Exploring colour planning strategies for children's outdoor playgrounds in communities: An analysis of children's diverse preferences in Shanghai, China

Yajun Wen, Yifan Yu
Affiliation: College of Architecture and Urban Planning, Tongji University, Shanghai 200092, China
Email: wenyajuna@tongji.edu.cn, yuyifan@tongji.edu.cn

Abstract
Children's understanding of the world is largely shaped by their visual perception of their surroundings, with colour playing an integral role. Colour not only creates a visual impact but also has a profound influence on children's emotions, cognition, and behavior. This study explored colour planning strategies for children's outdoor playgrounds in communities, specifically focusing on children's colour preferences. We collected data through a questionnaire survey conducted in Shanghai, China, and employed the chi-square test and single-factor logistic regression to analyze the correlations between colour preferences and individual attributes of children, including gender, age, and community type, which we hypothesized could influence the diversity of children's color preferences. It is found that there exist significant differences in children's colour preferences across various ages and community types. Based on the children's colour preferences and preferences differences, we proposed several strategies for colour planning of children's outdoor playgrounds in the communities. Through these strategies, it aims to enhance the scientificity and universality of colour planning. Overall, this research contributes to the field by providing evidence-based recommendations for colour planning in children's outdoor playgrounds, ultimately contributing to the creation of more inclusive and vibrant child-friendly communities.

Keywords: colour planning, colour preference, children's playground, child-friendly community

1. Introduction

In the process of children's understanding of the world, the primary and most crucial aspect is their perception of the surrounding environment through vision (Proverbio et al., 2004). Within this developmental process, the significance of colour cannot be understated. It possesses the capacity not only to elicit visual impact but also to influence children's emotions, cognition, and behaviour (Jiang et al., 2020). Consequently, reasonable colour planning within the built environment, holds the potential to cultivate a more harmonious, healthful, and conducive environment for children's growth. Conversely, an unsuitable colour environment may inadvertently induce stress and impede the healthy development of children. The community, as the fundamental unit of city, serves not only as the immediate locus of children's daily activities but also constitutes a pivotal point for the realisation of a child-friendly urban environment. In recent years, prompted by the Child-friendly City Initiative (CFCI), there has been a noticeable surge in attention towards the design of children's outdoor playgrounds. Nevertheless, research on colour within the framework of constructing child-friendly communities remains comparatively underdeveloped, marked by a deficiency in quantitative evidence-based studies and systematic planning methodologies. Traditional approaches to colour planning and design predominantly rely on colour coordination skills and planner experience, often neglecting children's colour preferences and the underlying principles. By accumulating and analysing factual evidence, that is, children's colour preferences and laws of

preferences, evidence-based research that replaces empirical means with scientific means can provide an important supplement to planning and design. Consequently, this article takes Shanghai as an example and proposes colour planning and design strategies for children's outdoor playgrounds in communities based on the investigation of children's colour preferences and rules of preferences.

2. Literature Review of Children's colour Preference

In the realm of colour psychology, colour preference, a predilection of an individual or group towards specific hues over others, stands as a pivotal aspect within the broader domain of colour research. This aspect has perennially captivated the scholarly pursuits of various disciplines, including psychologists, urban planners, and artists. Studying colour preferences provides us with a way to understand how perceptual experiences map to cognitive and affective judgements (Ou et al., 2004).

Research on children's colour preferences encompasses three primary dimensions. Firstly, investigations of children's abstract colour preferences. For instance, as early as 1924, Garth (1924) explored the colour preferences of 1,000 white children, revealing an inclination towards blue that heightened with educational attainment, whereas with a decreasing preference for red. Similarly, Xu, Xu, and Guo (2022) corroborated that children aged 3-6 exhibit a predilection for colours with higher brightness, such as red, blue, and yellow. Moreover, as children get older, discernible gender differences emerge, with boys gravitating towards blue and girls towards pink, while red maintains favourability across genders. The second dimension pertains to the investigation of colour preference and perception concerning various objects, including food colour (Walsh et al., 1990), furniture colour (Jiang et al., 2020), and indoor colour (Ghayouri and Ayat, 2020), among others. The third dimension involves examining group disparities in colour preference, with a particular focus on gender and age differences. Sex-based distinctions in children's colour preferences have historically engendered debate. Some studies have identified notable disparities in colour preferences between boys and girls. For instance, Mohebbi (2014) surveyed children aged 7-9 in Islamic countries, revealing significant differences between genders in preferences for blue, green, pink, and black. Conversely, certain studies have indicated the absence of significant gender-based differences in preschool-aged children's colour preferences (Mousavi Samimi and Sadraei Tabatabaei, 2022). Nonetheless, on the whole, a preponderance of research supports the existence of gender differences in children's colour preferences (Child, Hansen and Hornbeck, 1968; Khaki and Mahdavi, 2021). In contrast to the contentious discourse surrounding gender differences, there is a consensus regarding the age differences in children's colour preferences. For example, Baniani (2022) observed marked differences in colour preferences among Japanese primary and middle school students, with primary school students exhibiting a preference for gold. Additionally, there exists a body of research exploring cultural disparities in children's colour preferences.

