

PREFERENCE AND PERCEPTION OF URBAN GREEN SPACES: A CASE STUDY OF THE SOUTH CHINA NATIONAL BOTANICAL GARDEN

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(Received 8th Jul 2025; accepted 28th Oct 2025)

Abstract. User landscape preferences and recreation feedback are vital for optimizing urban green space stewardship. However, knowledge of how specific botanical garden landscape elements influence visitor behaviors and value acquisition is limited, especially from large-scale, real-world user data. To bridge this gap, this study explored relationships between landscape elements, visitor behaviors, and value acquisition using textual analysis. The objectives were to identify key landscape elements that attract visitors, understand their preferred recreational behaviors, and examine their connection to visitor values. The shopping basket method analyzed 6162 user evaluations of the South China National Botanical Garden from August 2017 to August 2022 on Meituan and Dianping platforms. The results showed that (1) natural elements were mentioned more frequently than non-natural elements, with greenhouses, flowers, fresh air, and trees being the main drivers of people coming to the botanical garden; (2) walking, taking photos, picnicking, biking, and flower viewing were the main behavioral activities; (3) Among the six identified value categories, aesthetics, emotion, and restoration were the most frequently mentioned.; and (4) significant correlation rules have been established between natural elements and their values. Natural elements such as lawn, fresh air, and a wide variety of plants were more likely to be associated with well-being and restorative experiences than aesthetic values. This study demonstrates that web review platforms serve as a novel tool for monitoring public interest in botanical gardens, providing a foundation to improve marketing strategies that enhance visitor experience and emphasize health benefits. These insights support adaptive stewardship and design to sustain botanical garden value in changing urban environments.

Keywords: *botanical garden, landscape elements, behavior preference, value acquisition, green space management and protection*

Introduction

Urban green spaces can provide people with leisure, fitness, recreational, and scientific educational services, all of which positively influence physical and mental health (Deng et al., 2020). In terms of physical health, recreation in urban green

spaces can relieve blood pressure and heart rate (García De Jalón et al., 2021), reduce the prevalence of overweight and obesity (Kabisch et al., 2021), promote respiratory health (Bozkurt, 2021), improve brain health (Lin et al., 2019), and support the nervous system (He et al., 2022). In terms of mental health, urban green spaces can help people relax mentally, reduce negative emotions, and relieve stress and anxiety (Stas et al., 2020). They also enhance people's positive emotions and overall sense of well-being by facilitating social interactions (Lin et al., 2019), especially during the COVID-19 pandemic, which helped to mitigate the negative impacts of lockdown on mental health (Allahyar and Kazemi, 2021).

Landscape elements of urban green spaces influence their value and users' behavior (Campagnaro et al., 2020). It has been shown that artificial elements and public art stimulate aesthetic qualities, while natural elements such as flowers, trees, and lawns evoke restorative values (Kong et al., 2022). Different age groups show preferences for different landscape elements due to their own needs (Yao et al., 2022). Exploring the correlation between unnatural elements and behavioral preferences across different age groups can assist in enhancing urban green space planning.

Tapping the value of specialized parks and allowing them to carry some of the functions of comprehensive parks, such as leisure and recreation, fitness and recreation, and social interaction, can help to promote green space sharing among residents of all classes, thus improving people's physical and mental health and well-being (Cheng et al., 2021). The State Council successively approved and agreed to establish the National Botanical Gardens in Beijing and Guangzhou, marking an important step in relocating botanical diversity conservation, plant scientific research, and education. The National Botanical Garden of South China is located in Guangzhou, Guangdong Province. The National Botanical Garden of South China is located in Guangzhou City, Guangdong Province. Its exhibition area features 38 specialized zones for the conservation of plants in tropical and subtropical regions of the world, including the Magnolia Garden, the Palm Garden, and the Ginger Garden, which serves as an excellent base for recreation and nature education.

