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Article

Social Media Users' Visual and Emotional Preferences of Internet-Famous Sites in Urban Riverfront Public Spaces: A Case Study on Changsha, China

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Abstract: With the increasingly online exposure of urban public spaces, the new concept of "Internet-celebrity cities" has emerged in China. The online internet-famous sites are the main characteristics of "Internet-celebrity cities". To fully understand online users' preferences in such kind of public spaces, this article took 27 typical riverfront internet-famous sites (RIFS) in Changsha city (China), as an example. Through the online images and review comments on social media platform "Xiaohongshu", the study analyzed users' perception of RIFS specially on visual and emotional preferences. It revealed the following findings: (1) The popularity of RIFS had a significant head effect and there were far more positive emotions than neutral and negative emotions in review comments. (2) According to 5 different categories of RIFS: modern buildings with river views, restaurants with strong visual impact became the main attractions on commercial RIFS. The art exhibition RIFS attracted visitors to experience traditional culture and highlight their aesthetic pursuits. In the historical and cultural RIFS, people preferred to see the historical buildings with surrounding natural environment, as well as river and mountains views. Ecological Recreational RIFS showed the similar results with the uncultivated RIFS, for the main focus was on the ecological environment, a broader vision and the specific atmosphere. Moreover, the uncultivated RIFS showed more diversified attraction points. This study can provide a new perspective on the waterfront vitality and can offer a targeted and attractive manner for waterfront regeneration that are different from traditional methods.

Keywords: riverfront public space; riverfront internet-famous sites (RIFS); visual elements; emotional preferences; social media; internet-celebrity city; Changsha; China

1. Introduction

During the COVID-19, China's "home quarantine" policy has led to the rise of social media, through which people used to connect with the outside world. People shared their experiences and insights about a culture of a city, lifestyle, and spatial environment online. A few years after the cancellation of home quarantine policies, citizens were free to go outside and choose someplace popular on social media. This phenomenon highlighted the preference of citizens to the urban public spaces, leading to a surge in the number of offline tourists [1] and thus stimulating urban vitality. Therefore, the new concept of "Internet-celebrity cities" has emerged, which could have a new impact on people's daily life [2]. "Internet celebrity" originally referred to some people, who became popular online due to a certain event, or who continuously gained popularity by outputting professional knowledge. After that, the connotation of "internet celebrity" has gradually extended from "people" to various fields, such as tourist attractions [3], buildings [4], and cities [5]. Among them, few studies

have been conducted concerning “internet celebrity cities” beyond China. Although it has been increasingly noticed by scholars, there is also a lack of research related to urban public spaces. In China, the topic of “internet celebrity city” has received wide discussion in the daily lives of citizens. However, its identification has not yet been unified in the academic circles. Moreover, the academic community has not yet formed a specialized theoretical system for “internet celebrity cities”, and related research articles were mostly based on practical aspects. Some scholars have interpreted “Internet celebrity cities” as to cities that have become popular through the trend of social media integration [6]. Ding et al. [7] summarized the basic characteristics of “internet celebrity cities”: first and foremost, they have multiple “internet-famous sites”. Secondly, visitors in “Internet celebrity cities” would like to upload their travel spatial experience through social media, which may cause a surge on the online views and offline visits. The concept of internet celebrity cities is gradually attracting public attention. Therefore, the online images and review comments on urban public space can provide new observation perspective on urban life, becoming one of the most direct, authentic, and down-to-earth evaluation criteria for measuring urban vitality.

Some research on “internet celebrity cities” focused on principle analysis. Comprehensive research has been conducted on Interdisciplinary fields, such as media geography, social psychology, landscape studies, and visual Communications etc., From the perspective of media geography, Liang et al. [5] proposed that urban images were the visual representations of individual cognition. And social media users played the key roles as the most direct and authentic observers in internet celebrity cities. From the perspective of social psychology, Liu et al. [8] highlighted the importance of internet-famous sites. And Wang et al. [9] said that the development of internet-famous sites relying on media platforms can widely influence people’s understanding and aesthetics perception of urban space, presenting a popular, secularized, and carnival aesthetic trend, which has gradually become a cultural phenomenon. In the study of Chen et al. [10], the internet-famous sites have brought out significant changes in the urban landscape structure.

Moreover, visual communication is a discipline that studies the behavior and process of visualizing dissemination of information [11]. Visual symbols have symbolic, indicative, persuasive, explanatory, and documentary qualities [12]. And high intensity visual information [13], which was previously difficult to convey through text and language, has extremely high dissemination efficiency via intuitive images and symbolic information. What’s more, social media is one of the main ways for the public to obtain information and express opinions [14]. Social media data has advantages such as easy to access, large time span, and large data volume [15]. Therefore, this article regards urban image elements as the main media system in social media, where material elements are transformed into visual symbols, and non-material elements are summarized through the evaluation and feedback of users’ comments on social networks, thus constructing a coding table for visual and emotional symbols.

Another group of scholars conducted relevant case studies on urban planning analysis of internet-famous spaces. In macro scale, relevant research mainly focused on the overall distribution patterns [16,17], industry form classification [18] and man-land relationship [19]. In micro scale, correlational studies are mainly on the function and design of internet-famous buildings [20]. However, few studies have in-depth research on meso urban public spaces. Notably, urban public space plays an increasingly important role in the internet-celebrity era. It can enhance urban vitality and can encourage public participate [21]. Due to the acceleration of information iteration and updates, new urban problems have appeared. Therefore, traditional urban design approach needs to be optimized to meet the demands of the rapidly developing new era.

Urban riverfront space is one of the most prominent open spaces in the city, the key area of urban design, and a representative area that locates many internet-famous sites. Based on this, the article chose the internet-famous sites in urban riverfront public spaces in Changsha, China as an example, to explore the core focus of tourists using social media data. Therefore, the main research questions of this article are as follows:

- What are the basic features of the spatial images of riverfront internet-famous sites (RIFS)?
- What are the visitor’s visual focuses in different types of RIFS?

- What are the visitor's emotional preferences in different types of RIFS?

2. Materials and Methods

2.1. Methodological Framework

In this paper, the analysis of RIFS is based on studying the features of urban spatial symbols in online images and review comments. Jin et al. [22] divided urban spatial symbols into two main categories: one is visual image, such as urban spatial layout, streets, buildings, transportation, etc. Another is perception image, such as historical culture, social order, humanistic atmosphere, civic spirit, etc. This article will conduct a comprehensive study on the two types of urban spatial symbols mentioned above, with visual image as the research focus.

Due to the insufficient research on RIFS, this article made a tentative study framework integrating three relevant methods: destination image formation model, previous research on the elements of urban riverfront public space and human activities, and previous research on other internet-famous spaces. Among them, destination image formation model [23] is a three-dimensional model based on the overall image, affective, and cognitive of the destination. It has been widely used on cognitive evaluation of research destinations. Besides, based on correlational research by scholar Chunxia Yang et al. [24–26], the elements of urban riverfront public space were divided into spatial elements (such as the base, shoreline, function, facilities, etc.), temporal elements (such as daytime, season, etc.), and other elements (such as weather, climate, etc.). And human activities were divided into viewing stay (such as watching others, watching the scenery, taking photos, etc.), sports stay (such as running, biking, fitness, etc.), leisure stay (such as rest, walk the dog, playing on the waves, etc.) and social stay (such as chatting, dating, camping, etc.) [27]. What's more, scholar Jiechun Lu [28], recognized internet-famous streets in four aspects: visual elements, emotional images, social behaviors and emotional preferences. Based on integration, we made this research mainly from two aspects: visual elements and emotional preferences

2.2. Study Area

Changsha is a provincial capital city in central China, with prosperous commerce, abundant tourism resources, and long-standing historical culture. As a typical 'Internet Celebrity' City, Changsha was rated as China's first "world-class City of Media Arts" by UNESCO [29] and ranked 6th in the "China's Top 100 Internet Celebrity Cities" in 2020 [30]. At the same time, in the white book "Beautiful City Index: The Relationship Between the Short Video and Urban Prosperity", Changsha was also rated as "A-class city" in the offline prosperity index [29]. What's more, during the COVID-19, Changsha ranked first in the nationwide livable cities released by The Economist in 2022 [31]. Therefore, we chose Changsha as our research city.

