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An Extended Theory of Planned Behavior Approach to Analyzing Decision-Making Processes for Urban Park Use under COVID-19 in Seoul*,**

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Abstract

In a situation where activities outside the home are greatly restricted due to COVID-19, the desire and preference to use urban parks with a relatively low risk of infection are increasing. However, it is uncertain whether this leads to an increase in urban park use. Based on the theory of planned behavior (TPB), this study identifies the behavioral processes for urban park usage in Seoul under COVID-19 restrictions by analyzing urban residents' decision-making processes through a survey and structural equation model. The analysis results are as follows: First, as awareness of COVID-19 risks increases, the need to use urban parks increases while the attitude toward the use of urban parks decreases, leading to a decrease in park usage time. Second, the convenience and accessibility of urban parks have a positive effect on urban park use. Third, perceived behavioral control has a positive effect on the attitude toward urban park usage, leading to an increase in the park usage. Fourth, in terms of park type, users of waterfront parks spend longer times in the parks. The second through fourth results did not differ before and after COVID-19. These results suggest that when a pandemic is prevalent, it is necessary to increase accessibility and convenience to satisfy the needs for urban parks and to guide use in a safe direction. It is also necessary to create urban parks equipped with facilities and environments suitable for the prevention of infectious diseases. Moreover, by expanding 'risk perception' into the TPB model, this research provides a conceptual framework to predict and analyze the decision-making process of urban park users under COVID-19.

Keywords COVID-19, Urban Park, Decision-making, Theory of Planned Behavior (TPB), Structural Equation Model (SEM)
주제어 코로나19, 도시공원, 의사결정과정, 계획행동이론, 구조방정식 모형

Ⅰ. Introduction

As of March 11, 2020, the World Health Organization (WHO) declared COVID-19 a pandemic. All across the world, over 524 million people have been infected by COVID-19, and among them, more than 6.28 million people have even lost their lives to the virus (as of May 26, 2022). Many scholars and experts worldwide have pointed to this crisis as a historical turning point in the 21st century, with many of them assuming that even after the COVID crisis comes to an end, the world will not be able to return to the way things were before the pandemic (Kim, H.S., 2020).

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Indeed, COVID-19 has been transforming the way people live in urban areas. Notably, given that outdoor leisure activities outside the home have been significantly limited due to the pandemic, there has been increasing preference and demand for the use of urban parks, which involve a relatively low risk of infection. Since the spread of COVID-19, urban parks have evolved to provide expanded health and comfort functions (Kim, Y.K. et al., 2021). In the past, urban parks were considered to be a space serving as an antidote to address deteriorated sanitation and the spread of infectious diseases caused by rapid industrialization during the 19th century. Now, these classical functions of urban parks are again at the center of attention (Pae, J.H., 2020). This is because urban parks are now becoming a requirement for enabling urban activities even in cases of disasters, such as Covid-19 (Kim, I.H., 2020).

However, the way urban spaces are used varies depending on when and how infectious diseases occur, such as the scale of the target country, region, city, the timing of the pandemics, community spreads, and mass infection; this also applies to urban parks. For example, in the early stages of the COVID-19 crisis, from January to March 2020, the usage rate of urban parks was found to differ from country to country depending on the prevention measures implemented by each country and the level of infection spread. According to the Google Mobility Report, the usage rate of urban parks in Korea was 51% higher in the period of March 27-29 compared to January 2020, but in the US, Japan, and Italy, the figure decreased by 19%, 25%, and 90%, respectively (Lee, H.J., 2020).[1)] On the domestic front, the number of visitors to urban parks in Seoul was found to increase in the period from January to June of 2020, but the number tended to decrease in Daejeon during the same period. According to a big data analysis of the floating population conducted by the Smart City Department of Daejeon Metropolitan City (2021), it was assumed that Daejeon citizens refrained from going outside because they more sensitively responded to COVID-19. In contrast, in Seoul, which is more densely populated, the number of visitors to the Han River Parks rather sharply increased despite the government's efforts to enhance prevention measures to suppress the spread of the virus (Oh, S.H., 2020). Later, when social distancing was eased to Level 2, the number of visitors to the Han River Parks decreased compared to when the level was 2.5 (Kim, S.H., 2020). As such, visitor behavioral patterns regarding urban parks vary depending on the region and the level and timing of COVID-19 spread.

Furthermore, with the pandemic dragging on, there has been increased uncertainty in predicting how the way people use urban parks will change. However, there is no sufficient empirical research demonstrating in an objective manner how significantly the COVID-19 crisis has affected the needs of people to use urban parks or how such decisions are made before they actually use them. In addition, given that, unlike other disasters, the coronavirus pandemic has been affecting every aspect of people's lives for an extended period of time, transforming the way people behave and the fundamental structure of cities, it is also necessary to conduct research on their attitudes and psychology. In fact, urban parks are infrastructure that helps respond to the spread of infectious diseases in a flexible manner. With the emergence of pandemic-level infectious diseases occuring at ever-shorter intervals, sociopsychological factors that translate people's needs for urban parks into actual behavior also need to be discussed at a fundamental level as well.

Against this backdrop, this study aims to examine how the decision-making process actually works when people decide to use urban parks during the COVID-19 crisis, while identifying factors that affect such decision-making. Further, factors to be considered in a new kind of urban park design and planning in a post-pandemic era will be identified and discussed from urban-planning perspectives.

To this end, the theory of planned behavior (TPB), which is widely used for the prediction of human behavior, was employed to come up with research hypotheses regarding the relationship between people's risk perception of COVID-19 infection and their decision-making processes regarding using urban parks. A survey was conducted to obtain the necessary data for analysis; each survey question was asked twice before and after the COVID-19 outbreak to determine the effect of the pandemic on the usage pattern of urban parks. In the present study, structural equation models were employed to implement an empirical analysis of factors affecting each individual's decision-making process of whether to use urban parks, which was considered to have been affected by the spread of COVID-19, as well as the relationship among the factors. Among the dependent variables

of the model, park-use behavior refers to the actual usage time. In an attempt to determine the effect of the COVID-19 outbreak on people's urban park use behavior, two models that used the usage time after COVID-19 and the change in the usage time before and after COVID-19 as dependent variables, respectively, were used for analysis.

Ⅱ. Theory and Literature Review

1. Needs for Urban Parks and Corresponding Usage Patterns

Urban parks have contributed to creating public spaces to provide a pleasant environment, improving the quality of life for every citizen. Notably, various values and benefits brought by urban parks serve as an effective means to help meet a variety of desires of each individual and society. Urban parks significantly vary in terms of values and functions, including societal, eco-environmental, and landscape functions. From user perspectives, they are considered important public spaces that directly have influences on the quality of life for all residents (Kim, M.J., 2014).

Meanwhile, recent research on urban parks has particularly focused on the development of a sense of community, among their various functions. Urban parks are physical spaces where a sense of community arises and thus must be equipped with community facilities and open spaces of various sizes that allow users to meet and communicate with each other in a comfortable atmosphere. These spaces should reflect the symbolism and uniqueness involved in each region, as well as regional characteristics, while enabling frequent social interactions among the residents (Oh, J.H., 2013). Therefore, planning and design of parks and green spaces in urban areas require not only comprehensive approaches from urban-planning perspectives but also a thorough understanding of the expected usage patterns of the actual users, that is, the residents of each region, as well as the expected demand for them (Park, C.I., 2010).

1) Needs for urban park use

People residing in urban areas often satisfy their needs and desires by visiting urban parks to enjoy nature, watch others play sports or other activities, or engage in various leisure activities with other people (Carr et al., 1992). Based on the Theory of Hierarchy of Needs[2] by Maslow (1954), Carr et al. (1992) proposed the five basic human needs[3] to be considered in the planning and design of urban parks. Drivers et al. (1991) insisted that if there is a failure to react to visitors' needs and preferences, parks may be transferred to unsuccessful and uninteresting places. Thus, the planning and design of the urban park must reflect the various desires and preferences of visitors to contribute to its benefits for communities. Matsuoka and Kaplan (2008) reviewed 90 previous studies focused on how people interact with the urban environment to define human needs, preferences, attitudes, and activities. The authors revealed through the research that the needs for nature and human interaction[4] significantly affected how people used parks and the demand for high-quality neighborhood parks.

