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Research on "Identification–Cognition–Perception" of the Pedestrian Spaces Around Subway Stations near Popular Tourist Attractions from the Tourists' Perspective: A Case Study of Tianjin

Weiwei Liu [1,2,*], Jianwei Yan [1], Xiang Sun [3] and Ruiqi Song [2]

[1] School of Architecture, Tianjin University, Tianjin 300072, China; yanjw22@tju.edu.cn
[2] School of Architecture, Tianjin Ren'ai College, Tianjin 301636, China; 223044@tjrac.edu.cn
[3] School of Art & Design, Tianjin University of Technology, Tianjin 300384, China; sxlvv@email.tjut.edu.cn
* Correspondence: lww2019@tju.edu.cn; Tel.: +86-158-2290-2005

Abstract: Public transportation serving urban tourism has a positive impact on sustainable urban development. With the rapid rise of "subway tourism" in China and the emergence of numerous popular attractions, the pedestrian spaces connecting subway stations and attractions are important public spaces for tourists' perception. Identifying, cognizing, and perceiving the pedestrian spaces around subway stations near popular tourist attractions from the tourists' perspective holds significant value for promoting station–city coordination and enhancing spatial quality. This paper establishes an optimization design framework for the pedestrian spaces around subway stations near urban popular tourist attractions, moving from identification to cognition and perception. Taking Tianjin, China as an example, we collected 11,405 travelogue data entries and street network data of the subway stations around popular attractions. (1) We constructed an LDA topic model to identify popular tourist attractions; (2) we applied space syntax to understand the features and forms of the pedestrian spaces around subway stations; (3) we utilized the ROST-CM network text analysis method to analyze tourists' overall perception of the pedestrian spaces around subway stations; (4) we proposed suggestions for optimization. The contribution of this study lies in constructing a vertical analytical framework that transitions from "identification" to "cognition" to "perception". The cognitive and perceptual dimensions can mutually corroborate some of their findings but are not interchangeable. Future urban spatial optimization research should consider both cognitive and perceptual dimensions, enhancing the comprehensiveness of the human-centered perspective. The research results provide empirical references and guidance for the management and practice of urban space renewal around subway stations near major cities' tourist attractions.

Keywords: pedestrian spaces around subway stations; popular attractions; identification–cognition–perception; LDA topic model; space syntax; network text analysis

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Academic Editors: Pasquale De Toro, Francesca Nocca, Martina Bosone and Francesca Buglione

Received: 21 December 2024
Revised: 7 January 2025
Accepted: 10 January 2025
Published: 12 January 2025

Citation: Liu, W.; Yan, J.; Sun, X.; Song, R. Research on "Identification–Cognition–Perception" of the Pedestrian Spaces Around Subway Stations near Popular Tourist Attractions from the Tourists' Perspective: A Case Study of Tianjin. *Land* **2025**, *14*, 145. https://doi.org/10.3390/land14010145

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1. Introduction

The deep integration of urban public transportation and tourism is a rigid pathway to meet the diverse travel needs of the public and an inevitable measure to promote high-quality urban tourism development. With the accelerated expansion of subway coverage and its deeper integration into daily life, the subway not only serves as a vital transportation backbone for the city but has also become an important part of people's lives. In the context of urbanization, daily life, and diverse demands for tourism, phenomena such as "taking

the subway to tour Xi'an" and "taking the subway to tour Beijing" have emerged as popular trends in China. Meeting the high-quality demands for subway station areas near tourist attractions in this new era, facilitating the construction of "tourism cities on subways", and creating shared spaces for local residents and tourists have become important propositions for fueling China's new urbanization efforts.

As of the end of December 2023, there are a total of 59 cities in mainland China with urban rail lines measuring 11,232.65 km, and the total passenger volume for the year exceeded 29 billion trips. During the 2023 Mid-Autumn Festival and National Day Holiday, due to the surge in tourist traffic, the passenger volume of urban rail transit reached 628 million trips, with a daily average of 66.5163 million trips, reflecting a year-on-year increase of 56.07%. This indicates that subway has become a backbone transportation system with high capacity for urban tourism in China. In the new era, the widespread dissemination of new sharing social media has led to the emergence of experiential leisure districts and "City Walk" old town streets as popular tourist attractions, providing key opportunities for the convenience of public tourism through subway transportation. However, the development of the space environment around subway stations in popular attractions poses significant challenges, including safety during peak holiday passenger flow, poor connections between subways and tourist attractions, inadequate transitional environments, mismatched demand, low service quality within stations, and a lack of tourism culture in station areas.

Therefore, this paper aims to adopt a human-centered perspective, following the "cognition–emotion" theory and the logic of spatial perception, to construct a theoretical framework for the "identification–cognition–perception" of pedestrian spaces around subway stations in urban tourist attractions. It will establish a technical route to explore renewal pathways for pedestrian spaces around subway stations in popular tourist locations, providing strategic recommendations for the high-quality development of urban transportation and tourism integration. Section 2 describes the conceptual framework. Section 3 introduces the analysis methods and an overview of case studies. The results, discussions, and suggestions are presented in Sections 4 and 5, with conclusions drawn in Section 6.

2. Literature Review

2.1. Research on the Identification of Urban Spaces Around Popular Tourist Attractions

Recently, social media has become a powerful data platform for academia when researching certain public-related issues. The commentary data on these platforms contain insights into public attitudes, which can be leveraged to explore the public's enthusiasm for urban spaces, thereby identifying popular urban areas.

Research related to the identification of urban spaces mainly focuses on two aspects: First, utilizing social media data to identify the characteristics of urban spaces. Sueda K. et al. generated visual "city images" through nickr photos and tags [1]. Liu Yong extracted geographical tags from travel images on Flickr, Picaso, and Panoramic to identify popular tourist attractions [2]. Chen Ning et al. explored popular tourist attractions in Beijing through Flickr [3]. Jiang Zhuoyu investigated the spatiotemporal distribution of attractions in Changsha using Weibo and POI data [4]. Al-Kodmany, K. visualized location data from social media platforms (Twitter, Facebook, and Instagram) as heatmaps to identify the most popular areas in Chicago [5]. Martí, P. et al. [6] and Nolasco-Cirugeda, A. et al. [7] combined Instasights heatmaps with social media data (Foursquare, TripAdvisor, Google Places, Twitter, Airbnb) to identify the most popular tourist areas in the Spanish Mediterranean Arc and Bucharest, respectively. Second, exploring the public's perception of urban spaces. Ren X., Song M., E H et al. proposed a five-dimensional Twitter-latent Dirichlet allocation (SM-Twitter LDA) model that integrates text, images, location, time,

and tags [8]. Ferrari L., Rosi A., Mamei M. et al. employed the LDA model to analyze Twitter text data and extract popular tourist attractions [9]. The above research confirms that social media data are gradually gaining importance among scholars, being utilized to identify popular urban spaces and perceptions of those spaces.

2.2. Cognition and Perception Study of Pedestrian Spaces Around Subway Stations

There is no unified and clear definition of pedestrian spaces around subway stations in academia. In the 1990s, Peter Calthorpe officially proposed the theory of "transit-oriented development", which addresses key issues such as walkability in station areas, street networks, and public spaces [10]. Xu Leiqing and others believe that pedestrian spaces around station areas are a system that includes the public spaces of subway stations and the indoor and outdoor public spaces directly connected to the walkable urban areas within the station area [11]. In this paper, pedestrian spaces in station areas primarily focus on the above-ground urban spaces within the station area, specifically the pedestrian public spaces connecting the station to attractions.

Current research primarily includes two aspects. First, it focuses on the influencing factors and spatial characteristics of pedestrian spaces. Reid Ewing proposed 23 design features that are "pedestrian- and transit-friendly" [12]. Chen Yanping et al. suggested that the pedestrian system in station areas must consider both spatial and temporal continuity [13]. Huang Yuangang found that the density and connectivity of the pedestrian network are the main influencing factors for pedestrian activities [14]. Pilgrim, C. A. et al. used the Blue Line Light Rail Transit station areas in Minneapolis as a case study to reveal pedestrian experience factors related to land use [15]. Second, it explores the experiences related to pedestrian spaces in station areas. John Zacharias et al. revealed that accessibility, safety, and comfort influence the walking experience through their analysis of Shinjuku Station [16] and Tokyo Station in Japan [17], as well as stations in Bangkok, Thailand [18]. Alfonzo argued that the demand for walking includes passability, accessibility, safety, comfort, and enjoyment [19]. Chen Yong et al. considered convenience to be a key indicator of pedestrian accessibility in station areas [20]. Chu Dongzhu et al. summarized the design goals for urban station areas, which include safety, efficiency, comfort, and enjoyment [21]. Agrawal A.W. revealed that convenience, safety, comfort, and enjoyment rank from high to low in importance [22]. It is evident that the cognition and perception studies of pedestrian spaces around subway stations have garnered sustained attention from scholars, accumulating a wealth of findings that provide an important foundation for this research.

2.3. Gaps and Aims

The pedestrian spaces around subway stations remain an important research area in urban design and environmental behavior, gradually showing a trend of interdisciplinary integration with planning, sociology, and psychology. Scholars are increasingly focusing on exploring the mechanisms that connect the public with pedestrian spaces and prioritizing the design of pedestrian-friendly areas in the revitalization of tourist cities [23,24]. Moreover, with the rise of social media, which offers relatively authentic data, it has become an important reference for studying urban tourism and experiential perception. However, based on existing research subjects and data samples, studies on pedestrian spaces around tourist attractions near subway stations are still limited, and the connection mechanisms between these spaces and visitors remain unclear, necessitating extensive empirical analysis and data conclusions.

In summary, this paper aims to explore the identification, cognition, and perception of pedestrian spaces around popular tourist attractions from the tourists' perspective, focusing

on the interaction between the characteristics of these spaces and tourists' subjective perceptions. The key questions addressed include:

1. How can social media data be used to identify popular urban tourist attractions?
2. How do we understand the features of pedestrian spaces?
3. What are tourists' subjective perceptions of pedestrian spaces, and is there coherence or divergence between spatial cognition and subjective perception?

Therefore, the main purpose of this paper is to empirically study the comprehensive experiential logic of visitors regarding the pedestrian spaces around subway stations near popular tourist attractions. It draws on Walter Mischel's cognitive–affective processing system (CAPS) theory, which posits that certain cognitive and emotional characteristic patterns are activated when individuals face specific situations, ultimately influencing their behavioral choices [25]. The CAPS theory effectively reveals the generative logic among cognition, emotion, and behavior, providing a theoretical foundation for exploring visitors' cognition and perception of the pedestrian spaces around subway stations near tourist attractions.