The banks of Xiangjiang River are the most important urban public areas in Changsha (Figure 1), showing a narrow and long spatial form of North-South expansion of the city. Moreover, the riverfront public space has the most concentrated internet-famous sites. We chose the Changsha ring expressway as the boundary in north-south direction. We also chose a 500m buffer zone or adjacent main roads as the boundary in east-west direction with best visual and perceptual distance to the river. Next, we used social media data to select riverfront internet-famous sites (RIFS) within the study area.



Figure 1. Xiangjiang riverfront in Chhangsha, China (Source: Sheng Long).

2.3. Samples Acquisition and Selection

2.3.1. Selection of Social Media Platform

We compared the most commonly used social media platforms in China, that is, Sina Weibo, Tiktok, Kwai, Dianping and Xiaohongshu. Among them, Sina Weibo provides real-time push notifications for online articles, but it is unable to provide stable hot news rankings. Tiktok and Kwai are also popular social media, but these two platforms mainly focus on short videos. Compared with photographs, visual elements on short videos are relatively difficult to extract. And the data quantification analysis on above two social media platform is difficult. Dianping is a consumer-oriented website, with users sharing contents such as merchant information, consumer comments and discounts. It is often used for research on urban consumption spaces which is not suitable for this study. Notably, Xiaohongshu is a social media platform that showcases different lifestyles and public activities. The text, images, and videos on Xiaohongshu has a large amount of information with highly relevance to our study. Therefore, we chose Xiaohongshu as the source of data acquisition.

2.3.2. Selection of Riverfront Internet-Famous Sites (RIFS)

The first step was to determine the search keywords. We used the keywords “Changsha, Riverfront” or “Changsha, Waterfront, Internet-famous sites” or “Changsha, Riverfront, Internet-famous sites” to get relevant posts (Figure 2). Secondly, we selected relevant posts with high popularity values. By drawing on previous research methods [32–34], we added up the total number of “likes”, “collects”, and “comments” as the popularity value, retaining relevant posts with a popularity value exceeding 1000. In this way, we collected 120 popular posts which representing 27 RIFS totally (Figure 3). The author of the post, number of “likes”, “collects”, and “comments”, the review contents and photographs are kept as the basic database for this study, subtracting the irrelevant information. Through calculation, a total of 1186 valid image data and 20257 text data were obtained in this study.

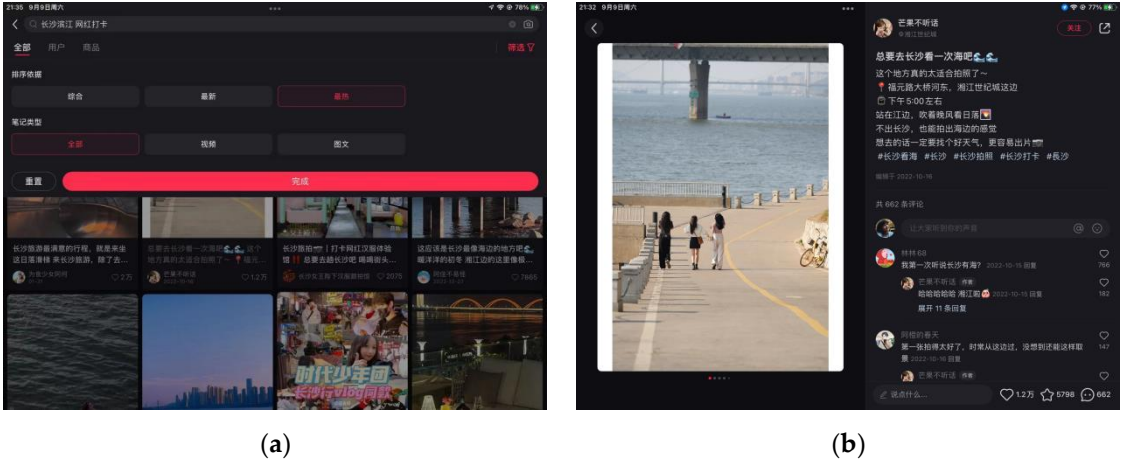


Figure 2. (a) Search interface of Xiaohongshu; (b) Relevant posts on Xiaohongshu.

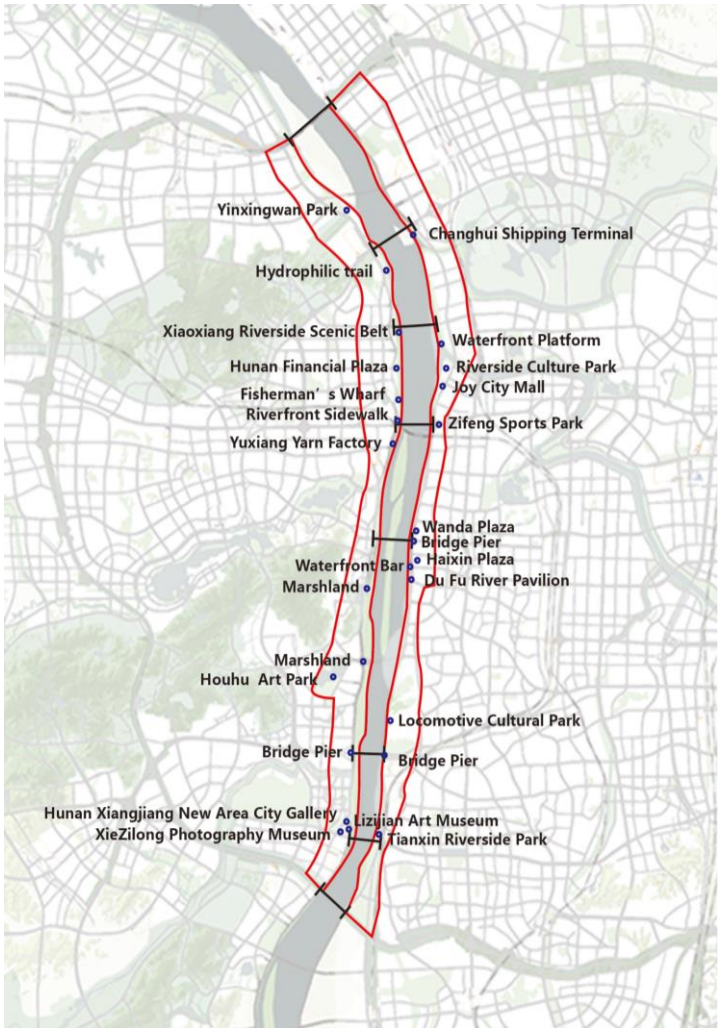


Figure 3. Locations of 27 riverfront internet famous sites in Chhangsha, China.

2.4. Data Analysis

The first step was to classify different types of RIFS: commercial RIFS (such as a store or a commercial complex), Ecological Recreational RIFS (rich ecological vegetation landscape such as forests, wetlands, and water bodies), art exhibition RIFS (art centers, art galleries, cultural centers, museums, etc.), historical and cultural RIFS (historical and cultural buildings with surrounding environments), the uncultivated RIFS (areas without standardized development and operation, most

of which are niche, mysterious, and primitive). The next step was to develop a visual and emotional symbol coding table for RIFS based on images and accompanying text (Table 1). Due to the lack of symbol coding table before, this study combined studies from Liu [35], Jin [22] and Yang [24] to make an suitable coding table for RIFS.

Table 1. Visual and emotional symbol coding table for RIFS.

