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The Effect of Group Activity Spaces in Community Parks on Social Interactions

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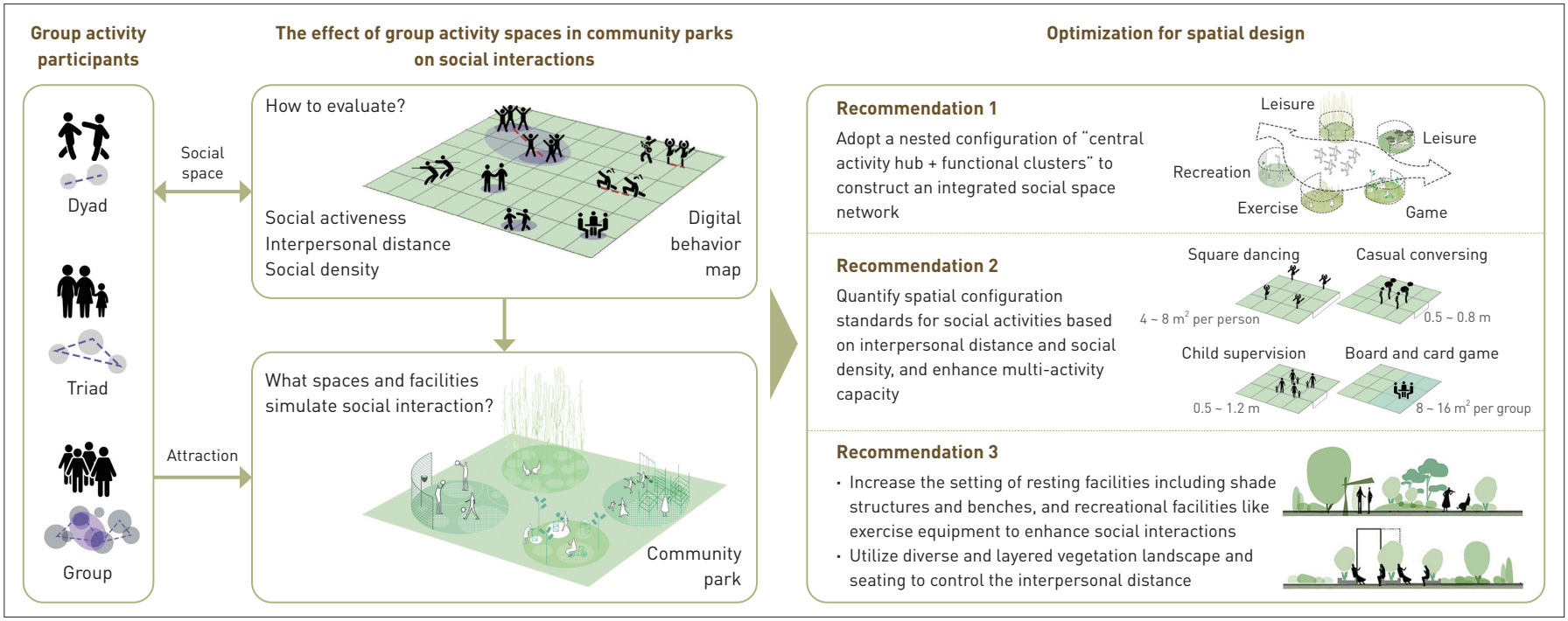
GRAPHICAL ABSTRACT



ABSTRACT

Social interaction plays a vital role in fostering interpersonal relationships and building social cohesion. As primary venues for residents' daily recreation and interactions, unlocking its potential for promoting social activities is essential for enhancing place attachment and advancing social well-being. This research selects typical community parks in Harbin as sample sites. Combining behavioral annotation and environmental observation, it visualizes group activities through digital behavior maps and evaluates social interaction levels through three indicators: social activeness, interpersonal distance, and social density. Kernel density estimation, correlation analysis, and variance analysis are employed to identify the environmental features that promote social interaction within community parks. The results indicate that the level of social interaction is significantly influenced by spaces and facilities: the addition of recreational facilities increases social activeness; adding paved surfaces and lighting tend to extend interpersonal distance, while a higher number of enclosure interfaces shortens it; and the increasing of convenience facilities contributes to higher social density. Moreover, discrete leisure spaces and linear boundary spaces are identified as primary hotspots of group activity. Based on these findings, this research proposes spatial optimization strategies that promote social

interaction in community parks, to revitalize community parks through micro-scale spatial improvements, thereby encouraging broader social participation and enhancing residents' physical and mental well-being.

KEYWORDS

Community Park; Social Interaction; Interpersonal Distance; Social Density; Urban Spatial Optimization

HIGHLIGHTS

- Evaluates social interaction levels using social activeness, interpersonal distance, and social density
- Reveals that space, boundary, and facility in community parks significantly affect social interaction
- Finds differences in social activeness, distance, and density across types of group activity spaces

RESEARCH FUND

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1 Background

The rapid urbanization, coupled with the rise of digital networks, has reshaped residents' daily habits and modes of social interaction. These changes have led to the weakening of interpersonal relationships, and in extreme cases, to social withdrawal and isolation. Urban public spaces play a critical role in fostering social engagement and strengthening social bonds, thereby helping alleviate psychological distress[1]. As cities shift toward qualitative development, community parks—typical small-scale urban green spaces—have gained prominence due to their high accessibility[2]. They not only function as vital sites for everyday social interaction, but also serve as key spatial resources for urban micro-renewal initiatives[3][4]. Accordingly, examining the relationship between social behaviors and the spatial characteristics of community parks at a micro scale, and developing activity space design strategies that foster social interaction, are essential for enhancing residents' social well-being and mental health and for informing urban design and regeneration strategies.

1.1 Methods for Assessing Social Interaction in Outdoor Spaces

Social interaction refers to communicative actions rooted in social bonds, typically measured by the level of connection and interpersonal contact[6]. It is commonly evaluated at four dimensions: direction (relationships between interacting individuals), depth (degree of mutual dependence), breadth (spatial extent of interaction), and frequency (how often interaction occurs)[7]. Psychologists and sociologists have employed surveys, structured interviews, and behavioral observation to assess social interaction level based on factors such as group size, intensity of interpersonal contact, emotional connectedness, and duration and frequency of interaction (Table 1)[8]~[18]. Among these, the social participation observation scale developed by Mildred B. Parten and colleagues categorizes children's interactions into six types—unoccupied behavior, solitary independent play, onlooker, parallel activity, associative play, and organized supplementary play[15]. This typology has become a classic paradigm in assessing interaction levels[19]. Nevertheless, survey- and interview-based methods, which rely heavily on subjective perceptions, fall short in capturing the direct relationship between social behaviors and the surrounding environment objectively, thereby lacking the quantitative rigor to guide evidence-based spatial design decisions[20].

With the advancement of research, scholars have begun to view social interaction as a result of the interplay between spatial relationships and relational attributes. Urban Design studies suggest that social density can serve as an indicator of social interaction level, as higher occupancy often correlates with greater opportunities for interaction[16]. In addition, research in Proxemics has highlighted the critical role of interpersonal distance in shaping interpersonal interactions[21]. American anthropologist Edward T. Hall conceptualized interpersonal distance as the physical proximity between individuals in social contexts, categorizing it into four types: intimate, personal, social, and public distances[17]. Subsequent studies have largely adopted Hall's distance categories directly. However, due to cultural differences and evolving

Table 1: Academic contributions of related disciplines to the assessment of social interaction

Discipline	Dimension	Indicator	Research method	Key Contribution	Source
Sociology	· Direction · Frequency	· Group size · Interaction type · Interaction duration · Activity frequency · Contact intensity	· Field observation · Systematic observation	Emphasizes the degree of socialization and social attributes of groups	Refs. [8][9][11][15]
Psychology	Depth	· Contact intensity · Emotional attachment · Social support · Neighborhood bonding	· Questionnaire · Structured interview	Emphasizes the strength of interpersonal connections	Refs. [10][12]~[14]
Proxemics	Breadth	Interpersonal distance	· Systematic observation · Virtual simulation experiment	Highlights spatial relationships as implicit components of social interaction, and suggests that interpersonal distance reflects varying levels of group connection	Refs. [17][18]
Urban Design	Breadth	· Activity density · Activity frequency	Systematic observation	Emphasizes spatial utilization pattern	Ref. [16]

relationships between social behavior and space, there remain gaps and misinterpretations in understanding appropriate interpersonal distance scales in small public spaces[18]. This underscores the need to re-examine the micro-scale dimensions of social interaction spaces.

Overall, it is essential to integrate interdisciplinary perspectives from Psychology, Sociology, and Proxemics to assess social interaction in public spaces. Such assessment should be grounded in a comprehensive understanding of interpersonal dynamics and spatial usage patterns. By incorporating spatial indicators such as group size, contact intensity, interpersonal distance, activity density, and activity frequency, it is possible to systematically evaluate the direction, depth, breadth, and frequency of social interaction. This, in turn, supports the reconstruction of an evaluation framework for social interaction in public spaces, which can guide the design of spaces for social activities.

1.2 The Impact of Community Parks on Social Interaction

Community parks refer to independently designated green spaces equipped with basic recreational and service facilities, designed to meet the everyday leisure needs of nearby residents. These spaces embody both the economic characteristics of public goods and the sociological attributes of the public realm[22]. From an economic perspective, existing research has primarily focused on the supply–demand relationships of park services and diverse interactions, analyzing multiple demographic groups' preferences and needs for activity spaces and facilities[23], as well as examining how the equity of park siting and layout[24], facility allocation, and service[25][26] influence the frequency and diversity of group activities. It has been found that proximity to restaurants, commercial areas, and office buildings can significantly increase the intensity of visiting parks[27]. In addition, existing research has evaluated the physical activity levels of group activities based on health benefit objectives and explored how community park spaces and facilities affect the type, duration, and frequency of activities[28]~[32]. For instance, higher shape index of community park and tree diversity have been proved to be negatively correlated with activity diversity[28]; areas with higher vegetation coverage and richer recreational or convenience facilities tend to support a wider variety of activity types[29][30]; furthermore, good lighting, hygiene, and safety conditions can increase the duration and frequency of activities[31][32].

