

Enhancing Forest Parks Planning Through Smellscapes Design: A Web-Based Text Mining Study of Tourist Scent Perception and Experience

Abstract

The objective of this study was to explore the perceptual value of smellscape design in enhancing forest park planning, using web-based text mining and sentiment analysis of scent perception. Smellscapes remain underexplored in scenic planning due to their intangible nature, limited theoretical grounding, and a lack of consumer behaviour research—particularly in forest parks. Using 9,020 manually validated smell-related tourist comments collected via a web crawler from the travel platform Ctrip, this study applied web-based text mining to analyse tourists' olfactory experiences. Guided by grounded theory and perceived value theory, a conceptual model of tourists' perceived value of smellscapes was developed. Analysis identified four core dimensions: olfactory aesthetic value, olfactory experience value, recreational and wellness value, and olfactory emotional value, reflecting both sensory and psychological responses to natural scents. The study proposes three practical recommendations for forest parks: (1) promote the health and wellness benefits of scents; (2) maintain and design diverse and continuous olfactory environments; and (3) enhance interactive experiences through scent-based installations and activities. Future research should integrate offline interviews and contextual factors such as age, residence, and climate conditions to refine understanding of tourists' scent preferences and enhance the precision of smellscape design in forest parks.

Keywords: tourists' perceived value, forest park, smellscapes, web-based text mining, grounded theory

1. Introduction

Humans are innately endowed with five senses—vision, audition, taste, touch, and olfaction. These inherent faculties empower individuals to explore the unknown and discover broader horizons. Among them, olfaction enables us to perceive and identify various scents. We use our olfaction constantly—within every breath, we detect and respond to different scents. Remarkably, the human nose is capable of distinguishing at least one trillion different scents (Ischer et al., 2014; McLoughlin, 2025). Porteous was the first to propose that olfaction can be used to experience the invisible smellscapes, suggesting that olfaction constitutes a form of landscape—an intangible, elusive, and boundaryless virtual landscape (Porteous, 1985). Because smellscapes are discontinuous in perception, fragmented in space, and occasional in time (Kubartz, 2014), research on smellscapes remains limited. Since the mid-to-late 20th century, olfactory perception has gained attention as a key experiential ability for environmental exploration. Internationally, studies on smellscapes have increased since the 1980s, often in the form of olfactory exploration activities (Bushdid et al., 2014). In China, relevant research has focused on olfactory evaluation systems in scenic areas and other spaces, spatial design and construction, as well as the health and wellness functions and place attachment effects of smellscapes (Lo et al., 2006; Getz, 1993).

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In recent years, forest-based wellness and recreational tourism have gained increasing attention as a significant direction for sustainable development. Since 2016, a growing number of policies and initiatives have been introduced in various countries to promote the integration of ecological conservation and public health through forest experiences. As a result, the landscape design and sensory quality of forest parks have become a focal point in both academic research and practical development. Forest parks, typically comprising large areas of natural or planted forests, are characterised by abundant natural resources, clean air rich in negative oxygen ions, and plant-emitted volatile compounds that are often associated with therapeutic effects. Due to their unique natural attributes, these parks offer tourists the opportunity to experience diverse smellscapes. This study takes forest parks as the research subject and aims to explore, from the perspective of tourist perception, how smellscapes influence tourist experiences. Therefore, the study seeks to identify effective strategies for enhancing olfactory environments in forest parks and to provide valuable insights for tourism planners and managers.

2. Literature review

2.1. Conceptual framework

Definition of Smellscapes. Positive scents, such as floral scents, tend to evoke pleasant emotional responses, while negative scents, such as the stench of garbage, often trigger adverse reactions. For a long time, vision was regarded as the noblest and most superior of the senses, often associated with rationality, clarity, and even divine perception. In contrast, olfaction was considered a primitive biological instinct, marginal and unworthy of scholarly attention. However, with the advancement of sensory experience research, academic focus has gradually expanded beyond the visual domain. In the 1980s, geographer Porteous first introduced the concept of the “smellscapes” (olfactory landscape) in his seminal work «Smellscape» (Porteous, 1985). He argued that smellscapes are spatially unfixed, making their perception discontinuous, fragmented, and occasional. Further expanding on this idea, researchers proposed that olfaction can shape space, contributing to the atmosphere, narrative, and even the form of the environment (Alkasasbeh & Ghinea, 2020).

Definition of Tourist Perception. The definition of tourist perception originates from the field of psychology, which examines how humans perceive the world through their sensory systems (Sun et al., 2024). The incoming sensory data is then filtered, interpreted, and reconstructed through the individual’s knowledge and personal experiences, ultimately forming personal perception. In the context of tourism, tourist perception (Na et al., 2023; Bustamante Martínez et al., 2024) not only influences how tourists evaluate a destination but also has a direct or indirect influence on their travel-related decision-making processes. This process is understood as a gradual deepening of perception, developing from surface-level impressions to more comprehensive and reflective evaluations. Based on previous studies, it can be summarised that tourists’ perception is formed across three stages: before, during, and after travel.

