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Spatial Affordances of Chinese Kindergarten Classrooms for Children's Immediate Actions in Free Play Session

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Abstract
Early childhood is widely regarded as a critical period during which the foundations of development are established. This study aims to examine how physical environmental features influence Chinese children's immediate actions, both individually and socially, as well as their awareness of classroom space. The observation involved 73 children (45.2% girls) from three same-age classes in a typical public kindergarten in Nanchang, China. A novel extended taxonomy of spatial affordance was proposed to measure children's ongoing actions and its influential environmental features. Future studies should further investigate the nexus between children's continuous play behavior and actions within the classroom environment.

Keywords: Early Childhood Education and Care; Physical environment; Spatial affordances; Children's actions

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1.0 Introduction

The relationship between early childhood education environments and children's behaviors and outcomes has been continuously examined by researchers over the past two decades (e.g., Maxwell, 2007; Tamblyn et al., 2023). High-quality physical environments in early childhood education, particularly well-designed spaces, play a critical role in shaping children's behaviors, learning processes, and social interactions (Acer et al., 2016; Deng & Zhao, 2023; Sando & Sandseter, 2022). Furthermore, exploring preschool classroom spaces that are suitable for children must center on their perspectives. To achieve this goal, Gibson's ecological psychology approach provides an effective means for in-depth research into children's behaviors. Its core concept is affordance, which refers to the possibilities for action that the environment offers to its users (Heft, 2018). Therefore, spatial affordance is essential for effectively linking children's actions with the environmental features they perceive, thereby offering guidance for the spatial design of preschools (Deng et al., 2024). However, limited attention has been given to understanding children's immediate perceptions and real-time interactions with their surroundings, especially in Early Childhood Education and Care (ECEC) environments. Specifically, in China, research exploring environmental perceptions from the perspective of children is still scarce. Thus, whether the spatial affordances in Chinese preschool contexts support children's exploration, participation, and interactions with their surroundings and peers remains open.

Exploring the affordances of preschool classroom spaces involves studying how physical environments facilitate or constrain certain behaviors, such as movement, play, and collaboration. This concept is rooted in ecological psychology, emphasizing the interaction between children's perceptions and the opportunities provided by space (van Liempd et al., 2020). For example, the arrangement of

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furniture, the availability of materials, and the flexibility of activity zones significantly influence children's ability to express creativity, autonomy, and curiosity (Abbas et al., 2016). Therefore, the objective of this study is to explore the spatial affordances of preschool classrooms in China, specifically the physical environmental features and their impact on children's immediate actions. By analyzing the spatial composition of secondary settings within classrooms and their alignment with children's activities, the study aims to investigate how physical environmental characteristics and spatial constituents related to children's performances.

2.0 Literature Review

Ecological psychology examines perception, cognition, and behavior, emphasizing the intricate relationship between organisms and their environment. J. J. Gibson pioneered this perspective in perception research (Lobo et al., 2018). Unlike environmental psychology, which focuses on long-term human-environment interactions across various temporal scales (Gifford, 2014; Stokols, 1978), ecological psychology emphasizes real-time, continuous perception and action (Raymond et al., 2017). It treats the environmental-biological system as a single analytical unit, with affordances as the primary object of perception research (Michaels & Palatinus, 2014). In this study, children directly perceived ecological information and acted upon the affordances available to them. Referring to Deng et al. (2024), these interactions between action and environment continuously modified the ecological information, creating a reciprocal cycle. Gibson's ecological theory underscores this dynamic relationship between perception and action, with affordances acting as a bridge linking children to their surroundings. Consequently, this section examines the affordances of typical Chinese kindergarten spaces and the movement patterns of children within indoor kindergarten environments.