To sum up, in order to explore evidence-based colour planning for child-friendly community environments based on children's colour preferences, this study intends to address the following two research questions:

(1)What are children's colour preferences for children's outdoor playgrounds in communities?

(2)Are there differences in children's colour preferences for outdoor playgrounds in communities?

Drawing upon existing literature, this study formulates research hypotheses to address the second research question, focusing on gender and age disparities in colour preferences. Moreover, extant studies have evidenced significant variations in city colour preferences among residents inhabiting different housing types (Wen, Himeno and Chung, 2023), with Shanghai exhibiting several distinctive housing typologies. Hence, this investigation posits the following three research hypotheses:

(1) There exist significant differences in children's colour preferences for outdoor playgrounds across genders;

(2) There exist significant differences in children's colour preferences for outdoor playgrounds across ages;

(3) There exist significant differences in children's colour preferences for outdoor playgrounds across various community types.

3. Survey of Children's Colour Preferences

The content of the survey

Colour is the perceptual interpretation of light wavelengths through the visual apparatus of the eyes, processed by the brain, and influenced by life experiences. The diverse colours can broadly be categorised into two groups: achromatic and chromatic. Achromatic colours, characterised by a saturation level of 0, include typical black, white, and grey. In the common perception of the Chinese people, the colour spectrum is traditionally delineated into red, orange, yellow, green, cyan, blue, and purple—commonly referred to as the rainbow colours. Among these, red, yellow, and orange are considered warm hues, while blue, green, and purple are classified as cool hues.

Therefore, the questionnaire item concerning colour preference for outdoor playgrounds within communities is formulated as follows: "What colour do you most would like for the outdoor playgrounds in your community?" Respondents are provided with a single-choice selection from the following options: A. Warm colour, B. Cool colour, C. Black, white, and grey, D. Multicoloured (a mix of warm and cool tones), E. Other. Additionally, demographic details such as gender, age, and housing type of the participants were captured in the questionnaire.

3.1 Selection of survey area and analysis

Housing type is one of the variables of this study, so the area shown in Figure 1 was carefully selected as the investigation area. This area is located in the south-central part of Hongkou District, Shanghai, covering an area of about 1.5 square kilometres and is a 15-minute living circle. Encompassing three prevalent housing typologies emblematic of Shanghai, namely traditional lane blocks predating 1949, post-1949 public housing, and commercial and affordable housing constructed since the 1990s [33], this locale offers a diverse representation of urban residential architecture. Among them, traditional lane housings generally occupy a small area, exhibiting high building density, and dense road networks; public housing residences exhibit obvious grading characteristics, with large land use, low building density and low road network; The newer commercial and affordable housing developments encompass a range of sizes, with high-rise structures characterised by lower density, ample green spaces, and open areas.

There are abundant children's education facilities in the survey area, including one nursery, four kindergartens, four primary schools and three middle schools. Notably, Primary School No. 1

and Kindergarten No. 3 are predominantly surrounded by traditional lane housing, while Primary School No. 2 and Kindergarten No. 4 are situated in high-rise commercial housing. Conversely, Primary School No. 3 and Kindergarten Nos. 1 and 2 are primarily surrounded by multi-storey public housings.

