Investigation and Study on the Environment and Residents' Satisfaction Degree of Urban Residential Areas in the North of Xi'an City

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Abstract. Taking the closed community in the northern district of Xi'an as an example, this paper describes the spatial environment of the area as a closed community from the perspectives of the number of residential developments, land area, number and form of entrances and exits, shape of road and community boundaries, and guard level. Additionally, through a questionnaire on resident satisfaction, the basic shape of the area, factor analysis, and cluster analysis were analyzed to provide factual evidence for the gradual opening of the closed community in the future.

Keywords: Gated Community · Location environment · Resident Satisfaction · Investigation and Research

1 Introduction

Blakely and Snyder (1997) defined gated communities in their book "Fortress America: Gated Communities in the United States" [1]. Hess P.M. (1997) later analyzed the impact of Crossroads and Wallingford on pedestrian traffic systems using graphics [2]. Gated communities' impact on living environments is now widely recognized among domestic scholars. Starting in 2005, cities like Dalian and Guangzhou attempted to limit their impact on urban transportation space through "banning orders" with little success. Domestic scholars have also studied the issue [3]. Miao Pu (2004) first criticized the social problems caused by closed residential areas in China [4], followed by many related case studies [5]. This paper examines the development time, quantity, and land area of closed residential areas in the northern district of Xi'an, and conducts a resident satisfaction survey based on this information.

2 Research Background

This paper focuses on the Daxing New District of Xi'an City, specifically four core areas within a scale range of 1600 m × 1600 m. The research period spans from 2000 to 2018, covering the period before and after the establishment of the Daxing New

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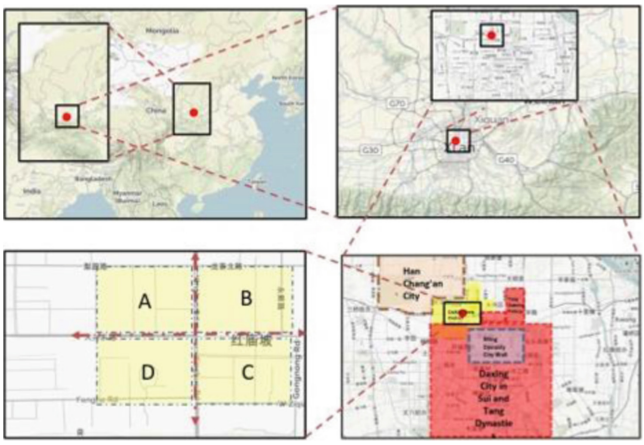

Fig. 1. Location and scope of the study area

District. Historically, this area belonged to the transitional zone between the Sui and Tang Dynasties' Daxing City and the Han Chang'an City, and is considered a crucial historical and cultural area [6]. In the 1950s and 1960s, this area became the west gate of Xi'an City, and was surrounded by dilapidated factory buildings and chaotic traffic until around 2008 [7]. In 2008, the Xi'an Municipal Party Committee and Municipal Government designated this area as the first comprehensive old-city renovation and industrial enterprise relocation area in the city [8]. The Daxing New District of Xi'an City was established, with a goal of building an international and modern commercial and residential district with livable features. After nearly a decade of construction, the area has been transformed into a new livable district (Fig. 1).

3 Situation Analysis

3.1 The Amount of Development Time and the Type of Building Texture

The area's development is divided into four unknown periods. Before 2000, development was mainly concentrated in the D area. Between 2000 and 2008, 20 residential communities were developed, mainly in the C and D areas. After 2008, 15 residential communities were developed, mainly in the A and B areas. Of the total number of residential communities developed in the area, 81.39% were developed after 2000. The development intensity in areas A and B was greater than in C and D.

The total number of residential communities in the four areas is 43, with 17 multi-story residential communities accounting for 39.53% and 18 high-rise residential communities accounting for 41.86%. Eight residential communities have a mix of multi-story and high-rise buildings, accounting for 18.60%. The C and D areas have more residential communities than the A and B areas. High-rise residential communities are distributed evenly across the four areas, while multi-story residential communities are mainly concentrated in the C and D areas.

Fig. 2. Boundary of the road network and residential areas within the study area

The survey found that most of the residential communities (44.18%) had two exits, while only one community (1 out of 43) had one exit and 13.95% had more than two exits. The size of the communities with one exit was relatively small and they were mainly developed around 2000, while larger communities with two exits were mainly developed after 2008. Regarding the entrance of the communities, electric gates were used in 79% of the entrance gates, and 67.44% of the exits had obvious signs, while 32.56% of the entrances did not.

