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Classifying Community Space at a Historic Site through Cognitive Mapping and GPS Tracking: The Case of Gulangyu, China

Abstract: Local community space at historic sites are easily unsettled by the flood of numerous tourists, but arguably the negative impacts of hard tourism on community spaces are even more severe. Understanding the situation and seeking appropriate optimization strategies to balance urban tourist development and community space protection has gradually become a commonly desired norm amongst researchers and practitioners alike. Nevertheless, as investigators have suggested, the construction of this balance is often very difficult and actual workable and practical solutions to real problems are often still rare. Part of the reason for a lack of workable solutions lies in the difficulties of understanding conflicting space. This article presents a quantitative approach to identify various types of community spaces, by overlaying cognitive maps of local community with data on the behavioral patterns of tourists via GPS tracking. Based on the classification of various kinds of community spaces, a series of corresponding optimization strategies to protect various communities are proposed. To conclude, this article explores new analytical frameworks for the sustainable development of historic sites by the classification of community spaces, via a combination of cognitive mapping, GPS tracking and GIS visualization methods.

Keywords: Cognitive Map, GPS Tracking, GIS, Community Residents, Tourists
1. Introduction

Introducing tourism to revive and conserve historic sites has become a common agenda for urbanists, state officials and developers (McKercher et al, 2005; Hayllar et al, 2008; Su and Teo, 2009; Wang and Bramwell, 2012; Blumenfield and Silverman, 2013). In this process, original community spaces within historic sites can easily become hot tourist destinations which, in turn, become doubly encumbered by pressures from both local residents and numerous tourist arrivals (Timothy and Tosun, 2003; Murphy, 2013). Many studies have been conducted on the various impacts of urban tourism on historical communities (Gilbert and Clark, 1997; Pearce, 2001; Barker and Page, 2002; Su and Teo, 2009; Blumenfield and Silverman, 2013). However, often these existing studies are constructed through the lenses of tourist management and social capital based investigations, so as to reveal the relationship between multi-stakeholders (including the residents, the local state and the developers). With the exception of excellent studies such as Su and Teo (2009), there are a limited numbers of studies, that actually explore genuine community spaces where live conflicts of interest occur on a regularly basis.

The term community space (used herein) can be defined as those spaces which are mainly accessed by local community members at historic sites, but are also available to visitors or outsiders to these areas. Community spaces are those spaces where local residents come to kill time, gather for social activities and reproduce local community social bonds (Solomon, 2005). As an essential element of retaining public memory,
social integration and quality of life, the importance of community space as a
important human resource has been well recognized in recent decades (Smith et al.,
1997; Franck and Stevens, 2013).

Due to the growing pressures of rising tourist numbers arrivals and the pursuit of
local community life interests, the demand to better understanding the situation of
community spaces at historic tourist sites has become more pressing. According to
Soja (1980) spatial arrangements can reflect certain social structures and cultural
connotations, and vice versa (see the concept of the socio-spatial dialect) (Soja, 1980).
Affected by both rising tourist numbers and local resident feeling, community spaces
might be constructed in ways that meet differing interests. Some community spaces
might be attractive to both tourists and residents, while other forms of community
space might simply cater for one interest group or the other. Classifying various
community spaces and understanding their different inherent features are the first step
to optimizing sustainable balances within historic Chinese tourist sites.

But a previous lack of appropriate analytical frameworks and methods makes this
task difficult. Traditional cognitive mapping is a classical approach for studying local
resident preferences towards community spaces (Lynch, 1960). But its qualitative and
manual features mean that a more quantitative in-depth analysis is difficult to achieve.
Nevertheless, recent advances in spatial analytical tools bring new opportunities to
address this challenge. Firstly, new modes of GIS provide a quantitative platform for a
detailed analysis of the results within cognitive mapping (Hirtle, 1998). Secondly,
tracing tourist preferences through GPS tracking devices has led to the development
of new techniques in recent years (Shoval, 2008). Thus, real time tourist behavior can now be recorded through GPS tracking devices to reveal tourist preferences quantitatively.