Major Category	Sub-Category	Basic Types
Visual Symbol	Base	riverfront topography grass slopes, tree ponds, forests, flat lawns, shoals, flower beds, terraced lawns, sandy areas, hard areas..
		altitude difference flood control base, transition base, hydrophilic base, steep slopes, outdoor steps, slopes, terraces..
	Shore-line	shoreline waves, tidal ebb zone, stones, ecological embankments, railings, hard embankments, docks, bike lanes, winding paths, tides, embankments, light shows, flood walls, fireworks, flat shorelines, convex banks, and mooring piers (including opposite shore , distant mountains and islands)...
		overhang face shaped overhang, vertical overhang, enclosed overhang, terrace... buildings on the opposite bank, art museums, landmark buildings, architectural details, restaurants, attics, shops, markets, commercial
		building buildings, villas (lakeside villas), old industrial buildings, amusement parks, cultural and creative shops, squares, cafes, main stores, tea houses, milk tea shops, vending machines...
	Function & Facilities	structure river-spanning bridge, billboards, piers, stone bridges, roads, parking lots, street lights, signboards, sculptures of great figures, cartoon sculptures, large screens, building stairs, lighthouses, boardwalks, parks, water towers, railway tracks, underground passages, slides, trash cans, sports venues, utility poles, public toilets...
		transportation cruise ships, bicycles, fishing boats, trains (steam trains), motorcycles, cars, rowing...
	Time & Climate	items neon lights, food, tables and chairs, children’s dolls, umbrellas (sunshades), barbecues, tents, daily necessities, beds, luggage, kites, tea sets, speakers, chess and cards, balloons...
		resting facilities tree pool, stool, steps, flower pond, seats...
		others graffiti,Scene location for variety shows..
	Animals & Plants	season spring, summer, autumn, winter
		time early morning, morning, noon, afternoon, nightfall, day, night, festival...
		weather sunrise, sunset, blue sky, clouds, moon, rainbow, starry sky, wind...
		climate Sunny, cloudy, rainy, snowy, smog...
		plants trees, grasses, flowers, aquatic plants, arbor, deciduous plants, potted plants, shrubs, vines, dead woods...
		animals dogs, cows, swans, horses, birds, cats...
	People	types of people youth, women, police officers, men, vendors, tourists, children, residents, elderly, couples, wanderers, teenagers, middle-aged, delivery drivers, singers, bands...
		behaviors 1.viewing stay: personal posing, taking wedding photos, capturing scenery... 2.sports stay: walking, cycling, paddle boarding, swimming, running, skateboarding, square dancing... 3.leisure stay: camping, fishing, walking dogs, stepping on water (waves), barbecue, taking baby out for a walk, listening to music, singing at karaoke bar, strolling around, having picnics, flying kites, reading books, playing, singing, lying down, eating snacks.. 4.social stay: drinking tea, chatting, dating, stamping, punching, eating melon seeds, strip the skewers, playing chess...
Emotional Symbol	Positive, Neutral & Query, Negative	(analyze based on review comments)

3. Results

3.1. General Conditions of RIFS

3.1.1. General Conditions of Different Types of RIFS

RIFS have been divided into five main categories (Table 2). In terms of quantity, the number of Ecological Recreational RIFS and the uncultivated RIFS was tied for the first, with 7 for each, accounting for 25.9% of the total. The number of commercial RIFS ranked the third, with a total of 6, accounting for 22.2%. The art exhibition RIFS ranked the fourth, with a total of 4, accounting for 14.8%. And the number of historical and cultural RIFS was the lowest, only 3, accounting for 11.1%. In fact, different types of RIFS had diverse attraction points based on their own resources. In terms of popularity values, although the number of commercial RIFS ranked third, their maximum popularity values and total popularity values are the highest, indicating that commercial RIFS had the strongest online dissemination ability and attracted the largest numbers of audience. However, the Ecological Recreational RIFS and uncultivated RIFS with the highest number of sites, had reciprocal popularity values, indicating that their online dissemination ability are relatively weak. Moreover, the number of art exhibition RIFS and historical and cultural RIFS was small, whereas their overall popularity is relatively high.

Table 2. Popularity of different types of RIFS.

Types	Popularity Ranking	RIFS (popularity values ; ranking)
Commercial RIFS	1	Joy City Mall(101877; 1), Waterfront Bar(Haixin District)(31296; 6), Houhu Art Park(14587; 11), Haixin Plaza(13614; 12), Fisherman’s Wharf(10356; 14), Wanda Plaza(1077; 25), total:6
Art Exhibition RIFS	2	Xie Zilong Photography Museum(93280; 2), Changsha Riverside Culture Park(48651; 4), Li Zijian Art Museum(4372; 18), Hunan Xiangjiang New Area City Gallery(1150; 24), total :4
Historical & Cultural RIFS	3	Du Fu River Pavilion(24014; 8), Yuxiang Yarn Factory(17336; 10), Locomotive Cultural Park(2481; 22), total :3
Ecological Recreational RIFS	4	Changhui Shipping Terminal(55069; 3), Hunan Financial Plaza(22125; 9), Marshland(Fubuhe Station)(12616; 13), Zifeng Sports Park(6152; 15), Yinxingwan Park(3634; 19), Marshland(Taozihu Station)(2690; 20), Tianxin Riverside Park(1013; 27), total :7
Uncultivated RIFS	5	Hydrophilic trail(Zhuohua District)(39508; 5), Waterfront Platform(Fangyuanhui District)(25992; 7), Bridge Piers of Houzishi Bridge(west)(4708; 16), Xiaoxiang Riverside Scenic Belt(west of Fuyuan bridge)(4506; 17), Riverfront Sidewalk(west of Yinpenling bridge)(2548; 21), Bridge Piers of Houzishi Bridge(east)(2478; 23), Tunnels of Juzizhou Bridge(1031; 26), total :7

¹ The overall popularity ranking is calculated based on the average popularity of each RIFS.

3.1.2. Popularity Values of Each RIFS

In the data collection stage, a total of 27 eligible RIFS were selected, and each of their popularity values were shown in the following Figure 4. Among them, the Joy City Mall ranked the first and Xie Zilong Photography Museum ranked the second. The popularity values of these two RIFS above were basically twice as many as the Changhui Shipyard Shipping Terminal (ranked 3rd), 10 times as many as the Fisherman’s Pier (ranked 14th) and incredibly 100 times as many as Tianxin Riverside Park (ranked 27th). The above result indicated that the head effect of the popularity values of RIFS is obvious. That is, as the popularity ranking decreased, the speed of popularity decayed dramatically. What’s more, it indicated a phenomenon associated with audience fragmentation, in which social networks push recommended content to relevant groups through built-in algorithms, thereby continuously accumulating the popularity of the top RIFS. At the same time, it was also the manifestation of the agglomeration effect of urban spatial development in the virtual environment.

