

Scenic Image Research Based on Big Data Analysis - Take China's Four Ancient Cities as an Example

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Abstract

This paper aims to compare the scenic images of four ancient Chinese cities including Lijiang, Pingyao, Huizhou and Langzhong, so as to provide specific development strategies for the ancient cities. In this paper, the ancient cities' scenic images are divided into three sub-indexes and eight evaluation dimensions. Based on this, the study first uses Python software to collect tourists' online comments on the four ancient cities. Then, the social network analysis method is used to build a high-frequency keywords matrix of tourist comments and the R language is used to generate a visual network graph. After this, the entropy weight method is used to determine the weights and values of eight evaluation dimensions. Finally, the tourists' overall satisfaction indexes of the four ancient cities are calculated accordingly. The results show that (1) the overall satisfaction of Lijiang is the highest, while that of Huizhou is the lowest; (2) from the weight of each evaluation dimension, it can be seen that tourists care more about the national culture and historical culture; (3) from tourists' satisfaction index on each evaluation dimension of the four ancient cities, we can find that the four ancient cities has their own advantages and disadvantages in tourism development. (4) local tourism-related institutions should strengthen their

advantages and improve their deficiencies so as to enhance tourists' overall image of the ancient city.

Keywords: Scenic Image, Big Data, Ancient city, Content Analysis Method, Social Network Analysis, Entropy Weight Method.

1. Introduction

With the improvement of the status of international cultural tourism and the increase of people's demand for scenic tourism, scenic tourism has become one of the important lifestyles of people today. People's decision on tourist destination will be made based on online comments and recommendations from closest family members under present network age. Excellent comments on scenic areas will perform a major influence on tourists' plans. By browsing online comments and listening to families' advises, the initial images and concepts of a scenic area will be formed in the mind of potential tourists. Accordingly, tourists will decide whether to visit the scenic spot or not. This logical process indicates the formation of scenic image [1]. The concept of scenic image has been academically studied for about fifty years. It is regarded as a highly valued concept in the process of people's selection behaviour for tourist destination [2]. However, most researchers only take one single scenic image into consideration, which is lack of horizontal comparison between scenic images for multiple potential scenic areas. By considering this situation, based on Baloglu's theory of 'Cognitive - Affective', this paper extends the scenic image theory and classifies the collected online comments on the four ancient cities in China. Then, the entropy weight method is used to make a horizontal comparison of the rankings of these ancient cities in different dimensions. According to the comparison results, the shortcomings of these scenic spots in different dimensions are found, and some suggestions are put forward.

2. Relevant investigation review

The term 'image' was proposed by Boulding in 1956, which has been widely used in academic and economic fields such as psychology, tourism and marketing, etc. The concept

of 'image' is that people make decisions according to their subjective values and knowledge and it is a tool to connect individuals and external environments [3]. Kevin Lynch believed that image is composed of three factors as characteristic, structure and sense. The term 'characteristic' means the features of a physical place, while the term 'structure' is the appearance of objects that can be related to each other. 'Sense' is helping an individual to build deep connection with characteristics. The improvement of these three factors will enhance the image formed in people's mind [4]. Rapoport pointed out that image is an abstract concept, which is the result of the combination of individual's past experience and present excitement [5]. In the 1960s, Kevin Lynch proposed the concept, composition and research method of urban image in his book "The image of the city". Meanwhile, he subdivided city image into five categories: roads, borders, districts, nodes and landmarks by using sociological analysis method [4]. Many subsequent scholars drew on his relevant studies when studying cities.

The concept of scenic image was proposed in 1970's. Different from scenic appearance, Hunt (1971) defined scenic image as tourists' perception to target scenic area. The perception factors contain climate, environment and humanity culture, etc. [6]. In addition, Baloglu (1979) took more emotional factors into consideration, including cognition, image and impression [2]. Chon (1990) had a similar theory with Baloglu. He believed that scenic image is a combination of tourists' expectation, feeling and impression on the scenic spot [7]. Coshall (2000) added a new factor as a scenic characteristic in his research on scenic image and he believed that the individual's perspective on the characteristics of scenic area will influence one's future planning for that place [8]. Kim and Richardson (2003) pointed out that tourists' impressions, thoughts, expectations and feelings towards the scenic spot would change over time [9]. From the perspective of individual psychology, Bai Kai (2009) proposed that the scenic appearance focuses on the subjective consciousness and positioning of the marketers of tourist destinations, while the scenic image is more about the evaluation formed by the combination of tourists' cognition of various information sources of scenic spots and their own experience in scenic spots. [10]. Peng Dan (2019) classified the cognition image into view image, culture image and emotion image when she conducted investigation on scenic image for LiJiang ancient city [11].

