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Application of EMGB to Study Impacts of Public Green Space on Active Transport Behavior: Evidence from South Korea

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Abstract: Public green spaces (e.g., parks, green trails, greenways) and motivations to engage in active transport are essential for encouraging walking and cycling. However, how these key factors influence walker and cyclist behavior is potentially being increasingly influenced by the use of smart apps, as they become more ubiquitous in everyday practices. To fill this research gap, this work creates and tests a theoretically integrated study framework grounded in an extended model of goal-directed behavior, including public green space and motivation with perceived usefulness of smart apps. In order to accomplish the purpose of this study, we conducted an online survey of Korean walkers (n = 325) and cyclists (n = 326) between 10 and 25 July 2021 and applied partial least squares, structural equation, and multi-group analysis to validate the research model. Results revealed that active transport users' awareness of public green space positively influences attitude toward (γ = 0.163), as well as behavioral intention of (γ = 0.159), walking and cycling. Additionally, motivation (extrinsic and intrinsic) greatly influences attitude (γ = 0.539) and behavioral intention (γ = 0.535). Subjective norms (γ = 0.137) and positive (γ = 0.466) and negative anticipated emotions (γ = 0.225) have a significant impact on the desire that leads to behavioral intention. High and low perceived smart app usefulness also significantly moderates between public green space and attitude (t-value = 25.705), public green space and behavioral intention (t-value = 25.726), motivation and attitude (t-value = −25.561), and motivation and behavioral intention (t-value = −15.812). Consequently, the findings are useful to academics and practitioners by providing new knowledge and insights.

Keywords: active transport; walking/cycling; public green space; motivation theory; goal-directed behavior; smart app

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1. Introduction

Public green space plays many important roles, including improving mental and physical health, enabling personal and public well-being, and contributing to environmental and/or climate change mitigation goals [1–3]. The provision of green space enhances active transport use, such as walking and cycling, resulting in benefits for human and environmental health [4–10]. Studies of extrinsic and intrinsic motivations also help explain pedestrian and cyclist behaviors.

Researchers have had a long-standing interest in the theories of goal-directed behavior [11–13], with models of goal-directed behavior (MGB) often being applied to examine sustainable consumer behavior [14–18]. Research on active transport has found that an MGB greatly explains pedestrian and cyclist behaviors [19,20]. However, the nature of

walking and cycling is changing, with there being greater use of smart app technology; consequently, research on smart apps for active transport has found that they can influence walkers' and cyclists' perceptions in a variety of ways [21–24]. Nevertheless, despite the importance of green space and motivation for engagement in active transport, research on public green space and extrinsic/intrinsic motivation has been neglected in terms of the role of smart apps for walking and cycling based on goal-directed behavior theory.

1.1. Theoretical Context

1.1.1. Public Green Space Relevant to Walking and Cycling

Given its diverse and many social, economic, and environmental benefits, public green space, e.g., parks, gardens, forests, woods, greenbelts, and green spaces that are openly available to the public, is indispensable to society [3,25]. It is well recognized that urban green spaces have a positive influence on individuals' health and well-being [2,26]. The availability of green space is associated with reduced adult mortality, improved social capital, lower stress, and improved air quality [1,27]. Positive impacts of green spaces on individual activity behavior (e.g., walking) and health have also been increasingly highlighted in terms of street design and planning [7,9,10].

Compared to areas with poor public green space and trail access, people residing in neighborhoods with high availability of public green space and cycle trails are more likely to walk and cycle [5,8]. The significance of walking in urban green space to health has also been highlighted, revealing the potential health benefits of supporting such behavior [4]. As well as encouraging physical activity, public green space can also help mitigate air pollution and urban heat island effects [6]. Therefore, this study considers public green space as an important public good that can encourage the active transport of walking and cycling and contribute to more sustainable urban environments. Thus, public green space is defined as parks, gardens, forests, woods, greenbelts, greenways, and green trails; such green space can improve mental and physical health, enable personal and public well-being, and contribute to environmental and/or climate change mitigation goals [4–10].

1.1.2. Motivation Theory

Motivation can be defined as a desire, drive, wish, goal, and/or need, which is classified as being both extrinsic and intrinsic in nature [28]. Extrinsic motivation refers to behaviors and/or actions, which are a possible achievement of some outcome, whereas intrinsic motivation are behaviors, which engage in an action for the fulfillment or gratification inherent in the execution of the action [29,30]. Specifically, intrinsic motivation remains an important construct, reflecting the natural human propensity to learn and assimilate; however, extrinsic motivation may vary considerably in its relative autonomy and can thus either reflect external control or true self-regulation [31,32]. Intrinsic motivation is also found to be positively related to moderate-to-vigorous physical activity [33].

Researchers have been interested in motivations relevant to walking and/or cycling from a variety of disciplines and perspectives [34–37]. This is partly because the motivations, which persons have for active transport activities—walking trips, for example—are a strong indicator of the degree of satisfaction with the activity [35]. Extrinsic (fitness and appearance) and intrinsic (competence, enjoyment, and social) motivational impacts on participation in a walking campaign are diverse according to demographic characteristics [31]. Leisure benefits are positively affected by cycling motivation, and both cycling motivation and leisure benefits have a positive impact on well-being [37]. Rejón-Guardia et al. [33] found that the primary motivations for participation in mountain cycling are weather (physiological or perceived) and route signage, followed by utilitarian practices (cost of the trip) and intrinsic motivations, such as the enjoyment of being engaged in physical challenges.

Based on the literature, this research therefore regards motivation (intrinsic and extrinsic) as a vital variable in the context of walking or cycling.

1.1.3. Models of Goal-Directed Behavior (MGB)

The theory of reasoned action (TRA) suggests that human attitudes as well as subjective norms can forecast intentions, applying beliefs, attitudes, intentions, and behaviors [38]. Subsequently, the theory of planned behavior (TPB) was developed to resolve the limitations of the TRA by dealing with issues of incomplete volitional control [39]. In other words, TPB emphasizes that human behavior is governed by human attitudes and subjective norms (social pressures) and a perceived sense of behavioral control [40]. TPB also describes behavior in terms of it being preceded by an intention to complete the predicted behavior, an element of the theory, which is found to be well supported by empirical evidence [39]. More recently, an MGB has been established by developing an extended TPB incorporating anticipated emotions and desire [40].

Theories of goal-directed behavior are regarded as providing a suitable conceptual framework for examining both routine and non-routine travel [13]. The MGB has been found to predict travel behavioral intention with respect to subjective norms, attitude, positive and negative anticipated emotion, desire, and perceived behavioral control [38–40], as well as by behavioral studies [41,42]. For example, during a flu pandemic, consumer travel intention was highly explained by an EMGB, which added key constructs of non-pharmaceutical interventions and perception of infectious diseases [43]. Differences in international travel behavior between males and females has also been significantly explained by the MGB, along with frequency of past behavior [44]. Consumer behavior has been substantially predicted by the goal-directed behavior, including key variables of motivations of extrinsic (usefulness) and intrinsic nature (enjoyment) [29,41,42]. In an international crisis setting, the EMGB well identified potential consumers' behavioral intention by adding important constructs, such as physical, financial, privacy, and performance as perceived risks [45].

In sustainable travel research, studies have used an EMGB to understand behavior [16,17]. For instance, responsible travel behavior has been explained by the EMGB, incorporating critical factors of perceived ethics (economic, socio-cultural, and environmental concern) [15]. In crowdfunding settings, funder behavior has been forecast by an EMGB with the additional concept of co-creation [16]. Research has also shed light on crowdfunding of Sustainable Development Goals (SDGs)-related projects, with the inclusion of constructs of perceived risks (financial, privacy, and performance) [17]. Travel mode choice, cycling, consumer attitude and behavior in active travel, and public transport have also been predicted by the MGB [19]. Consumer attitude and behavior with respect to urban sustainable mobility was identified by the MGB, together with prescriptive and descriptive norms [20]. Grounded in such literature, this study applies the EMGB, incorporating key concepts of awareness of public green space as well as motivation as a formative second-order construct with extrinsic and intrinsic sub-factors.

1.2. Hypothesis Development

The object of the work is therefore to create and assess a conceptual framework based on an extended MGB (EMGB), adding key variables of awareness of public green space and extrinsic and intrinsic motivation, along with the moderating effect of perceived usefulness of smart apps. This study raises three research questions: Do awareness of public green space and motivation for using active transport influence attitude, desire, and behavioral intention to walk and cycle; does an EMGB model predict walkers' and cyclists' behavioral intention; and does the perceived usefulness of smart apps moderate between awareness, motivation, attitude, desire, and behavior? Given the importance of active transport and green space for public and environmental health, the findings of the work potentially offer valuable academic and managerial insights for research and action on active transport initiatives.

Active transport use in urban green space is well recognized as a stress reduction behavior and for having positive benefits for mental and public health [46–49]. Awareness can be defined as the state of being cognizant of something and, importantly, it is the

capability to identify and notice, to sense, or to be conscious of actions, positions, and/or some information in an extensive range of behavioral intentions [50]. Cycling behavior in a travel context is influenced by cognitive (e.g., awareness), evaluative (e.g., attitude), and motivational processes (e.g., desire) [51]. In terms of green mobility, consumers' awareness of consequences has a significant impact on their attitude that then influences intentions and behaviors [52]. In addition, eco-friendly knowledge positively influences ecological attitude relevant to green purchase behavior [53], implying that awareness can lead to attitude, desire, and behavioral intention. Environmentally friendly awareness has also been found to significantly influence green purchase intention [54]. From a sustainability perspective, the perceived economic, socio-cultural, environmental concerns (e.g., awareness) significantly influence attitude toward and behavioral intention in relation to responsible travel behavior [15]. Hence, we propose three hypotheses:

Hypothesis 1a (H1a). *Awareness of public green space has a positive effect on attitude toward walking and cycling.*

Hypothesis 1b (H1b). *Awareness of public green space has a positive effect on desire to walk and cycle.*

Hypothesis 1c (H1c). *Awareness of public green space has a positive effect on behavioral intention of walking and cycling.*

Intrinsic motivation impacts satisfaction related to attitude, which, in turn, influences supporting behavior [30]. Travel consumers' extrinsic and intrinsic motivations have significant effects on attitude relevant to desire, leading to their behavioral intentions [29]. Consumers' motivation influences their flow experience related to well-being and behavioral intention from a travel perspective [55]. Motivations to belong to social groups influence the desire of people to develop and maintain stable inter-personal relations [56]. In a green bed and breakfast context, consumers who are motivated by environmental friendliness are more likely to have a strong desire toward green experiential loyalty [57]. Intrinsic motivation is highly correlated to leisure-time physical activity, such as walking [58]. Individuals' motivations for participating in walking trips are a strong predictor of their satisfaction level that significantly leads to a desire to walk [35]. Grounded in the literature review above, we posit three hypotheses:

Hypothesis 2a (H2a). *Motivation has a positive effect on attitude toward walking and cycling.*

Hypothesis 2b (H2b). *Motivation has a positive effect on the desire to walk and cycle.*

Hypothesis 2c (H2c). *Motivation has a positive effect on behavioral intention of walking and cycling.*

Perugini and Bagozzi [40] suggest that desires can be defined as the proximal cause of behavioral intentions and fully mediate between anticipated emotions, attitudes, subjective norms, perceived behavioral control, and intentions. These relationships are significant in travel environments [43–45]. In travel consumer behavior, associations with attitude, perceived behavioral control, negative anticipated emotion, positive anticipated emotion, desire, and intentions are positively significant [16]. In responsible travel contexts, relationships between attitude, subjective norms, perceived behavioral control, positive anticipated emotion, and negative anticipated emotion toward the desire relevant to behavioral intention are significant [15,19]. Subjective norms, perceived behavioral control, and positive and negative anticipated emotion have significant impacts on desire, which leads to behavioral intention in sustainable consumer behaviors [17,20]. In line with this literature, we suggest six hypotheses:

Hypothesis 3a (H3a). *Attitude has a positive effect on the desire to walk and cycle.*

Hypothesis 3b (H3b). *Subjective norms have a positive effect on the desire to walk and cycle.*

Hypothesis 3c (H3c). *Perceived behavioral control has a positive effect on the desire to walk and cycle.*

Hypothesis 3d (H3d). *Positive anticipated emotion has a positive effect on the desire to walk and cycle.*

Hypothesis 3e (H3e). *Negative anticipated emotion has a positive effect on the desire to walk and cycle.*

Hypothesis 4 (H4). *Desire has a positive effect on the behavioral intention of walking and cycling.*

Increased use of multi-app-equipped smartphones is changing the way people walk and engage in physical activity and the way they use apps [59], which are increasingly incorporated into behavioral interventions to encourage walking [22]. A mobile phone app has been found to substantially increase personal mobility, including walking with respect to specific goal settings, self-monitoring, and/or responses [24]. Walking actions (such as unilateral stopping, turning, restarting) can be connected to actions displayed on a map app [24]. iPhone apps enabled reliable evaluations of walking activities [23]. Users of Google Maps and other apps are able to obtain safer routes for walking and crossing in urban areas [21]. These results suggest that individuals with high perceived usefulness of smart app for walking and cycling are potentially likely to possess different characteristics from individuals with low perceived usefulness of smart apps for active transport. Hence, we suggest the following hypothesis:

Hypothesis 5 (H5a–H5f). *The high and low groups of perceived usefulness of smart apps have significantly different impacts on the relationships between public green space and attitude, public green space and desire, public green space and behavioral intention as well as motivation and attitude, motivation and desire, and motivation and behavioral intention of walking or cycling.*

The suggested relationships above are grounded in prior literature, applied in a range of different circumstances and locations. The study framework is presented in Figure 1.