Overall, community park space and facility serve not only as key points influencing residents' activity behaviors but also as essential criteria in planning and design guidance[33]. However, existing research remains limited in examining how spatial and facility characteristics influence the levels of social interaction[34], lacking evaluation of the sociological attributes of community parks

from an integrated perspective of spatial design and behavioral interaction[35], making it difficult to clarify the mechanisms by which physical park features stimulate social interaction. Therefore, it is urgent to determine whether interventions in community park space and facility can alter the levels of social interaction within group activities. This is essential for improving the precision of social demand assessments in community parks and for meeting the finer-granular requirements of urban micro-regeneration.

To re-conceptualize micro-scale social interaction and to uncover the potential and value of group activity spaces in community parks to promote social interactions, and to provide a basis for the renewal and construction of community parks, this study takes selected community parks in Harbin as a case study. By conducting behavioral annotation with GPS tracking, this research generated digital behavioral maps of group activities to explore the following questions: 1) How can group activities be evaluated from the perspective of promoting social interaction? 2) Do spatial and facility characteristics of activity spaces influence social interaction level? 3) What are the characteristics of different types of group activity spaces in community parks, and are there differences in their social interaction levels? And 4) which spaces and facilities in community parks can guide and encourage diverse forms of interaction?

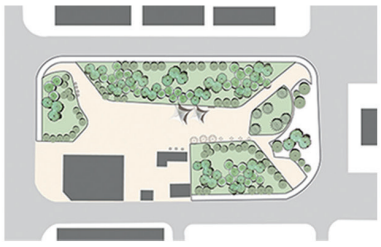
2 Research Methods

2.1 Sample Site Selection

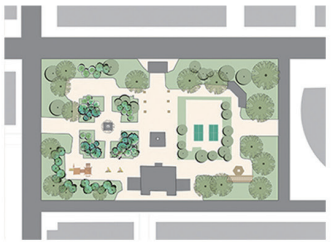
This research followed the definition and criteria for community parks outlined in the *Standard for Classification of Urban Green Space* (CJJ/T 85–2017), screening green spaces with an area of 0.5 ~ 2 hm^2 and a service radius of less than 1 km around the residential areas in the central city area of Harbin as sample sites. All selected community parks should be located within a 15-min living circle of residential communities. Internally, the parks should be equipped with adequate service and recreational facilities and provide ample activity spaces to meet the social needs of users. A total of 11 community parks meeting these criteria were finally selected as sample sites (Fig. 1).

The observation period extended from September 1 to November 7, 2021. During this time, each community park was

1. Sample sites of community parks.



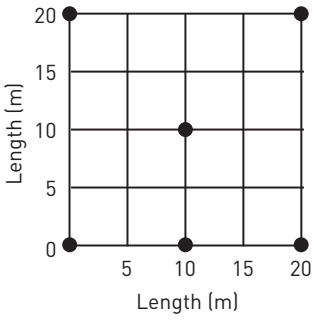
1 Beixiu Square (1.20 hm^2)



2 Xuanqing Community Park (1.01 hm^2)

3 Dideli Community Park (0.76 hm^2)

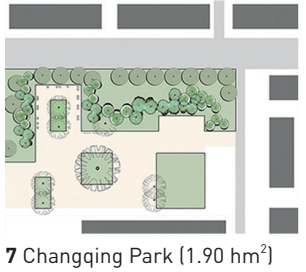
4 Baihua Garden (1.32 hm^2)



Social scale quadrat

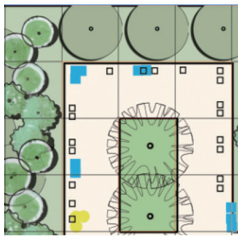
5 Hongqi Community Park (1.50 hm^2)

6 Development Zone Landscape Square (1.98 hm^2)



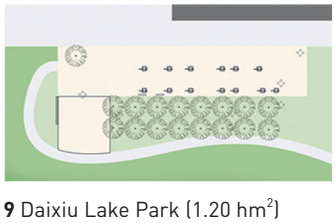
7 Changqing Park (1.90 hm^2)

8 Dongzhi Park (1.68 hm^2)



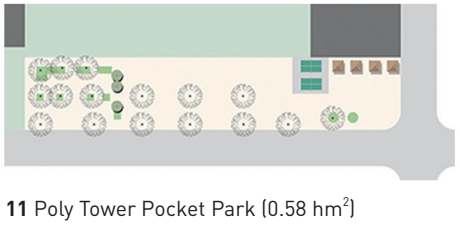
Group activity annotation

Quadrat of group activity unit



9 Daixiu Lake Park (1.20 hm^2)

10 Yongping Community Park (1.02 hm^2)



11 Poly Tower Pocket Park (0.58 hm^2)

surveyed on one weekday and one weekend day, with observations conducted across five time slots: 7:00–9:00, 9:00–11:00, 13:00–15:00, 15:00–17:00, and 17:00–19:00. All observation days were sunny, with average temperatures ranging from 10°C to 13°C. Activity data were collected using a quadrat method. Based on Yoshinobu Ashihara's external modulus theory, 20 ~ 25 m is considered the threshold distance for facial recognition, which facilitates interpersonal communication while maintaining strong spatial rhythm and variation[36]. Accordingly, the quadrat size was set at 20 m × 20 m (Fig.1). Only quadrats in which group activities involving two or more individuals occurred were included as units for analysis. A total of 293 such units were recorded.

2.2 Data Collection

Behavioral annotation and environmental observation are effective tools for assessing human–place interplay and are widely used to extract activity characteristics and spatial demands[37]. This study adopted these tools and incorporated the Social Interaction Scale (SIS) to evaluate the social interaction of group activity units in community parks. The degrees of social interaction were classified as onlooker, parallel, associative, and cooperative (Table 2)[15][20]. A team of three trained observers conducted on-site behavioral annotation during the observation periods. Following the SIS observation protocol, when sampling high-density activity areas, the observers divided the park into zones and conducted instantaneous sampling within each. To avoid misrecording due to the activity variation, only activities without an interaction type change within a 15-min period were recorded as annotation events. Observers used the 2bulu app as the GPS tracker to log the latitude and longitude coordinates of each activity event, while also annotated additional information in the app, including the time, the activity type, the level of social interaction as measured by SIS, and the size of the activity group. In total, 110 on-site observations were conducted across all sample parks, yielding 466 recorded group activity annotation events. Finally, the annotated activities were visualized using ArcGIS to generate digital behavior maps.

This scale integrates evaluation items from established international environmental quality assessment tools for community parks, including Community Park Audit Tool (CPAT), Bedimo-Run Assessment Tool-Direct Observation (BRAT-DO), and Neighborhood Green Space Tool (NGST)[38]. Items that were not applicable to the selected sites (e.g., restroom, sink, water feature) were excluded (Table 3). A total of 14 indicators across six categories were selected, covering site metrics (area, perimeter), number of enclosure interfaces, amenity facilities (bench, picnic table, shade structure, paved surface), recreational facilities (fitness equipment, playground, sports court), natural quality (tree), and safety and maintenance (lighting, warning sign, entrance). These indicators were quantified through on-site observation. Among them, the number of enclosure interfaces was scored as 0, 1, 2, 3, or 4 according to the number of side boundaries. Paved surface was coded as a binary variable: presence as 1, absence as 0.

2.3 Data Analysis

This research used indicators of social activeness, interpersonal distance, and social density to evaluate the level

Table 2: Overview of the SIS observation protocol

Degree of social interaction	Score	Description	Example
Onlooker	1	Individuals observe others in the group but do not participate or communicate	A group of people watching a game together without interacting
Parallel	2	People participate in the group activity but focus more on the activity than on interacting with peers	A group of people skateboarding in the park, focused on the activity with little to no communication
Associative	3	Individuals in the group interact with others, but in an unstructured way	A group casually gathering for a birthday party in the park
Cooperative	4	Individuals participate in an organized group activity	A group playing basketball in the park, with each person taking on a different role in the game

Table 3: Objective indicators of community park environmental features

Park No.	Area (m^2)	Perimeter (m)	Number of bench	Number of picnic table	Number of shade structure	Number of fitness equipment	Number of playground	Number of sports court	Number of tree	Number of lighting	Number of warning sign	Number of entrance
1	12,000	390	8	6	3	8	0	1	61	4	3	4
2	10,100	340	22	2	5	5	1	3	46	5	3	3
3	7,600	320	15	3	6	3	1	1	43	6	1	4
4	13,200	480	15	4	5	9	1	1	35	12	1	5
5	15,000	470	12	5	5	5	1	2	51	8	1	1
6	19,800	530	15	3	5	12	0	1	57	6	3	3
7	19,000	340	11	1	3	8	0	2	41	5	2	2
8	16,800	480	12	6	3	8	0	1	37	18	2	4
9	5,000	410	10	5	3	20	1	1	38	8	1	5
10	10,200	460	3	1	2	12	0	1	36	5	2	5
11	5,800	320	8	4	6	18	0	2	45	6	3	5

NOTE

Indicators for paved surface and the number of enclosure interfaces were recorded during the sampling in 20 m × 20 m quadrats and are therefore not included in this table.

of social interaction in group activities. Social activeness (V) was measured by combining activity frequency, degree of social interaction, and group size. The calculation is as follows:

$$V = \sum(F \times SIS \times G), \quad (1)$$

where F refers to activity frequency, representing the number of observation time slots when the activity occurs. If an activity appears in all five time slots, then F = 5; if only in one, F = 1. SIS represents the degree of social interaction, with values defined in Table 2; G denotes group size, i.e., the number of participants in the group activity. For example, in one unit, observers recorded three people conversing during three time slots, and six people playing table tennis throughout all five time slots. The interaction degree of the conversation is associative (SIS = 3), and that of table tennis activity is cooperative (SIS = 4), then the social activeness score for conversation is 3 × 3 × 3, and for table tennis is 5 × 4 × 6. The total social activeness for the unit is the sum of them, i.e., 147.

Interpersonal distance was measured using the ArcGIS distance measuring tool, representing the physical distance between annotated points. Social density was defined as the number of participants per unit area and was calculated with quadrats as follows:

$$D = P/A, \quad (2)$$

where D is the density, P is the number of participants, and A is the area of the corresponding quadrat (m^2).

Finally, SPSS was utilized to statistically analyze the correlations between spatial/facility characteristics and social interaction levels across all parks and within each activity unit. Meanwhile, this research applied Kernel Density Estimation (KDE) to visualize the spatial distribution and clustering patterns of group activities, and overlaid the KDE results with maps of activity spaces and facilities in the sample parks to validate the analytical results of the correlations.

