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THE IMPACT OF THE DIGITAL ENVIRONMENT ON ECO-FRIENDLY BEHAVIOURAL CHANGE TOWARDS NATURE: EXPLORING THE CONCEPT OF FOREST BATHING WITHOUT FOREST

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Abstract: *The article quantitatively investigates transformative changes in human behavioral patterns about nature due to using digital forests in relaxation practices. In the era of COVID-19, when physical outings and social interactions have been limited, there has been a growing trend for people to engage in digital interactions with nature. This article aims to quantify the impact of people's behavior and interaction in the digital space on the change of personal behavioral patterns in the physical natural environment, as well as to analyze the potential effects of digital "bathing in the forest". Since in work it is advisable to take into account the influence of hidden factors, structural equation modeling was used for the needs of this study. The primary data were the answers of 300 respondents, which were obtained based on the results of a survey of people in the capital region of Japan. A five-point Likert scale was used to evaluate and analyze respondents' opinions. The internal reliability of the questionnaire scales was tested using Cronbach's alpha. The work offers an integral indicator for assessing the personal characteristics of individuals, based on which two groups of respondents were formed - extroverts (the index is higher than the median) and introverts (the index is lower than the median). The study analyzed the pathways that lead to changes in human behavior caused by the development of digital natural relaxation methods. The work established a statistically significant relationship between the effect of digital "bathing in the forest" and a change in human behavior (correlation coefficient 0.872). According to the results of structural modeling, it was found that digital "forest bathing" has a significant mediating effect on the promotion of pro-environmental behavior (correlation coefficient is 0.634) and that users who regularly experience nature in cyberspace are more likely to change their behavior concerning nature. It is substantiated that people closer to introversion are more actively involved in the digital space and interact with others, and significantly more often change their behavior towards the environment. This study is a rare contribution demonstrating the potential of enjoying digital "forest bathing" to induce environmentally oriented behavior, even in the physical absence of forests.*

Keywords: forest bathing, cyberspace, connectedness, behavioural change, structural equation modelling.

JEL Classification: I39, Z19.

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1. Introduction

1.1 Background of the study

This study examines well-being in the digital age, which we are relearning while undergoing COVID-19, in terms of subjective health awareness brought about by virtual forest bathing in digital spaces. After a period of lockdown, we seem to be more and more active in digital spaces, sharing the experience of interacting in virtual spaces and engaging more and more with nature in virtual spaces than ever before.

There is a programme hidden in the background of our lives. It is called 'biophilia'. The term was first coined by Erich Fromm (Orr, 1993) and described by biologist E.O. Wilson as 'an innate attraction to life and vital activity' (Wilson, 1984). The concept of biophilia can be applied to the current research topic of the significance and impact of digital forest bathing. Even modern people living an urban lifestyle feel some kind of connection to nature. According to Wilson, biophilia is the wisdom stored in our genes to coexist with nature, to survive the struggle against enemies, and the knowledge to survive is woven into us (Sciebel et al., 2022).

1.2 Research rationale

How can we identify the relationship between humans and nature in cyberspace, through the medium of the lockdown, and suggest ways in which we can contribute to improving people's subjective health (Amankwah-Amoah et al., 2021)? In an environment of increasing digitisation and increasing activities in digital spaces, it is timely to examine the impact of digital activities on people's well-being and to propose actionable suggestions.

Our daily lives are made up of a combination of physical and cyber environments. Evidence and empirical evidence shows that contact with nature supports subjective well-being, reduces stress, improves concentration and has health benefits (Prati & Mancini, 2021).

During the lockdown, we took up the fascinating topic of digital forest bathing, with the help of 300 participants, to collect data and conduct empirical quantitative analysis to examine the impact of activities in digital spaces on people's well-being through any path, as we believe this is an essential research genre to examine well-being in the digital age and to be able to offer concrete suggestions. In particular, it is a well-known finding that contact with nature in digital spaces positively influences people's psychological well-being (Reyes-Riveros et al., 2021; Song et al., 2021). This study also aims to maximise the implications and contributions of the research findings by examining whether digital behaviours and interactions, including digital forest bathing, result in people's environmentally conscious behavioural change, and the factors necessary to evoke such behavioural change (Oe & Yamaoka, 2021).