2.2 Theoretical foundations

Grounded Theory. Grounded theory is a qualitative research methodology that tries to uncover the underlying core meanings behind observed phenomena through systematic coding of the collected raw data to develop theoretical assumptions based on the relationships among concepts (Mekawy, 2022). In this study, NVivo 11 Plus was employed to conduct a three-level coding of olfactory-related tourist comments from forest parks, which served as the primary data source. Through this process, key dimensions of tourists’ perceived value of forest park scents were extracted and analysed. Based on the findings, targeted recommendations for the enhancement of smellscapes in forest parks are proposed.

Tourists’ Perceived Value Theory. Tourists’ perceived value has been recognized as a new source of competitive advantage and has a significant impact on consumer behaviour, customer satisfaction, and loyalty.

During interactions with the external environment, tourists either actively or passively receive information, which is then internalised into personal perception, representing their cognitive evaluation of tourism products or services. Research on tourists' perception adopts both specific and holistic perspectives, with commonly used measurement indicators including destination awareness, satisfaction, and attitude (Sahabuddin et al., 2026). This study explores tourists' perceptions of smellscape through the lens of tourists' perceptions and employs grounded theory to construct a model of tourists' perceptions of forest park smellscape.

2.3. Related studies

Related Studies on Smellscape. Research from international scholars on smellscape has primarily focused on the planning and implementation of "smellwalks" and the creation of smell maps. Current studies related to smellscape could be categorised into three main areas:

- (1) Research on the Perception of Smellscape: Previous studies (Wankhede et al., 2023; Kubartz, 2014; Liang et al., 2024; Lygum & Xiao, 2025) conducted detailed studies on the perception of smellscape, including the associative meanings and content evoked by such perceptions.
- (2) Research on the Construction of Evaluation Systems for Smellscape: Studies in the past developed evaluation indicator systems for health-oriented smellscape from the perspective of public perception (Na et al., 2023; Lygum & Xiao, 2025; Parra Saad et al., 2025).
- (3) Research on the Design of Smellscape in Public Spaces: Researchers explored the application of scent characteristics and functions in the creation of olfactory environments across various types of public spaces (Na et al., 2023; Ischer et al., 2014).

Relevant Studies on Tourist Perception. Tourism destination products may be tangible or intangible, and smellscape can also be regarded as a component of the tourism offering (Na et al., 2023; Bielska et al., 2022). Research on tourists' perception primarily focuses on two aspects: the formation and evaluative analysis of perception, and the construction of perception models (Digance, 2003).

Related Studies on Tourists' Perception. Online reviews (Fazal-e-Hasan et al., 2024; Na et al., 2023; Gupta & Sharma, 2019) reflect tourists' preferences and experiential evaluations, serving as valuable data for improving tourism products and services. In recent years, such research based on online texts has mainly focused on two key areas: perceived image and perceived value.

- (1) Perceived Image: Previous studies (Thomas & Richins, 2003) analysed tourists' perceived comments to depict the image of tourism destinations as perceived by tourists. In addition, researchers further refined the concept of perceived image by introducing the notion of perceived mental imagery and adopted an image-tagging approach to categorise and label destination images based on tourists' impressions (Starosta et al., 2019).
- (2) Perceived value: Researchers applied the theory of tourists' perceived value (Fazal-e-Hasan et al., 2024; Sahabuddin et al., 2026). Based on the extraction of high-frequency terms from tourist reviews, they summarised the dimensions of perceived value and proposed targeted suggestions for improvement corresponding to each dimension.

Identifying the Blind Spots in Tourist Smellscape Research. Studies using online textual data have concentrated on perceived image and perceived value (Na et al., 2023). Online reviews provide a large volume of research data and significantly broaden the scope of investigation. During the literature review, it was noted that there is a lack of research on olfaction from the perspective of consumer behavior, as well as limited studies specifically addressing olfactory environments in forest parks.

3. Methodology

3.1. Research data collection

Web-Based textual data related to forest parks from the period 2017 to 2022 were selected for analysis. Due to the large user base and abundant travel reviews on Ctrip, a popular Chinese travel platform, a web crawler was deployed using rule-based configurations in the HouYi Collector to extract relevant information from the site. A keyword search for “forest parks” was performed, and forest parks with a rating above 4.0 and a relatively high number of reviews were selected for data extraction. The review timeframe was restricted to comments posted between January 2017 and January 2022. After obtaining the raw data, reviews were screened to identify those containing olfactory-related content. Following deduplication and manual filtering to eliminate promotional content unrelated to forest parks, a total of 9,020 olfactory-related comments were retained as the dataset for analysing tourists’ olfactory perceptions.