Taking these points into consideration, in this paper we seek an in-depth understanding of community spaces at historic tourist sites through the application of both traditional and newly-forged GPS methods. Following this introduction, section 2 illustrates our research methodology which contains information on the research cases and explanations of the applied methods and research design we have employed. Section 3 examines and explores our empirical analyses to classify community spaces by overlaying the cognitive maps of local residents with GPS tracking and GIS platform information. In section 4, we discuss a series of optimization strategies outlining various prototypes of community space through the application of our on-site survey. Then finally, in section 5, we examine the significances and conclusions of our research.

2. Research Method

2.1. Study Case

As an island located to the east of the coast of Xiamen (also called Amoy during the colonial period, in Fujian province in southern China), Gulangyu is around 2 km² in area. It is home to about 20,000 people and is an increasingly popular domestic tourist destination (between 25,000 to 65,000 tourists daily). Located near China’s southeast coast, Gulangyu is currently facing a dramatic conflict between booming tourist
development and a conservationist ethos that seeks to protect the historic heritage of the Island. Since the 1990s, local authorities have pursued pro-tourist development policies and as a result commentators have contended that both the existing community culture and the attractiveness of the Island has been increasingly threatened (Lin, 2010). Statistical data shows that Gulangyu received more than 11,360,000 tourists in 2013, and guestimates of approximately 13 million for the end of 2014 (Administrative Committee of Gulangyu, 2014). On certain days, particularly peak days, the number of tourists on the Island can even exceed 70,000 (see Figure 1).

Of course, the rising numbers of tourists brings many benefits to the local economy. As commentators have pointed out, these growing tourist numbers have also bought unique troubles to the historical communities residing within Gulangyu (Yu, 2011). Recently, Gulangyu has also been included in the Final National Preparatory Directory 2017 for World Cultural Heritages, which proposes tourist development must be balanced with historical and cultural protection. In this context, Gulangyu can be regarded as a typical modern heritage site that has had to seek a development/conservation balance between tourism and traditional community space. Reflecting on the challenges posed by the problem of balancing tourism and conservation, the task for urban planners and urban designers is to try to seek and develop a deep and rich understanding of the utilization of community spaces for both tourists and local residents; for planners and designers achieving such a balance also requires workable analytical tools.
Figure 1: Gulangyu Island and its overcrowded tourist sites in peak time

2.2. Research Questions

Confronting the direct pressure of the increasing tourist presence on the island and overused community spaces, the main research objective of this paper is to construct an analytical approach which is able to classify different types of community spaces under the preference of both residents and tourists, so as to seek a systematic optimization approach for balancing tourist development and community space protection.

Two main research questions are proposed to fulfill our objectives:
1) Firstly, how do we identify and understand various patterns of community space in a historical tourist site, which are jointly affected by tourists and local residents’ preferences?

2) Secondly, how do we optimize these spaces and the behavioral patterns that take place in these spaces, to keep a balance between community space protection and tourist development?

The first question aims to find solutions through the classification of space based on the preferences of both tourists and local residents. For historic tourist sites, there should be some places which permeate between tourist and local resident preferences. It should be possible to measure and classify the different patterns within each of the areas according to the degree of the two preferences.

The second question aims to optimize the spaces in question from both urban design and tourist management perspectives. According to the spatial and behavior patterns within each types of space, some strategies could be proposed in order to balance tourist development and community protection.

Responding to these research questions, we propose the following analytical framework (Figure 2). Firstly, cognitive mapping of local residents will be produced through questionnaire surveys. Two typologies described as ‘high’ and ‘low’ cognition degree will be utilized. Here, high or low cognition typologies are used to distinguish local residents’ preferences towards community spaces, which can be acquired by overlaying each subject’s cognitive area. Specifically, high cognition spaces are those community spaces used very frequently by local residents, which are,
in turn, defined as the highest 50% overlapping cognitive areas. These high cognition areas represent the community spaces that are most important and intensively used by local residents. In turn, low cognition spaces reflects those community spaces that are recognized by local residents but are not used frequently. These spaces are defined as the lowest 50% overlapping cognitive areas in the analysis.