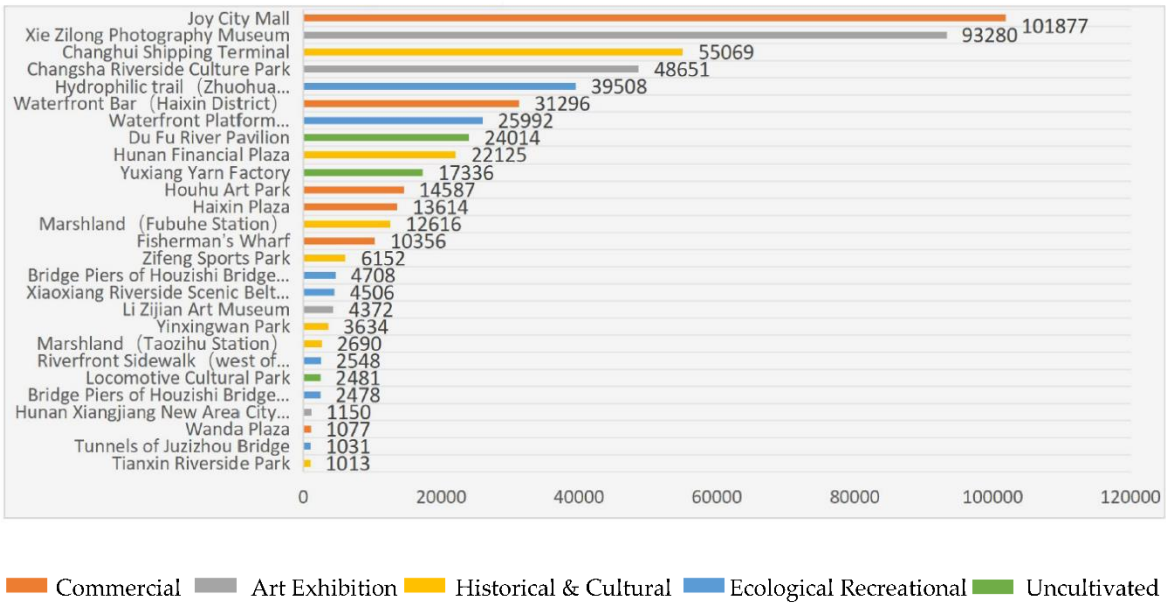


Figure 4. Popularity Values of Each RIFS in Changsha City.

3.1.3. General Preferences of Visual Elements in RIFS

Among the major categories of visual symbols(Table A1), “people”(1814) and “function & facilities”(1761) were far more numerous than “animal & plant”(516), “base”(379) and “shoreline”(597). It is worth noting that “time and climate”(705) also appeared more frequently. In most photographs, citizens tended to combine “time and climate” elements with various waterfront scenery and human activities to create a typical sense of atmosphere. Table 3 shows the statistics of high-frequency visual symbols for the RIFS, including the distribution of categories and symbol quantities. The top 10 high-frequency symbols are displayed below.

Table 3. Top Ten Visual Elements of RIFS.

Ranking	Visual Element	Frequency	Attribute (Sub-Category)	Attribute (Major Category)
1	youth	421	types of people	people
2	personal posing	317	behaviors	people
3	women	305	types of people	people
4	buildings on the opposite bank	236	buildings	function & facilities
5	river-spanning bridge	187	structures	function & facilities
6	police officer	159	types of people	people
7	neon lights	137	items	function & facilities
8	trees	134	plants	animals & plants
9	waves	132	shoreline	shoreline
10	sunset	130	climate	time & climate

In the major category of “people” symbols, the top three tags were “youth”(421), “personal posing”(317) and “women”(305), which intuitively reflects that the current user group of this social network platform was mainly young women. What’s more, behaviors such as personal posing that showcased oneself occupied the main position on social media. Notably, the specific character type “police officer”(159) ranks high, because he was famous for “helping residents and tourists to take photos and teach styling”. From this, it can be seen that citizens are interested in “topical issues and individuals”.

In the major category of “function & facilities” symbols, “buildings on the opposite bank”(236) and “river-spanning bridge”(187) ranked fourth and fifth respectively, with a higher frequency than other spatial elements. This indicates that the preference of citizens for riverfront public spaces was

closely related to the distant views of the opposite bank and cross river landscapes. The element of “neon lights”(137) often appeared simultaneously with elements such as “nightfall”, “river-spanning bridges”, “commercial buildings” and “billboards”, reflecting people’s pursuit of modernization and commercialization while highlighting visual effects.

Meanwhile, “trees”(134) were basically an indispensable natural symbol for every popular riverfront sites. The color changes of trees in different seasons have become a natural symbol for people to perceive the seasonal changes in cities, which can enrich the sense of the landscape level to urban riverfront. What’s more, “waves”(132) and “sunsets”(130) often appeared simultaneously in the image. The sunset implied a special metaphor for time, which was highly favored by the public due to its unique aesthetic characteristics of celestial phenomena. The afterglow of the sunset was reflected on the shimmering river, highlighting a sense of calm and gentle atmosphere.

3.1.4. Emotional Preferences of Review Comments in RIFS

The review comments on RIFS reflects their emotional perception. The high-frequency words indicated a strong cognitive consensus among citizens. Through manual filtering to remove irrelevant text content, a total of 3340 emotional comments were obtained (Table 4). Among them, there were 3055 positive emotions, accounting for 91.47%, far higher than the number of neutral emotion symbols (frequency:257, accounting for 7.69%) and negative emotions (frequency:28, accounting for 0.84%).

Table 4. Frequency of Emotional Elements of RIFS.

Emotional Preference	Main Points	Representative Comments (Frequency)
Positive (total: 3055)	Beautiful Scenery (total: 1478)	wide vision(97), lovely dolls(65), share photo shooting experience(32), spectacular islands(18), romantic marshland(15), cinematic atmosphere(15), graceful spatial geometrical modelling of architecture(14), nostalgia atmosphere(8), sense of technology(7), a holiday exclusive edition(6), sense of oil painting(3), the distinctive features of the old city(3), sense of mysterious(1)
	Fun (total: 55)	one stop experience of Changsha wonderful night & intangible cultural heritage(27), Internet-famous children’s slide(7), alcohol and music(4), delicious food(4), fashionable style of middle ages(3), home-stay(3), a trendy way of entertainment(3), coffee & dessert(2)
	Want to visit (total: 1216)	film and television shooting location(21), the celebrity effect attracts popularity(8)
	Other Compliments (total: 306)	the police have a professional level of photography skills(252), inclusion and respect for vulnerable groups(51), comfortable(2), unique(1)
Neutral & Query (total: 257)	Safety (total: 25)	questioning safety of amusement facilities(20), questioning the level of traffic and public security(5)
	Comfort (total: 101)	whether there are too many people and crowds(46), whether the temperature is comfortable(23), is there any odor from the excrement of cattle and sheep(13), whether mosquito bites or not(7), is there any snakes in the grassland(4), are there any tourists trampling on the grass (3)
	Convenience (total: 48)	whether convenient to parking lots(40), whether there is any restrooms (4), whether the activity free of charge(4)
	Experience (total: 83)	how to stamp and commemorate(44), the specific time of the fireworks display(18), the flower season(12), whether the food is delicious(9)
Negative (total: 28)	Disappointed (total: 28)	there is a discrepancy between the actual situation and the inline photos(16), water turbidity(5), tourists trample on flowers and plants at will(4), fragmentation of visual information(2), lack of humanistic atmosphere(1)

Firstly, the content of positive emotions can be roughly summarized into four categories: “Beautiful Scenery”, “Fun”, “Want to visit” and “Other Compliments”. The high frequency of

“Beautiful Scenery”(1478) and “Want to visit”(1216) proved that internet-famous posts on social media could have a strong ability to attract audience. In the category of “Beautiful Scenery”, citizens attached great importance to the “wide vision”(97) of riverfront perspective, the “children’s dolls”(65) in festival activities , and the “sharing photo shooting experience and skills”(32). Meanwhile, the frequency of “film and television shooting locations”(27) and “one stop experience of Changsha wonderful night & intangible cultural heritage”(21) was also high, indicating that the attraction of film and television promotion and local characteristic experiences to netizens was also obvious. In the field of “Other Compliments”(306), the anecdote of “a police officer at a certain scenic spot who had a professional level of photography skills”(252) became an internet celebrity. In addition, the “inclusion and respect for vulnerable groups”(51) in riverfront space have also received a lot of attention. Secondly, in terms of neutral emotions and queries, netizens mainly introduced RIFS from four perspectives: “comfort”(101), “fun”(83), “convenience”(48) and “safety”(25). Thirdly, negative emotions were extremely rare, mainly due to “the discrepancy between the actual situation and the photos”(16), as well as dissatisfaction with the hygiene and environment.

Overall, the vast majority of comments were positive emotions, indicating that the majority of users had a positive attitude towards the RIFS; Notably, neutral and query contents that could directly reflect the concerns of netizens; A small number of negative evaluations cannot be ignored, for it can expose the problems existing in riverfront public spaces, and also the key to improve the quality of the physical environment.