Since the word "image" is a psychological concept, the academic community has not formed a unified understanding of this concept since 1971 when Hunt began to introduce the word "image" into the study of tourism management. Echtner and Ritchie (1991) proposed a conceptual framework for destination image, which was composed of three continuous dimensions including holistic-attributes, functional characteristics-psychological

characteristics and common-unique [12]. This theory provides a way to operationalize the concept of tourist destination image, but how to measure the psychological attribute of tourist destination image is a key problem. Gartner's theory (1994) pointed out that tourist destination image is composed of three distinct but hierarchically related components: cognitive, affective and conative. The relationship between these components will determine the destination predisposition [13]. Baloglu and McCleary (1999) established the image connections between 'cognitive-overall image', 'affective-overall image' and 'cognitive-affective image' [2]. The theory model of 'cognitive-affective' divides scenic image into two dimensional structural systems. Each dimension in the system contains different sub-categories, which effectively eliminates the ambiguity of scenic image. Based on the previous studies, this paper subdivides the structure of scenic image, analyzes the tourists' evaluation of the scenic spot in each sub-dimension, and then obtains the overall scenic image. The findings reveal strengths and weaknesses of four ancient cities and implications for their positioning development as well as promotion strategy.

3. Research Methodology

3.1 Research sample

The four ancient cities in China are 5A-class scenic areas, including LiJiang in YunNan, PingYao in ShanXi, HuiZhou in HuiZhou and LangZhong in SiChuan. Thanks to the supportive policies of the state, these four ancient cities have been greatly developed in the past three decades, especially LiJiang ancient city and PingYao ancient city, which have applied for world cultural heritage. The growth of modern tourism demand has made a great contribution to the economic development of the four ancient cities. Based on this, several Online Travel Agency (OTA) sites have a fair amount of comments on the four ancient cities. They are abundant in number and have great emotional differences, which make them suitable as research samples.

3.2 Data sources and preprocessing

The materials in this paper are tourists' comments randomly obtained from highly used tourism websites in China, including XieCheng, QuNa'er and MaFengWo. The tourists' comments selected for investigation contains 48640 comments (average at 12160 comments for each ancient city), ranging from 2015 to 2019. These original comments are pre-processed before formal analysis by following rules: 1) deleting default comments and single-word comments, 2) deleting repeat contents in comments, 3) deleting extreme comments and non-related contents, 4) unifying words with identical meanings. After

pre-process progress, the amount of comments has been reduced to 40000 (10000 comments for each ancient city).

3.3 Research method

The research method in this paper is based on big data analysis of public sentiment on network. First of all, the Python is used to capture the big data of tourists comments. The definition of big data refers to the collection of data that cannot be collected, managed or processed by conventional software or tools within a certain period of time [14]. Whereas, the characteristics of online public sentiment are openness and diversity. For example, netizens can actively leave various messages on the website, which shows the different values of them. All these characteristics of public sentiment fit the definition of big data, which demonstrates that the public sentiment is involving into big data stage [15].

Secondly, this paper applies the social network analysis method to establish the matrix of frequently-used keywords for tourist comments, then the visualization of the text data correlations can be achieved by adopting R language to analyze the related-words matrix and generate a high-frequency words network map. ‘Social network’ is an index that evaluates the importance of an individual in the network. If the individual transmits a large amount of information to other individuals in the network, the centrality of this individual will be higher. Therefore, the higher the individual’s centrality is, the more contact other individuals will have with that individual [16].

Finally, this paper determines the weights of different comment indexes by using entropy weight method and then calculate tourists’ overall satisfaction indexes of the four ancient cities. The entropy weight method is a mathematical analysis to determine objective weight according to the variability of comment indexes. The original entropy is a physical parameter describing the chaos of a system. C. E. Shannon introduced entropy into theory of information and made it widely applied in different academic fields. The entropy weight method determines the weight according to the amount of information provided by the entropy value. The criterion is that the smaller the entropy value is, the greater the entropy weight is, and the larger the information content of the corresponding evaluation index is, and the more important the evaluation index is. On the contrary, the higher the entropy value is, the smaller the entropy weight is, and the lower the importance of the index is. The entropy weight method can be used to objectively give the index weight, which has high credibility and can effectively avoid the interference of human factors.