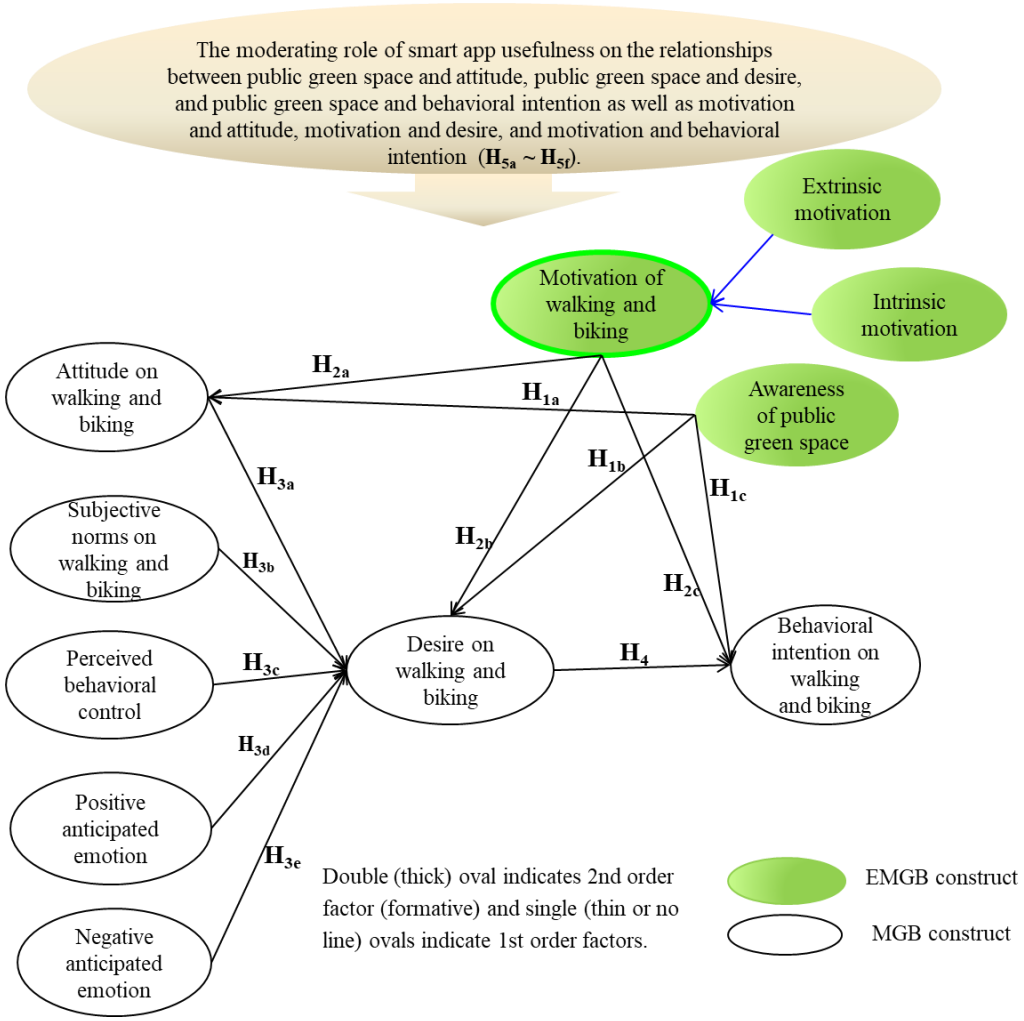


Figure 1. Proposed research model.

2. Materials and Methods

2.1. Measurements

Due to measurement inaccuracies associated with single items, questionnaires were used after previously validated multiple measures were adapted for the context of this study [60]. In this study, the survey instrument originally included 44 questions and 11 concepts: awareness of public green space, extrinsic and intrinsic motivations, attitude, perceived behavioral control, subjective norms, positive anticipated emotion, desire, negative anticipated emotion, intentions, and perceived usefulness of smart apps.

Awareness of public green space was assessed with four items grounded in prior literature [1,5,6,15] (e.g., "I am interested in public green space for walking/cycling"). Extrinsic and intrinsic motivations were measured by four items each, drawing upon prior literature [15,30–34,37,55] ("Walking/cycling improves my personal health" and "Walking/cycling is enjoyable for me").

Subjective norms, perceived behavioral control, attitude, positive and negative anticipated emotion, desire, and intentions of walking/cycling were assessed with four questions based on Kim and Hall [16,17] and Lee et al. [43] (e.g., "Walking/cycling is an affirmative behavior," "Most people who are important to me think I should walk/cycle," and "To increase my personal well-being, I am planning to walk/cycle"). The perceived usefulness of smart apps for walking and cycling was assessed with four questions drawn from previous literature [22–24,59,61] (e.g., "I believe that using smart apps for walking/cycling would enable me to accomplish walking/cycling better").

Ranging between (1) strongly disagree and (7) strongly agree, a total of 44 questions were provided to respondents on a 7-point Likert-type scale. Seven-point Likert-type measures were used because they offer reliability as well as discriminant validity [62,63]. General characteristic questions associated with walking/cycling (i.e., participation types, reason for walking/cycling, comparison before COVID-19, using smart apps and types, personal safety, companions) were also added to the final survey. Seven items relevant to socio-demographics, such as gender, age, marital status, monthly household income, educational level, residential area, and occupation were also included.

2.2. Content Validity and Pilot and Pre-Test

To accomplish this study's goals, the instrument was initially designed in English and then interpreted into the Korean version with three specialists suitably expert in the two languages reviewing the survey design. The Korean questionnaire was then back-interpreted into English to remedy any expression incongruities from English to Korean, resulting in the editing of both language versions of the survey [64].

For content validity, three experts in sustainable mobility performed a primary assessment of the measurements. As this stage, one item each of awareness of public green space, extrinsic motivation, and behavioral intention was added in order to better convey the intended meaning of each construct (i.e., "Green spaces are attractive for walking/cycling at any time of year," "Walking/cycling improves public health," and "To increase public well-being, I am planning to walk/cycle"). Several items were also slightly revised regarding public green space, extrinsic motivation, intrinsic motivation, and perceived usefulness of smart apps, so as to clarify questions. Three online survey specialists from the survey company used for this study also assessed whether the questionnaire could suitably evaluate walking and cycling. Subsequently, instructions, screen questions, socio-demographic variables, and general questions were developed to meet the requirements of digital survey systems. The questionnaire was also administered online to five Korean graduate students. The definitions of walking, cycling, active transport, leisure, tourism, and work were subsequently slightly reworded in light of their comments. A pre-test was then administered on 60 Korean residents who had walked or cycled for leisure, tourism, or work in the prior 12 months. Subsequently, as shown in Appendix A, three items relevant to respondent commitment to the quality of answers, time spent on answering the survey, and riding an e-cycle were added.

2.3. Data Collection

Due to their efficiency and efficacy, web survey services are increasingly used for online surveys, especially when large panels are available [65]. During the COVID-19 pandemic, online surveys are also an extremely appropriate data collection method for health and ethical reasons. The target respondents were Korean residents who were 18 years old and older and who walked or cycled. Since the initial outbreak of COVID-19 in January 2020 in Korea, travel has been strictly restricted under social distancing. Thus, this study did not specify a time period of experience with walking and cycling within a certain time. Based on resident registration demographics drawn from data provided by the Ministry of the Interior and Safety [66], a quota sampling technique was used in relation to the population age, gender, and residential area.

To obtain the data, a digital survey firm with the largest panel in Korea (approximately 1.5 million of Koreans) as of 4 September 2021 was used [67]. To ensure data quality, the firm used appropriate sampling measures, including: verification of participant identity; surveys finished too quickly were deleted; respondents not meeting the screening query were removed; every subject had a different question order to lessen answer bias; and subjects were asked to present the name of activity types among leisure, tourism, and work that they had most recently experienced by walking or cycling.

Data were collected through the online survey between 10 and 25 July 2021. An invitation detailing the study background and privacy measures was emailed to 4993 people

for walking and 6191 for cycling subjects based upon a random sampling of 1,471,974 consumers on the survey company databases. Of the 2403 walking and 3003 cycling people who clicked on the invitation, 1528 (walking) and 1941 (cycling) individuals, respectively, looked further into it. All participants were required to specify whether they walked and cycled for leisure, tourism, and/or work (i.e., "Have you walked (cycled) for leisure-, tourism-, and/or work-related activities?"). At the beginning of this survey, definitions were presented. That is, in this study, "the term active transport refers to walking and biking; leisure activity means an activity chosen for pleasure, relaxation, or other emotional satisfaction, typically outside of work time, including daytrips; tourism is defined more generally as people traveling to and staying in places outside their usual home environment for no more than one consecutive year for leisure and no less than 24 h; walking can refer to walking for outdoor activity, leisure activity, recreation, exercise, hiking/tramping, and/or tourism-related activities; and biking can refer to biking for outdoor activity, leisure activity, recreation, exercise, sports, mountain biking, and/or tourism-related activities" (Appendix A). Only the 1258 panelists (492 cases for walking and 755 cases for cycling) who said "yes" to the screen questions were qualified to answer the questionnaire. Of those, 770 (walking: 370 cases, and cycling: 400 cases) validly completed the survey. After outliers and inappropriate respondents (e.g., completing the survey in less than 5 min) were deleted [68], 651 questionnaires were coded for the analysis, revealing a response rate of 51.7% (651/1258) using the American Association for Public Opinion Research criteria [69] (p. 58).

2.4. Data Analysis

This study conducted chi-square tests between the walking (325 cases) and cycling groups (326 cases) to understand whether they could be combined for analysis because the respondents were surveyed by separate walking and cycling groups. There is a statistically insignificant difference between walking and cycling behavior (Cochran, 1952) [70] according to Pearson chi-squared test ($\chi 2 = 25.642$, df = 27, p-value = 0.539). This study is therefore able to combine and analyze respondents from the walking and cycling groups to evaluate the proposed research model, since the null hypothesis that there are no differences between the two groups is true.

Partial least squares and structural equation (PLS-SEM) was used to evaluate the proposed research model. When assessing the first-order factors synchronously related to second-order factors, PLS-SEM is appropriate [71]. PLS-SEM is regarded as better than typical SEM, such as covariance-based approaches, when studies have non-normal distribution, small sample sizes, and/or complicated framework by multi-group analysis (MGA) [72]. Therefore, SmartPLS 3.3.3 was used to test the measurement as well as structural frameworks [73]. To validate the comparison between the two groups of high and low perceived usefulness of smart apps, MGA was used in accordance with PLS-SEM procedures [68,70], with moderating impacts tests as recommended by Chin et al. [74] and Keil et al. [75] (p. 315).

Furthermore, all tests (Harmon's single-factor and marker variable approach) demonstrate that common method bias does not occur in this work (Appendix B).

