



# An Index System for Playable Streets and Its Application based on The Child-Friendly Perspective

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**Abstract.** The playable street is an indispensable part of a child-friendly city. Taking “playability identification” as the orientation, the study explores street playability from the subject and object dimensions and groups index factors into different hierarchies via the analytic hierarchy process (AHP). Accordingly, a scale of street playability influence factors and indexes and an evaluation system for playable streets are established. The research adopts the fuzzy comprehensive evaluation (FCE) to analyse the playability of Sujiatun Road in Shanghai as the subject. Through the IPA, The indicators in the Focused Area are the main optimisation directions for the road to improve the play experience. At last, based on the evaluation results, this study proposes a method to enhance the playability of street by improving the continuity of street play spaces, creating informal street game scenes and increasing children’s participation.

**Keywords:** The Playable-streets; Street space; Urban street design; Play place; Child-friendly city

## 1 INTRODUCTION

Play is an essential characteristic of childhood <sup>[1]</sup>. Fredrich Froebel, the founder of modern preschool philosophy, noted, “Play is the highest expression of human development during childhood, for play expresses the freedom in a child’s soul. <sup>[2]</sup>” As play influences children’s cognition, learning ability, health, and physical development <sup>[3]</sup>, free play is crucial to their growth.

However, the research and practice on streets as important urban child-friendly spaces are still in the exploratory stage—most of the street planning and design projects focus on space safety and quality optimization for all ages, instead of children’s play needs, in street construction and renewal. The current children’s play space lacks child-friendly features, indicating a trend towards isolated play areas, over-reliance on play equipment, limited variety in play options, and inflexible playground design. In light of the opportunities and challenges facing the research of child-friendly streets (or playable streets) currently in China, this paper aims to identify the indexes that decide the playability of a street from the child-friendly perspective and build an evaluation system for playable streets. In this way, it should provide quantifiable indi-

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M. Ali et al. (eds.), *Proceedings of the 2024 International Conference on Urban Planning and Design (UPD 2024)*, Advances in Engineering Research 237,

[https://doi.org/10.2991/978-94-6463-453-2\\_9](https://doi.org/10.2991/978-94-6463-453-2_9)

cators for the construction of playable streets that serve as part of child-friendly cities to make them more inclusive and playable.

## **2 CONCEPT: THE PLAYABLE STREET BASED ON THE CHILD-FRIENDLY PERSPECTIVE**

### **2.1 The Child-Friendly City**

The concept of a “play-friendly city” (also known as “playable city”) comes from the Child-Friendly City Initiatives (CFCI) launched by the United Nations International Children’s Emergency Fund (UNICEF). In the broad sense, a playable city is an urban area that integrates game elements and interactive experiences into its spaces and designs. According to Playable City, a creative company in Bristol, UK, “a playable city is a city where people, hospitality and openness are key, enabling its residents and visitors to reconfigure and rewrite its services, places, and stories. [4]” A playable city should look for opportunities for children to play freely and take their welfare into consideration in urban planning. Also, the role of playable infrastructures in child development and children’s demand to use these infrastructures in a healthy and safe way should be noticed<sup>[5]</sup>. The construction of a playable city is a long-term process that requires massive practices, the government’s generous investments, and children’s active participation<sup>[6]</sup>.

### **2.2 The Playable Street for children**

Street safety and children’s accessibility to games and interactions are two major factors of playable street for children. In this case, safety is the foundation for children to play safely, and a diversified street environment can spark various kinds of play behaviors, from self-entertainment, to child-object, to child-child, among others. According to Liu and Wei, children would pay more attention to micro-level street elements, such as interface, vegetation, and color, because of their highly different physiological and cognitive features from adults<sup>[7]</sup>.

## **3 THE INDEX SYSTEM FOR PLAYABLE STREETS**

### **3.1 Building Process of the Index System**

The Index system for playble streets is complex, with both qualitative and quantitative aspects.

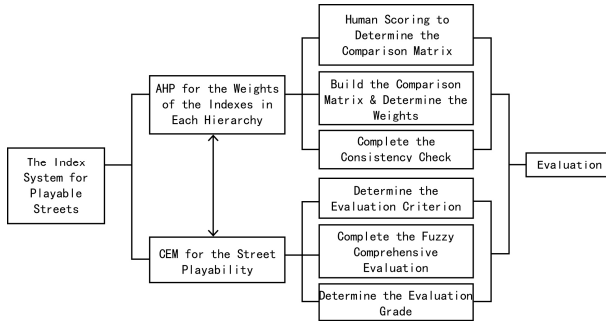


Fig. 1. Build Process of the Index System for Playable Streets.