This study establishes a theoretical framework of "identification–cognition–perception" for pedestrian spaces around subway stations near popular tourist attractions. Here, "cognition" refers to the interaction between tourists' subjective mental activities and the objective spatial environment, i.e., the individual and the environment constitute the cognitive system. Based on spatial cognitive abstraction and spatial configuration analysis, space syntax reveals spatial autonomy and the relationship between space and society, represented through metrics such as accessibility, transitivity, and intelligibility. "Perception" is formed through the experiences and emotions arising from the comprehensive interactive process during pre-travel planning and post-travel evaluation, characterized by three types of emotional attributes: Positive, neutral, and negative. "Cognition" and "perception" are the dual dimensions of tourists' comprehensive experience of subway station areas near urban popular attractions. However, they are not isolated; rather, they are bidirectionally interactive and integrative. Perception depends on cognition, while cognition influences perception, forming a dynamic cyclical system. By synthesizing tourists' cognition and perception of pedestrian spaces around subway stations near popular attractions, this study explores their consistency and differences, proposing renewal strategies to contribute to "human-centered" urban development. The details are illustrated in Figure 1.

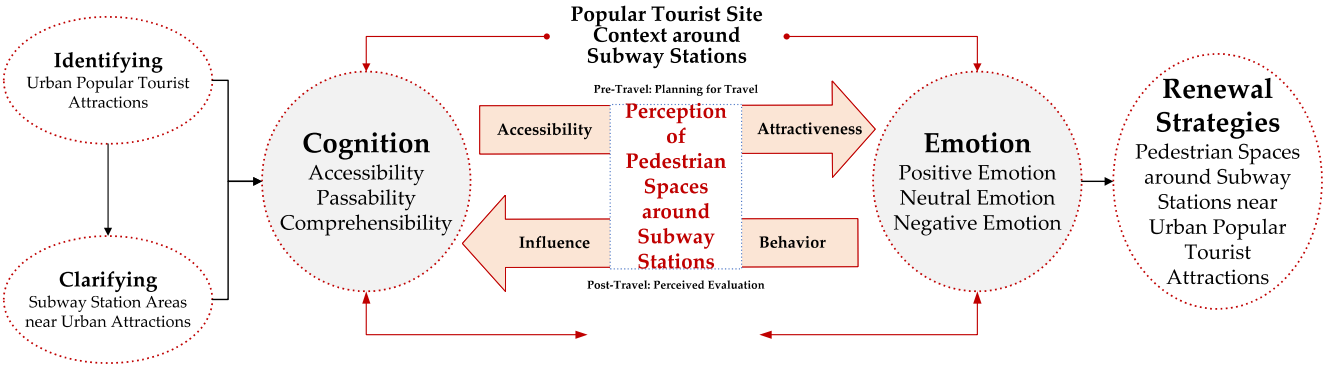


Figure 1. The "identification–cognition–perception" theoretical framework for pedestrian spaces around subway stations near urban popular tourist attractions.

3. Methods and Data

This research targets Tianjin, detailing the methodology pathway (Figure 2). First, popular tourist areas were identified and the research scope of subway station areas was determined. Using Python tools, social media text data from Xiaohongshu with the

keyword "Tianjin tourism" were collected to construct an LDA topic model, identifying subway station areas near popular tourist attractions. Second, the cognition of pedestrian spaces in these subway station areas was analyzed. Based on OSM pedestrian network data, space syntax was applied to examine the cognitive characteristics of pedestrian spaces through integration, choice, synergy, and intelligibility. Third, the perception of pedestrian spaces in subway station areas near popular tourist attractions was explored. Using social media data, the ROST-CM network text analysis method was employed to construct a social semantic network and analyze tourists' emotional perception of these spaces. Finally, the consistency and differences between the cognition and perception of pedestrian spaces in these areas were analyzed. Based on the findings, renewal strategies for pedestrian spaces in subway station areas near popular tourist attractions are proposed to enhance experience and quality.

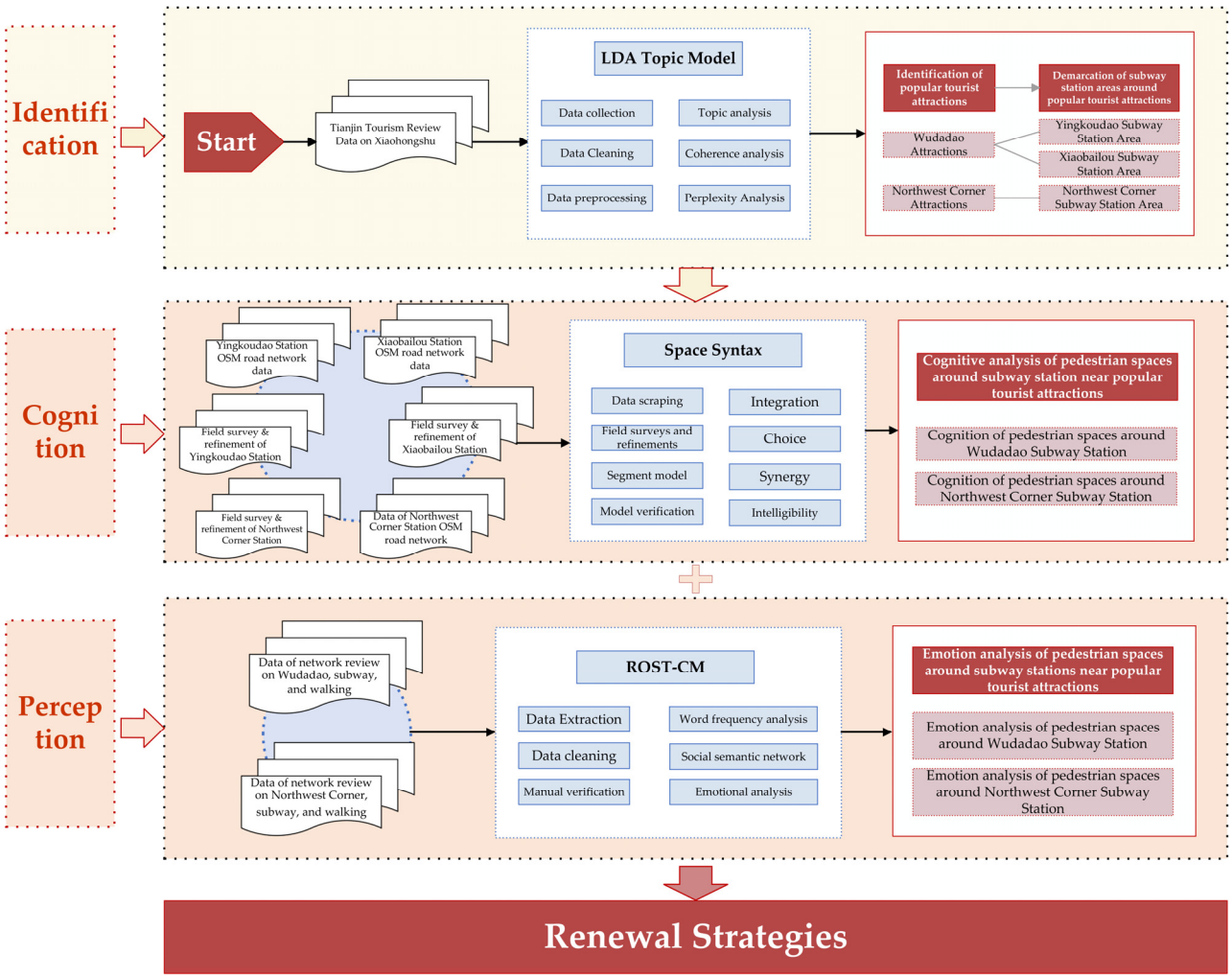


Figure 2. Methodology and pathway of the research.

3.1. Methods

3.1.1. LDA Topic Model

Latent Dirichlet allocation (LDA) serves as a key model for unsupervised topic extraction in text analysis [26] (Figure 3). LDA can reveal unobserved information based on observed data. It has been widely applied in natural language processing, and Blei et al.'s work provides more technical details. It utilizes the Gibbs sampling algorithm to estimate parameters and employs perplexity and topic coherence to identify the best number of topics. Typically, lower perplexity values and higher topic coherence suggest a better fit for

the model. Presently, LDA techniques have been applied in fields like tourist needs [27], customer satisfaction [28], and the spatial preferences of visitors [29].

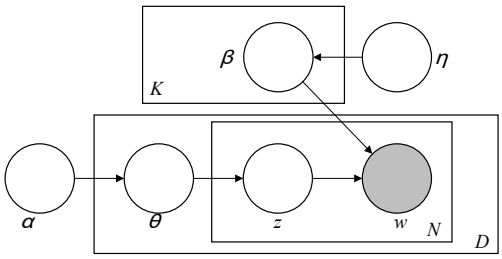


Figure 3. Internal mechanism of LDA topic analysis.

The boxes are "plates" representing replicates. The outer plate represents documents, while the inner plate represents the repeated choice of topics and words within a document. Here, α and β are given parameters, θ represents the joint distribution of topic mixtures, z is a set of N topics, and w is a set of N words. This research employs Python tools to gather travel narratives about "Tianjin tourism" from Xiaohongshu, detailing four steps: Data collection, text pre-processing, optimal topic number determination, and LDA model construction (Figure 4). It extracts latent thematic information from extensive text data. Referring to the study by Haijing Hao et al., for the hyperparameters (parameters of a prior distribution) of the Dirichlet prior, alpha is set to a default value of 0.1, and beta is set to 0.01 [30], to identify popular tourist attractions.

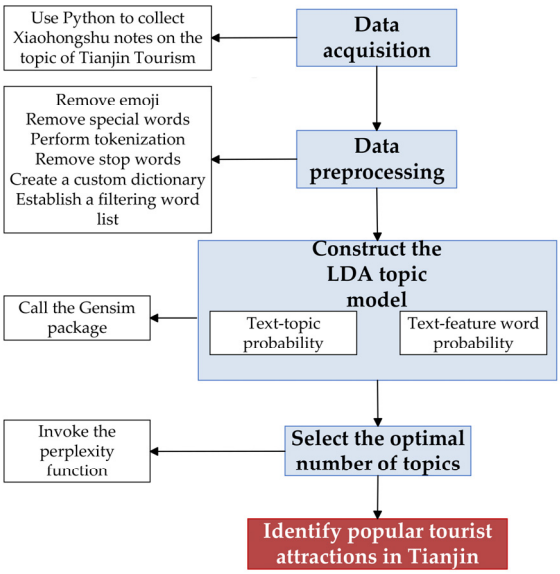


Figure 4. LDA topic model construction.

① Topic Perplexity

If the cosine similarity between topics declines with an increasing number of topics, it may indicate an over-clustering problem. To address this, perplexity is utilized as a metric [31], as shown in Formula (1).

$$\text{Perplexity} = \exp\left\{-\frac{\sum_{d=1}^{M}\log p(w_d)}{\sum_{d=1}^{M} N_d}\right\} \quad (1)$$

Here, $p(w_d)$ represents the probability of each word in the test set, and N_d denotes the total number of words in the test set. A lower perplexity score indicates a higher predictive capability of the model.

