Research on the spatial perception evaluation of settlement streets based on the concept of sustainability

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Abstract. Nowadays, the perception of the street space environment in urban residential areas is receiving more and more attention, and a sick urban space environment can make environmental participants feel their safety is threatened. By redesigning the street space environment, the safety of the street and the perception of the environment can be improved. Taking Guitang Road as a typical residential street in Yuhua District of Changsha City, we use Depthmap software to analyze the degree of connectivity, integration and selection of street axes, and apply the reliability validity test, principal component analysis and multiple linear regression analysis in SPSS software based on the statistical results of the questionnaire to quantitatively study the statistical data and explore the main physical Environmental factors. Based on the six categories of spatial elements in CPTED theory, we propose a design strategy to reduce the fear of victimization in residential street space, so as to improve the street space environment and sustainable development. The aim is to promote urban planning and environmental sustainability to carry each other, in order to make urban planning diverse and stable through rational planning and construction of new environmental elements.

1. Introduction
Maslow's hierarchy of needs shows that security needs, i.e. people need to be stable, protected, free from fear and anxiety, etc., is one of the basic needs of human beings. The improvement of street environment is an important element to create a safe living environment and enhance the public's sense of security. The impact of urban street space on criminal behavior is receiving increasing attention, and the idea of solving the crime problem is not only to deal with it afterwards, but gradually to prevent it beforehand, and crime prevention is also extended to the whole community management and environment, urban design and other fields [1]. Therefore, methods to improve the safety of public space by improving and designing the spatial environment through a series of means are gradually gaining attention.

2. Study Area
Guitang Road, which belongs to Yuhua District of Changsha City, is a north-south urban secondary artery. The street is dominated by residential areas and their supporting facilities on both sides, and its street space type is somewhat representative. The diversity of its own functions leads to the area being an easy target for criminals, while the complex composition and mobility of the people in the mixed commercial and residential area makes it easy to hide and escape after the crime is committed, resulting in the users of the area feeling less secure about the environment [2], which has a certain research typicality.
Table 1. Research selection table.

| Research Projects                  | Guitang Road North | Guitang Road South |
|-----------------------------------|--------------------|-------------------|
| Street length                     | 1.01km             | 2.50km            |
| Street width                      | 36m                | 36m               |
| Street section form               | One board          | One board         |
| Sidewalk width                    | 2m                 | 2m                |
| Main business layout on           | Residential area   | Residential area, school |
| both sides of the street          |                    |                   |

3. Research ideas and analysis methods

3.1 Research idea
Firstly, Depthmap software was used to analyze the connectivity and integration degree of the axis model, the selectivity degree of the line segment model and the view space syntax of the convex space model for the street space of Guitang Road in Yuhua District, Changsha City, which was combined with the field research to summarize some of the hazard points initially. Secondly, through field research and questionnaire survey, the environmental elements of Guitang Road street were evaluated, and the results of the two methods were integrated to organize and extract the distribution of different levels of hazard points. Finally, the main factors affecting the perception of spatial safety in the streets of Guitang Road are analyzed and the preliminary strategies to reduce the residents' fear of being harmed are proposed.

3.2 Analysis methods

3.2.1 Field Research and Statistical Analysis
Field research was conducted on Guitang Road, Yuhua District, Changsha City, using photography to collect real photos of environmental factors that influence the sense of victimization, and questionnaires to collect people's perceptions of street safety, and statistical analysis was conducted to verify the environmental factors that influence the sense of victimization. The questionnaire was designed mainly from the perspective of fear of victimization and contained six main categories of environmental elements that are currently widely accepted: domainality, access control, environment and maintenance, activity support, natural surveillance, and goal reinforcement [3]. A total of 210 questionnaires were distributed in this study, and a balanced number of questionnaires were distributed in the north and south ends of Guitang Road, and 152 valid questionnaires were collected.