3.2. Visual Preferences of Difference Types of RIFS

3.2.1. Visual Preferences of Commercial RIFS

The commercial type of RIFS were mainly composed of riverfront shopping malls (Joy City Mall, Haixin Plaza, Wanda Plaza), riverfront restaurants and entertainment blocks (Fisherman’s Wharf, Houhu Art Park), and commercial stores (waterfront bars in the Hisense area). Generally, the specialty store or a cluster of specialty stores, with its unique riverside location, has become one of the main attractions for visitors. This kind of internet-famous sites had a large number of people flow, lively atmosphere and strong visual appeal. At the same time, the unique merchandise and services were favored by visitors.

Through the sample statistics (Table 5), the frequency of “youth”(45) was relatively high, which reflected the trend of youth in commercial RIFS, and largely catered to the consumption habits of young people. Gourmet “food”(59) appeared most frequently, and usually appeared along with “neon lights”(59) and “restaurants”(34). The vast majority of online comments were related to specific food, such as barbecue, fried chicken and seafood, as well as different decoration styles such as Korean, French and new Chinese. On the one hand, this phenomenon reflected that social networks have spawned a new type of “food socializing” [36]. Food and catering “has become an important content and indispensable element of visual cognition of riverside commercial space, and can provide an irreplaceable experience. On the other hand, some internet-famous riverfront commercial spaces such as restaurants, bars, and cafes can attract citizens to stay and engage in visual enjoyment or material consumption, which can also show a trend of “fashion lifestyle”. This phenomenon showed a meaningful integration of urban riverfront spaces and visual-consumption oriented spaces.

Table 5. Top Ten Visual Elements of Commercial RIFS.

Ranking	Visual Element (Basic Types)	Frequency	Attribute (Sub-Category)	Attribute (Major Category)
1	food	59	items	function & facilities
2	neon lights	59	items	function & facilities
3	youth	45	types of people	people
4	buildings on the opposite bank	44	buildings	function & facilities
5	billboards	38	structures	function & facilities

6	store	34	buildings	function & facilities
7	restaurant	34	buildings	function & facilities
8	nightfall	32	time	time & climate
9	sunset	29	climate	time & climate
10	cartoon sculptures	24	structures	function & facilities

What’s more, Commercial RIFS were often related to special festivals. For example, every Valentine’s Day, Kaifu Wanda Plaza and Hisense Plaza decorated “zebra stripes in the color of love”, “neon lights in the shape of love”, “roses on the giant screen”, stairs covered with roses in line with the festival atmosphere. Also, like the cartoon sculpture (24) placed on the riverfront square in front of Joy City during Children’s Day, it attracted many visitors taking photos and uploading online. This kind of display design that is in line with holiday nodes has formed a positive emotional interaction with consumers. At the same time, it had important characteristics of changing spatial organization over time. In fact, this kind of display design that was in line with holiday styles has formed a positive emotional interaction with consumers. At the same time, Commercial RIFS also had important characteristics of changing spatial organization over time.

3.2.2. Visual Preferences of Art Exhibition RIFS

The commercial type of RIFS were often set up in the art museums or galleries (such as Xie Zilong Photography Museum, Li Zijian Art Museum, Hunan Xiangjiang New Area City Gallery) or centralized cultural exhibition area (such as Changsha riverside Cultural Park, which is composed of Changsha Museum, Changsha planning exhibition hall, Changsha library, Changsha concert hall and surrounding Riverside Landscape Park). “Checking in” the exhibition activities has also become a fashion trend of young people today, reflecting the citizens’ pursuits of art and aesthetics.

Through sample statistics(Table 6), the frequency of types and behaviors of people such as youth (191), women (177), police officer (157) and personal posing (181) ranks in the top four. Among them, the “police officer” acted as a typical “internet-famous photographer” to help tourists take photos with the Art Museum (56). These kind of personal posing behaviors have emphasized an integration of visitors’ physical gestures with the scenic spots. Besides, in the online post articles of Xie Zilong Photography Museum, Li Zijian Art Museum, Hunan Xiangjiang New Area City Gallery, some existing personal posing photos generally became templates for visitors to imitate. Visitors have put on similar outfits and used same postures to simulate internet celebrities, immersing themselves into the same atmosphere.

Table 6. Top Ten visual Elements of Art Exhibition RIFS.

Ranking	Visual Element (Basic Types)	Frequency	Attribute (Sub-Category)	Attribute (Major Category)
1	youth	191	types of people	people
2	personal posing	181	behaviors	people
3	women	177	types of people	people
4	police officer	157	types of people	people
5	art museums	56	buildings	function & facilities
6	blue sky	33	weather	time & climate
7	architectural details	31	buildings	function & facilities
8	stones	27	shoreline	shoreline
9	summer	26	season	time & climate
10	eating snacks	25	behaviors	people
10	cloud	25	weather	time & climate

Obviously, the appearance of internet-famous art buildings had a strong sense of form, which attracted the audience by unique shapes, novel technical materials and bright colors. Also, to present a perfect view, visitors often uploaded their photos by only highlighting the good parts of

architectural details (31) and hiding the undesirable parts, which may broke the overall perception of architecture.

3.2.3. Visual Preferences of Historical & Cultural RIFS

The Historical & Cultural RIFS were mainly rely on riverfront historical and cultural resources, which gave people a sense of historical vicissitudes or humanistic atmosphere. Buildings and structures were often historical legacy with distinct characteristics of the times, regions, and styles, and their were often the main attraction points of the sites. Through high-frequency symbol statistics(Table 7), the frequency of character types and behaviors such as women (61), youth (58), and personal posing (54) ranked in the top three, which was similar to Art Exhibition RIFS. Besides, the neon lights (43) on the landmark buildings (34) at night (22) were high-frequency urban visual elements that visitors tended to take photos of. Due to the regional characteristics of historical and cultural RIFS, it often attracted a large number of visitors. Meanwhile, netizens also tended to constantly repeat and imitated “standardized performance templates” provided by internet celebrities, which made the uploading photos similar to each others.

Table 7. Top Ten Visual Elements of Historical & Cultural RIFS.

Ranking	Visual Element (Basic Types)	Frequency	Attribute (Sub-Category)	Attribute (Major Category)
1	women	61	types of people	people
2	youth	58	types of people	people
3	personal posing	54	behaviors	people
4	neon lights	43	items	function & facilities
5	children’s dolls	43	items	function & facilities
6	landmark buildings	34	buildings	function & facilities
7	attic	34	buildings	function & facilities
8	trees	27	riverfront topography	base
8	tidal ebb zone	27	shoreline	shoreline
10	night	22	time	time & climate

According to the study, there were three main Historical & Cultural RIFS, that is, Du Fu River Pavilion, Yuxiang Yarn Factory and Locomotive Culture Park. The first one is Du Fu River Pavilion. As the largest Tang style wooden structure building in Hunan province, Du Fu River Pavilion is close to the Xiang River with Orange Island (famous for the sculpture of Chairman Mao) in the West and overlooks Yuelu Mountain on the opposite bank. Du Fu River Pavilion is also the cultural landmark of Changsha city. During the children’s day, the children’s Dolls (43) were placed in the attic (34), which created a novel mixture of styles and also brought a different kind of vitality to this city’s representative riverfront landmark.

The second is Yuxiang Yarn Factory, also known as Hunan No. 1 Yarn Factory, is one of the important projects representing the development of light industry in Changsha and also the best preserved industrial heritage in Changsha at present. In the early stage, Yuxiang Yarn Factory building complex included factory gate, bell tower, office buildings, plank roads, wharf, etc. At present, the main building has been transformed into Yuxiang Yarn Factory Museum. The tidal ebb zone(27) and metasequoia forest or trees(27) on the front terrace of the building complex are the popular places for netizens to experience the “historical vicissitudes” of modern industry and shipping.