② Topic Coherence

To assess the interpretability of topics, researchers such as Mimno et al. introduced the concept of topic coherence. This measure posits that if a topic is easier to explain, the top words within that topic will appear more frequently in the corpus documents [32]. This relationship is expressed in Formula (2).

$$C_k = \sum_{m=2}^{M} \sum_{l=1}^{m} \log \frac{D\left(v_m^k, v_l^k\right) + 1}{D\left(v_l^k\right)} \quad (2)$$

In this context, $V^k = (v_1, \ldots, v_m{}^k)$ represents the list of the top M words in topic k. $D(v)$ denotes the number of travel notes containing the word v, while $D(v, v')$ indicates the count of reviews where words v and v' appear together at least once.

3.1.2. Space Syntax Analysis

In the 1970s, Hillier developed space syntax as a quantitative approach to describe urban form based on topological relationships. This methodology enables the scaling and segmentation of space, facilitating a rational exploration of the relationship between people and their environment [33]. It has found extensive applications in planning and urban spatial structure, such as urban traffic accessibility [34,35] and land use configurations [36,37]. This research utilizes OSM maps and field studies, integrating Depthmap-Beta 1.0 software to create axial maps and conduct calculations. The analysis focuses on parameters including integration, choice, synergy, and intelligibility. Integration measures the ability of a space to attract traffic as a destination, reflecting its centrality within the entire system, and can be used to represent the accessibility of subway station areas near popular tourist attractions. Choice examines the advantage of a spatial unit as the shortest travel path, reflecting the likelihood of it being traversed. It can be used to represent the transitivity of pedestrian spaces in subway station areas near popular attractions. Synergy explores the relationship between global and local integration, measuring the coordination between local space and overall space within the subway station area. Intelligibility examines the correlation between global integration and connectivity, evaluating whether local spaces within the subway station area can be used to understand the overall spatial structure. Therefore, a comprehensive quantitative analysis of these metrics enables a thorough and effective exploration of tourists' "cognition" of pedestrian spaces in subway station areas.

3.1.3. ROST-CM Emotion Analysis

ROST Content Mining (hereinafter referred to as ROST-CM) is a digital humanities research platform designed and coded by Professor Shen Yang from Wuhan University. This platform can analyze textual information for word frequency, clustering, classification, emotion, etc., allowing for the induction of persuasive general conclusions from digitized materials. This study collects and pre-processes textual data from Xiaohongshu on "Tianjin tourism", resulting in a corpus for analyzing perceptions of pedestrian spaces around popular subway stations. Using ROST-CM 6.0, we perform word segmentation on the selected texts, conduct word frequency analysis, and derive perception dimensions of pedestrian spaces around subway stations, followed by semantic network and emotion analysis.

3.2. Study Area Characteristics

Tianjin is one of China's four centrally administered municipalities, the largest coastal open city in the north, a national historical and cultural city, and one of the first excellent tourist cities in China. The six districts of Tianjin (Heping, Nankai, Hexi, Hedong, Hebei, and Hongqiao) are centers of urban tourist attractions and have a well-established subway network.

Rich in cultural tourism resources, Tianjin was recognized as an excellent tourist city in 1998 and currently boasts four national-level leisure districts and 103 A-level attractions, showcasing its deep cultural heritage and unique Tianjin culture. As the second city in China to operate a subway, Tianjin has a well-developed rail network, with nine operational lines covering 298.3 km and 181 stations as of December 2023. In 2024, during the May Day Holiday, the city welcomed 14.0786 million tourists, generating a tourism revenue of CNY 12.21 billion, with a peak subway ridership of 2.1 million on that day, particularly around popular attractions. Tianjin exemplifies typical and representative features in both urban tourism and subway development.

3.3. Data Collection and Pre-Processing

3.3.1. Online Text Data

In this research, we take into account the audience, coverage, and quantity of reviews on social media, choosing Xiaohongshu to gather online text data. Xiaohongshu is a leading sharing-based social media platform in China, encompassing a wide range of lifestyle topics. By January 2023, the platform had more than 350 million users who create billions of posts each day. The study employed Python to search for travel reviews related to "Tianjin tourism" from March 2018 to December 2023, resulting in the collection of 11,405 reviews and a total character count of 4.4 million. The data were cleaned and organized, with duplicate and irrelevant reviews removed manually, and adjustments made to internet language. This process yielded 10,056 valid reviews.

Pre-processing the data is essential for minimizing noise and enhancing model fitting. The process, using Python's NLP toolkit (www.nltk.org), consists of six steps: ① Removing emojis and emoticons. ② Deleting special characters and tags (such as "!", "@", "%", "&", "?") [38]. ③ Particle processing; performing tokenization to convert text into word vectors. ④ Removing stop words like "the", "and", "is", as well as repetitive words such as "Tianjin", "strategy", and "records". ⑤ Creating a custom dictionary for attractions, locations, and tourism activities, including terms like "Wudadao", "Northwest Corner", "Former Residence of Zhang Xueliang", and "Tianjin Eye". ⑥ Compiling a filter list of words; compiling a filter list of unrelated words like "we", "but", "and then", and "still" that do not relate to tourism in Tianjin.

3.3.2. Walking Network Data

In conjunction with OpenStreetMap (OSM), we obtained walking network data for the tourist attractions surrounding subway stations. Through a detailed comparison and integration of relevant planning materials and field surveys, we determined the walking range for popular attractions in Tianjin, specifically covering the area within a 25 min walk from both attractions and subway entrances. Using AutoCAD for visualization, we constructed an axial diagram by employing the least number of longest axes to navigate through the street space. We interrupted the axes at their intersections to create a line segment diagram [39], forming a space syntax axial model for the neighborhood roads, which will lay the groundwork for further analysis with the space syntax software Depthmap.

4. Results

4.1. Identification of Pedestrian Spaces Around Subway Stations near Popular Attractions

4.1.1. Optimal Number of Topics

To ensure that the topic modeling results are more scientific and objective, we adopted a combined approach of topic coherence and perplexity to determine the optimal number of LDA topics. Topic coherence evaluates the semantic association of words within the same topic to determine the number of topics. Higher coherence indicates stronger semantic connections among words within a topic, resulting in better topic model identification performance. Perplexity, on the other hand, is a deterministic evaluation metric for distinguishing topics within the model. It reflects whether the model is applicable to new samples and whether it can correctly differentiate topic divisions. A lower perplexity score indicates that the model structure is more stable, with relatively lower expected error values. However, conclusions drawn from topic coherence and perplexity often differ. Relying solely on one method to determine the optimal number of topics may result in biased topic number extraction. Therefore, we consider topic coherence and perplexity metrics to determine the optimal number of topics. This balances the depth and breadth of topics, ensuring selecting the most appropriate topic number. The computations were conducted using Python and the Gensim package.

First, keywords from the literature were extracted to form the experimental corpus. Then, using the Gensim library in Python, the experimental corpus was vectorized through counting methods. The functions *ida*.perplexied() and *ida*.coherence() are called to calculate perplexity and coherence, with input parameters set as $\alpha = 0.1$, $\beta = 0.01$. The number of iterations for Gibbs sampling is set to 100, and topics ranging from 0 to 10 are evaluated. Using the Python visualization tool LDAvis, it can be observed that when the topic number is set to 4, the coherence score is the highest (Figure 5), while perplexity is on a downward trend (Figure 6). Compared with manual evaluation, it was found that a topic number of 4 contains sufficient information, which is better than the case with 5 topics. Thus, this study determines the optimal number of topics to be 4.

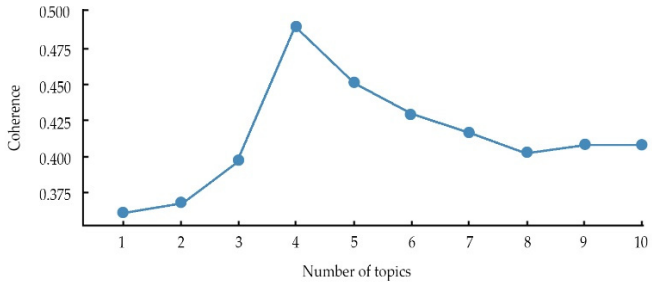


Figure 5. Assessment on topic coherence.

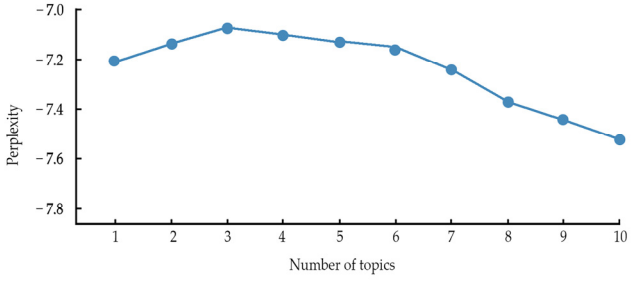


Figure 6. Assessment on topic perplexity.

4.1.2. LDA Topic Model Construction

According to the results of topic coherence and perplexity, LDA topic clustering was applied to 10,056 valid reviews. The resulting LDA topic model is presented in Table 1, revealing four topics, each characterized by the ten most significant words. The analysis identifies four topics: Urban architecture, food, events, and tour. Topic 1, urban architecture, encompasses landmarks such as Wudadao, the Porcelain House, museums, and the Tianjin Eye, indicating tourists' awareness of the city's architectural landscape. Topic 2 highlights food, showing that cuisine in the Northwest Corner is well-loved by visitors. Topic 3 pertains to events, including New Year's celebrations, fireworks, and light displays. Finally, Topic 4 relates to tour, as the Cool Docks, Seagull, and Tanggu emerge as popular tourist attractions due to Tianjin's location by the Bohai Sea.

Table 1. Probability distribution of topics—feature words.

Topic 1	**Probability**	**Topic 2**	**Probability**
Wudadao	0.016	Snack	0.029
Street	0.010	Delicious	0.015
The Porcelain House	0.009	Delicacy	0.013
Museums	0.007	Northwest Corner	0.009
The Tianjin Eye	0.007	Buy	0.007
Architectures	0.007	Taste	0.005
The Century Bell	0.006	Specialty	0.005
Square	0.006	Guoba dish	0.005
Ancient Culture Street	0.005	Scout the store	0.005
Zhang Xueliang's Former Residence	0.005	Carbon water	0.004
Topic 3	**Probability**	**Topic 4**	**Probability**
New Year's Eve	0.015	Seagull	0.013
Haihe River	0.008	Hotel	0.011
Fireworks	0.007	Park	0.007
Taking photos	0.007	The Cool Docks	0.006
Christmas	0.006	For free	0.005
Show	0.005	Tianjin Station	0.005
Countdown	0.005	Tour	0.004
Scout the store	0.005	Seaside	0.004
Lighting	0.004	Tanggu	0.004
New Year's Day	0.004	Coast	0.004

4.1.3. Identification of Popular Attractions and Subway Station Areas

Analysis of the LDA topic model results indicates that tourists have a strong impression of the architectural beauty and cuisine in Tianjin, which are reflected in Topic 1 and Topic 2. The two most popular areas identified are the Wudadao Cultural Tourism Area and the Northwest Corner Specialty Food Street. Subsequently, we selected subway stations within a walking distance of 1500 m from these attractions: Yingkoudao Station and Xiaobailou Station (the Wudadao Cultural Tourism Area) and Northwest Corner Station (the Northwest Corner Specialty Food Street), as shown in Figure 7. These stations are the focus of this study.