3.2. Data preprocessing

Since the data collected were obtained from web-based sources, manual validation was conducted to ensure the objectivity and authenticity of the textual content. The preprocessing process included the following steps: (1) Perspective Filtering: Comments were manually screened to retain only those reflecting genuine tourist experiences. Promotional content from marketing accounts, park advertisements, and travel guides was excluded to preserve the credibility of the dataset. (2) Deduplication and Text Cleaning: Duplicate entries were removed. Sentences lacking semantic meaning or dominated by symbols/emoticons were filtered out. Obvious textual errors were corrected. (3) Synonym Merging: Semantic standardisation was performed by unifying synonymous phrases. For instance, expressions such as “worth visiting” and “worth a trip” were consolidated into a single term “recommended destination”. (4) Olfactory Keyword Screening: To extract smell-related perceptions, keywords such as “fragrant”, “smelly”, “smell”, “sniff”, “odor”, “air”, and “scent” were used. Text search functions were applied to identify relevant comments, which were then manually verified to confirm they reflected tourist olfactory experiences. (5) Stopword Filtering in High-Frequency Analysis: Non-informative words such as “one” and “some” were added to the stop-word list during high-frequency word analysis. After multiple rounds of refinement, a final set of valid high-frequency terms was established. After the above processing steps, a total of 9,020 smell-related tourist comments were retained for further analysis.

3.3. Extraction of olfactory perception factors of forest park tourists

Using the ROST CM6 software, a high-frequency keyword analysis was conducted on the collected textual data, summarising the top 50 most frequently occurring terms. Since the dataset includes comments specifically related to tourists’ olfactory perceptions in forest parks, the most frequent word identified was “air”, indicating that air is both the most easily perceived and most salient element in tourists’ smellscape experiences. Among the top 50 words, the terms were categorised into nouns, adjectives, and verbs.

Sentiment analysis is defined as a computational technique within natural language processing that identifies, extracts, and categorises subjective information—such as opinions, emotions, and attitudes—from textual data (Jim et al., 2024). This task plays a pivotal role in transforming unstructured textual content into actionable insights, with wide-ranging applications in domains such as business intelligence, social media monitoring, healthcare, and public policy (Sharma et al., 2025). Methodologically, sentiment analysis spans a spectrum of approaches, from lexicon-based systems relying on sentiment dictionaries (e.g., SentiWordNet, VADER) to machine learning and deep learning models. In recent years, pre-trained language models—particularly transformer-based architectures such as BERT and RoBERTa—have demonstrated superior performance

in capturing contextual semantics and adapting to domain-specific linguistic patterns (Jim et al., 2024; Sharma et al., 2025). Despite significant advancements, the field continues to face persistent challenges, including the detection of linguistic phenomena such as sarcasm, irony, and context-dependent sentiment, which often undermine classification accuracy. Furthermore, ethical concerns related to data privacy, model bias, and the responsible deployment of sentiment analysis systems have been increasingly emphasised in recent systematic reviews (Mao et al., 2024). These considerations underscore the complexity of sentiment analysis as both a technical and sociotechnical endeavour, necessitating careful design and evaluation in real-world applications.

3.4. Data coding and analysis

The 9,020 tourist reviews collected from forest parks were systematically merged and sequentially numbered (e.g., the first review from the Ctrip website was labelled XC01, the second XC02, and so on) to facilitate subsequent research. Two-thirds of the comments were used for open coding, while the remaining one-third was reserved for theoretical saturation testing. All reviews were imported into NVivo 11 Plus for qualitative analysis. Open coding involved extracting concepts from the sentences and “labelling” the text to identify key themes. To summarize concepts from an objective perspective, for example, the comment “The park environment is great, and the air is very fresh. The city is usually heavily polluted, but here you can breathe fresh air and feel instantly relaxed. The park is full of greenery—it's like a natural oxygen bar! Definitely worth visiting” can be segmented into several parts during the coding process. During the coding process, NVivo tracks the frequency of each concept and the number of reference points associated with it. Following the above coding approach, a total of 6,791 tourist comments were coded line by line, with corresponding concepts and initial dimensions extracted.

In this study, NVivo 11 Plus software was employed to compare and correlate the ten initial dimensions, defined as axial coding analysis. The initial dimensions were further refined, ultimately resulting in four core dimensions: olfactory aesthetic value, recreational and wellness value, olfactory emotional value, and olfactory experiential value.