Previous research on urban green space users has mainly relied on questionnaires, interviews, and email surveys. However, these conventional approaches are often constrained by sample bias, limited spatial coverage, and participants' subjective responses, which may not fully capture genuine public perceptions. Moreover, during periods of epidemic prevention and control, such as the COVID-19 pandemic, these methods became difficult to implement effectively. On the one hand, collecting data from online platforms saves economic costs and avoids screening errors generated by human participation; on the other hand, user-generated content on digital platforms provides spontaneous, large-scale, and real-time expressions of people's behavioral preferences and emotional experiences, offering a more authentic representation of public sentiment (Kong et al., 2022). Despite the growing availability of social media and review-based data, knowledge about how online user evaluations (i.e., Meituan and Dianping.com) can be systematically used to reveal the relationships between specific landscape elements, behavioral preferences, and perceived values of urban green spaces, particularly in botanical gardens, remains limited.

This gap restricts our understanding of how people interact with and assign meaning to specialized green spaces beyond general urban parks. Therefore, this study aimed to analyze user evaluations of the South China National Botanical Garden, collected from the Meituan and Dianping platforms, to explore the associations among landscape

elements, user behavioral preferences, and value acquisition. Specifically, the objectives were to (1) identify which landscape elements (e.g., lawns, plants, and greenhouses) contributed most to users' perceived physical and mental well-being, and (2) examine how visitors' behavioral preferences reflected their value perceptions of the botanical garden. It was hypothesized that natural landscape elements-such as flowers, trees, and open lawns-would be mentioned more frequently than artificial elements and would show stronger associations with restorative and well-being values. The findings of this study revealed that natural elements were indeed the most frequently mentioned, with walking, photographing, and picnicking as dominant behaviors. Among six value categories, aesthetic, emotional, and restorative values were emphasized most strongly, demonstrating that visitors' engagement with natural elements in the botanical garden promoted both aesthetic appreciation and psychological restoration.

Materials and methods

Study area

South China National Botanical Garden is located in Tianhe District, Guangzhou City (longitude 113.367196 east, latitude 23.181797 north), belonging to the southern subtropical monsoon climate, with sufficient light and heat, abundant rainfall, average annual temperature of about 20-22°C, average annual precipitation of about 1720 mm (Li et al., 2024, 2025), and a frost-free period of 340 d throughout the year. Its predecessor is the Institute of Agricultural and Forestry Botany of Sun Yat-sen University, which was founded by the famous botanist academician Chen Huanyong founded in 1929, approved by the State Council as a national botanical garden in May 2022, and became a high-quality nature education base in Guangdong Province in July 2022, with a total area of 333 hectares in its exhibition and scientific research areas, and 38 specialized parks such as Magnolia Garden, Palm Garden, Ginger Garden, etc., within the exhibition area, which contains 643 species of rare and endangered plants, and 337 species of national key wild-protected plants. 337 species. The service objects are oriented to the whole country and have important scientific value.

Data access

The data source consists of user reviews for the South China National Botanical Garden from August 2017 to August 2022, sourced from Meituan and Dianping.com. Each retrieved review contains the date of posting, the user name, and descriptive content. Of these, the descriptive content is the only source for identifying landscape elements, behaviors, and values, supplemented by photographic content for clarification when necessary. Identical descriptive content, advertisements, and irrelevant evaluations by the same user were removed to avoid double-counting, totaling 6162 evaluations. To further protect privacy, recognizable identifiers such as user names, photographs, and evaluation times will not be revealed in this study.

Data coding

Text and a full understanding of context were considered for data encoding. Landscape elements, behaviors, and values were categorized with reference to the literature on human-landscape interactions, and values were classified into six categories: aesthetics, well-being, restoration, euphoria, emotion, and memory (Kong et

al., 2022), which were extracted from the descriptive content and replaced with synonyms based on their meanings. For example, “flower” was selected as “peony flower” (*Paeonia × suffruticosa* Andr.), “hibiscus flower” (*Hibiscus mutabilis* Linn.), “flower” (*Hibiscus × mutabilis* Linn.), and “flower” (*Hibiscus × mutabilis* Linn.). (*Hibiscus mutabilis* Linn.) and “*Rhododendron simsii* Planch.” “Walking” was chosen as “walking,” “strolling,” “walking slowly,” “hiking” and “trekking.” Similarly, “happiness” was chosen to represent “happy,” “joy” and “enjoyment.” The classification of landscape elements, behaviors, and values is shown in *Table 1*, and the extraction results were imported into a Microsoft Excel spreadsheet for data processing (*Table 2*).

