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Restorative Environment Characteristics of an Urban Forest Based on Big Data Analytics

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Abstract: Since the COVID-19 pandemic, urban forests have become important restorative environmental spaces for which demand-customized management based on users' experiences is needed. We collected 21,557 data points from blogs from January 2020 to December 2021. For data analysis, keyword frequency, term frequency–inverse document frequency, and sentiment analyses were conducted using TEXTOM 4.0, and a semantic linkage network was established and analyzed using Gephi 0.92. In the analyses, the restorative environment components of "being away", "fascination", "extent", and "compatibility" were derived from users' experiences. Fascination, which stems from natural objects such as rocks, valleys, and trails, was derived the most frequently, and being away and compatibility, representing leisure activities such as climbing and walking, formed the largest cluster in cluster analysis. Sentiment analysis revealed a high positive word rate of 91.6%, with favorable feelings accounting for 87.5%, whereas the proportion of joy and interest (12.5%) was relatively low. In addition, this study showed that hard fascinations such as sports, entertainment, and education are required to improve the experience quality in urban forests as restorative environments. Hence, the necessity of local government policies and projects is emphasized.

Keywords: urban forest management; forest culture; urban forest mountain; restorative space; semantic network; COVID-19

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1. Introduction

In the post-COVID-19 era, the world has seen an increase in non-face-to-face activity with a corresponding decrease in outdoor activity, leading to mental and physical health issues such as depression and anxiety. Amidst these changes, the value and importance of green spaces is being reevaluated [1–3].

The United Nations [4] noted that new models of urban development incorporating green space are needed for urban resilience and sustainability, emphasizing the roles and responsibilities of local governments and practitioners. Scholars worldwide have been interested in the changes in urban green space utilization patterns and value perceptions after COVID-19 [1]. They have found that urban landscape utilization has increased in green spaces that allow for outdoor activities [5–10], and the role of green space in health promotion is being increasingly valued [3,9,11–14]. In addition, from a social equity perspective, the importance of accessibility has been emphasized to ensure that anyone, anywhere, can easily reach green spaces [9,11,14,15]. The preferences for and visits to urban and suburban forests with dense trees and forests, abundant shade, and trails have increased [5,7]. This is important not only for physical health but also for mental health as it promotes stress reduction and psychological safety [11,14,16] and social health by allowing for social interactions and bonding [12,13,16]. Therefore, it is important for governments and managers to consider how to manage urban forests to promote physical, mental, and

social health in the post-COVID-19 era. Chae [17] has proposed eco-friendly–healthy city plans to change the utilization of urban forests in Korea after COVID-19.

Relationship studies between urban forests and cities have revealed that natural environments such as urban forests in high-density living environments have important value for restorative purposes for people [18]. Moreover, they are essential elements in creating a livable city because they provide a restorative experience [19]. Kaplan [20] has found that the natural environment helps recover attention and relieves stress. In line herewith, natural elements, such as sunlight and wind, rather than pictures of indoor plants, have been found to contribute to attention improvement and fatigue reduction [21]. These effects have been suggested to positively contribute to people's lifestyles during COVID-19. To confirm this, we selected Seoul metropolitan city as our research area in this study.

As of 13 April 2020, Seoul (Korea) is the city with the highest increase (~51%) in green space visits worldwide since the COVID-19 outbreak [22]. In Korea, approximately 63% of the land area is comprised of mountainous forests, and most cities have natural urban forests that are managed [23]

Seoul has a high proportion of urban forests—approximately 22% [24]—with a city topography in the form of lines and rings that locate these forests very near residential areas, making them highly valued as urban green and leisure spaces [25]. Based on the unique Korean topographical characteristics and perceptions of nature, urban forests have been used and valued pluralistically since the Joseon Dynasty (14th century) [26]. Chae and Cho [27] analyzed big data on the public use of urban green spaces such as forests, watersides, parks, and walkways collected from blogs and found that people used them as a space for daily leisure activities, appreciating natural resources and engaging in activities such as exercise and walking, expressing the emotional word happiness. This research revealed that users of urban forests directly or indirectly expressed their expectations and experiences of them as a restorative environment.

Researchers are attempting to analyze semantic changes in peoples' descriptions of urban forests before and after the COVID-19 outbreak [27,28]. Forest management according to residents' perception [29], preferred motivation and companion characteristics [30], and ecological sensitivity [31] have been raised. Chae [18] suggested that there is a role in reflecting the demand for urban forests in the era of COVID-19 and considering the physical and topographical characteristics of the city. Lee and Yeon [28] collected data from 20–30-year-olds and analyzed 13 mountains, suggesting the need for customized services by age group. Rice and Pan [32] suggested that it is necessary to identify changes and impacts through a spatial application of big data collected after COVID-19. In the future, after COVID-19, urban forests need to be managed as restorative spaces that reduce stress and positively affect mental health. However, there is a lack of studies on perceptions, behaviors, and emotions based on individual experiences of urban forests as a restorative environment. In addition, although numerous recent studies have aimed to improve service quality based on perceptions by analyzing individual experiences, opinions, and evaluations [33,34], and other studies have revealed cultural context and place meaning [35], there is a lack of humanistic social scientific research on urban forests.