3. Results

3.1. Sample Profile

Participants were almost equally distributed between male (49.3%) and female (50.7%). Around half of participants (44.9%) were in the 40–59 age bracket. The majority of the respondents had undergraduate or higher education (66.8%) and were married (61.9%). Most respondents lived in households with a monthly family income of over 4 million Korean Won (KRW) (USD 1 is equivalent to KRW 1142 as of 15 July 2021) and were engaged in full-time employment. More than a half of participants lived in the Seoul metropolitan regions.

The respondents answered all the questions, taking five minutes or more, as well as saying "yes" with respect to providing thoughtful and honest answers. The main reason to participate in walking and cycling is for physical well-being and health (67.0%). A little more than half of respondents engaged in walking and cycling more than or same as compared to before the pandemic (55.5%). A majority of respondents used smart apps for walking and cycling (64.7%). The most frequently used smart apps were ones that count the steps or measure the distance traveled (43.8%). During walking and cycling, just over two-fifths of respondents worried about their personal safety (40.2%). The majority of respondents (59.3%) usually walked or cycled alone. See more details in Appendix C.

3.2. Results of Measurement Model Testing

A shown in Table 1, confirmatory factor analysis (CFA) using all 47 indicators obtained factor loadings of over 0.7 [68]. Cronbach's α, Rho_A as reliability coefficient, and the composite reliability of constructs were over 0.7, thus confirming internal consistency and reliability (Table 2) [76,77]. In confirming the convergent validity, the average variance extracted (AVE) of all constructs was over 0.5, and over 0.7 for the factor loadings of all indicators [71].

Table 1. Reliability and discriminant validity.

Construct	Heterotrait–Monotrait Ratio (<0.9)									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1. Awareness of public green space										
2. Extrinsic motivation	0.548									
3. Intrinsic motivation	0.628	0.520								
4. Attitude	0.572	0.632	0.596							
5. Subjective norm	0.486	0.430	0.506	0.607						
6. Perceived behavioral control	0.502	0.522	0.517	0.574	0.399					
7. Positive anticipated emotion	0.594	0.568	0.860	0.618	0.545	0.502				
8. Negative anticipated emotion	0.409	0.248	0.377	0.456	0.519	0.306	0.415			
9. Desire	0.510	0.410	0.726	0.579	0.590	0.411	0.763	0.554		
10. Behavioral intention	0.677	0.732	0.754	0.689	0.603	0.503	0.755	0.442	0.694	
Cronbach's alpha ≥ 0.7	0.856	0.899	0.909	0.849	0.884	0.766	0.927	0.942	0.914	0.852
Rho_A (reliability coefficient) ≥ 0.7	0.866	0.901	0.915	0.861	0.891	0.800	0.927	0.946	0.914	0.852
Composite reliability ≥ 0.7	0.898	0.926	0.937	0.899	0.920	0.846	0.948	0.958	0.939	0.894
AVE ≥ 0.5	0.638	0.717	0.787	0.691	0.742	0.581	0.82	0.852	0.795	0.629
Effect size (Q^2) > 0	-	-	-	0.288	-	-	-	-	0.456	0.394

Note: -: Exogenous variables give effects to endogenous variables, so only endogenous variables have an effect size in causal modeling.

Table 2. CFA on the measurements, descriptive statistics, and normal distribution.

Constructs	Factor Loading	*t*-Value	Mean	SD *	Kurtosis	Skewness	VIF **
Awareness of public green space							
1. I am interested in public green space for walking/cycling.	0.864	71.650	5.261	1.218	0.394	−0.653	2.685
2. I am aware of public green spaces for walking/cycling.	0.693	24.276	4.939	1.343	0.173	−0.628	1.486
3. I care about public green trails for walking/cycling.	0.866	75.457	5.427	1.164	0.640	−0.682	2.701
4. Public green spaces provide cool areas in which to walk/cycle when it is hot.	0.772	37.634	5.498	1.135	0.496	−0.727	1.782
5. Public green spaces are attractive for walking/cycling at any time of year.	0.787	35.861	5.450	1.154	0.503	−0.692	1.846
Extrinsic motivation							
1. Walking/cycling improves my personal health.	0.729	31.041	5.937	0.949	*1.597*	−0.987	1.562
2. Walking/cycling contributes to the environment.	0.903	70.813	5.533	1.120	0.460	−0.665	3.565
3. Walking/cycling contributes to mitigating climate change.	0.891	60.295	5.396	1.182	*1.003*	−0.789	3.558
4. Walking/cycling contributes to lowering air pollution.	0.895	94.862	5.512	1.212	0.896	−0.849	3.520
5. Walking/cycling improves public health.	0.802	42.136	5.144	1.118	0.120	−0.333	1.999

Table 2. *Cont.*

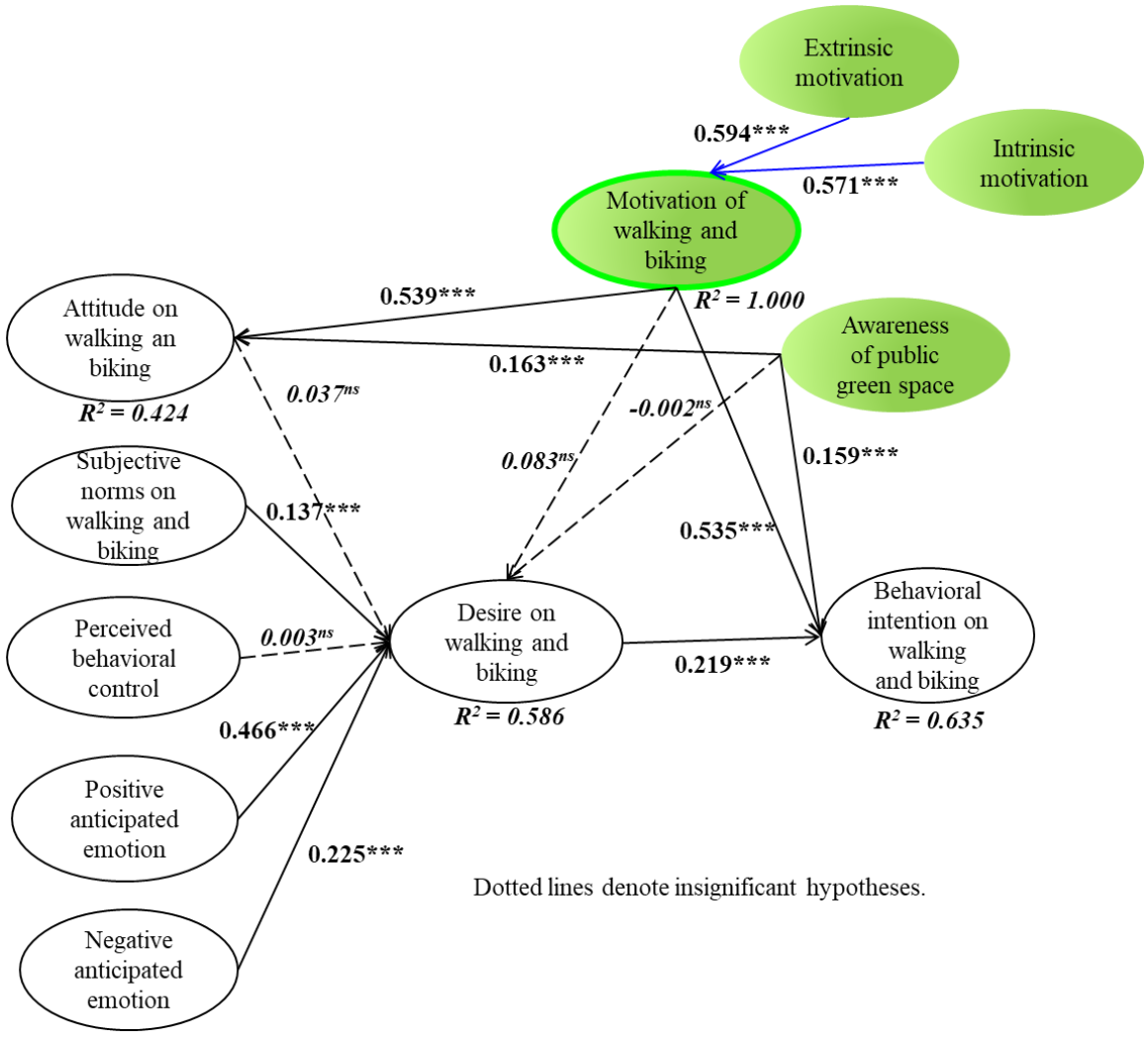
Constructs	Factor Loading	*t*-Value	Mean	SD *	Kurtosis	Skewness	VIF **
Intrinsic motivation							
1. Walking/cycling is enjoyable for me.	0.911	112.620	5.287	1.164	0.363	−0.551	3.366
2. Walking/cycling brings me self-satisfaction.	0.896	95.143	5.298	1.168	0.434	−0.550	2.887
3. Walking/cycling makes me happy.	0.915	132.335	5.169	1.178	0.199	−0.387	3.484
4. I walk for refreshment.	0.824	38.645	5.339	1.163	*1.025*	−0.763	2.037
Attitude to active transport							
1. Walking/cycling is an affirmative behavior.	0.881	90.493	5.690	1.009	*1.041*	−0.759	2.563
2. Walking/cycling is a beneficial behavior.	0.864	67.478	5.730	0.987	0.524	−0.648	2.418
3. Walking/cycling is an essential behavior.	0.713	26.581	4.763	1.428	−0.231	−0.397	1.498
4. Walking/cycling is a legitimate behavior.	0.857	67.214	5.255	1.100	0.275	−0.406	2.213
Subjective norm on active transport							
1. Most people who are important to me think I should walk/cycle.	0.860	65.546	4.293	1.409	−0.391	−0.223	2.445
2. Most people who are important to me would want me to walk/cycle.	0.897	82.026	4.516	1.331	−0.028	−0.288	3.016
3. Most people who are important to me support my walking/cycling.	0.819	37.580	4.980	1.244	0.633	−0.630	2.010
4. Most people who are important to me are proud that I go walking/cycling.	0.869	63.156	4.429	1.324	0.314	−0.345	2.187
Perceived behavioral control							
1. Walking/cycling or not is entirely up to me.	0.652	16.000	5.954	0.997	0.931	−0.990	1.412
2. I can walk/cycle whenever I want.	0.786	29.999	5.320	1.317	0.266	−0.798	1.683
3. I have the physical strength to walk/cycle.	0.750	23.633	5.696	1.025	0.139	−0.686	1.365
4. I have time to walk/cycle.	0.848	49.348	5.281	1.137	0.268	−0.542	1.696
Positive anticipated emotion							
1. If I walk/cycle, I will feel excited.	0.900	85.682	5.157	1.203	0.393	−0.521	3.098
2. If I walk/cycle, I will feel glad.	0.920	117.165	5.210	1.152	0.728	−0.556	3.782
3. If I walk/cycle, I will feel satisfied.	0.887	88.516	5.461	1.031	0.669	−0.582	2.747
4. If I walk/cycle, I will feel happy.	0.915	124.078	5.252	1.140	0.349	−0.449	3.576
Negative anticipated emotion							
1. If I cannot walk/cycle, I will be angry.	0.921	120.119	3.989	1.736	−0.848	−0.035	3.881
2. If I cannot walk/cycle, I will be disappointed.	0.932	157.084	4.607	1.695	−0.762	−0.390	4.200
3. If I cannot walk/cycle, I will be worried.	0.902	76.368	4.539	1.687	−0.869	−0.243	3.285
4. If I cannot walk/cycle, I will be sad.	0.937	174.769	4.458	1.750	−0.848	−0.278	4.488
Desire to walk/cycle							
1. I do want to walk/cycle.	0.847	67.976	5.167	1.197	0.712	−0.670	2.122
2. My desire to walk/cycle is passionate.	0.914	130.799	4.525	1.367	0.022	−0.431	3.495
3. I am enthusiastic about walking/cycling.	0.886	70.491	4.038	1.382	−0.267	−0.146	3.151
4. I am eager to walk/cycle.	0.916	128.309	4.258	1.397	−0.201	−0.308	3.827
Behavioral intention in active transport							
1. To increase my personal well-being, I am planning to walk/cycle.	0.785	42.778	5.301	1.099	0.746	−0.652	1.951
2. To improve my personal health, I will make an effort to walk/cycle.	0.740	26.692	5.605	1.093	*1.104*	−0.861	1.771
3. To mitigate climate change, I am willing to walk/cycle.	0.822	54.767	4.900	1.275	0.310	−0.588	2.574
4. To protect the environment, I do intend to walk/cycle.	0.822	50.032	4.693	1.372	−0.082	−0.387	2.795
5. To increase public well-being, I am planning to walk/cycle.	0.792	42.040	4.584	1.312	−0.037	−0.259	1.973
Perceived usefulness of smart applications							
1. I believe that using smart applications for walking/cycling would enable me to accomplish walking/cycling better.	0.897	89.006	4.628	1.244	0.067	−0.266	2.880
2. I believe that using smart applications for walking/cycling would improve my walking/cycling performance.	0.885	73.279	4.866	1.22	0.197	−0.358	2.871
3. I believe that using smart applications for walking/cycling would make it easier to do my walking/cycling.	0.861	60.945	4.567	1.329	−0.124	−0.304	2.238
4. I believe that using smart applications for walking/cycling would enhance my effectiveness in walking/cycling.	0.876	72.385	5.022	1.149	0.724	−0.493	2.664

Note: The italics indicate non-normal distribution. * Standard deviation. ** Variance inflation factor.