Table 1. Categorization framework for landscape elements, user activities, and perceived values in online reviews of the South China National Botanical Garden

Categorization		Representative word
Landscape elements	Naturally	Greenhouses, flowers, seasonal landscapes, plant variety, animals, large amount of green, lawns, scents, water features, exotic plants, sunsets, weather, shade trees
	Unnatural	Sightseeing buses, little trains, yogurt
Activity	Immobile	Photographing, picnicking, flower-viewing, camping, barbecuing, kite-flying, sight-seeing, partying, chatting, sitting quietly, sketching, talking, bird-watching, tea-drinking
	Dynamic	Walking, running, exercising, working out, riding the tour bus, feeding the fish, playing soccer, walking the kids, playing, group bonding, biking
Value	Esthetics	Good-looking, beautiful, beautiful, graceful, very beautiful, nice view, beautiful view, ecological, natural beauty, pleasant view, picturesque, scenic, splendid, first-class, scenic, empty, profound, spectacular, fascinating, pleasant, artistic beauty, colorful, warm, pleasant, ordinary view, lots of views
	Well-being	Happy, joyful, enjoyable, pleasant, good experience, satisfying, blissful
	Memorization	Popularization of science, eye-opening, good memories, unforgettable, satisfying curiosity
	Rehabilitate	Comfortable, relaxing, quiet, cool, resting, decompressing, clearing, serene, secluded, healing, calming
	excitement	Boring, interesting, novel, fantastic, rare, amazing, shocking, bland, vibrant, boring, exciting
	Feelings	Liked, satisfied, loved, lingered on

Table 2. Coding scheme examples for landscape elements, behaviors, and values in user evaluations. Each row shows representative words classified under two categories of landscape elements, two types of behaviors, and two value expressions

Representative word	Landscape element 1	Landscape element 2	Behavior 1	Behavior 2	Value 1	Value 2
Example 1	Lawn	Many plants	Picnic	Camping	Happily	Relaxing
Example 2	Greenhouse	Flower	Photograph	Popularization of science	Delightful	Broaden horizons
Example 3	Sunset	Waterscape	Chat	Walk	Elegant	Decompression

Each evaluation may contain multiple landscape elements, behaviors, and values

Statistical analyses

The frequency of coded elements and values was counted. The frequency with which words are mentioned serves as the basis for preference ratings and suggests the degree of importance of landscape elements and specific values. The higher the frequency, the more the element and value were noticed. To investigate whether there is an association between landscape elements and specific values, the strength of the association between landscape elements, behaviors, and values was examined using the shopping basket analysis “arules” package (Hahsler et al., 2011) in R version 4.2.1. This relationship is usually in the form of a rule “ $a \rightarrow B$ ”, where a is the antecedent (i.e., landscape element, behavior, or value) and B is the consequent (i.e., landscape element, behavior, or value). The existence of the prior implies the occurrence of the outcome. The threshold values for support and confidence were set to 2% and 25% in this study to filter out rules with low support and confidence, respectively. The boosting value was set to be greater than 1 to measure the interest of the extracted rules, i.e., the correlation between the rule’s prior and outcome terms.

Results

Landscape elements

As shown in *Figure 1*, there is a clearer preference for natural and unnatural elements. In terms of natural elements, users tend to mention greenhouses, flowers, fresh air, trees, and diverse plant species. Unnatural elements such as Huanong yogurt and sightseeing cars attracted people’s attention. Natural elements, such as flowers, lawns, plants, and fresh air, were mentioned more frequently than non-natural elements, like Huanong yogurt. Descriptions involving specific plants include peony flowers, camellias (*Camellia* sp.), harvest flowers (*Mucuna birdwoodiana* Tutcher), orchids (*Cymbidium virescens* Lindl.), and larch (*Taxodium distichum* (L.) Rich.). Among them, the fallen fir, as one of the eight scenic spots in Yangcheng, has brought many people to the Garden. This study shows that people prefer landscape elements such as flowers, greenhouses, lawns and trees in the Arboretum. The lawn offers better visual openness and serves as the main place for people to take photos, camp, picnic, kite fly, and enjoy social interaction and group activity space. Most people mentioned a wide variety of plants, and some mentioned dynamic landscapes (sunset, wind blowing, etc.) as well as seasonal landscapes, indicating that the seasonal beauty of the plants in the South China National Botanical Garden is well received. Some said they would visit regularly to see the flowers, conveying a deep attachment to the place.

