

Study on Vitality of Small Open Space based on Behavior Observation Techniques

by Xu Haoran
Tongji University

Keywords: Open space, Behavior mapping, Usage Frequency.

Abstract: In the trend of high-density urban development, small open space has gradually become a popular subject of both designing and research. A small open space with high quality can encourage walking behavior and outdoor activities, promote social communication and improve urban vitality, as well as other comprehensive benefits. This research has improved the traditional method of behavior mapping by two means: first, to conducted random sampling by repeated time periods to get rid of the question of subjectivity; second, to pre-designate symbols for different behavior information and arrange a technique to use the CAD software, therefore solve the problem of conduct quantitative analysis to abundant behavior information. In case study, this analysis method which integrated statistic analysis and data visualization, allow the researchers not only to intuitively judge the efficiency of space use, but also further explore two important spatial vitality indicators, the ratio of lingering and passing behaviors and the mixing degree of population composition. This can give a full picture of space usage and then thoroughly conduct interpretation in combination with physical spatial attributes. In short, this empirical study proves that behavior mapping is a promising research tool. By the collection of integrated information of both spatial location and behavior, it can help the researchers to answer the fundamental question in the field of environment and behavior studies – how and to what extend does the physical and spatial factors of built environment influence people’s conception and behavior.

1. Research Background

In the trend of high-density urban development, small open space has gradually become a popular subject of both designing and research. A small open space with high quality can encourage walking behavior and outdoor activities, promote social communication and improve urban vitality, as well as other comprehensive benefits. However, due to the restrictions on minimum size of urban green area by China’s Urban Planning Documents, these small green spaces are not included in the calculation of overall area index, so little attention is paid by researchers and corresponding findings are relatively scarce.

From actual effects, the usage frequencies, also called as space vitality of enormous small open spaces in urban areas are in relatively big difference. Only part of public open space wins the flavor form citizens, and others are deserted. So, what are the reasons that encourage or

discourage people to visit these open space? To unravel the mystery, two small open spaces of similar size have been selected at Hangzhou City Center Zone where detailed, accurate and systematic investigation and analysis has been conducted to spot new discovery.

2. Case study and the research questions

2.1. *The selection of two cases*

Two selected small open spaces of similar conditions at Hangzhou City Center Zone are Xiaoying Park and the green space in the front of Zhejiang Provincial Library which are respectively abbreviated as Site A and Site B. The two sites are similar in size, and one is 2,640 square meters, the other 3,222 square meters. 670 meter distance between Site A and Site B can ensure that the surrounding population composition is similar, reducing the impact on usage frequency. In addition, in order to preclude the repulsive effects of West Lake, a large open space on small open space, the minimal linear distance between the two sites and West Lake is about 1.3 km, namely 20-minutes paces off.

The two sites are of similar size but of different spatial characteristics. As for Xiaoying Park, it has wide east-west path, narrow north-south path and high southeast topography without walls all around; in terms of the green space in front of Zhejiang Provincial Library, it has narrow east-west path, wide north-south path, and broad stairs in the south of the main entry to the library with fences and flat terrain. When it comes to the landscape, Xiaoying Park is of traditional garden style, with a large grassland surrounded by shrubs and at the southeast corner is a rockery and pavilion; the green space in front of Zhejiang Provincial Library is much more natural, and at the large admissible grass scattered around are low trees and at the northwest corner stand tall cedars. The two sites are equipped with medical facilities in the surroundings, such as the Second Hospital of Zhejiang Province in the vicinity of Xiaoying Park and Tai Rentang Clinic of Traditional Chinese Medicine in the front of the library, and the former is much larger. In addition, in the surroundings of Xiaoying Park, a large number of cultural and historical buildings exist, such as Former Site of Ting Palace the Taiping Heavenly Kingdom, Memorial Hall for Chairman Mao's Visit at Xiaoying, and so on; the green space in front of Zhejiang is surrounded by dwelling buildings, and such large public service buildings as Zhejiang Library and Youth Holiday Activity Center.