Based on Henseler et al. [78], the Heterotrait–Monotrait (HTMT) ratio was used to evaluate discriminant validity. The HTMT ratio with a cut-off value of below 0.90 is regarded as a more precise measure than the widely applied Fornell–Larcker criterion analysis for investigating discriminant validity [72,78]. The HTMT ratio in this study is below 0.9 of the cut-off, supporting discriminant validity. Furthermore, suitable relevance levels were achieved, as Q2 standards over zero (from 0.288 to 0.456) were confirmed for all endogenous variables [79,80]. The multicollinearity of variables was tested by employing the variance inflation factor (VIF). Since the outer VIF values were from 1.365 to 4.488, multicollinearity seems not to be a problem [68].

3.3. Results of Structural Model Testing

We utilized PLS-SEM to test the 14 relationships of five main hypotheses because the data indicated non-normal distributions by excess kurtosis (Table 2). The R^2 (variance explained) shows attitude (42.5%), desire (58.6%), and behavioral intention (63.5%) (see Figure 2). To evaluate the sampling with non-normal distribution, the path coefficients, as well as the evaluated t-statistics of the relationships, were tested by employing PLS-SEM with bootstraps of 5000 re-samplings [71,74].



*** $p < 0.001$; ns = non-significant.

Figure 2. Results of path analysis.

As demonstrated in Figure 2, awareness of public green space positively influences attitude (γ = 0.163, t-value = 3.617, $p < 0.001$) as well as behavioral intention (γ = 0.159, t-value = 4.703, $p < 0.001$). Motivation for walking and cycling highly influences attitude (γ = 0.539, t-value = 12.805, $p < 0.001$) and behavioral intention (γ = 0.535, t-value = 14.993, $p < 0.001$). Desire is significantly affected via subjective norms (γ = 0.137, t-value = 3.473, $p < 0.001$), positive anticipated emotion (γ = 0.446, t-value = 10.046, $p < 0.001$), and negative emotion (γ = 0.225, t-value = 5.997, $p < 0.001$). Behavior is significantly affected by desire (β = 0.219, t-value = 7.127, $p < 0.001$). Thus, H_{1a}, H_{1c}, H_{2a}, H_{2c}, H_{3b}, H_{3d}, H_{3e}, and H_4 were all supported. However, the relationships between awareness and desire (H_{1b}: $\gamma = -0.002$, t-value = 0.056, $p > 0.05$), motivation and desire (H_{2b}: γ = 0.083, t-value = 1.642, $p > 0.05$), attitude and desire (H_{3a}: γ = 0.037, t-value = 0.857, $p > 0.05$), and between perceived behavioral control and desire (H_{3c}: γ = 0.003, t-value = 0.080, $p > 0.05$) were insignificant, thus H_{1b}, H_{2b}, H_{3a}, and H_{3c} were not supported. Furthermore, for the formative second-order construct, extrinsic motivation was more closely related to motivation (λ = 0.594, t = 42.106, $p < 0.001$) than intrinsic motivation (λ = 0.571, t = 35.084, $p < 0.001$).

In order to test the mediating roles of attitude as well as desire in the research framework, PLS-SEM bootstrapping by 5000 re-samples was utilized (Appendix D). Behavior was confirmed to be indirectly affected via subjective norms (γ = 0.032, t-value = 3.369, $p < 0.001$), positive anticipated emotion (γ = 0.116, t-value = 6.541, $p < 0.001$), and negative anticipated emotion (γ = 0.050, t-value = 4.798, $p < 0.001$). Thus, desire was confirmed to have mediating effects on the framework, while attitude had insignificant effects. The effect scales (f^2), the f^2 values (effect size), in this study were reported as ranging from 0.000 (no impact) to 0.394 (major impact) [81].

3.4. Moderating Effect of Perceived Usefulness of Smart Apps

The construct of perceived usefulness of smart apps was divided into high and low groups by the K-mean clustering method, with the average mean of four items (Appendix E). The high group of perceived usefulness of smart apps for walking and cycling had 433 cases with the mean score of 5.36, while the low perceived group had 218 participants with the mean value of 3.61. By using the PLS algorithms, each group was considered appropriate for MGA, letting the two groups be utilized for comparison [68]. As shown in Table 3, the high perceived group of smart app usefulness had greater impacts of awareness of public green space on the attitude and behavioral intention than their counterparts. In contrast, the low perceived participants of smart app usefulness had greater effects of motivation on the attitude and behavioral intention than their counterparts. Thus, H5 was partially supported.

Table 3. Moderating role of high and low perceived usefulness of smart apps.

H5	Path	High Group (A)	Low Group (B)	A–B	t-Value	p-Value	Hypothesis Test
H5a	Awareness of public green space → Attitude	0.206 ***	*0.076 ns*	0.130	25.705	<0.001	Supported
H5b	Awareness of public green space → Desire	*0.017 ns*	*−0.068 ns*	0.085	20.052	ns	Not supported
H5c	Awareness of public green space → Behavioral intention	0.202 ***	*0.099 ns*	0.102	25.726	<0.001	Supported
H5d	Motivation for walking/cycling → Attitude	0.470 ***	0.585 ***	−0.115	−25.561	<0.001	Supported
H5e	Motivation for walking/cycling → Desire	*0.086 ns*	*0.027 ns*	0.058	10.128	ns	Not supported
H5f	Motivation for walking/cycling → Behavioral intention	0.494 ***	0.561 ***	−0.067	−15.812	<0.001	Supported

*** $p < 0.001$; ns = non-significant. Since the two hypotheses in the high and low groups are insignificant, H5b and H5e are not supported.

4. Discussion

This work suggests that people with higher awareness of public green space (e.g., parks, gardens, forests, greenbelts, greenways, institutional green spaces) are more likely to have a positive attitude toward, as well as behavioral intention of participating in walking

and cycling. Although such results may seem readily apparent, they actually extend previous literature on personal values and public green space in active transport in relation to attitude and behavior in urban areas [47]. The strong relationships between motivation and attitude as well as motivation and behavioral intention suggest that individuals with strong motivation for walking and cycling are more likely to have better attitude toward, as well as behavioral intention of participating in active transport behavior. These findings reinforce previous research on individuals' motivations and satisfaction with respect to walking trips [35] and, perhaps more significantly, provide insights into more effective behavioral interventions that seek to encourage walking and cycling. This is particularly important, as extrinsic motivations are found to be more significant than intrinsic ones in terms of wanting to walk and cycle, extending previous findings on intrinsic and extrinsic motivations applied by the self-determination theory [31–33].

The positive influences of subjective norms, positive anticipated emotion, and negative anticipated emotion on the desire to walk and cycle are substantially significant. This work therefore expands previous findings on MGB in the context of active travel behavior for the travel mode choice cycle [19] and sustainable transport for cities [20]. In particular, the insignificant relationships between awareness and desire, motivation and desire, perceived behavioral control and desire, and attitude and desire suggest that people's desires to walk and cycle are not influenced by awareness, motivation, perceived behavioral control, and attitude. A possible reason for these findings is that walking and cycling are essential to Korean residents who are dealing with the COVID-19 pandemic, so that even without the influences of awareness, motivation, attitude, and perceived control on desire, Koreans still continue to walk and cycle for leisure, tourism, and/or work. These findings are partially consistent with the findings of prior research on support for the Sustainable Development Goals (SDGs) in Korea [17].

With regard to the moderating effect of smart app usefulness, the stronger relationships between awareness of public green space and attitude as well as between awareness of public green space and behavioral intention from the high perceived group of smart app usefulness than the low group imply that a person with higher awareness of public green space for active transport tends to have stronger attitudes and behavioral intentions of walking and cycling if that person has a higher perceived usefulness of smart apps. These findings extend the literature on using apps for active transport in the context of smart cities [21,22]. On the other hand, the low perceived group of smart app usefulness has greater impacts on the relationships between motivation and attitude as well as motivation and behavioral intention compared to the high perceived group on smart app usefulness. These results are unexpected and contrary to our hypotheses and previous studies on fuzzy logic app for pedestrians [21].

5. Conclusions

This work, based on applying consumer behavior theory to active transport, provides several theoretical contributions to the literature. First, the factors of awareness of public green space relevant to using active transport were found to have critical impacts on walking and cycling behavior. Second, adding extrinsic and intrinsic motivations reinforced the importance of motivation for walking and cycling in different contexts. Third, this work sheds light on potential roles in the EMGB in active transport consumer behavior. Finally, the significant moderating role of perceived usefulness of smart apps for active transport relevant to public green space, motivation, attitude, and behavioral intention potentially shows the importance of including the role of apps in assessments of active transport behavior for walkability and cyclability, given their increasing influence on consumer behavior in the active transport context.

This work also provides practical contributions to stakeholders. The effects of awareness of public green space on the attitude and behavioral intention reinforce the view that relevant public agencies should focus on highlighting the awareness of public green spaces, such as parks, green trails, and greenways, in order to increase positive attitude toward

and behavior for active transport. The impacts of motivations on attitude and behavioral intention suggest that appropriately designed campaigns and interventions could boost peoples' extrinsic and intrinsic motivations for walking and cycling, which, in turn, influence their attitude and behavior toward active mobility, resulting in improvements in the environment and their personal health. The positive influences of subjective norms and positive and negative anticipation emotions on desire to walk and cycle that this study identified may be particularly important variables for campaigns to focus on to encourage greater engagement, given the significant impact of desires on behavioral intentions.

The identification of the moderating effect of the perceived usefulness of smart apps for active transport also presents a potential new departure point for walking and cycling interventions that will potentially become even more important in the future, as cities seek to improve the sustainability of their environments and transport strategies. The results of this research highlight that when environmental, health, and transport agencies target consumers with high perceived usefulness of smart apps, then the general public's awareness of urban green space should be stressed, drawing upon the significantly greater impact of city green space on the attitude and behavioral intention in the high group. Additionally, the results of this work suggest that when targeting people with low perceived usefulness of smart apps for active transport, then the general public's motivation to walk and cycle should be emphasized according to the sufficiently greater effect of motivation on attitudes and intentions in the low perceived usefulness group.

6. Limitations and Future Research Directions

Although this work makes a number of contributions and has theoretical and practical implications, it also has some limitations that provide future study opportunities. First, this survey was only implemented in one country (South Korea) and during the COVID-19 pandemic (from 10 July to 25 July 2021), so the generalization of the findings needs to be carefully considered, with further research in other cultures and active transport environments required. Second, although this study outlines the importance of understanding walking and cycling behaviors in the specific context they occur, e.g., tourism, leisure, and work, more detailed examination of the different types of walking and cycling activities would be extremely valuable with respect to the purpose of such activities and their connection to other transport modes. Third, even though this study applied PLS-SEM and MGA, the adoption of other research methods, such as fuzzy-set qualitative comparative analysis (fsQCA) and in-depth interviews would also be valuable to understand more deeply the sequential relationships existing among the stated attitudes, behavioral intentions, and actual behaviors, particularly with smart app use. Furthermore, although this study sheds light on walking and cycling behavior in terms of green space, motivation, and MGB, a future study on the differences among tourism, leisure, and work activities would be valuable to better understand walking and cycling behavior.

