Analysis of Factors Influencing Children's Use of Public Activity Spaces in Old Communities in Ningbo

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Abstract: The rapid development of urbanization today and the huge amount of infrastructure to be replaced have led to the emergence of a large number of children and the urban space tension problem. In the context of building a child-friendly city, this study uses factor analysis to analyze the Yinzhou District of Ningbo City. Research on children's public activity space in old communities. Through questionnaire surveys and field surveys, the research data is obtained, and SPSS software is used to analyze the questionnaire data, and the direction and strategy of children's activity space creation in old communities based on the construction of child-friendly cities are

1. Introduction

In 1996, the United Nations proposed the creation of 'child-friendly cities' in response to the UN resolution on habitat: making cities fit for all and suggesting that the health of children is the ultimate measure of human living conditions and government management. Over two decades, more than 400 cities have been involved in the development of child-friendly cities, including Surrey (CA) in Canada, Auckland (NZL) in New Zealand and Amman (JD) in Jordan.

The community in which they live is the main area of daily activity for young children and early school-age children and is vital to their physical and mental development. For urban children, access to play outside the home and in the community is limited by motor vehicles, environmental pollution, lack of facilities for children's activities, and environmental threats to their health and safety. A city fit for children will be a city fit for all, and studying the urban environment from a child's point of view actually places higher demands on urban development.

In the face of rapid urban development, older neighbourhoods are faced with problems such as poor street patterns, single function activity spaces and a lack of outdated public facilities, and the poor outdoor environment in older neighbourhoods has a particular impact on children's health. Older neighbourhoods were built earlier and often occupy central locations in cities; a large number of housing estates built in a specific historical context exist in almost every city. The large footprint, high residential density and the number of households living in the community lead to extremely high demolition costs, making it difficult to use large-scale demolition and redevelopment for urban

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regeneration. Older communities are therefore particularly important for the renewal of child-friendly activity spaces.

This thesis takes the old communities in Yinzhou District as an example, obtains research data through field visits and questionnaires, uses factor analysis methods to screen the main factors affecting children's public activity spaces in old communities, determines the material vitality factors of children's public spaces in old communities through analytical methods, and summarises the existing problems of children's activity spaces in old communities, thus providing a valuable reference for the renewal and improvement of child-friendly public activity spaces in old communities.

2. Research Methods

2.1 Questionnaire Design

Based on field research and surveys of the environment of children's public spaces in the community, this study selected 20 influencing factors (Table 1) from social factors, traffic safety and environmental factors, combined with previous research conducted by scholars on children's activity spaces in old communities, and generated questions related to these factors for the research questionnaire, asking parents to rate the importance of the influencing factors, using the Likert scale grading method, with five scales of very important, important, average, unimportant and very unimportant, with scores of 5, 4, 3, 2 and 1 in that order.

Table 1 Influencing Factors Of Children's Activities in Public Spaces in Old Communities

Influencing factor codes	Name of influencing factor	Influencing factor codes	Name of influencing factor
X1	Distance to the event space	X11	Configuration of cultural facilities on the site
X2	Crossing of the carriageway on the way to the event space	X12	Configuration of sports facilities on the site
X3	Number of obstacles along the pavement to the event space	X13	Configuration of recreational facilities on the site
X4	Number of traffic accidents around the site	X14	Configuration of sitting and resting facilities on the site
X5	Site plant safety	X15	Degree of environmental tidiness within the site
X6	The condition of the roads connected to the site openings	X16	Number of types of activities for children organized by the community
X7	Safety of landscape facilities on site	X17	Sunlight and temperature conditions on the site
X8	Site ground safety	X18	The abundance of plants and water features in the community
X9	Security of areas such as water features on the site	X19	The size of the venue suitable for a variety of community events
X10	Adequate lighting of the site	X20	Use of the site by age groups

2.2 Overview of the Study Area

The questionnaire research was implemented from June 2020 to May 2021, the time was chosen to cover four seasons of the city, and the research was conducted in five old communities in Yinzhou District, the central city of Ningbo (Table 2). The questionnaires were distributed by random sampling, and the total number of questionnaires sent out was 292, with a recovery rate of

100%. Excluding invalid questionnaires such as incomplete and indiscriminate repetition, the total number of valid questionnaires was 257, with an effective rate of about 88%, which can ensure the efficiency and authenticity of the sample and meet the requirements of sample size reliability.