2.2. *Research questions*

Next, we will give a systematic and detailed account of the material space characteristics and behaviors with regard to the two cases to make a comparative analysis. As an explorative study on vitality of small open space based on behavior observation techniques, the specific issues under the focus include the following two aspects.

The first one is about importance of methodology. Although we can easily distinguish vitality degrees on the basis of subjective experience, but in terms of scientific research, we should collect behavioral data by objective and quantitative methods to illustrate the differences in viability. In this study, we will try to collect behavioral information by the method of behavioral mapping rather than common questionnaire method in the traditional research. Secondly, we should be committed to mining the knowledge that can facilitate designing. For example, which material space characteristics have concerns with usage frequency and how designers

manage sites to create a small open space popular with citizen. From the text below, it is obvious that complex information acquired by the method of behavioral mapping can facilitate our discussions on the connection between usage frequency and material space characteristics.

3. Methodology

3.1. Collection of behavioral data

During the case study on open space, the main method for scholars to collect information is questionnaire method. The data obtained by observation method is considered as subjective and difficult to carry out statistical analysis, so it is auxiliary. the main method to collect information in this study is behavior mapping, in combination of a series of sophisticated technical auxiliary methods can clean up two problems above, and the most important is the method can simultaneously record specific behaviors and their spatial location of high precision (Dai Xiaoling, 2013). The spatial information of high-degree precision can be elusive on the basis of written questionnaires.

In this study, we use two types of behavioral mapping to describe the behaviors in selected sites. Snapshot, the primary one designed to describe users lingering in the sites is a variant of behavioral mapping and widely used by researchers on the Theory of Space Syntax. Just as the name suggests, the step is to observe users' behaviors at certain moment, snap pictures in surveyors' minds, and immediately indicate the symbols of these instant messages on the prepared map. We have referred to the practices of Golick and others (2010) and determined a set of symbols (Figure 1) in advance. This approach allows investigators to quickly collect rich information about behaviors and conduct systematic analysis and map expression later. In light of researchers' better familiarity with CAD software, we have made improvements different from the practices of Golick and others where they input information into GIS platform. As shown in Figure 1, the designed symbols can simultaneously record to record four types of user information. [Type a quote from the document or the summary of an interesting point. You can position the text box anywhere in the document. Use the Drawing Tools tab to change the formatting of the pull quote text box]: spatial position, gender, age and postures (sitting, standing and movement). In more detail, symbolic forms are used to distinguish postures, colors are for different ages, and solid or hollow expression for genders. This symbolic system can easily

behavior \ age \ gender	<7		7<age≤18		18<age≤60		>60	
	neutral	male	female	male	female	male	female	
sit	■	■	□	■	□	■	□	
stand	▲	▲	△	▲	△	▲	△	
walk	♂	♀	♂	♀	♂	♀	♂	

Figure 1. Behavioral Symbols Determined in Advance (Source: Self-drawn).

collect complex information, and in the following analysis, will play a key role in the interpretation of behavioral patterns.

In order to conduct random sampling, the recording on space users is conducted on the mornings, at noon and at night of both weekdays and weekends. Since the survey data of two sites are collected at the same period, the usage frequency for the two sites is valid and not subject to changes in whether.

The second structural observation method as an auxiliary is called as gate count used to describe the users across the site. This approach means that a number of important footpaths in the survey area are aimed and a street section (gate) is selected to record the number of pedestrians and bicycles on the chosen footpaths. The counting section includes all the paths to the site and main sidewalks of surrounding roads. There are twelve observation points selected in Site A, and six in Site B. Similarly, the counting is conducted on the mornings, at noon and at night of both weekdays and weekends with 2 statistics during each period of 5 minutes, so that the time is random. The collection of this information can help quickly form an objective understanding of the internal and external flow of people in the sites, and it is conducive to the interpretation of behavioral patterns.

3.2. Analysis of behavioral data

Then we will express and analyze the behavior data. At first, the simple statistics of overall behavior data is conducted. Electrolyze the two types of field records and respectively input them into excel and CAD software. Snapshot data should be input in CAD, through make block and layer management, integration of multiple information and mathematical statistics can be realized at the same time. Secondly, we will make visual mapping of usage frequency on the map, and finally compare usage frequency with material spatial characteristics to discuss the link between the two.