This study assumed that people would desire to use urban parks despite the risk of COVID-19 infection because their desire and preference to use them exceeded the perceived risk of COVID-19. Accordingly, variables of this research used to evaluate their need for urban park use were designed based on the needs of residents for urban environments, proposed by Matsuoka and Kaplan (2008).

2) Usage patterns of urban parks

User behavior and usage patterns must be precisely recognized for urban parks to be sustainable while helping satisfy the various needs of visitors. In fact, the majority of prior research has applied surveys to investigate the effects of the physical environment, functions, and features of urban parks on the use behavior patterns of visitors. Lee, J.U. (2005) analyzed patterns observed when people use spaces and facilities in neighborhood parks from a behavioral approach and further identified factors that affected accessibility to parks and the frequency of visits to propose measures necessary to create and maintain urban parks. Kim, H.K. and Jung, S.W. (2010) analyzed the usage patterns of urban parks, especially with respect to the frequency of visits or user preferences, identifying the interaction between the physical environments of parks and the patterns to suggest future directions in urban park design and planning.

Previous studies focused on the relationship between user perception of the environment of urban parks and their use behavior as follows: Rabinowitz (1989) concluded that user satisfaction or preference for certain environments was

closely related to attitudes toward the environments, and this was confirmed by users' post-use evaluation. Marans et al. (1981) reported that certain behaviors of each individual observed in a certain space were affected by various factors, including their satisfaction with the given environment, objective features that have influences on the quality of the environment, and each individual's attitude and evaluation responding to the above factors. Research related to this perspective includes the following two studies: Ban, Y.U. et al. (2008) investigated user satisfaction with large-scale urban parks, especially with respect to functions of improving physical health, natural and ecological functions, and social functions and further analyzed factors that affected satisfaction to propose the necessary conditions for supplying urban parks. Kim, Y.I. (2010) comprehensively analyzed user satisfaction for parks and factors that were considered important by the visitors to determine the relationship between the visitors and the societal and physical environments exposed to them.

Based on the previous studies described above, it was confirmed that need for urban park use, the physical environment of the parks, and individual perception, attitude, and evaluation regarding the park environment were closely related to the users' behavioral patterns.

2. Change in Usage of Urban Spaces Caused by COVID-19

The COVID-19 crisis has significantly affected the behavior and awareness of residents in urban areas, for example, by expanding the use of outdoor spaces and changing how people travel and what they do for leisure. Extensive research regarding this issue has been performed at home and abroad. On the international front, the following studies are included in this category: studies on the effect of the socioeconomic attributes of citizens and environmental contexts of their residential areas on the access and use of green spaces (Uchiyama and Kohsaka, 2020), studies on changes in the perception and importance of urban green space since the outbreak of COVID-19 (Ugolini et al., 2020; Grima et al., 2020; and Xie et al., 2020), a study that numerically analyzed the accessibility and allocation of public green space to identify methods for safely making parks and gardens publicly available for residents (Shoari et al., 2020), a study on the impact of COVID-19 on public space (Honey-Ross et al., 2020), and studies focused on the impact of COVID-19 on leisure activities (Kim et al., 2020 and Kim and Kang, 2021).

On the domestic front, various relevant studies were conducted using big data analysis. A study that analyzed changes in the number of visitors to urban parks after the outbreak of COVID-19 (Park, I.K. et al., 2021), a study on changes in the floating population (Kim, Y. et al., 2021), and a study on changes in the movement of population and personal consumption (Kang, T. and Gil, Y., 2020) are included in this category. Also, Kim, Y.K. et al. (2021) analyzed changes in usage behavior of neighborhood parks and green spaces before and after the pandemic to propose strategies for improving their quality and to proactively respond to the post-COVID-19 era.

These studies largely demonstrate that the COVID-19 crisis has significantly affected how city residents use given urban spaces. However, the existing studies have failed to conduct an in-depth analysis of what motives are behind such changes and how these motives are then related to the outbreak of COVID-19.

3. Risk Perception and the Extended Theory of Planned Behavior (ETPB)

1) Theory of planned behavior (TPB)

In psychology, in which human behavior itself is the main subject of research, various theories have been developed to predict how people behave and how decision-making for such behavior works. Among them, the theory of reasoned action (TRA) and the theory of planned behavior (TPB), both proposed by Icek Ajzen, a social psychologist, have been widely employed to account for the decision-making processes that occur when individuals intend to conduct certain activities.

The TRA (Fishbein and Ajzen, 1975), as an early-stage theory, defines attitude, subjective norm, and behavioral intention as the prerequisite factors affecting the behavior of each individual. The term 'attitude' refers to a person's positive or negative evaluation of a given subject, and this factor is considered to be an effective indicator to predict his or her future action. The subjective norm refers to a person's attitude toward a given act that has been shaped and affected by other people who are considered significant by the person,

for example, his or her family, friends, or acquaintances. The TRA states that a person's attitude does not always coincide with the way he or she behaves. Meanwhile, the behavioral intention is considered to be formed based on the interaction between a person's attitude and the subjective norm, thus contributing to the increasing accuracy of behavior prediction.

The TRA is a simple and straightforward approach to accounting for the decision-making process of human behavior; however, the theory is limited when examining the behavioral intention and the resultant behavior of individuals in environments that cannot be controlled by human will (Xu, H. and Lee, C., 2015). In an attempt to overcome this limitation, the concept of perceived behavioral control (PBC) was incorporated into the TPB (Ajzen, 1991). The PBC refers to the degree to which a person believes that he or she is conducting a given act within his or her control. If the perceived level of difficulty is beyond the person's control, his or her behavioral intention and behavior may not be affected by such control. In short, the TPB assumes that PBC has a significant impact on intention and behavior. It is also reasoned that the three factors, attitude, subjective norm, and PBC, tend to interact. As such, the TPB can be improved in terms of interpretability regarding how a certain action is performed; by admitting that certain restrictions exist that may affect the relationship between a person's intention and the actual behavior conducted by the person and further extending the theory to include appropriate prediction variables. Furthermore, an extended theory of planned behavior (ETPB) has also been proposed, which provides improved prediction and interpretability for the decision-making process for human behavior by adding new variables.

2) Extending the TPB based on risk perception

Risk perception represents the degree of risk intuitively perceived by a person arising from undesirable causes that person has already been, or may be, exposed to (Renn and Rohrmann, 2000). Risk perception can be observed in various fields, such as natural disasters, climate change, infectious diseases, terror attacks, and wars, and has thus been at the center of attention for policymakers or researchers for a long period of time. The perception of risks is known to be affected by various factors, including those at the personal level, such as personal experience, faith, judgment, attitude, and emotions, as well as social, cultural, and even institutional factors (Cori et al., 2020). Kang, J.W. et al. (2016) concluded that establishing strategies to prevent and respond to risks must start by gaining a correct understanding of the risks they were faced with, and the more likely the given risk is to occur or create negative values, the more intensely it is perceived by the person.

Pakpour et al. (2020) conducted a study on the effect of the COVID-19 crisis on the psychological responses of people. The researchers reported that negative psychological changes caused by the perception of risks related to COVID-19, anxiety, stress, etc. significantly affected human behavior. The perception of risks related to infectious diseases, such as COVID-19, may have effects on not only a person's personal beliefs, values, and attitudes but also his or her direct behavior itself (Cori et al., 2020). Notably, the perception of risks related to diseases may serve as a direct motive for preventive measures to be taken while also affecting various acts to protect health from risks; thus, careful attention needs to be paid to this type of risk perception (Schütz and Wiedemann, 2005).

Meanwhile, several previous studies on the ETPB with risk perception added as a new variable have focused on determining the effect of risk perception on major variables of the TPB, including attitude, subjective norm, and PBC, as follows: Yoon, S.M. et al. (2010) confirmed that the perceived risk related to overseas travel has significant effects on people's attitudes. Lee, H.Y. and Kim, N.J. (2017) reported that the effect of perceiving the risk of fine dust on the attitude and subjective norm toward recreational activities was significant. Han et al. (2020) employed the ETPB to gain a clear understanding of the decision-making process of US travelers to foreign countries when choosing a travel destination that would be relatively safer than others against the risk of COVID-19 infection. This study confirmed that the risk perception of COVID-19 significantly affected the subjective norm, attitude, and behavioral intention of US travelers while they were selecting safer destinations. Kim and Kang (2021), aimed to determine the relationship between perceived crowding when using leisure activity spaces, risk perception of COVID-19, and preventive measures; among them, risk perception was found to have a significant effect on leisure activities.