3 Analysis of Social Interaction Levels

3.1 Social Activeness

Through on-site observation, this research identified ten types of social activities across the sample parks, and categorized their

participants into groups and subgroups based on group size and the social characteristics of participants (Table 4, Fig. 2). Group activities typically involve larger numbers of participants. In contrast, subgroups—often composed of dyads or triads—exhibit more direct, frequent, and intense interpersonal interactions[7]. By comparing each activity's degree of social interaction, activity frequency, and group size, and calculating the average social activeness for each type of activity (Table 5), the results show that group activities such as board and card games and square dancing are cooperative interactions. These activities not only recorded the highest frequencies and participant numbers but also scored the highest in terms of social activeness. Activities with moderate activeness include group-based ball games with cooperative relationships, as well as unorganized casual conversing by subgroups, both show relatively high degrees of social interaction and frequent participation with larger group sizes. Conversely, walking in dyads and child supervision in triads exhibit lower frequencies and social activeness. Although whipping tops is generally played in groups, it falls into the category of parallel activity with minimal interaction among players, which registers the lowest scores across degrees of social interaction, activity frequency, and group size—making it the least socially active behavior observed.

Table 4: Classification of group activities in community parks

Participants of social interaction	Group	Subgroup	
		Dyad	Triad
Group activity	Board and card game; square dancing; ball game; Tai Chi; Whipping top; playing musical instrument	Fitness exercise; walking	Casual conversing; child supervision

3.2 Interpersonal Distance

The results (Fig. 3) reveal significant differences in interpersonal distance across various group activities in community parks. Activities characterized by strong social bonds and conducted in groups typically keep intimate distances of around 0.45 m. For instance, in board and card games, both core participants and onlookers tend to maintain a proximity within the range of 0.45 m. Interactions among close friends and family members, often occurring in dyads or triads, usually with the personal distance of 0.45 ~ 1.2 m. Relevant activities include fitness exercises, casual conversing, walking, and child supervision. Specifically, the internal distances for child supervision range from 0.5 m to 1.2 m, while inter-group distances can extend from 1 m to 10 m. Activities such as Tai Chi and square dancing maintain social distances of approximately 1.5 ~ 2.5 m, which helps preserve comfortable spatial arrangements and avoids the discomfort caused by excessive proximity. Ball games, including

2. Total number of participants of each group activity at different time slots in community parks.

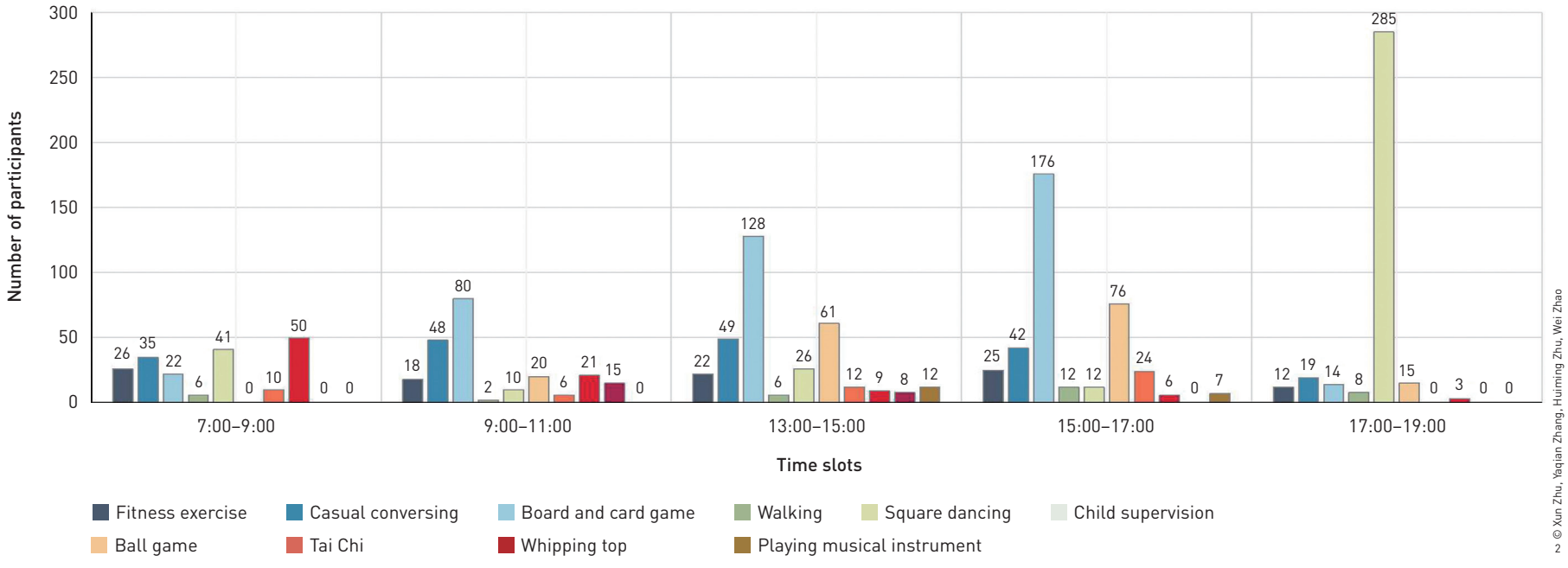


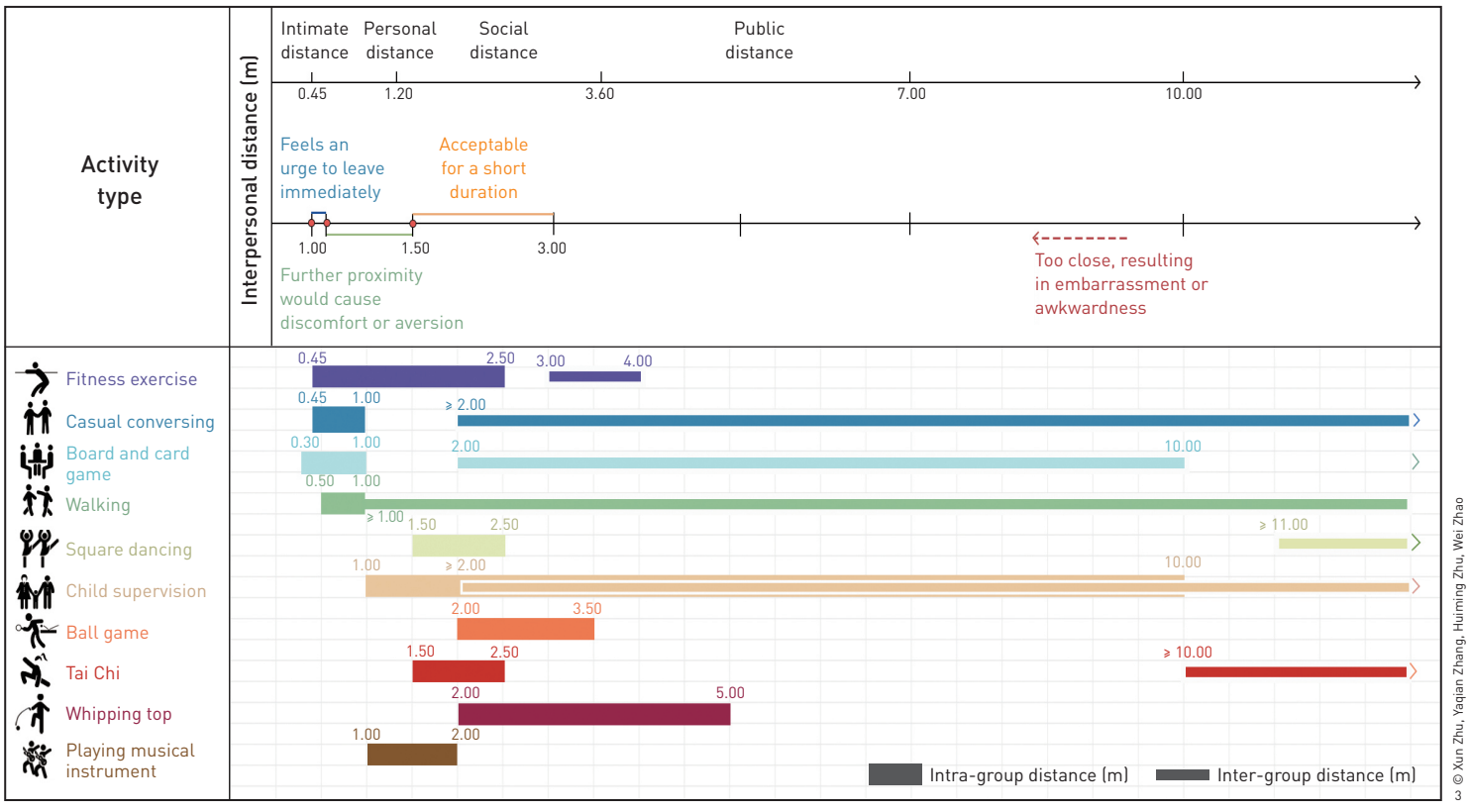
Table 5: Average levels of social interaction for different group activities

Group activity	Social activeness	Interpersonal distance (m)	Social density (persons/m^2)
Fitness exercise	36.182	2.591	0.533
Casual conversing	45.002	0.528	0.682
Board and card game	88.704	0.456	0.884
Walking	16.544	3.427	0.180
Square dancing	86.688	2.296	0.257
Child supervision	27.779	2.733	0.464
Ball game	55.824	2.715	0.251
Tai Chi	37.216	2.335	0.264
Whipping top	13.800	3.400	0.112
Playing musical instrument	19.200	1.800	0.136

