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Environmental and Management Stress in Urban Campgrounds: A Social Media Analytics Approach

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ABSTRACT

Campgrounds in urban parks have become increasingly popular destinations for urban residents, with camping emerging as an important recreational attraction. Enhancing their sustainability requires understanding camper satisfaction determinants, yet comprehensive studies in the urban context remain scarce. Our study fills this gap by analyzing 17,554 social media comments from 6 urban parks through integrated methods: grounded theory identified 29 environmental factors across 6 categories (accessibility, physical attributes, experience perception, functionality, safety, management); sentiment analysis assessed the performance of the 29 factors; while Importance-Performance Analysis (IPA) and Social-Media-Based Improvement Index (SMII) prioritized interventions. Results reveal a clear IPA-SMII complementarity: IPA captures latent expectations (e.g., commercial services as important but non-urgent), whereas SMII detects active management crises (e.g., parking and pedestrian flow control provoking immediate frustration). Across the 6 parks, factors related to physical attributes generally showed higher satisfaction levels, while issues related to management and facilities exhibited greater variability and urgency. These findings offer actionable insights for optimizing urban campgrounds by enabling administrators to resolve acute infrastructural deficiencies while holistically enhancing visitor experiences and eventually contributing to sustain-

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able management.

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1. Introduction

Rapid urbanization makes city residents feel more cut off from nature. Therefore, urban nature becomes very important for helping people connect with nature. Urban green infrastructure (UGI), as a key part of the built environments in cities, is getting more and more attention [1,2]. UGI offers essential venues for physical and mental benefits in densely populated areas where access to nature is often limited [3,4]. The COVID-19 pandemic's lasting effects have significantly impacted people's choice of long-distance travel [5]. This change has made people turn to local recreation. As a result, urban camping has become unprecedentedly popular in the post-pandemic era [6]. Unlike camping destinations in remote areas, urban camping in China focuses on accessible public open spaces, leveraging urban parks to meet the recreational needs of residents. This shift aligns with global research showing that UGI is crucial for recreational activities and well-being, particularly during public health crises [7].

While urban camping thrives post-pandemic, there is a lack of research on the level of satisfaction that users experience at campgrounds located in urban parks. Existing studies on environmental factors influencing satisfaction with urban parks primarily focus on landscape quality and daily recreational activities [8,9]. We still know little about the specific factors affecting the satisfaction of campgrounds in urban parks, even though these places play a critical role in promoting human well-being and public health. This gap in our knowledge hinders designers, planners, and city administrators from evaluating and improving the camping experience and the performance of urban campgrounds. To address the gap in understanding user satisfaction with urban park campgrounds, our study investigates this topic by analyzing social media data (SMD) on campgrounds in urban parks. SMD gives us a good way to see how people feel in real time. It shows many different views that old survey methods often omit. We innovate through the integration of the social-media-based improvement index (SMII) and importance-performance analysis (IPA), as well as identify and prioritize areas for improvement systematically. Based on the scalable and powerful real-time data processing features provided by SMD, a new approach for measuring people's satisfaction with urban campgrounds in Chinese cities is proposed in this paper.

Chengdu, known for the "Park City" plan in China, is a special context for this study. The "Park City" plan focuses on adding green spaces to urban planning. This creates a good setting to investigate the relationship between UGI and recreational satisfaction. The dense populations and special geographical features in Chengdu offer an ideal context for our research and also contribute to generalizable insights applicable to other rapidly urbanizing cities worldwide. The following are the aims of our research: (1) to investigate the factors that impact people's satisfaction with campgrounds in urban parks, as determined by SMD; and (2) to formulate strategies for campground improvement according to the findings of satisfaction evaluation. By pursuing these research objectives, we aim to furnish a reference for the sustainable development of campgrounds in urban parks.

2. Social Media Data (SMD) as a New Vehicle to Understand the Satisfaction of Campgrounds

Camping, an expanding subsector of outdoor tourism, is becoming increasingly accessible to a diverse range of individuals. The discourse surrounding camping on social media platforms has maintained its appeal. Comments on social media can serve as a relatively new way to understand people's satisfaction with built environments [10]. Studies by Li J. et al. [11], Khalid and Collier [12], Li Z. et al. [13], García-Mayor C. et al. [14] and J. Osorio-Arjona et al. [15] have explored the use of SMD to analyze sentiments and perceptions related to various urban spaces, contributing to a novel understanding of public satisfaction with built environments. Simi-

larly, SMD can reveal key themes and variables affecting campground satisfaction, informing planning and management improvements.

2.1. The Advantages of Using SMD in Understanding People's Satisfaction

Satisfaction assessment as a metric to evaluate the extent of users' satisfaction with a product, service, system, or experience [16] has been widely applied to optimize designs of built environments [17]. The determinants that impact user satisfaction have been the subject of investigation by designers, stakeholders, and researchers in previous research. For example, Bedimo-Rung et al. [18] identified park features, conditions, access, aesthetics, safety, and policies as important factors influencing park satisfaction. Moreover, McCormack et al. [19] showed that factors such as safety, aesthetics, amenities, maintenance, and proximity play an important role in people's satisfaction with parks.

Traditional satisfaction assessment primarily employs surveys and interviews, which can be conducted in person, by mail, by phone, or online. These methods enable researchers to pose targeted queries—ensuring relevance and direct alignment with study objectives. Such control over question design is particularly important when exploring detailed insights or factors influencing satisfaction [20,21]. However, these studies can be high-cost and energy-consuming. The top-down predetermined questions may not reflect the real situation and become outdated quickly [22]. Therefore, it is worth considering alternative sources of data for satisfaction research.

With the fast development of the Internet and social media, an increasing number of individuals post online reviews of products, experiences, and services [23–25]. Employing SMD in satisfaction research offers advantages in terms of scale and real-time insights, which can partially offset the aforementioned deficiencies associated with conventional approaches [26]. Studies employing SMD are also known as non-interventional research, which is an emerging way of studying social behavior without affecting the subjects of research [27]. The study that contrasted survey responses and SMD found that urban park satisfaction is consistent across the two data sources [28]. SMD facilitates enhanced monitoring of visitor feedback and the identification of scale-spanning influential factors.

2.2. Satisfaction Determinants of Campgrounds

Previous research has shown a correlation between individuals' satisfaction with a place and their utilization of the space, highlighting how characteristics of built environments can significantly impact people's contentment [29,30]. Using SMD, Huai et al. [28] have identified the environmental factors influencing people's satisfaction and utilization of several parks. Utilizing SMD has been effective in evaluating user satisfaction in other recreational contexts [3], but the application to urban campgrounds has been limited.