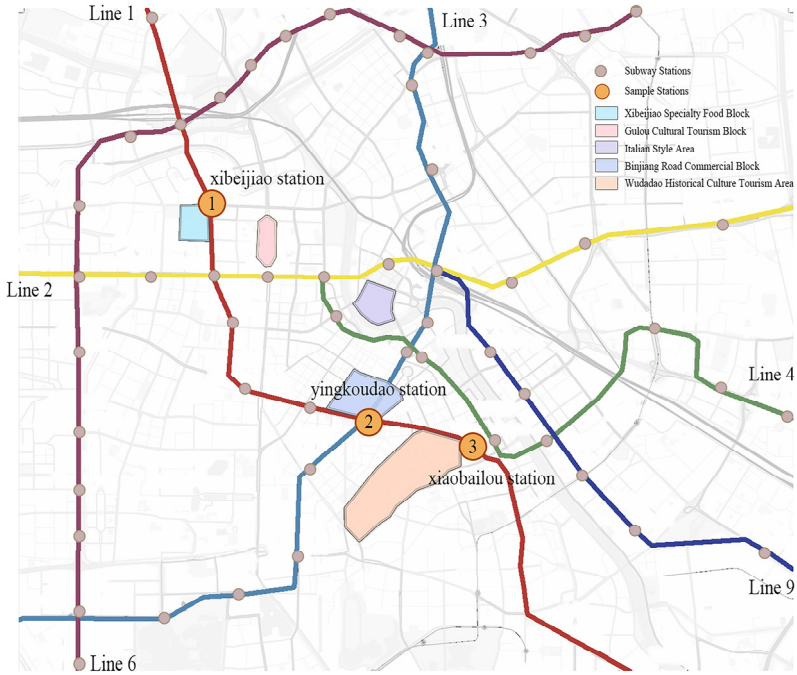


Figure 7. Location of the three sample subway stations in Tianjin City.

As shown in Figure 7, the Northwest Corner has developed into a scaled specialty food street in Tianjin, primarily featuring Hui cuisine, including popular dishes such as jianbing guozi (a type of Chinese crepe), erduoyan zhagao (fried rice cakes), and beef pancakes. This area has become a hub for tourists to experience authentic Tianjin flavors and is recognized as a newly popular attraction in the city. The Wudadao Cultural Tourism Street is located in the Heping District of Tianjin, enclosed by five roads: Chengdu Road, Nanjing Road, Machang Road, Xikang Road, and Guizhou Road. This area is home to 2185 buildings of various architectural styles, collectively referred to as the "World Architecture Expo".

4.2. Cognition of Pedestrian Spaces Around Subway Stations at Popular Tourist Attractions

4.2.1. Integration

This study employs a segment map for indicator analysis. Integration is the ratio between the theoretically maximum generalized distance and the generalized distance from a specific segment to all other segments. It describes how far a street segment is from other segments and measures the spatial potential of reaching that street segment [40].

Therefore, integration is used to measure the accessibility of a space, reflecting its attractiveness and regional status within the urban area. The higher the integration, the stronger the centrality, clustering, and accessibility. In the analysis of integration axis lines, the color transitions from red to blue, where warmer colors indicate higher integration, as shown in Table 2. In this figure, the red dots represent subway stations (Yingkoudao Station and Xiaobailou Station).

Nodes with higher global integration significantly influence the region to a certain extent. According to the analysis results in Table 2, the pedestrian space in the northwest of the Wudadao Attractions has a higher global integration. The integration core (the axis lines with top 5% integration ranking from high to low) is primarily distributed along Nanjing Road, Xinhua Road, Yingkou Road, and Guizhou Road, indicating strong connectivity and accessibility on these roads, which mainly facilitate traffic dispersal. The major thoroughfares within the attractions also feature high integration. From the exits of Yingkoudao Station (B3, C2, C3) to Wudadao District, Cangwu Road, Yueyang Road, and Xi'an Road (Figure 8) demonstrate high accessibility, while Tongguan Road has lower

accessibility. From the exits of Xiaobailou Station (A, C) back to Wudadao District, Machang Road and Chongqing Road show high accessibility, whereas Zhengzhou Road (Figure 9) has lower accessibility, indicating that the likelihood of tourists reaching this location is relatively low.

Table 2. Global and local integration of pedestrian spaces around subway stations near popular tourist attractions.

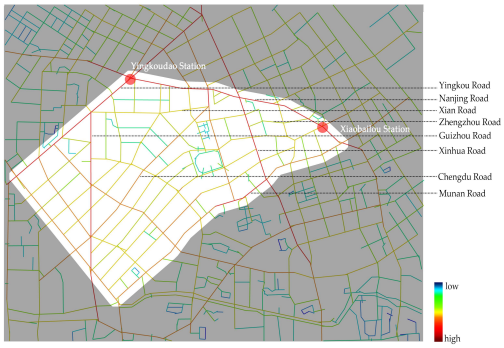
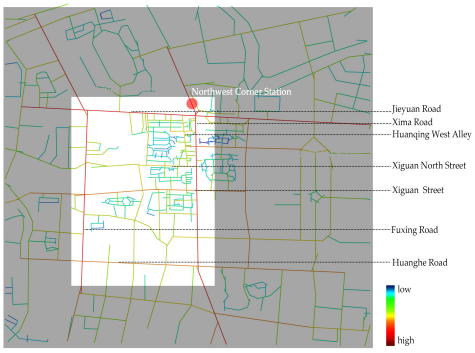
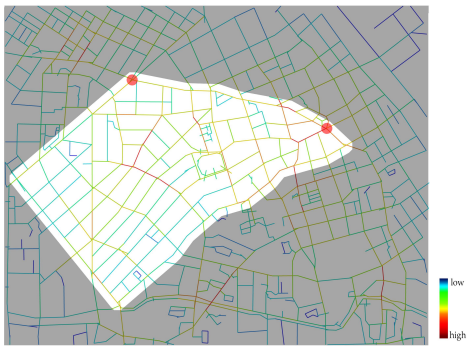
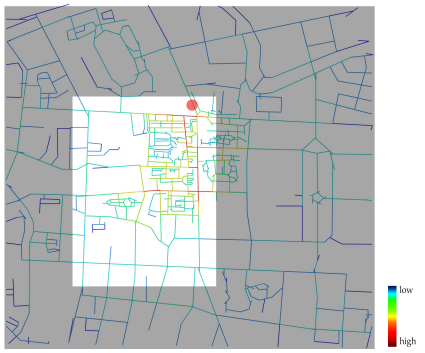
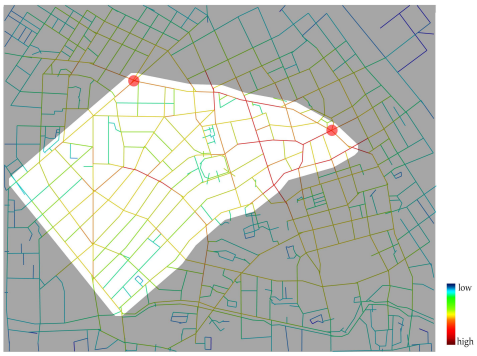
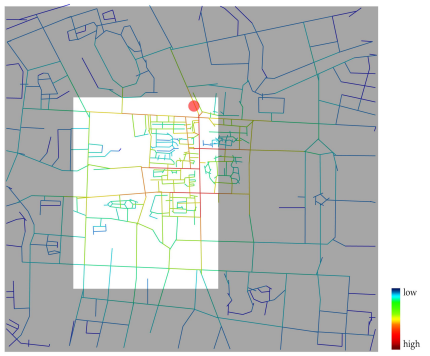
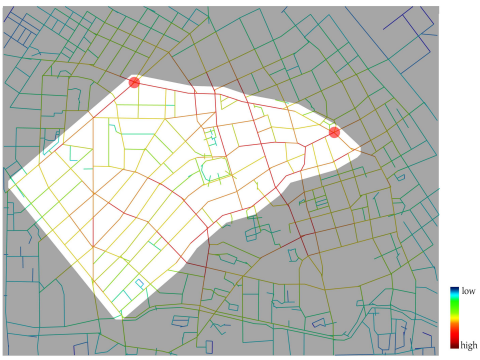
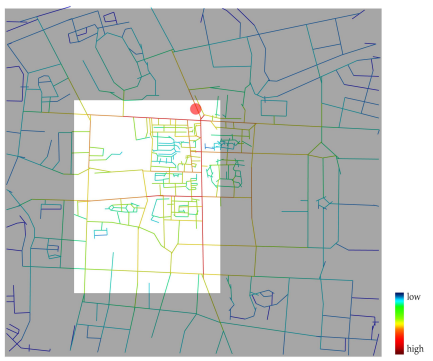
	Subway Station Area Around Wudadao Attractions	**Subway Station Area Around Northwest Corner Attractions**
Global integration		
Integration of *R*400		
Integration of *R*800		
Integration of *R*1200		



Figure 8. Xi'an Road of high accessibility.



Figure 9. Zhengzhou Road of low accessibility.

The main thoroughfares within the subway station area of the Northwest Corner Food Street are all regions with high integration (as shown in Table 2). The highest global integration is found along the transportation corridors of Jieyuan Road, Xima Road, Fuxing Road, and Huanghe Road. From Exit C of the Northwest Corner Station to the food street, Xima Road (Figure 10) has high accessibility, while Xiguan North Street (Figure 11) and Huanqing West Alley (Figure 12) have lower levels of accessibility. This area is primarily a residential zone, predominantly occupied by local residents, with many food shops serving as neighborhood businesses. This setup differs from traditional commercial street patterns and limits its role in tourism.



Figure 10. Xima Road.

By analyzing the pedestrian spaces around the station areas of two popular attractions, it can be observed that the integration within the station areas exhibits a ring-like distribution, radiating inward and outward from the city's main thoroughfares. The inward radiating pathways primarily serve tourists and local residents, with a medium level of accessibility; the further away from the center, the lower the integration and accessibility, primarily serving local residents.



Figure 11. Xiguan North Street.