4. Research analysis

4.1 Scenic image dimension classification

Beerli and Martin (2004) proposed that scenic image is made up of many aspects, such as natural resources, cultural views, tourism facilities and social service environment [17]. Zhou YongBo (2010) divided the scenic image into sixteen sub-categories when he studied three-dimensional structure of scenic image, including sizable frame, special configuration, internal integrity, historical culture, architectural style, celebrity residence, national culture, entertainment facilities and dietary conditions [18]. Peng Dan (2019) divided scenic image into natural views, cultural views, social environment and business environment when he conducted investigation on LiJiang ancient city [11]. Scenic image is a dynamic interaction system [19] and tourists will present different emotions according to their own past experience and new information obtained during their touring period. Based on the above scholars' studies and the unique characteristics of the four ancient cities as well as the collected tourists' comments, this article divides the scenic image into three sub-images, which are view image, cultural image and place image. In these sub-images, eight dimensions including natural view, cultural view, historical culture, national culture, dietary culture, living environment, social environment and business environment are used to evaluate ancient cities correspondingly (see Table 1). View image is tourists' perception of landscape features, including natural landscape and cultural landscape. During the tour, tourists will have a unique subjective understanding of these landscapes, which constitutes an important part of the view image. Cultural image can be interpreted as the combination of the most representative elements of local culture, such as cultural characteristics and visual impacts. In addition, it also represents tourists' understanding, imagination and perception of the material culture and spiritual culture of the scenic spot. With regard to the place image, it refers to the tourists' expectation and perception of the landscape environment, which is a special environment different from the tourists' daily life.

Table 1. Scenic image classification for four ancient cities in China

Image	Sub-image	Sub-category (Comment index)
Scenic image for ancient cities	View image	Natural view
		Cultural view
	Culture image	Historical culture
		National culture
		Dietary culture

	Place image	Living environment
		Social environment
		Business environment

4.2 Analysis of perception characteristics for scenic image

In order to study tourists’ perception and emotional preference of the scenic image, this paper adopts R language to analyze the word frequency of collected tourists’ comments (see Table 2) . In addition, the network analysis of the correlation of high-frequency words is shown in Fig. 1, from which we can find the preliminary correlation between the collected comments.

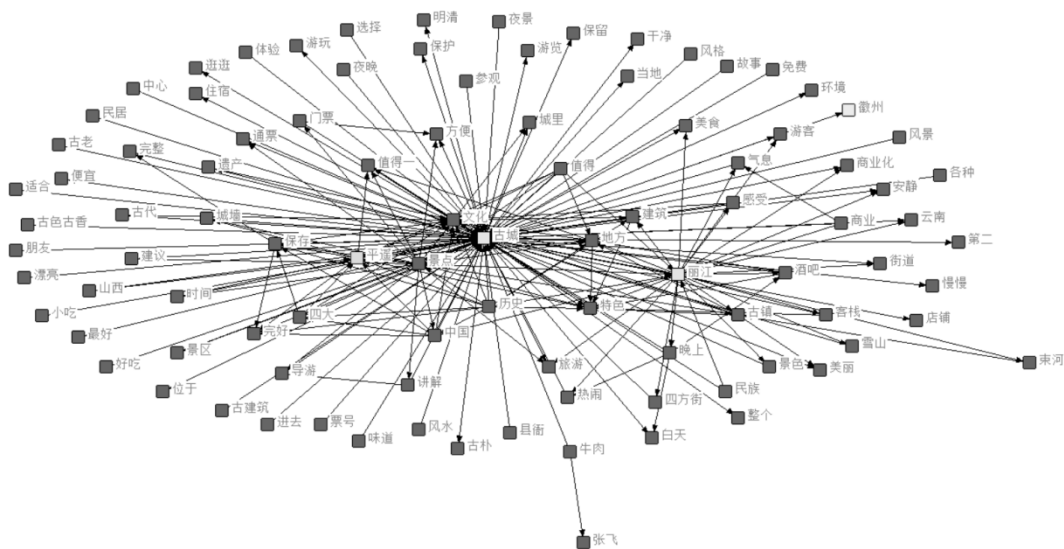


Fig. 1. Word frequency correlation network analysis

Table 2. Word-frequency for online comment texts

No.	Text	Word-frequency	No.	Text	Word-frequency	No.	Text	Word-frequency
1	Ancient city	8421	16	Night	4015	31	Downtown	2575
2	LiJiang	7644	17	Time	3988	32	Natural view	2499

