Spatial Evolution Path of Historical International Community from the Perspective of Actor Network: A Case Study of Gulangyu Island

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Abstract

Gulangyu Island is a special case of social development and changes since modern China. In the past, Chinese and foreign people lived together and Chinese and Western cultures coexisted, resulting in an international community with outstanding cultural diversity and modern quality of life. As a functional carrier, space is of great reference significance to the research on the spatial evolution path of Gulangyu international community with the accelerating globalization and rapid expansion of urbanization. Based on the interpretation of historical maps and the integration of historical geographic information, this paper explores the evolution path of Gulangyu community space in modern times from the perspective of actor network theory. It is found that: (1) The change of key actors promotes the spatial evolution of Gulangyu international community. (2) In the stage of foreign culture dissemination (1840-1902), foreign nationals, as key actors, promoted the formation and development of actor networks through administrative recruitment and other means, and promoted Gulangyu Island to change from a traditional Minnan community to a modern community form, with the embryonic form of an international community beginning to emerge. (3) In the stage of multicultural integration (1903-1940), overseas Chinese returning home became key actors. The concept of combination of Western cultures was not only embodied in community management, but also acted on space practice to promote the multicultural integration of Gulangyu international community. This paper summarizes the effects of various factors on the evolution of community space, in order to provide reference for other coastal cities to rationally develop islands and promote the multicultural integration of local communities.

Introduction

Today's society is in a new era of drastic changes. The intensification of mobility and flexibility, the coexistence of globalization and localization, and the acceleration of multicultural exchanges and collisions constitute the characteristics of this era [1]. It is of great reference significance and data value to analyze the development of international historical communities through GIS digital technology [2]. City is a symbol of human civilization and a product of social development to a certain stage. Only by combining the operation track of capital and power under a specific social form and the behavioral motives of various interest groups in the social process can the mechanism of spatial form change be fully explained [3]. The existing research mostly analyzes the urban area and or urban system pattern under typical historical sections through historical documents [4], or makes a more in-depth analysis of the change process of a single city in the past 100 years in combination with historical data [5], while the research on exploring the evolution path of historical space in a specific community using actor network theory is less [6]. Gulangyu Island, as a typical example of intercultural communication, witnessed the convergence, collision and integration of multiple values in the early days of Asian globalization. Its urban texture clearly retains traces of community development and changes [7]. Taking Gulangyu Island as an example, this paper explores the evolution path of the spatial form of international historical communities from the perspective of actor network through the integration of historical map interpretation and geographic information. This study is helpful to deepen the understanding of the

evolution and reconstruction of historical communities, and provide reference for the integration of diverse communities and the protection of heritage communities under the background of contemporary globalization.

Literature Review

"Space" has always been the core topic of geography and urban and rural planning, and has become increasingly complicated under the background of globalization. Space is no longer an instrumental container, but is regarded as a place for reproduction of local social relations [8]. The connotation of space has evolved with the three changes in human geography, namely "regional differences-spatial analysis-social theory" [9], which makes people have different understandings when interpreting the concept of "space". Many scholars explore the evolution of urban space from the perspective of material form. Wang's research team reappearance the spatial evolution of the city through participatory historical map translation (PHMT), identified the city's heritage with key elements of landscape structure, and visualized its heritage value with GIS [10]; Jiang Yuchao and other researchers used historical documents, ancient maps, survey maps of the Republic of China (1912-1949) and remote sensing images to restore the expansion process of urban spatial form in 56 cities in Jiangsu and Shanghai since the Ming Dynasty [11]; Stingy Tao and others reviewed Xiamen Island's 100-year urban development process through the combination of picture trimming and remote sensing geographic analysis, and discussed the potential factors of island city expansion from the aspects of planning, industry, topography and population [12].