2.1 Spatial affordance in Chinese kindergarten context

In China, kindergartens cater to children aged 3 to 6 and represent the primary form of early childhood education. Most kindergartens adopt an age-based system to divide children into three grades: lower grade (Xiǎo bān), middle grade (Zhōng bān), and upper grade (Dà bān) (Wu et al., 2022). Current research on the environments of Chinese kindergartens primarily focuses on children's play behavior patterns (Han et al., 2023), spatial layout (Cai et al., 2024), and play props (Ye, 2015). However, significant gaps remain in the study of immediate perception-action dynamics within classrooms. Despite the Chinese government's introduction of new requirements for the layout, functionality, and infrastructure of indoor kindergarten spaces (Li, 2022), many public and private kindergartens still exhibit design shortcomings. Common issues include a lack of vertical communication spaces for children (Xu, 2015), uniformity in furniture and materials (Dong, 2007), and inefficient space utilization (Chen, 2020). Many kindergarten classrooms mimic traditional classroom designs, with poorly placed play materials and suboptimal spatial organization, which hinder practicality and limit spatial affordances (Kyttä, 2003). Consequently, traditional classroom environments in many developing countries, including China, fail to fully support children's cognitive and social development. Although prior studies have highlighted the challenges in designing kindergarten classrooms, problems such as uniform layouts across age groups persist (Huang, 2021). Therefore, improving the quality of Chinese kindergarten classrooms is an urgent priority. To support children of different age groups, classrooms must provide diverse activity opportunities, adopt a child-centered perspective, and address children's perceptions and behaviors.

2.2 Children's perception-action pattern in childcare indoor environment

The perception-action cycle in ecological psychology illustrates the dynamic process through which children perceive environmental information and use it to guide their actions (Heft, 2001). In current research on the physical environments of preschool classrooms, the design patterns of indoor spaces are regarded as key environmental features. These features stem from the human organization and arrangement of material elements within the classroom. Within the scope of the physical environment, children's direct perception of the classroom corresponds to their interpretation of environmental features or spatial design patterns, while their subsequent behavior reflects these perceptions. This perspective aligns with the principles of the perception-action cycle, as supported by empirical studies e.g.(Cetken-Aktas & Sevimli-Celik, 2023). For instance, Acer (2016) found that children's play processes improved significantly when activity areas were defined by clear boundaries and visual separation. One environmental feature—boundaries—was shown to reduce distractions during play. Thus, children's perception mediates the influence of environmental characteristics on their gaming preferences and performance (Aziz, 2014). By perceiving these environmental features, children's gaming preferences are guided, and their play behavior is shaped by the classroom environment. Therefore, investigating the relationship between children's perceptual behavior patterns and other environmental features in Chinese kindergarten classrooms through the lens of affordance taxonomy offers valuable insights into the optimization of indoor layouts and the placement of play materials.

3.0 Methodology

This study aimed to explore the relationship between the physical environmental features of the classroom and children's behaviors in a public kindergarten in Nanchang, China. A qualitative research design, underpinned by focused ethnography, was employed to gather in-depth insights into how children interact with and are influenced by their classroom environment.

3.1 Participants

The study was conducted with a sample of 73 children (45.2% girls), aged between 3 to 6 years, from three same-age classes at a typical public kindergarten in Nanchang, China. These children were selected from an institution that follows standard kindergarten

practices, ensuring a representative classroom environment for this investigation. The classrooms, which were similar in size and design, were chosen based on their typical setup and layout, typical of public kindergartens in urban areas of China.

3.2 Data collection

Spatial deconstruction, a technique commonly used in environmental psychology and educational studies (Huang, 2017), was employed to analyze the spatial components and features of the classroom sub-settings. This method involved a detailed examination of the physical layout of the classrooms, including the arrangement of furniture and play materials, as well as designated activity areas. These elements were descripted and categorized to understand how they might influence children's actions and interactions within the space. Non-participatory systematic observation was used to collect real-time data on children's actions during class activities. This observational method allowed the researchers to track and record children's interactions with the physical environment without influencing or interrupting their natural behavior (Loebach & Cox, 2020). The observations focused on how children engaged with various classroom sub-settings during four play sessions in four different days.