Secondly, GPS tracking of tourist arrivals to the Island will be utilized following two considerations: the intensity of tourist visiting and staying at Gulangyu. The first consideration reveals how intense agglomerations of tourists arrive on the Island, and how they then subsequently walk through specific areas; as we shall investigate these walking patterns may be caused by the configuration structure of street networks and land use patterns. The second consideration explores why intense agglomerations of tourists stay on the Island for a limited period of time; specifically we explore the possibility that specific tourist attractions and appropriate tourist services etc. may encourage the length of tourist stays on the island; the development of the investigation in this way will lead to the construction of four typologies that recognize ‘high’ and ‘low’ values in both visiting and staying. Considering that low frequencies of staying are interrelated to areas of low visiting, it is possible to simplify the four typologies into three: high visiting, low visiting and high staying. Specifically, high or low visiting reveals how intensely and frequently tourists pass through and visit community spaces. High or low visiting is measured through nuclear density analysis via GPS tracking points and the classification of ‘high’ or ‘low’ patterns through Standard Deviations in GIS. The highlighted first half belongs to high visiting and the
second half belongs to low visiting. The former results represent hot tourist areas intensively visited by tourists while the latter results represent areas that tend to be less attractive to tourists. In comparison to the concept of high visiting, high staying needs to be discussed separately as it reveals another different concept; in short, high staying reveals the length of time tourists like to stay in the areas they visited. High staying is therefore measured by calculating the moving speed of tourists through the position changes of GPS tracking points. Since the normal pedestrian speed is around 50 meter/per minute, we therefore define high staying as 1/5 of the normal speed (10 meter/per minute). According to our findings high stay areas are the most attractive, crowded and welcoming areas for tourists.

After we unpack these results, we suggest that community spaces can be separated into six different types through the overlaying of high and low preferences of tourists and residents on a GIS platform (Figure 3). Generalizations and evaluations regarding these different types of community spaces will be made following this approach. After this analysis, corresponding design strategies will be given based on the spatial and behavior inducing features of the urban form.
Identifying Cognitive Space from Community Residence

Identifying Activity Space from Tourist

GPS Trajectory

Classifying Intercourse Space

Overlay

Interpreting and Investigating Behavior

Classifying Intercourse Space

Balancing Tourism and Community Protection

Classification Strategies

Cognitive Map

Classify-> Discussion

Figure 2: Analytical framework

Figure 3: Classifying various types of community space based on the preferences of tourists and residents.
2.3. Analysis methods

2.3.1. Cognitive mapping

Cognitive mapping (i.e., mental mapping) is a traditional approach which unpacks how people understand their metaphorical spatial environment. The concept was initially proposed by Tolman (1948) and then introduced into urban studies through the work of Lynch (1960). By an exploration of three American cities, Lynch argues that people in urban situations orient themselves by means of cognitive maps. According to Lynch, people move through cities based on how they reflect upon, recognize and organize various urban elements (Figure 4).

![Cognitive map](image)

**Figure 4:** A mental map of Los Angeles (Dorling and Fairbairn, 1997, p. 168) produced according to Lynch’s (1960) work. Four key elements: paths, edges, districts, nodes and landmarks are marked and the various degrees of intensity are shown through the thickness of the lines.
Therefore, Lynch’s work yields four common methods for cognitive map analysis within the fields of planning and design; these four forms of analysis include: free drawing, limited drawing, the boundary figure method and the space element figure method (Soini, 2001). Since the main objective of cognitive mapping is to identify and reveal local resident preferences in community spaces, the boundary figure method is the most appropriate one. By asking respondents to mark the boundaries or nodes they frequently visit, community space can be depicted.

Meanwhile, many scholars combine the quantitative descriptions of questionnaires with quantitative GIS analyses to seek visualized results (Kwan, 2000; Goodchild, 2007). Advances in GIS bring new potential to quantitatively analyze surveys that can only be qualitatively described. This specialized technique can also be utilized in our study to produce more in-depth understandings in cognitive mapping by overlaying various survey results together to reveal total cognition.

2.3.2. GPS tracking

In comparison to qualitative approaches involving cognitive mapping, GPS tracking offers a new quantitative method to map and measure human behavior and to understanding subjects’ reflections and feelings about urban form (Ye and van Nes, 2014). In many new techniques (e.g., Cell phone tracking, Wi-Fi tracking, RFDI tracking), GPS tracking can be viewed as a really advanced method for tracing and measuring the intensity of tourist activities. Such GPS data present three practical advantages: (1) these data give the researcher the capacity to record and understand people’s movements in real-time, (2) the data gives researchers the ability to choose
appropriate subjects to analyze in detail how people use places (e.g., passing by, short stay or long stay), and (3) the data yielded by this technique allows the researcher to illustrate high-resolution data on different geometric locations. Meanwhile, since most tourists are not familiar with the sites they occupy (and given that tourists only stay in these places for a short period), cognitive mapping is not appropriate for reflecting on how tourists use community spaces. In this regard, GPS tracking can be regarded as being a high-resolution approach only.