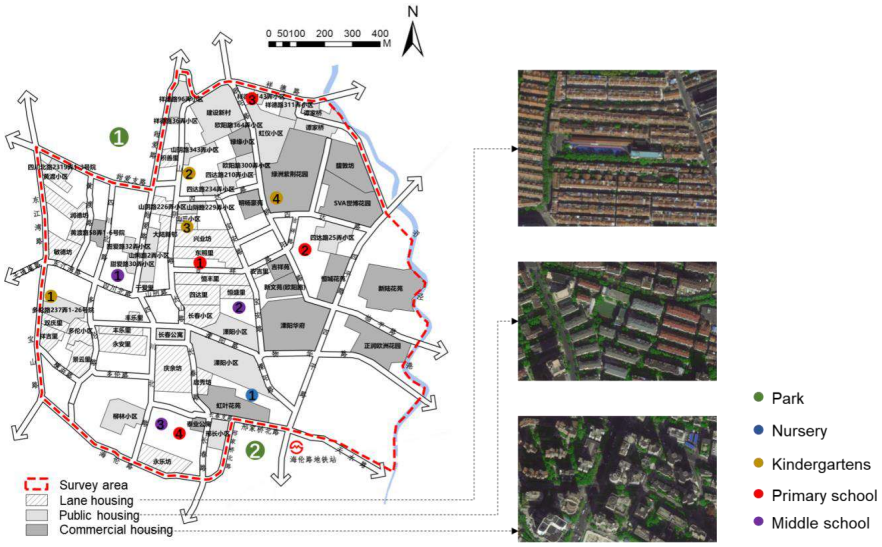


Figure 1. Survey area

3.2 Survey procedures and participants

In October 2023, a questionnaire survey was conducted within the designated area. Employing an offline random sampling approach, the survey targeted children aged below 18 years. Over one month, a total of 210 questionnaires were gathered, out of which 204 were deemed valid, yielding an effective rate of 97.1%. The demographic composition of the participants is illustrated in Figure 2. Specifically, the participants comprised 107 male children (52.45%) and 97 female children (47.55%). The age range spanned from 1 to 17 years, with an average age of 10 years. As per the United Nations Convention on the Rights of the Child, individuals under 18 years are classified as children. In line with the eight-stage theory of personality development proposed by psychologist E.H. Erikson, and the insights from famous Chinese psychologist Zhixian Zhu, the ages of the surveyed children were categorised into four groups: 0-3 years old (1.47%), 4-6 years old (10.78%), 7-12 years old (63.73%), and 13-17 years old (24.02%). Additionally, the distribution of housing types among the 204 participants was relatively even, with 64 children residing in lane housing, and 70 children each inhabiting public housing and commercial housing, respectively.

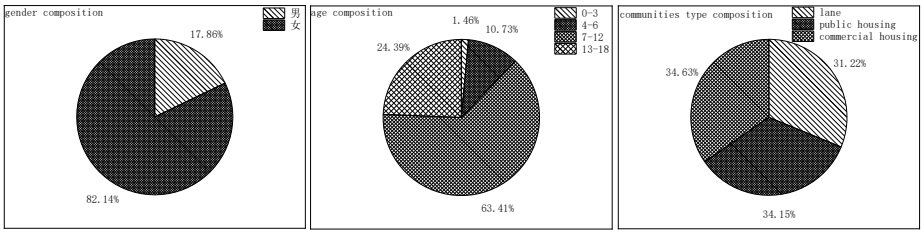


Figure 2. The composition of participants

3.3 Results

Figure 3 depicts the descriptive statistical outcomes of children's colour preferences for outdoor playgrounds in communities, presented as frequencies. Broadly, warm colours emerge as the most favoured choice among children, constituting 40.6% of responses, closely followed by a blend of cold and warm hues, representing 39.2% of preferences. Conversely, the least selected outdoor colour schemes are achromatic options, that are black, white, and grey.

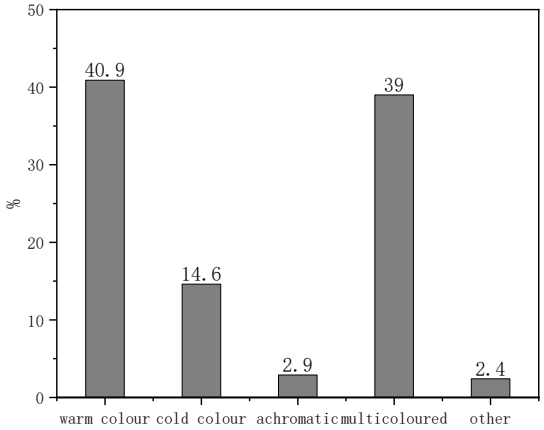
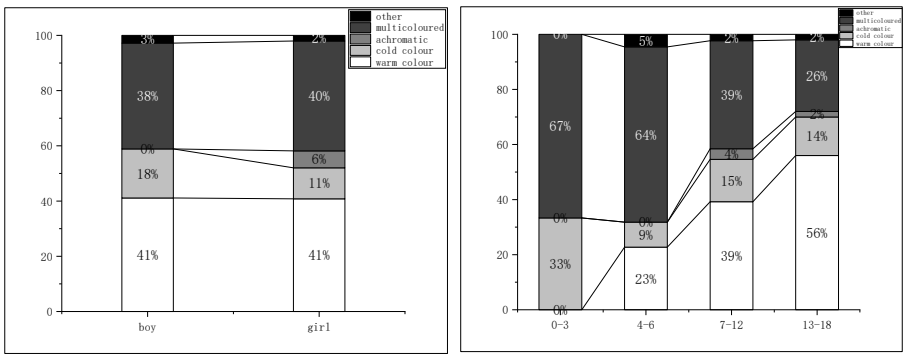