The findings in previous studies on the TPB and risk per-

ception indicated that risk perception concerned attitude and behavior, two major variables of the TPB; thus, the risk perception of COVID-19 was of significance as a variable to enable the ETPB. Accordingly, in this study, an ETPB with COVID-19 risk perception added as a new variable was employed as a framework for analysis (Figure 1).

So far, only a few studies have been conducted on the application of the TPB for analyzing the usage of urban parks. This is because, in normal times, human desires naturally cause people to use parks. Thus, in the past, it was less necessary to study sociopsychological factors that may affect people's decision-making processes when using urban parks. However, since the outbreak of the pandemic, airborne infection has emerged as a new risk factor, leading to increased uncertainty in the usage of urban parks over time.

As such, this study differs from previous studies in the decision-making process of urban park users before and after the outbreak of COVID-19 and factors affecting such decision-making, applying the ETPB. Also, this study proposes a conceptual framework to help predict the demand for urban parks in conditions with similar perceived risks, and significant components and directions to be considered in new guidelines for urban park design and planning.

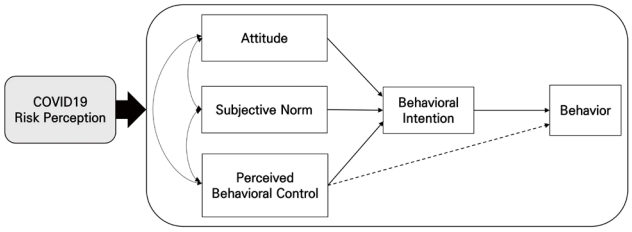

Figure 1. Framework of extended theory of planned behavior (ETPB)

4. Research Model and Hypotheses

1) Analytical framework of research model

Figure 2 shows the structural relationship between COVID-19 risk perception, PBC, and the decision-making process of urban park use and how the convenience, accessibility, and physical characteristics of urban parks affect the structure.

First, based on the literature reviewed earlier, and TPB, the decision-making process for urban park use was defined as a series of steps, as follows: *Need for Urban Park Use → Attitude toward Urban Park Use → Behavior of Urban Park Use*. This process assumed that the need to use a park was first reflected in the attitude toward using the park, and this attitude then translated into a behavior that led to the actual use of the park.

Then, as PBC affects attitude and behavior according to the TPB, PBC of urban park use was added to the analysis as a variable that may affect attitude and behavior among the variables of the decision-making process of using urban parks.

Among the major variables of the TPB, the subjective norm and behavioral intention were excluded from this analysis. According to recent research, the effect of the subjective norm on the behavioral intention is smaller when

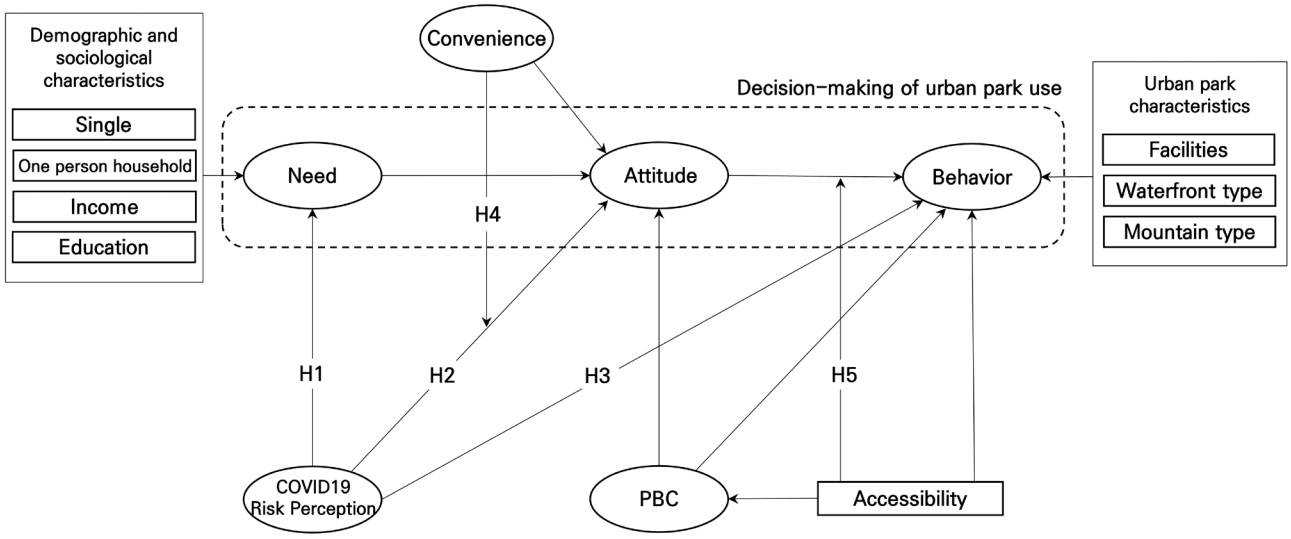

Figure 2. Proposed research model

perceived behavioral control is larger. Thus, there have been discussions about reconsidering the role of the subjective norm (La Barbera and Ajzen, 2020). Also, in previous studies on interpreting eco-friendly or altruistic behavior, the subjective norm was often excluded from the scope of consideration. Accordingly, the effect of subjective norms on neutral acts, such as the use of urban parks, was considered to be insignificant.

Meanwhile, in the case of behavioral intention a number of theories in social psychology, including the TPB, assume that the intention causes a certain behavior to occur. When the subject of this paper was considered, survey items that asked about attitude and intention were similar to each other, and thus it was difficult to categorize them; and the purpose of this study was to observe the actual act of using parks rather than identify the intention of using them. For those reasons, behavioral intention was also excluded from the analysis.

2) Extended research model

To establish an extended research model capable of analyzing the effect of COVID-19 on the decision-making process for urban park use. COVID-19 risk perception was added as a new variable to the basic framework based on the TPB.

In addition, on the basis of the literature review of the use of urban parks and user satisfaction, the convenience, accessibility, and physical characteristics(facilities and types of parks) were added as variables to the model because they are considered to have significant effects on the decision-making process for urban park use. It was worth noting that satisfaction was excluded from the scope of analysis. This was because even though the necessary data to represent the degree of satisfaction was obtained through the survey, the survey items were rather similar to those asking about convenience; thus, using the two variables in parallel for the analysis was considered invalid.

A dependent variable of this model was urban park use behavior, which was used to predict changes in the use of urban parks after the outbreak of COVID-19. We conducted two models to compare patterns in the use of urban parks before and after the COVID-19 crisis. The dependent variables of each model were urban park usage time after COVID-19 and change in urban park usage time before and after COVID-19, respectively.

3) Research hypotheses

In this study, hypotheses were formulated based on the decision-making process for urban park use, defined above. The greater the need to use parks, the more positive the attitude toward using them becomes while the COVID-19 crisis is ongoing. Here, it is assumed that such an attitude is eventually put into behavior. In this study, COVID-19 was considered to have a direct effect on the decision-making process. Accordingly, Hypotheses 1, 2, and 3 were formulated. Hypotheses 4 and 5 are related to the moderating effect of the convenience and accessibility of urban parks,[5] which were referenced in previous studies reporting that features and characteristics of parks affected the perception and attitude of individuals (Lee, J.U., 2005; Ban, Y.U. et al., 2008; and Kim, Y.I. et al., 2010).

[**Hypothesis 1**]

The higher *COVID-19 risk perception* is, the higher the need for urban park use will become.

[**Hypothesis 2**]

The higher *COVID-19 risk perception* is, the more negative attitude toward using urban parks will become.

[**Hypothesis 3**]

In the COVID-19 era, higher *COVID-19 risk perception* will have a more negative effect on urban park use behavior.

[**Hypothesis 4**]

The *convenience* of urban parks will have a moderating effect on attitudes toward using urban parks.

[**Hypothesis 5**]

The *accessibility* of urban parks will have a moderating effect on urban park use behavior.

Ⅲ. Research Data and Methods

1. Survey Design

The necessary data for the analysis were collected through a survey and based on existing secondary data. We surveyed adults aged 19 and over residing in Seoul, who had used urban parks in Seoul within the last month. This survey was

conducted online by a survey company for 10 days, from May 12 to 21, 2021.[6] Among the questionaries answered by 431 respondents, six datasets in which the parks that they visited did not belong to the category of urban parks[7] and 14 datasets in which the respondents were considered to have answered insincerely were excluded from the analysis. In total, 411 usable responses for our research were gathered and utilized in this analysis.