Activity behavior

People’s activity behaviors mainly include walking, taking photos, picnicking, biking, flower viewing, camping, barbecuing, kite flying, walking children, sightseeing, partying, running, and so on (*Fig. 2*). Static activities include plant viewing, firefly watching, photo taking, camping, etc., and dynamic activities include walking, running, playing ball games, playing with toys, etc., which can help people exercise, relieve stress, reduce mental fatigue, and enhance the sense of well-being and place attachment (Du et al., 2021). Different landscape elements attract people of various ages. The large lawn is particularly popular across all age groups. It serves a wide range of functions, such as camping, barbecuing, taking photos, flying kites, playing chess, playing cards, and more. Through field exploration, it was found that images related to running, walking, and

playing ball games were more frequently posted in the evening. However, this pattern may not fully reflect the actual timing of these activities. Some visitors indicated that they would regularly bring their children to the Botanical Garden for flower viewing, highlighting its importance in recreation, plant viewing, and science education.

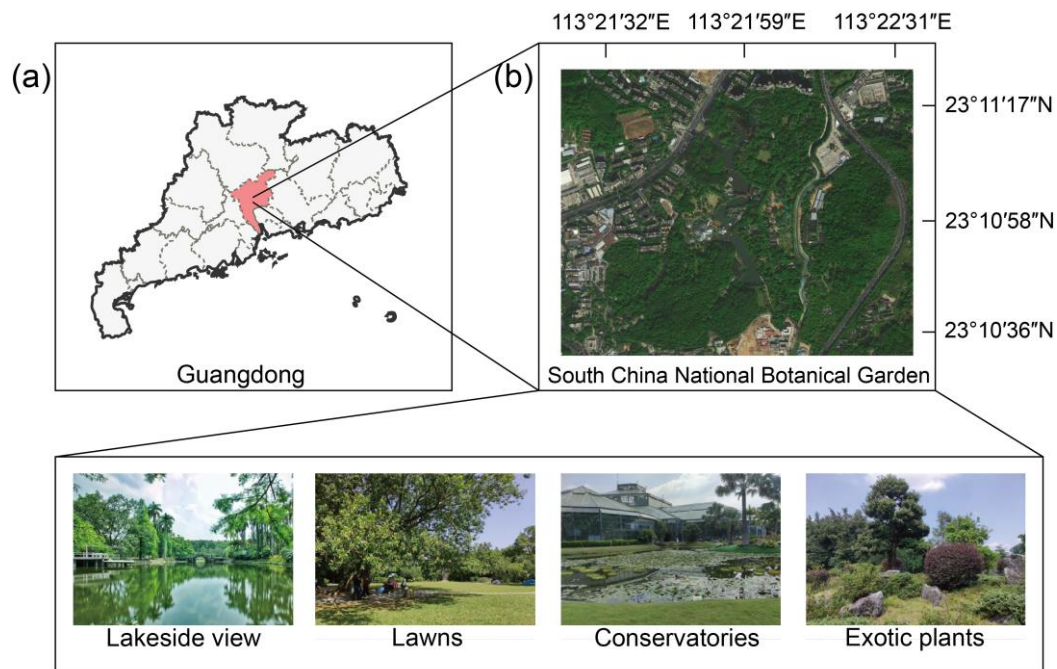


Figure 1. Landscape elements in the South China National Botanical Garden. This figure illustrates the distribution and types of landscape elements identified within the garden, emphasizing the prominence of natural features such as greenhouses, flowers, trees, fresh air, and diverse plant species. These elements form the core of visitor attraction and shape user experiences in the botanical garden