There is a hierarchical structure among the different influencing factors, and therefore, the analytic hierarchy process (AHP) is used to construct the weights of the indicators. conclude the influencing factors of street playability from two dimensions – the subject (i.e., children and their caregivers) and the object (i.e., street space) – to list a range of evaluation indexes. then determine the evaluation indexes and their weights (Fig. 1).

### 3.2 Scale of Street Playability Influence Factors and Indexes

As shown in Tab. 1, the street playability index is refined into 4 primary indexes, 9 secondary indexes, and 18 influence factors.

### 3.3 Determination of the Weights of the Evaluation Indexes

Given the fact that influence factors can be different in effect degree, the research used the AHP to group them into different hierarchies and conduct a qualitative-quantitative analysis to evaluate the importance of each influence factor; questionnaires were distributed to city planners, city managers, and caregivers. At last, a multi-hierarchy comparison matrix was built to, after the consistency check, determine the index weights (Tab. 2).

### 3.4 Determination of the Memberships of the Evaluation Indexes

This part was a questionnaire survey that used fuzzy words for description and sorting. Using the Likert scale (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree), the research determined the membership of each index according to the statistics (by percentage).

Table 1. The scale of Street Playability Influence Factors and Indexes.

Dimension	Primary Index	Secondary Index	Index Layer
Subject: Street	Subject Behavior	Access Percep-	Accessibility of Educational

User	Demand	tion	Facilities
			Accessibility of Commercial Facilities
			Accessibility of Residential Communities
	Child Participation Demand	Early Participation	Number of People in Activity
			Density of All-Age Facilities
		Activity Participation	Play Streets

Object: Street Space	Surroundings	Street Interface	Ratio of Transparent Interfaces
			Ratio of Child-Related Businesses
		Street Element	Visual (Color) Richness
			Spatial (Level) Richness
	Site Conditions	Walking Space Support	Walking Conditions
			Traffic Quietness and Safety
		Environmental Facility Support	Density of Natural Vegetation
			Street Object Richness
		Game Facility Support	Free Node Spaces
			All-Weather Game Stations

**Table 2.** The index weights of Street Playability Influence Factors and Indexes.

Dimension	Primary Index	index weights	Secondary Index	index weights	Index Layer	index weights
Subject: Street User	Subject Behavior Demand	0.214	Access Perception	0.117	Accessibility of Educational Facilities	0.187
					Accessibility of Commercial Facilities	0.159
					Accessibility of Residential Communities	0.201
			Activity Perception	0.097	Number of People in Activity	0.196
	Density of All-Age Facilities	0.257				
	Child Participation Demand	0.2	Early Participation	0.147	Child-Centered Research	0.325
					Participatory Research with Children	0.410

			Activity Participation	0.053	Play Streets	0.265
Object: Street Space	Surroundings	0.157	Street Interface	0.05	Ratio of Transparent Interfaces	0.197
					Ratio of Child-Related Businesses	0.121
			Street Element	0.107	Visual (Color) Richness	0.261
					Spatial (Level) Richness	0.420
	Site Conditions	0.419	Walking Space Support	0.109	Walking Conditions	0.134
					Traffic Quietness and Safety	0.126
			Environmental Facility Support	0.14	Density of Natural Vegetation	0.165
					Street Object Richness	0.169
	Game Facility Support	0.17	Free Node Spaces	0.272		
			All-Weather Game Stations	0.134		

## 4 APPLICATION: THE INDEX SYSTEM FOR PLAYABLE STREETS

### 4.1 Sample Selection

Sujiatun Road in Yangpu District (Shanghai) is chosen as the typical street for the empirical research of playability evaluation. Sujiatun Road is one of the top 10 landscape roads in Shanghai, with a high density of households around. Also, it is the only way for children to go to school, in which fitness, graffiti, arts, and other cultures assemble. Since the “Open your space: Design Intervention in Siping Community” project in 2015, Sujiatun Road has experienced a series of street updates that aimed to make the best of the free space and thus become an example among traditional living streets.