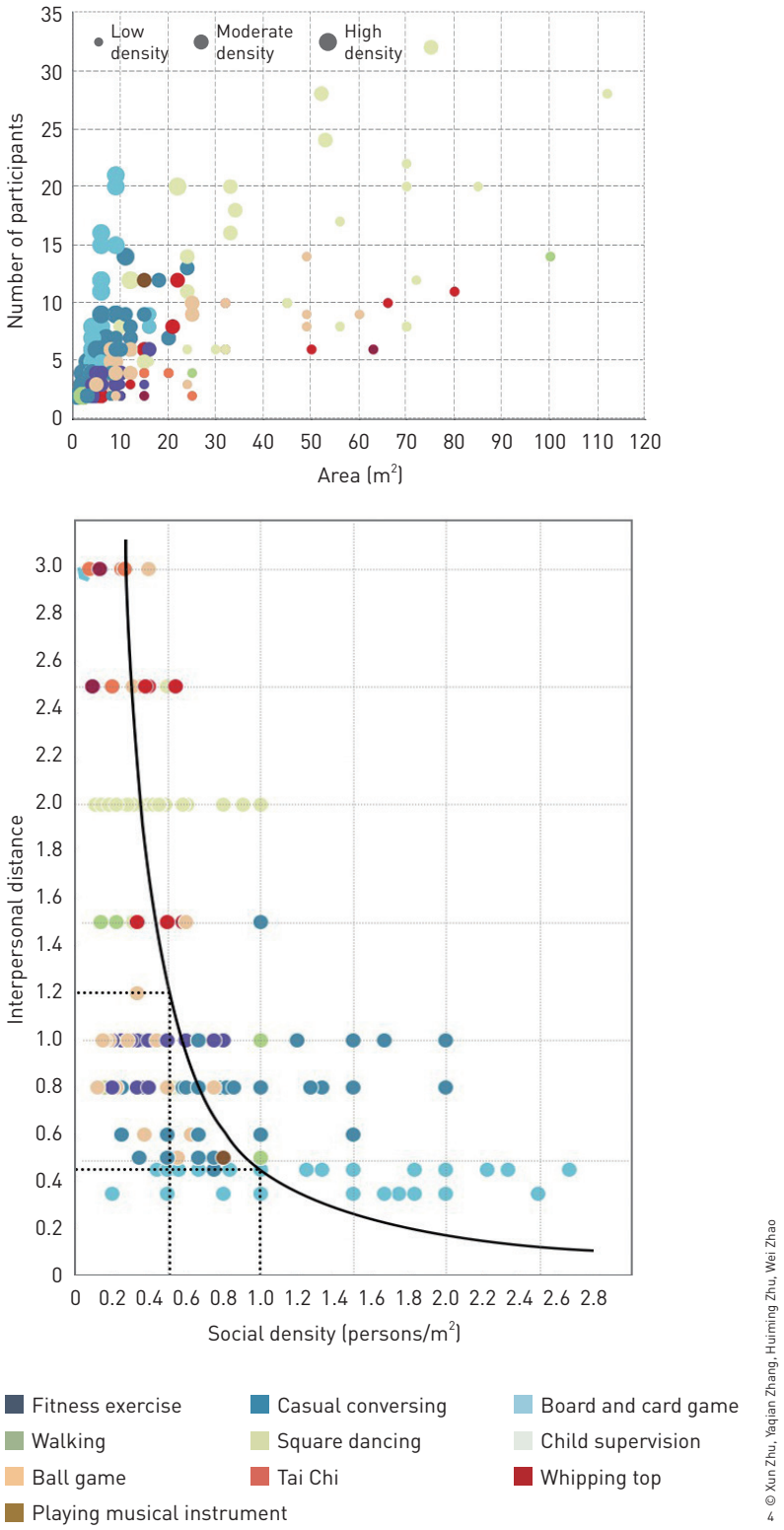
badminton and table tennis, exhibit relatively small variations in interpersonal distance (3 ~ 4 m). According to proxemics theory, individuals in formal or spatially constrained public settings tend to maintain a public distance of 3.7 ~ 7.5 m. However, the physical constraints and interactive nature of specific activities can significantly alter this normative range. In this research, whipping top shows a marked deviation: due to the limited site size and the inherent susceptibility to interference and risk of conflict during gameplay, participants frequently maintain inter-group distances exceeding 10 m, while intra-group interactions typically occur within 2 ~ 5 m.

3.3 Social Density

High-density activities in community parks include board and card games (0.88 persons/m^2), fitness exercises (0.65 persons/m^2), and casual conversing (0.6 persons/m^2), which involve stationary engagement. Moderate-density activities include ball games, square dancing, and child supervision, while low-density activities consist of walking, whipping top, and playing musical instrument (Fig. 4). By applying the least squares method to fit the relationship between interpersonal distance and social density, an L-shaped curve emerges (Fig. 4). When social density is below 0.5 persons/m^2, activity types are relatively limited, spatial distribution is loose, and interpersonal distances typically range from 1.2 m to 3 m, with minimal influence from surrounding spatial features or facilities. When the density reaches 0.5 ~ 1 persons/m^2, the average interpersonal distance falls within the personal distance of 0.45 ~ 1.20 m. People have



3. Interpersonal distance differences across various group activities.



4. Social density across group activities and its relationship with interpersonal distance.

the greatest spontaneity in choosing how to use the space, and the probability of changing activity is also the highest. However, when density exceeds 1 persons/m², interpersonal distances tend to converge to the intimate distance of 0.45 m. In such conditions, high social density suppresses variability in activities and reduces the likelihood of other types of activities emerging.

4 Analysis of the Influence of Community Park Environmental Features on Social Interaction Levels

4.1 Correlations Between Community Park Environmental Features and Social Interaction

According to the correlation analysis between social activity indicators and environmental features (Table 6), the spatial and facility characteristics of community parks have a significant impact on social activeness, social distance, and social density. Specifically, social distance shows a significant positive correlation with the number of bench, picnic table, paved surface, shade structure, and lighting. In addition, the perimeter, area, and number of fitness equipment have a significant positive correlation with social activeness. The perimeter and area reflect the maximum carrying capacity for the number of participants in social activities: spaces with greater capacity are more likely to attract organized group activities, thereby enhancing the overall social activeness of the site. Meanwhile, social density is positively correlated with the number of bench and picnic table, indicating that high-density activities are more dependent on the availability of leisure amenities.

Through the KDE analysis of the spatial distribution and clustering patterns of group activities, it is evident that spatial form and facilities in community parks have a certain influence on social density. Discrete recreational spaces tend to promote the level of activity clustering, while linear spaces along site boundaries show moderate clustering of activities. From morning to evening, activity hotspots consistently concentrate around amenity facilities including picnic tables and seating areas, as well as recreational facilities such as fitness equipment zones, indicating that the presence and spatial arrangement of such facilities significantly affect both the number of participants and the degree of spatial clustering in activities.

4.2 Differences in Activity Levels Across Various Social Activity Spaces

Referring to international classification standards for spatial zones in community parks[39], this research categorized group activity spaces in the study area into five types based on activity patterns and spatial functions: central gathering spaces, peripheral leisure spaces, anchored recreational spaces, equipment-based

Table 6: Correlation analysis between community park environmental features and social activity indicators

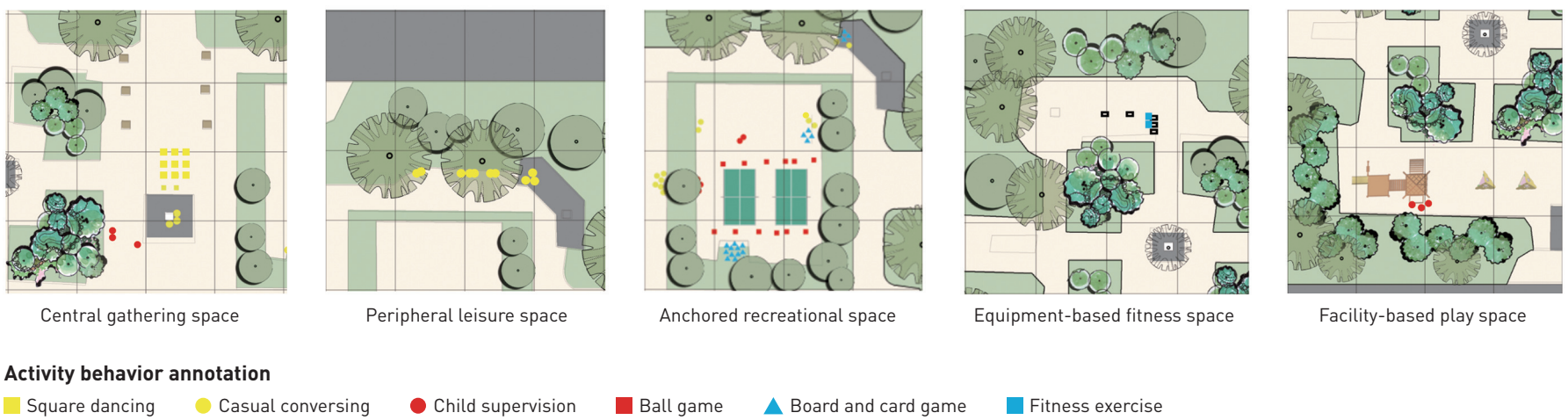
Community park environmental feature	Social activity indicator					
	Social activeness		Interpersonal distance		Social distance	
	r	*Sig.*	*r*	*Sig.*	*r*	*Sig.*
Area	0.412**	0.000	0.253	0.493	0.326	0.536
Perimeter	0.281*	0.017	0.196	0.175	0.186	0.387
Number of enclosure interface	0.065	0.333	−0.206	0.083	0.224	0.297
Number of bench	0.007	0.171	0.269**	0.000	0.128*	0.031
Number of picnic table	0.021	0.751	0.198**	0.003	0.151**	0.007
Number of shade structure	0.032	0.637	0.133*	0.046	0.006	0.924
Paved surface	0.130	0.053	0.437**	0.000	0.004	0.509
Number of fitness equipment	0.138*	0.039	0.110	0.229	0.081	0.101
Number of playground	0.063	0.286	−0.008	0.887	0.007	0.901
Number of sports court	−0.054	0.359	0.362	0.609	−0.172	0.896
Number of tree	−0.249	0.141	−0.228	0.853	0.115	0.655
Number of lighting	0.002	0.972	0.212**	0.001	0.070	0.297
Number of warning sign	−0.062	0.290	−0.224	0.204	0.137	0.916
Number of entrance	0.013	0.831	−0.081	0.167	0.027	0.647

NOTE

* indicates *Sig.* < 0.05, ** indicates *Sig.* < 0.01 (two-tailed test).

fitness spaces, and facility-based play spaces (Fig. 5). Central gathering spaces are open areas accommodating multiple coexisting activities, characterized by high spatial extensibility. These spaces support a variety of activities such as square dancing, whipping top, walking, and child supervision, and are often equipped with lighting facilities to enable nighttime use. Peripheral leisure spaces are shaded linear zones along park edges, often featuring shade structures and attracting more leisure activities such as casual conversing. Anchored recreational spaces rely on the presence of convenience and recreational facilities such as picnic tables and benches to support activities like board and card games and ball games. They are typically enclosed with a strong sense of territoriality. Equipment-based fitness spaces and facility-based play spaces are fewer in number and show a strong dependence on specific equipment and site conditions, often located near park entrances.