Data were collected across multiple observation sessions to capture a variety of classroom activities and to ensure that different spatial constituents were explored. Observations were conducted during children's free play time of the school day, to ensure a comprehensive understanding of children-oriented behaviors in relation to the physical classroom environment.

3.3 Data analysis

Once data collection was complete, thematic analysis was employed to examine the relationship between the physical environmental features and the children's ongoing actions in the classroom. Thematic analysis is a flexible method used to identify, analyze, and report patterns within qualitative data (Braun & Clarke, 2012). In this study, the researchers focused on identifying how specific environmental features (such as the rigid-soft surface, terraced surface, holistic play object, and big play object) influenced children's actions and interactions.

The data were coded based on observed actions (e.g., scrutinizing, assembling, displaying) and spatio-physical contexts (e.g., surface, object, boundary). These codes were then grouped into broader themes that described the interaction between the physical environment and the children's behavioral patterns.

4. Results and Findings

The classrooms for lower, middle, and upper grades are located on the first, second, and third floors of the teaching building, respectively. Each classroom is a separate, enclosed space within the floor plan. However, the indoor layouts of all three classrooms feature a visually open ground area and a semi-enclosed elevated platform. For this study, these areas were categorized into three sub-settings: floor play setting (FP), table play setting (TP), and raised platform setting (RP). In this sense, the subsequent sections analyze these sub-settings to identify their similarities and differences.

4.1 Floor play setting

Across the three classrooms, the spatial characteristics of this area are consistent, with furniture serving as storage and boundaries. The flooring in these classrooms combines hard surfaces with foam mats, creating a dual-function plane that supports children's activities. Play materials in this area vary by age group: the small and middle classes use toy boxes and loose toys, while the upper class adds a tent to this configuration. Therefore, the play materials in all three classrooms share the physical attributes of being storable, loose, and holistic (see Table 1).

Table 1. Spatial characteristics of floor play setting (FP) in three classrooms

Classroom	Spatial components	Spatial constituents	Physical properties
Lower	Furnishings	Shelve	Storable, Boundary
	Ground objects	Wood floor	Rigid-flat surface
		Foam pad	Soft-flat surface
	Play materials	Toy box	Storable
		Toy	Loose, Holistic
Middle	Furnishings	Shelve	Storable, Boundary
	Ground objects	Wood floor	Rigid-flat surface
		Foam pad	Soft-flat surface
	Play materials	Toy box	Storable
		Toy	Loose, Holistic
Upper	Furnishings	Shelve	Storable, Boundary
		Bookshelf	Storable
	Ground objects	Wood floor	Rigid-flat surface
		Foam pad	Soft-flat surface
	Play materials	Toy box	Storable
		Toy	Loose, Holistic
		Book	Holistic
		Big play object	Holistic

(Source: Author, 2024)

4.1.2 Table Play Setting

Three classrooms arranged this zone with a significant section of wooden flooring, which supports the arrangement of tables and chairs. Observations revealed that children rarely engage in play on the ground in this area, whereas the wooden floor still considered part of the tabletop activity area. The physical composition and characteristics of the TP setting are consistent across the three classrooms. The difference lies in the play materials: the upper class features mostly loose toys, the lower class primarily uses integral toys with a few loose toys, and the middle class evenly balances loose and integral toys (see Table 2).