3.2.2 Spatial syntactic analysis
Depthmap software was used to conduct spatial syntactic analysis of the street space and the surrounding buildings, mainly involving connectivity, integration and choice, which can get the analysis results of the road's easy accessibility, accessibility and the possibility of being crossed [4]. The parameters of the southern and northern sections of Guitang Road were also compared to determine the relationship between the factors of the physical environment of the street space and the occurrence of delinquent behavior.
4. Result Analysis

4.1 Safety perception analysis based on spatial syntax

4.1.1 Extraction of hazard points in the northern section of Guitang Road

First, based on the consideration that street intersections tend to provide more escape routes for criminals, major street intersections were selected for analysis. Through the convex spatial model local visual depth of field of view can be seen, urban road intersections have relatively high line of sight connectivity, reflecting that people in these areas, the area that can be seen is larger, and the line of sight is more permeable [5,6] so such areas are more likely to be monitored, which is conducive to crime prevention, so locations 1-4 are not classified as dangerous points.

Secondly, the north section is analyzed by combining the selection and integration degree with the current situation. Location 5, the north side of Tongcheng Commercial Plaza, has a complex structure and low possibility of "being crossed", and its north side is a closed fence, which makes users feel that the space is less safe and is a hidden danger point. Location 6 is a cut-off road, located on the right side of Wan Kun Tu Square, with low integration and low accessibility, which is also one of the hidden
dangers. Location 7 is a street road inside Hunan Non-ferrous Metals Secondary Professional School, the global integration degree decreases gradually from the street to the inside, which is not conducive to the formation of natural surveillance, but because there is a better access control from the city road to its internal road network, so it is not set as a dangerous point.

In addition, through the research, it was found that the square of Xinxing District is opposite to the continuous fence interface, and the interior of the fence is an old and dangerous house to be demolished. At the same time, the feasible layer integration of the northern section of Guitang Road shows that the area has low spatial line of sight integration, which is not conducive to crime prevention behavior, so it is formulated as a dangerous point location 8.

4.1.2 Guitang Road South Hazardous Spot Extraction

At the same time, as a city street running north-south, most of the buildings on both sides are facing the street with a hill wall, and only a small part of the ground floor shops along the street have natural surveillance on the street, so for the natural surveillance of the southern section of Guitang Road, the small proportion of windows facing the street is the main problem of the surveillance conditions. From the selection degree and line of sight control analysis of the line segment model (Figure 16), it can be seen that the school, the main entrance of the district and the public square have high line of sight control values due to the open space. In addition, the road intersections in the southern section have high connection values but low line of sight control values and integration of the visual field due to the continuous fence interface. From the overall analysis, it is easy to find that the fence and the vegetation around the building make locations 9-11 more sheltered and easier to escape, so locations 9-11 are classified as dangerous.

4.1.3 Hazardous point collation summary

The spatial syntactic analysis of the connectivity, global integration, selection and feasible layer of view of 11 important locations in Guitang Road by Depthmap software, combined with the current situation of the north and south sections of Guitang Road, initially concluded 6 hazard points on the streets of Guitang Road.

In the northern section of Guitang Road, hazard point 1 is the path north of Xiangzang Lanting, which has poor environment and maintenance, and low visual integration. Hazard 2 is the road north of Tongcheng Commercial Plaza, the possibility of passing through this section is low, and both sides are fences and public buildings. Danger 3 is the entrance and exit of a cut-off road connected with
Xiangzhuang Road on the right side of Wankuntu Plaza, where the parking is chaotic and the sense of space users' domain is extremely low.

The intersection of Kweitang Road South and Jingwan Road, Danger Point 4, is surrounded by old buildings. The intersection is surrounded by old buildings with low environmental tidiness, and the intersection provides multiple escape routes for offenders; Danger Point 5 is the intersection of Kweitang Road South and Lianhu Road, which is surrounded by contact fence interfaces with low sightline control values and visual domain integration; Danger Point 6 is the section south of Minmetals Wanjing Waterfront Phase 3, which has low spatial vitality and low choice.

4.2. Analysis of spatial security perception based on questionnaires

4.2.1 Characterization based on multiple choice questionnaire items

From the analysis of multiple choice questions on the current sources of insecurity in the street in the questionnaire, it can be concluded that the sources of insecurity of street space users mainly come from the three aspects of lighting, how many intersections and road widths, and how many street space users and activities, and this conclusion provides the basis for the determination of hazard points later.