Figure 3. Preferred colour of children

Figures 4 illustrates the colour preferences of children across various genders, age groups, and housing types. Analysis reveals discernible patterns: boys exhibit a greater inclination towards cool colours compared to girls, while girls manifest a heightened preference for achromatic hues in contrast to boys. Regarding colour preferences among children residing in diverse community types, those inhabiting lane communities demonstrate a penchant for vibrant, multicoloured schemes, whereas children in public housing communities preferred warm colour palettes for outdoor playgrounds. Conversely, children in commercial housing communities were more likely to choose cool colours relative to other housing types.



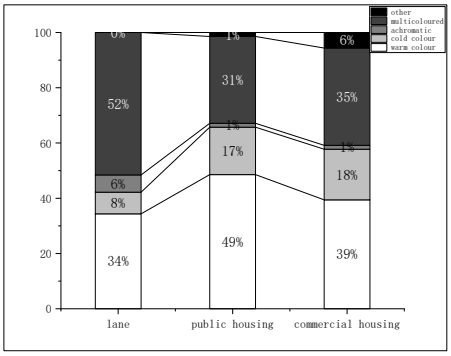


Figure 4. Colour preferences of children across various genders, ages, and housing types

In order to evaluate the statistical significance of gender and housing type differences in children's colour preferences for outdoor playgrounds, this study employed the chi-square test, a widely utilised hypothesis testing method. The chi-square test assesses the extent of deviation between observed and expected values in a statistical sample. The magnitude of this deviation determines the chi-square value, with larger values indicating greater discrepancies and smaller values indicating lesser discrepancies (Wen, Himeno and Chung, 2023). Furthermore, since age is a numerical variable while colour preference is categorical, the chi-square test is suitable for analysing variables when both are categorical. Therefore, to examine the relationship between age and colour preference, this study utilised a single-factor regression model.

The above tests were all performed through IBM SPSS 26. The test results are summarised in Table 1. According to Table 1, the p-value for age (0.043) and housing type (0.043) are both below the significance threshold of 0.05, indicating that the age difference and housing type differences in children's colour preference are significant at the 95% confidence level. That is, children's age and housing type are significantly related to children's colour preference for outdoor playgrounds in communities. Conversely, the p-value associated with gender (0.084) exceeds the 0.05 threshold. Thus, the analysis suggests that gender differences in children's colour preferences for outdoor playgrounds within communities are not statistically significant at the 95% confidence level.

Table 1. Results of significance test

	Value	df	Asymptotic significance	Exact significance
Gender	8.214	4	0.084	0.072
Age	22.346	4	0.000 (significance)	-
Housing type	16.256	8	0.039	0.043

In summary, the findings of this study support the establishment of research hypotheses 1 and 3. Specifically, the results indicate significant age and community-type differences in children's colour preferences for outdoor playgrounds within communities. Conversely, hypothesis 2 is not supported, as there are no statistically significant differences observed in children's colour preferences for outdoor playgrounds across genders.

4. Colour Planning Strategies for Children's Outdoor Playgrounds

Children often exhibit a strong inclination to congregate with peers of the same age group, each age group possessing distinct physiological, psychological, and behavioural needs.

Consequently, many outdoor playgrounds now incorporate activity zones tailored to accommodate children of varying age ranges. However, it is observed that the colour series employed across these activity areas often remain uniform, failing to account for the diverse colour preferences observed among children of different ages. Based on the research findings presented in this article, which underscore significant age-related disparities in children's colour preferences, it is imperative to reconsider the colour schemes utilised in community children's activity venues. Specifically, colour delineations should be integrated alongside age and activity type categorisations. For instance, vibrant and diverse colour palettes are recommended for play areas catering to younger children, whereas a more restrained colour palette may be suitable for play areas targeting older children. By aligning colour choices with the preferences of each age group, community activity venues can better cater to the diverse needs and preferences of children across various developmental stages.