This research applied Brown-Forsythe ANOVA to further compare differences in social activity indicators among the five types of social activity spaces (Table 7). Results show significant differences across social activeness, interpersonal distance, and social density ($p < 0.05$). Central gathering spaces exhibit the highest level of social activeness but the lowest social density and relatively longer interpersonal distances. Peripheral leisure spaces show the closest interpersonal distances, indicating more intimate social interactions. Anchored recreational spaces are characterized by high social density and activeness, along with relatively close social distances. Equipment-based fitness spaces and facility-based play spaces, due to their specific functions, exhibit lower levels of social activeness.



5. Different types of group activity space in community parks.

Table 7: ANOVA results of different group activity spaces in community parks

Social activity indicator	Group activity space type (mean ± standard deviation)					Brown *F*	*p*
	Central gathering space (*N* = 74)	Peripheral leisure space (*N* = 99)	Anchored recreational space (*N* = 77)	Equipment-based fitness space (*N* = 36)	Facility-based play space (*N* = 7)		
Social activeness	99.01 ± 6.78	33.81 ± 2.80	66.29 ± 3.82	22.86 ± 1.20	22.86 ± 0.38	29.762	0.000**
Interpersonal distance	1.67 ± 0.65	0.80 ± 0.28	0.86 ± 0.95	0.96 ± 0.08	0.97 ± 0.14	35.151	0.000**
Social distance	0.43 ± 0.26	0.82 ± 0.37	1.05 ± 0.61	0.53 ± 0.27	0.76 ± 0.53	21.922	0.000**

NOTE

* indicates $p < 0.05$, ** indicates $p < 0.01$.

4.3 Effects of Community Park Environmental Features on Social Interaction

Among the five types of group activity spaces, this research focused on central gathering spaces, peripheral leisure spaces, anchored recreational spaces, and equipment-based fitness spaces. It is worth noting that although facility-based play spaces (i.e., areas equipped with fixed children's play equipment) are essential components of community parks, the number of units in sample parks that clearly featured such facilities was limited ($N < 30$). As such, the sample size did not meet the minimum data requirements and statistical validity for reliable correlation analysis and inference. Therefore, facility-based play spaces were excluded from the statistical analysis.

The correlation analysis between social park environmental features and social activity indicators across various space types shows that in central gathering spaces, interpersonal distance has a significant negative correlation with the number of enclosure interface ($r = –0.262$, *Sig.* = 0.013), and positively correlated with area ($r = 0.692$, *Sig.* = 0.001). This indicates that the interpersonal distance is constrained by the spatial scale and degree of enclosure. Central gathering spaces mainly accommodate organized activities such as Tai Chi and square dancing. When bounded by trees or other strongly defined side interfaces and boundaries, activities tend to follow a dual-row pattern, maintaining a consistent distance of 1.5 ~ 2 m. In contrast, in fully open spaces, fitness exercises and square dancing tend to form layered concentric

patterns, with a core of 3 ~ 5 rows of participants, a 2 ~ 5 m buffer zone between dancers and onlookers, and an outer ring maintaining an approximate 3 m safety distance from the boundary. In addition, social activeness and social density in these gathering spaces are significantly correlated with area and the number of lighting, suggesting that nighttime lighting functions as a catalyst for activating the space use and enhancing participation.

Periphery leisure spaces primarily support casual conversing. The variation in interpersonal distance within these spaces is significantly correlated with the number of enclosure interface (r = –0.202, *Sig.* = 0.027). People who gather near boundaries generally maintain intimate to personal distances (0.45 ~ 1.2 m), which aligns with the boundary effect described in environmental psychology[17].

Anchored recreational spaces exhibit a high dependency on facilities. Interpersonal distance in these areas has a significant negative correlation with the number of enclosure interface (r = –0.394, *Sig.* = 0.037), and significant positive correlations with the number of bench and fitness equipment (r = 0.284, *Sig.* = 0.013; r = 0.362, *Sig.* = 0.025). Benches tend to attract casual conversing at personal distance (0.45 ~ 1.2 m), whereas four-seat picnic tables accommodate intimate-distance interactions such as board and card games (within 0.45 m). In addition, bench is a key factor influencing social density in anchored recreational spaces. Arranging benches along boundaries and providing a sense of prospect and shelter are more effective at encouraging social interaction.

In equipment-based fitness spaces, social density is positively correlated with the number of bench, picnic table, shade structur, and sports court, suggesting that functional integration in such spaces helped attract users' clustering. Benches and picnic tables likely provide places for rest and conversation, while shading structures may extend the duration of stay, thereby further increasing social cohesion.

5 Conclusions and Discussion

5.1 The Relationships Between Social Interaction and Space

This research, from the perspective of promoting diverse interactions, conducted a detailed investigation of social interactions in community parks and proposed an innovative evaluation method that used social activeness, interpersonal distance, and social density as key indicators. Compared with the interpersonal distance categories proposed and widely validated by Hall, the results of this research indicate that group activities in community parks broaden both social and public distances. People tend to enter a model of safe and sharing space, maintaining a more close social distance (1.5 ~ 2.5 m). Public distance exceeds the conventional threshold of 7.5 m to a critical range of 10 m. Personal and intimate distances show more flexible variations, often presenting as more compressed or closely clustered configurations. Relevant research also confirms that social relationships can be reshaped in small-scale public spaces, and their spatial patterns do not strictly conform to Hall's classification—social behaviors can also occur at much closer distances[18]. Meanwhile, this research identifies facility-related factors that influence the levels of social interaction, finding that social activeness in community park is positively associated with the presence of fitness and recreational facilities, which aligns with the findings of Tinghong Guo et al., who suggested that recreational amenities (e.g., playground) enhance park vitality by supporting social interaction behaviors[40]. Furthermore, this research reveals that interpersonal distance has a significant positive correlation with the number of lighting and a significant negative correlation with the number of enclosure interface. Related research similarly confirms that low lighting levels are negatively correlated with pedestrian mobility[41], and relatively low spatial permeability tends to promote social interactions and reduce distances[42]. The number and distribution of amenity facilities emerge as key factors influencing social density, discrete recreational spaces and linear boundary spaces are identified as the primary zones for activities and clustering. However, these findings contrast with those of Shuolei Chen et al., who concluded—based on measures of contact intensity and group size—that safety and maintenance features are the primary factors promoting social interaction in Nanjing's community parks, while amenity facilities have only limited effectiveness in attracting social groups[34]. A comparative study of community parks in Belgium also finds that increasing amenity and recreational facilities have no significant impact on the number of people participating social interactions per hectare[43]. These differing conclusions suggest that cultural, geographic, and climatic contexts may influence social interaction patterns and spatial preferences, and further research with a broader geographic scope and larger sample size is needed to verify the generalizability of the relationship between facilities and social catalysts.

5.2 Spatial Optimization Strategies to Promote Social Interaction

Based on systematic observational data, this research analyzed how spaces and facilities in community parks contribute to social interaction, and proposed the following recommendations for spatial optimization in community park design.

1) To optimize the spatial layout and functional zoning for social activities, a nested spatial configuration of "central activity hub + functional clusters" can be adopted to construct an integrated social space network. In this layout, the central activity hub serves as a gathering space, while functional clusters—such as fitness, recreational, and leisure modules—are distributed around the periphery, stimulating diverse patterns of social behavior among residents.

2) Quantify spatial configuration standards for social activities to enhance multi-activity capacity. Based on the level of dependence on facilities, spatial standards can be categorized into three types. First, for activities in gathering spaces by groups, site demand can be estimated based on social density. For example, 4 ~ 8 m^2/person for square dancing, 9 m^2/person for whipping top, and 4 ~ 6 m^2/person for Tai Chi. Second, for activities taking place in leisure spaces by sub-groups (e.g., casual conversing, child supervision), activity capacity can be calculated based on interpersonal distance and the number of participants. For instance, the radius of interaction for casual conversing is 0.5 ~ 0.8 m, and 0.5 ~ 1.2 m for child supervision. Third, for activities in play, fitness, or recreational spaces that are highly dependent on specific facilities, spatial scale should be assessed according to the size of facilities. For example, 8 ~ 16 m^2 per board and card game table unit, and 3 ~ 6 m^2 per fitness equipment unit.

3) Leverage environmental amenities to create diverse and interactive social activity spaces. In recreational areas, increase the setting of resting facilities including physical structures, benches, and potential seating elements. In gathering areas, adjust the coverage of lighting to activate nighttime vitality and extend the duration of active use. Along spatial boundaries, install shade structures to create comfortable leisure zones that encourage lingering and interaction. In fitness areas, incorporate layered and diverse planting designs, and increase seating and shade structures to create multifunctional spaces that further strengthen social cohesion.

5.3 Limitations and Prospects

This research employed a combined method of behavioral annotation and environmental observation tools, supplemented by precisely geolocated GIS mapping to create digital behavior maps and analyze the level of social interaction and its influencing factors within small-scale spatial contexts. This method provides fundamental information during the early stages of urban planning and design, assisting designers in developing evidence-based social spaces. However, direct observations based on a small sample size may involve case-specific biases. Future research could expand the sample size to improve the generalizability of the findings. In addition, as the limited accuracy of GPS positioning may result in slight measurement errors, the application of digital technologies should be further developed to more accurately track interaction trajectories, exploring the dynamic spatial distribution of social interactions and informing the layout of functional and spatial planning.

ELECTRONIC SUPPLEMENTARY MATERIAL

Supplementary material is available in the online version of this article at https://doi.org/10.15302/J-LAF-0-020041.

Competing interests | The authors declare that they have no competing interests.