On the other hand, some scholars pay attention to the local social culture of urban space and interpret the community cultural space of Gulangyu Island. Chen described the history of conflicts, negotiations and compromises among different groups during the development of Gulangyu Island in the semi-colonial era (1903-1937) based on archival materials and on-site investigations, and pointed out that it cultivated a new model with Xiamen characteristics in terms of urban construction, governance and living environment [13]; Based on the analysis of historical documents, Lu Ning and others explained the elements of Gulangyu international historical community heritage, urban spatial mechanism, architecture and landscape, and analyzed its cultural connotation value [14]; Qiu Lili and others, based on the perspective of narratology, introduced spatial syntax quantification method to give cultural spatial quantification explanation to the spatial right representation, functional representation and characteristic representation of historical urban areas [15]. In addition to the spatial understanding of material and society, with the development of information and communication technology, more scholars have abstracted space and interpreted space from the perspective of mobility and network. Li Yuan and others have discussed the network characteristics of Gulangyu tourism flow in combination with GIS and GPS [16].

The existing research provides an important reference for understanding the spatial evolution of international historical communities, but the excavation of social relations and action paths behind the spatial evolution of communities is insufficient. Few studies combine material space with social space to fully explain the spatial evolution of Gulangyu historical communities and its influencing factors. In order

to eliminate the binary opposition between material space and social space, local space and mobile space, and to understand the mechanism of spatial evolution more comprehensively and profoundly, it is necessary to introduce a new perspective to explore the social relations behind material space and its action path. The actor-network theory (ANT) is good at analyzing the relationship between the materiality and sociality of space, and unifies the traditional "Space of place" and the "Space of flows" promoted by globalization into "Space of actor-networks" made by practice [17]. The international historical community is the result of the role of multiple actors in different stages, Therefore, the actor network theory can provide a powerful framework for the spatial evolution of the international historical community. The introduction of this perspective is conducive to analyzing the interactive logic between different actors and between actors and space, and has guiding significance for the understanding of the evolution path of the international historical community and the subsequent heritage protection.

This paper takes the theory of actor network as the breakthrough point, selects Gulangyu Island as a typical case, analyzes the actor network of Gulangyu Island in different stages of development, and discusses how it causes changes in the main body and function of space use, and then promotes the change of community material space form, providing a new explanation path for the spatial evolution of international historical communities.

Study Area And Research Method

A. Study areas

Gulangyu Island, which belongs to Xiamen City, Fujian Province, is located at the mouth of Jiulong River in the south of Fujian Province (referred to as "Minnan") on the southeast coast of China. It is an island in Xiamen Bay, facing Xiamen Island across the 600-meter-wide Lujiang Strait. It was uninhabited for a long period of time in history. The great geographical discovery in the 15th century involved Minnan region in the first wave of globalization. Maritime trade and maritime economic activities brought Minnan immigrants into Gulangyu Island and became traditional local settlements [18]. In the nearly 100 years from the middle of the 19th century to the middle of the 20th century, with the opening of Xiamen, Gulangyu Island has become an important window for cultural exchange and integration between China and foreign countries. From fishing village islands to international communities, to historical communities after the reform and opening up, and even to 2017, Gulangyu Island has been listed as a world cultural heritage. The evolution of its community spatial form is of typical significance and is worth reviewing and exploring.

The spatial evolution of Gulangyu International Historical Community has obvious stage characteristics. It has successively experienced the period of local cultural accumulation (before the Opium War), the period of foreign cultural dissemination (from the Opium War to the signing of the Public Land Boundary Charter in 1902), the period of multicultural integration (from 1903 to the outbreak of the Pacific War) and the spatial transformation of the post-international community (from 1941 to the present) [19]. According to the change of participants, this paper focuses on explaining the characteristics of community spatial

evolution path in Gulangyu Island during the period of foreign culture dissemination and the period of multicultural integration.