Table 2. Spatial characteristics of table play setting (TP) in three classrooms

Classroom	Spatial components	Spatial constituents	Physical properties
Lower	Furnishings	Table	Detached
		Chair	Detached
		Shelve	Storable
			Boundary
	Ground objects	Wood floor	Rigid-flat surface
	Play materials	Toy box	Storable
		Toy	Loose
			Holistic
Middle	Furnishings	Table	Detached
		Chair	Detached
		Shelve	Storable
			Boundary
	Ground objects	Wood floor	Rigid-flat surface
	Play materials	Toy box	Storable
		Toy	Loose
			Holistic
Upper	Furnishings	Table	Detached
		Chair	Detached
		Shelve	Storable
			Boundary
	Ground objects	Wood floor	Rigid-flat surface
	Play materials	Toy box	Storable
		Toy	Loose
			Holistic

(Source: Author, 2024)

4.1.3 Raised Platform Setting

In terms of spatial components, the raised platform setting in the lower and middle classes covers a wider range compared to other sub-settings. In contrast, the RP area of upper class includes only three components: ground, vertical elements, and toys. Furniture in this area also differs: the lower class features a cabinet, and the middle class includes a bookshelf, both used for storing toys and books, while the upper class lacks furnishing constituents. The ground is covered with foam pads, creating a soft surface for children's activities. Big play objects, such as toy kitchens, desk and chair sets, and fast-food counters, are consistently placed in this area across all classrooms (see Table 3).

Table 3. Spatial characteristics of raised platform setting (RP) in three classrooms

Classroom	Spatial components	Spatial constituents	Physical properties
Lower	Furnishings	Shelve	Storable
	Ground objects	Foam pad	Soft-flat surface
	Vertical objects	Stairs	Terraced surface
		Bars	Boundary
	Play materials	Toy box	Storable
		Toy	Holistic
		Big play object	Holistic
Middle	Ground objects	Foam pad	Soft-flat surface
	Furnishings	Bookshelf	Storable
	Vertical objects	Staircase	Terraced surface
		Bars	Boundary
	Play materials	Toy box	Storable
		Book	Holistic
		Toy	Holistic
		Big play object	Holistic
Upper	Ground objects	Foam pad	Soft-flat surface
	Vertical objects	Staircase	Terraced surface
		Bars	Boundary
	Play materials	Toy	Holistic
		Big play object	Holistic

(Source: Author, 2024)

5. Discussion

This study explores spatial affordance as a key factor in understanding how children interact with their environment in depth. It addresses the primary research question: How do children in different sub-settings within the classroom use their environment to facilitate their actions during free play? Specifically, spatial components function as the foremost entities that provide children with environmental affordances in the classroom, as well as the principal objects of their interaction with surroundings.

5.1 Spatial affordances for children's actions

Based on the analysis of spatial components in the research sample (refer to Section 4), the number of spatial constituents in various areas across the three classrooms is similar. The lower classroom contained a total of 18 spatial components distributed across its three sub-settings, while the middle and upper classrooms each had 19 constituents. Consequently, the affordance levels provided by the three classrooms to children are comparable. More specifically, a greater number of spatial components in sub-settings correlated with a higher amount of children's actions and social activities. Therefore, from the perspective of classroom spatial composition, this finding macroscopically supports the notion that the physical environment of childcare spaces influences children's actions (Acer et al., 2016; Rentzou, 2021).

In the lower classroom, the TP and RP areas exhibited similar types of affordances, whereas the FP area had only 23 affordances, fewer than in the other two areas. During free play, children in the TP area were observed to engage in considerable movement on the wooden floor. This behavior was influenced by the types of play materials, as the toys in the TP area were mainly holistic, whereas the FP area featured a more limited variety. Thus, in addition to proximity (Maxwell, 2007), the abundant categories of play materials (Monsur, 2013) also influenced the extent to which children engaged with them. In other words, the accessibility of play materials, particularly the adjacency between toys and children, as well as their variety and quantity, played a significant role in stimulating children's actions. This finding partially in line with previous research on the importance of layout in childcare space design (Acer et al., 2016), particularly in relation to affordance theory.