Table 2 Older Community Subjects Involved in This Study

No.	1	2	3	4	5
Older community names	White Crane Community	Songzhao qiao Community	FeiHong Community	FanYu Ⅰ Village	FanYu Ⅱ Village
Number of samples	122	67	46	56	54

2.3 Factor Analysis

Factor analysis refers to the study of statistical techniques for extracting common factors from groups of variables. It was first introduced by the British psychologist C.E. Spielman. Factor analysis allows the identification of hidden representative factors among many variables. Grouping variables of the same essence into a single factor reduces the number of variables and also tests the hypothesis of relationships between variables. This study uses factor analysis to derive five influencing factors for children's activities in older communities, and proposes recommendations for the optimal design of public spaces in older communities in relation to the influencing factors.

3. Analysis and Discussion

3.1 Questionnaire Validity Test

Firstly, the Spearman's rank correlation coefficient was used to test for correlation between the 20 influencing factors. Secondly, the KMO and Bartlett's spherical tests were used to test the sampling appropriateness and significance level. As can be seen from Table 3, the KMO value was 0.836, which is greater than 0.8, and the p-value was 0.000, which reached the 0.05 significance level and met the requirements for implementing factor analysis. The validity test shows that the questionnaire data can be subjected to factor analysis.

Table 3 Kmo and Bartlett's Spherical Test Table

KMO		0.836
Bartlett test	Approx. Chi-Square	700.49
	df	190
	p value	0.000

3.2 Factor Exraction

As a total of 20 factors influencing children's activities in older communities were proposed, a factor analysis was conducted using SPSS in order to focus these factors into more defined categories. Factors with eigenvalues greater than 1 were extracted using principal component analysis, and the knot and gravel plot, with a total of 5 common factors for the 20 indicators, had a cumulative explained variance of 73.078%, meeting the criterion of an explained variance of 60% or more (Table 4)

Table 4 Explaining the Variance of the Factors

Total Variance Explained									
Factor	Eigen values			% of variance (Initial)			% of variance (Rotated)		
	Eigen	% of Variance	Cum. % of Variance	Eigen	% of Variance	Cum. % of Variance	Eigen	% of Variance	Cum. % of Variance
X1	9.35	46.749	46.749	9.35	46.749	46.749	4.051	20.256	20.256
X2	1.849	9.244	55.993	1.849	9.244	55.993	3.104	15.52	35.776
X3	1.367	6.835	62.828	1.367	6.835	62.828	2.791	13.955	49.731
X4	1.054	5.27	68.098	1.054	5.27	68.098	2.373	11.867	61.599
X5	0.996	4.98	73.078	0.996	4.98	73.078	2.296	11.479	73.078
X6	0.82	4.1	77.178	-	-	-	-	-	-
X7	0.76	3.802	80.98	-	-	-	-	-	-
X8	0.605	3.024	84.004	-	-	-	-	-	-
X9	0.551	2.756	86.76	-	-	-	-	-	-
X10	0.465	2.325	89.085	-	-	-	-	-	-
X11	0.376	1.881	90.966	-	-	-	-	-	-
X12	0.339	1.693	92.659	-	-	-	-	-	-
X13	0.322	1.608	94.267	-	-	-	-	-	-
X14	0.282	1.412	95.679	-	-	-	-	-	-
X15	0.24	1.201	96.88	-	-	-	-	-	-
X16	0.198	0.991	97.871	-	-	-	-	-	-
X17	0.149	0.746	98.617	-	-	-	-	-	-
X18	0.111	0.554	99.171	-	-	-	-	-	-
X19	0.097	0.485	99.655	-	-	-	-	-	-
X20	0.069	0.345	100	-	-	-	-	-	-