B. GIS interpretation of historical map

Under the background of "digital humanities" and the concept of big data, the informatization of historical geography can reproduce the scene at that time. At present, the research on historical geography is still not detailed enough, and many historical environment elements and information on the map have not been discovered and applied. This study draws lessons from the concept of "cultural layer" in archaeology, and discriminates the disappeared historical sites based on the idea of stratification [20]. With culture as clue, time as sequence and space as carrier, historical maps are geographically registered and digitally translated. Through the hierarchical interpretation of historical map information, combined with contemporary measured building statistics, high-definition remote sensing images, digital elevation models and historical documents, the disappearing international historical community relics are screened from three levels of point, line and surface, and historical buildings, roads and coastlines are vectorized and unified into GIS database for superposition and evolution analysis. The historical map data used come from Xiamen Library and British Library (Figure 1).

C. Actor Network Theory

Actor-network theory (ANT), originated in 1980s, is a scientific practice research method proposed by French social scientist M. Callon, which includes three core concepts: actor, translation and heterogeneous network [21]. Actors refer to all factors in the process of scientific practice, It includes both human actors and non-human materials and ideas. Different actors are heterogeneous in terms of interest orientation and behavior. The stability of the network depends on the continuous translation of the interests of various actors. The power to deviate from the network may occur within the network due to objections. The key link of actor network research is translation, that is, four basic links: Problematization, Interestement, Enrollment and Mobilization (Figure 2).

"Problem presentation" makes the objects concerned by different actors problematic, thus forming a network alliance, and at the same time makes the problems of core actors become "Obligatory Points of Passage" (OPP) to achieve the goals of other actors; "Benefit endowing" strengthens the definition of actors' roles in the problem presentation process through various devices and strategies; As a result, actors are "recruited" to become members of the alliance; "Mobilization" means that the proponent rises to the Spokemen of the entire network alliance and exercises power over other alliance members to maintain the stable operation of the network. Objections may arise in the process and need to be overcome [3]. Translation by actors may lead to changes in meaning, relationship and rights, so it is a "dynamic network" [22]. Actor theory brings all factors from society and nature into a unified interpretation framework, which is suitable for explaining the process of spatial evolution of community form in the stage of impassability.

Community Space Evolution in the Stage of Foreign Culture Dissemination (1840-1902)

A. Composition of the network of actors

Before the Opium War, Gulangyu Island followed the traditional economic model of farming and fishing. There were about 100 families and more than 1,000 people on the island. Neicuo'ao, Luer Reef and Yanzijiao are dominated by Huang surname, while Tianwei area is dominated by Hong surname. The residents of the island follow the belief and custom of Minnan people who believe in gods and worship many gods. There are Sunlight Rock Temple of Buddhism, Zhongde Palace and Xingxian Palace dedicated to Baosheng Emperor on the island. After the Opium War, different actors jointly promoted the construction of actor alliance based on their own goals, so as to encourage foreigners to assume key actors. Actors include administrative units: Qing government and consulates of various countries; Community groups: Aborigines, consular officials and their families, Western businessmen, missionaries and other foreign nationals. Non-human actors mainly include material elements: landscape resources, traditional dwellings and public space; Conceptual elements: local conditions and customs, traditional religions (Table 1). The compulsory passage point (OPP) shared by the above actors is "the embryonic form of the international community". As shown in Figure 3, it shows the problems that different actors expect to solve and the goals to be achieved.

Table 1 Composition of actors in the stage of foreign culture communication

Related Composition	Category	Conten
Human actor	Administrative unit	The Qing government, Consulates
	Community group	Aborigines, Consular officials and their families, Foreign nationals, Missionaries, and other foreign nationals
Non-human actor	Material element	Landscape resources, Traditional dwellings, Public spaces
	Conceptual elements	Local customs and practices, Traditional religions

B. Actor Translation Process

Translate the goals of multiple actors, give benefits to all actors, and remove obstacles to action. At this time, the foreign nationals on Gulangyu Island acted as the helm, leading a few leading actors to make more actors join the network alliance by recruiting and being recruited, so as to maximize the benefits.