3	Scenic spot	6788	18	Scenic area	3901	33	Snack	2344
4	PingYao	6532	19	HuiZhou	3764	34	Landscape	2318
5	Place	6501	20	Business	3686	35	Street	2301
6	Culture	6422	21	Bar	3542	36	Lively	2148
7	History	6215	22	Tour guide	3498	37	Taste	2078
8	Ancient town	6177	23	Retain	3315	38	Narration	1987
9	Worth	5987	24	Feeling	3277	39	Beef	1741
10	Feature	5889	25	Smell	3212	40	Beautiful	1735
11	Ticket	5322	26	Suggestion	3101	41	Delicious	1591
12	Convenient	4877	27	Tourist	3007	42	Local	1576
13	China	4812	28	City wall	2875	43	Antique	1361
14	Inn	4778	29	Suitable	2788	44	Travelling	1260
15	Building	4215	30	LangZhong	2719	45	Experience	1201

In order to obtain the index value of tourist satisfaction of the eight sub-categories of each ancient city, this paper first analyzes the core keywords of the tourist comments. The specific method is to decompose the keywords contained in each comment, delete the objective statement, and keep only the subjective statement until only one subject word is retained in each comment; Then, through artificial semantic analysis, tourist comments of each ancient city are judged and classified into the corresponding eight sub-categories. Further, according to tourists' different attitudes towards the scenic image, R language is used to divide the collected comments into three types: positive comments, neutral comments and negative comments. On this basis, fuzzy analysis and normalization methods are used to process the classification results of the comments. The weight of the three types of comments is set as 1 for positive comments, 0.5 for neutral comments and 0.1 for negative comments.

Accordingly, the tourist satisfaction index values of the eight sub-categories and the overall of the three sub-images can be obtained by the following three steps.

(1) Normalization of the initial values of satisfaction indexes for the eight sub-categories.

By assuming a_{ij} to be the value of satisfaction index of j index in i comment object, there are four comment objects in this paper (m ranging from 1-4). A is the initial satisfaction index matrix for the eight evaluation indexes (n ranging from 1-8), and A is expressed as:

$$A = \begin{pmatrix} \alpha_{11} & \cdots & \alpha_{m1} \\ \vdots & \ddots & \vdots \\ \alpha_{1n} & \cdots & \alpha_{mn} \end{pmatrix}$$

By normalizing values in matrix A , a new matrix A' can be obtained as:

$$A' = \begin{pmatrix} \alpha'_{11} & \cdots & \alpha'_{m1} \\ \vdots & \ddots & \vdots \\ \alpha'_{1n} & \cdots & \alpha'_{mn} \end{pmatrix}$$

Where the normalization function are:

$$\alpha'_{ij} = \frac{\alpha_{ij} - \min \alpha_{ij}}{\max \alpha_{ij} - \min \alpha_{ij}}$$

$$\alpha'_{ij} = \frac{\max \alpha_{ij} - \alpha_{ij}}{\max \alpha_{ij} - \min \alpha_{ij}}$$

The standardized values calculated in the A' matrix are the tourist satisfaction index values of the eight sub-categories as shown in the last four columns of [Table 3](#).

(2) Calculation of the information entropy for the eight sub-category indexes.

$$H_j = -k \sum_{i=1}^m p_{ij} \ln p_{ij}$$

Where $k = \frac{1}{\ln m}$ (k is Boltzmann constant, $k > 0$) and $p_{ij} = \frac{\alpha'_{ij}}{\sum_{i=1}^m \alpha'_{ij}}$.