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社区公园群体活动空间对社交互动的影响

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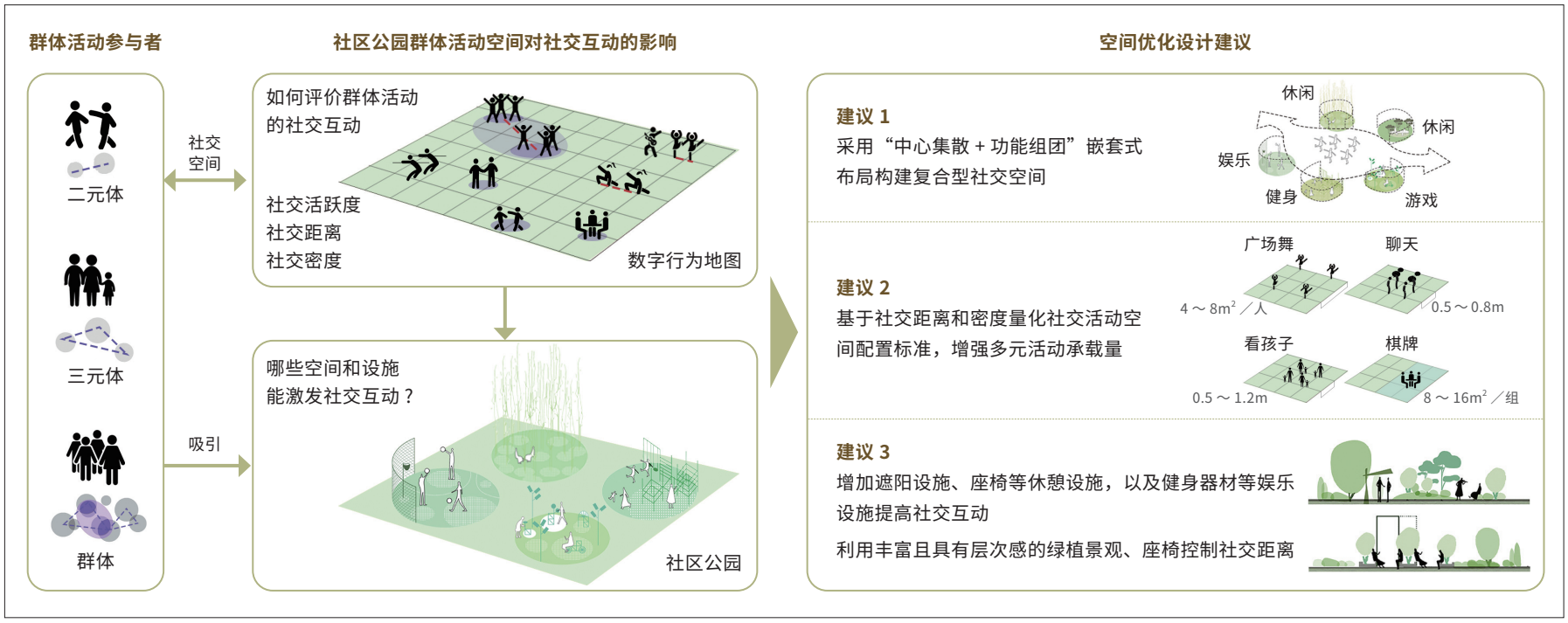
图文摘要



摘要

社交互动在促进人际交往、建立社会联结方面有重要作用。社区公园作为居民日常休闲互动的主要载体，挖掘其促进社交活动的潜力对于提升场所依恋、提升社会福祉具有重要意义。本文以哈尔滨市典型社区公园为调查对象，结合行为注记法和环境观察法绘制群体活动的数字行为地图，测量社交活跃度、社交距离和社交密度三项指标以评估群体活动的社交互动水平，并运用核密度分析、相关性分析和方差分析等方法识别社区公园中促进社交互动的环境特征。结果表明，社交互动水平受到社区公园空间与设施的显著影响，增设娱乐设施可提高社交活跃度；增设铺装、照明设施的增加可延长社交距离，增加围合界面则可缩短社交距离；增设便利设施可提高社交密度；另外，点状休闲空间和线型边界空间是主要的活动聚集热点。据此，本研究提出了促进社区公园社交互动的空间优化策略，以期通过微空间更新为社区公园赋予活力，进而促进社交参与和提高居民身心健康。

关键词

社区公园；社交互动；社交距离；社交密度；城市空间优化

文章亮点

- 利用社交活跃度、社交距离和社交密度评价社交互动水平
- 发现社区公园的空间、边界和设施对社交互动有显著影响
- 不同群体活动空间在社交活跃度、社交距离和社交密度上存在差异

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1 背景

快速城镇化进程和虚拟网络环境的发展重构了当前居民的生活习惯和社会交往方式，导致人际关系淡漠，甚至出现“息交绝游”等现象。而城市公共活动空间可有效促进居民交往、增加社会联结，进而缓解焦虑[1]。此外，随着城市进入存量发展，城市社区公园作为典型的微小型城市绿地，凭借可达性强等特征[2]，既承载日常社交互动的重要功能，也是实现城市微更新的关键空间资源[3][4]。因此，在微观尺度研究人群社交活动行为及其与社区公园空间的互动关系，建立促进社交互动的活动空间设计策略，对保障居民社会福祉和心理健康[5]，以及指导城市设计与更新具有重要意义。

1.1 户外空间社交互动的评估方法

社交互动指因社会联结关系而建立的交往活动，常通过与他人的联系和互动程度来反映其水平[6]。社交互动包含4个维度——向度（互动双方关系）、深度（互动双方依赖程度）、广度（互动空间大小）和频度（互动频率）[7]。心理学和社会学家通过问卷调查、结构访谈和行为观察手段，从群体规模、与人的接触强度、情感联结程度、互动时长和频次等维度评估了社交互动水平（表1）[8]~[18]。其中，米尔德莱德·B．帕顿等开发了用以评估儿童间互动程度的社交互动系统观察量表，包含无参与行为、单独游戏、旁观、平行游戏、联合游戏、合作游戏6种互动类型[15]，已成为评估社交互动水平的经典范式[19]。然而，由于问卷访谈多基于个人主观感知对社交互动进行间接评价，这类评估方法尚无法客观反映社交互动与所处空间的直接关联，难以提供定量数据辅助空间设计决策[20]。

伴随研究的深入，部分学者开始将社交互动视作空间关系和属性关系共同作用的结果。城市设计研究表明，社交密度可反映社交互动水平——容纳的人数越多则社交互动可能性越高[16]。此外，空间关系学研究表明，社交距离在社交互动关系的形成过程中起到关键作用[21]。美国人类学家爱德华·T．霍尔将此概念定义为人际交往的物理距离，分为亲密距离、个人距离、社交距离和公共距离4类[17]。后续相关研究则多直接沿用霍尔距离分类。然而，由于文化差异、交往与空间关系模式的变化，学界对小型公共空间中社交距离的尺度仍存在一定缺位和误读现象[18]，有待重识社交互动空间的微观尺度。

综合来看，有必要跨学科融合心理学、社会学和空间关系学视角进行公共空间社交互动评估。同时，需要基于对人群互动关系和空间使用模式的理解，整合群体规模、接触强度、社交距离、活动密度和活动频次等空间落位指标，系统评估社交互动的向度、深度、广度和频度，重新构建公共空间中社交互动水平的评估框架，更好地指导城市社交活动空间设计。

1.2 社区公园对社交互动的影响

社区公园是指用地独立、具有基本游憩和服务设施、服务周边居民日常休闲活动需求的绿地。它既具有公共物品的经济学属性，也具备公共领域的社会学属性[22]。从经济学视角出发，相关研究多聚焦于社区公园服务和多元互动的供需关系，分析不同人群对活动空间和设施的需求与偏好[23]，探讨公园选址布局[24]、设施配置与服务的公平性[25][26]对群体活动频度和丰富度的影响。研究表明，邻近餐馆、商业和办公室可提升社区公园的访问强度[27]。此外，亦有研究基于健康效益目标评估了部分群体活动的体力活动水平，分析了社区公园的空间和设施对活动类型、时长和频率的影响[28]~[32]。例如，社区公园空间形状指数、乔木树种多样性和活动多样性呈负相关[28]；绿化覆盖率高、游憩和便利设施丰富的区域活动类型更为丰富[29][30]；配套设施良好的采光、卫生和安全条件有助于提升活动时长和活动频率[31][32]。

整体来看，社区公园的空间与设施不仅是干预居民活动的重要切入

表 1：相关学科领域对社交互动评估的学术贡献

学科	维度	指标	研究方法	关键贡献	来源
社会学	· 频度 · 向度	· 群体规模 · 互动类型 · 互动时长 · 活动频次 · 接触强度	· 田野调查 · 系统观察	强调群体的社会化程度和社会属性	参考文献 [8][9][11][15]
心理学	深度	· 接触强度 · 情感依恋 · 社会支持 · 邻里联结	· 调查问卷 · 结构访谈	强调与人的联系程度	参考文献 [10][12]~[14]
空间关系学	广度	· 社交距离	· 系统观察 · 虚拟仿真实验模拟	强调空间关系是人际交往中隐藏的组成部分，且社交距离反映群体间的不同关系	参考文献 [17][18]
城市设计	广度	· 活动密度 · 活动频次	系统观察	强调空间使用模式	参考文献 [16]

点，也是规划设计指导的重要指标[33]。然而，现有研究对空间与设施特征如何影响社交互动水平的研究相对薄弱[34]，缺少从整合空间设计和行为互动的视角衡量社区公园的社会学属性[35]，难以厘清场地特征触发社交互动的作用路径。因而，亟需明确对社区公园空间与设施的干预是否会改变群体活动的社交互动水平，以满足社区公园社交需求评估精确度和城市微更新调控单元粒度要求。

为了重新认识微观尺度的社交活动，挖掘社区公园群体活动空间促进社交互动的潜力和价值，为社区公园更新建设提供依据，本研究以哈尔滨典型社区公园为研究案例，通过行为注记法结合GPS定位绘制群体活动的数字行为地图，探索以下问题：1）如何从促进社交互动的角度评估群体活动？2）活动空间与相关设施的特征是否影响社交互动水平？3）社区公园中不同类型的群体活动空间分别具有怎样的特征，其社交互动水平是否具有差异性？以及4）社区公园中哪些空间及设施会调节引导多元互动？

2 研究方法

2.1 样地选择

研究基于《城市绿地分类标准》（CJJ / T85－2017）对社区公园的定义和规范，筛选哈尔滨市中心城区居住区周边面积为0.5 ~ 2hm^2、服务半径小于1km的绿地为样地。研究要求社区公园处在居住区15分钟生活圈范围内，内部配备完善的服务及游憩设施，并拥有充足的活动空间以满足使用者的社交需求。本研究最终筛选出11个典型社区公园为样地（图1）。

研究调研周期为2021年9月1日 ~ 11月7日。研究团队分别选择工作日、休息日各一天中的5个时间段（7:00－9:00、9:00－11:00、13:00－15:00、15:00－17:00和17:00－19:00）对各样地进行活动调查。观测期均为晴天，平均温度为10 ~ 13℃。研究通过样方法采集活动数据。根据芦原信义的外部模数理论，20 ~ 25m是识别人脸的距离阈值，此距离能有效促进个体之间的交流互动，同时其空间节奏感和差异性较强[36]。因此，本研究将采样样方设定为20m × 20m（图1）。以样地中出现两人及两人以上群体活动的样方为统计单元，共采集293个单元。