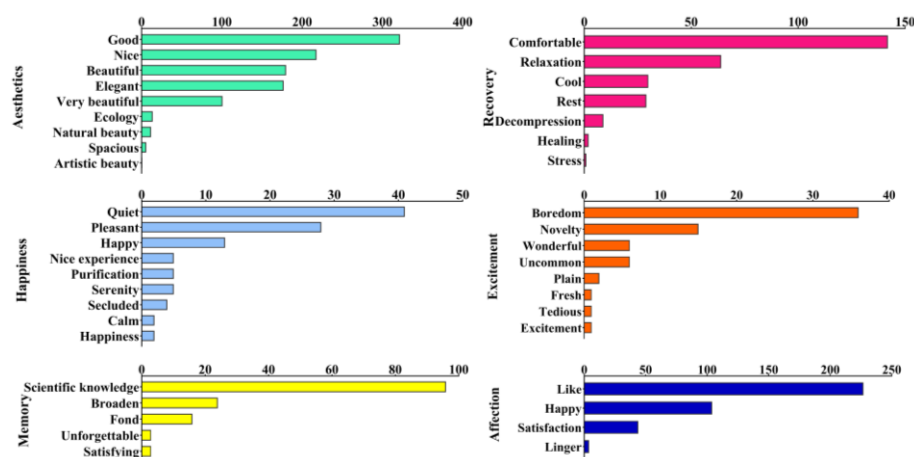


Figure 2. Interrelationships among landscape elements, user behaviors, and value perceptions in the South China National Botanical Garden. This figure illustrates the connections between various landscape features, the activities they encourage among visitors, and the values that users derive from these experiences. It highlights how natural and artificial elements influence behavior patterns such as walking, photography, and picnicking, ultimately shaping visitors' aesthetic appreciation, emotional well-being, and restorative experiences

Value acquisition

In terms of results, people's use of the Arboretum was primarily an aesthetic and restorative experience. The aesthetic experience transcended the restorative one, with people describing the Arboretum as a beautiful, graceful, and picturesque environment. Most people expressed a sense of recovery and closely related feelings of well-being, such as "comfortable," "relaxing," "cool," "resting," "decompression," "healing," "stress relief," "happy," and "quiet," and that the environment is "beautiful," "pleasant," and "quiet". People used the words "popularization of science," "eye-opening," "good memories," and "unforgettable," "satisfy curiosity" to describe the memory value of the Botanical Garden, "like," "satisfied," "linger on like," "satisfied," "linger" to express their love for the Botanical Gardens.

Correlation between landscape elements, user behavior and values

The results of the shopping basket analysis showed a close association between landscape elements and values (Table 3). The elevation of the lawn for picnics and photo taking was 5.520 and 1.989, respectively, suggesting that lawn elements induce these behaviors. Flowers, desert greenhouses, picnics, and fresh air were found to stimulate aesthetic experiences. People tend to associate walking, flower viewing, and relaxation with comfort. Affective values were induced primarily by natural elements, including lawns, a wide variety of plants, greenhouses, camping, fresh air, and flowers. The most frequent mentions of greenhouses in people's evaluations were in the tropical rainforest area (quirky plants), the alpine polar region (air-conditioned and protected from the heat), and the desert area (cactus (*Opuntia dillenii* (Ker Gawl.) Haw.), and cactus (*Echinopsis × wilkensisii*), which suggests that the peculiar shapes of the plants can excite and shock people, and generate a sense of novelty.

Table 3. Association rules linking landscape elements, visitor behaviors, and perceived values. This table summarizes the significant association rules identified in the analysis of visitor reviews at the South China National Botanical Garden. Each rule reflects the relationship between a "pilot project" (landscape element or behavior) and a corresponding "result" (behavior or value), with metrics of support, confidence, and lift (promotion degree) indicating the strength and significance of each association. These findings reveal key patterns in how specific landscape features and activities relate to visitor experiences and value perceptions