Author Contributions: M.J.K. designed and revised the questionnaire, collected/analyzed the data, and wrote the first draft. C.M.H. provided the seminal ideas, designed and revised the questionnaire, and co-wrote/edited the manuscript. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Appendix A

Walking Questionnaire.

A survey on active transport of walking

Our team of international researchers are conducting a study regarding the sustainable transport of walking. Your sincere response will contribute to a better understanding of resident behavior in walking.
We would greatly appreciate your time and cooperation in completing this questionnaire. Thank you very much!
Researchers:
Names of the researchers and university are eliminated for anonymity.
The layout of this questionnaire is for MS word file only, which is quite different from the online survey screen.
10~25 July 2021.

Note 1: Active transport describes all human-powered forms of travel, through non-motorized means, based around human physical activity. One of the best known forms of active transport is walking.

Note 2: In this study, **walking** can refer to walking for work, outdoor activity, leisure activity, recreation, exercise, hiking/tramping, and/or tourism-related activities.

Note 3: Leisure activity means an activity chosen for pleasure, relaxation, or other emotional satisfaction, typically outside of work time, including daytrips.

Note 4: Tourism is defined more generally as people traveling to and staying in places outside their usual home environment for no more than one consecutive year for leisure and no less than 24 h.

We care about the quality of our survey data and hope to receive the most accurate measures of your opinions, so it is important to us that you thoughtfully provide your best answer to each question in the survey.

Do you commit to providing your thoughtful and honest answers to the questions in this survey?

1. I will provide my best answers: Go to the next question.
2. I will not provide my best answers: End the survey.
3. I cannot promise either way: End the survey.

Screen question(SQ)
SQ1. Have you walked for work-, leisure-, and/or tourism-related activities?

① Yes: ☞ If you checked "yes," please answer the following general question (GQ)1.
② No: ☞ Close the survey (We thank you for your time spent taking this survey. Your response has been recorded).

General question (GQ)
GQ1. Please select the type of walking in which you have most frequently participated (quota sampling).

① Leisure-related activities
② Tourism-related activities
③ Walking to/from work

GQ2. What are your primary reasons for participating in walking (multiple selection available)?

1. Self-satisfaction
2. Experiencing the community
3. Mental well-being and health
4. Physical well-being and health
5. Opportunity to socialize
6. Contact with nature
7. Visiting attractions
8. Protecting the environment

9. Access to public transport
10. Access to shopping
11. Dog walking
12. Opportunity to be alone
13. Opportunity to be with family
14. Other_____

GQ3. Compared to before the COVID-19 outbreak, do you walk more often?

① Yes ② No ③ Same

GQ4. Have you used smart applications related to walking?

① Yes ② No
Yes: ☞ If you checked "yes," please answer the following general question (GQ)5.
No: ☞ If you checked "no," please answer the following construct question (GQ)6.

GQ5. What is your primary smart application used related to walking (multiple selection available)?

① GPS/Maps (e.g., tracker, route) ② Fitness (e.g., calorie counting) ③ Counter (e.g., walking 10,000 steps) ④ Heart rate (e.g., pulse measurement) Safety (e.g., CCTV location) ⑥ Amenity (e.g., toilet, shelter) ⑦ Augmented reality apps ⑧ Other_____

GQ6. I worry about my personal safety when walking.

① Strongly disagree ② Disagree ③ Somewhat disagree ④ Neither agree nor disagree
Somewhat agree ⑥ Agree ⑦ Strongly agree

GQ7. When you walk, who are your major companions?

① Alone ② Friends ③ Family/Relatives ④ Coworkers Other

Construct question (CQ)

Please carefully read each item and check the score that you think fits best (Select one for each) (1: strongly disagree; 2: disagree; 3: somewhat disagree; 4: neither agree nor disagree; 5: somewhat agree; 6: agree; 7: strongly agree).

CQ1. Awareness of Public Green Space	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. I am interested in public green space for walking.	1	2	3	4	5	6	7
2. I am aware of public green spaces for walking.	1	2	3	4	5	6	7
3. I care about public green trails for walking.	1	2	3	4	5	6	7
4. Public green spaces provide cool areas in which to walk when it is hot.	1	2	3	4	5	6	7
5. Public green spaces are attractive for walking at any time of year.	1	2	3	4	5	6	7

CQ2. Extrinsic Motivation for Walking	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. Walking improves my personal health.	1	2	3	4	5	6	7
2. Walking contributes to the environment.	1	2	3	4	5	6	7
3. Walking contributes to mitigating climate change.	1	2	3	4	5	6	7
4. Walking contributes to lowering air pollution.	1	2	3	4	5	6	7
5. Walking improves public health.	1	2	3	4	5	6	7

CQ3. Intrinsic Motivation for Walking	**Strongly Disagree**	**Disagree**	**Somewhat Disagree**	**Neither Agree nor Disagree**	**Somewhat Agree**	**Agree**	**Strongly Agree**
1. Walking is enjoyable for me.	1	2	3	4	5	6	7
2. Walking brings me self-satisfaction.	1	2	3	4	5	6	7
3. Walking makes me happy.	1	2	3	4	5	6	7
4. I walk for refreshment.	1	2	3	4	5	6	7

CQ4. Attitude on Walking	**Strongly Disagree**	**Disagree**	**Somewhat Disagree**	**Neither Agree nor Disagree**	**Somewhat Agree**	**Agree**	**Strongly Agree**
1. Walking is an affirmative behavior.	1	2	3	4	5	6	7
2. Walking is a beneficial behavior.	1	2	3	4	5	6	7
3. Walking is an essential behavior.	1	2	3	4	5	6	7
4. Walking is a legitimate behavior.	1	2	3	4	5	6	7

CQ5. Subjective Norm on Walking	**Strongly Disagree**	**Disagree**	**Somewhat Disagree**	**Neither Agree nor Disagree**	**Somewhat Agree**	**Agree**	**Strongly Agree**
1. Most people who are important to me think I should walk.	1	2	3	4	5	6	7
2. Most people who are important to me would want me to walk.	1	2	3	4	5	6	7
3. Most people who are important to me support my walking.	1	2	3	4	5	6	7
4. Most people who are important to me are proud that I go walking.	1	2	3	4	5	6	7

CQ6. Perceived Behavioral Control	**Strongly Disagree**	**Disagree**	**Somewhat Disagree**	**Neither Agree nor Disagree**	**Somewhat Agree**	**Agree**	**Strongly Agree**
1. Walking or not is entirely up to me.	1	2	3	4	5	6	7
2. I can walk whenever I want.	1	2	3	4	5	6	7
3. I have the physical strength to walk.	1	2	3	4	5	6	7
4. I have time to walk.	1	2	3	4	5	6	7

CQ7. Positive Anticipated Emotion	**Strongly Disagree**	**Disagree**	**Somewhat Disagree**	**Neither Agree nor Disagree**	**Somewhat Agree**	**Agree**	**Strongly Agree**
1. If I walk, I will feel excited.	1	2	3	4	5	6	7
2. If I walk, I will feel glad.	1	2	3	4	5	6	7
3. If I walk, I will feel satisfied.	1	2	3	4	5	6	7
4. If I walk, I will feel happy.	1	2	3	4	5	6	7

CQ8. Negative Anticipated Emotion	**Strongly Disagree**	**Disagree**	**Somewhat Disagree**	**Neither Agree nor Disagree**	**Somewhat Agree**	**Agree**	**Strongly Agree**
1. If I cannot walk, I will be angry.	1	2	3	4	5	6	7
2. If I cannot walk, I will be disappointed.	1	2	3	4	5	6	7
3. If I cannot walk, I will be worried.	1	2	3	4	5	6	7
4. If I cannot walk, I will be sad.	1	2	3	4	5	6	7

CQ9. Desire to Walk	**Strongly Disagree**	**Disagree**	**Somewhat Disagree**	**Neither Agree nor Disagree**	**Somewhat Agree**	**Agree**	**Strongly Agree**
1. I do want to walk.	1	2	3	4	5	6	7
2. My desire to walk is passionate.	1	2	3	4	5	6	7
3. I am enthusiastic about walking.	1	2	3	4	5	6	7
4. I am eager to walk.	1	2	3	4	5	6	7

CQ10. Behavioral Intention of Walking	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. To increase my personal well-being, I am planning to walk.	1	2	3	4	5	6	7
2. To improve my personal health, I will make an effort to walk.	1	2	3	4	5	6	7
3. To mitigate climate change, I am willing to walk.	1	2	3	4	5	6	7
4. To protect the environment, I do intend to walk.	1	2	3	4	5	6	7
5. To increase public well-being, I am planning to walk.	1	2	3	4	5	6	7

CQ11. Perceived Usefulness of Smart Applications	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. I believe that using smart applications for walking would enable me to accomplish walking better.	1	2	3	4	5	6	7
2. I believe that using smart applications for walking would improve my walking performance.	1	2	3	4	5	6	7
3. I believe that using smart applications for walking would make it easier to do my walking.	1	2	3	4	5	6	7
4. I believe that using smart applications for walking would enhance my effectiveness in walking.	1	2	3	4	5	6	7

Demographic characteristics (DQ)

DQ1. What is your gender? (quota sampling)
① Male ② Female ③ Other

DQ2. What is your age? (quota sampling)

1. Between 18 and 19 years old
2. Between 20 and 29 years old
3. Between 30 and 39 years old
4. Between 40 and 49 years old
5. Between 50 and 59 years old
6. Between 50 and 59 years old
7. 70 years old and over

DQ3. What is the highest level of education you have completed? (quota sampling)

① High school diploma or lower ② 2-year college, attending or degree
③ 4-year university, attending or degree ④ Graduate school, attending or degree

DQ4. What is your marital status?

① Single ② Married ③ Other (specify) _____

DQ5. What is your monthly household income?

① Less than KRW 2.00 million ② KRW 2.00–3.99 million ③ KRW 4.00–5.99 million
④ KRW 6.00–7.99 million KRW 8.00 million or more

DQ6. What is your occupation?

① Professional (e.g., attorney, engineer, architect) ② Entrepreneur/Self-employed ③ Service employee ④ Office/Administrative/ Clerical Civil Servant (Government) ⑥ Home maker ⑦ Student ⑧ Retiree ⑨ Unemployment ⑩ Other (specify)_____

DQ7. Where do you normally reside?

① Seoul ② Busan ③ Daegu ④ Incheon ⑤ Daejeon ⑥ Ulsan ⑦ Gwangju ⑧ Sejong ⑨ Gyeonggi ⑩ Gangwon ⑪ Chungbuk
⑫ Chungnam ⑬ Jeonbuk ⑭ Jeonnam ⑮ Gyeongbuk ⑯ Gyeongnam ⑰ Jeju

We thank you for your time spent taking this survey!
Your response has been recorded.

Cycling Questionnaire.

A survey on active transport of cycling

Our team of international researchers are conducting a study regarding the sustainable transport of cycling. Your sincere response will contribute to a better understanding of resident behavior in cycling.
We would greatly appreciate your time and cooperation in completing this questionnaire. Thank you very much!
Researchers:
Names of the researchers and university are eliminated for anonymity.
The layout of this questionnaire is for MS word file only, which is quite different from the online survey screen.
10~25 July 2021.

Note 1: Active transport describes all human-powered forms of travel, through non-motorized means, based around human physical activity. One of the best known forms of active transport is biking. Biking, also called cycling or bicycling, is the use of bicycles for transport, recreation, exercise, or sport. Cycling means two-wheeled bicycling, as well as the riding of unicycles, tricycles, quadricycles, recumbent, and similar human-powered vehicles (HPVs), including cycles that use electricity as a supplemental form of energy to human power (e-cycles).

Note 2: In this study, **cycling** can refer to cycling for work, outdoor activity, leisure activity, recreation, exercise, sports, mountain cycling, and/or tourism-related activities.

Note 3: Leisure activity means an activity chosen for pleasure, relaxation, or other emotional satisfaction, typically outside of work time, including daytrips.

Note 4: Tourism is defined more generally as people traveling to and staying in places outside their usual home environment for no more than one consecutive year for leisure and no less than 24 h.

We care about the quality of our survey data and hope to receive the most accurate measures of your opinions, so it is important to us that you thoughtfully provide your best answer to each question in the survey.