The survey questionnaire, with reference to relevant previous studies, was designed based on the seven-point Likert scale to measure factors that may affect the decision-making process for urban park use. As a result, a total of 53 survey questions were prepared, as follows: Five questions about COVID-19 risk perception, eight questions about needs for urban park use, five questions about attitude toward using parks, five questions about PBC to use parks, two questions about behavior of park usage, seven questions about the convenience of urban parks that the respondent visited, and three questions about satisfaction are included along with basic questions and other questions regarding the usage status of parks.

As the representative physical characteristics of urban parks, the park facilities and types of parks were reorganized based on the 2020 Statistic of Parks in Seoul.

2. Variable Setting and Analysis Method

In this study, seven latent variables were formulated based on the survey questions, as follows: COVID-19 Risk Perception (CRP); Attitude, Behavior, and Perceived Behavioral Control (PBC), which account for the decision-making process of urban park use; and Convenience and Satisfaction, which affect the behavior. In addition, as control variables, Accessibility, Single (no spouse), One-Person Household (OPH), Income, and Education, which represent social and demographic characteristics, were added. The physical characteristics of urban parks were represented by the Facilities of parks and the types of parks, including Waterfront and Mountain parks, classified by the geological characteristics of areas where parks were located.[8]

As described above, the Behavior of urban park use, the dependent variable, represents how many hours people spend using parks; the two models were designed to compare changed patterns in the use of parks after the pandemic. The dependent variables of the first and second models were usage time after COVID-19 (Usage) and change in usage time before and after COVID-19 (Change), respectively. To measure the dependent variable, using the frequency of use and staying time in practice, the total annual usage time was calculated by converting the frequency of use into the annual frequency and multiplying it by the average staying time. Items on the questionnaire about the frequency of use and staying time allowed the respondents to select the range that best suited them, and these measures were scored based on the median value of each selected range. Then, the change in the usage time before and after COVID-19 was determined by subtracting the total usage time before COVID-19 from the total usage time after COVID-19.

To test how each measured item of the questionnaires as observed variables properly represented the latent variables, confirmatory factor analyses (CFA) were performed. As a result, the verified observed variables and latent variables were applied to structural equation modeling (SEM). SEM is a statistical method to evaluate the causal relationship and correlation among variables. This analytical method is capable of estimating not only the relationship between multiple independent and dependent variables but also the causal relationship between the dependent variables in parallel (Woo, J.P., 2012, p.16). Also, this modeling method is widely used in research based on the TPB. Considering the purpose of this study, SEM is a suitable method to trace the paths of how park users make their decisions, especially under the influence of COVID-19.

3. Sample Characteristics and Descriptive Statistics

The demographic characteristics of the respondents were as follows: In terms of gender, the respondents were composed of 55% (n=225) men and 45% (n=186) women. In terms of age, 15.6% (n=64) were in their twenties, 18.2% (n=75) were in their thirties, 18.0% (n=74) were in their forties, 19.5% (n=80) were in their fifties, and 28.7% (n=118) were in their sixties or older. By region, among the four major districts of Seoul,[9] 17.8% (n=73) belonged to the Northwest Region, 32.4% (n=133) belonged to the Northeast Region, 30.2% (n=124) belonged to the Southwest

Region, and 19.7% (n=81) belonged to the Southeast Region. These proportions by region were found to be consistent with the actual population distribution. In terms of marital status, 33.6% (n=138) were single, while 66.4% (n=273) were married. Among the parks mentioned in the answers, 30.2% (n=124) were city-type parks,[10] 19.2% (n=79) were mountain-type parks, and 50.6% (n=208) were waterfront-type parks.

Descriptive statistics of the analyzed variables are summarized in Table 1. The mean value of total usage time after COVID-19 was estimated to be 90.65 hours, shorter than the value of 103.27 hours before COVID-19. Using a *t*-test, the results confirmed that this time decrease was a statistically significant difference, with a t-value of 14.296($p<0.000$). All mean values of CRP measured through the survey were 5.7 or more, indicating that COVID-19 was perceived to be dangerous. The mean values of all Need items were 5.6 or higher, indicating that users' needs for parks was largely high. In the case of Attitude, the means ranged from 4.9 to 5.1, which were relatively lower than values of Need. The mean values of items regarding PBC were all 5 or more, and this can be interpreted as the respondents being highly likely to perceive themselves as being able to use urban parks. Also, in Convenience, the mean of all items were also 5 or more, indicating that the respondents evaluated the parks that they had visited to be highly convenient.

Table 1. Descriptive statistics of the urban park use time

Latent variable	Observed variable	Size	Mean	Std. dev.	Min.	Max.
Behavior of urban park use (hour)	Total usage time before COVID-19	411	103.27	146.44	0.75	1456
	Total usage time after COVID-19	411	90.65	145.34	0.75	1092
	Changes in total usage time before and after COVID-19	411	-12.63	146.03	-847	975
COVID-19 risk perception	If COVID-19 spreads in the community, I try to avoid long stay in indoor spaces outside the home.	411	5.75	1.15	1	7
	If COVID-19 spreads in the community, I try to avoid crowded spaces.	411	6.10	1.01	1	7
	If COVID-19 spreads in the community, I try to avoid crowded times.	411	5.89	1.05	1	7
	If COVID-19 spreads in the community, I try to follow standard precautions.	411	6.18	1.01	1	7
Need for urban park use	I want to relax and walk in urban parks for physical and mental health.	411	5.82	1.01	1	7
	I want to feel the natural environment such as the sounds, scents, and textures of nature in urban parks.	411	5.83	1.00	2	7
	I want to get away from everyday life and have may own time to mediate and contemplate in urban parks.	411	5.60	1.03	1	7
Attitude toward urban park use	During the COVID-19 Pandemic, I think using urban parks is a happy thing.	411	5.06	1.25	1	7
	During the COVID-19 Pandemic, I think positively about using urban parks.	411	5.07	1.36	1	7
	During the COVID-19 Pandemic, I think using urban parks is valuable to me.	411	5.08	1.26	1	7
	During the COVID-19 Pandemic, I think using urban parks will bring me good outcomes.	411	4.91	1.30	1	7
PBC of urban park use	I have enough time to use urban parks.	411	5.08	1.17	1	7
	I live in an environment with good access to urban parks.	411	5.36	1.18	1	7
	Overall, I can use urban parks whenever I want.	411	5.40	1.10	2	7
Convenience of urban park	The park I visit most often is reasonably sized for use.	411	5.55	1.05	2	7
	The park I visit most often is well equipped with the necessary exercise facilities.	411	5.23	1.16	1	7
	The park I visit most often provides a full experience of the natural environment.	411	5.30	1.14	1	7

Ⅳ. Results

1. Confirmatory Factor Analysis (CFA)

Prior to the evaluation of the SEM, we conducted confirmatory factor analysis (CFA) to assess the reliability of major variables and measurement items and verify the relationship between observed variables and latent variables. The results are summarized in Table 2. All of the latent variables achieved a Cronbach's α value of more than 0.7, confirming that all the items were reliable. Indicating acceptable convergent validity, all the standardized coefficient values of factor loading for the measurements of five latent variables were higher than 0.5, and the values of the composite reliability (C.R.) were above 0.7.

To achieve discriminant validity, the average variance extracted (AVE) value of a latent variable should be 0.5 or more, and exceed the squared correlation coefficient between two latent variables. Results of the discriminant validity are reported in Table 3. As Satisfaction was found to be highly correlated with Convenience and thus demonstrated insufficient discriminant validity, it was excluded from model analysis.[11] The correlation coefficient between all latent variables, except for Satisfaction, was found to meet the discriminant validity requirements.