2.2 数据收集

行为注记和环境观测是评估人与场所相互作用的有效工具，被广泛用于提取活动特点和空间需求[37]。本研究采用这些工具，结合社交活动量表（Social Interaction Scale，SIS）评估社区公园群体活动单元的社交互动，并以旁观、平行、联系和合作体现群体中的社交互动程度（表2）[15][20]。观察小组由3名经过培训的观测者组成，对公园进行现场观察注记。依据SIS观察流程，在对活动密度较大的场地进行整体采样

表 2：SIS 观测标准

社交互动程度	评分	解释	例子
旁观	1	在群体中的个体观察他人动作，但不参与或不相互交流	一群人坐在一起看球赛，但不互相交流
平行	2	个体参与群体活动，但对活动的兴趣高于与同伴互动	一群人可能在公园里一起玩滑板，但他们专注于滑板，没有相互交流
联合	3	群体中的个人与他人互动，但以无组织的方式进行	一群人非正式地聚集在公园里参加生日派对
合作	4	一群人一起参与有组织的活动	一群人在公园中打篮球，他们每个人都可能在比赛中扮演不同的角色

时，需要对公园划分片区进行瞬时采样。同时，为避免活动变化造成信息的错误捕捉，观测者仅记录15min内未发生互动行为变化的活动。观测者利用两步路软件作为活动GPS追踪器，定位活动发生点的经纬度坐标，同时在软件上注记观测活动信息，包括活动时间、活动类型和SIS测量的社会互动程度和活动人群规模。本研究共在所有样地公园进行了110次现场观测，采集了466组群体活动注记事件。最后通过ArcGIS将活动注记可视化，形成数字行为地图。

综合国外社区公园环境质量评估工具中的社区公园审核工具（CPAT）、直接观察评估工具（BRAT-DO）、邻里绿色空间工具（NGST）的环境特征评估项目[38]，排除不适用于调研样地的评估项目（如卫生间、洗手池、水景等），本研究设置6类共14项评价指标（表3），包含场地指数（面积、周长）、围合界面数量、便利设施（座椅、公园桌、遮阳设施、铺装）、娱乐设施（健身器材、游乐场、运动场）、自然品质（乔木）、安全维护（照明设施、警示牌、出入口），

表 3：社区公园环境特征指标统计

公园	面积（m^2）	周长（m）	座椅（个）	公园桌（个）	遮阳设施（个）	健身器材（组）	游乐场（组）	运动场（组）	乔木（株）	照明设施（个）	警示牌（个）	出入口（个）
1	12 000	390	8	6	3	8	0	1	61	4	3	4
2	10 100	340	22	2	5	5	1	3	46	5	3	3
3	7 600	320	15	3	6	3	1	1	43	6	1	4
4	13 200	480	15	4	5	9	1	1	35	12	1	5
5	15 000	470	12	5	5	5	1	2	51	8	1	1
6	19 800	530	15	3	5	12	0	1	57	6	3	3
7	19 000	340	11	1	3	8	0	2	41	5	2	2
8	16 800	480	12	6	3	8	0	1	37	18	2	4
9	5 000	410	10	5	3	20	1	1	38	8	1	5
10	10 200	460	3	1	2	12	0	1	36	5	2	5
11	5 800	320	8	4	6	18	0	2	45	6	3	5

注
铺装和围合界面在 20 m × 20 m 样方中进行统计，因此未在表格中呈现。

并通过现场观测做出定量统计。其中，围合界面数量以侧界面的数量赋值为0、1、2、3、4，铺装以“有无存在”为标准，将“有”赋值为1，“无”赋值为0。

2.3 数据分析

研究利用社交活跃度、社交距离和社交密度指标衡量群体活动的社交互动水平。社交活跃度（V）综合活动频率、社交互动程度、群组规模来衡量，具体计算方法为：

$$V = \sum(F \times SIS \times G), \quad (1)$$

式中F为活动频率，反映社交活动在5个观测时间段中出现的次数，若活动出现在全部时段，则F=5，仅出现在1个时段，则F=1；SIS为社交互动程度，赋值见表2；G表示群组规模，即群体活动中的人数。例如，观测者发现在某个单元中，3个人在3个时段持续进行聊天，6个人在全天候开展乒乓球活动，其中聊天的互动程度为联合（赋值3），打球为合作（赋值4），则聊天的社交活跃度为$3 \times 3 \times 3$，打球的社交活跃度为$5 \times 4 \times 6$，此单元总体社交活跃度为二者总和，即147。

社交距离即活动注记点之间的物理距离，由ArcGIS距离测量工具测算。社交密度以单位面积内的活动人数表征，通过样方统计计算：

$$D = P/A, \quad (2)$$

式中D代表密度，P代表活动人数，A代表对应样方的面积（m^2）。

最后，利用SPSS分析统计各样地整体和各类活动单元中空间和设施特征与社交互动水平的关系。同时，借助核密度分布图展示群体活动的空间分布特征和聚集程度，并与样地的群体活动空间和设施图叠加，以验证关联规则的分析结果。

表 4：社区公园的群体活动分类

社交参与者	群体	亚群体	
		二元体	三元体
群体活动	棋牌；广场舞；打球；太极；抽尕；乐器	健身；散步	聊天；看孩子

表 5：不同群体活动的社交互动水平平均值

群体活动	社交活跃度	社交距离（m）	社交密度（人／m^2）
健身	36.182	2.591	0.533
聊天	45.002	0.528	0.682
棋牌	88.704	0.456	0.884
散步	16.544	3.427	0.180
广场舞	86.688	2.296	0.257
看孩子	27.779	2.733	0.464
打球	55.824	2.715	0.251
太极	37.216	2.335	0.264
抽尕	13.800	3.400	0.112
乐器	19.200	1.800	0.136

3 社交互动水平分析

3.1 社交活跃度

经观察，本研究在各样地中识别了10项社交活动，并依据活动规模和参与者的社会属性，将活动人群分为群体和亚群体两类（表4，图2）。群体常涉及较大规模的社交行为，亚群体则表现出更强烈、频繁和积极的直接互动，通常以二元体和三元体为代表[7]。通过比较各项活动的社交互动程度、活动频率和规模，并计算各项活动的社交活跃度平均值（表5），研究发现，样地中以群体为单位开展的棋牌、广场舞等有组织活动属于合作关系，其活动频率最高、人数最多且社交活跃度最高。中活跃度活动包括以群体为单位伴随合作关系的打球活动，以及以亚群体为单位开展的无组织聊天活动，其社交互动程度和活动频率较高且人数较多。以二元体开展的散步和以三元体为单位的看孩子活动的活动频率和社交活跃度较低。抽尕虽以群体为单位开展，但其属于互不干扰的平行活动，互动程度、活动频率和人数最低，因此其社交活跃度最低。

3.2 社交距离

测算结果（图3）表明，各项社区公园群体活动之间呈现出明显的社交距离差异。具有强烈联系且以群体为单位的活动常保持在0.45m范围的亲密距离。例如，在棋牌活动中，核心人群和围观人群的社交距离均在0.45m以内。以二元体和三元体为单位的亲密朋友和家人之间互动一般保持0.45 ~ 1.2m的个人距离，相关活动包括健身、聊天、散步和看孩子。其中，看孩子活动内部距离为0.5 ~ 1.2m，群体间距离为1 ~ 10m。太极和广场舞等活动保持1.5 ~ 2.5m的社交距离，以维持适当的队形间距，避免因过度接近而引起不适。羽毛球和乒乓球等球类活动的社交距离波

动较小（3～4m）。依据空间关系学理论，在正式或空间受限的公共接触情境中，个体普遍倾向于维持3.7～7.5m的公共距离。然而，具体活动的物理约束与互动特性可显著影响这一距离范围。本研究观察到的抽忝活动即呈现明显偏差：受限于场地规模及其活动过程中固有的易干扰性与冲突风险，群体间普遍接受并维持10m以上的公共距离，群体内保持2～5m的社交距离。

3.3 社交密度

社区公园中的高密度活动包括保持停留状态的棋牌（0.88人／m^2）、健身（0.65人／m^2）和聊天（0.6人／m^2），中密度活动有打球、广场舞和看孩子，低密度活动涵盖散步、抽忝、乐器活动（图4）。通过最小二乘法拟合社交距离和密度关系，发现其呈现“L”形曲线转化关系（图4）。当人群密度小于0.5人／m^2时，活动类型较少，人群在空间中的分布松散，社交距离保持在1.2～3m，受活动空间和设施的影响较小。当人群密度达到0.5～1人／m^2时，交往距离保持在0.45～1.20m，人们在空间中自由活动的选择性最高，活动发生变化的概率也最高。当人群密度超过1人／m^2时，人与人之间的距离趋向于亲密交往距离0.45m。高社交密度抑制了活动的变化，减少了其他行为活动的产生。

4 社区公园环境特征对社交互动水平的影响分析

4.1 社区公园环境特征与社交互动的相关性

根据社交活动指标和环境特征相关性分析结果（表6），社区公园的空间与设施特征对社交活跃度、社交距离和社交密度有显著影响。其中，社交距离与座椅、公园桌、铺装、遮阳设施和照明设施数量呈显著正相关关系。活动空间的周长、面积和健身器材数量与社交活跃度显著正相关。活动空间的周长和面积反映了其社交活动人数的最大承载能力，承载力大的空间可以吸引更多以群体为单位的有组织活动，提高场地的社交活跃度。社交密度与座椅和公园桌呈现正相关关系，体现了高密度活动对休闲设施的依赖性。

通过KDE群体活动空间分布特征和聚集程度分析，发现社区公园空间形态和设施对社交密度有一定影响。点状休闲空间引导活动高度聚集，沿场地边界空间则呈现活动中度聚集。从早至晚，活动热力点均集中于公园桌和座椅等便利设施及健身器械等娱乐设施分布的区域，表明这两类设施的存在和布局明显影响参与活动的人数及活动空间聚集程度。