Camping has long been a popular activity in regions such as Europe and North America, where traditional practices often prioritize natural and undisturbed settings [31]. In these regions, national park campgrounds and private RV parks cater to users seeking remote and scenic experiences, with limited human intervention. For example, organizations like the National Park Service (NPS) and Kampgrounds of America (KOA) manage campgrounds located in rural or sparsely populated regions, prioritizing the preservation of natural resources over urban convenience. In contrast, urban camping has just emerged recently in densely populated areas, driven by the urbanization process and the impact of the COVID-19 pandemic and lockdown [6,32]. Urban camping prioritizes accessibility and convenience, integrating campgrounds within urban parks to cater to the growing recreational demands of urban residents [7,32]. For example, Chengdu's Park City initiative promotes urban campgrounds as viable alternatives to traditional campgrounds, offering people extra opportunities to contact nature.

The growing popularity of urban camping has introduced unique challenges and opportunities for managing urban campgrounds, yet research on the characteristics of campgrounds influencing visitors' satisfaction remains underexplored. While studies have examined broader determinants of camping satisfaction, such as psychological well-being during public health crises and facility constraints [32,33], limited attention has been

devoted to how specific conditions in urban parks may influence people's satisfaction with the campgrounds. This gap is particularly significant given the distinct characteristics of urban campgrounds, which often operate in densely populated areas compared to rural or remote counterparts. For example, prior research on Recreational Vehicle (RV) camping [34] and caravan users [35] has highlighted the importance of temporal, spatial, and social dimensions, as well as environmental and spiritual preferences, in camper decision-making. However, these findings have yet to be effectively implemented for urban park campgrounds. In response to this issue, using the method of SMD analysis, which has shown promising results in other recreation situations [32,36], could offer essential references for evidence-based improvement and sustainable management measures in urban camping environments.

3. Methods

3.1. Study Area and Materials

This study was conducted in Chengdu, a major city in southwest China. Chengdu is known for its innovative way of urban planning and substantial investment in public green spaces. Covering an area of 14,335 km^2 and home to approximately 21.4 million residents, Chengdu has become a leader in integrating nature into its urban landscape in China. According to Chengdu's Action Plan for Building a Park City Demonstration Area Practicing the New Development Concept 2021–2025, Chengdu had constructed about 6,000 km of greenways and added about 43 km^2 of public parks by the end of 2022. The city of Chengdu has established 20 campgrounds in the urban parks (**Figure 1**). In this study, we have retrieved comments on the 20 parks with campgrounds from 2017 to 2022. Then we identified 6 parks (marked as green) with the most comments on camping as our research areas.

The SMD utilized in this study is accessible information via the Dianping website. Founded in 2003, the Dianping website is the foremost local lifestyle platform in China. By the first quarter of 2015, Dianping had more than 200 million monthly active users and over 14 million listed merchants, according to the Baidu Baike entry [37]. Researchers had employed comments on Dianping to analyze park sentiment and validate multi-source data [38].

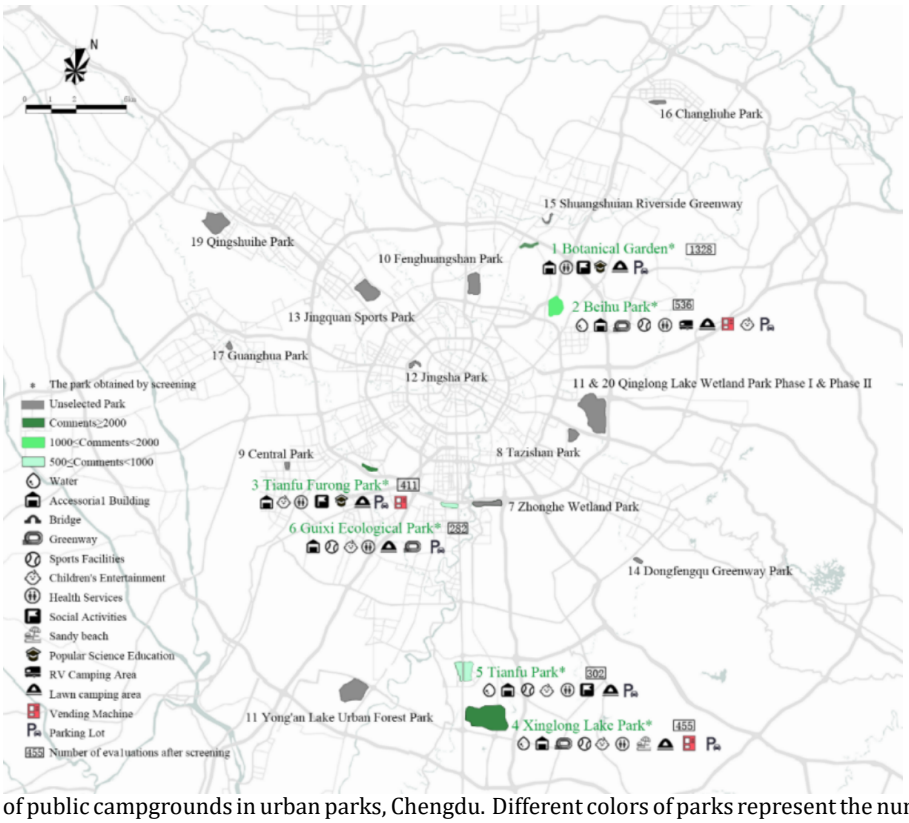


Figure 1. Location of public campgrounds in urban parks, Chengdu. Different colors of parks represent the number of comments.

3.2. Coding Factors

In this study, we have applied the three steps of grounded theory [39] to identify the factors that are associated with the satisfaction of campers in urban parks. First, we conducted open coding by identifying concepts and initial codes directly from comments. We compared incidents applicable to each category and began to develop categories and properties. After open coding, the comments were reassembled in the second step, named axial coding, which involves two main scopes—the initial scope and the main scope. For the initial scope, we broke down the comments into discrete pieces and identified initial categories. The focus here was on defining and refining these categories and their properties. We aimed to look for patterns and similarities that can help in understanding the phenomenon. The main scope of axial coding is where we started to integrate the categories by identifying the relationships between them. We aimed to build a conceptual framework linking these categories. The final step was selective coding, where a core category related to other categories was identified. We focused on refining and developing the theory by weaving and integrating all major categories. Therefore, a complete storyline can be developed to obtain the final grounded theoretical model [40].

To make the coding results more reliable, an independent researcher checked the whole coding process, and reviewed a random 10% of the comments. The auditor made sure the coding was consistent, and evaluated the logical coherence of the emerging framework. Through collaborative discussion to resolve discrepancies and minimize bias individually, we can thereby improve the validity and reliability of our study. Through continuous comparison, analysis, and refinement of codes, we obtain a substantive theoretical system anchored in data which can serve as the basis for further empirical testing.

3.3. Sentiment Analysis

For the sentiment analysis, we focused on the identification and classification of opinions expressed in a piece of text to reflect people's attitudes toward factors that affect their satisfaction. In previous research, there are generally two approaches: automated annotations based on machine-learning algorithms and manual annotations [41]. Both approaches have been applied across various fields, such as psychology, marketing and environmental studies [42,43]. Roberts et al., for instance, have performed a sentiment analysis to study the emotional responses to UGI with Twitter data [44]. In this study, we originally applied SnowNLP for automatic sentiment analysis of the camping-related comments. However, a paired-samples *t*-test revealed that there was a substantial difference in scores compared to manual annotations ($t = 12.73$, $p < 0.001$). This may be due to the limitations of SnowNLP in interpreting ambiguous expressions such as sarcasm and culture-specific references in Chinese SMD. Irony, such as " What a 'peaceful' camping experience!", was often misclassified due to a lack of contextual awareness in the automated systems.