Moreover, given the significant disparities in children's colour preferences for outdoor playgrounds across different community types, this study advocates for tailored colour design strategies for each community archetype. Specifically, lane and public housing communities represent the predominant housing typologies in Shanghai, characterised by high building density and limited space availability. In such high-density urban settings, the scarcity of land resources poses challenges for the incorporation of children's playgrounds. Thus, the study proposes the utilisation of existing spaces, such as idle areas or underutilised spaces within the lane and public housing communities, to augment open space provisions for children. Furthermore, fragmented spaces like stairwells can be repurposed to enhance the availability of recreational areas. Notably, colour can serve as an effective tool for delineating boundaries within these communities. Lane communities are encouraged to employ vibrant and diverse colour combinations, while public housing communities should predominantly utilise warm hues to foster a child-friendly community ambiance. Conversely, commercial housing communities typically offer ample green spaces and open areas, albeit with a more introverted spatial layout. Building upon this foundation, these communities should strive to provide a higher quality colour environment conducive to children's well-being. For instance, outdoor playground floors can be painted according to children's colour preferences, while activity facilities should be adorned with colours tailored to the cognitive and preference profiles of children within the corresponding age groups. By aligning colour design with the unique characteristics and needs of each community type, a more enriching and child-friendly environment can be cultivated within urban neighbourhoods.

5. Conclusion

Children grow up in the urban environment, and the urban environment, especially the community environment, plays a decisive role in their growth. If the community environment is planned in a way that meets the needs of children, such a community environment will not only help children grow up but will also become a beautiful home for future generations. From the perspective of children, this study investigated children's colour preferences for outdoor playgrounds in communities and found the following results: (1) For the colours of outdoor playgrounds in communities, children least like achromatic colours, that is, black, white and grey (2) Children's colour preferences exhibit significant age differences. Specifically, as children's age increases, their preference for warm colours also increases, while their preference for colourful colours decreases; (3) Residential type is related to children's colour preference for the outdoor playgrounds in the community. Children living in lane communities preferred colourful colours than children in other community types, and are less willing to choose cool colours. Children in public housing communities are more willing to choose warm colours for outdoor playgrounds in the communities.

In light of these findings, this article proposes colour planning strategies informed by children's colour preferences and preference trends. By integrating these insights into community renewal initiatives, urban planners and designers can craft children's outdoor playgrounds that are visually captivating, culturally resonant, and emotionally enriching. By prioritising children's colour preferences, community activity spaces can be transformed into vibrant and welcoming settings that enhance the overall experience and well-being of children within the community.

Reference

Baniani M. (2022) 'The association between colors, color preferences, and emotions among Japanese students: From elementary school to university', Color Research & Application, 47(4): 992-1004.

Child I L, Hansen J A, Hornbeck F W. (1968) 'Age and sex differences in children's color preferences', *Child development*, 237-247.

Garth T R. (1924) 'A color preference scale for one thousand white children', *Journal of experimental psychology*, 7(3): 233.

Ghayouri R, Ayat S. (2020) 'Colour Preference Based on Children's Choices for the Interior Spaces of Kindergartens', *International Research Journal of Advanced Engineering and Science*, 5(2): 154-159.

Jiang L, Cheung V, Westland S, et al. (2020) 'The impact of color preference on adolescent children's choice of furniture', *Color Research & Application*, 45(4): 754-767.

Khaki A, Mahdavi M. (2021) 'Study of Age and Gender Differences with Color Preference Approach in Primary School Students in Tehran And Khorasan Razavi', *Educational and Scholastic studies*, 9(4): 241-259.

Mohebbi M. (2014) 'Investigating the gender-based colour preference in children', *Procedia-Social and Behavioral Sciences*, 112: 827-831.

Mousavi Samimi P, Sadraei Tabatabaei N. (2022) 'Preschool children's indoor and outdoor playground HSV color preferences', *Color Research & Application*, 47(3): 745-757.

Ou L C, Luo M R, Woodcock A, et al. (2004) 'A study of colour emotion and colour preference. Part III: Colour preference modeling', *Color Research & Application*, 29(5): 381-389.

Proverbio A M, Burco F, del Zotto M, et al. (2004) 'Blue piglets? Electrophysiological evidence for the primacy of shape over color in object recognition', *Cognitive Brain Research*, 18(3): 288-300.

Walsh L M, Toma R B, Tuveson R V, et al. (1990) 'Color preference and food choice among children', *The journal of psychology*, 124(6): 645-653.

Wen Y, Himeno Y, Chung J. (2023) 'Potential conflicts between individual preferences and city color planning: A case study of Busan, South Korea', *Journal of Asian Architecture and Building Engineering*, 22(6): 3649-3664.

Xu W, Xu H, Guo X. (2022) 'Modelling Design of Color Graphics Books Using Visual Vocabulary Based on Children's Color Language Preferences', *CMES-Computer Modeling in Engineering & Sciences*, 130(2).