First, administrative recruitment. Western countries signed the Treaty of Nanking with the Qing government, Forcing Xiamen to open its trading port, The British troops were stationed in Gulangyu Island. The signing of a series of treaties and subsequent clauses allowed the British to lease land and

houses at trading ports. The subsequent signing of the Sino-US Wangxia Treaty and the Sino-French Huangpu Treaty enabled foreigners to obtain consular negotiations, missionary work and the right to set up hospitals. More and more countries have consular offices located in Gulangyu Island.

Second, the fund Committee call up. By the 1870s, there were nearly 200 foreign nationals in Gulangyu Island. At that time, there was little to say about the island. There were no recreational facilities and commercial facilities. There was not even a road in the modern sense. The sanitary conditions were extremely poor. In order to improve the quality of social life, western countries set up the Gulangyu Road Cemetery Fund Committee in 1880 to invest in urban construction through tax payment, bringing the culture of social public space governance into Gulangyu.

Third, housing and landscape recruitment. In 1853, Forced by the attack of the Knife Rebels, Foreigners in Xiamen poured into Gulangyu Island to "take refuge", Soon they found that Gulangyu Island, which is located in a corner, seems safer and more comfortable. Gulangyu Island has gradually become the main residence for foreigners in southern Fujian. At first, it rented local houses for accommodation and work, and the high rent made the aborigines willing to trade with it. For example, the existing Huang Xiaozong was the foothold of missionary Abeel and doctor Gan Ming who first came to Xiamen to preach, and then gradually began to buy land to build their own houses.

Fourth, cultural recruitment. Western missionaries were not recognized at first, and even expelled from villages where ethnic groups lived. Then schools and hospitals were set up to train Chinese priests and spread Christianity in southern Fujian by waiving tuition fees, providing accommodation, accommodating many poor children and abandoned babies.

To sum up, the translation process in actor network creation as shown in figure 4 is formed.

C. Community Spatial Evolution with the Intervention of Heterogeneous Actors

Different aims and behaviors of heterogeneous actors not only shape social networks, but also reproduce and construct the spatial characteristics of Gulangyu Island. The island space has changed from a space for local people to live and fish and cultivate to a multi-functional composite space shared by local people, foreign nationals and consulates of various countries. The function and form of the space have changed(Figure 5).

In the stage of local cultural accumulation, the local settlement is roughly divided into three areas: Neicuo'ao, Yanzijiao and Luer Reef, which are scattered in the flat land facing the sea. A large amount of land serves and fishes the farming economy. Traditional religions such as Sunlight Rock, Zhongde Palace and Xingxian Palace are dotted sporadically, which is the public cultural activity space of the aborigines. The original road is rugged and complex. Guided by buildings and natural conditions, it basically follows the distribution of mountain-shaped terrain or buildings. The angle changes a lot, is irregular and often deviates.

In the stage of foreign culture dissemination, consulates of various countries have chosen this site one after another. Western-style buildings with veranda architectural style are mostly chosen on the mountains and by the sea, making full use of the island landscape resources and having a certain space distance from the aborigines. Foreigner firms rely on the wharf on the east side of Gulangyu Island to form commercial storage facilities on the east side of the island.

At the same time, the number of roads on the island has increased, mainly connecting the residences of foreign nationals and the traffic between the residences and docks, basically forming a three-circle road system. One circle is the northern ring road around Bijia Mountain, connecting the residential area of Neicuo'ao in the western part of the island with the eastern part of the island; One circle is the Sunlight Rock Ring Road to the south and the Yanzijiao Ring Road to the east, connecting the traditional settlement of Yanzijiao; One circle is the Luer Reef Ring Road in the southeast, which surrounds the Luer Reef residential area; A number of radial roads leading to docks and beaches on the seashore have been built from the three-circle ring road, forming the basic framework of Gulangyu traffic.

In addition, churches, schools and hospitals serving the spread of Western religions have emerged, municipal infrastructure such as cemeteries, and recreational facilities such as clubs and stadiums have emerged. Generally speaking, foreign nationals played a direct role in the spatial evolution of Gulangyu Island during this period. By the end of the 19th century, Gulangyu Island had more than 10 consulates, 6 church schools, 5 churches, 2 foreign-run hospitals, telegraph offices and several foreign firms, as well as many private houses all over the island. The formation of a situation in which local ethnic groups and foreign foreigners live separately and coexist peacefully has begun to take shape in the embryonic form of an international community.