Do you commit to providing your thoughtful and honest answers to the questions in this survey?

1. I will provide my best answers: Go to the next question.
2. I will not provide my best answers: End the survey.
3. I cannot promise either way: End the survey.

Screen question (SQ)
SQ1. Have you cycled for work-, leisure-, and/or tourism-related activities?

① Yes: ☞ If you checked "yes," please answer the following general question (GQ)1.
② No: ☞ Close the survey (We thank you for your time spent taking this survey. Your response has been recorded).

General question (GQ)
Please select the type of cycling in which you have most frequently participated (quota sampling).

① Leisure-related activities ② Tourism-related activities ③ Cycling to/from work

GQ2. What are your primary reasons for participating in cycling (multiple selection available)?

1. Self-satisfaction
2. Experiencing the community

3. Mental well-being and health
4. Physical well-being and health
5. Opportunity to socialize
6. Contact with nature
7. Visiting attractions
8. Protecting the environment
9. Access to public transport
10. Access to shopping
11. Cycling with a dog
12. Opportunity to be alone
13. Opportunity to be with family
14. Other_____

GQ3. Compared to before the COVID-19 outbreak, do you cycle more often?

① Yes ② No ③ Same

GQ4. Have you used smart applications related to cycling?

① Yes ② No
Yes: ☞ If you checked "yes," please answer the following general question (GQ)5.
No: ☞ If you checked "no," please answer the following construct question (GQ)6.

GQ5. What is your primary smart application used related to cycling (multiple selection available)?

① GPS/Maps (e.g., tracker, route) ② Fitness (e.g., calorie counting) ③ Counter (e.g., distance) ④ Heart rate (e.g., pulse measurement) Safety (e.g., CCTV location) ⑥ Amenity (e.g., toilet, shelter) ⑦ Augmented reality apps ⑧ Other_____

GQ6. I worry about my personal safety when cycling.

① Strongly disagree ② Disagree ③ Somewhat disagree ④ Neither agree nor disagree
Somewhat agree ⑥ Agree ⑦ Strongly agree

GQ7. When you cycle, who are your major companions?

① Alone ② Friends ③ Family/Relatives ④ Coworkers Other

GQ8. Do you primarily ride an e-cycle or not?

① Yes, I mostly ride electric cycles. ② No, I mostly ride conventional cycles.

Construct question

CQ1. Please carefully read each item and check the score that you think fits best (Select one for each) (1: strongly disagree; 2: disagree; 3: somewhat disagree; 4: neither agree nor disagree; 5: somewhat agree; 6: agree; 7: strongly agree).

CQ1. Awareness of Public Green Space	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. I am interested in public green space for cycling.	1	2	3	4	5	6	7
2. I am aware of public green spaces for cycling.	1	2	3	4	5	6	7
3. I care about public green trails for cycling.	1	2	3	4	5	6	7
4. Public green spaces provide cool areas in which to cycle when it is hot.							
5. Public green spaces are attractive for cycling at any time of year.							

CQ2. Extrinsic Motivation for Cycling	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. Cycling improves my personal health.	1	2	3	4	5	6	7
2. Cycling contributes to the environment.	1	2	3	4	5	6	7
3. Cycling contributes to mitigating climate change.	1	2	3	4	5	6	7
4. Cycling contributes to lowering air pollution.	1	2	3	4	5	6	7
5. Cycling improves public health.	1	2	3	4	5	6	7

CQ3. Intrinsic Motivation for Cycling	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. Cycling is enjoyable for me.	1	2	3	4	5	6	7
2. Cycling brings me self-satisfaction.	1	2	3	4	5	6	7
3. Cycling makes me happy.	1	2	3	4	5	6	7
4. I cycle for refreshment.	1	2	3	4	5	6	7

CQ4. Attitude on Cycling	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. Cycling is an affirmative behavior.	1	2	3	4	5	6	7
2. Cycling is a beneficial behavior.	1	2	3	4	5	6	7
3. Cycling is an essential behavior.	1	2	3	4	5	6	7
4. Cycling is a legitimate behavior.	1	2	3	4	5	6	7

CQ5. Subjective Norm on Cycling	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. Most people who are important to me think I should cycle.	1	2	3	4	5	6	7
2. Most people who are important to me would want me to cycle.	1	2	3	4	5	6	7
3. Most people who are important to me support my cycling.	1	2	3	4	5	6	7
4. Most people who are important to me are proud that I go cycling.	1	2	3	4	5	6	7

CQ6. Perceived Behavioral Control	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. Cycling or not is entirely up to me.	1	2	3	4	5	6	7
2. I can cycle whenever I want.	1	2	3	4	5	6	7
3. I have the physical strength to cycle.	1	2	3	4	5	6	7
4. I have time to cycle.	1	2	3	4	5	6	7

CQ7. Positive Anticipated Emotion	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. If I cycle, I will feel excited.	1	2	3	4	5	6	7
2. If I cycle, I will feel glad.	1	2	3	4	5	6	7
3. If I cycle, I will feel satisfied.	1	2	3	4	5	6	7
4. If I cycle, I will feel happy.	1	2	3	4	5	6	7

CQ8. Negative Anticipated Emotion	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. If I cannot cycle, I will be angry.	1	2	3	4	5	6	7
2. If I cannot cycle, I will be disappointed.	1	2	3	4	5	6	7
3. If I cannot cycle, I will be worried.	1	2	3	4	5	6	7
4. If I cannot cycle, I will be sad.	1	2	3	4	5	6	7

CQ9. Desire to Cycle	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. I do want to cycle.	1	2	3	4	5	6	7
2. My desire to cycle is passionate.	1	2	3	4	5	6	7
3. I am enthusiastic about cycling.	1	2	3	4	5	6	7
4. I am eager to cycle.	1	2	3	4	5	6	7

CQ10. Behavioral Intention of Cycling	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. To increase my personal well-being, I am planning to cycle.	1	2	3	4	5	6	7
2. To improve my personal health, I will make an effort to cycle.	1	2	3	4	5	6	7
3. To mitigate climate change, I am willing to cycle.	1	2	3	4	5	6	7
4. To protect the environment, I do intend to cycle.	1	2	3	4	5	6	7
5. To increase public well-being, I am planning to cycle.	1	2	3	4	5	6	7

CQ11. Perceived Usefulness of Smart Applications	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. I believe that using smart applications for cycling would enable me to accomplish cycling better.	1	2	3	4	5	6	7
2. I believe that using smart applications for cycling would improve my cycling performance.	1	2	3	4	5	6	7
3. I believe that using smart applications for cycling would make it easier to do my cycling.	1	2	3	4	5	6	7
4. I believe that using smart applications for cycling would enhance my effectiveness in cycling.	1	2	3	4	5	6	7

Demographic characteristics (DQ)

DQ1. What is your gender? (quota sampling)
① Male ② Female ③ Other

DQ2. What is your age? (quota sampling)

① Between 18 and 19 years old
② Between 20 and 29 years old
③ Between 30 and 39 years old
④ Between 40 and 49 years old
⑤ Between 50 and 59 years old
⑥ 60 years old and over

DQ3. What is the highest level of education you have completed?

① High school diploma or lower ② 2-year college, attending or degree
③ 4-year university, attending or degree ④ Graduate school, attending or degree

DQ4. What is your marital status?

① Single ② Married ③ Other (specify) _____

DQ5. What is your monthly household income?

① Less than KRW 2.00 million ② KRW 2.00–3.99 million ③ KRW 4.00–5.99 million
④ KRW 6.00–7.99 million KRW 8.00 million or more

DQ6. What is your occupation?

① Professional (e.g., attorney, engineer, architect) ② Entrepreneur/Self-employed ③ Service employee

④ Office/Administrative/Clerical ⑤ Civil Servant (Government) ⑥ Home maker ⑦ Student ⑧ Retiree ⑨ Unemployment
⑩ Other (specify)_____

DQ7. Where do you normally reside? (quota sampling)

① Seoul ② Busan ③ Daegu ④ Incheon ⑤ Daejeon ⑥ Ulsan ⑦ Gwangju ⑧ Sejong ⑨ Gyeonggi ⑩ Gangwon ⑪ Chungbuk ⑫ Chungnam ⑬ Jeonbuk ⑭ Jeonnam ⑮ Gyeongbuk ⑯ Gyeongnam ⑰ Jeju

We thank you for your time spent taking this survey!
Your response has been recorded.

Appendix B. Common Method Bias Tests

Test Method	Test	Result
Harmon's single-factor test	The EFA results are as follows: Nine factors appeared (the total 71.9% variance explained) First factor: 38.3% Second factor: 7.4% Third factor: 5.2% Fourth factor: 4.9% Fifth factor: 4.3% Sixth factor: 3.7% Seventh factor: 3.2% Eighth factor: 2.6% Ninth factor: 2.4%	Since more than one factor appears, and the first factor has less than 50% variance, common method bias is not an issue (Podsakoff, P.M.; MacKenzie, S.B.; Lee, J.Y.; Podsakoff, *n*.P. Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies. *J Appl Psychol* **2003**, *88*, 879–903. https://doi.org/10.1037/0021-9010.88.5.879.).
Marker variable approach: Correlations between the marker variable (perceived knowledge of smart applications for walking/cycling) and all the constructs in the research model	The 11 correlations are as follows: 1. Awareness of public green space: 0.291 2. Extrinsic motivation: 0.167 3. Intrinsic motivation: 0.312 4. Attitude: 0.314 5. Subjective norm: 0.408 6. Perceived behavioral control: 0.250 7. Positive anticipated emotion: 0.324 8. Negative anticipated emotion: 0.346 9. Desire: 0.429 10. Behavioral intention: 0.335 11. Perceived usefulness of smart applications: 0.529	The average of squared multiple correlations: 0.122. Since the correlations are low, and the average of squared multiple correlations with the marker variable is small and insignificant, common method bias is not an issue (Lindell, M.K.; Whitney, D.J. Accounting for Common Method Variance in Cross-Sectional Research Designs. *J Appl Psychol* **2001**, *86*, 114–121. https://doi.org/10.1037//0021-9010.86.1.114.).

Note: All tests show that common method bias is not problem in this study.

Appendix C. Demographic Characteristic and General Information of the Entire Group for Walking and Cycling

Characteristics	651 (*n*)	100 (%)	Characteristics	651 (*n*)	100 (%)
Gender			**Participated-in types of walking/cycling**		
Male	321	49.3	Leisure-related activities	216	33.2
Female	330	50.7	Tourism-related activities	217	33.3
Other	0	0.0	Work-related activities	218	33.5
Age			**Reason for walking/cycling**		
Between 18 and 29 years old	117	18.0	Self-satisfaction	268	41.2
Between 30 and 39 years old	115	17.7	Experiencing the community	77	11.8
Between 40 and 49 years old	144	22.1	Mental well-being and health	236	36.3
Between 50 and 59 years old	149	22.8	Physical well-being and health	436	67.0
60 years old and over	126	19.4	Opportunity to socialize	82	12.6
Educational level			Contact with nature	267	41.0
Less than or high school diploma	117	18.0	Visiting attractions	149	22.9
2-year college	99	15.2	Protecting the environment	91	14.0
University	357	54.8	Access to public transport	177	27.2
Graduate school or higher	78	12.0	Access to shopping	129	19.8

Characteristics	651 (*n*)	100 (%)	Characteristics	651 (*n*)	100 (%)
Marital status			Walking/cycling with a dog	37	5.7
Single	240	36.9	Opportunity to be alone	118	18.1
Married	403	61.9	Opportunity to be with family	112	17.2
Other	8	1.2	Other	26	4.0
Monthly household income			**More walking/cycling compared to before COVID-19**		
Less than KRW 2.00–3.99 million	264	40.6	Yes	155	23.8
From KRW 4.00 to 7.99 million	294	45.1	No	293	45.0
KRW 8.00 million or more	93	14.3	Same	203	31.2
Occupation			**Used smart applications for walking/cycling**		
Professional (e.g., attorney, engineer)	66	10.1	Yes	421	64.7
Business owner/Self-employed	44	6.8	No	230	35.3
Service worker	73	11.2	Used types of smart applications for walking/cycling		
Office/Administrative/Clerical worker	235	36.0	GPS/Maps (e.g., tracker, route)	242	37.2
Civil servant (government)	29	4.5	Fitness (e.g., calorie counting)	173	26.6
Home maker	76	11.7	Counter (e.g., step or distance measurement)	285	43.8
Student	35	5.4	Heart rate (e.g., pulse measurement)	103	15.8
Retiree	21	3.2	Safety (e.g., CCTV location)	23	3.5
Unemployed	29	4.5	Amenity (e.g., toilet, shelter, facilities)	43	6.6
Other	43	6.6	Augmented reality apps	11	1.7
Residential area			Other	16	2.5
Seoul metropolitan area	428	65.6	**Worry about personal safety when walking/cycling**		
Non-metropolitan area	223	34.4	Disagree	253	38.8
Duration of answering the survey			Neither agree nor disagree	137	21.0
Between 5 and 533.8 min	651	100.0	Agree	261	40.2
Riding e-cycle			**Companions when walking/cycling**		
Yes, I mostly ride electric cycles	27	4.1	Alone	386	59.3
No, I mostly ride conventional cycles	624	95.9	Friends	82	12.6
Providing thoughtful/honest answers			Family/relatives	162	24.9
Yes	651	100.0	Coworkers	19	2.9
No	0	0.0	Other	2	0.3

Note: The walking activity group has 325 cases, while the cycling activity group has 326 cases.