4. Simple statistical analysis of behavioral data

4.1. General demographic property of observation samples

Against gate count, a total of 1,303 people at internal paths and surrounding streets were recorded (848 at Site A and 455 at Site B). As for snapshot method, the recorded number of people staying or lingering at the site is 517 (272 at Site A and 245 at Site B). The proportion of users collected by two different methods is basically consistent, and young users at Site B are slightly more than Site A for Site B is located at the square in front of the library.

4.2. Information management under Gate Count

The average flow rate is converted into hourly flow, and then its distribution is analyzed.

Main findings include (1) the paths in the two open spaces are relatively quiet compared with the external streets with high stream of people. (2) The flow of people at various entrances of open spaces is of great difference.

4.3. Information management under snapshot

By inputting snapshot data into excel, we get a trend chart where overall behavior changes with time (Figure 2). Since we simultaneously collected the number of users who pass through and lingering, separate display is conducive to discussions on the relationship between static and dynamic activities. Two conclusions can be drawn from Figure 2. First of all, with the change of time, there is a big fluctuation in the general behaviors of on the two sites. Secondly, there is no correlation between the static and dynamic activities of the same site at the same time, and in some cases, the opposite trend is presented. As at noon on the weekends, the reduction of pedestrians passing Site A and the increase of lingering people coexist; then, at a noon on weekdays, the increase of pedestrians passing Site B and the reduction of lingering people coexist.

Though the layer control tools CAD software, we can easily get Behavior Distribution Graph and Behavior Overlap Graph at a single observation period. From Overlap Graph, it is found that usage situations of the whole site are of strong inhomogeneity. Therefore, it is necessary to divide the site into three main aspects, including overused, being used and abandoned (Marcus, 1998).

5. Detailed analysis of behavior distribution

Next, we will describe and discuss the behaviors at the two types of open spaces, including 8 sections in more detail (Figure 3). Jan Gehl has pointed that static activity is the best indicator of the quality of public spaces: large flow of people walking in the city do not necessarily translate into excellent spatial quality, however, if there are a lot of people in the outdoor space of urban cities killing time, it shows excellent public space quality (Gehl-Architects, 2004). Therefore, in order to explore the source of vitality of small open space, the following content will focus on a detailed analysis of what spatial characteristics can influence the frequency of static activities on the sites.

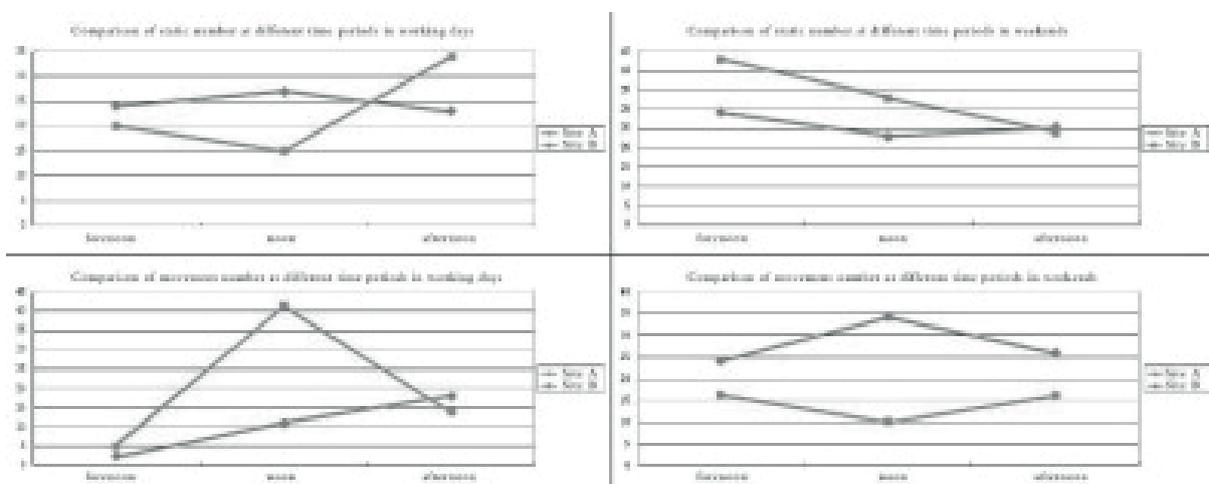


Figure 2. Comparison Diagram of Static/Dynamic Headcount at Two Sites during Different Period (Source: Self-drawn).