In the middle classroom, the number of social actions performed by children in the TP area was the highest among the three classrooms. This suggests that the physical elements of indoor spaces positively influence children's social behaviors, even in relatively confined spaces (Sandseter, 2022). Chinese children, in particular, are accustomed to collective curricula and activities, which fosters a greater demand for social interaction (Li et al., 2014). During free play, children aged four and older tend to prioritize social communication and group engagement rather than personal goals. This finding leading to their more interactive actions emerged on several private spaces (e.g. two children trying to fix the tent in the RP area shows in Fig. 1), which contradicts to western context studies. Moreover, children in this age group, typically aged four to five, are more adept at controlling their bodies, which enables them to manipulate more complex toys and create intricate structures (Piek et al., 2008). Their actions are also more purposeful, reflecting greater engagement in classroom activities.

Fig.1 Two children collaborate to repair the tent in the middle classroom
(Source: Author)

Interestingly, the number of behaviors exhibited by children in the upper class during free play was not higher than that of the other two lower grades. This discrepancy can be attributed to the distribution of spatial components. The upper class focused on enriching the FP and TP areas, but the RP area had fewer props. Furthermore, children in the upper class tended to use objects on the ground to facilitate their actions. Unlike the table, where children typically use only their hands, movement on the ground involves both hands and feet, allowing for a broader range of motion. This may explain why children in all three classes showed similar behaviors in this regard. In contrast to the other two classes, the social space in the upper class seems to have little connection to the openness of the physical

space. This is likely because the social dynamics of the upper class tend to be more verbal and cooperative, which is related to the developmental stages of children's social abilities (Asik-Ozturk et al., 2019).

5.2 Functional taxonomy of affordances in three classrooms

Children utilize material entities in their environment to actualize actions. Observations of children aged 3–6 during free play indicate that they tend to engage in more individual or social actions on soft surfaces. This suggests that, compared to detached furnishings, larger spaces and softer textures offer children greater opportunities for performance and communication, thereby fostering their social and cognitive development. Previous research has emphasized factors such as classroom size e.g. (Cha, 2023), the density of play activity areas (White, 2004), and group size (Rimm-Kaufman et al., 2005). This study extends these findings by demonstrating that larger operable areas promote children's real-time communication behaviors. Furthermore, compared to rigid surfaces, soft surfaces better support motor activities such as lying, prostrating, and kneeling.

At the social affordance level, flat surfaces and play materials most strongly support children's social actions. In the lower classroom, children often engage in co-presence, spectating, mimicking, and parallel play, as well as basic forms of cooperation. Middle-class children, on the other hand, tend to develop rules around specific toys and exhibit more advanced group entry skills, often engaging in parallel play. Older children in larger classrooms, with their advanced physical skills and creativity, frequently construct models inspired by real-life objects, including those seen in animated films. They also form groups and establish rules independently to facilitate more complex social patterns. However, behaviors such as distribution, sharing, and exchange are notably less frequent or absent among these older children.

6. Conclusion

This study examines the provision of spatial components across classrooms for different age groups and their influence on children's behaviors. For teaching practice, it is crucial not only to differentiate types of play props but also to configure furniture and allocate spatial areas according to children's play preferences. Additionally, the interplay between same-age and mixed-age groups is both distinct and interrelated. Affordance taxonomy offers a foundational framework for understanding the dynamics of children's behaviors and the spatial configuration of kindergarten classrooms. However, the limitation of this study is that an increase in actualized spatial affordances does not necessarily correlate with greater engagement. In fact, higher affordances might reflect diminished focus, leading to frequent changes in material use. Social affordances reveal how children utilize spatial components to engage in social behaviors, but the frequency and duration of these behaviors require more precise definition. Future research should investigate children's play behaviors and social participation patterns in greater depth. By analyzing the correlation between actions and behaviors, a comprehensive understanding can be developed of how children's fragmented actions evolve into events and how these behaviors relate to physical environmental characteristics.

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Paper Contribution to Related Field of Study

This study contributes to the understanding of children's real-time behavior in Chinese kindergartens and introduces a novel extended taxonomy for evaluating the utilization of classroom space within these settings.

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