Shoval (2007, 2008) was one of the first researchers to use GPS receivers to record the movements of visitors in a city for the purposes of tourism management. Van Schaick and van der Spek (2008, 2009) also further developed and empirically applied Shoval’s original methodological innovation. Schaick and van der Spek (2008, 2009) also used this instrument to analyze both individual routes and collective aggregate patterns of visitor behavior. Data from the study, on improving city centers for pedestrians (Figure 5) received positive results.

Figure 5: GPS tracking results from Koblenz superimposed on the locations of commercial functions/spaces (van der Spek et al., 2009, p.13).
3. Classifying Results

3.1. Cognitive mapping analysis in Gulangyu

Cognitive mapping was utilized three times in the Longtou Road and Neicuoao communities on Gulangyu island from September 2014 to April 2015. The survey was constructed according to both demographic and geographical statistically representative considerations. Regarding the demographic aspect, the proportion of men to women is 10 to 9 according to the latest Sixth National Census Data in Gulangyu. Elderly people living in this district also make up more than 30% of the total population. Thus, the subjects in this survey were selected according to these statistical characteristics. With regard to the more geographical aspect of the sample, all the subjects in this study were gleaned evenly from the different geographical areas mentioned.

260 subjects in total were selected and 253 effective questionnaires were recovered. In this survey, each subject would be asked to mark the boundaries they frequently visit and evaluate their frequency of visits from 0 to 100%. All the manual drawing results were then collected and converted via the GIS platform. Various percentages of visiting frequency for community residents were then visualized through the overlay analysis represented below (see Figure 6 below).

As shown in Figure 6, local residents have quite different visiting frequencies, which can also be understood as strong sites of cognition with regard to the community spaces on Gulangyu island. As we shall demonstrate below, from red to green, the cognition of community spaces decrease. For instance, the Longtou Road Commercial Street is the most important community space for local residents, which is marked as red. Trinity Church and the Neicuoao Business District are also frequently used, and so
they are marked as yellow.

![Cognitive mapping in the Gulangyu island](image)

**Figure 6:** Cognitive mapping in the Gulangyu island which visualizes the preferences of local community residents.

### 3.2. GPS tracking analysis in Gulangyu

GPS tracking was also utilized in the same study area during the same period. The Meitrack MT90 personal GPS tracker was used and 274 subjects were randomly selected. The teams were equipped with GPS devices and questionnaires which were then given to pedestrians.

All these GPS devices recorded pedestrian movements from the beginning of their visit to their departure from the island; data from these movements provided the
researchers with detailed information as to how tourists moved around the whole of the island. In order to collect as much data as possible and decrease redundant recording, we chose to distribute the GPS tracker to tourists at the highest access points to Gulangyu: the docks. People who had arrived at the docks onto the island were asked to contribute to the research. If they belonged to the target group of tourists, they were offered a flyer explaining the background and setup of the study. Using two locations at the same time meant that we were able to collect sufficient and comparable data. The data was then used generically as all data from the different locations on the island were collected under the same circumstances.

Meanwhile, the collection of data took place over a number of multiple days from Monday to Sunday so that generically useable data could be accumulated. Specifically, the devices were activated around 10am and were collected at 9pm. Track logs resulting in temporal-geographical information were recorded and converted into compatible files for ArcGIS using GPS Utility. In the maps we have created below, from the information gathered in this data collection process, every dot on the map represents 5 seconds. Through analyzing point numbers and the changing locations of tourists, tourist behavior can be recorded in detail (Figure 7).

In Figure 7, from a to b, we could generate the general visiting density of tourists by using the point density function in GIS. From a to c, we would generate the staying location for each trajectory by summarizing the staying time in the given cell. From c to d we could get the general staying density of all tourists by using the overlaying function in GIS. e is the map produced in section 3.1 (Figure 6c) and shown as the
community boundary. We used e, b and d to generate the classified map (Figure 7f).