Rule ID	Pilot project	Result	Degree of support	Confidence level	Promotion degree
[1]	Lawns	Picnic	0.013699	0.404762	5.519885
[2]	Beautiful	Happy	0.011281	0.202899	1.998390
[3]	Lawns	Photograph	0.011281	0.333333	1.988782
[4]	Flower	Prettier	0.024174	0.2	1.969841
[5]	Picnic	Photograph	0.024174	0.32967	1.966927
[6]	Good-looking	Photograph	0.047542	0.324176	1.934145
[7]	Elegant	Fresh air	0.010475	0.25	1.903374
[8]	Desert greenhouse	Good-looking	0.011281	0.264151	1.801161
[9]	Enjoy leisure	Walk	0.014504	0.28125	1.586506
[10]	Flower	Scenic	0.041096	0.34	1.490954
[11]	Comfortable	Walk	0.017728	0.25	1.410227
[12]	Have fun	Walk	0.014504	0.219512	1.238248
[13]	Flower-viewing	Walk	0.012087	0.208333	1.175189
[14]	Picnic	Scenic	0.019339	0.263736	1.156526
[15]	Like	Scenic	0.026591	0.244444	1.071928

People associated the recovery experience with natural elements such as trees, plants, and lawns. There were association rules between lawns, fireflies, and well-being, whereas no strong associations were found between non-natural elements and excitement, emotion, and memory. Access to fresh air was a driving factor for visits to botanical gardens, with people expressing pleasure in terms of “oxygen bar” and “full of negative ions.” The positive emotional value provided by fresh air justifies the need to protect more urban green space. Good air quality is also the main reason why people enjoy walking, running and working out in the Botanical Gardens.

Discussion

Landscape elements and user behavior

People’s inherent impression of botanical gardens is plant viewing, which is their primary attribute. This study shows that science education, sports and fitness, and recreation are the main motives for people to enter botanical gardens. In addition to their core functions of plant science popularization and conservation, botanical gardens are increasingly taking on roles in recreation, sports and fitness, and health and wellness.

The attraction of South China National Botanical Garden is its greenhouses (strange plants) and colorful flowers, which enhance people’s sense of well-being. The scent of the flowers has a function in rehabilitation and health care; however, missing the flowering period can make people feel unhappy and regretful. People’s preference for colorful plants and the associated positive value should be of concern to green space managers. To this end, plant configuration forms should be further enriched, plant color richness and colorful plant coverage should be increased, and the use of aromatic plants should be improved (Wan et al., 2021; Meng et al., 2025).

The high number of people mentioning the lake may be due to the Botanical Garden’s proximity to the densely populated urban village. The crowded living environment prompts neighboring residents to enter the Botanical Garden to seek a more open landscape and enjoy nature without any obstruction. The openness of the space provides a place for people to relax and de-stress, confirming previous research linking visual open space to recovery (Kong et al., 2022).

Giving new value to botanical gardens

People are aware of the beneficial effects of nature, including cultural ecosystem services such as beauty appreciation, relaxation, place attachment and recreational opportunities (Park et al., 2020). Green spaces are an influential component when people look for restorative environments that help users recover from stress (Veitch et al., 2021; Sheng et al., 2024; Ma et al., 2025). Previous studies have shown that green environments contribute to increased well-being by promoting distractions, photo opportunities, recreational activities, and social interactions (Tu et al., 2020; Ugolini et al., 2020). The COVID-19 pandemic has increased the emphasis on the healing effects of nature and the acquisition of restorative, aesthetic, and emotional values (Allahyar and Kazemi, 2021).

Odd plants are united with excitement, and oddly shaped exotic plants often evoke a different aesthetic experience. Observing oddly shaped plants can bring a sense of surprise and well-being for park users. In the future, the ornamental qualities of plants

should be further explored (Tu et al., 2020), and horticultural research and application should be strengthened to create landscapes with substantial visual impact and memory points, fostering a sense of lingering experience. In addition, understory spaces have been designated to evoke a sense of tranquility and contribute to stress reduction.

Many people point out that the landscape outside the greenhouse is no different from that of an ordinary park, which may be because apart from the blooming period, the greenhouse is primarily green, with a predominance of natural landscapes, and that there are many parks in Guangzhou, such as the historic Yuexiu Park, the Baiyunshan Park with its mountainous landscapes, and the many excellent city parks that raise the aesthetic threshold for the public. How to stand out in the many parks, avoid homogenization of the landscape and form their own characteristics is a problem that botanical garden managers need to consider.