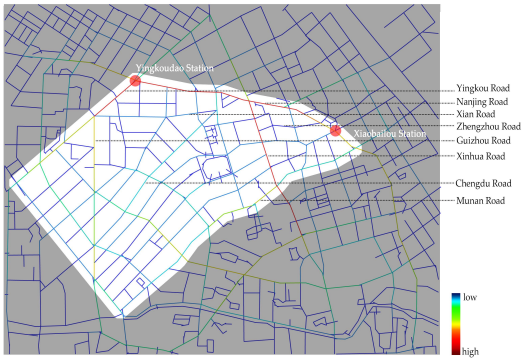
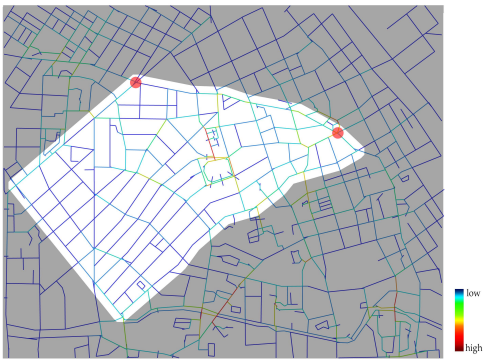
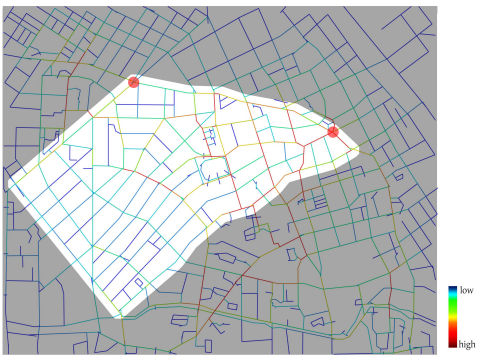
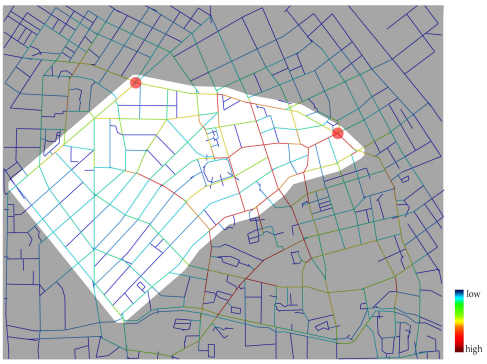
Figure 12. Huanqing West Alley.

4.2.2. Choice

Choice is the ratio of the number of times the shortest paths pass through a specific axis to the total number of shortest paths. It describes the extent to which the street segment serves as part of the shortest paths and measures the spatial potential of traversing that street segment [40]. Therefore, choice measures the advantage of spatial units in the system as the shortest path for travel [41]. It is used to assess a node's potential to attract traffic. In the figure, the warmer the color of the axis line, the higher the choice, indicating greater traffic volume.

It can be observed that the global choice within the station area of the Wudadao Attractions (Table 3) has high axes located along the main thoroughfares of Xinhua Road, Yingkou Road, and Nanjing Road, which aligns with the vehicular traffic system. As the analysis radius gradually decreases, the passage capacity shifts from the external area of the station to the interior, achieving a higher choice centered around Wudadao Minyuan Square. Conversely, the passage degree along the routes connecting Yingkou Road Station and Xiaobailou Station to the scenic streets—Cangwu Road, Tongguan Road, Xian Road, and Changsha Road—remains relatively low, which is related to the one-way streets in this area. Additionally, the existing road network in Wudadao District is characterized by a dense combination of rectangular, radial, and irregular layouts, while the network connecting the subway and attractions is a later-planned network that does not coordinate well with the original road system.

Table 3. Global and local choice of the pedestrian spaces around the subway stations at popular attractions.

	Subway Station Around Wudadao Attractions	Subway Station Around Northwest Corner Attractions
Global choice		
Choice of 400 m		
Choice of 800 m		
Choice of 1200 m		

Around the Northwest Corner Subway Station, the global choice (Table 3) has higher axes along the main thoroughfares of Jieyuan Road, Xima Road, and Fuxing Road. As the analysis radius continues to decrease, the main locations for passage traffic shift from the external city thoroughfares into the interior of the districts, ultimately leading to the internal roads of the residential area south of the food street. The main street of the food area, Xiguan North Street, has a medium choice, while the internal roads have a low choice due to the area being primarily residential, with a strong sense of closure that is unfavorable for transit and passage. Huanqing West Alley features spatial characteristics that make it less prone to disturbances, making it a popular gathering place for both residents and tourists. In contrast, Xima Road, as a city thoroughfare, has a high passability, which is not conducive to attracting tourists or encouraging food tasting.

4.2.3. Synergy

The synergy describes the correlation between the integration of local space and that of overall space, typically expressed as the ratio of local integration at a topological radius of 3 to global integration. The synergy is represented by R^2. When $R^2 < 0.5$, there is a weak correlation between global integration and local integration, indicating poor spatial vitality. When $0.5 < R^2 < 0.7$, the synergy is average; there is a connection between local and Global integration but they are not close enough. When $0.7 < R^2 < 1$, the synergy is high, indicating that the local space and overall space are well-coordinated and closely connected, reflecting high spatial vitality.

In Figure 13 (with a topological radius of 3), the minimum local integration value for the Wudadao Subway Station is 0.5817, and the maximum value is 2.9785. The global integration values range from a minimum of 0.5577 to a maximum of 1.6107, while the synergy is 0.6451. This indicates that the synergy level in the area of Wudadao Subway Station is average; there is some connection between the local and overall structures, but they are not sufficiently close, resulting in average accessibility. In Figure 14 (with a topological radius of 3), the minimum local integration value for the area around the Northwest Corner Subway Station is 0.3333, and the maximum value is 3.7618. The global integration values range from a minimum of 0.5521 to a maximum of 2.2583, with a synergy of 0.7284. This suggests that the synergy level in the Northwest Corner Subway Station area is relatively high, with more connections between the local and overall structures, leading to stronger accessibility.

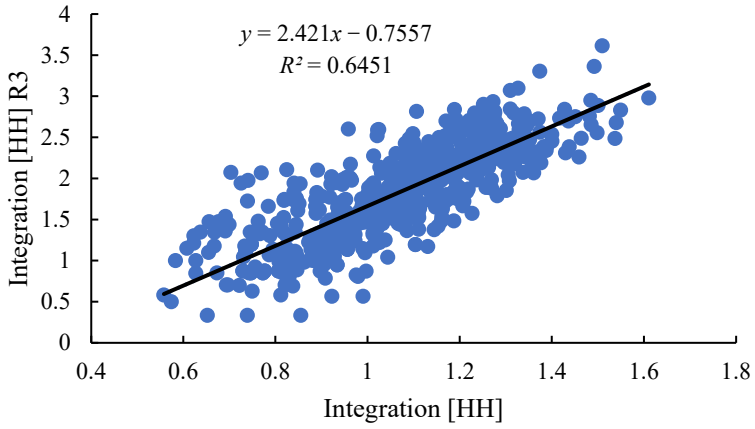


Figure 13. Synergy of the pedestrian spaces around Wudadao Subway Station.

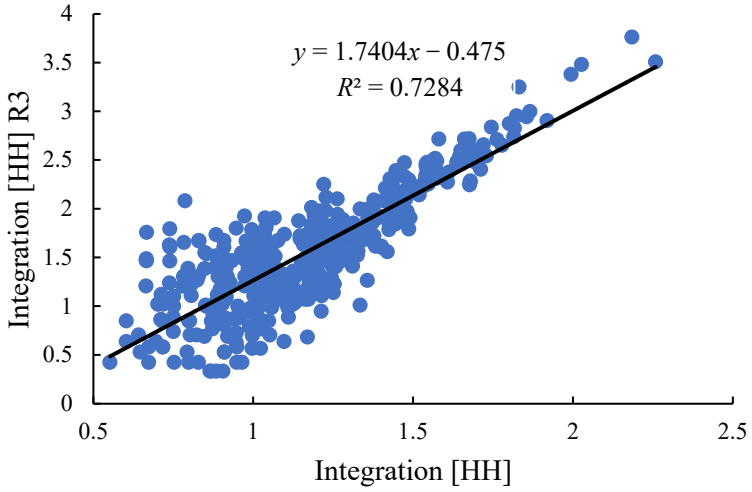


Figure 14. Synergy of the pedestrian spaces around Northwest Corner Subway Station.

4.2.4. Intelligibility

Intelligibility represents the correlation parameter between global integration and connectivity within a spatial system, which measures the effectiveness of understanding the overall spatial structure through local structures. It is denoted by R^2, with values between 0.5 and 0.7 indicating good spatial intelligibility and values above 0.7 indicating excellent spatial intelligibility. An R^2 value below 0.4 indicates low spatial intelligibility and poor identifiability.

From Figure 15, it can be seen that the minimum connection value for the pedestrian spaces around Wudadao Attractions is 1, while the maximum is 20. The global integration values range from a minimum of 0.55766 to a maximum of 1.61069, indicating a relatively low level of intelligibility, with a value of only 0.3522. Figure 16 shows that the minimum connection value for the pedestrian spaces around Northwest Corner Attractions is 1, and the maximum is 27. The global integration values range from a minimum of 0.55211 to a maximum of 2.25829, also indicating a low level of intelligibility with a value of only 0.2280. This suggests that both Wudadao and Northwest Corner have low intelligibility in their pedestrian spaces, making it difficult for visitors to recognize their location within the districts and to have a clear intelligibility of the pedestrian spaces around the attractions.

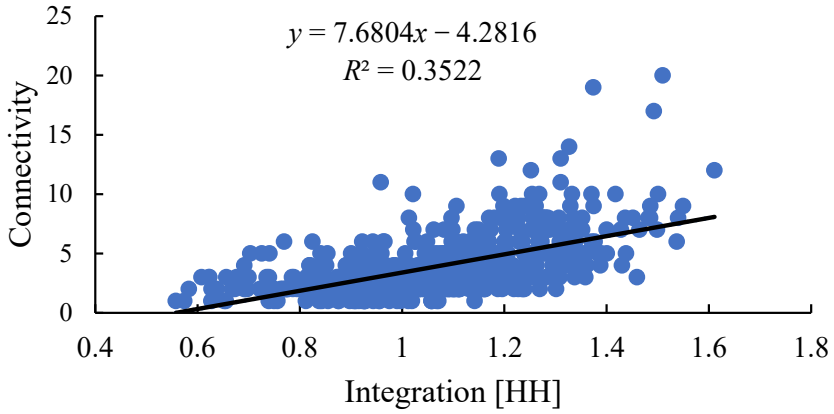


Figure 15. Intelligibility of the pedestrian spaces around Wudadao Subway Station.