Given these shortcomings, we chose to rely on the traditional, reliable gold-standard approach of manual sentiment analysis [44]. Two trained coders rated the sentiment on a five-point scale (**Table 1**), ranging from 1–2 for negative, 3 neutral, and 4–5 positive [45]. One coder annotated the entire dataset while the other one did another 10% of the full samples separately. Discrepancies among the two coders were resolved through consensus discussions to ensure strong inter-rater reliability (Cohen's $\kappa = 81.3\%$). This approach allowed us to capture subtleties in tone, irony, and cultural context that automated tools may overlook, ensuring a valid and nuanced understanding of people's opinions in SMD.

Table 1. Rating scales of sentiment analysis.

Rating	Vocabulary Samples
5	Very, excellent, extremely, great, awesome, most, rare, classic
4	Not bad, kinda, OK, quite, kinda good, worthy, comparable
3	So-so, nothing special, ordinary, just so, moderate, usual, bland, nothing special, not particularly good...
2	Not recommended, not interesting, nothing, not good, not worth it, not great...
1	Very bad, massively bad, unbearable...

3.4. Importance-Performance Analysis (IPA)

The Importance-Performance Analysis (IPA) model was originally used in marketing and service management to identify key areas for improvement and prioritize resources effectively[46,47]. By plotting attributes on a matrix with importance on the x-axis and performance on the y-axis, the IPA framework visually maps out the attributes into four quadrants: the Keep Up the Good Work quadrant for attributes that excel in both importance and performance, the Possible Overkill quadrant for those performing well but deemed less important, the Low Priority quadrant for attributes that are neither critical nor performing well, and the Concentrate Here quadrant that highlights areas of high importance but poor performance, signaling a need for improvement (**Figure 2**).

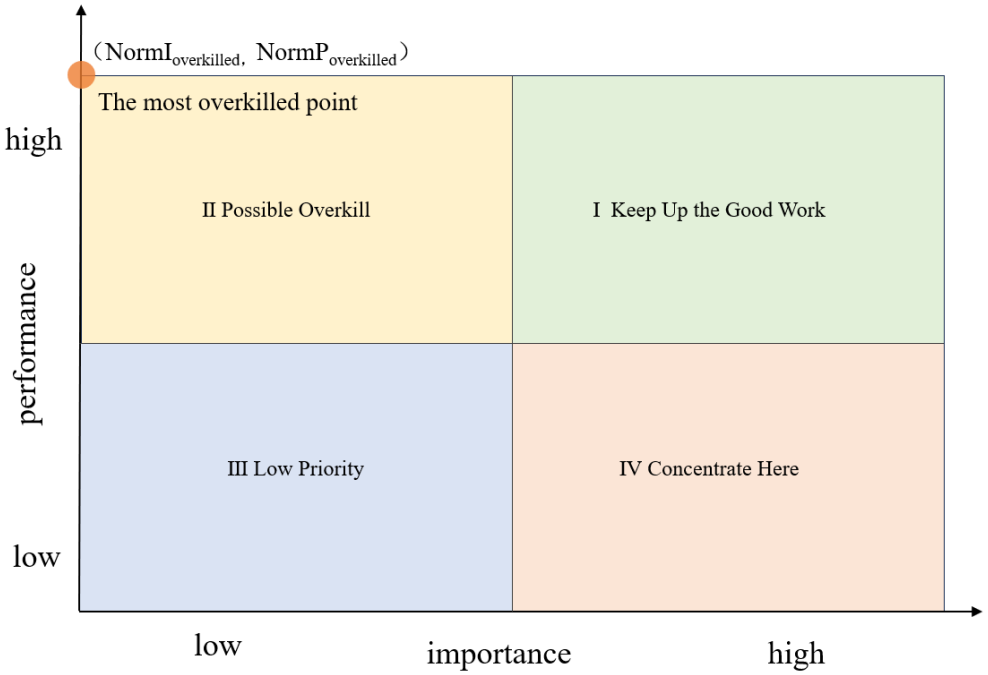


Figure 2. Four quadrants based on importance and performance scores.

In this study, the factors identified through the grounded theory in Section 3.2 were systematically mapped onto the IPA framework. The importance of each factor was determined by its frequency in comments, reflecting its perceived value to campers.

$$I_{i,j} = n_{i,j} \div N_i \times 100 \quad (1)$$

where i is for different parks, j is for different factors, $I_{i,j}$ is the importance of each factor in urban parks, $n_{i,j}$ is the number of times a factor in an urban park is mentioned in the comments, and N_i is the total number of comments for the urban park. $I_{i,j}$ ranges from 0 to 100. The closer to 100, the more important the factor, and the closer to 0, the less important the factor.

$$P_{i,j} = M_{i,j} \div 5 \times 100 \quad (2)$$

where $M_{i,j}$ is the 5-point score obtained by the sentiment analysis, and $P_{i,j}$ is the performance score, which ranges from 0 to 100. The closer to 100, the more satisfied the camper is with a factor. The performance was assessed based on how effectively each factor meets campers' expectations.

3.5. Social-Media-Based Improvement Index (SMII)

Building on the critical areas for improvement identified through IPA, SMII was introduced to systematically prioritize these initiatives by leveraging SMD. SMII offers an innovative method of urban planning and renewal by harnessing the power of SMD to understand and prioritize public needs and preferences effectively[48].

Grounded in the IPA framework, SMII is calculated by determining the area between points on the IPA quadrant and the origin (the most overkilled point, i.e., lowest importance but highest performance). Both importance and performance scores are normalized to a scale of 0 to 100 for comparability. Higher values mean a greater need for improvement. The method can be used at different spatial and temporal scales. And it can also contribute to dynamic and comprehensive decision-making.

In this study, the importance score of SMII consists of two parts: frequency scores based on the number of comments mentioned in SMD, and degree centrality that measures the structural importance of these factors in the network formed by users' comments[49]. To measure the degree centrality of each factor, we constructed a co-occurring network for these factors that have appeared simultaneously in individual user comments. In this network, each factor is taken as a node, and links are generated between factors that appear together in one comment. The degree centrality refers to the total connections that one factor has with others within the network, which indicates how often it appears together with other factors. Therefore, a larger score of degree centrality suggests that the factor is more deeply embedded in users' discussions and is more likely to associate with other environmental or management concerns. Incorporating degree centrality into SMII can reveal both its frequency mentioned in SMD and the extent to which it plays a role structurally across all nodes in the users' perception. To determine the weighting scheme of these two parts, we conducted a professional consultation. A total of six experts who have backgrounds in environmental management and design took part in the consultation. The six experts represented both academic researchers and industrial practitioners, all of whom had experience in planning, designing, and managing urban public spaces as well as recreational environments. During consultations, the experts assessed the relative importance of the two parts used in identifying the importance score of factors for SMII reflected in SMD. Each expert gave a weight to both parts. Based on the average score of the six experts' evaluations, we finally set a weight of 60% for frequency-based analysis and a weight of 40% for degree-centrality measurement. The weighting reflects an overall opinion of experts' consensus, that frequency captures the immediacy and prevalence of users' concerns, while degree centrality represents the structural impact of factors in the comment network.