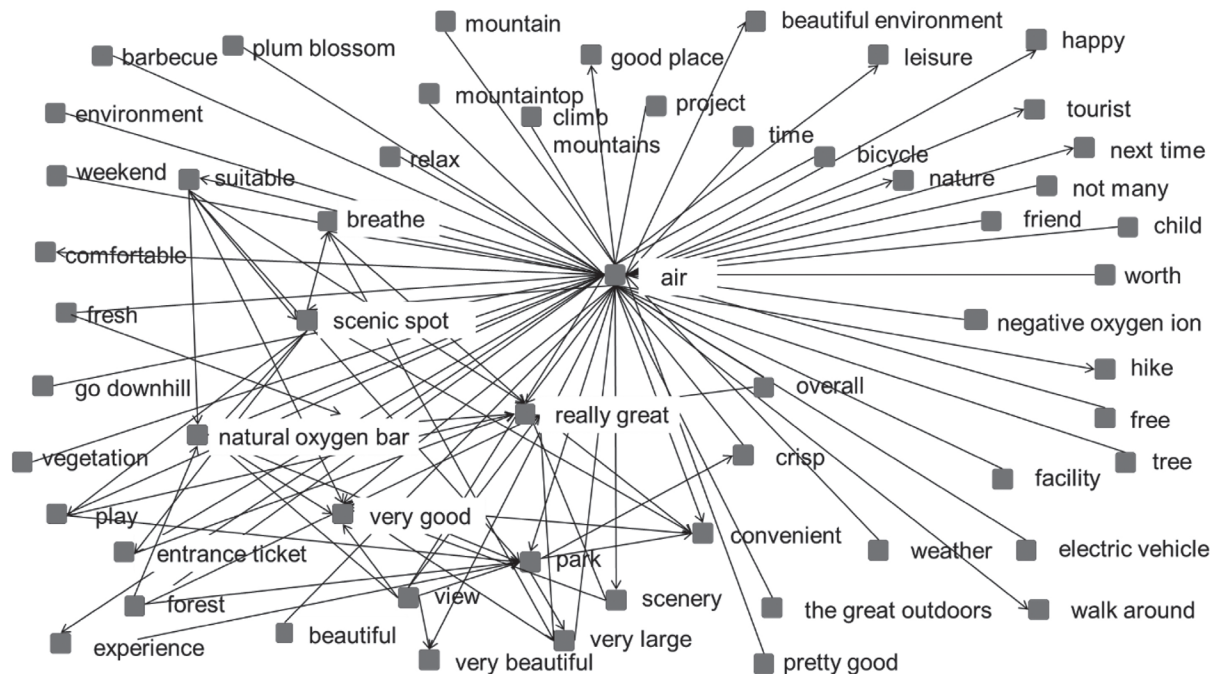
To ensure the reliability and validity of grounded theory, a theoretical saturation test must be conducted on the original data. If the above coding procedures no longer generate new concepts, the data can be considered theoretically saturated. One-third of the reserved comments were used for the test, and it was found that the dimensions derived from the coding corresponded exactly to the dimensions established in this study, without new elements emerging. Therefore, this study concludes that the constructed theoretical model (Figure 3) has reached saturation.

4. Results

4.1. Keyword frequency analysis

Many adjectives—such as “very nice”, “fresh”, “worthwhile”, and “refreshing”—reflect positive emotional expressions, suggesting that tourists’ olfactory perceptions are generally favourable (see Table 1). Based on the high-frequency words, a semantic network diagram was generated through the software. As shown in Figures 1 and 2, “air” serves as the central node, representing the core element of tourists’ olfactory perception in forest parks. The noun group includes “air”, “scenery”, “forest park activities”, “ticket”, and “time”, indicating that in addition to olfactory perception, tourists are also concerned with practical aspects of the park experience. In terms of verbs, words like “breathe”, “play”, and “hike” reveal preferred in-park activities.

Figure 2
Semantic network of high-frequency words



4.2. Sentiment analysis

Using the ROST CM6 software, sentiment analysis was conducted on tourists' olfactory perceptions of forest parks to explore their emotional tendencies. As shown in Table 2, among tourists' comments on the smells of forest parks, the results indicate that tourists' comments regarding forest park smells are predominantly positive. Specifically, positive emotions account for 90.91% (8,200 comments), neutral emotions for 4.33% (391 comments), and negative emotions for 4.76% (429 comments). Overall, the proportion of positive sentiment holds an absolute advantage, suggesting that tourists generally express favourable emotions in their olfactory experiences and post-visit feedback. This also indirectly reflects high satisfaction among tourists, which is further supported by the high frequency of positive descriptive terms identified earlier. Negative emotions slightly outnumber neutral ones. Although both account for a relatively small proportion, they should not be overlooked.

Table 2
Composition of positive and negative emotions

Emotion type	Intensity	Frequency (Entries)	Proportion (%)
Positive emotion	Mild (0—10)	2510	27.83
	Moderate (10—20)	3075	34.09
	High (Above 20)	2615	28.99
Neutral emotion	—	391	4.33
Negative emotion	Mild (-10—0)	390	4.32
	Moderate (-20— -10)	31	0.34
	High (Below -20)	8	0.10
Total	—	9020	100

4.3. Data coding and analysis

In total, 34 concepts and 10 initial dimensions were identified. These dimensions include positive odors, negative odors, health and wellness functions, sensory smell, closeness to nature, self-discovery, comfort and relaxation, sense of pleasure, social connection, and cost-effectiveness. An example of open coding is presented in Table 3. Axial coding analysis details are provided in Table 4.