Based on the restorative environment theory [20,21], this study aimed to derive the characteristics of the restorative environment components of urban forests based on big data from the NAVER and DAUM blogs on social media. Our end goal was to suggest implications for how to manage these environmental factors to enhance their restorative effect.

2. Literature Review

According to the legal definition of urban forests [36], including mountains in city areas, in Korea, all forests and trees preserved and managed in urban areas are expected to enhance citizens' health and recreation activities, promoting emotional wellbeing and activity-based programs. In addition to their social and personal environmental benefit value, urban forests have been recognized for their psychological and spiritual benefits as users experience them. In particular, urban forests have been shown to be more effec-

tive in reducing stress than other natural environments, such as urban parks and green spaces [1,27,37]. This is because the intrinsic fascination for natural elements such as streams, green leaves, sunsets, and old forests is mentally consumed in daily life to restore and orientate attention. This is referred to as the attention restoration theory [20,38]. Therefore, it is necessary to examine urban forests as a restorative environment. Kim [39] found that perceived stress among urban residents was negatively correlated with restorative environment use through leisure activities, while it showed a significant positive correlation with restorative experiences, which, in turn, affected quality of life. This suggests the impact of restorative environments and their negative correlation with stress. Many scholars have sought to understand the sense of a place based on the embedded memories and experiences of individuals in that particular place [40]. More recently, big data from social media, where individuals' experiences are recorded, have been analyzed to understand this. For example, Kim [35] sought to understand the cultural context and flow of local identity in Seochon. Researchers have attempted to analyze individual perceptions by collecting online data [34] as a measure of immediate service experience [33]. Chae and Cho [27] analyzed perceptions by clustering blog data and identified experiences such as usage behaviors, activities, time, and other behaviors. They also extracted emotional language data during their analysis. A review of studies related to the attention restoration theory [41–44] suggested four restorative environment components, "being away", "fascination", "extent", and "compatibility", and four restorative experiences, stress relief, attention recovery, energy revitalization, and health promotion, for attention restorative environments.

Urban forests as a restorative environment are conveyed through the experience of the above four components of restorative environments [20,41]. Studies on the restorative environment [42], environmental components [41], and recovery effects [45] have been conducted by examining structured questionnaires and reviewing the literature [46]. In this study, we attempted to structure and interpret the experiences recorded by individuals using big data. Our approach is different in that we used blog big data to clarify the components of the restorative environment [20,41,43] and to reveal that perception and behavior are related to emotion. We derived positive and negative sentiments on how perception and behavior affect the components of the restorative environment and established a model for how to apply these results to the management of urban forests (Figure 1).

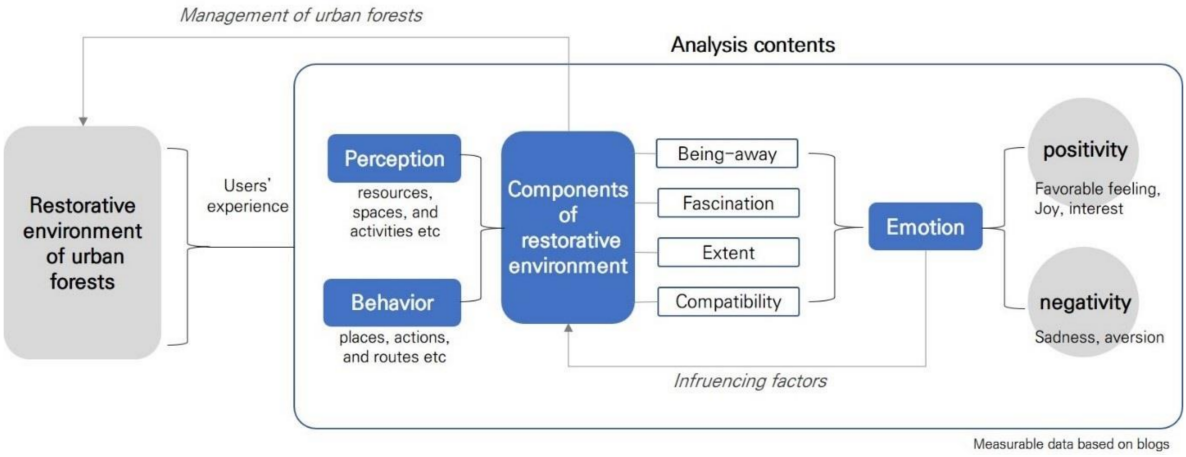

Figure 1. Study model.