This weighting scheme is in line with previous studies on public space satisfaction. In those studies, frequency-based measures were used to show user demand. Centrality measures were used to show how factors are related to each other[48,50]. By using this weighting scheme based on experts' opinions, SMII can make sure improvement priorities come from both direct comments and from the relational significance of factors in the satisfaction framework.

$$SMII_I = I_{i,j} \times 60\% + D_{i,j} \times 40\% \quad (3)$$

where, $SMII_I$ is the importance score for SMII. $D_{i,j}$ is the degree centrality of factor i in park j.

On the other hand, the performance metrics in SMII are based on scores from the IPA method.

$$SMII = (NormSMII_I - NormI_{overkilled}) \times (NormP_{overkilled} - NormP_{i,j}) \quad (4)$$

where, $NormSMII_I$ is the normalized importance score. $NormP_{i,j}$ is the normalized performance score for factor i in park j.

4. Results

In this study, we have analyzed 17,554 comments from 6 urban parks in Chengdu (**Table 2**). The Botanical Garden became the most discussed park, with 8,620 comments. Tianfu Park had the fewest, with 891 comments. Out of all comments, 2,107 were about camping experiences. The Botanical Garden had the most in this subset. In contrast, Guixi Ecological Park had the fewest mentions related to camping. We had one interesting finding about Beihu Park. Even though it had fewer total comments than Tianfu Furong Park and Xinglong Lake Park, it had a lot more camping-related comments. This indicates it is a popular destination for camping.

The average satisfaction rating for the 6 parks was 4.40 out of 5 (**Table 3**). Guixi Ecological Park scored the highest overall satisfaction, while Chengdu Botanical Garden had the lowest. Ratings for camping-related comments were generally higher than overall ratings.

Table 2. Summary of the six selected parks with campgrounds (sort by the number of camp-related reviews).

Park Names	Areas (km^2)	Areas of Campground (m^2)	Total Number of Comments	Comments on Camping
Botanical Garden	2.07	2,000	8,620	620
Beihu Park	1.23	4,000	1,561	417
Tianfu Furong Park	1.00	70,000	2,570	335
Xinglong Lake Park	3.00	2,100	2,100	320
Tianfu Park	2.30	56,700	891	227
Guixi Ecological Park	0.93	500	1,812	188
Total	10.53	135,300	17,554	2,107

Table 3. The satisfaction scores of six parks.

No.	Park Names	Overall Rating	Rating of Camping-Related Comments
1	Botanical Garden	4.03	4.29
2	Tianfu Park	4.53	4.53
3	Xinglong Lake Park	4.45	4.58
4	Tianfu Furong Park	4.29	4.51
5	Beihu Park	4.53	4.52
6	Guixi Ecological Park	4.58	4.62
Total		4.40	4.51

4.1. Factors Influencing Satisfaction

Through the application of grounded theory, 56 factors were identified and grouped into six categories: Accessibility, Physical Attributes, Experience Perception, Functionality, Security, and Management and Maintenance (**Figure 3**). Many factors, such as accessibility and facilities, aligned with previous research [17]. While some factors, like temperature perception and photo effect, emerged from our analysis, reflecting under-explored aspects of campground user experience.

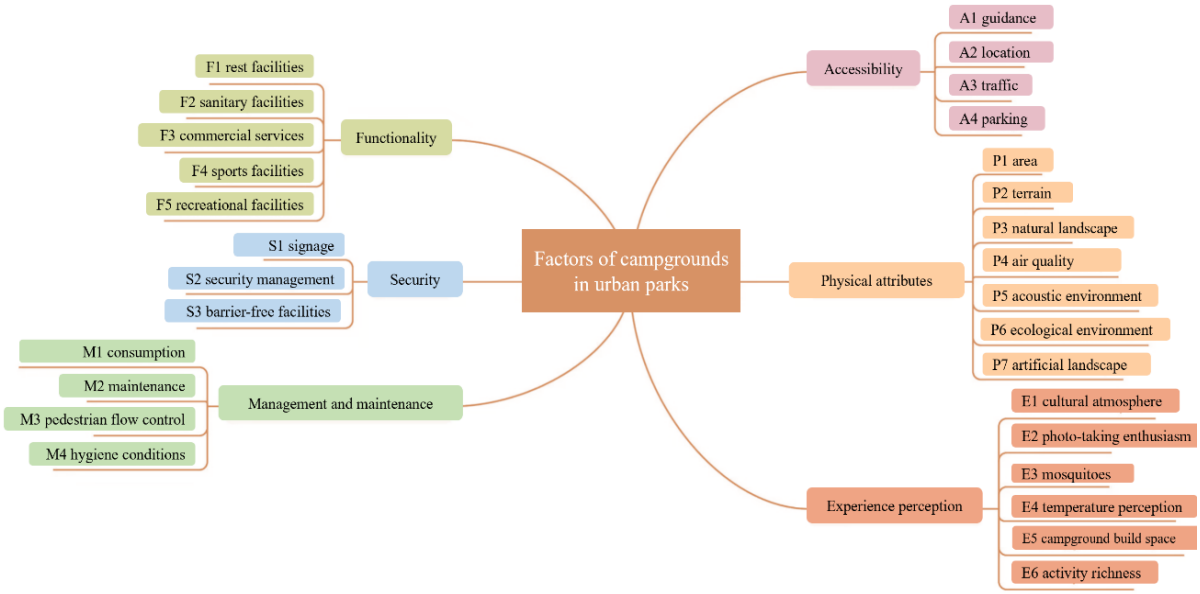


Figure 3. The attributes of campgrounds in urban parks that impact people's camping experience.

4.2. IPA on Factors of Campgrounds

4.2.1. Performance of Factors

We evaluated the performance of each factor by sentiment analysis, which revealed an average score of 3.69 across all factors (**Table 4**). While most factors scored above 3, only a few factors had lower scores. The category of Physical Attributes generally performed well, with high scores for air quality (4.43) and area (4.39). On the other hand, the Experience Perception and Functionality categories had mixed performance. Factors such as mosquitoes (1.88) and sanitary facilities (2.89) under-

performed.

The performance scores varied across the six parks. Xinglong Lake Park scored at the top, with an average of 3.83. While the Botanical Garden scored the lowest at 3.31, which had 12 factors—such as mosquitoes and maintenance—below the threshold of 3. Factors were ranked by their average score of performance on the heatmap in **Figure 4**.