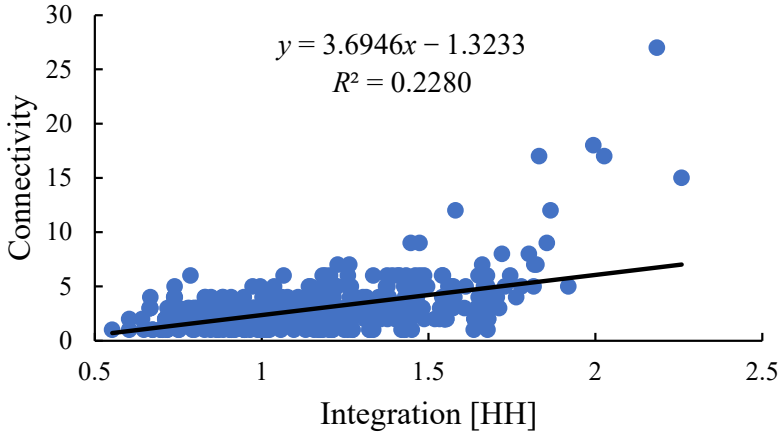


Figure 16. Intelligibility of the pedestrian spaces around Northwest Corner Subway Station.

4.3. Perception of Pedestrian Spaces Around Popular Attractions and Subway Stations

Based on the pre-processing and filtering of text data from Xiaohongshu, a total of 605 tourist reviews comprising 131,561 characters related to the pedestrian perception of the subway station area around Wudadao Attractions were obtained. For the pedestrian travel texts around the Northwest Corner Attractions, there were 329 reviews totaling 57,270 characters. The ROST-CM 6.0 tool was used to segment the filtered text data, followed by frequency analysis, semantic network analysis, and emotion analysis.

4.3.1. Frequency Analysis

Generally, when certain words appear frequently in online reviews, it indicates a stronger sense of agreement and shared experience among tourists regarding those words [42]. Thus, analyzing and summarizing high-frequency words can help provide a comprehensive understanding of tourists' overall perceptions of space. The filtered texts titled "Wudadao & Walking & Subway Tourist Review Data.txt" and "Northwest Corner & Walking & Subway Tourist Review Data.txt", along with customized terminology, were imported into ROST-CM 6.0 software for word segmentation and frequency analysis. This involved addressing meaningless words, synonyms, and related terms, and ranking the words by frequency from highest to lowest to identify the top 100 high-frequency terms.

(1). Pedestrian Spaces of Popular Attractions around Wudadao Subway Station

Regarding word categories, there are 70 nouns, which constitute 72.5%, primarily describing locations, architecture, food, and routes; 17 verbs, making up 18.6%, reflecting tourist activities such as taking photos, walking, and touring; and 13 adjectives, comprising 8.9%, which revolve around tourists' perceptions of the attractions and the overall atmosphere of the Wudadao Attractions, including terms like beautiful, convenient, charming, pretty, and romantic. The top 20 high-frequency words associated with online reviews of walking and subway experiences around Wudadao are presented in Table 4.

(2). Pedestrian Spaces of Popular Attractions around Northwest Corner Subway Station

In terms of word categories, there are 75 nouns, accounting for 78.3%, primarily describing locations, snack foods, subway stations, and time; 13 verbs, constituting 11.1%, reflecting tourist activities such as queuing, taking photos, tasting, and traveling; and 12 adjectives, which account for 10.6% and describe tourists' perceptions of the food street in the Northwest Corner, including terms like delicious, special, convenient, authentic, and worth it.

Table 4. Top 20 high-frequency words related to online reviews of pedestrian spaces and subway experiences in the Northwest Corner Attractions.

	Wudadao Attractions			**Northwest Corner Attractions**	
No.	High-frequency words	Frequency	No.	High-frequency words	Frequency
1	Wudadao	1820	1	Northwest Corner	769
2	Taking photos	1272	2	Walking	571
3	Architecture	1058	3	Delicacy	521
4	Subway	1058	4	Subway	487
5	Walking	1054	5	Delicious	448
6	Binjiang Road	602	6	Vicinity	446
7	Minute	586	7	Suggestion	438
8	Suggestion	499	8	Queuing	429
9	Pedestrian street	449	9	Snack	380
10	Xiaobailou	430	10	Time	370
11	Zhang Xueliang's Former Residence	417	11	Breakfast	366
12	Museum	394	12	Jianbing Guozi	314
13	Local	386	13	Guoba dish	302
14	Ticket	384	14	Juanquan	297
15	Minyuan Square	359	15	Cross talk	289
16	Specialty	358	16	Taste	286
17	Touring	329	17	Local	278
18	Convenience	320	18	Morning snack	270
19	Feeling	318	19	Minute	268
20	Weekend	304	20	Convenience	262

Note: The table lists the data as of 5 December 2023.

4.3.2. Social Semantic Network

The semantic network analysis capability in ROST-CM 6.0 software was employed, and with the help of NetDraw, we generated both a semantic network diagram of overall text and a semantic network diagram of negative emotions related to the pedestrian space reviews around Wudadao Subway Station (Figures 17–20). These diagrams provide a visual representation of the relationships between high-frequency words found in tourist reviews. In the diagram the connections between these high-frequency terms illustrate the strength of semantic relationships in the text; the greater the number of intersections and the denser the lines, the stronger the co-occurrence of those terms.

(1). Pedestrian Space around Wudadao Subway Station

The semantic network analysis diagram of the overall text (Figure 17) shows a divergent distribution, roughly structured into three layers: The first layer is the core area, formed by the highest-frequency co-occurring words such as "architecture, Porcelain House, Zhang Xueliang's Former Residence, taking photos", representing tourists' objective recognition of the attractions' names and locations. The second layer is the sub-core circle, consisting of "subway, pedestrian spaces, Minyuan Square, pedestrian streets, specialties". The third layer is the marginal layer, comprising "style, convenience, Xiaobailou Station,

ticket, hour", reflecting tourists' cognitive understanding of the features of pedestrian spaces in the station area and their tourism assessment.

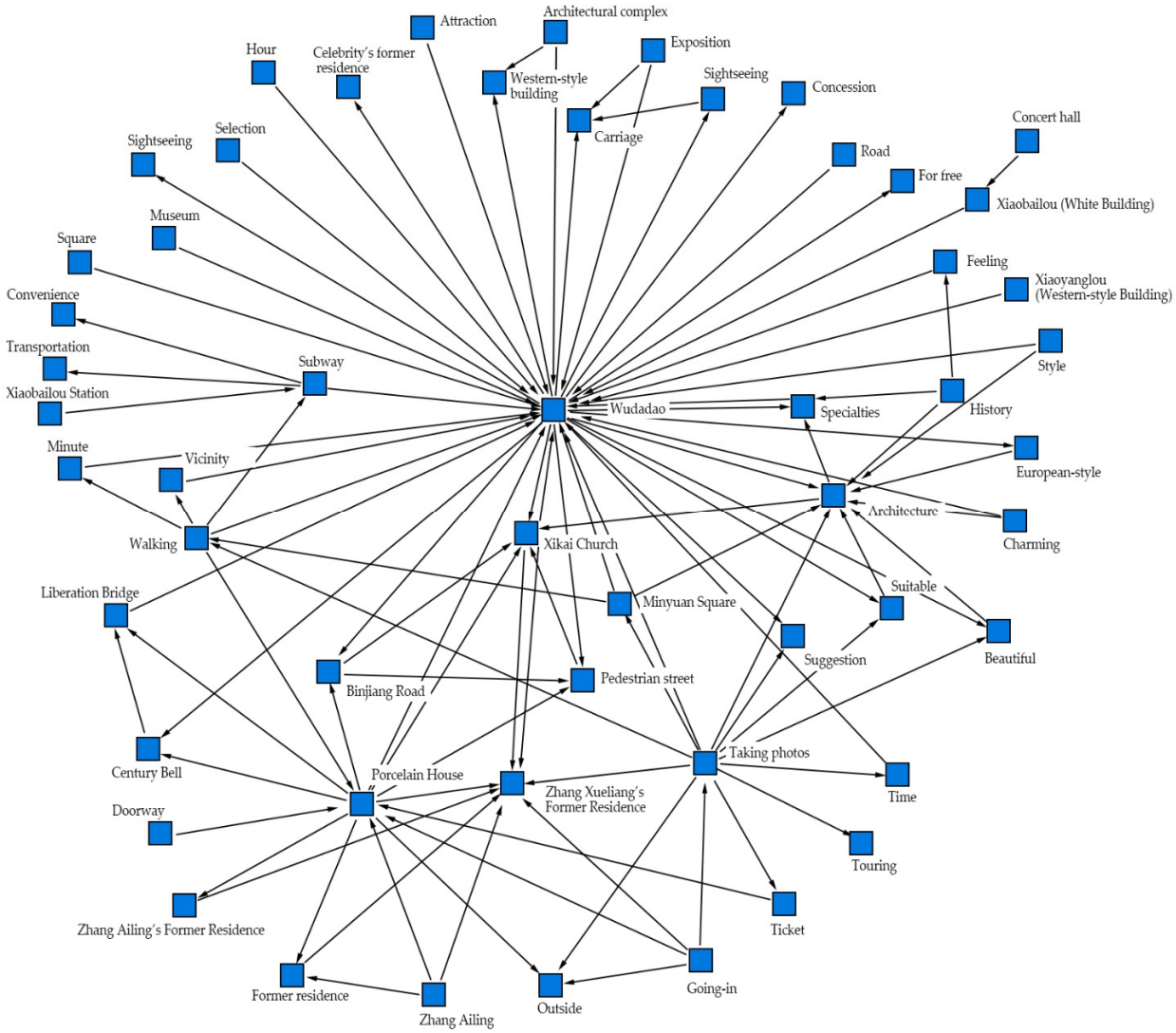


Figure 17. The semantic network analysis diagram of the overall text of Wudadao tourism reviews.

It is evident that there is a strong correlation among "Wudadao, subway, walking, architecture, European style" and "taking photos, history, specialties", indicating tourists' strong perception of transportation and urban imagery.

Negative texts highlight tourists' fundamental expectations for spatial experiences and identify issues that need attention in future developments. Analyzing the structure of the negative emotional semantic map (Figure 18), we see that the core layer is made up of "time period, peak, local, commute", showing that the experience of congestion at Wudadao during peak commuting times is a primary source of negative emotions for visitors. In the second layer, key words such as "design, complexity, walking, subway entrance" are present, which, when integrated with the original travel writings, clarify the reasons behind tourists' dissatisfaction while walking from the subway entrance to Wudadao District. This includes the complicated road design between the subway and the attractions, as well as challenges in wayfinding between stations and attractions.