Overall, the latent variables CRP, Need, Attitude, PBC, and Convenience, along with 17 observed variables that comprise the latent variables, were reliable and achieved convergent validity and discriminant validity. Thus, it was confirmed that all these variables were suitable to be employed in the SEM analysis. To establish the final model, the CFA results were reflected in the proposed model based on previous research reviews and hypotheses. Two forms of the final model were constructed to determine changes in the usage of urban parks before and after COVID-19, and perform the SEM accordingly. The first model was designed

Table 2. Result of confirmatory factor analysis for convergent validity

Latent variable	Observed variable	Convergent validity				Reliability
		Coef.	S.E.	AVE	C.R.	Cronbach's α
COVID-19 risk perception	If COVID-19 spreads in the community, I try to avoid long stay in indoor spaces outside the home.	0.739	0.025	0.653	0.882	0.88
	If COVID-19 spreads in the community, I try to avoid crowded spaces.	0.885	0.017			
	If COVID-19 spreads in the community, I try to avoid crowded times.	0.830	0.019			
	If COVID-19 spreads in the community, I try to follow standard precautions.	0.768	0.023			
Need for urban park use	I want to relax and walk in urban parks for physical and mental health.	0.822	0.023	0.603	0.817	0.805
	I want to feel the natural environment such as the sounds, scents, and textures of nature in urban parks.	0.861	0.022			
	I want to get away from everyday life and have may own time to mediate and contemplate in urban parks.	0.623	0.034			
Attitude toward urban park use	During the COVID-19 Pandemic, I think using urban parks is a happy thing.	0.833	0.017	0.758	0.926	0.925
	During the COVID-19 Pandemic, I think positively about using urban parks.	0.874	0.014			
	During the COVID-19 Pandemic, I think using urban parks is valuable to me.	0.909	0.012			
	During the COVID-19 Pandemic, I think using urban parks will bring me good outcomes.	0.863	0.015			
PBC of urban park use	I have enough time to use urban parks.	0.677	0.032	0.593	0.813	0.803
	I live in an environment with good access to urban parks.	0.841	0.024			
	Overall, I can use urban parks whenever I want.	0.782	0.027			
Convenience of urban park	The park I visit most often is reasonably sized for use.	0.734	0.032	0.512	0.758	0.752
	The park I visit most often is well equipped with the necessary exercise facilities.	0.627	0.038			
	The park I visit most often provides a full experience of the natural environment.	0.775	0.031			

Table 3. Result of confirmatory factor analysis for discriminant validity

Latent variable	COVID-19 risk perception	Need for urban park use	Attitude toward urban park use	PBC	Convenience of urban park	AVE
COVID-19 risk perception	1					0.603
Need for urban park use	0.263 (0.513***)	1				0.653
Attitude toward urban park use	0.006 (0.075***)	0.207 (0.455***)	1			0.759
PBC of urban park use	0.046 (0.215***)	0.318 (0.564***)	0.232 (0.481***)	1		0.593
Convenience of urban park	0.078 (0.279***)	0.32 (0.566***)	0.192 (0.438***)	0.46 (0.679***)	1	0.512

Note: The number in parentheses indicates the correlation coefficient, and the number outside indicates the square of the correlation coefficient.
*p<0.05, **p<0.01, ***p<0.001

to find the decision-making process for urban park use in the current situation after the outbreak of COVID-19, with Usage as a dependent variable. The second model was designed to compare the behavior of urban park use before and after the outbreak of COVID-19, with Change as a dependent variable.

2. Analysis of Urban Park Use Behavior after COVID-19

The first model with Usage as a dependent variable was analyzed to track the decision-making process of whether to use urban parks at the current moment after the outbreak of COVID-19. The fitness of this model[12] was considered to be desirable with $\chi^2_{(df=314)} = 813.25^{***}$, RMSEA = 0.062, CFI = 0.877, and TLI = 0.863.

The first model found that the paths connecting Need to Attitude and Attitude to Usage were both positive (+) (Figure 3). This result proved the validity of the decision-making process for urban park use, which was defined above as the default path of the model, as follows: Need → Attitude → Behavior. Here, Attitude serves as a parameter between Need and Usage. This means that the effect of the need to use urban parks on Usage is further enhanced by Attitude.

To determine changes in the decision-making process caused by the pandemic, the effects of major variables on Need, Attitude, and Usage were examined, as shown in Table 4. First, in terms of the total effect, CRP was found to have a positive (+) effect on Need and Attitude but a nega-

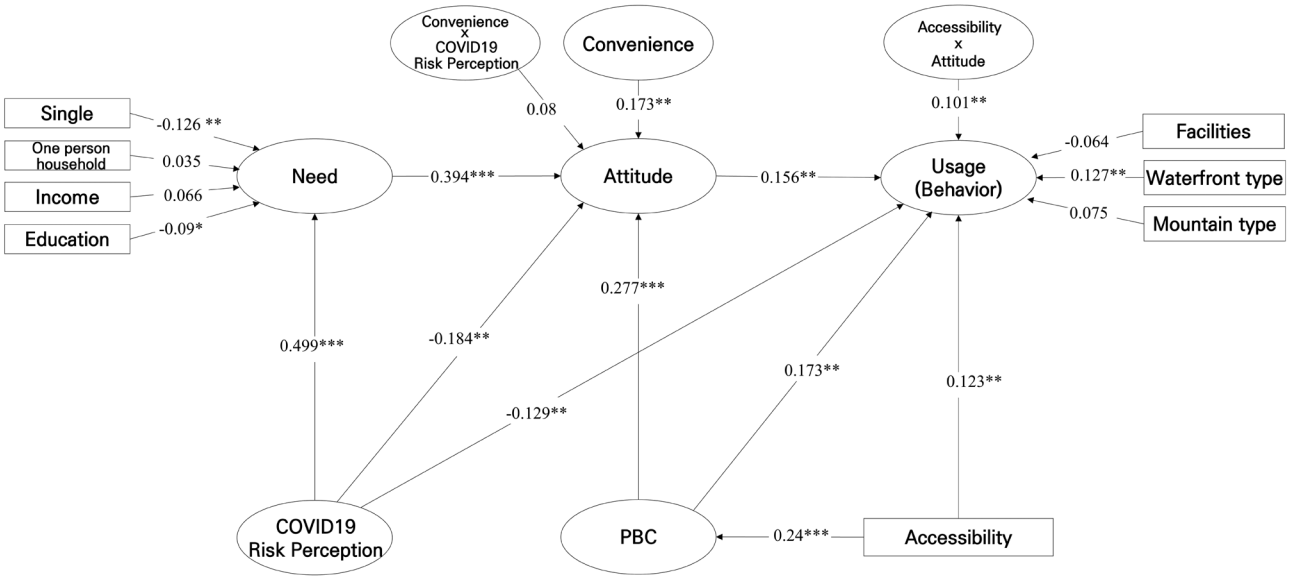

Figure 3. Structural model A with path coefficients

Table 4. Decomposition of total effects for model A

Path			Total	Direct	Indirect
COVID-19 risk perception	→	Need	0.499***	0.499***	-
Single	→	Need	-0.126**	-0.126**	-
One person household	→	Need	0.035	0.035	-
Income	→	Need	0.066	0.066	-
Education	→	Need	-0.09*	-0.09*	-
Need	→	Attitude	0.394***	0.394***	-
COVID-19 risk perception	→	Attitude	0.012	-0.184**	0.197***
PBC	→	Attitude	0.277***	0.277***	-
Accessibility	→	Attitude	0.067**	-	0.067**
Convenience	→	Attitude	0.173**	0.173**	-
Convenience × CRP	→	Attitude	0.08	0.08	-
Single	→	Attitude	-0.049**	-	-0.049**
One person household	→	Attitude	0.014	-	0.014
Income	→	Attitude	0.026	-	0.026
Education	→	Attitude	-0.035*	-	-0.035*
Need	→	Usage	0.061**	-	0.061**
Attitude	→	Usage	0.156**	0.156**	-
COVID-19 risk perception	→	Usage	-0.127**	-0.129**	0.002
PBC	→	Usage	0.216***	0.173**	0.043**
Accessibility	→	Usage	0.175***	0.123**	0.052**
Accessibility × Attitude	→	Usage	0.101**	0.101**	-
Convenience	→	Usage	0.027**	-	0.027*
Convenience × CRP	→	Usage	0.012	-	0.012
Facilities	→	Usage	-0.064	-0.064	-
Waterfront type	→	Usage	0.127**	0.127**	-
Mountain type	→	Usage	0.075	0.075	-
Single	→	Usage	-0.008*	-	-0.008*
One person household	→	Usage	0.002	-	0.002
Income	→	Usage	0.004	-	0.004
Education	→	Usage	-0.006	-	-0.006
Accessibility	→	PBC	0.24***	0.24***	-

*p<0.1, **p<0.05, ***p<0.001

tive effect (−) on Usage. It is worth noting that the total effect of CRP on both Need and Usage was the same as the corresponding direct effect in terms of both direction and intensity. However, the total effect of CRP on Attitude was found to be positive (+) but statistically insignificant, while the corresponding direct effect was negative (−) at -0.184 and statistically significant. This was because the corresponding indirect effect was greater in the opposite direction, i.e., +0.197, thus offsetting the contribution of the direct effect.

