concentrated; the activity distribution at each time is more uniform, and the utilisation rate is better.
Zone A-3	Square	Hard paved ground, the terrain is 0.5 meters lower than Zone3	Public openness	Square dancing is the main concentrated activity, and other activities are distributed in dots or concentrated. The elderly activity in the evening has the largest number of people and the highest utilisation.
Zone B-4	Outdoor corridor space	Have a long corridor; Narrow and long space	Semi-public	Watching and chatting were the main activities, and the distribution of activities was linear. Activities are evenly distributed in all time periods.
Zone B-5	Sculpture display area	The central sculpture of the whole park is in the middle of the square, with a hard-paved floor and plants around it	Public openness and exhibitionism	Activity use is low, and few older people stay except for morning exercise.
Zone B-6	Tree array area	Small space surrounded by tree array and seats, near the east entrance	Semi-public	The tree array is the main concentrated activity, and the other activities are dotted or concentrated. There are more elderly people sitting and watching during the day, as well as more elderly people dancing at night.
Zone B-7	Plant communities enclose Spaces	A small space enclosed by conifers	Semi-privacy	Activities in each period are uniform, such as morning exercise, tai chi, square dance, etc. Due to the small venue and certain privacy, the number of participants is not very large.
Zone C-8	Sports field	Sports venues, including table tennis venues,	Public open space	All kinds of sports activities are evenly distributed, the site is lively, and there are many activities for the elderly.

	Zone Characteristics	Environmental Characteristics	Environmental Attribute	Activity Analysis
		fitness facilities, basketball courts, etc.		
Zone C-9	Tree array square	Many tall trees, square without obstacles, a corridor enclosed	Public open space and enclosure	The main activities are playing cards, and other morning exercise activities. The elderly especially like to gather in the enclosed space, where there are always people.
Zone C-10	Waterscape	The landscape space dominated by the pond is surrounded by more green trees	Public open space	Watching is the main activity, as is enjoying the lotus, interacting, and engaging in other activities. Elderly people like to gather here for exercise.

In Space A, Zone A-1 had the lowest number of elderly users. This is a semi-private space, so keeping quiet. The main activities of the elderly are watching and chatting beside the surrounding bushes. Zone A-2 has a hard-paved floor and some shrubs. The main activities for the elderly are chatting and square dancing. Zone A-3 is a large amount of hard-paved ground with almost no plants. While there are many activities in this area, the most popular one is square dancing, which attracts 134 people, occupying about half of the total number of people in Space A. In China, the elderly are very fond of square dancing. They believe it helps them experience life and improves physical and mental health (Chang et al., 2024).

At Zone B-4 in Space B, there is a long corridor where different people pass by and sit down intermittently to chat. Especially in the morning and afternoon, many older adults rest and chat here. Zone 5 is the sculpture square in the city's centre, where people play badminton in the morning and do other activities. There is a tree array in Zone B-6, where the elderly mainly watch, sit, and chat in the daytime and ballroom dance in the evening. However, one environmental problem identified by the behaviour mapping is that the lighting needs to improve at night. Zone B-7 has a lot of coniferous trees and is relatively private; in the morning, a few older adults are dancing, and afternoon activities are mainly chess and cards.

Zone C-8 is a sports ground where the elderly are active all year round. There are volleyball, shuttlecock, and other activities in the morning, as well as more cards and fitness activities in the afternoon. The table tennis court is usually occupied throughout the day. Many seats are under the shade, so many people sit and watch or chat. The shade from trees reduces the outdoor temperature. When the weather is hot, the elderly's heat adaptation behaviour is to move to the shade provided by trees or buildings (Li et al., 2022). Zone C-9 is mainly an array of tall trees on a flat site. There were more elderly users daily from morning to night, and the utilisation rate was the best. About 300 people were active. Zone C-10 is a small pond, adding much beauty to the scene. Many elderly individuals stop here, yet their visits are brief due to absence of seats and the sun's exposure.

By analysing the environment from the above table and photos, it can be concluded that Zone C-9 was the most popular area in Space C. Tall trees and vines in the corridor provide plenty of shade in the space, which is very cool in summer and comfortable in spring and autumn. Shaded spaces attract more social activities, and compared to young people, the activities of the elderly are more susceptible to heat stress, and they prefer shady environments (Huang et al., 2022). So, there are a lot of older people lingering in this environment. Many old people engage in card games, whether they are playing cards themselves or watching chess. Square dancing is also the activity in which the elderly participate the most. Meanwhile, compared with the corridor in Space B, Space C had a very high utilisation rate. This corridor is in the centre, separating the sports field from the tree array. Many people like to take a view here. They can see both the crowd and the scene of playing cards under the tree array, so the corridor's utilisation rate was quite high. Due to the popularity of electric bikes, many elderly people ride them to play cards or participate in sports activities. The comfortable environment also attracts many people of different ages, including the elderly and some young people, to play basketball here. The whole area is alive with energy.

The tables and figures in this study revealed two primary findings. First, the most popular activities for the elderly in Qingdao were square dancing and sports. This was followed by watching activities, sitting in the sun on a chair, or standing to watch chess, cards, etc. Other events typically involved a few people.

The second was that the environmental characteristics of the elderly's activity preference are places with trees, especially trees, which can avoid heat when the weather is hot and can bask in the sun when the weather is cold. In addition, ecological environments such as water systems and pergolas are particularly suitable for the elderly's sedentary activities. There will also be more vigorous activity in the square, especially under the trees.

6. Conclusion

Significance. SOPARC was used to monitor the locations of elderly activities in Labor Square. Based on the monitoring conducted, it was meant to explore the essential factors of older adults' landscape perception. For the elderly, a good environment can better meet their activity needs, especially an excellent ecological environment, so they prefer outdoor activities. The surrounding environment is cool and fresh in the tree-lined space, and the number of elderly activities was also higher than in other areas. At the same time, the location and facilities of the space significantly influenced the activities of the elderly. Safety, convenience, comfort, diversity, and ecology were the primary factors in a high-quality outdoor environment.

This study explored the factors of exercise preference and landscape perception among the elderly. Although the research object was the elderly in Qingdao, it has a high reference significance for China and other countries or regions in East Asia. Understanding the influence of various environmental factors and elderly activity preferences can help designers better design outdoor environments suitable for the elderly.

Limitations. First, SOPARC requires a lot of time and patience to record, and is not suitable for larger outdoor environments. However, it is a useful analytical tool for small and community parks. Secondly, it is suitable for studying activities in specific regions and cultures. For example, older adults in China like doing square dancing, which may not be suitable for other areas or countries. Third, only one community park was studied in this study, limiting the range of activities and park preferences.

Future research. SOPARC is suitable for small outdoor environments. This paper analysed the activities of the elderly in Labor Square, comprehensively examined the relationship between environmental boundary quality, activity items, and activity frequency, and determined the significance of ecological factors. Future studies should investigate multiple parks, comprehensively compare activity connectivity, analyse the relationship between activities and environmental attributes, and explore deeper factors of landscape perception among Chinese seniors.

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