Figure 3. *Index Plan of Detailed Analysis* (Source: Self-drawn).

5.1. Usage and interpretation of block space

On the basis that spatial shape and size can pose limitations on its activities, physical activity space can be divided into two categories, linear space and block space. We first focus on the usage of block space (or centralized site) which is defined as a small square of less-than-6 meter side and not-less-than-100m² size where a variety of activities can be conducted. Under this definition, two pairs of sub regions can be identified as A1/A2 and B1/B2. From the behavior data, only Site B1 does not hold lingering people and the other three sites are much more popular.

Main Entrance of Xiaoying Park (Site A1)

From the behavioral data, Site A1 is relatively crowded at the three periods of a whole day. The users are highly mixed in terms of gender, age and body postures. Group activity occurs in the middle of the field both in the afternoon and at noon when individual activity is more common.

Site A1 mainly include favorable factors. First of all, on the three sides of the site are luxuriant greenbelts with sufficient sunshine, suitable for group activities such as group dancing, playing with children. Secondly, the terrain at southeast corner is naturally elevated, and multiple seats are lined along the uplifted area from which a panoramic view of the whole site is possible. In this region, relatively frequent communications activities occur (Figure 4-A).

Site A2 in Front of Yulu Xiaoying

From the Behavior Overlap Graph under snapshot method (the left one of Figure 4-B), it is found users at Site A2 are highly mixed in terms of gender, age and body postures and the usage frequency at the site is relatively high. There are three main advantages for this site. In the first place, tree shade and seats lined on both sides of the square contribute a heaven for rest and recreation. In addition, on the south side is a small community office building of attractive veranda style. Finally, due to the west bus station, the site has become a shortcut for passengers.

Site B1 on the East of Zhejiang Library

After the comparison of Behavioral Overlap Graphs at six periods (the right one of Figure 4-B), it is found that, the usage frequency of Site B1 is the lowest among there four centralized sites. Most people at this site just walk through without stay. On the basis of data under gate count, the northern side of the site leads to a secondary entrance, but the front-porch square has a high popularity. Why is the utilization rate of this regular space so low? We speculate that there are two main disadvantages. First of all, in the south stands a three-story building with terrible green landscape and poor lighting. Secondly, the public toilet in the east side is quite crowded, which discourage other potential users. Of particular note is a public toilet on the west of Site A2 which is against regular space, so no negative impacts occur.

Stairs in Front of Zhejiang Library (Site B2)

On the basis of Behavioral Overlap Graphs under snapshot method, it is found users at Site B2 are highly mixed in terms of gender, age and body postures and the usage frequency at the site is highest. There are three main advantages for this site. In the first place, the uplifted front porch of the library translates into good visual landscape, and the elegant forms of historical architectures also make this site enjoy aesthetic and exceptional advantages. Secondly, the spatial width can accommodate several static activities; the porch facing the south provides suitable micro climates. Finally, the library itself has a great effect to centralize flow of people. We note that, at the moment of library opening and library closing, the dynamic activities at the stairs are especially frequent. On the afternoon when primary students are dismissed from school, parents will play with their children here and the static activities at front steps (playing badminton, playing games, reading, playing the ball) have increased (Figure 4-C). Of course, compared with the other three sites, the average age of users is much younger.