Table 4. The average performance scores for each factor for each park.

Categories	Factors	Botanical Garden	Tianfu Park	Xinglong Lake	Tianfu Furong Park	Beihu Park	Guixi Ecological Park	Total
Accessibility	guidance	3.59	4.30	3.70	3.40	3.31	2.17	3.41
	location	4.22	3.90	3.76	3.67	3.99	4.22	3.96
	traffic	3.84	4.36	3.83	3.40	3.15	3.75	3.72
	parking	2.64	3.98	3.55	4.06	3.34	4.59	3.69
Physical Attributes	area	3.97	4.46	4.41	4.46	4.28	4.73	4.39
	terrain	2.34	3.00	3.67	5.00	3.41	4.25	3.61
	natural landscape	3.88	4.24	4.54	3.90	4.33	4.00	4.15
	air quality	4.53	4.46	4.26	4.50	4.38	4.43	4.43
	acoustic environment	4.50	3.93	4.25	3.33	3.90	3.67	3.93
	ecological environment	4.28	4.24	4.32	3.60	4.27	4.75	4.24
	artificial landscape	3.75	4.46	4.26	4.95	4.26	4.00	4.28
Experience Perception	cultural atmosphere	4.25	4.33	4.63	4.25	4.63	4.21	4.38
	photo-taking enthusiasm	3.98	3.80	4.55	4.21	4.45	3.71	4.12
	mosquitoes	1.67	1.73	1.88	1.65	2.14	2.20	1.88
	temperature perception	2.73	2.89	2.75	4.36	3.41	2.77	3.15
	campground build space	4.09	4.22	4.01	4.14	4.08	4.16	4.12
	activity richness	4.21	4.45	4.00	4.11	3.90	4.37	4.17
Functionality	rest facilities	2.38	3.67	3.19	3.84	3.70	3.54	3.39
	sanitary facilities	2.25	3.25	3.33	2.12	3.24	3.14	2.89
	commercial services	3.40	2.29	4.03	3.13	3.34	3.43	3.27
	sports facilities	2.33	3.80	3.78	4.03	4.12	4.16	3.70
	recreational facilities	2.89	3.21	3.88	4.03	4.38	4.35	3.79
Security	signage	4.00	3.00	3.57	2.14	3.50	4.67	3.48
	security management	2.24	4.10	4.08	2.76	3.42	2.50	3.18
	barrier-free facilities	3.67	3.67	4.00	3.33	4.60	3.50	3.80
Management and Maintenance	consumption	4.05	4.28	3.66	3.79	3.89	4.26	3.99
	maintenance	1.69	3.71	3.92	2.89	3.82	3.29	3.22
	pedestrian flow control	2.13	4.29	3.17	2.78	2.77	2.78	2.99
	hygiene conditions	2.59	4.06	4.08	3.08	4.10	3.45	3.56
Total		3.31	3.80	3.83	3.62	3.80	3.76	3.69

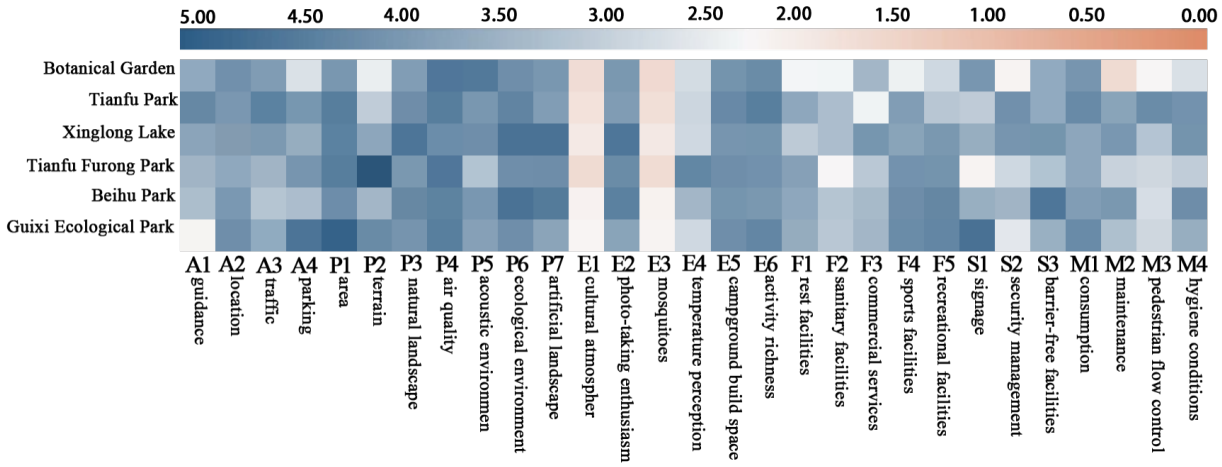


Figure 4. Heatmap of performance scores across six urban parks, with factors sorted by mean values.

4.2.2. Importance of Factors

Importance was calculated by the proportion of times each factor appeared in the camp-related comments. Specifically, the category of Physical Attributes accounted for 65% of all comments. While the factor of natural landscape received the most attention. However, the category of Security had the lowest score of importance (8.59%).

The importance of factors varied across parks. For example, the comments of the Botanical Garden frequently mentioned factors of cultural atmosphere and consumption due to its dual function as a recreational and educational space, whereas the comments of Guixi Ecological Park focused on recreational facilities.

4.2.3. Plotting the IPA Framework

By plotting vertical and horizontal reference lines at the average importance and performance scores, we created four distinct quadrants to categorize all factors (**Figure 5**). Factors such as location, area, natural landscape, campground build space, activity richness, and consumption fell into the Keep Up the Good Work quadrant. The Possible Overkill quadrant encompasses factors such as acoustic environment, artificial landscape, cultural atmosphere, sports facilities, and barrier-free facilities. The Low Priority quadrant included factors such as mosquitoes, guidance, terrain, rest facilities, sanitary facilities, signage, and security management. The finding that mosquitoes received low scores in both performance and importance in the IPA framework suggests the presence of mosquitoes is acknowledged as poorly managed but this does not translate into high user frustration because it is not a dominant concern. As the climate in Chengdu is quite humid, people may tolerate mosquitoes as a "normal" part of the environment. Moreover, if campers are preoccupied with larger problems (e.g., overcrowding), mosquitoes may fade into the background. The fourth quadrant, named Concentrate Here, identified factors like parking, temperature perception, commercial services, and pedestrian flow control. After exploring the correlation among factors in the Concentrate Here quadrant, we found no significant relationship.