As stated above, tourist behavior can be analyzed from two perspectives: visiting density and staying density. On the one hand, according to the GPS density analysis (Figure 7a and 7b), Longtou Road Commercial Street, Sunlight Rock and Shuzhuang Garden are the most frequently-visited places for tourists – which are marked in red. Other places marked from yellow to green represent the decrease in tourist arrivals to the island. On the other hand, the temporal distribution of tourists is also analyzed. A grid unit of the size of 50*50m is applied as a basic unit in the analysis of staying tourists. Tourists staying in one grid for more than 5 minutes are defined as high staying visitors (red) (Figure 7c), which means that tourists moving speeds in high staying areas are at least 5 times lower than the average pedestrian speed of tourists recorded in this study. In order to show the general staying density of all tourists, we count the frequency of 5-min staying cells, where the higher staying preference is marked in red and the lower staying preference is marked in green.
3.3. Overlaying the two analyses to reveal the conflicts between tourists and residents

After we collected the data described above, the overlaying analysis of both local residents’ cognitive mapping and tourist travel behaviors can help us understand further the nature of community spaces in Gulangyu. As a result of the combination of various values, community spaces can be classified into six different types according to three different types of tourist behavior features and two different types of resident cognitive features (Figure 8).

From Type 1 to Type 6, the degree of spatial conflict between local residents and tourist arrivals decreases. The main conflicting areas (Type 1 and Type 2) are those that are highly attractive to both local residents and tourists, which easily leads to
overcrowded places and brings negative effects to community life. These areas are mainly located around the Longtou Road Commercial Street, the Sunlight Rock area and the Beach-Shuzhuang Garden area. The rest of the surveyed areas (Type 3 to Type 6) are not used intensively by either local residents or tourists, and therefore these spaces demonstrate much lower spatial conflicts between the two groups. More detailed discussions are developed in the next section regarding the spatial and behavior characteristics of the types of space we have analysed.

Figure 8: Classifying different types of community spaces based on cognitive mapping and GPS tracking.
4. Discussion

4.1. Type 1: High Staying and High Cognition (Conflicting Area)

4.1.1. Discussions

Type 1 illustrates the spaces that have both high resident cognition and high levels of long term tourist stays. Type 1 is also representative of the tensions that occur when traditional community spaces are unsettled by large numbers of tourist arrivals. Traditional community spaces become extremely crowded and expensive as a result of tourists who intend to stay in the space for long periods of time. Although these places are important for local residents, many of these local subjects are highly dissatisfied with these spaces preferring to decrease their use of these places in the peak tourist season. As we understand in interacting with local residents, over time, these community spaces will be gradually eroded from resident public memory and won’t be regarded as important community spaces in the long run. Importantly this result sends out a clear message to urban planners and designers who are seeking to consider the possibility of decreasing high pressure in these spaces.

As shown in Figure 9, Type 1 includes 5 places, with a total area of 18, 500 square meters. The main land use functions for Type 1 are commercial, beach and concert. Important examples of these land functions in Type 1 includes the Longtou Road Commercial Street, the Concert Hall, and part of Gangzaihou Beach, etc. All these areas tend to have an attractive core, which might include historical commercial areas, the beach, or a renowned concert hall, for both tourists and local residents alike.
Furthermore, these areas (b and d) also have well-connected streets so that subjects can easily arrive in these spaces. It is these two factors that most likely lead to high conflicts between tourists and locals. As well as these factors, observations made by the researchers in the Type 1 space found that attractive facilitates for both local residents and tourists might be another reason for high conflicts (Table 1). The three typical cases we studied have some facilities that can attract tourists and locals, which also leads to the co-presence of high cognition and staying.

Figure 9: Spatial characteristics of type 1.
Table 1: Observed environmental and behavioral characteristics of type 1.

<table>
<thead>
<tr>
<th>Types</th>
<th>Observed environmental and behavioral characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Photo</td>
</tr>
<tr>
<td>1</td>
<td><img src="image" alt="Park of Longtou Road Commercial Street" /></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Gate of Suzhuang Gardon" /></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Gangzaihou Beach" /></td>
</tr>
</tbody>
</table>

4.1.2. Optimization Strategies

As we found all the type 1 spaces are important and attractive for both tourists and local residents alike and as we have stated above, it is the intention of the authors not to favor one of these sides. Nevertheless, applying detailed spatial organization to
separate tourist and residential flows is certainly a workable option. Two strategies can, therefore, be proposed for handling the current problems with the site: 1) setting new zoning rules and road network management to encourage the making of separated tourist and residential cores; 2) re-organizing the resting places and other facilities to strengthen a well balanced spatial division.