3.3 Factor Categorization

After several factor analyses, it was found that X4 The Number of traffic accidents around site, X17 The Sunlight and temperature conditions on the site, and X18 The abundance of plants and water features in the community were too little correlated with their remaining factors to show the significance of their common factors, so these three factors were deleted. The five common factors and the corresponding 17 effective influencing factors were finally obtained by SPSS variance rotation.

Among the influencing factors of common factor 1, there are six factors with factor loadings above 0.584, including X5 Site plant safety, X7 Safety of landscape facilities on site, X8 Site ground safety, etc. Among them, factors 5, 7 and 10 have the highest scores above 0.751, while X5 Site plant safety and X7 Safety of landscape facilities on site are the main factors of children's public activity space facilities. Factor 1 is therefore named the site safety factor.

Among the factors affecting public factor 2, there are three factors with factor loadings of 0.624 or more, including X14 The Configuration of sitting and resting facilities in site, X19 The size of the venue suitable for a variety of community events, and X20 Use of the site by age groups by various age groups, etc. Among them, X19 and X20 have the highest scores of 0.799 or more. X20 The use of the site by age groups is the main factor in the sharing of space for children's public activities, so factor 2 is named the integrated space sharing factor.

Among the factors that influence Common Factor 3, there are two factors with factor loadings of 0.685 or more, including X12 The configuration of sports facilities on the site and X13 The Configuration of recreational facilities on the site, with the highest score of 0.842 for Factor 13. The

factor of facilities.

Among the factors that influence public factor 4, there are four factors with a factor loading of 0.440 or more, including X1 The distance to the event space,X2 the crossing of the carriageway on the way to the event space, and X3 The number of obstacles along the pavement to the event space.X1 The distance to the event space is the main factor in the accessibility of children's public activity space, so factor 4 is named as the site accessibility factor.

Among the factors that influence public factor 5, there are two factors with a factor loading of 0.647 or more, including X11 The Configuration of cultural facilities on the site and X16 The number of types of activities for children organized by the community. The cultural facilities on site factor.

The above factors are mainly proposed for children's public spaces in older communities, and therefore do not fully cover all aspects of public spaces in older communities. These five influencing factors combine to influence the use of children's public spaces in older communities by residents in different dimensions.

Table 5 Factor Load Table

Factor name	Items	Factor loading				
		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
the site safety factor	X5 Site plant safety	0.753	-	-	-	-
	X7 Safety of landscape facilities on site	0.779	-	-	-	-
	X8 Site ground safety	0.688	-	-	-	-
	X9 Security of areas such as water features on the site	0.727	-	-	-	-
	X10 Adequate lighting of the site	0.751	-	-	-	-
	X15 Degree of environmental tidiness within the site	0.584	-	-	-	-
the integrated space sharing factor	X14 Configuration of sitting and resting facilities on the site	-	0.624	-	-	-
	X19 The size of the venue suitable for a variety of community events	-	0.813	-	-	-
	X20 Use of the site by age groups	-	0.799	-	-	-
Activity facility factor	X12 Configuration of sports facilities on the site	-	-	0.685	-	-
	X13 Configuration of recreational facilities on the site	-	-	0.842	-	-
the site accessibility factor	X1 Distance to the event space	-	-	-	0.824	-
	X2 Crossing of the carriageway on the way to the event space	-	-	-	0.772	-
	X3 Number of obstacles along the pavement to the event space	-	-	-	0.440	-
	X6 The condition of the roads connected to the site openings	-	-	-	0.600	-
The cultural facilities on site factor	X11 Configuration of cultural facilities on the site	-	-	-	-	0.647
	X16 Number of types of activities for children organized by the community	-	-	-	-	0.716

3.4 Factor Impact Analysis

The mean values of the five influencing factors are all above 2.2, and each influencing factor

shows a tendency to influence. The influencing factors on the vitality of children's public spaces in old communities are diverse, and the current situation of children's public spaces in old communities is the result of the influence of several influencing factors. The current situation of children's public spaces in old communities is the result of several influencing factors. This is a reference for how to attract residents to the site and increase the vitality of children's public spaces through the renovation of children's public spaces.