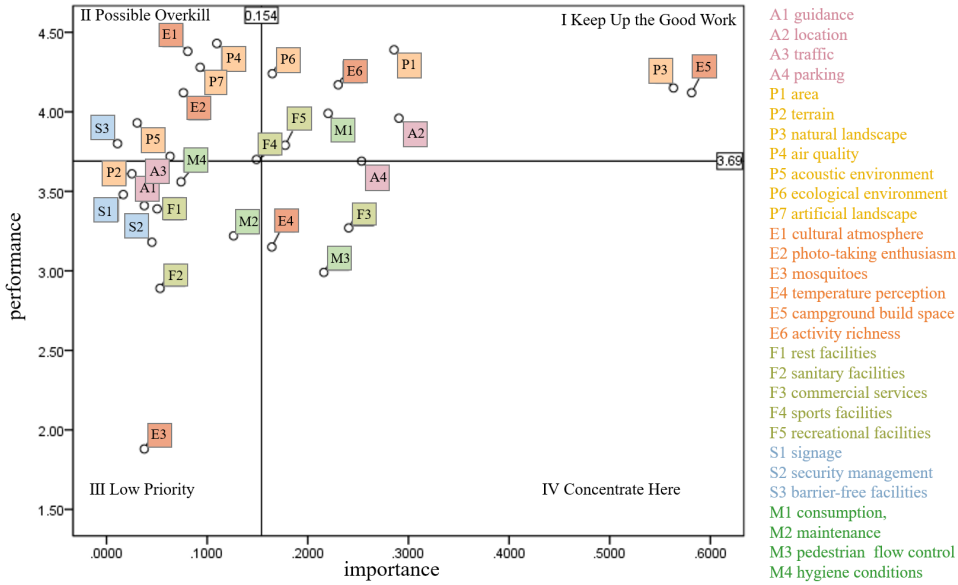


Figure 5. IPA diagram of 29 factors across the 6 parks.

Next, we compared the factors in the Concentrate Here quadrant across the six parks. Common to all the parks in this quadrant were factors such as parking, temperature perception, commercial services, and pedestrian flow control, mirroring those identified for Beihu Park. Notably, parking, commercial services, and pedestrian flow control were in the Concentrate Here quadrant for both the Botanic Garden and Guixi Ecological Park. The absence of temperature perception shows their ecological advantage. The rich vegetation may improve thermal comfort. Tianfu Furong Park had three factors in the Concentrate Here quadrant: commer-

cial services, pedestrian flow control, and hygiene conditions. As a significant cultural-entertainment district, many events are regularly held here, including lotus exhibitions and cultural festivals, which may boost the needs for food, drinks and other souvenirs. Insufficient commercial services can lead tourists to bring external supplies, increasing litter and hygiene issues. Tianfu Park, adjacent to the international conference centre, mainly consists of commercial services in the Concentrate Here quadrant. It can be seen that, compared with other parks, it has played a more centralised function in this kind of mixed-use park. Xinglong Lake Park has an exceptionally wide range of influencing factors in the Concentrate Here quadrant, including parking, temperature perception, campground build space, commercial services, and pedestrian flow control. This shows systematic challenges associated with its newness and high visitors' expectations, which amplify gaps between current performance and user priorities. The different factors within the Concentrate Here quadrant across the six parks show how crucial it is to find the nuanced balance in campground management. For example, campground managers need to deal with universal stressors like parking and pedestrian congestion while also making sure that each site has the proper amenities for its needs, from preserving ecological micro climates in mature parks to scaling amenities in busy recreational areas.

4.3. Prioritizing Strategies Based on SMII

Based on this principle of ranking high scores as having a more urgent need to be addressed when improving the six campgrounds, we then applied SMII. Pedestrian flow control and parking were identified as the top two deficiencies across the six parks (**Figure 6**). Temperature perception was ranked third. The commercial services factor, which has also fallen into the Concentrate Here quadrant, is not the first place to be improved based on the results of SMII. The difference between IPA and SMII for commercial services shows how both frameworks can work together. While SMII clearly identifies current pain areas, such as parking and pedestrian flow control, which immediately irritate visitors, IPA exposes latent visitor expectations, where things like commercial services have value but lack urgency.

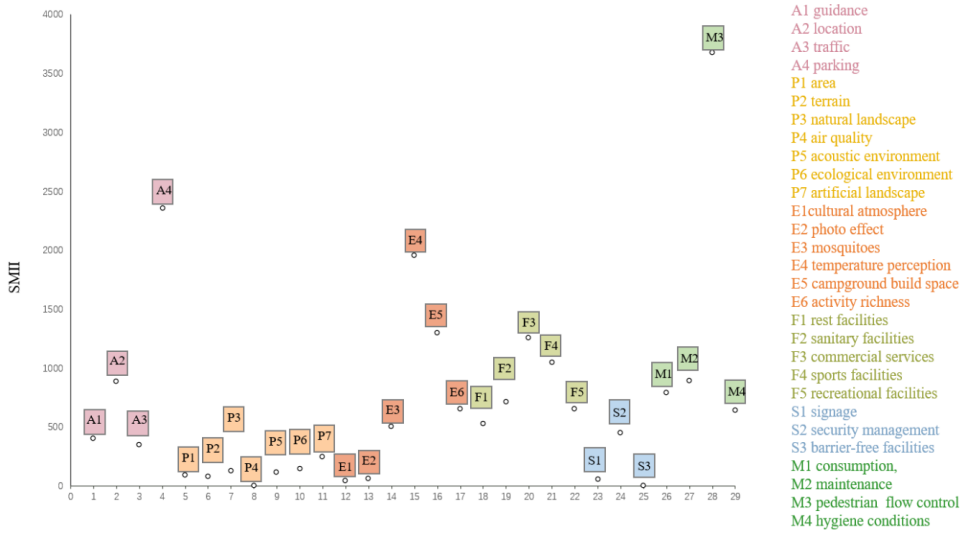


Figure 6. SMII results of 29 factors across the 6 parks.

Figure 7 presents the improvement priorities of the six parks based on SMII. Beihu Park emerged as the highest priority for improvement, with Xinglong Lake Park and Guixi Ecological Park following in second and third positions respectively—separated by a marginal difference in their SMII. As a prominent camping destination, Beihu Park attracts large crowds, amplifying pressure on its infrastructure. High visitation exacerbates issues like pedestrian congestion and campground overcrowding, which dominate social media feedback. Since

the four factors located in the Concentrate Here quadrant of Beihu Park align perfectly with those identified across all six parks, we selected Beihu Park as a representative case study for in-depth analysis using the SMII framework to illustrate broader enhancement priorities for campgrounds in urban parks.