3.2 Area and Number and Form of Entrances and Exits

The total area occupied by the 43 small communities in the entire district is currently 92.09 hectares, accounting for 35.93% of the entire district area (256 hectares). The largest community in terms of land area in the A district is Longhu Shuijing Licheng (4.67 hectares), while the smallest is the Municipal Machinery Branch Family Compound (0.74 hectares). Of all the communities, 48.83% have access control systems, while 51.17% do not; and 48.83% have a system for separating pedestrians and vehicles (Fig. 2).

3.3 Road and Community Boundary Patterns

The entire area consists of four types of roads. Xingxinghuo Road, which runs north-south, is the expressway of the area. Liyuan Road, Longshou North Road West Section, Daxing East Road, and Hongmiaopo Road are the main roads of the city, among which Hongmiaopo Road is planned as the main road of the city but has always been a dead-end road. In 2018, the Xi'an Municipal Government was determined to connect the dead-end roads in Xi'an, and Hongmiaopo Road became the real main road of the city, undertaking the main transportation function of the area. Da Bai South Road in A area, Yongquan Road in A area, Yongxin Road in B area, Ziqiang West Road in C area, and Fenghe Road in D area are the secondary roads of the area, serving as the transportation hub and functional service of each area. Yong'an Road in A area, Xinghuo East Lane and Mingzhu Lane in C area, and Yongyi Road in D area are the branch roads connecting the residential areas and secondary roads of each area. Among them, the branch roads in B area have been gradually eaten away by closed communities (represented by JinHui Swan Bay) in the urban development of the past 20 years.

Table 1. Statistics of Community Guard Levels

Area	Unkonw	None	Weak	Medium	Strong	Very Storong
A	1	0	1	3	3	0
B	0	3	2	4	1	0
C	0	0	1	7	2	2
D	0	0	4	5	4	0
Total	1	3	8	19	10	2
Rercentage	2.3%	6.9%	18.6%	44.1%	23.2%	4.6%

The morphology of residential community interfaces takes on various forms, such as street-facing shops, fences, walls (transparent or opaque), greenery, and unclear boundaries. Closed communities in the area primarily have street-facing shops (72%), fences (25.58%), transparent walls (2.32%), and opaque walls (83.7%) as their interface forms. The street-facing facade usually faces the road on branch and secondary roads, while opaque walls surround the interior of the community. The form of the residential area interface also includes other forms such as greenery, and the closed communities in this area have similar interface forms, mainly consisting of street-facing shops, fences, transparent or opaque walls. The street-facing facade primarily appears on the support roads and secondary roads, while opaque walls surround the interior of the community.

3.4 Guard Level and Degree of Closure

Gated communities are a popular type of residential area. The research team categorized the guard levels of the entire area into six levels: unknown (2.3%), none (3.9%), weak (18.6%), medium (44.1%), strong (23.2%), and very strong (4.6%). Based on the guard level, the team then rated the communities according to their overall situation and level of closure. Communities with a strong guard level account for 67.3% of the entire area, and 44% of the communities have security personnel. Closed communities with three- and four-star ratings account for 60.3% of the total number of communities. The C area has two communities with a very high guard level, Xi'an Construction Community and Aiju Garden. There are five-star closed communities in A and D areas with three each, and in C area with two, and B area with one (Table 1).

4 Resident Satisfaction Questionnaire

4.1 Basic Information

The research team randomly distributed 200 survey questionnaires to different residential areas within the four areas of A, B, C, and D. Out of the total, 185 questionnaires were found to be effective. The survey questionnaire was designed in two parts: satisfaction with the internal environment of the community and satisfaction with the external environment. Satisfaction with the internal environment was assessed based on factors such

as sports venues, overall environment, building appearance, motor vehicle traffic, pedestrian traffic, and living service facilities. Satisfaction with the external environment was assessed based on factors such as bus stop facilities, shopping and dining options, public places, medical institutions, fitness facilities, and convenience of vegetable markets (Table 2).

This study considered the economic disparities among the four areas of A, B, C, and D, which could directly impact residents' overall satisfaction. Therefore, different correlation analysis methods were used to analyze resident attributes such as age, education level, monthly income, family population, occupancy method, occupation, and travel method with the evaluation scores of living satisfaction. The results showed that one of the seven resident attributes was highly correlated with the score of community residential satisfaction. Specifically, age was highly correlated with pedestrian traffic, external public places, and external medical institutions. Education level was highly correlated with the overall internal environment. Monthly income had a high correlation with the overall appearance of community buildings, internal living service facilities, and external public places. Family population was highly correlated with external public places and external fitness facilities. Occupation had a high correlation with the overall internal environment. Meanwhile, occupancy method and travel method had weak correlations. The Pearson correlation coefficient of the overall appearance of community buildings was 0.262, and the significance (two-tailed) was 0.004 (Fig. 3).