It was not that CRP did not affect Attitude toward using urban parks at all; the reality was that the direct and indirect effects worked in the opposite direction, causing the total effect to become zero. Overall, effects of CRP on the decision-making process of urban park use can be interpreted as follows.

First, the higher the CRP is, the greater Need becomes, but while people recognize the risk of COVID-19, they tend to have negative attitudes toward using parks. However, their needs to use urban parks is very high, and thus their attitude toward using them ends up being slightly positive. In reality, however, the fear of COVID-19 exceeds the desire to use urban parks or the attitude toward using them; this was considered to be the reason for a reduction in the actual usage time of urban parks.

Second, PBC was found to have a positive direct and indirect effect on both Attitude and Usage. This can be inferred as follows: the more people perceive that they are allowed to use urban parks, the more likely they are to consider the use of urban parks to be positive, and the greater the actual duration of using them becomes.

Third, Convenience is an exogenous variable while, at the same time, serving as a moderating variable between CRP and Attitude. The total effects of Convenience, as an exogenous variable, on Attitude and the dependent variable Usage were 0.173** and 0.027**, respectively. These results indicated that the more convenient urban parks were, the more likely people were to have positive attitudes toward using them, and, in addition, the moderating effect of Attitude directly or indirectly affected the increase in actual usage time after the outbreak of the pandemic. Next, the product of Convenience and CRP, as an interaction term,[13] was analyzed to determine their moderating effect. The results confirmed that the corresponding total effects were statistically insignificant. This result implied that Convenience played no role in the process of risk perception affecting people's attitude toward using them.

Fourth, Accessibility is not only an exogenous variable but

also a moderating variable between Attitude and Usage. As an exogenous variable, Accessibility was found to have a positive (+) effect on Attitude, PBC, and Usage. Here, both PBC and Attitude serve as mediating parameters while having an indirect effect on the path from Accessibility toward Usage. Accordingly, the corresponding total effect was found to be 0.175^{***} as a result of the direct effect (0.123^{**}) combined with the indirect effect (0.052^{**}). This result suggests that the higher Accessibility is, the more capable people are of determining whether they are allowed to use the park. As a result, they tend to have more positive attitudes toward using it, and this also leads to an increase in the duration of using the park after the outbreak of COVID-19. Furthermore, the interaction term of Accessibility as a moderating variable was found to have a value of 0.101^{**}, which is statistically significant. This result suggests that Accessibility positively affects people's attitudes toward using them, possibly increasing the duration of their use as well.

Finally, the social and demographic characteristics, which control Need, and the physical characteristics of urban parks, which control Behavior, were analyzed. As a result, Single and Waterfront were found to have significant effects on Usage. The total effect of Single on the overall decision-making process was found to be negative (−). This means that married persons have a greater desire to use urban parks with more positive attitudes toward using them compared to single persons. This is why the usage time increased among married persons after COVID-19. The total effect of Waterfront on Usage was found to be positive (+). It can be reasoned that the type of waterfront park positively affected the decision-making process because even before the outbreak of COVID-19, people preferred waterfront-type parks to mountain-type parks.

As such, the following seven variables were found to have significant effects on the path toward the decision to use urban parks: CRP, PBC, Convenience, Accessibility, Accessibility (moderator), Single, and Waterfront.

Simply put, these variables are factors affecting the usage of urban parks at the current moment, when COVID-19 is spreading widely. However, it is also necessary to determine whether these variables had such significant effects even before the pandemic or whether the COVID-19 crisis has caused the variables to be as influential as they are now. To this end, the results discussed above should be compared with these factors obtained by the second model regarding changes in usage patterns caused by COVID-19.

3. Analysis of Changes in Usage of Urban Parks Caused by COVID-19

To analyze changes in the usage of urban parks before and after the outbreak of COVID-19, the second model includes Change as a dependent variable. Here, if the dependent variable exhibits the equivalent statistical significance and the same-sign coefficient in both models, the variable is considered to have a significant effect on causing changes in usage patterns under the influence of the COVID-19 pandemic. In contrast, if the statistical significances, along with the coefficient signs, do not coincide in the two models, the corresponding variable may be interpreted as a universal, common factor that has affected the usage of parks at all times, regardless of COVID-19. The fitness of this model was considered to be desirable with $\chi^2_{(df=314)}=802.77^{***}$, RMSEA=0.062, CFI=0.878, and TLI=0.864.

The results obtained from the second model confirmed that CRP was the only variable that significantly affected the decision-making process after the outbreak of the pandemic, as shown in Table 5. The total effect of CRP on Need and Attitude was all positive (+) but negative (−) on Change, showing same patterns observed in the results of the first model. These results derived from the comparison of the two models implied that there were changes in the park-use behavior of people after the outbreak of COVID-19, as follows: Similar to the analysis of the first-model results, perceiving COVID-19 as a risk factor enhances people's desire to use urban parks while inducing them to have more positive attitudes toward them, but this eventually leads to a reduction in the park-use time.

Next, the decision-making process for urban park use was examined. As previously discussed, the path of Need → Attitude → Behavior was valid for the first model, but in the second model, the coefficient for the path from Attitude to Change was found to be statistically insignificant (Figure 4). For that reason, Attitude as a mediator is not able to account for the relationship between Need and Change. This means that the positive relationship between the need to use urban parks and the attitude toward using them holds regardless of external risk factors, e.g., COVID-19.

Table 5. Decomposition of total effects for model B

Path			Total	Direct	Indirect
COVID-19 risk perception	→	Need	0.5***	0.5***	-
Single	→	Need	-0.125**	-0.125**	-
One person household	→	Need	0.035	0.035	-
Income	→	Need	0.067	0.067	-
Education	→	Need	-0.09*	-0.09*	-
Need	→	Attitude	0.395***	0.395***	-
COVID-19 risk perception	→	Attitude	0.013	-0.184**	0.197***
PBC	→	Attitude	0.276***	0.276***	-
Accessibility	→	Attitude	0.066**	-	0.066**
Convenience	→	Attitude	0.173**	0.173**	-
Convenience × CRP	→	Attitude	0.08	0.08	-
Single	→	Attitude	-0.049**	-	-0.049**
One person household	→	Attitude	0.014	-	0.014
Income	→	Attitude	0.026	-	0.026
Education	→	Attitude	-0.035*	-	-0.035*
Need	→	Change	0.029	-	0.029
Attitude	→	Change	0.074	0.074	-
COVID-19 risk perception	→	Change	-0.162**	-0.163**	0.001
PBC	→	Change	0.086	0.066	0.02
Accessibility	→	Change	0.021	0.001	0.21
Accessibility × Attitude	→	Change	0.006	0.006	-
Convenience	→	Change	0.013		0.013
Convenience × CRP	→	Change	0.006		0.006
Facilities	→	Change	0.007	0.007	-
Waterfront type	→	Change	-0.002	-0.002	-
Mountain type	→	Change	-0.023	-0.023	-
Single	→	Change	-0.004		-0.004
One person household	→	Change	0.001		0.001
Income	→	Change	0.002		0.002
Education	→	Change	-0.003		-0.003
Accessibility	→	PBC	0.239***	0.239***	-

*p<0.1, **p<0.05, ***p<0.001

Further, it can also be inferred that indirect paths through which other variables move toward Change through Attitude as a mediating agent are not statistically valid. Such variables include those except for CRP, as follows: PBC, Convenience, Convenience (moderator), Accessibility, Single, OPH, Income, and Education. Among them, PBC, Convenience, Accessibility, and Single were valid for the first model but not for the second model. Waterfront was also not valid for the second model. As such, some of the variables were found to be valid for the first model but not for the second model, and this implies that the effects of these variables on the park-use time remain the same regardless of the spread of COVID-19. In contrast, insignificant variables in both models, including Convenience (moderator), OPH, Income, Education, Facilities, and Mountain may be interpreted as factors that do not affect the decision-making process of using parks.