The research subject is Sujiatun Road (395 meters approximately, from Fuxin Road to Jinxi Road) and the surrounding area within a 50-meter radius (Fig. 2). On both sides of the road are old communities. In the western junction, there is a business district, where most of the shops are for catering. Sujiatun Road has a continuous pedestrian space and various public spaces (e.g., leisure square, fitness site, and recreation trail).

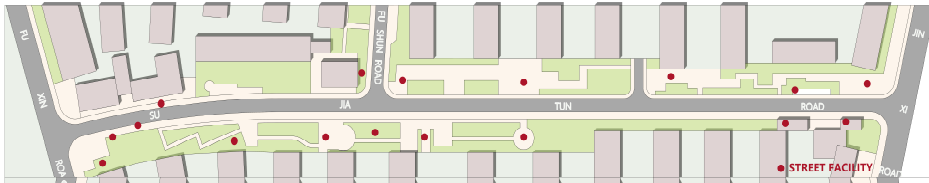


Fig. 2. Site plan of Sujiatun Road.

#### 4.2 Comparison of Evaluation Results

In this research, the questionnaire was designed based on the items on the scale of street playability influence factors and indexes and either filled out in person or answered orally by on-site children and their caregivers. The participants’ intuitive feelings were quantitated using the 5-point Likert Scale and analysed; the calculation formula is as follows:

$$Y=W_1 \times X_1+W_2 \times X_2+W_3 \times X_3+\dots+W_n \times X_n$$

Where, Y is the overall playability score of the street space; W is the weight of the index; X is the questionnaire score; and n is the number of the index.

The average playability score of Sujiatun Road is 3.337, between “playable” and “very playable.” As shown in Tab.3, Sujiatun Road is dominant in “Site Conditions” and “Subject Behavior Demand” yet poor in “Surroundings” and “Child Participation Demand.” The weighted score of “Subject Behavior Demand” is 4.014 (very playable), indicating favorable access perception and activity perception for children and their caregivers. The weighted score of “Site Conditions” is 3.867 (very playable), which means there is sufficient walking space and public and play facilities. However, the limited functions of the lands around Sujiatun Road result in fewer business types and space hierarchies. In other words, there is much room for improvement in street playability in “Surroundings.” At last, both studies on the effective mechanism of child participation and practical children-targeted street games are insufficient – the playability is unfavorable in terms of “Child Participation Demand.”

Table 3. Summary of Sujiatun Road Playability Scores.

Project	Street Score		
	Weight	Questionnaire Score	Weighted Score
Subject Behavior Demand	0.214	3.933	4.014
Child Participation Demand	0.200	2.556	2.625
Surroundings	0.157	2.722	2.910
Site Conditions	0.419	3.759	3.867

### 4.3 Importance-Performance Analysis (IPA) for the Evaluation Results

An overlay analysis was conducted to determine the importance and perception of playability influence factors. The importance and perception values of each index are shown in Fig. 3; the importance mean is 0.220, and the perception mean is 3.377. Taking the intersection point (3.377, 0.220) of x and y as the origin, a coordinate system with four quadrants was built: (1) high importance and high perception area; (2) high importance and low perception area; (3) low importance and high perception area; (4) low importance and low perception area.

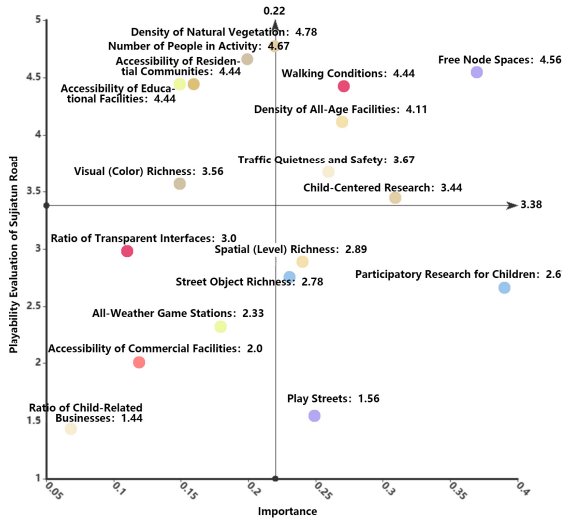


Fig. 3. IPA Results of Sujiatun Road Playability.