3.4.1 Influence of the Facilities Factor on Residents

With a mean score of 2.791, the Facilities for Venue Activities factor ranks 3rd out of the five factors.X13 The configuration of recreational facilities on the site is the primary factor influencing residents' access to children's public spaces. X12 The configuration of sports facilities on the site is the second most important factor in influencing residents to visit children's public spaces .It is possible to understand in the questionnaire that residents go out to play and that the configuration of the sports facilities in the venue will be an attraction for these people and an irrelevant factor for some residents who want to play with novel facilities rather than activities, a relatively low impact factor.

3.4.2 The Impact of the Space Composite Sharing Factor on Residents

The average score for the space compound sharing factor is 3.104, ranking 2nd out of the 5 factors, with the highest score for X19 The size of the venue suitable for a variety of community events, which shows that there are some differences in the requirements of the venue for different activities, on the one hand residents do not want the venue to be a limiting factor for activities, and on the other hand the children's public space cannot exclude some activities. For older communities In the case of children's public spaces in older communities, this factor is a complex one. The lowest score was given to X14 Configuration of sitting and resting facilities on the site, and many people in the questionnaire said that they would only need a seat to rest in the space for strenuous exercise, but would not need a seat to chat or walk in the space on a daily basis. This resulted in a difference in the scores for this factor for different situations.

3.4.3 The Impact of Spatial Accessibility Factors on Residents

The spatial accessibility factor has a mean score of 2.373, ranking 4th out of 5 factors, with X1 The distance to the event space being the most influential factor, followed by X2 The crossing of the carriageway on the way to the event space, both of which are above 0.772, indicating that accessibility is still important to residents. In the questionnaire, many residents said that they would be less likely to come to an activity space if it was not easily accessible.

3.4.4 The Impact of Spatial Safety Factors on Residents

The spatial safety factor has a mean score of 4.051, ranking 1st out of 5 factors, and is the primary influence on the vitality of public spaces for children in older communities, with the highest score for X7 The safety of landscape facilities on site, followed by X5 The safety of the plants. The difference in scores between these two factors is not significant, suggesting that both X7 The safety of landscape facilities on site and X5 The safety of the plants influence the choice of residents to come to the children's public space. In the field research, it was found that spaces away from more dangerous spaces and spaces away from plants that can cause harm are preferred by residents for children to play in.

3.4.5 The Impact of the Cultural Facilities Factor of the Site on Residents

The mean score for the walking space factor was 2.296, ranking 5th out of 5 factors, the influence factor of X16 The number of types of activities for children organized by the community scored highest. This was followed by X11 The configuration of cultural facilities on the site. In the on-site research, it was found that there were more cultural facilities such as bulletin boards in older communities, but it emerged that these cultural facilities were not being utilised, hindering the spread of community culture.

4. Design Orientation for Child-Friendly Spaces in Older Communities

4.1 Siting of Children's Activity Spaces

The results of the influence factor study show that residents of older communities place great importance on the location of the space, and when choosing a space for children's activities, they tend to choose a site that is closer to their homes, more convenient and has activities for residents. Therefore, for older communities that lack children's spaces and are interested in creating children's spaces, the location of the space is particularly important, and residential areas and the vicinity of schools are relatively good choices.