Community Space Evolution in the Stage of Multicultural Integration (1903-1940)

In 1902, western countries and Japan competed for power in Gulangyu Island, forcing the Qing government to sign the "Xiamen Gulangyu Public Land Boundary Regulations" with western countries, set up the Ministry of Industry as the management organization, and issued the "Gulangyu Ministry of Industry Regulations" as the specific rules for municipal administration. Gulangyu Island realized multi-country co-management and integrated guardianship. The goal intention of the actor network is usually the same as that of the key actors. With the First World War and the change of the world pattern, a large number of overseas Chinese from southern Fujian who returned home became the emerging social group that dominated the settlement pattern and spatial evolution pattern of Gulangyu Island, gradually replacing foreign nationals and becoming key actors. The reconstruction and re-deduction of the actor network promoted the further evolution of Gulangyu community space.

A. Changes in the composition of the network of actors

With the improvement of Gulangyu's infrastructure and the emergence of modern communities, the mandatory point of passage (OPP) of the actor network in the stage of multicultural integration has also changed to "multicultural integration of international communities", and a number of new heterogeneous actors have joined the network alliance. The newly added actors mainly include: human actors such as the Ministry of Industry, the Japanese government, overseas Chinese, and non-human actors such as capital, land resources, residential features, industrial structure, political environment, laws and regulations (Table 2 and Figure 6).

Table 2 Composition of actors in the stage of multicultural integration

Related composition	Category	Content
Human actor	Administrative unit	The Qing Government, Municipal Council, Japanese Government
	Community group	Overseas Chinese, Chinese residents, Foreign nationals
Non-human actor	Material element	Capital, Land resources, Municipal facilities, Residential style, Industrial structure
	Conceptual elements	Political environment, Laws and regulations, Chinese and Western Cultures

B. Re-interpretation of the actor's translation process

With the change of key actors, new heterogeneous actors are re-recruited and recruited.

First, administrative Recruitment: During the period of the public concession, the administrative organization has always been the Ministry of Industry under the leadership of the board of directors. Its function is to "take charge of matters that should be handled within the community", including public security, taxation, patrol, health facilities, public facilities and markets. Gulangyu Island is inhabited not only by foreign nationals, but also by legal disputes between Chinese and foreign countries and between Chinese in the community. In the community, there is a Chinese judicial institution-joint hearing court, which is one of the few Chinese institutions that can play a practical role in Gulangyu Island. The Ministry of Industry's promotion of Gulangyu community municipal construction has caused great shock in the Chinese community. Overseas Chinese groups have strengthened their awareness of participating in community construction and have the desire to transform the city's appearance. Overseas Chinese groups not only joined the board of directors of the Ministry of Industry, but also played an obvious role in recruiting other actors. They actively formed social organizations and successively established the Chinese Taxpayers Association, the Chinese People's Association and the Chinese Council to safeguard their rights and interests and promote social reform.

Second, fund recruitment. Overseas immigrants from southern Fujian who returned home with abundant capital set up industries, built houses and infrastructure in Gulangyu Island. The community's water

supply, power supply, road traffic, communication, the ship crossing between Gulangyu Island and Xiamen, the construction of public greening and the construction of community public activity spaces such as schools all developed rapidly and represented a higher level at that time.

Third, recruitment of residential style. Returning immigrants have come into contact with western civilization and are familiar with various western customs when they make a living overseas. At the same time, they have full feelings for the native land of southern Fujian, which was born and raised in Sri Lanka. The interweaving of the two makes them an intermediary for the blending of Chinese and Western cultures, which is reflected in the architectural style. They build villas, private gardens and various foreign buildings for themselves and their families, or buy foreign buildings from foreigners for localization. From 1920s to 1930s alone, 1014 buildings were built on Gulangyu Island by returning overseas immigrants. From 1924 to 1936, 75% of the 970 building licenses issued by Gulangyu Municipal Bureau of Industry belonged to returning overseas immigrants and their families, which greatly changed the settlement pattern and spatial pattern of Gulangyu Island.