The step of selective coding involves further exploring the relationships among the axial dimensions to derive a core dimension through abstraction. The core dimension forms a related, theoretical, and logically coherent relationship with the core dimensions. On this basis, a theoretical model is constructed. In the development of grounded theory, scholar Glaser proposed theoretical models, including causal relationship models and dimensional models (Glaser, 1978). The dimensional model, in particular, reflects the hierarchical relationship between major and minor dimensions. In this study, through continuous comparison of the core dimensions and a review of relevant literature, "perceived value" was identified as the core dimension. The components of "olfactory aesthetic value," "olfactory experience value," "recreational and wellness value," and "olfactory emotional value" together constitute the specific connotation of "tourists' perceived olfactory value." These four aspects primarily shape the tourists' perception of forest park smellscape. Accordingly, this study adopts a dimensional relationship model to construct and present the perceived olfactory value dimensions of forest park tourists, as shown in Figure 4.

Table 3
Open coding results of tourist comments

ID	Initial dimension	Extracted concepts (examples)	Original statement (Example)	Reference Frequency	Date of comment (YYYY-MM-DD)
01	Positive smell perception	High air quality	Fresh air, pleasant surroundings—really enjoyable. The forest park offers an excellent environment and can be described as a genuine natural oxygen bar. (XC270)	4628	2020-9-29
		Floral fragrance	Amid the thronging crowd, delicate fragrances wafted gently—an experience of pure beauty. (XC04)		2021-3-15
		Scent of nature	It was truly a pleasant journey. Upon arriving in Ningyuan, the refreshing scent of nature filled the air, the sky was blue, the trees were green, and the scenery was beautiful. I felt completely relaxed. (XC4227)		2018-12-11
		Earthy fragrance	The air after the rain carried a faint, fragrant scent of earth. (XC5557)		2020-8-8
		Fresh scent of vegetation	The cool mountain breeze carried a distinctive fragrance of grass and trees. (XC4014)		2020-10-23
02	Negative smell perception	Unpleasant toilet odor	The most disappointing part was the dirty toilets in the scenic area, with a strong and unpleasant smell. (XC1891)	62	2018-3-14
		Strong diesel smell	Don't sit in the front row—the diesel smell is very strong. (XC2562)		2021-7-3
		Animal odor	Probably due to the nearby dairy farm, the air was filled with a bad odor, which was really unpleasant. (XC510)		2017-5-1
		Polluted water smell	The first part of the park was disappointing—dried-up, murky stream giving off an unpleasant smell. (XC3311)		2017-8-16
		Overpowering food odor	Many people were eating instant hotpot on the viewing platform—the strong smell and cigarette smoke made the experience really poor. (XC3824)		2021-9-19
		Vehicle exhaust fumes	There was no separation of pedestrians and vehicles, so while walking, you constantly inhale car exhaust—it was really annoying. (XC4464)		2019-9-15
		Cigarette smoke	The air quality was terrible. The park is big, but the barbecue area was choking and had no ventilation system! The barbecue set was bad too—would not recommend. (XC12)		2021-6-6
		Paint odor	The paint smell was unbearable. I couldn't even stay at the mountain top—it was suffocating. (XC2194)		2018-6-25

Table 3 (continued)