3. Materials and Methods

3.1. Study Area

The study area is Mt. Dobongsan, located in Dobong-gu, Seoul, Republic of Korea. Mt. Dobongsan has an altitude of 740 m above sea level and an area of approximately 24 km^2. It is located approximately 17 km from the center of Seoul (Jongno-gu). Dobongsan was designated as a national park in 1983 and is one of the 100 most famous mountains in Korea [47].

There is a natural ecological conservation area located in a metropolitan area, which is rare in the world [48]. It has high ecological, historical, and cultural values. For example, it is home to more than 1300 plant and animal species. It is home to wild boars, elks, and raccoons, and 9 species in 6 families of 3 orders have been found. Endangered species such as the leopard cat and falcon live here, and Mongolian oak, Quercus oak, and pine grow on the mountain [49]. Dobongsan also harbors the Dobongseowon Confucian Academy and Gakseokgun (Seoul Metropolitan City Monument No. 28), Cheonchuksa Temple Wooden Buddha Statue (Seoul Metropolitan City Tangible Cultural Property No. 347), and Maae Sari Pagoda (Seoul Metropolitan City Cultural Property No. 65) [48]. It attracts 10 million visitors per year. Its main resources include Dobong Valley, Obong Peak, and the National Mountain Museum. Dobongsan Subway Station is easily accessible from Seoul, Gyeonggi, Incheon, and other metropolitan areas (Figure 2). In addition, Mt. Dobongsan was one of the top three mountains in the metropolitan area, with high numbers of visits for hiking purposes after COVID-19 [28].

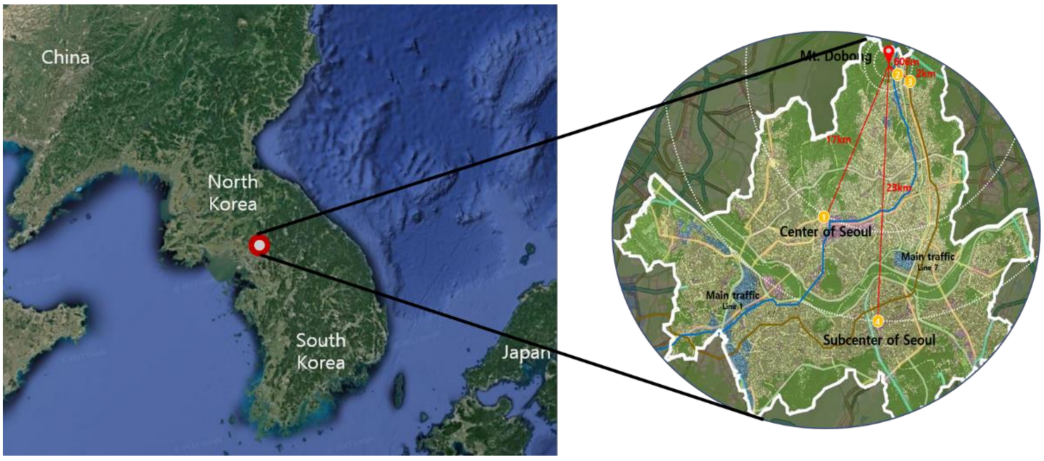

Figure 2. Map of the study area.

3.2. Data Collection and Analysis

3.2.1. Data Collection

In this study, text mining was conducted using the keyword "Dobongsan". Data were collected using TEXTOM 4.0, a program specialized in web and social network analysis, from Naver and Daum blogs, which are two representative portal sites in Korea. The data collection period was from 1 January 2020 to 31 December 2021, after the COVID-19 outbreak, for a total of two years, with a monthly collection rate of 1000. The collected data were automatically cleaned, and terms such as "apartment", "comprehensive real estate holding tax", and "buying and selling", which are related to real estate advertisements, were deleted from the cleaned files. A total of 21,557 data points were collected as the final data (Figure 3).

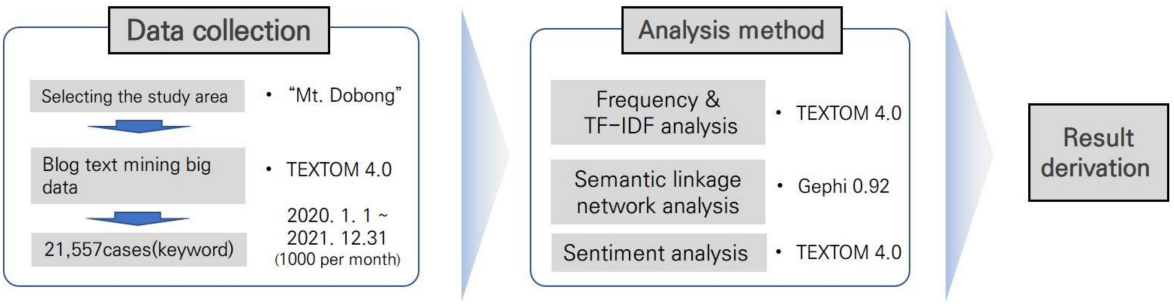

Figure 3. Data collection and analysis flow.