Table 2. Quantitative Standards for Resident Attributes Data Level.

Varible	Varibale Level	Value
Age	Ordinal	1. Teenagers 2. Middle-aged 3. Elderly
Education	Ordinal	1.Elementary school 2. Junior high school 3. High school/vocational school 4. Junior college/bachelor's degree 5. Master's degree and above
Monthly Income	Ordinal	1.Below 3000 RMB/month 2. 3000–6000 RMB/month 3. 6000–10000 RMB/month 4. Above 10000 RMB/month
Household poplation	Ordinal	1.Three-person household 2. Newlywed couple 3. Elderly couple 4. Single parent 5. Single 6. Three generations living together 7. Other
Housing type	Ordinal	1.Self-purchased and self-occupied 2. Rented
Occupation	Ordinal	1.Government employee 2. Public institution employee 3. Enterprise employee 4. Self-employed 5. Military personnel or other
Mode of transportation	Ordinal	1.Walking combined with public transportation 2. Bicycle/electric vehicle 3. Motor vehicle

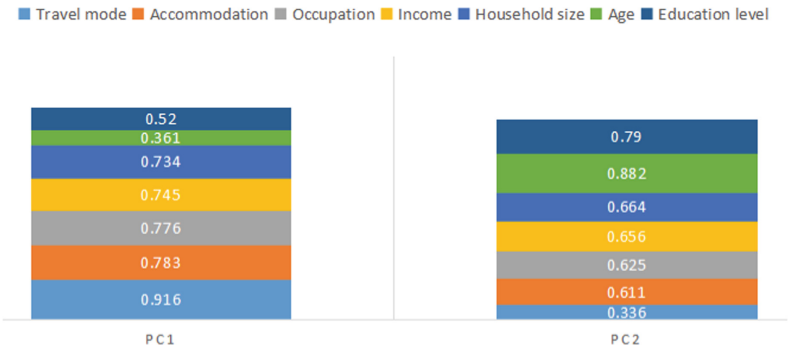

Fig. 3. Rotated component matrix A schematic diagram.

4.2 Factor Analysis

The socio-economic attributes of residents in the study area differ significantly. To obtain a more complete analysis result for measuring overall satisfaction, the residents were classified. Factor analysis was conducted using SPSS, extracting two components with eigenvalues greater than 1 from the 7 indicators, explaining 95.675% of the total variance. The first factor showed strong positive correlation with all 7 variables, while the second factor had less correlation with the original variables and negative correlation with travel mode. The first factor mainly explained the variables related to family structure, while the second factor mainly explained the variables related to cultural level. Dynamic clustering was used for quick classification with a cluster number of 3. Based on the final cluster centers, statistical charts of the main components for each group were drawn, which showed distinct characteristics for each group (Figs. 4 and 5).