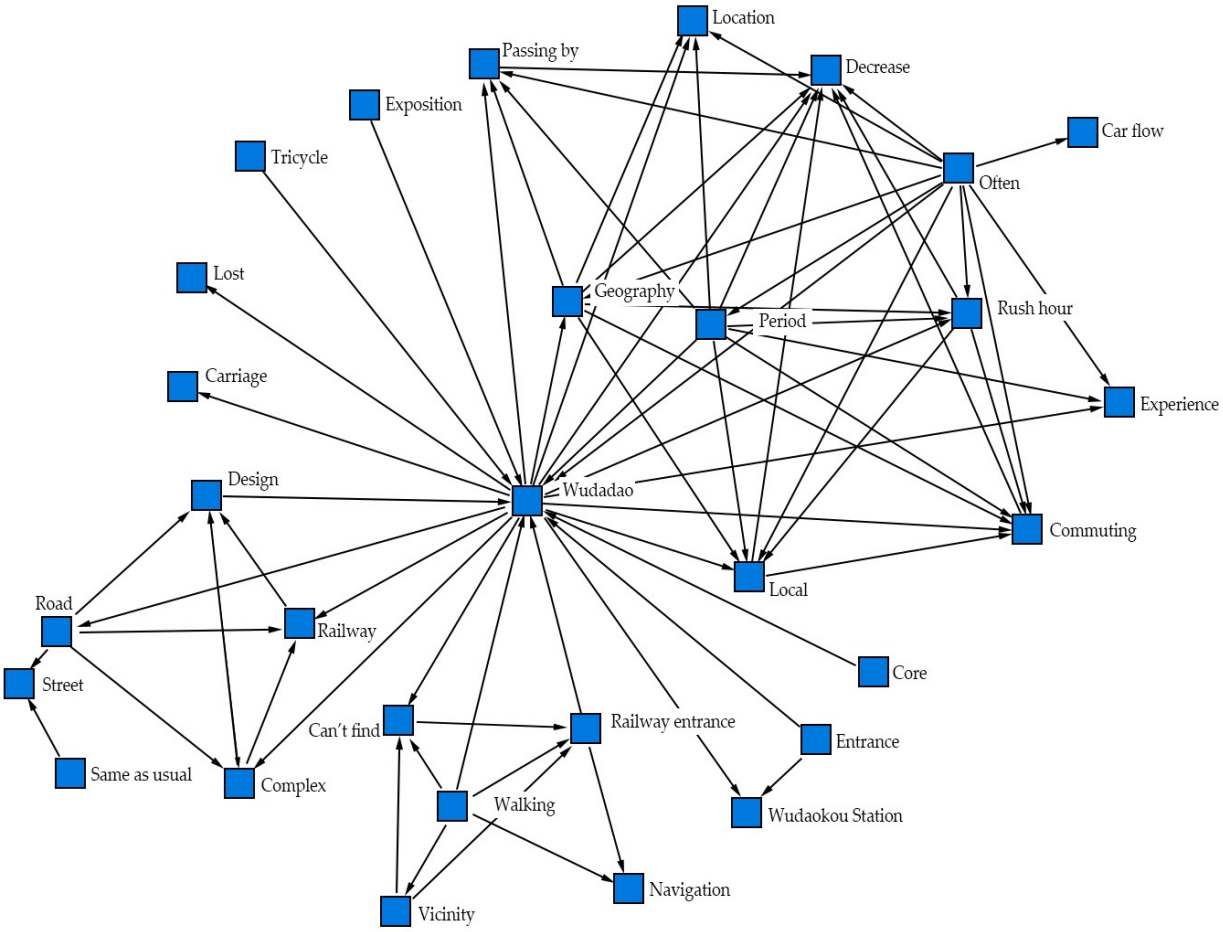


Figure 18. The semantic network diagram of negative emotions in Wudadao tourism reviews.

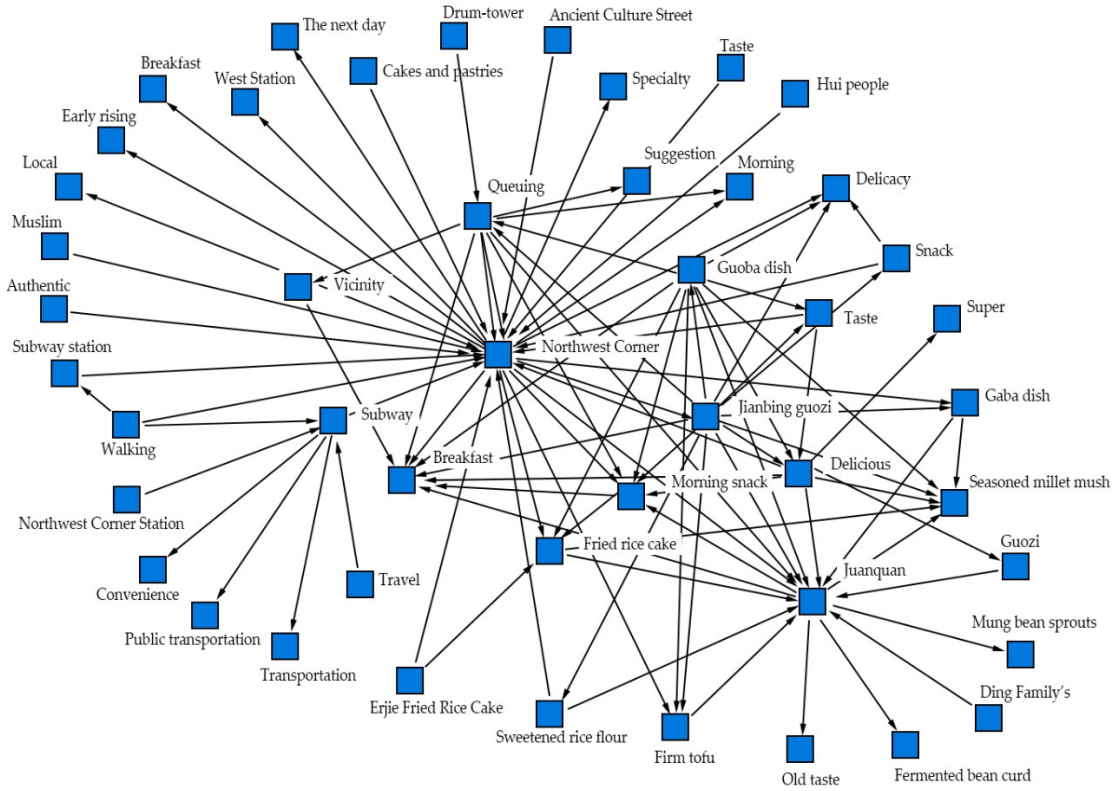


Figure 19. Semantic network diagram of overall text in Northwest Corner travel reviews.

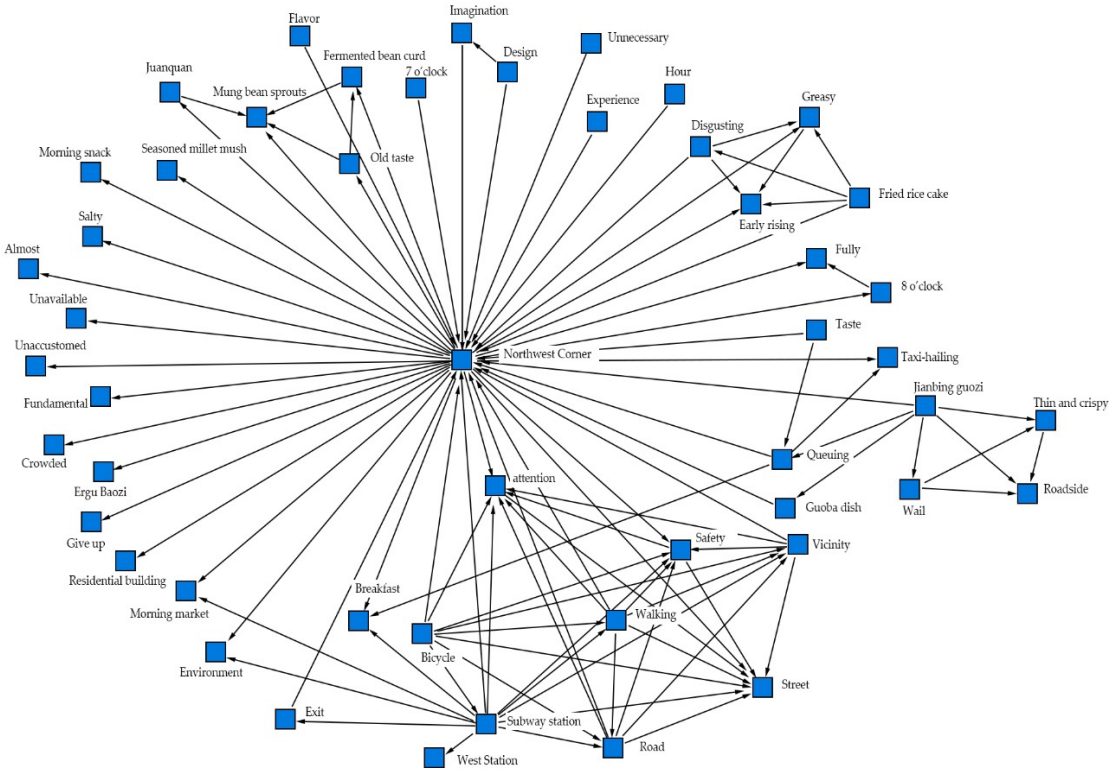


Figure 20. Semantic network diagram of negative emotions in Northwest Corner travel reviews.

(2). Pedestrian Spaces around Northwest Corner Subway Station

The semantic network analysis diagram of the overall text (Figure 19) shows a divergent distribution, roughly organized into three layers: The first layer is the core area, characterized by high-frequency co-occurring words such as "morning snack, fried rice cakes, delicious, jianbing guozi, and guoba dish", which represent tourists' experiences with food. The second layer is the sub-core area, made up of terms like "queuing, taste, subway, and vicinity", expanding upon the first layer. The third layer is the marginal layer, including words like "seasoned millet mush, juanquan, firm tofu, walking, convenience, and Northwest Corner Station", which reflect tourists' opinions on the food and the station area. The connections between "Northwest Corner", "subway, queuing", and "morning snack, walking" demonstrate a strong awareness among tourists regarding the food culture and pedestrian spaces at Northwest Corner.

From the structure of the semantic network diagram of negative emotions (Figure 20), the five words "attention, safety, walking, street, subway station" form the primary core layer of the semantic map. This indicates that there are safety issues with the pedestrian spaces between Wudadao Food Street and the subway station, which is a major factor contributing to tourists' negative emotions. The second layer of core vocabulary includes "queuing, early rising, greasy, environment", highlighting that the early rising, queuing, greasiness, and environmental issues are additional reasons for tourists' dissatisfaction.

4.3.3. Emotion Analysis

By identifying the emotional words within travel text, we can analyze the emotional tendencies that tourists wish to express, which is significant for understanding travelers' perceptions of specific public spaces in the city. The basic emotional words include three types: Positive emotions, neutral emotions, and negative emotions. The emotional lexicon used in this study is sourced from the "Emotion Analysis Vocabulary Collection (beta version)" released by HowNet in October 2007, which includes 12 files such as "Positive

Emotion Words (Chinese and English)" and "Negative Emotion Words (Chinese and English)". This lexicon, combined with the collected evaluative adjectives, is used to construct the emotion analysis lexicon for tourists in Wudadao and Northwest Corner District. Using ROST-CM 6.0, the texts related to the "pedestrian spaces at the subway station" were analyzed to determine the emotional tendencies of tourists in Wudadao and the Northwest Corner (Table 5).