Fourth, cultural recruitment. With the support of overseas Chinese returning home, the cultural service facilities on the island have been improved, the cultural living standards of the people have been improved, and Zhongshan Library, the first library in Xiagu area, has been set up. A large number of religious and non-religious newspapers and periodicals have been published one after another, and the printing industry has also made certain progress, promoting cultural exchanges between China and the West. Local education has also been further improved, such as Xiamen Girls' School established in Lin Qiaozhi and Ciqin Girls' Middle School in Huang Yizhu. More and more Chinese are participating in the network of actors, forming a pattern in which returning immigrants, local elites and expatriates from many countries participate in the construction and management. In combination with the above, the actor network translation process as shown in Figure 7 is formed.

In 1941, Japan acquired the management right of Gulangyu Island by means of military occupation, which finally declared the complete end of Gulangyu Island as a special era of international community.

C. Community Spatial Evolution under the Reconstruction of Actor Network

New actors have further promoted the change of Gulangyu community space through network operation. After entering the 20th century, the number of Chinese in Gulangyu Island increased rapidly. In 1920, there were about 15,000 Chinese residents on the island, far exceeding foreign nationals. These overseas immigrants with abundant capital are building large-scale projects in Gulang, and the community space of Gulangyu Island has been expanded (Figure 8).

Compared with 1900, the eastern and northern docks reclaimed land and increased land resources, and the island area increased from 1.62 km in 1900 to 1.71 km in 1935. Due to the limited space of Gulangyu Island and the sequence of building time, overseas Chinese businessmen returning home cannot form a special living space. Their seamless building mode further accelerates the integration of living spaces of different groups, making it difficult for Gulangyu Island to maintain strict zoning.

With the advancement of community construction, the desolate landform of Gulangyu Island has been gradually changed, more livable areas have been created, and the construction area on Gulangyu Island has been greatly expanded. From 1900 to 1927, the construction area increased at an annual rate of 9.71%. At the same time, the housing construction method is mostly DIY-made, equipped with Xiamen decoration style combining Chinese and Western styles, and the first floor is the same but not repeated. The Bagua Building and Huangjia Garden, which are still preserved today, all represent the exquisite level of construction at that time. The road network system has been comprehensively planned and constructed on the original basis, forming more than 30 roads. Dendritic branches go deep into the community, basically forming the traffic network structure of Gulangyu Island today.

In addition to residential buildings, overseas Chinese have built their own churches, such as Sany Hall, as well as public facilities serving the community, such as waterworks, telephone companies, vegetable markets, Yanping Theaters and clubs. A large number of factories, commercial shops and warehouses have appeared. Gulangyu's modern residential area, which is dominated by residential functions, is gradually equipped with various commercial functions and public service functions. The residential form has also gradually changed from traditional village settlements to modern community forms, with international communities showing multiple integration.

Conclusion And Discussion

A. Conclusion

Based on the perspective of actor network, taking Gulangyu Island from 1840 to 1940 as an example, this study analyzes the composition of actor network in the two stages of international community from embryonic form to pluralistic integration and its action path on the spatial evolution of Gulangyu Island. The change of key actors leads to the change of actor network structure, which promotes the spatial reconstruction and evolution of Gulangyu international community. The main conclusions are as follows:

First, the earliest development and construction of Gulangyu Island was promoted by neighboring Minnan immigrants, forming three traditional residential settlements: Neicuo'ao, Yanzijiao and Luer Reef. The land use function is mainly residential land and its affiliated farmland. Ancestral halls and temples are the main public activity spaces for people to use. This traditional settlement form in southern Fujian is far from modern urban communities.