4.2 Configuration of Activity Facilities

The primary factor influencing the choice of space for residents in older communities is the extent to which the facilities in the site are well developed and abundant. From the research results, it can be concluded that the current public activity space facilities in old communities tend to be uniform, and there is no tendency to target children, usually on one side of the site to arrange ordinary fitness equipment, which obviously can not meet the needs of children's activities, so in the renovation of children's public space in old communities should pay more attention to the configuration of children's facilities - -This is clearly not enough to meet the needs of children.

4.3 Arrangement of Public Spaces

The public spaces in older communities are generally small, and there is a lack of space for children's activities. As a group of people curious about life, children need not only flexible facilities, but also a good environment and atmosphere. In order to meet the spiritual and material needs of children, the environment of the venue is particularly important. The combination of plants and the colour scheme of the facilities will be an important factor in the children's activities.

4.4 Improving the Impact of the Surroundingroads

Road traffic safety has always been a constant issue, and the results of the questionnaire showed that “ whether the activity space needs to cross a carriageway along the way” topped the list of influencing factors, and that the poor condition of roads in older community, where children are involved in traffic accidents every year, is a painful fact to face up to.

Therefore, the following points should be taken into account in the design of public activity spaces for children in relation to the surrounding roads: firstly, planning the main and secondary entrances to the site to avoid some of the traffic roads; secondly, making iconic designs or modifications to important road sections to remind vehicles and pedestrians to protect children; thirdly, designing the site enclosure to avoid accidents caused by children climbing over.

4.5 Enhancing Safety within Public Activity Spaces

As a group of children with no experience in dealing with emergencies, the safety of their public activity space is naturally a top priority. Outdoor public spaces are richly furnished and decorated for aesthetic purposes. These are inessential to adults, but they can be a weapon for harming children. Safety issues should therefore be given greater attention in the layout of children's public spaces, with measures such as soft wrapping around the edges of facilities, improving the undulation of the site and avoiding plants with thorns and sharp leaves.

4.6 The Tendency for Shared/Composite Multi-Purpose Venues

The size of the space suitable for holding various community activities in the site has the highest score. It can be concluded that the unchanging function of the space no longer meets the needs of contemporary residents and children, and that the demand for space is in fact a demand for activities in disguise. How to create a multifunctional space that can guide community residents to carry out different activities will become a major trend in the reconstruction of old communities in the future.

Through data analysis and field research in a number of old communities, this study identified the factors that influence children's public activity spaces in old communities, and through secondary analysis, the degree to which these factors influence the vitality of children's public activity spaces in different ways and to different degrees. Based on the ranking of the influencing factors, the study effectively corroborates or proposes strategies for guiding the design of children's public spaces in old communities to facilitate the design of old communities. In summary, this study uses data analysis and field research in a number of older communities to filter out the influencing factors for children's public spaces in older communities, and through secondary analysis, the extent to which these factors influence the vitality of children's public spaces in different ways and to different degrees. Based on the ranking of the influencing factors, the design of children's public spaces in old communities is effectively proposed in order to improve the quality of children's public spaces in old communities and to create more attractive, healthy and safe spaces for children.

5. Conclusion

The residential community is the main area of daily activity for young children and early school-age children, and is vital to their healthy physical and mental development. It is important to create a space for children of all ages to participate in public activities within a limited space, to improve the use and satisfaction of residents and children with the community space, to fully activate the possibilities of the community public space as a place for children's activities, to restore the vitality of the community and to meet the needs of children's life and growth, and to enhance the healthy development of children and the child-friendliness of the city.

The research data were obtained through field visits and questionnaires, and the main factors affecting children's outdoor activity spaces in old communities were screened by factor analysis. Together, these five factors determine residents' satisfaction with and use of the existing children's public activity spaces in the community. Considering the special nature of children's public activity spaces and the cautiousness of residents in choosing them, any change in any of the five factors, as the main vitality influencing factors of children's public activity spaces in old communities, will affect the residents' use and satisfaction of them.

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