3.2.2. Data Analysis

For the data analysis in this study, frequency analysis, term frequency-inverse document frequency (TF-IDF) analysis, and sentiment analysis were conducted using Textom 4.0, and semantic network analysis was conducted using Gephi 0.92 (Figure 3). The results of the text mining analysis, frequency analysis, and TF-IDF analysis were compared. TF-IDF indicates how important a word is within a specific document. The higher the frequency of a word in a specific document and the fewer documents containing that word among all documents, the higher the TF-IDF value. Therefore, this value can be used to filter out words that are common in all documents and extract keywords from documents. For sentiment analysis, words related to emotions in the original data were categorized as positive or negative in the emotion lexicon set by TEXTOM. Positive keywords are classified into three words: interest, favorable feelings, and joy, and negative keywords are classified into six words: pain, sadness, anger, fear, surprise, and rejection. Each keyword was measured on a 7-point scale and analyzed [50]. Semantic network analysis uses network analytic techniques on paired associations based on shared meaning as opposed to paired associations of behavioral or perceived communication links [51]. The semantic network analysis program Gephi 0.92 was used to analyze centrality and modularity. Gephi 0.92 is an open-source program developed for the exploration and manipulation of networks, which has strengths in visual mapping compared to other existing connectivity analysis programs [52]. In this study, centrality and modularity analyses were conducted. In general, connectivity networks consist of nodes (nodes and vertices) and connectivity relationships or arcs (links, arcs, and edges). Through network analysis, it is possible to interpret what constitutes an important symbolic place and the relationships and nature of each symbol (place). Centrality analysis is mainly used to analyze the role and relationships of places, as it expresses how central a feature (place or actor) is in the network [53]. We used ForceAtlas2 for visualization analysis; we set the tuning scale to 400 and gravity to 1 and enabled overlap prevention. Average weighted degree was used because the degree value was high, including only the top 100 words. Node ranking was set to a minimum of 10 and a maximum of 100. For clustering analysis, we used modularity and set the parameter to 0.6, which is lower than the standard value of 1, because of the high clustering rate. The color of the nodes was based on the modularity to show clustering.

4. Results

4.1. Frequency and TF-IDF Analyses

The top 100 keywords for "Dobongsan", according to frequency analysis, are shown in Table 1. The 100 keywords can be categorized into the restorative environment components of fascination (F), being away (B), extent (E), and compatibility (C) based on the attention restoration theory, as shown in Table 2. Specifically, the keywords representing fascination were natural resources, such as Sinseondae Observatory, valley, and Obong peaks. The keywords representing being away were non-daily routine-associated words, such as weekend and Saturday. For extent, keywords were derived to identify the size of the space, such as parking lots, hiking trails, and ridge walking. For compatibility, keywords were derived for leisure activities, such as hiking, climbing, ridge walking, and exploration, indicating that the environment is suitable for such purposes.

Table 1. Frequency analysis results of the top 100 keywords.

Rank	Word	Frequency	Rank	Word	Frequency	Rank	Word	Frequency	Rank	Word	Frequency
1	Dobongsan Mountain	33,856	26	Start	1169	51	Thought	725	76	Seoninbong Peak	523
2	Hiking	7053	27	Darak Ridge	1158	52	Weekend	714	77	Ui	507
3	Climbing	6597	28	Visitor Center	1124	53	Parks	713	78	Mangwolsa Station	499
4	Hiking trails	6053	29	Autumn leaves	1108	54	Observatory	694	79	Dobongsan Entrance	489