4.2. Type 2: High Visiting and High Cognition (Hot Area)

4.2.1. Discussions

Type 2 illustrates the spaces that have both high resident cognition and high tourist visits. Type 2 differs from type 1, because these are the spaces where numerous tourists will visit; these spaces are also sites in which tourists will not stop for a long time due to the lack of tourist attractions or service functions (Figure 10). But as our research demonstrates often local residents like these areas a lot and are willing to have a rest and organize social activities within these spaces. From the perspective of community space protection, the situation in type 2 spaces are relatively healthier than the situation in type 1 spaces, since the conflicts between the two users are a little bit lower. Nevertheless, arguably the high amount of tourist flows to these spaces brings negative effects to these areas as well. Piano Wharf Square is representative of this type of space, given that it has a nice sea view and a large green space which is often more attractive to local residents, rather than tourists (Table 2).
Figure 10: Detailed spatial characteristics of type 2.

Table 2: Observed environmental and behavioral characteristics of type 2.

<table>
<thead>
<tr>
<th>Types</th>
<th>Observed environmental and behavioral characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Photo</td>
</tr>
<tr>
<td>2</td>
<td><img src="image" alt="Piano Wharf Square" /></td>
</tr>
</tbody>
</table>
4.2.2. Optimization Strategies

As stated, the main conflict inside Type 2 areas is the high amount of tourist flows which subsequently disturb the behavior of local residents. Therefore, a potential strategy to handle this situation might include the construction of appropriate spatial arrangements (e.g., the creation of more walk-ways and paths that encourage visitors use different route) to decrease conflicts. Take the Piano Wharf Square as an example, if the local authority could move the dock used by tourists a little bit further away from the square, conflicts over the space might be reduced. On the 20th of October, 2014 the local government actually begun to adjust the use of the three docks in Gulangyu, which has certainly improved the situation; however, as we are suggesting here it might be beneficial for the local authority to increase the distance between the docks and the Piano Wharf a little more.

4.3. Type 3: Low Visiting and High Cognition (Local Area)

4.3.1. Discussions

Type 3 illustrates spaces that have high resident cognition but low tourist preferences, which represents, in turn, well-kept traditional community spaces that are usually uninhabited by visiting tourists. These areas have streets that can be easily accessed and highly mixed residential and commercial functions. These areas demonstrate positive signs for community space protection. However, it is a pity that these types of community spaces are limited compared with type 1 if large beaches are excluded.
After a period of increasing tourist numbers, traditional community spaces become fragmented and atrophic (Figure 11). Large and continuous community spaces do not exist anymore and are broken into many smaller pieces. Important nodes in type 3 include Meihua Beach, the Trinity Church area and the Neicuooao Market, etc. Field observation conducted by the researchers illustrates this situation clearly (Table 3). Only a limited number of tourists come to this area and so the majority of the users of these spaces are local residents.

Figure 11: Detailed spatial characteristics of type 3.
Table 3: Observed environmental and behavioral characteristics of type 3.

<table>
<thead>
<tr>
<th>Types</th>
<th>Observed environmental and behavioral characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Photo</td>
</tr>
<tr>
<td>3</td>
<td><img src="image" alt="Meihua Beach" /></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Trinity Church" /></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Neicuoao Market" /></td>
</tr>
</tbody>
</table>

4.3.2. Optimization Strategies

As stated, Type 3 areas have a unique heritage and culture worthy of respect in their own right; a deeper understanding of this culture and the creation of new kinds of boundary making – even at a very soft level – might produce better balances between tourism, development and the protection of the local cultural and community identity. In this regard, an optimizing strategy might include the creation of no-go tourist zones.
that allow the islanders of Gulangyu to reclaim a sense of community space and possibly even sites of well-being from the hordes of tourists. Whilst such boundaries need not be eternally fixed – indeed no doubt over time residential boundaries can become malleable – the consideration of spaces such as these and the role of increased (and/or supervised) land rights for the islanders might produce more sustainable and well balanced spatial outcomes.