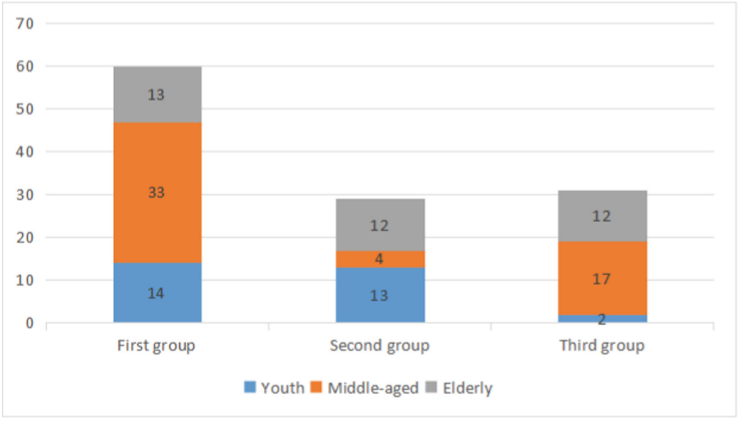

Fig. 4. Age Distribution of Different Population Groups

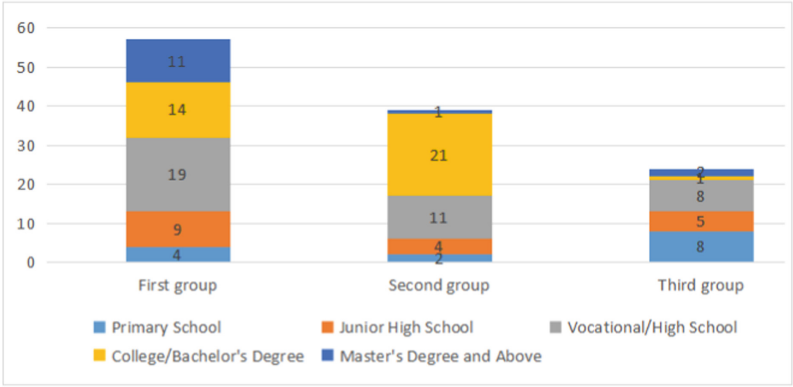

Fig. 5. Education Distribution Statistics of Various Populations

4.3 Cluster Analysis

The study analyzed the socio-economic attributes of three population groups and drew statistical charts for convenience. The first group is mainly composed of young and middle-aged people with a balanced education level, high-income groups, and more families with three generations living together. They work mainly in public institutions and corporate units and belong to the typical salaried class. The second group is mainly composed of young people with undergraduate degrees, and they work mainly in individual businesses and companies and belong to the typical young white-collar class. The third group is mainly composed of middle-aged and elderly people with generally low education levels and balanced income. They work mainly in other companies and individual businesses and belong to the typical retired population or the agricultural-to-non-agricultural population without pension.

4.4 Satisfaction Analysis of Population Groups

The study analyzed the satisfaction levels of the three population groups with the external residential environment in Daxing New District. Overall, the residents generally approved of the external environment, but comprehensive scores for fitness and public areas were relatively low. This indicates a contradiction between the demand for sufficient space for physical activities and the inadequate urban space. Similarly, the comprehensive scores for internal sports facilities and parking were also low, indicating low satisfaction with the living space. However, other indicators had high satisfaction ratings. When examining the satisfaction levels of the three population groups, the first group had high satisfaction with public spaces and shopping and dining areas, the second group had the highest satisfaction with medical institutions, and the third group had relatively high satisfaction with external markets, fitness areas, and bus stops. This reflects the different lifestyles and needs of the three groups (Fig. 6).

Overall, Daxing New District has a rich variety of commercial activities and reasonable and convenient transportation stations, as indicated by the high satisfaction levels

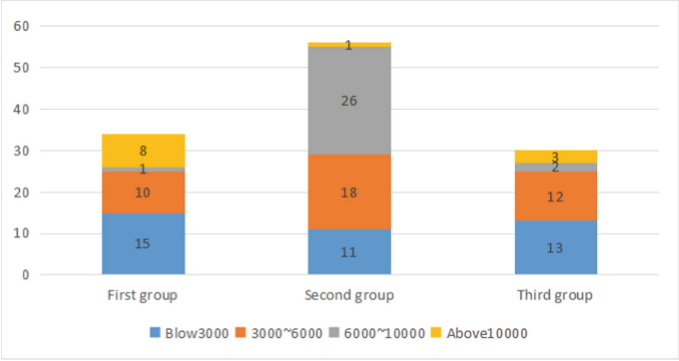

Fig. 6. Income distribution statistics for various groups of people

for external shopping areas and public transportation. However, the low satisfaction levels for external fitness spaces and public spaces reveal a lack of consideration for the quality of people's daily lives in urban design. This is attributed to an excessive focus on real estate development at the expense of important social spaces for residents.

When considering satisfaction with the internal residential environment among the three population groups, the first group does not have as high satisfaction levels with internal residential indicators compared to the second and third groups. They are particularly dissatisfied with internal life support and pedestrian traffic, likely due to their living in mid- to low-end communities. The second group, composed mainly of young white-collar workers, highly values the appearance of internal architecture and pedestrian traffic, but has the lowest satisfaction levels with parking spaces. The third group, mainly comprising elderly individuals, highly values internal life services and motor vehicle traffic due to their walking-oriented lifestyle. Parking issues remain a persistent problem in urban development, arising from the development of China's automobile industry, urban planning and construction, and real estate developers.

5 Conclusion

Overall, the residential communities in the northern part of Xi'an's Daxing New District have a high level of closure, with a predicted security level of 67.3% based on the guard level of the communities. Different population groups have varying satisfaction levels with the external and internal spatial environments of the communities. Middle-aged and young working-class people are more satisfied with external public places and shopping and dining outside the community, but their overall satisfaction with the internal environment is lower than that of white-collar workers and retirees. White-collar workers are more satisfied with external medical institutions, the appearance of internal buildings, and internal transportation, but their satisfaction with the parking environment in the community is low. Retirees or non-pensioned rural-to-urban migrants are more satisfied with external markets, fitness facilities, public transportation stations, and internal living facilities. It can be concluded that different population groups have distinct levels of satisfaction with their living environments due to the commodification

of urban residential areas, which has practical implications for both residents' living spaces and sociology.

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