(3) Determination of weight for the eight sub-category indexes, W_j .

$$W_j = \frac{1 - H_j}{\sum_{i=1}^n (1 - H_j)}$$

The values in parentheses below each sub-category are their respective weights as shown in the first column of **Table 3**. In combination with the weight and the corresponding satisfaction index value of each sub-category presented in **Table 3**, the overall satisfaction index E_{ij} can be expressed as:

$$E_{ij} = \sum_{i=1}^9 \alpha'_{ij} * W_j$$

The value of E_{ij} indicates the overall satisfaction of tourists for the scenic area. Larger values of E_{ij} represent higher satisfaction. The value of 1 means full satisfaction and the value of zero means total dissatisfaction. Finally, the weighted summation method is used to calculate the tourists' overall satisfaction of the four ancient cities. The results are shown in the last row of **Table 3**.

Table 3. Tourists' satisfaction index values for four ancient cities

Sub-categories	LiJiang ancient city	LangZhong ancient city	HuiZhou ancient city	PingYao ancient city
Natural view (0.1277)	1	4	3	2
	1.0000	0.0000	0.2989	0.6907
Cultural view (0.1169)	1	3	4	2
	1.0000	0.3825	0.0000	0.7435
Historical culture (0.1462)	1	3	4	2
	1.0000	0.0229	0.0000	0.4896
National culture (0.1875)	1	4	2	3
	1.0000	0.0000	0.8345	0.5333
Dietary culture (0.1041)	4	2	3	1
	0.0000	0.8851	0.6116	1.0000
Living environment (0.1011)	3	1	4	2
	0.4697	1.0000	0.0000	0.5876
Social environment (0.1111)	3	2	4	1
	0.4691	0.6003	0.0000	1.0000

Business environment (0.1045)	4	2	1	3
	0.0000	0.8706	1.0000	0.5419
Overall satisfaction index value	1	3	4	2
	0.6769	0.4079	0.2911	0.6739

5. Analysis of research results

Based on the results shown in [Table 3](#), LiJiang ancient city has the highest overall satisfaction index value. As compared with other three ancient cities, LiJiang ancient city ranks No.1 in the cultural view, historical culture and national culture. The excellent tourists' satisfaction in views and cultures for LiJiang ancient city can be confirmed by the content of most collected comments saying that the buildings are full of unique national styles and the social activities of local nations are very attractive. However, the dietary culture and business environment for LiJiang ancient city ranks No.4. Generally speaking, tourists are very sensitive to the local dietary style, especially in ethnic minorities areas. If the local dietary style is consistent with the tourists' daily life, the tourists' expectations will not be satisfied. Another issue of LiJiang ancient city is in its business environment. Low satisfaction index value of business environment is mainly reflected in the excessive marketing tricks in the scenic area, which severely disturbs the original appearance and feeling of the ancient city. Therefore, in order to consolidate tourists' high satisfaction with Lijiang ancient city, it is necessary to maintain its original style and avoid excessive commercialization.

PingYao ancient city ranks No.2 in the overall satisfaction index, which is only 0.003 lower than that of Lijiang ancient city. PingYao ancient city has highest scores in dietary culture and social environment, which confirms to its famous local characteristic of "lacquer, beef and long yam". Pingyao's good social environment is reflected in the fact that tourists can get along with new friends during their tour experience. It is worth mentioning that excessive commercialization is also an issue for PingYao, because it weakens the performance of the most unique national culture. This is why PingYao ancient city ranks only No. 3 in the national culture and business environment.

Langzhong ancient city ranks third in the general satisfaction index. Langzhong's fame cannot be compared with LiJiang and PingYao because of its inconvenient geographical location and lack of tourist routes. However, LangZhong's living environment, social environment and business environment are among the best. One of the problems facing LangZhong is that most of its interior architecture was rebuilt in 2013 in imitation of other architectural styles and lacks local features. Another problem is that the area and

infrastructure are not big enough to accommodate the number of potential visitors. These are the primary problems hindering the development of LangZhong ancient city.

HuiZhou ancient city in AnHui ranks No.4 in the overall satisfaction index. The major reason for this result is the serious homogenization of tourism market in southern AnHui. Coupled with fierce market competition and fewer tourist routes, HuiZhou ranks last. Among all eight sub-categories, only business environment ranks No.1. The local travel agent is supposed to focus on this feature and to promote it to the public so as to increase HuiZhou's competitiveness.

6. Strategies and suggestions

The rapid growth of tourism demand has brought about a broad development prospect for ancient cities. Meanwhile, it is essential for travel agents and relevant researchers to study how to exploit ancient cities in a protective way and how to promote outstanding and unique local products to attract more domestic and oversea tourists.