4.4. Type 4: High Staying and Low Cognition (Tourist Area)

4.4.1. Discussions

Type 4 illustrates the spaces that have low resident cognition but high numbers of long term tourist stays, which represent what we might describe as pure tourist spaces (Figure 12). These spaces usually have important commercial, leisure-based or residential services for tourist arrivals. The majority of local residents no longer regard these areas as places to visit. Important nodes in type 4 include the Longtou Road Commercial Street and Sunlight Rock, etc. In a similar way to type 1 spaces, type 4 spaces also contain a large number of easily accessible areas and encompass a large amount of commercial functions. Field observations conducted by the researchers illustrated this situation clearly (see Table 4). In the tourist high season, only tourists can be found in these areas.
Figure 12: Detailed spatial characteristics of type 4.

Table 4: Observed environmental and behavioral characteristics of type 4.

<table>
<thead>
<tr>
<th>Types</th>
<th>Observed environmental and behavioral characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photo</td>
<td>Longtou Road commercial street, with a wealth of spatial patterns and a high diversity of tourist business.</td>
</tr>
<tr>
<td>Environment</td>
<td>Only a few residents like to go shopping here because of the high prices and crowded conditions.</td>
</tr>
<tr>
<td>Local Residents</td>
<td>Tourist businesses in these areas are highly developed, and attract a large number of visitors.</td>
</tr>
</tbody>
</table>
### Longtou Road Commercial Street

<table>
<thead>
<tr>
<th>Sunlight Rock</th>
<th>Local residents only visit this attraction on the tourist off-season to avoid crowded conditions.</th>
<th>Regarded as the most important tourist destination on the island; the Rock is regarded as a must-go area.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunlight Rock</td>
<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Shuzhuang Garden</th>
<th>The place is not open to public and local residents seldom enter the place for leisure.</th>
<th>It is one of the four famous must-go area for tourists.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shuzhuang Garden</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Underwater World Museum</th>
<th>Because it needs tickets and the function is unique, local residents seldom visit the museum.</th>
<th>Parents like to take their children visiting the museum when they come to Gulangyu as visitors.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underwater World Museum</td>
<td></td>
<td></td>
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</tbody>
</table>

### 4.4.2. Optimization Strategies

As non-conflicting areas, Type 4 spaces do not need to handle the delicate balance between local residents and tourists. Nevertheless, improving the global accessibility of these areas, would mean that tourists could arrive more easily within these spaces; furthermore a strengthening local facilitates would also improve the tourist experience which might be considered as a corresponding strategy.
4.5. Type 5: High Visiting and Low Cognition (Passageway Area)

4.5.1. Discussions

Type 5 illustrates spaces with low resident cognition but high numbers of tourist visits (Figure 13). These spaces are also, to a certain extent, a kind of tourist-oriented space. These types of space are those spaces that tourists will easily or willing come to, but will quickly leave because of the lack of decent attractions. Since these types of space are not important to local residents, appropriate strategies should be considered to attract more tourists into these area (from type 1 and 2). Again field observation conducted by the authors illustrates this situation clearly (Table 5). In the high tourist season, only tourists can be found in these areas. Local residents pay little interest in these transitional spaces, when large numbers of tourists are passing through these spaces without staying.
Figure 13: Detailed spatial characteristics of type 5.

Table 5: Observed environmental and behavioral characteristics of type 5.

<table>
<thead>
<tr>
<th>Types</th>
<th>Observed environmental and behavioral characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Photo</td>
</tr>
<tr>
<td>5</td>
<td>1-Passageway to Qin Garden</td>
</tr>
</tbody>
</table>
4.5.2. Optimization Strategies

In a similar way to Type 4, Type 5 can also be characterized as a non-conflicting area. In detail, tourists tend not to stay in this area due to the lack of attractions, but they still pass through these spaces due to their highly accessibility. Therefore, a strategy for developing appropriate tourist attractions in this kind of area should be considered. A viable strategy should attend to the high pressure brought by numerous tourists to these areas; but such a viable strategy would also have to attend to the pressures put on these spaces by high numbers of tourists.