4.2 不同社交活动空间的活动水平差异

本研究参考相关社区公园的空间分区分类标准[39]，依据活动模式和空间功能将群体活动空间分为中心集会、边界休闲、锚点娱乐、器械健身和设施游戏空间（图5）。中心集会空间是多种活动共存的开敞空间，因其具有高延展性而承载了广场舞、抽忝、散步、看孩子等活动，且照明设施可为其夜间活动提供可能。边界休闲空间主要指带有遮阳设施、提供荫蔽的带状边界空间，常吸引聊天等休闲活动。锚点娱乐空间是依托桌椅等便利和娱乐设施开展棋牌、打球等活动的空间，空间围合性和领域感较强。设施游戏和器械健身空间数量较少，表现出对相应设施和场地的强依赖性，和公园出入口具有一定结构伴生性。

本研究采用Brown–Forsythe ANOVA方差检验进一步比较5类社交活动空间在社交活动指标上的差异（表7）。结果显示，5类空间在社交活跃度、社交距离和社交密度上均显著相关（p<0.05）。中心集会空间保持最高的社交活跃度，社交密度最低，同时社交距离较远。边界休闲空

表 6：社区公园环境特征与社交活动指标相关性分析结果

社区公园环境特征	社交活动指标					
	社交活跃度		社交距离		社交密度	
	r	*Sig.*	*r*	*Sig.*	*r*	*Sig.*
面积	0.412**	0.000	0.253	0.493	0.326	0.536
周长	0.281*	0.017	0.196	0.175	0.186	0.387
围合界面	0.065	0.333	－0.206	0.083	0.224	0.297
座椅	0.007	0.171	0.269**	0.000	0.128*	0.031
公园桌	0.021	0.751	0.198**	0.003	0.151**	0.007
遮阳设施	0.032	0.637	0.133*	0.046	0.006	0.924
铺装	0.130	0.053	0.437**	0.000	0.004	0.509
健身器材	0.138*	0.039	0.110	0.229	0.081	0.101
游乐场	0.063	0.286	－0.008	0.887	0.007	0.901
运动场	－0.054	0.359	0.362	0.609	－0.172	0.896
乔木	－0.249	0.141	－0.228	0.853	0.115	0.655
照明设施	0.002	0.972	0.212**	0.001	0.070	0.297
警示牌	－0.062	0.290	－0.224	0.204	0.137	0.916
出入口	0.013	0.831	－0.081	0.167	0.027	0.647

注

* 表示 *Sig.*<0.05，** 表示 *Sig.*<0.01（双尾检验）。

间的社交距离最近，其承载的交往活动关系较为紧密。锚点娱乐空间具有较高的社交密度与活动活跃程度，同时保持较近的社交距离。器械健身和设施游戏空间的专属性较强，其社交活跃度较低。

4.3 不同社交公园环境特征对社交互动的影响

在五类社区公园活动空间类型中，本研究着重分析了中心集会空间、边界休闲空间、锚点娱乐空间和器械健身空间。值得注意的是，尽管设施游戏空间（即配备固定儿童游乐设施的区域）是社区公园的重要组成部分，鉴于研究样本中拥有此类明确界定设施的活动单元数量有限（N<30），其样本量不足以满足后续相关性分析等统计推断所需的最低数据要求与统计效力。因此，本研究未将设施游戏空间纳入统计分析。

社交公园环境特征与各类空间社交活动指标相关性分析结果显示，中心集会空间的社交距离与围合界面数量呈显著负相关关系（r=－0.262，$Sig.$=0.013），与场地面积呈显著正相关关系（r=0.692，$Sig.$=0.001），表明社交距离受到活动空间尺度和界面围合状态的限制。集会空间主要承载太极和广场舞等有组织活动，当包含树木或其他限定性强的侧界面和明确的空间边界时，活动呈现出保持一定距离（1.5～2m）的双列队列状态。而在完全开敞的空间中，健身操和广场舞呈现出圈层结构，核心为3～5排跳舞活动，中间是围观人群和跳舞人群间2～5m的缓冲空间，最外圈则为围观人群与边界之间3m左右的安全距离。此外，集会空间的社交活跃度、社交密度与面积和照明设施数量显著相关，说明夜间照明设施可以作为激活空间、提高活动参与度的媒介。

边界休闲空间主要承载聊天活动，其人群社交距离变化与围合界面数量显著负相关（r=－0.202，$Sig.$=0.027），且靠近界面的人群普遍保持0.45～1.2m的亲密距离和个人距离，和行为心理学中的边界效应特点保持一致[17]。

锚点娱乐空间具有较高设施依赖性，社交距离与围合界面呈显著负相关（r=－0.394，$Sig.$=0.037），与座椅和健身器材呈显著正相关（r=0.284，$Sig.$=0.013；r=0.362，$Sig.$=0.025）。长椅更能吸引个人距离（0.45～1.2m）的聊天活动，而四人公园桌则承载了亲密距离（0.45m以内）的棋牌活动。此外，座椅是影响锚点娱乐空间社交密度的主要因素，沿边界排布、满足眺望－庇护感的座椅更能吸引人群互动。

器械健身空间的社交密度与座椅、公园桌、遮阳设施、运动场呈正相关，表明此类空间的功能复合化可以进一步吸引人群聚集。座椅和公园桌可能为人们提供休息和交流的场所，遮阳设施可能延长人们停留时间，进一步增强了社交黏性。

5 结论与讨论

5.1 社交互动与空间的影响关系

本研究从促进多元互动的视角出发，对社区公园社交互动进行了详细调研，创新性地提出了从社交活跃度、社交距离和活动密度指标评估社交互动水平的研究方法。相较霍尔提出并被普遍证实的社交距离，本研究结果表明，社区公园中的群体活动拓宽了社交距离和公众距离，人们倾向于进入一种安全共享空间的模式，即保持更亲密的社交距离（1.5～2.5m）。公众距离突破原有的7.5m，进一步扩大到10m的临界阈值。个人距离和亲密距离则具有更灵活的变化模式，呈现更亲密的挤压、组群化的现象。相关研究亦证实了社交关系可在小型公共空间中被重塑，其空间关系模式并不完全符合霍尔的分类，社交行为也可以在更紧密的距离中出现[18]。同时，本研究揭示了影响社交互动水平的设施要素，发现社区公园的社交活跃度受到健身娱乐设施的正向影响，与郭庭鸿等的研究结果一致，即游乐场等娱乐设施可通过支持社交互动行为来提升公园游憩活力[40]。其次，本研究表明，社交距离与照明设施呈显著

表 7：社区公园不同社交活动空间 ANOVA 方差分析结果

社交活动指标	社交活动空间（平均值 ± 标准差）					Brown F	p
	中心集会空间（N=74）	边界休闲空间（N=99）	锚点娱乐空间（N=77）	器械健身空间（N=36）	设施游戏空间（N=7）		
活动活跃度	99.01±6.78	33.81±2.80	66.29±3.82	22.86±1.20	22.86±0.38	29.762	0.000**
社交距离	1.67±0.65	0.80±0.28	0.86±0.95	0.96±0.08	0.97±0.14	35.151	0.000**
社交密度	0.43±0.26	0.82±0.37	1.05±0.61	0.53±0.27	0.76±0.53	21.922	0.000**

注

* 表示 p<0.05，** 表示 p<0.01。

正相关，与围合界面呈显著负相关。相关研究同样证实，低照明水平与人群流动性呈负相关关系[41]，空间渗透度较低则会促进社交互动，拉近活动距离[42]。便利设施的数量和分布是影响社交密度的主要要素，点状休闲空间和线型边界空间是活动聚集的主要空间。然而，陈硕蕾等利用互动接触程度和群体规模衡量南京社区公园社交互动水平的研究结论与本研究相反，指出公园中安全维护特征是促进社交互动的关键要素，而便利设施难以吸引更多的社会群体[34]。比利时的一项社区公园对比研究则认为增加便利娱乐设施对每公顷互动人数无明显影响[43]。不同的结论表明，不同文化、地域、气候背景可能会对社交互动模式和空间选择产生影响，未来有待扩大研究地域和样本数量，进一步论证设施与互动触媒关系的普遍性。

5.2 促进社交互动的空间优化策略

本研究以系统观察数据分析社区公园空间与设施促进社交互动的作用方式，为社区公园的空间优化设计提出了以下参考建议。

1）针对社交活动的空间布局模式和功能分区，可采用以“中心集散+功能组团”的嵌套式布局，构建复合型社交空间网络，即中心集散区承载集会功能，外围分布健身、娱乐休闲等功能模块，激发居民多样化社交行为。

2）量化社交活动空间配置标准，增强多元活动承载量。根据对设施的依赖程度，可分为三类尺度标准。第一类，针对集会空间中以群体为单位开展的活动，建议利用社交密度估算场地需求，广场舞4 ~ 8m^2 / 人、抽尕9m^2 / 人、太极4 ~ 6m^2 / 人。第二类，针对休闲空间中以亚群体为单位开展的活动（如聊天、看孩子），建议以社交距离和活动人数量化活动承载量，聊天的距离半径为0.5 ~ 0.8m，看孩子的距离半径为0.5 ~ 1.2m。第三类，针对游戏、健身和娱乐空间内对设施依赖程度高的活动，建议以设施规模为基准评估空间尺度，如棋牌8 ~ 16m^2 / 组，健身器材3 ~ 6m^2 / 个。

3）利用环境设施打造多元互动的社交活动空间。在娱乐空间中增加构筑物、座椅和潜在座椅等休憩设施。在集会空间中调节照明设施的覆盖范围，以激活夜间活力和延长活动时间。沿空间边界布置遮阳设施，营造舒适宜人的休闲空间，吸引人群驻留互动。同时，在健身空间中利用丰富且具有层次感的绿植景观，增设座椅、遮阳设施打造复合功能空间进而增强社交黏性。

5.3 不足与展望

本研究采用行为注记和环境观测工具相结合的方法，并结合精确定位的GIS制图绘制数字行为地图，分析小尺度空间中社交互动水平及其影响因素。这一方法可在城市空间规划和设计的早期阶段获取基本信息，帮助设计师进行科学的社交空间设计。但对小样本的直接观测存在一定个案性，未来可进一步扩大样本量，以提升结论的可推广性。同时，GPS定位精度有限可能带来细微测量误差，还需拓展数字技术以更精准地追踪互动轨迹，探究场地内社交互动的动态分布情况，进一步指导活动功能布局和空间规划。

补充材料

可通过https://doi.org/10.15302/J-LAF-0-020041查看本文补充材料。

图 1. 社区公园样地
图 2. 社区公园不同时段的各项群体活动总人数统计
图 3. 不同群体活动的社交距离差异
图 4. 群体活动社交密度及其与社交距离的关系
图 5. 社区公园不同群体活动空间分类