Table 5. Emotion analysis of texts on spaces around Wudadao Subway Station and Northwest Corner Subway Station, Tianjin.

Street	Category of Emotions	Statistical Result		Ordinary		Moderate		High	
		Amount/pcs	Percent/%	Amount/pcs	Percent/%	Amount/pcs	Percent/%	Amount/pcs	Percent/%
Wudadao	Positive emotion (5, +∞)	2334	61.71	1316	34.80	569	15.04	449	11.87
	Neutral emotion [−5, 5]	1062	28.08						
	Negative emotion (−∞, −5)	386	10.21	312	8.25	48	1.27	12	0.32
Northwest Corner	Positive emotion (5, +∞)	963	49.46	540	27.73	251	12.89	172	8.83
	Neutral emotion [−5, 5]	747	38.37						
	Negative emotion (−∞, −5)	237	12.17	173	8.89	48	2.47	8	0.41

Note: The intervals for positive emotions are categorized as follows: general (5, 15], moderate (15, 25], and high (25, +∞); the segmentation ranges for negative emotions are: ordinary [−5, −25), moderate [−25, −50), and high (−50, −∞); neutral emotions are not segmented.

(1). Pedestrian Spaces around the Subway Station in Wudadao Cultural Tourism District

The results indicate that visitors primarily express positive emotions toward the pedestrian spaces in Wudadao Attractions (61.71%), showing an overall positive trend and a high level of identification. The positive emotional responses highlight the rich architectural resources, pleasant street environment, and diverse activities, leading to high visitor satisfaction. Words such as "beautiful" and "charming" reflect strong feelings of joy and praise, indicating that the experience in the tourism district exceeded expectations. Negative emotions account for 10.21%, mainly arising from factors like subway transportation, environmental hygiene, road design, and wayfinding signage, suggesting that visitors are particularly concerned about the public spaces and environmental issues between attractions and subway stations.

(2). Pedestrian Spaces around the Subway Station in Northwest Corner Specialty Food District

Visitors express mainly positive emotions regarding the pedestrian spaces around the subway station at Northwest Corner Attractions, though the proportion is not high (49.46%), resulting in an overall average level of agreement. Neutral emotions are relatively high (38.37%), while negative emotions are low. Positive emotional responses indicate that visitors are quite satisfied with the local cuisine. Negative emotions account for 12.17%, primarily stemming from two aspects: One related to "early rising", "queuing", and "crowded", while the other concerns "subway", "walking", and "safety", indicating that the safety of the pedestrian spaces in the subway station area is a source of visitors' negative feelings.

5. Discussion and Suggestions

We constructed a theoretical framework of "identification–cognition–perception" for the pedestrian spaces of subway station areas near popular tourist attractions. By utilizing

LDA topic modeling for "identification", space syntax for "cognition", and ROST-CM network text analysis for "perception", this study complements human-centered perspective research on station area spaces. It expands the scope of urban tourism perception studies. The findings reveal consistencies and differences between cognition based on spatial morphology and perception derived from social semantics. Accessibility, transitivity, and emotional perceptions from network text analysis demonstrate consistency. However, spatial cognition focuses solely on the physical dimension and cannot directly capture the emotional perceptions of individual tourists. Conversely, network text analysis provides intuitive, quantifiable emotional dimensions. Cognition and perception of pedestrian spaces in subway station areas are complementary and mutually reinforcing, and their integration can better support human-centered perspective design.

The literature on cognition and perception of pedestrian spaces in subway station areas suggests that walking experiences are influenced by factors such as accessibility, safety, comfort [17,18], and convenience [20,22], aligning with this study's findings. Beyond these factors, we discovered that tourists unfamiliar with a city pay greater attention to wayfinding design in station areas. Tourists visiting newly popular "internet-famous" destinations are more concerned with walking safety and environmental comfort due to less mature pedestrian environments and road networks in these areas.

Additionally, our methodology forms a systematic framework from identification to cognition and perception. Existing studies have employed methods such as geographic information visualization of social media location data [5,6] or combined location heatmaps with social media activity concentration [7]. These approaches are intuitive and visual but cannot extract latent information. By leveraging the LDA model, this study extracts hidden information from extensive online text, transforming complex text data into a lower-dimensional topic space to effectively pinpoint research content [8]. The findings demonstrate that space syntax techniques can elucidate the relationship between cognition and spatial characteristics [43], which urban planners and designers use to support urban design and planning decisions [44]. Our method extends the cognitive dimension while incorporating group emotional perceptions. By combining qualitative and quantitative analyses through the ROST text mining method, textual content is converted into quantifiable data, enabling persuasive conclusions to be drawn from digital materials with characteristics of scalability and intelligence.

This study aims to explore the renewal of pedestrian spaces in subway station areas near popular urban tourist attractions. It focuses on Tianjin, China, one of Asia's earliest cities to introduce a metro system and the second in China, with a mature and continually developing rail transit system. During holidays, more than two million residents and tourists use the system daily, offering valuable insights and references for cities worldwide. The identified popular tourist station areas represent traditional and newly famous destinations, highlighting their typical characteristics. For instance, the Five Great Avenues represent traditional cultural tourism and share similarities with historical districts formed during urban development in many global cities. Meanwhile, the Northwest Corner Food Street is a popular "internet-famous" destination in the era of online communication, characterized by high population density and urgent spatial renewal needs. These features make it a pioneering reference for station area development in the new era of leisure tourism and global urban rail transit. Based on the conclusions and practical experience of subway station area spatial development in Chinese spatial development of subway stations near tourist attractions, this study provides recommendations for future design and renewal.

5.1. Enhancing Accessibility and Transitivity of Subway Stations Areas near Tourist Attractions

The study reveals that in both traditional and newly popular tourist attraction subway station areas, accessibility exhibits a ring-like distribution, gradually decreasing inward from main arterial roads. Given these areas' high population density, further improving the pedestrian system around the station areas is necessary. This includes connecting "dead-end roads", improving accessibility ramps [45], ensuring zero-elevation road intersections, and implementing micro-renewals to enhance pedestrian traffic efficiency. For newly popular "internet-famous" attraction station areas, measures such as widening roadways, strengthening the integration between station entrances/exits and urban spaces, improving road connectivity, and constructing pedestrian-friendly districts shared by locals and tourists are recommended.

5.2. Enhancing the Continuity of Wayfinding Design in Subway Station Areas near Tourist Attractions

The study indicates that despite two subway stations (Yingkoudao Station and Xiaobailou Station) in Wudadao Cultural Tourism District, tourist perceptions reveal negative emotions regarding wayfinding issues between the stations and the attractions. Generally, tourists are less familiar with the city, making the continuity of the guidance system between the stations and attractions particularly crucial. It is essential to establish a comprehensive wayfinding signage system for station areas [46]. It can be integrated with smart pathways and intelligent guidance systems based on IoT and big data technologies to enhance the convenience and overall walking experience for tourists.

5.3. Enhancing the Safety Perceptions in Pedestrian Spaces of Newly Popular "Internet-Famous" Tourist Attraction Station Areas

In newly popular "internet-famous" tourist attraction station areas, the strong network effect rapidly accelerates crowd gatherings within a short period. However, improving the urban physical environment has been relatively slow, making safety and environmental issues in pedestrian spaces a key concern for tourists. It is essential to enhance the safety perceptions in these areas through three aspects: Public security, traffic safety, and environmental safety [47]. Measures such as adding bike lanes, clearing obstructive "zombie cars", and strengthening road patrols can help mitigate urban safety risks. Additionally, micro-renewals of the station areas, including the addition of open spaces, public seating, and digital landscapes, can improve the overall environment and enhance the quality of the pedestrian spaces.

5.4. Creating Cultural and Tourism Narrative Scenarios in Subway Station Areas near Tourist Attractions

The study finds that tourists generally have positive emotional perceptions of tourist attractions, indicating that urban attractions' cultural and humanistic characteristics are highly appealing. As an essential part of tourist districts, subway station areas serve as significant spaces for tourists to perceive the city's distinctive culture. By strengthening the integration with surrounding cultural and tourism resources, pedestrian spaces can be enhanced with artistic installations, urban exhibitions, cultural markers, etc., to enrich the humanistic atmosphere of the streets [48]. Through narrative scenario design, an integrated "station-to-attraction" cultural setting can be created, providing tourists with a continuous cultural and tourism experience.

5.5. Regular Urban Experience Evaluation and Renewal for Tourist Attraction Station Areas

The study reveals that subway station areas in traditional and newly popular tourist attractions face issues such as low internal street accessibility and transitivity, while newly

popular attraction station areas also have safety and environmental challenges. Leveraging network text data can help identify popular urban attractions. For these hotspots, regular urban experience evaluations should be conducted to promptly identify issues in station areas. Based on these findings, special urban renewal plans and governance strategies should be formulated for station areas [49]. Establishing a long-term mechanism for periodic and detailed updates to station area spaces can effectively enhance tourist experiences and satisfaction levels.

6. Conclusions

This study serves as a cross-examination of pedestrian spaces within subway station areas and the tourism sector, expanding the existing research scope while innovatively developing an "identification–cognition–perception" model for the pedestrian spaces around subway stations near popular urban attractions. Utilizing a combination of quantitative and qualitative methods, it investigates tourists' holistic experiences in these subway stations' pedestrian spaces and offers optimization strategies, thereby providing practical recommendations for high-quality urban development that fosters "shared benefits" between residents and visitors. Nonetheless, certain limitations exist: The analysis of subway station area pedestrian spaces at urban tourist attractions is an exploratory endeavor at the intersection of transit and tourism. Future work should enhance the investigation of the relationship between spatial form metrics and emotional perceptions. Moreover, given the regional disparities among both traditional and new popular attractions within each city, it is essential to expand the range and quantity of research subjects for more robust conclusions. In future cross-disciplinary research involving urban rail transit and tourism spaces and behaviors, other variables could be integrated to enrich the depth and breadth of the study.

Author Contributions: Conceptualization, W.L. and X.S.; Data curation, X.S.; Formal analysis, X.S. and R.S.; Funding acquisition, W.L.; Investigation, W.L., X.S. and R.S.; Methodology, W.L. and X.S.; Project administration, W.L.; Resources, X.S.; Software, W.L.; Supervision, J.Y.; Validation, X.S. and R.S.; Visualization, W.L., J.Y. and X.S.; Writing—original draft, W.L.; Writing—review and editing, W.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the National Social Science Foundation of China, grant number: 17BXW062, and the Tianjin Arts and Sciences Planning Project, grant number: C20012.

Data Availability Statement: Data are available for use upon request.

Acknowledgments: The authors are greatly thankful to all the reviewers and editors.

Conflicts of Interest: The authors declare no conflicts of interest.

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