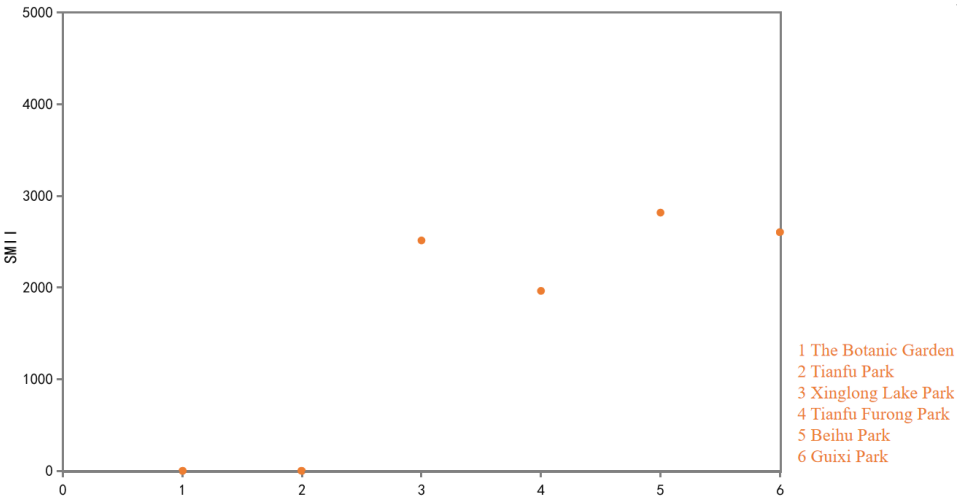
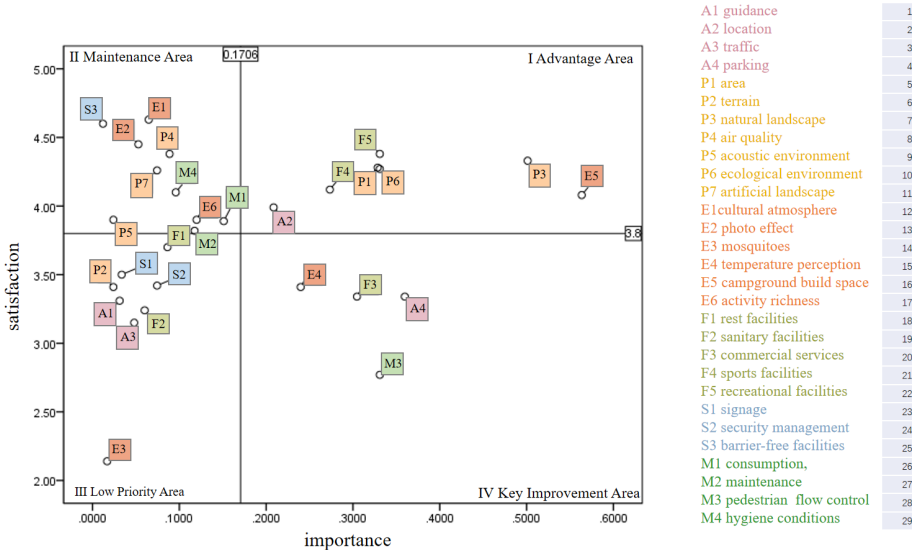


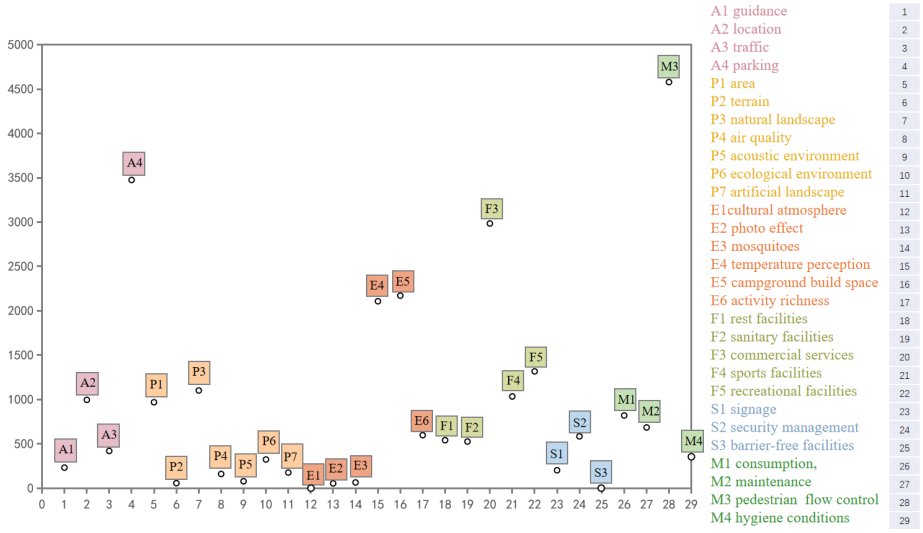
Figure 7. SMII results of the six urban parks.

For Beihu Park, the majority of factors were situated in the Possible Overkill quadrant and Low Priority quadrant, while four of them were in the Concentrate Here quadrant of the IPA matrix (**Figure 8a**). Among the four focus factors, there was a statistically significant positive correlation between pedestrian flow control and parking availability ($p < 0.05$). This finding shows that for campground design in urban parks, transportation planning needs to be considered holistically. Vehicle and pedestrian systems should be improved together to improve campers' experience. SMII analysis of Beihu Park showed that three of the four factors—pedestrian flow control, parking, and commercial services—were among the park's top improvement priorities. Moreover, campground build space was the fourth highest-priority factor in SMII, which was higher than that of temperature perception, even though the factor of campground build space did not appear in the park's Concentrate Here quadrant (**Figure 8b**). This outcome underscores the value of complementing IPA with SMII to uncover emerging issues and validate improvement priorities.



(a)

Figure 8. *Cont.*



(**b**)

Figure 8. (**a**) IPA of Beihu Park. (**b**) SMII of Beihu Park.

5. Discussion

This research examines people's satisfaction with campgrounds in urban parks through the lens of SMD. The most principal contribution is the identification of key factors influencing satisfaction across six categories, with a focus on those requiring immediate improvements. By investigating SMD on campgrounds in urban parks, we adopt a user-centric approach to unearth factors organically, rather than imposing preconceived categories. Our findings address a gap regarding the relationship between characteristics and satisfaction with campgrounds in urban parks, providing evidence-based strategies for the improvement of current campgrounds and informing the design of future urban park amenities.

5.1. Factors Associated with People's Camping Satisfaction

Utilizing SMD, our study applied grounded theory to uncover 29 factors linked to satisfaction with campgrounds, subsequently summarized into six categories. While our study echoes some findings from prior urban park satisfaction research, it also introduces novel factors that have come to light through our investigation. Many new factors are from the category of Experience Perception, a domain recognized for its significant impact on user experience [48]. Consistent with previous studies on urban park satisfaction, factors in these categories, such as activity richness [51–53] and temperature perception [54,55], are correlated with satisfaction with campgrounds in urban parks. Additionally, our research has unveiled new factors like photo-taking enthusiasm, cultural atmosphere, and campground build space as determinants of satisfaction within this category. In the age of social media, the propensity to share images online has surged [56], leading to an uptick in comments referencing ideal photo-taking spots and satisfaction with photos taken in campgrounds. The cultural atmosphere, increasingly a point of interest [57], is also important, especially in disseminating educational and scientific information, particularly to children. This is evident in the case of the Botanic Garden, which, despite its shortcomings in maintenance and the imposition of an entry fee, stands out for its cultural and educational offerings, a factor underscored by the frequent mention in SMD.