Policy recommendations

The results of the study may provide recommendations for optimizing care and developing social marketing strategies to maximize the use of the South China National Botanical Garden. Sophisticated care and improved facilities can encourage people to revisit and stay in the botanical garden longer. On the contrary, sloppy maintenance management, unclear guidance systems, and poor service staff attitudes are factors that can negatively affect people's experience and reduce their willingness to use green space (Kou et al., 2021). Among them, ticketing and checking are the first processes for people to enter the South China National Botanical Garden, and the staff's service attitude will affect the subsequent experience. Therefore, managers should effectively manage and maintain the South China National Botanical Garden.

Thunderstorms are prevalent in the Lingnan region, and rain and sun-shading facilities should be added as appropriate. Considering the ageing population of China and the impact of the three-child policy, the needs of vulnerable groups should be addressed in the future, such as adding handrails in public restrooms and shared baby strollers. Some people mentioned that mosquito bites affect the length of park visits and the value captured, so consideration could be given to increasing the use of anti-mosquito lamps. In response to the inconvenience of non-motorized car rental experienced by people, the route planning can be optimized by placing the car rental point close to the entrance. Some people mentioned that some areas of the South China National Botanical Garden are desolate and withered, with high plant depression and inconspicuous features, which will increase the sense of insecurity during the low peak of human flow during the epidemic. The balance of landscape development needs to be further improved for this reason. Many people pointed out that the landscape outside the greenhouse is no different from ordinary parks, except for the flowering period, the greenhouse outside the greenhouse is mostly green plants, the majority of natural landscapes, and there are many parks in Guangzhou, such as Yuexiu Park with a long history, Baiyunshan Park with mountainous landscapes, and many excellent city parks for the public to raise the aesthetic threshold. How to stand out in the many parks, avoid homogenization of the landscape and form their own characteristics is a problem that botanical garden managers need to consider.

People's preference for green space and its associated restoration value suggests that a detailed guided instruction system will be a significant consideration for future park enhancements. Some visitors suggested comparing the South China Botanical Garden to the Royal Botanic Gardens of the United Kingdom to create a paper guidebook. This

guidebook would include a brief description of the plants in each division, their flowering periods, and photographs, to enhance people's memory experience. In response, the Botanic Garden, as a specialized park, fully utilizes its science education function by introducing an interactive plant identification system, increasing plant science and conservation activities, and promoting interaction between people and the landscape. People mention cultural and tourism products less often (e.g., Huanong yogurt). Some tourists during the visit gave suggestions for enhancing cultural and tourism products. For example, a tourist mentioned that the tourism products of Xishuangbanna Botanical Garden (frostbite ointment, petal cake, etc.) are highly praised and suggested that South China National Botanical Garden could consider selling plant pots. Future park management also involves the challenge of raising users' awareness of the perceived value of botanical gardens. There is a need to enhance education and promote the beneficial value of using botanical gardens for human health to maximize participation in the urban green environment.

In this study, user evaluations were extracted through the online platform, but the demographic sociological characteristics of the users could not be further accessed. Whether there is a correlation between users' behavioral preferences and value acquisition and the visitors' social attributes (income, occupation, etc.) is a topic that needs further investigation. In addition, the perceptions of some older adults and children regarding the botanical gardens were difficult to convey through the online platform, and this issue needs to be further explored in future studies.

Conclusions

This paper extracts user reviews from Meituan and Dianping.com to identify people's preferences for landscape elements and their perceived value of the South China National Botanical Garden through content analysis. Analysis of data from citizen-driven online platforms shows that natural elements are mentioned more frequently than non-natural elements. Walking, taking photos, engaging in botanical science, camping, and biking are the main activities of people entering the South China National Botanical Garden. Aesthetics, happiness, and restoration were the most mentioned expressions in the six identified value categories. Significant association rules were established between natural elements and values. Natural elements such as flowers, lawns, fresh air and a wide variety of plants were strongly associated with well-being and restorative experiences compared to aesthetic values. The results of the study provide a basis for the optimization of botanical garden care and the development of social marketing strategies.

Funding. This study was funded by the Science and Technology Projects in Guangzhou (No. E33309), National Natural Science Foundation of China (Nos. 42207158 and 32471680) and the Science and Technology Program of Guangdong (No. 2024B1212080005).

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