Appendix D. Mediating (Indirect) Effects on the Proposed Research Model

Path	Direct Effect	Indirect Effect	Total Effect	*t*-Value	*p*-Value	f^2
Awareness of public green space → Attitude	0.163 ***		0.163 ***	3.708	<0.001	0.029
Awareness of public green space → Desire	*−0.002 ns*	*0.006 ns*	*0.004 ns*	*0.733*	>0.05	
Awareness of public green space → Behavioral intention	0.159 ***	*0.001 ns*	0.160 ***	4.734	<0.001	0.043
Motivation → Attitude	0.539 ***		0.539 ***	12.805	<0.001	0.319
Motivation → Desire	*−0.083 ns*	*0.020 ns*	*−0.060 ns*	*0.795*	>0.05	0.005
Motivation → Behavioral intention	0.535 ***	0.022 *	0.557 ***	16.958	<0.001	0.390
Attitude → Desire	*0.037 ns*		*0.037 ns*	*0.857*	>0.05	0.002
Attitude → Behavioral intention		*0.008 ns*	*0.008 ns*	*0.824*	>0.05	
Subjective norm → Desire	0.137 ***		0.137 ***	3.473	<0.001	0.027
Subjective norm → Behavioral intention		0.030 ***	0.030 ***	3.225	<0.001	
Perceived behavioral control → Desire	*0.003 ns*		*0.003 ns*	*0.080*	>0.05	0.000
Perceived behavioral control → Behavioral intention		*0.001 ns*	*0.001 ns*	*0.081*	>0.05	
Positive anticipated emotion → Desire	0.466 ***		0.466 ***	10.048	<0.001	0.204
Positive anticipated emotion → Behavioral intention		0.102 ***	0.102 ***	5.775	<0.001	
Negative anticipated emotion → Desire	0.225 ***		0.225 ***	5.997	<0.001	0.087
Negative anticipated emotion → Behavioral intention		0.049 ***	0.049 ***	4.731	<0.001	
Desire → Behavioral intention	0.219 ***		0.227 ***	7.127	<0.001	0.082

Note: *** $p < 0.001$; ns = non-significant.

Appendix E. Grouping the Moderator of Smart App Usefulness

Construct	Cronbach Alpha	Group	Sample Size	Mean
Perceived usefulness of smart applications	0.817	High	433	5.36
		Low	218	3.61

References

1. Hogendorf, M.; Groeniger, J.O.; Noordzij, J.M.; Beenackers, M.A.; van Lenthe, F.J. Longitudinal Effects of Urban Green Space on Walking and Cycling: A Fixed Effects Analysis. *Health Place* **2020**, *61*, 102264. [CrossRef] [PubMed]
2. Rehling, J.; Bunge, C.; Waldhauer, J.; Conrad, A. Socioeconomic Differences in Walking Time of Children and Adolescents to Public Green Spaces in Urban Areas—Results of the German Environmental Survey (2014–2017). *Int. J. Environ. Res. Public Health* **2021**, *18*, 2326. [CrossRef] [PubMed]
3. Shen, Y.; Sun, F.; Che, Y. Public Green Spaces and Human Wellbeing: Mapping the Spatial Inequity and Mismatching Status of Public Green Space in the Central City of Shanghai. *Urban Urban Green* **2017**, *27*, 59–68. [CrossRef]
4. Carpenter, M. From "healthful Exercise" to "Nature on Prescription": The Politics of Urban Green Spaces and Walking for Health. *Landsc. Urban Plan* **2013**, *118*, 120–127. [CrossRef]
5. Charreire, H.; Weber, C.; Chaix, B.; Salze, P.; Casey, R.; Banos, A.; Badariotti, D.; Kesse-Guyot, E.; Hercberg, S.; Simon, C.; et al. Identifying Built Environmental Patterns Using Cluster Analysis and GIS: Relationships with Walking, Cycling and Body Mass Index in French Adults. *Int. J. Behav. Nutr. Phys. Act.* **2012**, *9*, 59. [CrossRef]
6. Glazener, A.; Khreis, H. Transforming Our Cities: Best Practices towards Clean Air and Active Transportation. *Curr. Environ. Health Rep.* **2019**, *6*, 22–37. [CrossRef]
7. Istenič, S.P. Reviving Public Spaces through Cycling. *Etnološka Trib.* **2016**, *39*, 157–175.
8. Jim, C.Y.; Chen, S.S. Comprehensive Greenspace Planning Based on Landscape Ecology Principles in Compact Nanjing City, China. *Landsc. Urban Plan.* **2003**, *65*, 95–116. [CrossRef]
9. Ki, D.; Lee, S. Analyzing the Effects of Green View Index of Neighborhood Streets on Walking Time Using Google Street View and Deep Learning. *Landsc. Urban Plan* **2021**, *205*, 103920. [CrossRef]
10. Sarkar, C.; Webster, C.; Pryor, M.; Tang, D.; Melbourne, S.; Zhang, X.; Jianzheng, L. Exploring Associations between Urban Green, Street Design and Walking: Results from the Greater London Boroughs. *Landsc. Urban Plan* **2015**, *143*, 112–125. [CrossRef]
11. Bagozzi, R.P.; Baumgartner, H.; Pieters, R.; Zeelenberg, M. The Role of Emotions in Goal-Directed Behavior. In *The Why of Consumption: Contemporary Perspectives on Consumer Motives, Goals, and Desires*; Ratneshwar, S., Mick, D.G., Huffman, C., Eds.; Routledge: London, UK, 2000; pp. 36–58.
12. Kelley, N.J.; Gallucci, A.; Riva, P.; Lauro, L.J.R.; Schmeichel, B.J. Stimulating Self-Regulation: A Review of Non-Invasive Brain Stimulation Studies of Goal-Directed Behavior. *Front. Behav. Neurosci.* **2019**, *12*, 337. [CrossRef] [PubMed]
13. Lindenberg, S.; Steg, L. Normative, Gain and Hedonic Goal Frames Guiding Environmental Behavior. *J. Soc. Issues* **2007**, *63*, 117–137. [CrossRef]
14. Han, H. Consumer Behavior and Environmental Sustainability in Tourism and Hospitality: A Review of Theories, Concepts, and Latest Research. *J. Sustain. Tour.* **2021**, *29*, 1021–1042. [CrossRef]
15. Kim, M.J.; Park, J.Y.; Lee, C.K.; Chung, I.Y. The Role of Perceived Ethics in the Decision-Making Process for Responsible Tourism Using an Extended Model of Goal-Directed Behavior. *Int. J. Tour. Hosp Res.* **2017**, *31*, 5–25. [CrossRef]
16. Kim, M.J.; Hall, C.M. Can Co-Creation and Crowdfunding Types Predict Funder Behavior? An Extended Model of Goal-Directed Behavior. *Sustainability* **2019**, *11*, 7061. [CrossRef]
17. Kim, M.J.; Hall, C.M. Do Perceived Risk and Intervention Affect Crowdfunder Behavior for the Sustainable Development Goals? A Model of Goal-Directed Behavior. *J. Clean. Prod.* **2021**, *311*, 127614. [CrossRef]
18. Vermeir, I.; Weijters, B.; De Houwer, J.; Geuens, M.; Slabbinck, H.; Spruyt, A.; Van Kerckhove, A.; Van Lippevelde, W.; De Steur, H.; Verbeke, W. Environmentally Sustainable Food Consumption: A Review and Research Agenda from a Goal-Directed Perspective. *Front. Psychol.* **2020**, *11*, 1603. [CrossRef]
19. De Vos, J.; Singleton, P.A.; Gärling, T. From Attitude to Satisfaction: Introducing the Travel Mode Choice Cycle. *Transp. Rev.* **2021**, *42*, 204–221. [CrossRef]
20. Passafaro, P.; Rimano, A.; Piccini, M.P.; Metastasio, R.; Gambardella, V.; Gullace, G.; Lettieri, C. The Bicycle and the City: Desires and Emotions versus Attitudes, Habits and Norms. *J. Environ. Psychol.* **2014**, *38*, 76–83. [CrossRef]
21. Domínguez, J.M.L.; Sanguino, T. de J.M. Walking Secure: Safe Routing Planning Algorithm and Pedestrian's Crossing Intention Detector Based on Fuzzy Logic App. *Sensors* **2021**, *21*, 529. [CrossRef]
22. Ek, A.; Alexandrou, C.; Delisle Nyström, C.; Direito, A.; Eriksson, U.; Hammar, U.; Henriksson, P.; Maddison, R.; Trolle Lagerros, Y.; Löf, M. The Smart City Active Mobile Phone Intervention (SCAMPI) Study to Promote Physical Activity through Active Transportation in Healthy Adults: A Study Protocol for a Randomised Controlled Trial. *BMC Public Health* **2018**, *18*, 880. [CrossRef] [PubMed]
23. Manor, B.; Yu, W.; Zhu, H.; Harrison, R.; Lo, O.Y.; Lipsitz, L.; Travison, T.; Pascual-Leone, A.; Zhou, J. Smartphone App–Based Assessment of Gait during Normal and Dual-Task Walking-Demonstration of Validity and Reliability. *JMIR Mhealth Uhealth* **2018**, *6*, e8815. [CrossRef] [PubMed]
24. Walsh, J.C.; Corbett, T.; Hogan, M.; Duggan, J.; McNamara, A. An Mhealth Intervention Using a Smartphone App to Increase Walking Behavior in Young Adults: A Pilot Study. *JMIR Mhealth Uhealth* **2016**, *4*, e5227. [CrossRef] [PubMed]
25. Caprì, S.; Ignaccolo, M.; Inturri, G.; Le Pira, M. Green Walking Networks for Climate Change Adaptation. *Transp. Res. Part D Transp. Environ.* **2016**, *45*, 84–95. [CrossRef]
26. He, D.; Lu, Y.; Xie, B.; Helbich, M. Large-Scale Greenway Intervention Promotes Walking Behaviors: A Natural Experiment in China. *Transp. Res. Part D Transp. Environ.* **2021**, *101*, 103095. [CrossRef]