03	Health and wellness functions	Relieve fatigue	With ample oxygen, I felt refreshed and energized throughout the visit—didn't feel tired at all. (XC635)	134	2017-12-30
		Purify the lungs	It felt like a place detached from the mundane world—perfect for spending an afternoon immersed here, nourishing the eyes and cleansing the lungs. A true natural oxygen bar. (XC2340)		2018-4-1
		Beneficial to health	This scenic area is rich in negative oxygen ions—breathing the air here often is good for your health. (XC5636)		2018-6-2
04	Olfactory perception	Oxygen inhalation	The air was excellent, perfect for bringing children out to breathe in some oxygen. (XC920)	721	2017-6-17
		Pandemic-related air demand	After finally being able to go out during the pandemic, I just wanted to find a place with a good natural environment to breathe fresh air. (XC2011)		2020-4-1
05	Embracing the natural world	Respiratory experience during exercise	It's worth visiting Jingyuetan National Forest Park—a place where I can go hiking several times a week and breathe in the fresh air of nature. (XC4607)	68	2017-10-2
		Intimate encounter with nature	Feeling refreshed and relaxed—it's a natural oxygen bar and a chance for intimate contact with nature! (XC5496)		2017-10-7
			On the day I arrived at the park, I felt a deeper connection with nature. The air was as fresh as I had imagined. (XC4228)		2018-12-11
06	Self-discovery	Escape from urban pollution	The air in the park is so fresh! Beautiful environment! Clear lake water! It's a truly refreshing half-day escape from urban pollution. (XC465)	116	2017-4-19
		Get away from the city hustle and bustle	Been here many times—getting away from the city hustle just to breathe fresh air. (XC2058)		2017-7-13
		A destination desired by urban residents	The natural oxygen bar is something longed for by people living in cities. Even a deep breath here tastes sweet. (XC3159)		2019-2-11
		Relieve the fast pace of urban life	Urban life is usually too fast-paced—occasionally visiting an oxygen bar to breathe fresh air is a great relief! (XC3378)		2017-11-1
07	Comfort and relaxation	Relax the body and mind	Being close to nature, the air in the suburbs is especially fresh. It's been a long time since I felt this relaxed. (XC307)	259	2017-3-25
		Comfortable	The oxygen level on the mountain is extremely high, making it especially comfortable. (XC4030)		2019-10-16
		Pleasant	Breathing in the spring-scented air feels truly pleasant. (XC887)		2020-4-6
08	Sense of pleasure	Enjoy	My love for this place is genuinely heartfelt. I've visited three or four times, and each time I discover something new. I especially love the mountain air—rich in oxygen and incredibly comfortable. (XC4023)	367	2020-3-26
		Feel refreshed	As soon as we parked and reached the entrance, it felt completely different from the city—the air was excellent. Walking into the park, I instantly felt great. I'd been feeling unwell lately but today was different—my mood lifted immediately. (XC5614)		2021-4-18
09	Social connection	Trip with family	I brought my parents here specifically for oxygen therapy. The air is great, full of negative oxygen ions. (XC2240)	157	2021-5-21
		Trip with friends	A natural oxygen bar—very relaxing outing with friends, and online ticket booking was convenient. (XC7701)		2017-8-23
10	Cost-performance assessment	Worth visiting	The park has a great environment and very fresh air. Compared to the heavy pollution in the city, breathing the fresh air here really clears the mind. The park is very green, truly a natural oxygen bar! Definitely worth visiting! (XC5654)	245	2018-4-15
		Nice place to visit	Immersed in the park, I felt mentally refreshed. It's a great place to relax and breathe fresh air. (XC5564)		2017-1-13
		Not worth it	The environment is nice, but unfortunately there are very few resting spots. The newly built pavilions smell strongly of paint and have no seating at all—very disappointing and not worth it! (XC6717)	34	2020-11-8

Table 4

Axial coding

Main dimension	Initial dimension	Reference frequency	Percentage %
Olfactory aesthetic value	Positive olfactory	4690	69.06
	Negative olfactory		
Recreational and wellness value	Sensory perception of olfactory	1116	16.43
	Self-discovery		
	Cost-performance assessment		
Olfactory emotional value	Health and wellness functions	461	6.79
	Closeness to nature		
	Comfort and relaxation		
Olfactory experiential value	Sense of pleasure	524	7.72
	Social interaction		

Figure 3
Conceptual model of tourists' perceived value of smellscape

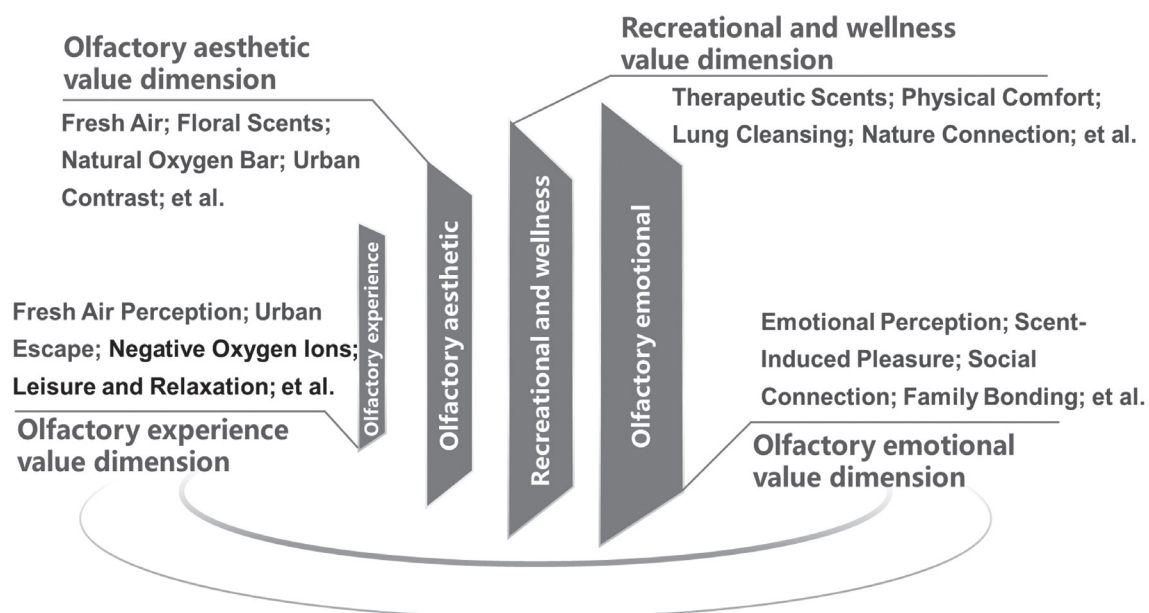
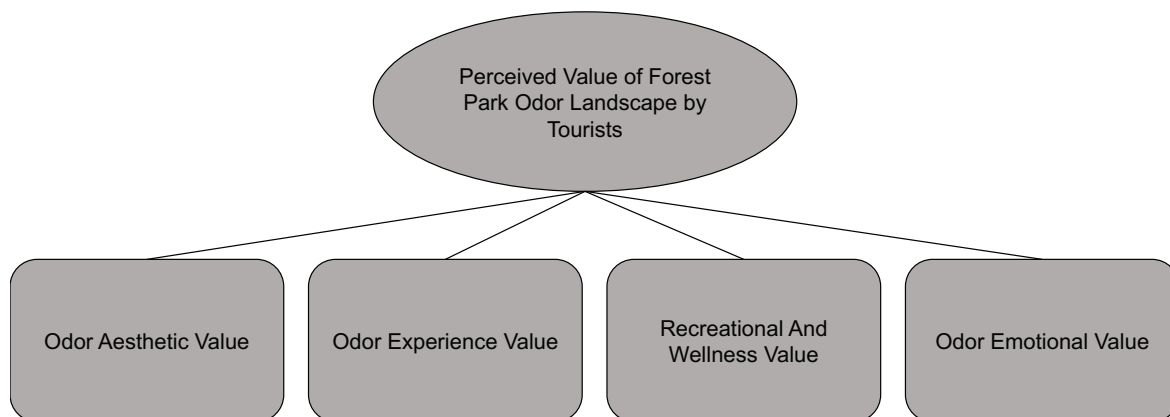