Table 1. *Cont.*

Rank	Word	Frequency	Rank	Word	Frequency	Rank	Word	Frequency	Rank	Word	Frequency
5	Dobongsan Station	5414	30	Mangwolsa Temple	1080	55	Arrival	675	80	Wontongsa Temple	478
6	Bukhansan Mountain	5249	31	Weather	1063	56	Explore	652	81	Peaks	478
7	Dobong	5238	32	Departure	1016	57	Bukhan	647	82	Tower	463
8	Seoul	4279	33	Uijeongbu	991	58	Dobon-gu	644	83	Down	458
9	Sinseondae Observatory	3759	34	Bulamsan Mountain	941	59	Sky	629	84	Winter	451
10	Valley	3238	35	Landscape	934	60	Exit	629	85	Connecting	440
11	Obong	3077	36	People	924	61	Distance	606	86	Clouds	427
12	Ridge	2744	37	Bus	900	62	Seoul Changpowon	589	87	Exercise	422
13	Suraksan Mountain	2681	38	Baekundae Peak	883	63	Location	589	88	Transportation	422
14	Summit	2660	39	Friends	867	64	Changpowon	585	89	Saturday	421
15	Sapaesan Mountain	2540	40	Gwanaksan Mountain	837	65	Daily routine	583	90	Wind	412
16	Trail	2434	41	Fall	828	66	Jubong	579	91	Cheonggyesan Mountain	408
17	Rocks	2099	42	Ridge walking	822	67	Amsan Mountain	578	92	Day	401
18	Fortress ridge	1821	43	Bukhansan National Park	795	68	Recommended	573	93	Manjangbong Peak	398
19	Today	1725	44	Center	794	69	Subway	568	94	Near	398
20	Songchu	1468	45	Climb down	781	70	Parking lots	561	95	Dobong-gu Seoul	394
21	Madang rock	1455	46	Morning	761	71	Beginner	551	96	Dobong-dong	390
22	Uiam Rock	1446	47	Famous mountain	754	72	COVID-19	540	97	Insubong Peak	389
23	Section	1422	48	Entrance	749	73	Stroll	538	98	Next	385
24	Yeoseongbong Peak	1386	49	Landscapes	738	74	Namsan Mountain	534	99	Summer	382
25	Jaunbong Peak	1348	50	Cheonchuksa Temple	733	75	After a long time	530	100	Sunday	382

Table 2. Components of the restorative environment of Mt. Dobongsan.

Component	Keywords	Notes
Fascination (F)	Dobongsan Mountain, Bukhansan Mountain, Seoul, Dobongsan Station, Dobong, Sinseongdae Observatory, Valley, Obong, Suraksan Mountain, Summit, Sapaesan Mountain, Trail, Rock, Fortress, Songchu, Madang Rock, Uiam Rock, Yeoseong, Jaun, Darak, Changpowon, National Park, Visitor Center, Mangwolsa Temple, Uijeongbu, Bulamsan Mountain, Baekundae Peak, Gwanaksan Mountain, Center, Cheonchuksa Temple, Observatory, Bukhan, Jubong, Namsan Mountain, Inbong Peak, Ui, Mangwolsa Station, Wontongsa Temple, Tower, Bomun, Cheonggyesan Mountain, Sapae, Sugol, Manjangbong Peak, Seondae, Dobondong, Insubong Peak, Park, Famous mountain, Autumn leaves, Weather, Landscape, Sky, Amsan Mountain, Clouds, Wind, Peaks	Natural resources
Being away (B)	Today, Morning, Weekend, After a long time, Winter, Saturday, Day, Daily routine, Fall, Next, Bus, Subway, Transportation	Breaking out of the daily routine
Extent (E)	Connecting, View, Thoughts, Arrival, Start, Departure, Near, Hiking trail, Ridge, Section, Distance, Down, Exit, Location, Entrance, Parking lot, Dobong-gu Seoul	Sufficiency of space to use
Compatibility (C)	Hiking, Climbing, Ridge walking, Exploration, Recommended, Stroll, Exercise, Climb down, People, Friends, Beginner, COVID-19	The environment matches my needs

In addition, as shown in Table 3, the top 10 keywords identified by TF-IDF analysis were similar to those of the frequency analysis, but the top keywords were different. The

top keywords were mainly related to the purpose and location of leisure activities, such as mountain climbing, hiking, ridge, Seoul, and hiking trails. This shows that the experience factor of leisure activities is important, with keywords corresponding to compatibility of the environment matching peoples' needs, highlighting it as a notable component of restorative environments.

Table 3. Comparison of the top 10 keywords identified by frequency and TF-IDF analyses.

Rank	Keyword	Frequency Analysis	Keyword	TF-IDF Analysis
1	Dobongsan Mountain	34,345	Climbing	10,974.9
2	Hiking	7053	Hiking	10,951.3
3	Bukhansan Mountain	6822	Ridge	10,668.4
4	Climbing	6597	Seoul	10,022.3
5	Hiking trails	6053	Hiking trails	9994.79
6	Seoul	5913	Bukhansan Mountain	9788.31
7	Ridge	5826	Dobongsan Station	9197.08
8	Dobongsan Station	5414	Dobong	8850.96
9	Dobong	5354	Sinseondae Observatroy	7901.51
10	Sinseondae Observatory	3739	Obong	7707.33

4.2. Analyzing Semantic Networks

When the semantic linkage network was analyzed using cluster analysis (modularity), it was divided into seven clusters, as shown in Table 4, Figures 4 and 5. Cluster 1 was characterized by activity content and companion type, corresponding to leisure activities in Mt. Dobongsan, activity time, and activity period. This cluster was related to the C and B components presented earlier as restorative environment components and accounted for the largest proportion of 32%. Surprisingly, COVID-19 was ranked 72nd in the frequency analysis (Table 1) and was situated in Cluster 1 in this analysis. Cluster 1 corresponded to recreation, and the restorative environment components corresponded to C and B. This can explain the value of urban forests, which allowed people to escape from their daily lives during COVID-19 and engage in activities that suited their purpose. As pointed out by da Schio et al. [1], this is considered to be a feature caused by the change in daily mobility after COVID-19 and the demand for more natural areas.