4.2.2 Space location extraction to be optimized

From the statistical analysis of the questionnaire, there are 6 elements to be optimized in the northern and southern sections respectively.

Table 2. Elements to be optimized.

| Research Projects | Guitang Road North | Guitang Road South |
|-------------------|--------------------|--------------------|
| Sense of domain   | Installation of leisure facilities | The setting of leisure facilities |
| Access Control    | --                 | The installation of parking facilities; The situation of street |
| Image and Maintenance | The accuracy of the signage system; Quality of the environment | Homeless people and scavengers, etc. |
| Activity Support  | Neighborhood communication | Residential area, school |
| Natural surveillance | Presence of law and order places | -- |
| Target reinforcement | The installation of fences | The installation of fences |

4.3 Extraction and grading of hazard points

Based on the spatial syntax street space analysis and the statistical analysis results of the questionnaire survey, the danger points of the street space of Guitang Road are extracted and graded by integrating the current problems. The first level hazard points are the areas where the spatial syntax hazard points extracted coincide with the positions of the elements to be optimized; the second level hazard points are the positions of the rest of the spatial syntax hazard points extracted; the common hazard points are the positions of the rest of the elements to be optimized.

4.4 Causes of danger points and optimization strategies

Settlement openness: The differences in real estate positioning, surrounding business, management status, residential population, environmental imagery, settlement cohesion, etc., will not only affect the residents' visibility and recognition of the spatial environment, but also affect the crime decision of potential criminals such as the proximity and passability of the target. Therefore, the design of the settlement street environment should be designed in such a way that the openness of the settlement
should be strengthened, the flexible boundary should be formed by fully integrating the street side green space landscape, and the visual penetration inside and outside the street node space should be strengthened, while the design of public space and green area should promote passive surveillance by making the maximum number of street eyes [7].

Environmental intention: The road maintenance of the northern section of Guitang Road is not timely, and vehicles are parked randomly, the identity of the space is not high and the domain is not strong. It should avoid cut-off roads and hidden routes in street design to create good environmental intention, and residential streets can try to set up a street manager management system to keep the street space neat and tidy, and regular maintenance and upkeep.

Spatial recognition: Analyzed from the perspective of spatial recognition, the northern section of Guitang Road lacks special node space and information marking system with high recognition, which weakens the sense of belonging to the space. At the same time, there is a problem of insufficient lighting at night in the main pedestrian trajectory and activity range in some residential communities. Nodes should be emphasized in street design, and more lighting should be provided at parking lots, building entrances and exits, or on roads to public transportation stops and stations.

Node space attractiveness: The node space on the street of Guitang Road South is not attractive enough, and there is an unbalanced distribution of public leisure and entertainment spaces for residents' activities, and some activity spaces lack popularity and are not highly used. Streets should provide composite all-age activity space, should plan different areas of activity space for different groups, and integrate the activity space composite to improve the popularity of the site.

Regional vision: The southern section of Guitang Road is covered by plant landscape or building wall facilities, a situation that not only affects the perception of street space users of the surrounding environment. Street design should take into account that structures, walls, columns, and sharp curves and lush natural scenery affect the visibility of the street space and ensure the openness of the street space as much as possible.

5. Conclusion
This paper analyzes the spatial security of the northern and southern sections of Guitang Road in Yuhua District, Changsha City, with the help of Depthmap, ArcGIS and other software, using statistical methods such as connectivity, integration and selectivity analysis in spatial syntax and reliability validity test, principal component factor analysis and multiple linear regression analysis in mathematical model. From the perspective of spatial security perception, a comparative study was conducted on the factors affecting the residents' fear of being victimized in different sections of the same street. In order to study the evaluation of spatial safety perception of Guitang Road street, the spatial sentence method is combined with the questionnaire analysis method to explore the coupling degree of the findings of the two methods and to provide new ideas and methods for the study of the fear of victimization.

Since it is impossible to obtain crime data in urban street space, it is not possible to integrate and think about the relationship between the crime areas that have occurred and the settlement street space, and in the future, we hope to combine the street-scale crime data and study the perception of safety in urban settlement street space from the perspective of sociology, economics and other comprehensive disciplines.

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