In the category of Functionality, previous studies have demonstrated that sports facilities, recreational facilities, and sanitary facilities significantly influence user satisfaction [58–61]. In contrast, SMD in our study focused more on the physical parts of commercial services. These include vending machines, eateries, retail outlets, and so on. This difference probably comes from how camping is different from other leisure activities in urban parks. Campers often stay for a long time and do many kinds of activities. Therefore, they have a growing need for commercial amenities. On the other hand, peo-

ple who visit urban parks for a short time usually do not rely on these commercial facilities as much.

Satisfaction with urban parks is often shaped by factors within the category of Management and Maintenance [62,63]. Our research identifies consumption and pedestrian flow control in this category. Typically, campgrounds that levy a fee offer a better-maintained environment, in contrast to those that are free and may suffer from inadequate management resources. Milman and Tasci [64] suggested that visitors who perceive exceptional value during their visit tend to report higher satisfaction. Moreover, pedestrian flow control in urban parks can affect the density perceived by campers and, consequently, their satisfaction.

Consistent with previous research on urban parks, our study affirms that the remaining three categories—Physical Attributes, Accessibility, and Security—are interlinked with people's satisfaction [65–67]. However, in the category of Security, there was a noted emphasis on signage systems rather than security management, diverging from previous research [68]. This discrepancy may stem from the fact that urban parks in this study are typically well-secured and monitored, leading campers to place greater importance on the signage system for efficient navigation to their camping sites.

5.2. Improvement Strategies Based on IPA and SMII Results

In this study, improvement strategies for campgrounds in urban parks are supported by the IPA and SMII results. Pedestrian flow control, commercial services, temperature perception, and parking are the key factors in the Concentrate Here quadrant for the six parks. However, only three of these four factors are at the top for improvement according to the SMII results. The discovered differences between SMII's top improvement factors and IPA's Concentrate Here criteria provide complex insights into urban park campground management. First, the difference in commercial services indicates the complementary value from both frameworks. IPA discovers latent expectations, while SMII highlights active pain points. Second, park-specific examples indicate that there are contextual interdependencies even though overall analysis revealed no significant correlations between the four factors in the Concentrate Here quadrant. At Beihu Park (parking-pedestrian flow control linkage, $p < 0.05$), due to the interconnection of various elements such as visitor demographics, usage intensity, and spatial design, the relationship among factors can vary under different circumstances. Therefore, while universal correlations remain elusive, the demonstrable park-level interactions warrant deeper investigation into contextual mediators to predict when and how these factors amplify one another. Future research should prioritize granular, park-specific modeling to disentangle these contextual dynamics.

As a factor that addresses a critical need for enhancing safety and comfort [69], pedestrian flow control has the highest SMII score. Strategies to improve pedestrian flow control can be achieved by various means such as signage, efficient pathway design, and during peak times, the implementation of a one-way system or time-slot reservations [70]. Parking, as the second priority according to the SMII score, stands out as it presses the x-axis of the IPA framework. The relatively low performance of parking could be attributed to the fact that urban parks often serve nearby residents in most cases. The majority of visitors prefer to walk or bike to these places [71]. Nevertheless, campers, who are a different group of urban park visitors, often bring various equipments, and they use personal vehicles to reach the campgrounds. This practice leads to a heightened demand for parking spaces in the vicinity of campgrounds in urban parks.

Moreover, temperature perception ranks third in terms of SMII. High temperatures can keep visitors away. A comfortable climate can make people stay longer and come back. Effective management of temperature perception involves strategies such as implementing UGI for shading and cooling effects and providing information on real-time temperature. These approaches support the sustainable use and appreciation of UGI, aligning with the findings that suggest a strong link between environmental quality and public satisfaction [17,72].

5.3. Limitations and Future Studies

SMD, as the principal data source for our research, might display inherent demographic biases, since the platforms tend to disproportionately represent younger,

technologically adept, and urban populations, while inadequately representing elderly citizens and those with restricted digital literacy. This skew may overamplify certain preferences while obscuring others, limiting the generalizability of findings. In the future, researchers can conduct targeted studies among the underrepresented population and investigate hybrid techniques that combine passive SMD analytics with participatory community mapping to equitably investigate people's needs for camping in urban parks.

In this study, we only examined campgrounds located in urban parks as a novel model of UGI for urban residents' leisure and entertainment. Given this type of UGI is quite new, our research is constrained by a lack of longitudinal data and difficulty in observing whether users' satisfaction levels change with time and whether park management policy adjustments have been influenced by this. Future research would further accumulate large volumes of data over an extended period to address this issue. Longitudinal studies can provide scientific grounds to develop all-round improvement plans for maintaining the overall structure, ecological status, and service capabilities of campgrounds in urban green spaces.

6. Conclusions

Based on the application of SMD technology in this study, we studied the situation of public satisfaction with urban parks with campgrounds. We employed the IPA method with a view to utilising SMII's scalability features to assess users' satisfaction levels with multiple factors of campgrounds in urban parks. By exposing not only latent expectations but also urgent priorities, our findings will provide park administrators, campground managers, and other stakeholders with evidence to diagnose gaps in campground infrastructure and strategically sequence interventions by resolving acute crises. The actionable insights validated across the six parks in Chengdu provide a feasible reference plan to transform UGI into a resilient and visitor-centred assessment under the background of rapid urbanization. Future implementations can adopt this diagnostic framework to balance immediate pain-point resolution with long-term satisfaction ecosystems, ultimately advancing sustainable urban livability.

Author Contributions

Conceptualization, L.H., X.W. and X.J.; methodology, L.H., X.W. and X.J.; software, L.H. and X.W.; validation, X.J., H.Z. and F.S.-R.; formal analysis, L.H. and X.W.; investigation, L.H., Q.G. and X.W.; resources, X.J., H.Z. and F.S.-R.; data curation, L.H. and X.W.; writing—original draft preparation, L.H., X.W., Q.G. and X.J.; writing—review and editing, X.J., H.Z. and F.S.-R.; visualization, L.H. and X.W.; supervision, X.J.; project administration, X.J.; funding acquisition, X.J. and H.Z. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

This study utilized publicly available social media data from the Dianping website, specifically comments on camping experiences in 20 parks in Chengdu from 2017 to 2022. The data was collected in accordance with Meituan-Dianping's terms of use, which permit the sharing, transfer, or public disclosure of such data without further notice or obtaining additional consent. All data was anonymized to protect user privacy, and no personal information was collected or disclosed. Because the study exclusively used publicly available and anonymized secondary data without direct interaction with human participants, formal ethical approval and protocol code requirements were waived by the Institutional Review Board.

Informed Consent Statement

The research did not involve direct interaction with participants, collection of personally identifiable information, or intervention involving human subjects. Therefore, informed consent was not required in accordance with institutional ethical guidelines for secondary analysis of publicly available data.

Data Availability Statement

Some or all data, models, or code that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflict of interest.

AI Use Statement

During the preparation of this manuscript, we used artificial intelligence (AI) solely for language polishing and grammar refinement.

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