Figure 4
Dimensional structure of tourists' perceived olfactory value in forest parks



5. Discussion

5.1. Olfactory aesthetic value dimension interpretation

This study, based on grounded theory (Mekawy, 2022), identifies four dimensions in the theoretical model of tourists' perceived value of smellscape in forest parks: olfactory aesthetic value, olfactory experience value, olfactory emotional value, and recreational and wellness value. Descriptions of "air" typically include positive adjectives, for example "fresh," "clean," or "pleasant," reflecting tourists' affirmation of the quality, value, and aesthetic appeal of the olfactory environment. In addition to air, the second most frequently identified forest scent is floral scents. Floral scent is a naturally pleasant olfactory stimulus emitted by flowers. When people enjoy the visual beauty of flowers accompanied by their fragrance, their overall sensory pleasure is enhanced. Tourists often describe floral scents using terms such as "fragrant" or "aromatic," with emotional responses such as "refreshing" or "intoxicating," reflecting tourists' appreciation and affection. Notably, positive olfactory descriptors account for 98.67% of all identified scent-related expressions, indicating an overwhelmingly favourable tourist experience. Statements, such as "Perfect for a family outing—the air is fresh after the rain, with birds chirping and flowers blooming. A natural oxygen bar at our doorstep—really wonderful", "If there's anywhere in Shanghai with the best air, it must be the southeast coast. The wind from the sea brings Shanghai's freshest breath of air—well-deserving of its status as a national forest and natural oxygen bar", suggest that tourists associate fresh air and natural fragrances with aesthetic pleasure, environmental quality, and positive destination evaluation.

5.2. Olfactory experience value dimension interpretation

The fast-paced lifestyle and poor air quality in urban areas have caused some residents to yearn for nature and unpolluted air. For many city dwellers, escaping urban life and its pollution to experience fresh air is an appealing option. As one tourist noted, "The air on the mountain is rich in negative oxygen ions—it feels like being inside an air purifier filled with them. In this peaceful place, I can forget the noise and restlessness of the city, release stress, and relax. If I can, I will definitely come back again." Others expressed similar sentiments: "Being away from the city has its advantages—the air here really is comfortable to breathe.", "The forest park is wonderful. For us coming from a smog-filled city, it truly is a natural oxygen bar."

5.3. Recreational and wellness value dimension interpretation

Tourists' physical responses to the perception of forest scents often include feelings such as "comfortable," "relaxing," and "enjoyable." For example: "Strolling along the forest trails and enjoying a forest bath, appreciating the lake and mountains near the dam, breathing pure air, staying away from the city's complexity and noise — it's so relaxing and pleasant." This illustrates the soothing effect of forest scents on tourists. As for the wellness functions of forest park scents, many tourists believe that the fresh air is beneficial to lung health, frequently describing the experience as "lung cleansing": "Walking in the park with the kids, breathing fresh air, looking at green plants — it's good for the lungs and eyes." "I took a deep breath and felt like my lungs were completely cleansed."

5.4. Olfactory emotional value dimension interpretation

In the original tourist comments, references to clean air, floral fragrance, and the fresh scent of grass and trees are often accompanied by emotional expressions such as "refreshing," "uplifting," and "pleasant." This suggests that tourists exhibit a positive emotional tendency when perceiving the agreeable olfactory environment of forest parks. Beyond sensory pleasure, the act of smelling these natural scents also stimulates a spiritual and aesthetic appreciation of the environment, as illustrated by the following comment: "The oxygen-rich mountain air brings a unique sense of intoxication; walking into the forest, surrounded by abundant negative ions, one can enjoy the enchanting and intoxicating mountain atmosphere."