Second, the formation of Gulangyu's modern international community pattern was first promoted by foreign nationals after foreign nationals entered Gulangyu. After that, the construction and management of Gulangyu community in modern times experienced two periods dominated by different actors, from foreign nationals to overseas immigrants. The social forces composed of different social groups had a great influence on the construction and management of Gulangyu community in modern times.

Third, the stage of foreign culture dissemination (1840-1902), Gulangyu Island changed from the original traditional community to the embryonic form of an international community. The key actors of

community construction in Gulangyu Island are foreign expatriates, and the community development shows the trend of specific zoning, and the community construction mainly serves foreign expatriates. However, limited to the island area and residents affected by different cultures entering Gulangyu Island to live, only relative zoning is maintained. In order to improve their living environment, foreign nationals have carried out basic public facilities construction on Gulangyu Island. Through the establishment of special institutions such as the "Road Cemetery Fund Committee", they have begun to systematically build public infrastructure such as roads, street lamps and cemeteries. At the same time, they have established modern education, medical care and health systems to promote the germination and initial development of international communities.

Fourth, multicultural integration stage (1903-1940), Gulangyu international community gradually evolved and formed. With the establishment of the Bureau of Public Lands and Industry, Influenced by the political environment, The key actors in Gulangyu community construction have changed from foreign expatriates to overseas immigrants from southern Fujian, A large number of overseas Chinese came to Gulangyu Island to settle down. Economic investment and land development have rapidly increased the scale of residential land, breaking the relative gap between Chinese residential areas and foreigners' residential areas. The supporting facilities have been significantly improved. The community space form has shown diversified characteristics and the international community has become more mature. This special international community came to an end after the Japanese military occupation of Gulangyu Island in 1941.

B. Discussion

The research shows that the spatial evolution of international community is the result of the joint action of multiple actors led by key actors. The interlacing of different interests and the collision of multiple cultures are one of the leading factors to promote the evolution of the spatial form, community construction and management development and change of Gulangyu international community in modern times. It constitutes a distinctive feature of Gulangyu community construction and management in modern times. Influenced by multicultural factors, Chinese and overseas Chinese reflect their personal ideas to Gulangyu Community, which makes the management mode of Gulangyu Community more characterized by multi-party game, integration, checks and balances, and compromise, which is reflected in its practice of transforming material space. The construction and display significance of Gulangyu spatial practice goes beyond the community life and cultural connotation it carries.

From the epistemological level, the actor network theory adheres to the principle of symmetry between human and non-human actors, bridges the long-term opposition between subjectivity and objectivity, nature and society, and combines the dual attributes of "nature" and "society" in space. At the methodological level, the actor theory promotes the transformation from rational construction of knowledge to practical construction of facts, while in spatial research, the "practical construction" of space replaces the "social construction". As Latour, an important interpreter of the actor network, said: "Facts can only be understood and constructed through practice, and practice is the field of interaction

between human and non-human actors" [23]. Space practice is the result of the joint action of human and non-human actors, which is rooted in local situations. Therefore, great attention should be paid to local situations in space research, especially the actor of overseas immigrants. Taking Gulangyu International Community as an example, this paper analyzes its spatial evolution mechanism. However, under different natural and social conditions, the network structure of actors is different. Strengthening the research on community space of different regional types and exploring the common law of international community space evolution are the directions that should be deepened in the future research.

Declarations

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Authors' contributions

The author read and approved the final manuscript.

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Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Competing interests

The authors declare that they have no competing interests.

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Figures

Figure 1

Historical map of Gulangyu in four periods

Figure 2

Schematic diagram of actor network translation process

Figure 3

Actors and obligatory points of passage in the stage of foreign culture communication

Figure 4

Actor network of foreign culture communication stage

Figure 5

Spatial evolution of Gulangyu under the intervention of heterogeneous actors

Figure 6

Actors and Obligatory Points of Passage in the Stage of Multicultural Integration

Figure 7

Actor network in the stage of multicultural integration

Figure 8

The spatial evolution of Gulangyu under the reconstruction of actor network