6.1 Reduce excessive commercialization of ancient cities.

It can be summarized from the above analysis that all four ancient cities are facing the issue of over-commercialization to some extent. Although commercialization can bring considerable profits to local residents and the government, it will also bring negative impact on the reputation of the scenic spot and affect the tourists' experience and acceptance of the particular area. In particular, due to the homogenization of marketing models and products, ancient cities are now losing their own features, which greatly reducing the tourists' experience and their feeling of local culture. Therefore, reducing over-commercialization of ancient cities is the most urgent strategy for the local government and relevant functional departments. The solution of this issue is closely related to whether the local tourism industry pursues short-term profits or long-term sustainable development.

6.2 Highlight local features and solve the problem of homogenization of tourist souvenirs.

It is a very common phenomenon that similar tourist souvenirs appear in almost all national scenic areas in China. The analysis results of this paper show that ancient cities scenic spots are also facing homogenization issue in tourist souvenirs. Tourist souvenirs play a very important role in all the tourism elements. Unique tourist souvenirs will not only bring tourists unparalleled shopping intention and pleasure, but also increase the local economic benefits. Therefore, local governments should collaborate with relevant research institutes to explore and create tourist souvenirs with regional culture. This will provide visitors with an

unforgettable shopping experience and increase the attractiveness of ancient cities.

6.3 Improve infrastructure construction and the quality of supervision and service.

The administrative departments should take measures to strengthen the supervision of market order and catering hygiene, so as to ensure the legitimate rights and interests of tourists and food safety. Secondly, the local government should improve the city's ability to deal with water pollution, air pollution and other kinds of pollution by speeding up the transformation of the old drainage system and air filtration system. In addition, the sanitary conditions should be improved to keep the city clean, even if some of the alleys are empty. Finally, considerate guides and adequate parking are also necessary to improve the convenience of visitors. At the same time, digital tour guides should play an important role in modern travel. In conclusion, the service quality of the tourism industry should be improved comprehensively to provide tourists with a satisfactory tourism environment.

6.4 Enhance advertisement of tourism in ancient cities.

China is an ancient country with a splendid culture of five thousand years. The ancient city is the epitome of Chinese culture, which is the best tourism features of the ancient city. The analysis results of the fourth part show that the advertisements of Lang zhong and Huizhou are not enough to extend their influence to the whole world. Therefore, the local government and the tourism department should use different forms such as the Internet, new media, tourism investment activities and unique regional celebrations to publicize the tourism characteristics of the ancient city, so as to attract more tourists and further promote the tourism development of the ancient city.

7. Conclusions and discussion

This paper investigated the tourists' perception generated from different dimensions of scenic image by using 'cognitive - affective' model as theoretical foundation. Four ancient cities in China were taken as study cases. This study analyzed the tourist comments collected on the Internet and compared the scenic images in different cities. The conclusions obtained in this paper are as follows:(1) The scenic image is a complicated concept, which contains multidimensional aspects. This paper divided it into view image, culture image and place image. The view image reflects the tourists' understanding and imagination of the characteristics of natural and cultural view. The culture image is tourists' imagination for historical culture, national culture and dietary culture of the scenic areas. The place image consists of tourists' perception and imagination of living environment, social environment

and business environment. It is worth mentioning that the total weight of historical culture and national culture accounts for 33%, which indicates that these two types of images are very important for tourists to visit scenic ancient cities. In this case, the development department should take actions to improve the exhibition performance of historical and national culture. (2) The scenic image is established by tourists' subjective emotions. During this process, the different cognition and affection generated by tourists will affect the reputation of the scenic area and the willingness to revisit the area. In the increasingly competitive tourism market, providing suitable and pleasant tourist routes and services can make tourists show positive cognition and affection towards the scenic spot, which is the basis for tourists to identify with and form dependence on the scenic spot.

However, there are still some limitations in this paper. The first limitation is the sample selection and pre-processing stages. The data used in this paper are mainly collected from three tourism websites. The data filtering process is still influenced by the author's subjective judgment to some extent. The second limitation is that this paper only classifies the collected comments in terms of content and semantics when calculating the weight, and does not classify them in the time domain. Based on these discussions, we can study the construction of tourist destinations image from more specific dimensions and further explore the relationship between the formation and dissemination of scenic image.

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