4.6. Type 6: Low Visiting and Low Cognition (Cold Area)

4.6.1. Discussions

Type 6 illustrates the spaces that have low resident cognition and low tourist preferences, which represents relatively ignored places (see Figure 14). It seems incredible that there are so many areas which demonstrate both low tourist and local residential figures on an island which has suffered as a result of the increasing numbers of tourists. Many public parks, hills and halls are not being well used. Again, field observation conducted by the researchers showed that inappropriate local
management leads to these situation (Table 6). Thus, it is the opinion of these authors that too many places of the island are restricted to both locals and tourists.

Figure 14: Detailed spatial characteristics of Type 6.

Table 6: Observed environmental and behavioral characteristics of type 6.

<table>
<thead>
<tr>
<th>Types</th>
<th>Observed environmental and behavioral characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Photo</td>
</tr>
<tr>
<td>6</td>
<td><img src="image" alt="Anxian Hall" /></td>
</tr>
<tr>
<td>Anxian Hall</td>
<td>residents and tourists.</td>
</tr>
<tr>
<td>-------------</td>
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</tr>
<tr>
<td>Music School</td>
<td>An educational place in Gulangyu with very old history and music professional background.</td>
</tr>
<tr>
<td>Second Middle School</td>
<td>An educational place in Gulangyu with very old history and good reputation.</td>
</tr>
</tbody>
</table>

### 4.6.2. Optimization Strategies

Considering the high population pressure on Gulangyu, appropriate strategies should be considered to attract local residents or tourists to “re-discover” these spaces. Revising previous allowances might be bought into play to encourage tourists to utilize less well used spaces that are infrequently visited. By adopting this strategy, these places might be marketed in more appetizing ways to appeal to a new generations of tourists.

### 5. Conclusions

This study adds to the existing literature by exploring and applying a set of new analytical methods to understand and classify community spaces; this paper has also sought to explore observed data that seeks to ‘balance’ tourist space organization and
community space protection at historic sites. Moreover, in this paper new techniques were developed which included cognitive mapping and GPS tracking techniques which were combined in a GIS platform to visualize and classify different types of community space based on local resident and tourists use. Obviously we have tried to adopt GIS-based quantitative methods for classifying community space; however, in this paper, we have also developed more advanced GIS-based methods to extend our research. For example, the sDNA (Chiaradia, etc. 2012), a new tool of space syntax, was used to provide us with an accurate illustration of the general spatial structure of various community spaces.

Besides the methodological novelties and techniques explored and developed in this paper, we have also demonstrated a series of empirical understandings of various types of community spaces under pressure from high tourist numbers. As a result of the increasing numbers of tourists on the Island, original community spaces have evolved into different types of space that have differing rates of high and/or low attractiveness to local residents and tourists. As we have suggested here then, these findings can provide further foundations for a series of spatial strategies for future interventions. We have also sought to address a gap in the current literature, by taking up Gospodini’s (2001) call for a combined consideration of urban design, urban space morphology and urban tourism research.

Furthermore, we have also suggested that, Gulangyu can also be regarded as a very good case example of the way officials and practitioners in many Chinese historic
towns might seek to develop decent balances between sustainable tourist development and community conservation in historic sites. This research contributes not only to the conservation issues of Gulangyu but also a larger number of investigations concerning historic towns in China that are confronting similar development-conservation problems.

With regard to the case of Gulangyu, we have suggested that there are six typical types of community space on the island; we have described these spaces as: hot areas, local areas, tourist areas, passageway areas, and cold areas. We also discussed some typical examples of these spaces to illustrate the spatial, environmental and behavior characteristics of these spaces. We believe our findings will therefore contribute to deeper understandings of community space and strategies that should be useful for keeping decent balances between community protection and tourist development in Gulangyu.

To conclude, the findings and tests in this study provide insights into the practices of historic community protection and tourist space organization; moreover, the research also offers suggestions for planners and investigators interested in promoting sustainable development in other Chinese historic towns. In the contemporary moment, work and investigations in this area are still in their infancy and there is still a long way to go before we can understand the nature and interactions between space and users of space. Nevertheless, to produce more guides, future explorations must focus on deep analyses of newly-raised techniques to uncover, in
real-time, how people interact with the urban form. As we would suggest then, more in-depth understandings might be achieved through further utilizations of the practical approaches discussed in this paper.

References


5(3-4): 3-4.