Table 4. Cluster analysis of the semantic linkage network.

Cluster	Keywords	Ratio (%)	Nature of Clusters	Notes
1	Dobongsan Mountain, hiking, climbing, hiking trails, Sinseondae Observatory, Summit, Today, Madang rock, Start, Autumn leaves, Weather, People, Friend, Fall, Morning, Famous mountain, Cheonchuksa Temple, Thought, Weekend, Arrival, Daily routine, Recommended, Beginner, After a long time, COVID-19, Winter, Exercise, Saturday, Wind, Day, Next, Summer	32	Recreation	 Compatibility (C) Being away (B)
2	Bukhansan Mountain, Suraksan Mountain, Rock, National park, Bulamsan Mountain, View, Baekundae Peak, Gwanaksan Mountain, Landscape, Observatory, Bukhan, Sky, Amsan Mountain, Namsan Mountain, Peak, Tower, Down, Clouds, Cheonggyesan Mountain, Insubong	20	Seoul Landscape Resources	 Fascination (F)

Table 4. *Cont.*

Cluster	Keywords	Ratio (%)	Nature of Clusters	Notes
3	Seoul, Dobongsan Station, Trail, Section, Changpowon, Departure, Uijeongbu, Bus, Center, Park, Dobong-gu	19	Neighboring Connected Resources	 Extent (E)
4	Ridge, Sapaesan Mountain, Fortress, Uiam Rock, Darak, Mangwolsa Temple, Ridge walking, Ui, Mangwolsa Station, Wontongsa Temple, Connected, Bomun, Sapae	13	Scenic Resources	
5	Dobong, Valley, Visitor center, Exploration, Sugol, Seondae	6	Natural Resources 1	 Fascination (F)
6	Jaun, Entrance, Climb down, Jubong Peak, Inbong Peak, Manjangbong Peak	6	Natural Resources 2	
	Obong, Songchu, Yeoseong, Parking lot	4	Natural Resources 3	

Component	Fascination (F)	Being away (B)	Extent (E)	Compatibility (C)
picture				

Figure 4. Examples of components of the restorative environment of Mt. Dobongsan.

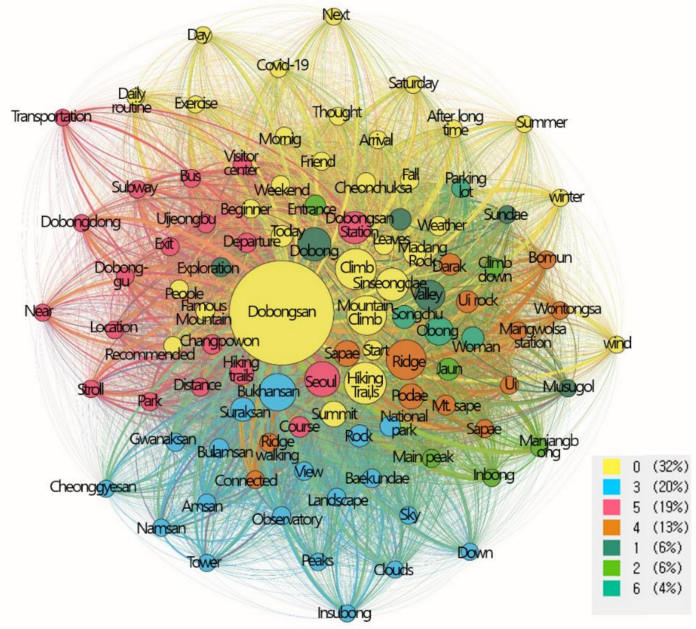

Figure 5. Semantic network analysis of keywords (over three degrees).

Cluster 2 involved mountains and landscapes in Seoul that are connected to Mt. Dobongsan as Seoul's landscape resources, such as Mt. Bukhansan, Mt. Bulamsan, Mt.

Suraksan, and Mt. Gwanaksan, or mountains with views. It was related to scale and accounted for 20% of the restorative environment component. It appeared at a high frequency, including the surrounding mountains. Cluster 3 included surrounding connected resources, such as Dobongsan Station, trails, Changpowon, and parks, which were related to the scale presented in the restorative environment component and accounted for about 19%. Cluster 4 included scenic resources, such as Mangwolsa Temple and Wondongsa Temple, which corresponded to the attractiveness suggested by the restorative environment component and accounted for approximately 13%. Clusters 5, 6, and 7 included natural resources, such as valleys, Manjangbong Peak, and Obong Peak, each of which corresponded to the attractiveness of the restorative environment component, and the total percentage was 16%, indicating that the same natural resources were perceived differently from different hiking trails. In summary, the proportions of the restorative environment components were 49% for F, 32% for C and B, and 19% for E, indicating that the proportions of the restorative environment components were appropriate in the perception clustering analysis.