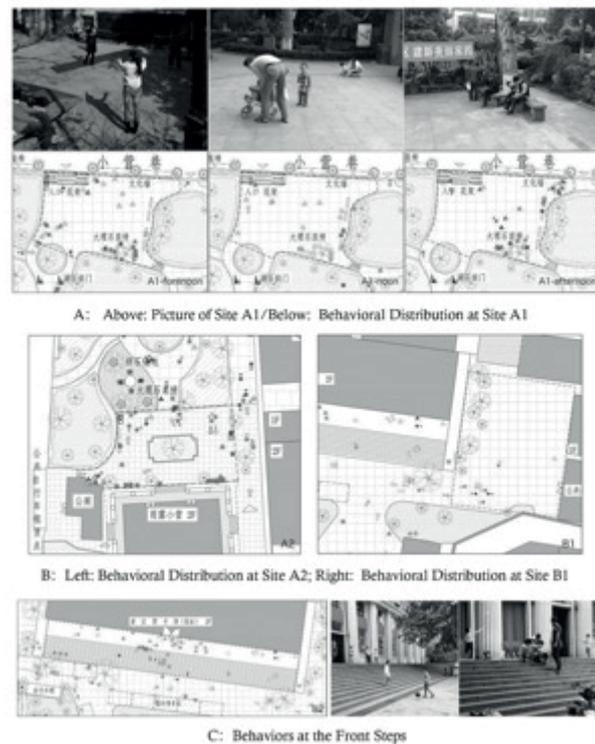


Figure 4. Behavior Mapping.

To sum up, we find centralized hard-ground squares popular with users are characterized by the following features. First, an available hard-ground site should meet the requirements of minimum width. Among the three sites with high usage frequency, only the center of Site A2 is occupied by rectangular flower beds, but its remaining ground meet the requirement more than 6 meters. Secondly, the site with high lingering rate is close to main traffic lines which do not go through the site. With the sense of enclosure, it is can also be relatively accessible. Site B1 does not satisfy this requirement, people coming into and out of public toilets can discourage visits by others. Thirdly, a certain amount of formal and informal seats should be equipped. We have found that in the three sites of high usage, the mixing rate of sitting, standing and passing arrives at a proper extent. An informal seat can be a step, the edge of a flower bed and a big rock. Finally, a perfect landscape and view can be appealing.

6. Conclusions

Based on empirical research, this study has discussed the most important physical and spatial factors which would influence the usage frequency and vitality of small open spaces. The main methods to collect data are snapshot and gate count. The snapshot method is an updating version of behavior mapping. It improved the old tool by two means: first, to conducted random sampling by repeated time periods to get rid of the question of subjectivity; second, to pre-designate symbols for different behavior information and arrange a technique to use the CAD software, therefore solve the problem of conduct quantitative analysis to abundant behavior information and also collected behavior data with higher resolution of spatial location which could not be abstained by questionnaire.

This new method can integrated statistic analysis and data visualization, allow the researchers not only to intuitively judge the efficiency of space use, but also further explore two important spatial vitality indicators, the ratio of lingering and passing behaviors and the mixing degree of population composition. This can give a full picture of space usage and then thoroughly conduct interpretation in combination with physical spatial attributes. Therefore, this new type of behavior mapping method described in this paper is a promising data collecting and analysis tool which have great potential and should be promoted in the field of environment and behavior studies.

References

- Dai X. (2013), *On-site Investigation Methodology in Urban Design*, China Architecture and Construction Press, Beijing, (in Chinese).
- Gehl-Architects (2004), *Towards a Fine City for People – Public Spaces – Public Life*, Transport for London & Central London Partnership, London.
- Golicnik B., Thompson C.W. (2010), *Emerging relationships between design and use of urban park spaces*, in *Landscape and urban planning*, 94, pp. 38-53.
- Ittelson W.H., Rivlin L.G. et al. (1970), *The use of behavioral maps in environmental psychology*. *Environmental Psychology: Man and his physical setting*, in Proshansky H.M., Ittelson W.H., Rivlin L.G., New York, Holt, Rinehart and Winston, pp. 658-668.
- Marcus C.C., Francis C., eds. (1998), *People places: design guidelines for urban open space* (2nd edition), John Wiley & Sons Inc.