The third one is Locomotive Culture Park, whose main landscape is the old steam engine locomotive. It was the last batch of this type of locomotive manufactured by the Tangshan Locomotive and Rolling Stock Factory of the former Ministry of Railways in China in 1975. When it was first built, the front of the car, which had been painted red and black, stood upright. Several carriages and a canopy style tail car basically retained the original old-fashioned tables, chairs, luggage racks, and other facilities. The park also retained the coal dock landscape, which once became a unique urban memory in Changsha city. At present, the carriage has been transformed into a retro

restaurant, and the park front terrace has also been designed as a venue for night markets and gatherings. In short, historical buildings, historical stories, cultural activities, urban development and evolution have become the focus of description in the text content of this type of RIFS.

3.2.4. Visual Preferences of Ecological Recreational RIFS

The Ecological Recreational RIFS were mainly riverfront parks (such as Hunan Financial Plaza, Xiangjiang Marshland Park, Zifeng Sports Park, Yinxingwan Park, Tianxin Riverside Park) or riverfront docks (Changhui Shipping Terminal). Visitors were not primarily aimed at consumption, but rather pursue ecological leisure experiences. According to the visitors’ familiarity, Ecological Recreational RIFS can be divided into two categories: the first type is the traditional landmark attractions with certain popularity which foreign tourists tend to visit, such as Hunan Financial Plaza, Xiangjiang Marshland Park and Tianxin Riverside Park etc. In addition to the aforementioned types, local residents were also interested in other new places with special meaning and relatively niche.

Through sample statistics(Table 8), the “buildings on the opposite bank”(91) and the “river-spanning bridge”(82) had the highest frequency of appearance. The buildings on the opposite bank form a distant skyline, and the cross river bridge highlights the depth and distance of the river. The two elements indicated that netizens who come to Ecological Recreational RIFS pay more attention to the “openness” and “grandeur” of vision. What’s more, the combination of waves(73) and sunset(48) in the most photographs created a beautiful and hazy atmosphere. It is worth noting that Orange Island in the middle of the Xiangjiang River, as the main landmark of the city, has erected a portrait of the great Chairman Mao, which was also a popular spot for netizens to take photos and check in.

Table 8. Top Ten Visual elements of Ecological Recreational RIFS.

Ranking	Visual Element (Basic Types)	Frequency	Attribute (Sub-Category)	Attribute (Major Category)
1	buildings on the opposite bank	91	buildings	function & facilities
2	river-spanning bridge	82	structures	function & facilities
3	waves	73	shoreline	shoreline
4	youth	63	types of people	people
5	sunset	48	weather	time & climate
6	grass slope	40	riverfront topography	base
7	stool	40	leisure	function & facilities
8	tree pool	37	riverfront topography	base
9	man	34	types of people	people
10	personal posing	31	behaviors	people

In addition, the Ecological Recreational RIFS were often described as “relaxed”, “free”, “green”, “comfortable”, and “resting”. Elements such as grass slope (40), stool (40), and tree pool (37), which can act as resting facilities, have become the main visual attractions. This type of RIFS often have rich natural landscapes. However, the identifiability and uniqueness of the sites were relatively weak.

3.2.5. Visual Preferences of the Uncultivated RIFS

The emergence and rise of the Uncultivated RIFS were closely related to the impact of the COVID-19. People’s outdoor activities tended to stay away from places with high population density. Therefore, explorers, mainly young people, have begun to find the domestic niche tourism destinations. With the support of internet-celebrity bloggers, a number of the Uncultivated RIFS around cities have been explored. The Uncultivated RIFS obtained in this paper are mainly composed of hydrophilic footpaths, hydrophilic platforms, piers and bridge openings etc. Notably, the above four types of RIFS, which were controlled by commercial capital, special investment or government

agencies, usually have certain standardization and safety in daily operation. However, there was no standardized development and operation of the Uncultivated RIFS, most of which are in the state of no management or weak management, or the geographical location was relatively remote, with basic conditions such as niche, mystery and aboriginal. Visitors in this type of RIFS usually described them such as “sense of mysterious”, “sense of fantasy” or “feeling like a movie set”, etc.

Through sample statistics (Table 9), the high-frequency city symbols of the Uncultivated RIFS were more similar to those of ecological recreational RIFS. That is, the six visual elements, namely the “buildings on the opposite bank”(73), “river-spanning bridge”(71), “youth”(56), “personal posing”(45), “waves”(29) and “ sunset”(28), all entered the top 10 high-frequency elements in both types simultaneously. Netizens were equally concerned about the “wide vision” and the “beauty of time and space atmosphere”.

Table 9. Top Ten Visual Elements of the Uncultivated RIFS.

Ranking	Visual Element (Basic Types)	Frequency	Attribute (Sub-Category)	Attribute (Major Category)
1	buildings on the opposite bank	73	buildings	function & facilities
2	river-spanning bridge	71	structures	function & facilities
3	youth	56	types of people	people
4	personal posing	45	behaviors	people
5	woman	36	types of people	people
6	sunny	34	climate	time & climate
6	stone bridge	31	structures	function & facilities
8	railings	29	shoreline	shoreline
9	waves	29	shoreline	shoreline
10	sunset	28	weather	time & climate

In addition, netizens have diversified perspectives on the Uncultivated RIFS. On the one hand, tourists tended to revisit places where celebrities or internet-celebrities have checked in, to obtain the same “check-in experience” as celebrities. For example, in the internet famous site, Hydrophilic trail in Zhuohua District, the elements of stone bridge(31) and railings(29) were once scenic elements used by Chinese film star Bai Jingting in his portrait images. Therefore, netizens chose these elements with similar photo compositions to mimic styles of celebrities. On the other hand, through the imitation of classic movie scenes, netizens seemed to be in a space full of fantasy. For example, by filming the rows of piers on the Houzishi Bridge combined with the hazy water mist along the riverside, netizens aimed to recreate the dreamlike scene of the movie “Inception”. Another example is the large-scale grassland landscape in the Xiaoxiang Riverside Scenic Belt, which has become the “Wizard of Oz” landscape imagined by photography enthusiasts.

Notably, social media users also upload photos to attract more attention from netizens towards people on the vulnerable groups. For instance, the observation, understanding, and even exposure of the lives of temporary migrant workers and some homeless people living in the bridge cave space of Jvzizhou Bridge, to some extent, can promote the improvement of environmental facilities for this type of waterfront “informal living space” in society.

3.3. Emotional Preferences of Difference Types of RIFS

Accoring to Table 10: the total number of comments on Commercial RIFS was the highest, with positive comments accounting for 93.47%. Representative comments included “beautiful and romantic Changsha version of the Bund”(14), “the distinctive features of the old city”(12), “a holiday exclusive edition”(6), “full of nostalgia”(6), “film and television shooting location”(21), etc. The frequency of neutral evaluation was 65 (accounting for 6.44%), mainly focusing on questioning the safety of amusement facilities (20), as well as questioning comfort such as overcrowding and comfortable temperatures (33). Notably, the frequency of questioning “whether the food is delicious” was only 9, which went against the high frequency food elements in visual symbols.

Table 10. Top Ten Visual Elements of the Uncultivated RIFS.