4. Sub-conclusion

Changes in the decision-making process for urban park use caused by the outbreak of the pandemic were analyzed and the results can be summarized as follows: First, CRP was found to be the only factor that significantly reduced park use after the outbreak of COVID-19. In fact, perceiving COVID-19 as a risk factor enhanced people's desire to use parks. However, CRP has strong negative influences on both Attitude and Behavior, exceeding the effect of Need on Behavior. Eventually, total effect of CRP on Behavior becomes negative and thus reduce the actual park-usage time. Second, PBC, Convenience, Accessibility, Single, and Waterfront were categorized as factors whose effect on the decision-making process remained the same regardless of COVID-19. These factors did not cause any further increase or decrease in the actual park-use time after COVID-19, but given that these variables have positively affected using behavior in a steady manner since the time even before the outbreak of COVID-19. Thus, they should be considered in the future planning of urban parks. Third, OPH, Income, Education, Facilities, and Mountain were found to intrinsically have no intrinsic effects on the decision-making process. Fourth, as demonstrated in the basic path of the analysis model, the decision-making process of using parks followed the path of Need → Attitude → Behavior. Further, it

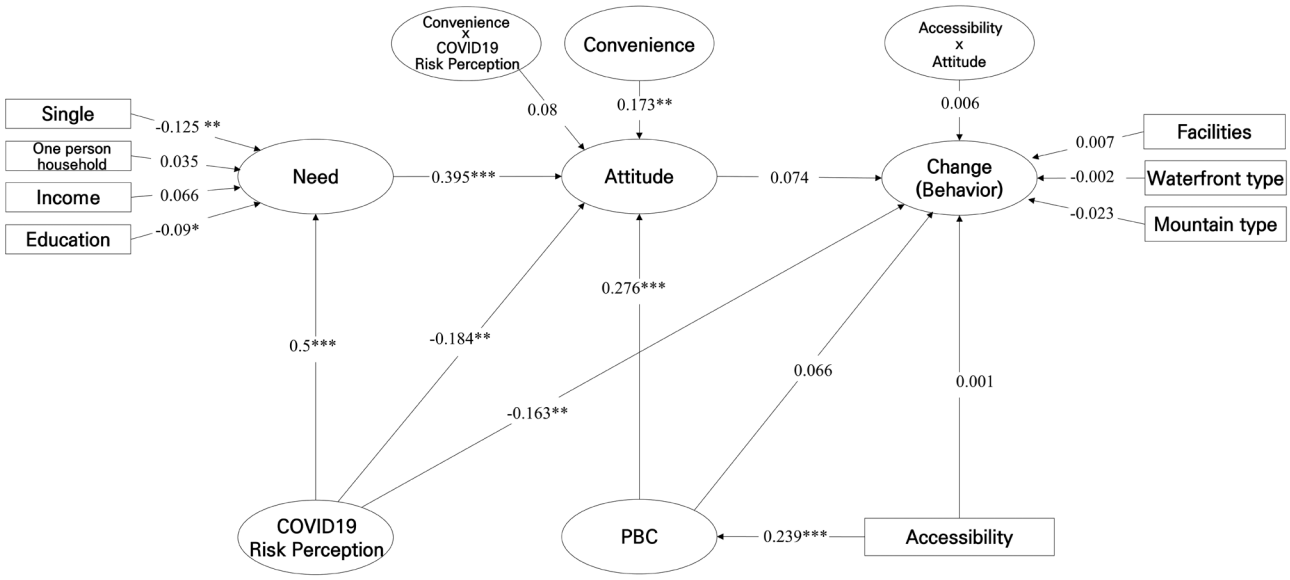

Figure 4. Structural model B with path coefficients

was also confirmed that PBC had a significant effect on this process. These results clearly demonstrate that PBC has contributed to improving the prediction accuracy and accountability for the decision-making process in an environment where infectious diseases, such as COVID-19, are spreading.

Based on the results above, the research hypotheses proposed in Chapter II were verified as follows. Among the hypotheses regarding the effect of the CRP on the decision-making process for urban park use, Hypotheses 1 and 3 were accepted, but Hypothesis 2 was rejected. In both models, CRP was found to have a positive effect on Need. Thus, it is true that perceiving COVID-19 as a risk factor enhances people's desire to use parks (Hypothesis 1 accepted). Next, it was also assumed that the higher the CRP was, the more negative Attitude would become due to the fear of infection. In reality, however, the direct effect of CRP on Attitude was negative, but this effect was offset by the indirect positive effect arising from the enhanced desire to use urban parks in both models. Overall, the effect of CRP on Attitude was found to be statistically insignificant (Hypothesis 2 rejected). Meanwhile, the total effect of CRP on the dependent variable of both models were all in the negative (−) direction. These results demonstrated that the actual park-usage time decreased after the outbreak of COVID-19 (Hypothesis 3 accepted).

Among the hypotheses regarding the moderating effect of Convenience and Accessibility of urban parks, Hypothesis 4 was rejected, but Hypothesis 5 was accepted. In the analysis, interaction terms were created to determine whether the moderating effect of Convenience affected the relationship between CRP and Attitude; in both models, these interaction terms were found to be statistically insufficient. Thus, it was confirmed that Convenience had no effect on the process in which the perception of COVID-19 as a risk factor affected people's attitude toward using urban parks (Hypothesis 4 rejected). In contrast, the moderating effect of Accessibility on Attitude and Behavior was found to be statistically significant. Similarly, an interaction term was created to determine the moderating effect of Accessibility, but the term was found to be valid for the first model only. This means that Accessibility as a moderator is considered to be the factor affecting park usage, which remains the same, i.e., positive, regardless of the spread of COVID-19. In fact, positive effect which Attitude has on Behavior may vary depending on the degree of accessibility of parks. Simply put, the better accessibility of parks, the greater positive effects of attitude on using parks become (Hypothesis 5 accepted).

Ⅴ. Conclusions

1. Summary and Implications

Since the outbreak of COVID-19, leisure activities in outdoor facilities have been significantly limited, and, in response, there has been an increasing desire and preference

for the use of urban parks, which have relatively low infection risks. However, with the pandemic dragging on, there has been increased uncertainty in predicting how the way people use urban parks will change going forward. Given that urban parks are infrastructure that helps respond to the spread of infectious diseases in a flexible manner, it is necessary to discuss what sociopsychological factors translate people's desire to use urban parks into actual action at the fundamental level. This study aimed to determine what factors had affected changes in the decision-making process of using urban parks since the outbreak of COVID-19. To this end, two of structural equation models were designed based on the theory of planned behavior and employed in the analysis. The two models used the usage time after COVID-19 and the change in the usage time before and after COVID-19 as dependent variables, respectively. The results obtained from both models were compared to analyze changes in the decision-making process before and after the outbreak of COVID-19.

The major findings of the present study are as follows: First, COVID-19 risk perception was found to have a significant effect on the decision-making process, the desire to use them, and the attitude toward using them, eventually affecting the actual park-use time. The higher the risk perception of COVID-19 is, the higher the desire to use urban parks becomes; this induces people to have more positive attitudes toward using them. Nonetheless, in a situation where the infectious disease was spreading, the fear of infection was considered to be greater than the desire to use urban parks, and thus the park-use time was found to decrease accordingly. As such, the risk perception of COVID-19 may have a positive effect on the desire to use urban parks, along with people's attitudes toward using them, but its effect on actual park-use behavior was found to be negative. This contradictory phenomenon may be attributed to the limitations of individual urban parks, or this could also be due to the failure of urban parks of today to be perceived as a safe haven. Thus, urban parks should be able to satisfy the needs of city residents even in the presence of infection risk factors to respond to another infectious disease outbreak in the future. Planning and design of urban parks are needed to encourage all visitors to use it in a safe way.

Second, in times of the pandemic, accessibility and convenience of urban parks, perceived behavioral control regarding the use of urban parks, and waterfront-type parks were derived as factors to be considered in the planning and design of urban parks. It was found that accessibility and convenience did not contribute to further increasing the use of urban parks compared to the level before COVID-19. Notably, the difference in convenience among urban parks was not large enough to affect the degree of satisfaction of park visitors with various needs. Thus, it can be inferred that convenience is not an important factor to be considered when people decide to visit urban parks. However, both accessibility and convenience do directly or indirectly increase the use of urban parks regardless of the influence of COVID-19. When parks, are more convenient, people are more likely to have positive attitudes toward them, thus leading to increased use of them. Therefore, the provision of parks equipped with various conveniences will positively affect people's park-use behavior. In addition, better accessibility not only directly encourages the use of urban parks but also, as a moderator, indirectly enhances the positive effects of attitudes toward using them on the behavior of using parks through perceived behavioral control. Thus, continuous efforts to improve the accessibility of urban parks should be made.