4.3. Sentiment Analysis

The sentiment analysis showed an extremely high positive rate of 91.6% and a negative rate of 8.4%, as shown in Figure 6. Among the positive sentiments, 87.5% were favorable feelings, 8.6% were joy, and 3.9% were interesting. Among the favorable feelings were "Good", "Awesome", "Beautiful", "Natural", "Cool", "Pretty", and "Lovely". Words of joy included "Best", "Happy", and "Enjoyable", whereas expressions of interest included "New", "Looking forward to", and "Special". Negative words included "Hard", "Cry", and "Regrettable" for sadness, and "Difficult" for rejection. Based on the user experience, Mt. Dobongsan is perceived as an exceptionally positive place, but relatively few words for favorable feelings and joy were derived, and negative feelings regarding physical activity in leisure activities were expressed. Kim [39] suggested that stressed people experience restoration in the form of relaxation, tranquility, mental stability, and vitality in a nature-based healing restorative environment. He also suggested that this restorative experience affects health-related quality of life. It is interpreted that users who experienced urban forest mountains had a positive restorative experience. When divided into specific restorative experiences, rest, calmness, and mental stability corresponding to favorable feelings (87.5%) accounted for the majority, whereas the proportion of vitality-related keywords corresponding to joy and interest (12.5%) was relatively low.

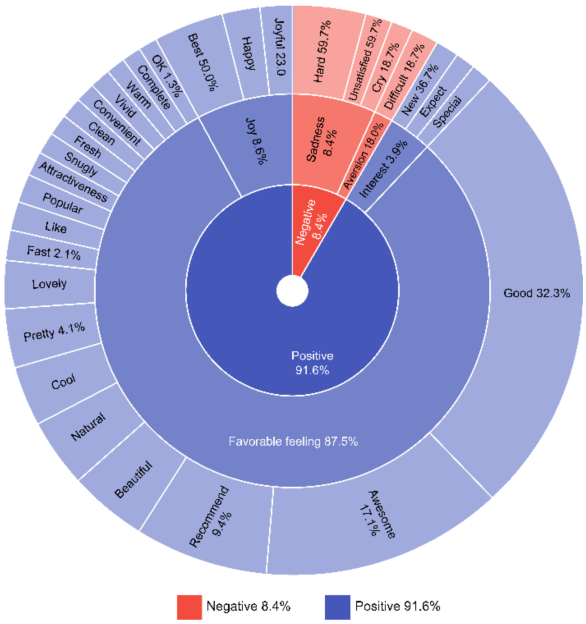

Figure 6. Sentiment analysis of Mt. Dobongsan.

5. Discussion

We investigated how urban forests played a role as a restorative environment and what were the restorative environmental components and characteristics of urban forests after COVID-19. We analyzed the recovery environmental characteristics of urban forests that citizens used and recognized through blog big data analysis for Mt. Dobongsan, one of the representative urban forests in the Seoul metropolitan area.

First, we found that urban forests in the Seoul metropolitan area played a role as a restorative environment, as previously suggested by Kaplan and Kaplan [38]. They suggested that the natural environment has four components constituting a restorative environment (being away, extent, fascination, and compatibility). Frequency analysis of the big data revealed that Mt. Dobongsan provided all four components. Among them, fascination appeared the most and was mainly related to natural resources. This shows that users are interested in natural elements, such as rocks, valleys, trees, etc., in urban forests. Herzog [41] suggested that fascination can be divided into "soft" and "hard" fascination. However, we found that "hard" fascination was rather limited as words corresponding to "soft" fascination were more often derived in the sentiment analysis, which will be discussed later. Therefore, to increase their value as a restorative environment, urban forests must provide "hard" beyond "soft" fascination. This is consistent with the research results of Herzog [54], who reported that attraction increases through the introduction of sports and entertainment elements to provide hard fascination. In order to enhance the attractiveness of urban forests as a restorative environment, it is necessary to introduce various activity elements.