RIFS Emotions Symbols	Positive		Neutral & Query		Negative		Total
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	
Commercial RIFS	944	93.47%	65	6.44%	1	0.10%	1010
Art Exhibition RIFS	744	96.50%	8	1.04%	19	2.46%	771
Historical & Cultural RIFS	276	79.31%	70	20.11%	2	0.57%	348
Ecological Recreational RIFS	695	90.49%	67	8.72%	6	0.78%	768
Uncultivated RIFS	396	89.39%	47	10.61%	0	0.00%	443

The proportion of positive comments on the Art Exhibition RIFS (96.50%) was the highest among the five types of RIFS. The comments mainly focused on sharing shooting experience and skills(32), expressing feelings about the “geometric sense”(14), “scientific sense”(4) and “oil painting sense”(3) of art architectural modeling, and praising the photographers’ photography level: “the police officer is really professional!”(252). At the same time, the “one stop experience of Changsha wonderful night & intangible cultural heritage”(27) was also the focus of netizens. Notably, the art exhibition RIFS was the only type whose negative comments (19) were more than neutral comments (8). The negative factors that disappointed netizens were “there is a discrepancy between the actual situation and the online photos”(13) and “turbid water”(5). It can be seen that the beautifying effect of online photos caused a certain degree of distortion, which may cause negative feelings during the offline experience.

The total number of comments in the Historical & Cultural RIFS was the least. Interestingly, the proportion of positive comments (79.31%) was the lowest among the five types of RIFS, while the neutral comments (20.11%) was the highest. Wherein, the positive comments mainly focused on “beautiful buildings with a sense of nostalgia”(25), “beautiful fireworks show”(14) and “interesting stamping of historical buildings”(17). The neutral query and inquiry were mainly reflected in the convenience of facilities and the way of visiting experience: “whether the site is convenient for parking”(3), “whether there is a public toilet”(1), “how to stamp for souvenir”(41) and “ask about the time of the fireworks show”(18). This result was closely related to the spatial attribute and human activities. However, the riverside historical and cultural space in Changsha was less preserved. With less activation and utilization, residents’ participation and experiential activities in such types of RIFS was relatively single.

The frequency and proportion of emotional symbols at Ecological Recreational RIFSs were: positive emotions (695, 90.49%), neutral emotions (67, 8.72%), and negative emotions (6, 0.78%). Among them, positive comments mainly included: “Wide vision”(28), “Jiangzhongzhou Island is very spectacular”(18), “Cinematic atmosphere”(9), and “Fantasy feeling”(4). Besides, neutral & query comments mainly focused on comfort, convenience and experience, such as: “whether there are too many people and crowds?”(26), “whether the temperature is comfortable?”(3), “Is there any parking lot or public restroom?”(22), “When will flowers bloom”(12), etc. In negative comments, the main focus is on criticizing “tourists trampling on flowers and plants at will”(4). The negative words have indicated that appropriate planning and management of this kind of RIFS have also attracted the attention of netizens.

The Uncultivated RIFS was the only type of RIFS with no negative evaluation. And its positive comments on visual elements were similar to those of Ecological & Recreation types. Notably, The Uncultivated RIFS have provided “temporary shelters and rest space”(51) for vulnerable groups in the city, which have received praises by many netizens. What’s more, neutral & query comments mainly focus on safety, comfort and convenience, such as “traffic safety”(3), “public security in the

places where homeless people gathered”(3), “Is there any parking lot or public restroom?”(15), “whether the temperature is comfortable?”(7), “how do plants and animals develop?”(20), etc.

3.4. Human Behaviors of Difference Types of RIFS

Human behaviors are diverse in the riverfront spatial environment, which is an important dynamic element of the riverside public space landscape. Together with the static environmental elements, human behaviors have shaped rich visual pictures. The symbol coding table of RIFS has counted the types and frequencies of human activities(Figure 5). Overall, the total frequency was 696, of which the viewing stay obtained the majority of 395 (51.01%); The proportion of leisure stay and sports stay were 24.71% and 14.51%, respectively; The number of social stay was the lowest, accounting for only 68 (9.77%). In terms of specific activities, “personal posing” and “eating and drinking” were the two main activities on RIFS, which were also popular activities transmitted on social media. Secondary high-frequency words included more than 30 kinds of activities, such as walking(62), fishing(40), drinking tea(25), cycling(24), walking the dog(23), and treading on the waves(22) etc, reflecting the strong diversity of waterfront behaviors.

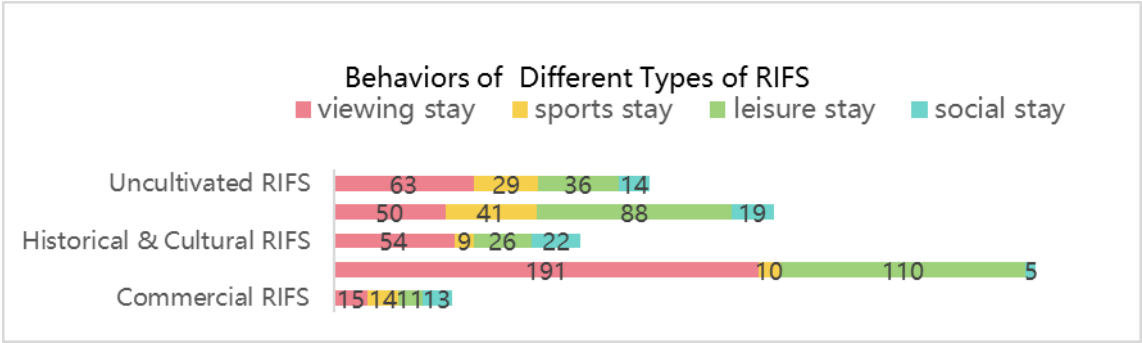


Figure 5. Human Behaviors of Different Types of RIFS.

In the Commercial RIFS, the frequency of viewing stay, sports stay, leisure stay and social stay were relatively close: In addition to “personal posing”, “dating”, “chatting”, “drinking tea”, “singing at outdoor karaoke bar” and other consumer activities account for the majority, which was closely related to the commercial nature of such spaces combined with online social networking to attract popularity. In the Art Exhibition RIFS, the frequency of viewing stay and leisure stay was far more than that of sports stay and social stay: traditional experience activities such as snack tasting, printmaking, seal cutting, brass rubbing, ceramic art and sugar painting etc. have aroused wide public interest. In the Historical & Cultural RIFS, the main human activities included:stamping, camping, stepping on the waves, listening to music, picnics, walking, etc. However, the proportion of activities related to traditional history and culture is relatively low, indicating that rich historical and cultural resources have not been well explored. In the Ecological Recreation RIFS, the proportion of leisure stay and sports stay was the highest among the other four RIFS. And the specific activities were also the most diverse, such as walking, cycling, paddle boarding, swimming, skateboarding, square dancing, camping, fishing, walking the dog, barbecue, stepping on the water, taking baby out for a walk, kite flying, etc. In the uncultivated RIFS, the viewing stay obtained the majority, while the characters of leisure stay and sports stay were similar to those of ecological recreation RIFS.

4. Discussion & Conclusions

This paper chose the riverfront internet-famous sites in Chinese representative “Internet-Celebrity City” Changsha as an example, using online images and review comments data on popular social media platform “Xiaohongshu”, to analyze the main concern factors of visual and emotional preferences of online netizens for riverfront internet famous sites. The main conclusions are as follows:

In general, the 27 RIFS selected in this paper were divided into five categories: Commercial RIFS, Art Exhibition RIFS, Historical & Cultural RIFS, Ecological Recreation RIFS and the Uncultivated RIFS, and their popularity ranking decreased in turn; From the perspective of a single RIFS, the head effect of the popularity value of RIFS was obvious. As the popularity ranking decreased, the speed of popularity decayed dramatically. From the overall situation of visual symbol elements, there were far more character symbols, facility & function symbols than animal & plant symbols, base symbols, and shoreline symbols. The frequency of time & season symbols was also high, and they often appeared in combination with various waterfront spatial environments and human activities. What's more, from the overall emotional descriptions, there were far more positive emotions than neutral and negative emotions. Specifically:

- The Commercial RIFS had the characteristics of large number of people flow, lively atmosphere and obvious trend of youth. And the main attractions of this type of waterfront space were the modern architecture featuring river scenery, cuisine, festivals, and strong visual expression. The frequency of the four types of stay activities (viewing stay, social stay, sports stay, leisure stay) were relatively balanced, with most of them being commercial related activities such as dating, drinking tea, and listening to music on outdoor Karaoke bar. Meanwhile, netizens were more concerned about the safety of facilities, as well as questioning comfort such as overcrowding and comfortable temperatures, etc.
- The Art Exhibition RIFS gained popularity mainly because of the art buildings with unique designs. The main attractive activities included taking part in the exhibition activities to experience the city's unique culture and highlighting personal artistic aesthetic pursuit. Also, netizens tended to replicate fashion postures, sharing filming experiences and other viewing and leisure behaviors. At the same time, they expressed dissatisfaction with the distortion in the experience of online photos and offline real-life environments.
- The Historical & Cultural RIFS were mainly landmark historical buildings. The historical buildings, together with the nearshore waterfront environments, and the background skyline on the opposite bank became the high-frequency visual symbols. Apart from personal posing and leisure activities, there was relatively few experiential activities related to history and culture. What's more, residents' participation in experiential activities were relatively single. Internet users were more concerned about the qualities of public service facilities.
- The Ecological Recreational RIFS and the Uncultivated RIFS had certain similarities. Users mainly focused on the ecological environment of the site, as well as emphasizing the creation of a wide vision and a beautiful spatial-temporal atmosphere. The construction of buildings on the opposite bank, river-spanning bridges, waves and sunset were the key visual elements. There were various forms of tourist stay activities, mainly focused on sightseeing, sports and leisure. The inquiries about these venues were mainly on comfort, convenience and experience. In addition, there is a more diverse focus on the Uncultivated RIFS, which could provided temporary accommodation for some vulnerable groups in the city.

In addition, the innovations of this study, which differ from previous studies on riverfront public spaces are the followings:

- The research scopes: the traditional research area generally covered the whole shoreline area, rather than focusing on the specific sites with certain attributes. This research area mainly focused on the riverfront sites with high internet-popularity.
- The riverfront spatial elements: in the previous researches, the focus of riverfront spatial elements was generally limited to the adjacent shoreline. This study has found that the prospects of the riverside landscape, as well as the river-crossing landscape, islands and landscapes on the opposite bank also had an important impact on the vitality of the riverfront. That is, users not only payed attention to the close view of the river, but also had high requirements for the quality of distant view.
- The relationship between "human activities" and "dynamic landscapes": Photos uploaded on social media has strengthened the relationship between "seeing" and "being seen" of people in riverfront. Various human activities have made human beings inseparable parts of riverside

landscape elements. Different types of characters on riverfront spaces have provided visitors of exploring and imagining diverse lifestyles.

- Weather and climate are also the important visual elements, combined with the landscape spatial environments, to create a variety of atmosphere. However, weather and climate elements were less considered in the traditional waterfront space design. But in the era of social media, when images as the main medium for information dissemination, netizens have included them as the key elements of concern.

In conclude, this paper has expanded the observation perspective and connotation of the vitality of riverfront public space, based on the perspective of social media users. Moreover, it can provide more concrete and operable directions and suggestions for the improvement of different types of riverfront environment in the future.

5. Limitations

The inadequacy of this paper is that the analysis of human activities was relatively general, which only distinguished from the types of RIFS and lacked the corresponding research on the micro spatial environment. Secondly, the research was conducted only from the perspective of online netizens, lacking a comparative perception of the real space use of offline visitors. Thirdly, there was a lack of research on whether the “internet-famous” sites directly corresponded to the offline high vitality sites. The above deficiencies can serve as the directions or ideas for future researchers.

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Appendix A

Table A1. Frequency of Visual Symbol Coding Table for RIFS.

Visual Symbol (total:5771)	Major Category	Sub-Category	Basic Types
	Base (total:379)	riverfront topography (total:316)	grass slopes(70), tree ponds(68), forests(66), flat lawns(38), shoals(27), flower beds(25), terraced lawns(17), sandy areas(4), hard areas(1)..
		altitude difference (total:63)	flood control base(2), transition base(0), hydrophilic base(9), steep slopes(2), outdoor steps(35), slopes(15), terraces(0)..
	Shore- Line (total:597)	Shoreline (total:546)	Waves(132), tidal ebb zone(71), stones(61), ecological embankments(53), railings(52), hard embankments(46), docks(20), bike lanes(16), winding paths(15), tides(11), embankments(10), light shows(7), flood walls(7), fireworks(5), flat shorelines(4), convex banks(2), and mooring piers (including opposite shore , distant mountains(22) and islands(12)...
		Overhang (total:51)	face shaped overhang(24), vertical overhang(18), enclosed overhang, terrace(9)...
	Function & Facilities (total:1761)	Building (total:571)	buildings on the opposite bank(236), art museums(58), landmark buildings(50), architectural details(47), restaurants(39), attics(34), shops(17), markets(17), commercial buildings(16), villas (lakeside villas)(14), old industrial buildings(13), amusement parks(9), cultural and creative shops(6), squares(5), cafes(4),

Time & Climate (total:705)	Structure (total:482)	main stores(3), tea houses(1), milk tea shops(1), vending machines(1)...
		river-spanning bridge(187), billboards(38), piers(36), stone bridges(35), roads(31), parking lots(26), street lights(26), signboards(22), sculptures of great figures(14), cartoon sculptures(14), large screens(14), building stairs(11), lighthouses(11), boardwalks(11), parks(10), water towers(6), railway tracks(6), underground passages(5), slides(5), trash cans(5), sports venues(3), utility poles(1), public toilets(1)...
		cruise ships(44), bicycles(24), fishing boats(19), trains (steam trains)(11), motorcycles(11), cars(10), rowing(2)...
		neon lights(137), food(92), tables and chairs(45), children’s dolls(43), umbrellas (sunshades)(18), barbecues(15), tents(6), daily necessities(5), beds(5), luggage(5), kites(4), tea sets(2), speakers(1), chess and cards(1), balloons(1)...
		tree pool(68), stool(64), steps(35), flower pond(25), seats(4)...
	Transportation (total:121)	Graffiti(9),Scene location for variety shows(2)..
		Spring(3), summer(53), autumn(7), winter(13)
		early morning(0), morning(1), noon(3), afternoon(15), nightfall(8), day(12), night(76), festival(4)...
		Sunrise(7), sunset(130), blue sky(93), clouds(68), sunset glow(69), rainbow(0), starry sky(0), wind(37)...
		Sunny(67), cloudy(8), rainy(2), snowy(0), smog(36)...
Animals & Plants (total:516)	Items (total:380)	Trees(134), grasses(125), flowers(54), aquatic plants(48), arbor(35), deciduous plants(13), potted plants(12), shrubs(19), vines(7), dead woods(3)...
		Dogs(23), cows(21), swans(15), horses(5), birds(1), cats(1)...
		Youth(421), women(305), police officers(159), men(79), vendors(35), tourists(29), children(29), residents(18), elderly(17), couples(13), wanderers (5), teenagers(3), middle-aged(3), delivery drivers(1), singers(2), bands(1)...
		1.viewing stay(total:355): personal posing(317), taking wedding photos(22), capturing scenery(16)...
		2.sports stay(total:101): walking(62), cycling(24), paddle boarding(4), swimming(4), running(3), skateboarding(3), square dancing(1)...
People (total:1814)	Resting facilities (total:196)	3.leisure stay(total:172): camping(32), fishing(40), walking dogs(23), stepping on water (waves)(22), barbecue(15), taking baby out for a walk(9), listening to music(10), singing at karaoke bar(10), having picnics(15), flying kites(4), reading books(3)..
		4.social stay(total:168): drinking tea(25), chatting(13), dating(10), stamping (9), eating melon seeds(8), strip the skewers(2), playing chess(1)...
	Others (total:11)	
	Season (total:74)	
	Time (total:114)	
	Weather (total:404)	
	Climate (total:113)	
	Plants (total:450)	
	Animals (total:66)	
	types of people (total:1118)	
	Behaviors (total:696)	

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