Third, perceived behavioral control was found to induce people to have more positive attitudes toward using urban parks regardless of influences from COVID-19, and this eventually led to an increase in the park-usage. This means that when people increasingly perceive themselves to be in a position to easily and comfortably use parks, they tend to visit them more frequently and stay longer as well. Therefore, it is important to create an environment where people can perceive parks as highly accessible and easy-to-visit places even while recognizing the risk of infection. It is also necessary to ensure that people perceive parks as safe even when their environment and facilities are used by a number of visitors at the same time.

Finally, waterfront-type parks provide greater accessibility to more people because they are generally surrounded by a larger area of the external environment compared to city-type parks of the same size. These parks also allow visitors to move freely and smoothly without congestion. Thus, it is necessary to find ways to create urban parks that share such characteristics of waterfront-type parks to improve accessi-

bility and the flow of visitors. In line with the ongoing efforts to create a green network within urban spaces in the era of infectious diseases, urban parks are expected to play a critical role in implementing flexible urban planning going forward.

2. Significance and Limitations

The present study developed structural equation models for changes in the park usage time after COVID-19 and change in usage time before and after COVID-19 as dependent variables and employed them to identify factors that affected the decision-making process of using urban parks; this was done while analyzing changes in the decision-making process after the outbreak of COVID-19. The present work is an early-stage study that explores the effect of the risk of infection on the usage of urban parks at the level of the decision-making process. This study is significant in that it has empirically verified how individuals' decision-making processes actually translate into action after the outbreak of COVID-19. To be more specific, from practical perspectives, factors that had continuously affected the usage of urban parks regardless of external factors, such as COVID-19, were identified, and the necessary factors and directions to be considered in the development of guidelines for the planning of urban parks were also proposed. From theoretical perspectives, it was found that perceived behavioral control regarding the use of urban parks directly or indirectly affected people's attitudes and actual park-use behavior. Based on this interpretation, it was also confirmed that the theory of planned behavior was suitable for determining how risk perception would affect people's behavior.

Notably, an attempt was made to incorporate the concept of risk perception into the theory of planned behavior to provide a conceptual framework capable of predicting and analyzing the decision-making process in the era of infectious diseases. With new infectious diseases expected to occur more frequently going forward, the major findings of the present study can be used to induce people to use urban parks in the desired manner based on a clear understanding of the psychology of individuals in order to more effectively respond to future natural disasters like COVID-19.

Despite its contributions, this study has limitations, as follows: First, the nature of the virus evolving over time with the COVID-19 crisis dragging on was not considered in the present study. The relationship between the transmissibility and fatality of the virus and the use of urban parks was also not taken into account. From an analytical perspective, the park-use behavior was measured based on the frequency of visits and staying time only, thus failing to reflect various aspects related to the use of parks, such as what activities are conducted in parks or whom they are with during their visit to parks. In addition, the accessibility index was measured through the survey by asking the respondents about the time taken to reach the park from home. Thus, this result may not be consistent with official indices for the accessibility of parks. Further, in an attempt to analyze the difference before and after the outbreak of COVID-19, the respondents were asked to answer the questions while recalling past events. This is also considered to have led to a decrease in the accuracy of the collected data. Second, with the outbreak of COVID-19, non-contact interactions have become part of life, and thus it is important to examine how urban parks have contributed to the formation of a sense of community, but this study was not able to examine this issue. In fact, the survey included questions related to this issue, but the confirmatory factor analysis concluded that they were statistically invalid. Thus, these data were excluded from the modeling analysis. A future study should be able to analyze more in-depth the urban park-use behavior of people and the resultant effect under the influence of infectious diseases through a more sophisticated, specific research design while considering the limitations of the present study. It is desired that the major findings of the present study lay the groundwork for such future research.

Note 1. Given that changes in the use pattern of parks may also be attributable to seasonal factors, it is difficult to attribute the observed changes exclusively to the effect of COVID-19. Thus, careful attention needs to be paid to the interpretation of this result. In an attempt to control the effect of seasonal factors, the Google Community Mobility Report was employed. The report described that the use of outdoor parks in Korea as of the current period (January 3 to February 6, 2020) was 15% lower compared to the level measured during the same period of the previous year (Park, I.K. et al., 2021). This result was consistent with the reduction in the park-use time observed in the present study.

Note 2. The theory hierarchically organizes the five different levels of human needs in order of importance, as follows: Level 1 (Physiological human needs), Level 2 (Security needs), Level 3 (Social needs), Level 4 (Esteem needs), and Level 5 (Self-

actualization needs).

Note 3. Comfort, relaxtion, discovery, and passive and active engagement with the natural environment are included in this category.

Note 4. The nature needs include 1) Contact with nature, 2) Aesthetic preference, and 3) Recreation and play. The human-interaction needs include 1) Social interaction and privacy, 2) Citizen participation in the design process, and 3) Sense of community.

Note 5. The moderating effect refers to an effect that a moderating variable has on the process by which an independent variable affects the corresponding dependent variables. This moderating effect may affect the effect of an independent variable on the dependent variables in terms of degree, coefficient sign, or intensity (Lee, H.K., 2018, p. 391). For example, a moderating variable is capable of enhancing or weakening the relationship between independent and dependent variables. It is also possible to turn a positive (+) effect into a negative one, or vice versa (Woo, J.P., 2012, p.394).

Note 6. The survey items regarding the use of urban parks were carefully designed to ensure that the effect of seasonal factors could be excluded, and the answers would not be affected by the specific characteristics of COVID-19 that may vary over time. Their habitual behavior patterns were examined by calculating the annual frequency of park use and the annual use time while also determining how these patterns had changed since the outbreak of COVID-19.

Note 7. Only those designated as urban parks under the Act on Urban Parks, Green Areas, Etc. were considered in the present study. In the survey, the respondents were not asked what type of park they used. Instead, they were asked to write down the location and name of the parks that they frequently visited. Based on these answers, the parks that the respondents mentioned were categorized as urban parks or non-urban parks. Among the 411 urban parks included in the standard dataset, the number of small-scale parks with an area of less than 100,000 was 38. These parks were initially excluded from the analysis due to concerns that they may differ from the others in some aspects. However, it was confirmed that the inclusion of these items did not make any difference in the results. Thus, these small-scale parks were also eventually included in the scope of analysis.

Note 8. The variables waterfront type and mountain type were dummy variables whose reference group was the city-type park.

Note 9. 1) Northeast Region: Dobong-gu, Nowon-gu, Gangbuk-gu, Seongbuk-gu, Jungnang-gu, Dongdaemun-gu, Seongdong-gu, and Gwangjin-gu. 2) Southeast Region: Seocho-gu, Gangnam-gu, Songpa-gu, and Gangdong-gu. 3) Northwest Region: Eunpyeong-gu, Seodaemun-gu, Mapo-gu, Jongno-gu, Jung-gu, and Yongsan-gu. 4) Southwest Region: Gangseo-gu, Yangcheon-gu, Guro-gu, Geumcheon-gu, Yeongdeungpo-gu, Dongjak-gu, and Gwanak-gu.

Note 10. The variable City-Type Park' is the reference group of the dummy variables Waterfront type and Mountain type, and this variable was not used in the actual analysis.

Note 11. In the design of the survey, the variable Convenience was intended to represent the cognitive aspect of individuals concerning the physical environment. The variable Satisfaction was intended to represent individual evaluation. Considering the relationship between two entities, if the two are satisfied with each other, then this will naturally lead to the establishment of trust. Therefore, the correlation between these two constructs turns out to be high, and this means that their discriminant validity is rather low (Woo, J.P., 2012, pp.177-178).

Note 12. In the present study, the fitness of the model was determined based on the following indices: χ^2 (absolute fit index), root mean squared error of approximation (RMSEA), goodness of fit index (GFI), Tucker-Lewis index (TLI), and comparative fit index (CFI). The p-value of each fitness index is recommended to meet the following requirements: $\chi^2 \geq 0.05$, RMSEA$\leq$0.05(moderate) and 0.08(good), CFI$\geq$0.9, and TLI$\geq$0.9.

Note 13. To analyze the moderating effect of variables, an interaction term, that is, the product of the independent and dependent variables, needs to be created. If the value of this interaction term is statistically significant, then the moderating effect exists.

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