#### Dominant Area (High Importance, High Perception).

In this area, Walking Conditions, Free Node Spaces, All-Age Facilities, Traffic Quietness and Safety, and Child-Centered Research are major index factors that contribute to its playability. At present, Sujiatun Road has an appropriate street scale and smooth pavements, as well as additional outdoor public spaces and children’s play facilities, after a series of repairs and renovations since the street renewal initiative in 2015. There are several sites for children to play and socialize, community greenbelts, and footpaths, among others, that have greatly improved Sujiatun Road’s playability.

#### Focus Area (High Importance, Low Perception).

Spatial (Level) Richness, Street Object Richness, Play Streets, and Participatory Research with Children should have an important influence on the area’s playability. However, these elements, given their current situation, yet cannot satisfy children’s needs for play, and attention should be paid to improving the play experience.

**Remain-the-Same Area (Low Importance, High Perception).**

Density of Natural Vegetation, Number of People in Activity, Accessibility of Educational Facilities, Accessibility of Commercial Facilities, and Visual (Color) Richness are five major index factors, and their perception values are all higher than the mean, indicating that the current conditions can basically satisfy children's demand and few improvements are needed.

**Low-Priority Area (Low Importance, Low Perception).**

Ratio of Transparent Interfaces, All-Weather Game Stations, Accessibility of Commercial Facilities, and Ratio of Child-Related Businesses are four major index factors in this area. However, their importance values are yet too insufficient to necessitate additional improvements.

## **5 DESIGN AND RETHINK: BASED ON THE EVALUATION RESULTS**

### **5.1 A Continuous Everyday Playable Street Space Combined with Life Scenes**

Christopher Alexander, in *A Pattern Language: Towns, Buildings, Construction*, suggested connecting a narrow strip of land that does not run across a road with the facilities within a certain range so as to form a play place where children can interact.<sup>[8]</sup> Thus, to realize a playable street, it has to first break the stereotype that an urban space should be used for a specific purpose only. In other words, city planning should be more systematic and comprehensive to link streets with schools, communities, and other places that children often use in their everyday lives, rendering these streets playable, uninterrupted, and consistent with their life traces. In this way, it should form a comprehensive life and play network that provides children with opportunities to play.

### **5.2 Impromptu: Informal Street Game Scenes**

Meaningless placement of facilities does not make a play place, and they are rather carriers of play behaviors. By the street facilities, including flower beds, fire hydrants, fences, chairs, and open spaces, children create play behaviors. Informal, free games are their favorite<sup>[9]</sup>. The existing playground planning principles, suggested by adults, aim at a risk-free play space that is provided with standard facilities with a prescribed playing method and compliant with the safety and administrative provisions but ignores children's needs for creative play. Based on a safe distance between people and vehicles, a playable street should provide children with as many opportunities as possible to risk and challenge. At the same time, more street elements can be set up to help children create new games (Fig. 4).





Fig. 4. Child-Friendly Street Elements.

### 5.3 The Method and Long-Term Mechanism to Child-Involved Planning

The realization of a playable street needs favorable policy and physical environments, as well as the public's effort and support<sup>[10]</sup>. Street improvements would be superficial and short-lived, without supportive social welfare, education, and child participation mechanisms. Without support from societal welfare, educational operations, and mechanisms for children's participation at the societal level, street optimization efforts carried out solely through planning and design means would only yield superficial benefits and lack the foundational support for long-term operations. Respect should be given to children's opinions in the whole construction process of the playable street. Through extensive social participation and public outreach, it should improve public awareness and make the public disposed to maintain the street's playability and appreciate and participate in street games. Also, it is crucial to make children's opinions and wishes heard and considered.<sup>[11]</sup>

## 6 CONCLUSION

Urban streets should not only be seen as a means of transportation for children, but also as important spaces for play and growth. Streets designed for children should facilitate safe passage, self-directed play, full access to and participation in social activities<sup>[12]</sup>. The paper's selected empirical research object is relatively homogeneous. To enhance the generalisability of the results, future research should include a wider variety of street types. As children's street play is associated with a high level of uncertainty, subsequent studies should conduct more detailed observations and in-depth descriptions to gain a better understanding of the interaction between street play and the environment.

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