Second, as a recovery environment, urban forests were classified according to their landscape characteristics. As a result of cluster analysis, a total of seven landscape resources were distinguished. However, strictly speaking, fascination (F) was classified into two clusters (2, 4/5/6/7), besides the compatibility (C) and being away (B) and extent (E) clusters (Table 4). F-2 included the natural scenery of Seoul connected to Mt. Dobongsan, and F-4/5/6/7 comprised natural and landscape resources by type within Mt. Dobongsan. F-2 is a very unique result, which shows that blog data represent users' experience of Mt. Dobongsan in terms of the overall recognition of the natural scenery of Seoul (surrounding mountains, valleys, etc.) connected to Mt. Dobongsan. In line herewith, Park and Hong [40] and Park [53] have pointed out that peoples' memories of a place have components of individual memory as well as integrated recognition. Clusters 4, 5, 6, and 7 were classified as natural and scenic resources, but all explained the characteristic landscape elements. Research has indicated that various individuals have preferences for different types of landscapes. While men have been found to prefer landscapes with a good view, women tend to prefer still-water scenes [18]. Similarly, da Schio et al. [1] reported that age, gender, and urbanization influenced attitudes towards urban forests and their use. Accordingly, the cluster shows a distinction between water spaces and mountain landscapes. This implies that it is possible to establish a customized landscape resource utilization plan and strategy for each subject considering each urban forest landscape characteristic in the future.

Third, sentiment analysis showed that urban forests are a highly restorative environment. This is in line with the finding in a previous study [27] that urban forests have a positive effect on people's sentiments. In this study, sentiment was expressed in more categories, but there was a slight difference with previous studies. In particular, most expressions were related to aesthetic experience and the appreciation of natural elements, whereas joy/pleasure or interest were less often expressed. It can be seen that there is a lack of words related to vitality. This is related to the concept of "soft" fascination introduced by Herzog [41,54], as mentioned above, and it was found that "hard" fascination was lacking. A close look at the negative words reveals that most of them were used as a means to express emotional healing and recovery despite the physical difficulties associated with mountain climbing. For example, the terms "Cry" and "Hard" were used to express mental difficulties associated with a restorative environment. It can be concluded that urban forests serve as a fundamental emotional healing/recovery environment that other sports

or leisure facilities in the city cannot provide. Hoh et al. [55] have evaluated that community gardens as urban forests have a higher leisure and recreation value than other values. In addition, Korcz et al. [56] suggested that not only dynamic activities, such as sports entertainment but also qualitative services, such as educational services, may be important. For example, they found that walking on an educational path improves happiness even when simply walking in a forest. Therefore, it is necessary to provide leisure services to enhance "hard" fascination and increase the restorative effect of urban forests.

6. Conclusions

We analyzed the user experience of Mt. Dobongsan, one of Seoul's representative urban forests, after COVID-19, based on restorative environmental components. Our study confirmed that Mt. Dobongsan served as an important restorative environment for people living in the city. They were mainly attracted to natural elements and were aware of not only Mt. Dobongsan but also the natural resources related to the mountain. In particular, we found that health and leisure facilities in the city provided components of a restorative environment, allowing for emotional healing. Vujcic et al. [16] have also suggested that the recreational function in urban forests after COVID-19 was important. However, while there was appreciation and utilization of the natural objects, they were not actively used as a means to provide interest and joy. In the future, these functions may be served through the provision of leisure activities with educational functions as well as the introduction of sports and entertainment elements. Our research results demonstrate that urban forests not only have physical effects but also contribute to mental health improvement, as previously shown for green spaces in a low-density area of Fuzhou, China, by Huang et al. [57]. Furthermore, Betro et al. [58] have suggested that the attention recovery environment can be reproduced not only in the natural area but also in eco-friendly architecture. Therefore, it is necessary to include urban forests in urban landscape design. Bornioli [19] recognized the potential and importance of urban forests as a restorative element in healthy city design, and their findings can guide the inclusion of urban forests as urban design elements in Korea. Our study confirmed that urban forests play an important role in the mental, physical, and social resilience of citizens. Users experienced the value of the natural resources of the urban forest at Mt. Dobongsan and used it as a restorative environment. However, hard fascination resources were relatively lacking. Urban forests provide an important restorative environment in cities, but if not only soft fascination resources but also hard fascination resources are accommodated, they will provide citizens with a more effective restorative environment. For example, an educational experiential trail around the remnants of the Confucian culture—the traditional culture of the Joseon Dynasty—in the valley or a safe and pleasant green walkway that connects the residential area to the urban forest would serve this purpose. In addition, forest leisure and sports programs such as orienteering, mountain biking, and a treetop walk could be implemented. To more effectively utilize urban forests in the future, it will be necessary to actively introduce various urban forest policies and spatial design programs. Urban forests are an important natural landscape in the densely populated city of Seoul, and preserving them in their original form should be a priority. Utilizing existing natural resources in a more effective way will enhance their utility as a restorative environment for urban residents who live far from nature. This study demonstrated the value of urban forests and provided directions for the effective utilization of these forests by examining their role and value as a restorative environment after COVID-19. While this study provided suggestions for ways to improve the value of urban forests as a restorative environment, structural associations between user sex- and age-specific preferences and urban design were not investigated and remain to be assessed in the future.

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