27. Keall, M.D.; Shaw, C.; Chapman, R.; Howden-Chapman, P. Reductions in Carbon Dioxide Emissions from an Intervention to Promote Cycling and Walking: A Case Study from New Zealand. *Transp. Res. Part D Transp. Environ.* **2018**, *65*, 687–696. [CrossRef]
28. Maslow, A.H. A Theory of Human Motivation. *Psychol. Rev.* **1943**, *50*, 370–396. [CrossRef]
29. Kim, M.J.; Preis, M.W. Why Seniors Use Mobile Devices: Applying an Extended Model of Goal-Directed Behavior. *J. Travel Tour. Mark.* **2016**, *33*, 404–423. [CrossRef]
30. Lee, C.-K.; Reisinger, Y.; Kim, M.J.; Yoon, S.-M. The Influence of Volunteer Motivation on Satisfaction, Attitudes, and Support for a Mega-Event. *Int. J. Hosp Manag.* **2014**, *40*, 37–48. [CrossRef]
31. Deci, E.L.; Koestner, R.; Ryan, R.M. A Meta-Analytic Review of Experiments Examining the Effects of Extrinsic Rewards on Intrinsic Motivation. *Psychol. Bull.* **1999**, *125*, 627–668. [CrossRef]
32. Ryan, R.M.; Deci, E.L. Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemp. Educ. Psychol.* **2000**, *25*, 54–67. [CrossRef] [PubMed]
33. Kalajas-Tilga, H.; Koka, A.; Hein, V.; Tilga, H.; Raudsepp, L. Motivational Processes in Physical Education and Objectively Measured Physical Activity among Adolescents. *J. Sport Health Sci.* **2020**, *9*, 462–471. [CrossRef] [PubMed]
34. Beauchemin, J.D.; Gibbs, T.A.; Granello, P.F.; Gabana, N.T. Motivation for Movement: Influences for Walking Event Participation. *Health Educ. J.* **2019**, *78*, 111–123. [CrossRef]
35. Manaugh, K.; El-Geneidy, A.M. Does Distance Matter? Exploring the Links among Values, Motivations, Home Location, and Satisfaction in Walking Trips. *Transp. Res. Part A Policy Pract.* **2013**, *50*, 198–208. [CrossRef]
36. Rejón-Guardia, F.; Alemany-Hormaeche, M.; García-Sastre, M.A. Ibiza Dances to the Rhythm of Pedals: The Motivations of Mountain Biking Tourists Competing in Sporting Events. *Tour. Manag. Perspect.* **2020**, *36*, 100750. [CrossRef] [PubMed]
37. Xu, H.; Yuan, M.; Li, J. Exploring the Relationship between Cycling Motivation, Leisure Benefits and Well-Being. *Int. Rev. Spat. Plan. Sustain. Dev.* **2019**, *7*, 157–171. [CrossRef]
38. Fishbein, M.; Ajzen, I. *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*; Addison-Wesley: Reading, MA, USA, 1975.
39. Ajzen, I. The Theory of Planned Behavior. *Organ. Behav. Hum. Decis. Process.* **1991**, *50*, 179–211. [CrossRef]
40. Perugini, M.; Bagozzi, R.P. The Role of Desires and Anticipated Emotions in Goal-Directed Behaviours: Broadening and Deepening the Theory of Planned Behaviour. *Br. J. Soc. Psychol.* **2001**, *40*, 79–98. [CrossRef]
41. Volpi, N.C.; Polani, D. Goal-Directed Empowerment: Combining Intrinsic Motivation and Task-Oriented Behaviour. *IEEE Trans. Cogn. Dev. Syst.* **2020**, *8920*, 1–12. [CrossRef]
42. Voon, V.; Baek, K.; Enander, J.; Worbe, Y.; Morris, L.S.; Harrison, N.A.; Robbins, T.W.; Rück, C.; Daw, N. Motivation and Value Influences in the Relative Balance of Goal-Directed and Habitual Behaviours in Obsessive-Compulsive Disorder. *Transl. Psychiatry* **2015**, *5*, e670. [CrossRef]
43. Lee, C.K.; Song, H.J.; Bendle, L.J.; Kim, M.J.; Han, H. The Impact of Non-Pharmaceutical Interventions for 2009 H1N1 Influenza on Travel Intentions: A Model of Goal-Directed Behavior. *Tour. Manag.* **2012**, *33*, 89–99. [CrossRef] [PubMed]
44. Kim, M.J.; Lee, M.J.; Lee, C.K.; Song, H.J. Does Gender Affect Korean Tourists' Overseas Travel? Applying the Model of Goal-Directed Behavior. *Asia Pac. J. Tour. Res.* **2012**, *17*, 509–533. [CrossRef]
45. Kim, M.J.; Lee, C.K.; Petrick, J.F.; Kim, Y.S. The Influence of Perceived Risk and Intervention on International Tourists' Behavior during the Hong Kong Protest: Application of an Extended Model of Goal-Directed Behavior. *J. Hosp. Tour. Manag.* **2020**, *45*, 622–632. [CrossRef]
46. Alcock, I.; White, M.P.; Wheeler, B.W.; Fleming, L.E.; Depledge, M.H. Longitudinal Effects on Mental Health of Moving to Greener and Less Green Urban Areas. *Environ. Sci. Technol.* **2014**, *48*, 1247–1255. [CrossRef] [PubMed]
47. Kleszczewska, D.; Mazur, J.; Bucksch, J.; Dzielska, A.; Brindley, C.; Michalska, A. Active Transport to School May Reduce Psychosomatic Symptoms in School-Aged Children: Data from Nine Countries. *Int. J. Environ. Res. Public Health* **2020**, *17*, 8709. [CrossRef]
48. Lin, W.; Chen, Q.; Jiang, M.; Tao, J.; Liu, Z.; Zhang, X.; Wu, L.; Xu, S.; Kang, Y.; Zeng, Q. Sitting or Walking? Analyzing the Neural Emotional Indicators of Urban Green Space Behavior with Mobile EEG. *J. Urban Health* **2020**, *97*, 191–203. [CrossRef]
49. Möller, H.; Haigh, F.; Hayek, R.; Veerman, L. What Is the Best Practice Method for Quantifying the Health and Economic Benefits of Active Transport? *Int. J. Environ. Res. Public Health* **2020**, *17*, 6186. [CrossRef]
50. Chalmers, D.J. The Conscious Mind. In *Search of a Fundamental Theory*; Oxford University Press: Oxford, UK, 1997.
51. Han, H.; Meng, B.; Kim, W. Bike-Traveling as a Growing Phenomenon: Role of Attributes, Value, Satisfaction, Desire, and Gender in Developing Loyalty. *Tour. Manag.* **2017**, *59*, 91–103. [CrossRef]
52. Mohiuddin, M.; Al Mamun, A.; Syed, F.A.; Masud, M.M.; Su, Z. Environmental Knowledge, Awareness, and Business School Students' Intentions to Purchase Green Vehicles in Emerging Countries. *Sustainability* **2018**, *10*, 1534. [CrossRef]
53. Dhir, A.; Sadiq, M.; Talwar, S.; Sakashita, M.; Kaur, P. Why Do Retail Consumers Buy Green Apparel? A Knowledge-Attitude-Behaviour-Context Perspective. *J. Retail. Consum. Serv.* **2021**, *59*, 102398. [CrossRef]
54. Herman, L.E.; Udayana, I.B.N.; Farida, N. Young Generation and Environmental Friendly Awareness: Does It the Impact of Green Advertising? *Bus. Theory Pract.* **2021**, *22*, 159–166. [CrossRef]
55. Kim, M.J.; Lee, C.K.; Bonn, M. Obtaining a Better Understanding about Travel-Related Purchase Intentions among Senior Users of Mobile Social Network Sites. *Int. J. Inf. Manag.* **2017**, *37*, 484–496. [CrossRef]

56. Baumeister, R.F.; Leary, M.R. The Need to Belong: Desire for Interpersonal Attachments as a Fundamental Human Motivation. *Psychol. Bull.* **1995**, *117*, 497–529. [CrossRef] [PubMed]
57. Wu, H.C.; Cheng, C.C.; Chen, Y.C.; Hong, W. Towards Green Experiential Loyalty: Driving from Experiential Quality, Green Relationship Quality, Environmental Friendliness, Green Support and Green Desire. *Int. J. Contemp. Hosp. Manag.* **2018**, *30*, 1374–1397. [CrossRef]
58. Lee, S.; Lee, C.; An, J. Psycho-Social Correlates of Leisure-Time Physical Activity (LTPA) among Older Adults: A Multivariate Analysis. *Eur. Rev. Aging Phys. Act.* **2020**, *17*, 6. [CrossRef]
59. Laurier, E.; Brown, B.; McGregor, M. Mediated Pedestrian Mobility: Walking and the Map App. *Mobilities* **2016**, *11*, 117–134. [CrossRef]
60. Churchill Jr., G. A. A Paradigm for Developing Better Measures of Marketing Constructs. *J. Mark. Res.* **1979**, *16*, 64–73. [CrossRef]
61. Kramer, J.-N.; Künzler, F.; Mishra, V.; Smith, S.N.; Kotz, D.; Scholz, U.; Fleisch, E.; Kowatsch, T. Which Components of a Smartphone Walking App Help Users to Reach Personalized Step Goals? Results from an Optimization Trial. *Ann. Behav. Med.* **2020**, *54*, 518–528. [CrossRef]
62. Cicchetti, D.V.; Shoinralter, D.; Tyrer, P.J. The Effect of Number of Rating Scale Categories on Levels of Interrater Reliability: A Monte Carlo Investigation. *Appl. Psychol. Meas.* **1985**, *9*, 31–36. [CrossRef]
63. Preston, C.C.; Colman, A.M. Optimal Number of Response Categories in Rating Scales: Reliability, Validity, Discriminating Power, and Respondent Preferences. *Acta Psychol. (Amst.)* **2000**, *104*, 1–15. [CrossRef]
64. Brislin, R.W. Back-Translation for Cross-Cultural Research. *J. Cross-Cult. Psychol.* **1970**, *1*, 185–216. [CrossRef]
65. Wright, K.B. Researching Internet-Based Populations: Advantages and Disadvantages of Online Survey Research, Online Questionnaire Authoring Software Packages, and Web Survey Services. *J. Comput. Commun.* **2005**, *10*, JCMC1034. [CrossRef]
66. Ministry of the Interior and Safety. Resident Registration Demographics. Available online: https://jumin.mois.go.kr/# (accessed on 11 August 2021).
67. Embrain. The Largest Panel in Asia with 3 Million Panelists. Available online: http://www.embrain.com/eng/ (accessed on 26 May 2020).
68. Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E. *Multivariate Data Analysis*, 8th ed.; Cengage: London, UK, 2020.
69. American Association for Public Opinion Research. Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys. Available online: http://www.aapor.org/AAPOR_Main/media/publications/Standard-Definitions20169theditionfinal.pdf (accessed on 12 May 2019).
70. Cochran, W.G. The X2 Test of Goodness of Fit. *Ann. Math. Stat.* **1952**, *23*, 315–345. [CrossRef]
71. Hair, J.F.; Hult, G.T.M.; Ringle, C.M.; Sarstedt, M. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*; Sage: Thousand Oaks, CA, USA, 2017. [CrossRef]
72. Hair, J.F.; Sarstedt, M.; Ringle, C.M.; Mena, J.A. An Assessment of the Use of Partial Least Squares Structural Equation Modeling in Marketing Research. *J. Acad. Mark. Sci.* **2012**, *40*, 414–433. [CrossRef]
73. Ringle, C.M.; Wende, S.; Becker, J.M. SmartPLS 3.3.5. Available online: http://www.smartpls.com (accessed on 18 September 2021).
74. Chin, W.W.; Marcolin, B.L.; Newsted, P.R. A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and Electronic-Mail Emotion/Adoption Study. *Inf. Syst. Res.* **2003**, *14*, 189–217. [CrossRef]
75. Keil, M.; Tan, B.C.Y.; Wei, K.; Saarinen, T.; Tuunainen, V.; Wassenaar, A. A Cross-Cultural Study on Escalation of Commitment Behavior in Software Projects. *MIS Q.* **2000**, *24*, 299–325. [CrossRef]
76. Kline, R.B. *Principles and Practice of Structural Equation Modeling*, 3rd ed.; The Guilford Press: New York, NY, USA, 2011.
77. Stevens, J. *Applied Multivariate Statistics for the Social Sciences*, 5th ed.; Lawrence Erlbaum Publishers: Mahwah, NJ, USA, 2009.
78. Henseler, J.; Ringle, C.M.; Sarstedt, M. A New Criterion for Assessing Discriminant Validity in Variance-Based Structural Equation Modeling. *J. Acad. Mark. Sci.* **2015**, *43*, 115–135. [CrossRef]
79. Geisser, S. A Predictive Approach to the Random Effect Model A. *Biom. Trust* **1974**, *61*, 101–107. [CrossRef]
80. Stone, M. Cross-Validatory Choice and Assessment of Statistical Predictions. *J. R. Stat. Soc.* **1974**, *36*, 111–147. [CrossRef]
81. Cohen, J. A Power Primer. *Psychol. Bull.* **1992**, *112*, 155–159. [CrossRef]