6. Conclusion

6.1. Theoretical implications

This study utilised web crawling technology to collect user review data related to forest park scents from the Ctrip travel website. Grounded theory was employed to conduct three levels of coding—open coding, axial coding, and selective coding—ultimately constructing a tourist-perceived value model of forest park smells-capaces and analysing the meanings and relationships of primary and secondary dimensions within the model (Figure 3). During the open coding phase, original textual data were “labelled” by extracting initial concepts. In the final selective coding stage, “tourist-perceived value” was established as the core dimension, and the relationships between the core dimension and the other core dimensions were established, confirming that tourists’ perception of forest park scents is composed of four dimensions: olfactory aesthetic value, olfactory experience value, recreational and wellness value, and olfactory emotional value.

6.2. Practical implications

6.2.1. *Promote the health and wellness benefits of scents*

The “China Natural Oxygen Bar” is one of the first national climate labels established by the China Meteorological Administration since 2016. It aims to identify and promote regions with excellent ecological and climatic resources. Although the general public is somewhat aware of the health benefits of forest park air, understanding remains superficial. Promoting “forest bathing” may help raise tourists’ awareness of the health and wellness benefits of forest scents and encourage them to experience these olfactory environments. Therefore, promoting messages such as “oxygen bar + health” and “oxygen bar + stress relief”—leveraging the oxygen bar brand, forest bathing activities, and the influence of key opinion leaders—can enhance public recognition of the health-promoting functions of oxygen bars and attract wellness-seeking tourists to engage in the experience.

6.2.2. *Preservation and enhancement of olfactory environments*

Beyond floral aroma design, forest parks can incorporate phytotherapy principles by planting species known for their soothing and therapeutic effects. The natural volatile compounds released by such plants can help form an eco-health zone, enhancing tourists’ wellness experiences. When families visit forest parks to enjoy the fresh air, special attention should be given to elderly and young children, whose physical stamina may not match that of younger adults, as high-intensity activities are difficult for them to participate in. Paths in designated oxygen bar zones should have gentle slopes, and rest facilities like benches should be placed at reasonable intervals. In addition, mobility aids such as bicycles can be provided to help tourists enjoy nature comfortably and effortlessly as they move through the park.

6.2.3. *Strengthen scent-based interactive experiences*

Due to the complex mixture of scents present in forest parks, tourists who lack knowledge of plant fragrances often find it difficult to identify the sources of the smells they encounter. To address this, scent mapping can be introduced by categorising the dominant scent types in different areas of the park and marking them clearly on a visual olfactory map. Pandemic-related conditions have highlighted the recreational value of suburban and rural natural areas, and fragrances have been shown to influence human psychophysiological activity and emotional responses, supporting the potential use of scent-based products to extend forest park experiences (Sowndhararajan & Kim, 2016; Bielska et al., 2022). Promoting forest scents beyond the park can broaden tourists’ avenues for olfactory appreciation, help identify potential enthusiasts of natural forest fragrances and attract them to forest parks through the sensory appeal of scent-based products.

6.3. Limitations and future research perspectives

Since forest parks contain a wide variety of scents and individual preferences vary, this study developed a preliminary model of tourists' perceived value by analyzing online reviews. While this work serves as a meaningful initial exploration, the current model remains constrained by the limitations of data acquisition. Mining user-generated content effectively captures spontaneous feedback, but the source data carries inherent biases. First, the sample skews toward internet-active populations, likely underrepresenting children and the elderly. Second, relying solely on Ctrip means we missed valuable discussions found on social networking sites (like Weibo and Xiaohongshu) or general interest forums (such as Dianping). Third, online opinions tend to be polarised; extreme positive or negative experiences are overrepresented, while neutral or moderate experiences often go unrecorded. The lack of demographic details (e.g., age and gender) further restricts our ability to analyse how different user groups perceive the landscape.

To address these gaps, future research should move beyond single-source data toward a more integrated, mixed-methods approach. Researchers could triangulate digital footprints with traditional surveys and in-depth interviews to capture a fuller spectrum of visitor experiences. Incorporating objective physiological measures, such as eye-tracking or EEG, would also help cross-validate subjective reports and reveal the micro-psychological mechanisms driving scent perception.

The research direction can be further refined. For instance, during the data collection phase, a distinction can be made between the perception of "air quality" and specific "olfactory experiences." This allows for odor landscaping to create more functional forest parks. Furthermore, introducing spatial geographic information system tools can help deeply reveal the role odour landscapes play in human-environment interactions, thereby further optimizing the planning and design of forest park landscapes.

Data Availability Statement

Derived data supporting the findings of this study are available from the corresponding authors on request.

Declaration of Competing Interests

The authors declare that they have no known competing interests that could have appeared to influence the work reported in this paper.

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