2. Academic discussions

2.1 Activities and connections with others in cyberspace

Digital nature serves as a promising and refreshing alternative for individuals with mobility impairments and for those who are housebound (Gunasekeran et al.)

A mixed analytical approach was employed to investigate the impact of digital nature videos and overall leisure activities on the mental well-being of adults in the United States, revealing a positive association between engagement with physical nature and subjective well-being (Shen et al., 2022). Conversely, it is agreed that people who live far from the natural environment amplify loneliness to a significant degree compared to those who do not, and it has also been verified that short periods of contact with nature do not significantly alleviate loneliness. (Kryshtanovskaya & Lavrov, 2022).

While contact with nature has been linked to mental and social well-being (Sandifer et al., 2015; Zhang et al., 2020), there is a growing recognition that a certain "quantity" of nature interaction is necessary, and engagement with digital nature in cyberspace can positively impact individuals' well-being. This suggests that digital nature holds tremendous potential as a complementary strategy for individuals with limited mobility, infrequent access

to nature or social interactions, or older adults with mobility challenges (Oe, 2020; van Houwelingen-Snippe et al., 2020; van Houwelingen-Snippe et al., 2022).

2.2 Role of visual and auditory stimuli

Determining the different effects of visual (video and photographs) and auditory (sound) information is likely to provide a useful perspective for examining the impact of people's interaction with nature in digital spaces. How people's interaction with natural materials in digital form contributes to their subjective well-being and health was a topic of interest to many researchers and policy makers during the COVID era when outings were restricted. (Song et al., 2021). Drawing inspiration from Song et al.'s (2021) experimental design, the present study employed a forest stream video as visual stimuli (Figure 1). Participants engaged in the experiment watch a video in a relaxed environment, using a computer that they are used to using on a regular basis.

Figure 1. Experimental video

Source: Authors' compilation.

Next, they were given compound auditory stimuli, such as the rustle of trees in the wind and the murmur of a babbling brook. Each subject received the composite stimuli through the screen and speakers of a familiar personal computer. Prior to the experiment, 10 randomly selected participants were recruited as volunteers and the participants' assessment of the sound intensity had already confirmed that they found the volume to be 'audible'.

In this study, three aspects were ascertained: (1) the evaluation of visual stimuli only and combined stimuli, (2) the examination of the influence of combined stimuli on the participants' transformation towards environment-oriented behaviour, and (3) their subjective evaluation of visual stimuli only and combined stimuli.

2.3 Nudge effects on ecological behaviour change

There has been some debate in academia about how viewer interaction with digital natural materials contributes to viewers' well-being and mental health, including the different effects of visual information (videos and photographs) and auditory information (sound). (Zhao et al., 2018). The study notes that when people's behaviour was constrained during the COVID-19 era, online community and gaming activity increased; Oe (2020) examined the positive impact of feeling connected to others on activities in cyberspace, and the positive impact of online gaming on digital natives in particular. Digital natives have a high affinity for activities in digital space, with a

healing of loneliness and emotional support from the new interactions created in the gaming community. Digital natives' behaviour is proven to be positively influenced by their commitment to activities in the digital space.

During the period when people were restricted from going out due to Covid, there was a marked tendency to share videos and photos of nature scenes on social networking sites (Quick, 2021). Compared to pre-pandemic levels, more people are reported to have enjoyed gardening, going out to neighbourhood green spaces and getting in touch with nature in their immediate surroundings (Mostajeran et al., 2021). Interaction with nature in digital spaces may have a nudge effect on the actual physical landscape, raising people's conservation awareness and changing their behaviour. However, the pathways through which digital activities result in nudge effects have not been the subject of research.

2.4 Types of human behaviour and well-being

2.4.1 Accumulated research on the behavioural types of subjects

There is extensive research in psychology and clinical medicine on the behavioural types of subjects, with some research approaches examining the relationship between daily behaviour patterns and the incidence of specific diseases. The personality classification defined by the American physician and cardiologist Mayer Friedman and his colleague Rosenman has been applied, with some modifications, to the Japanese population, with many empirical results (Shaw & Dimsdale, 2010). Although it can be read as a personality classification, the scales and indicators used in the classification can be read as behaviour patterns that are repeated without the subject's awareness. Even before Rosenman's classification of behaviour as type A and type B, it was noted that some personalities were more prone to ischaemic heart disease (angina pectoris and myocardial infarction) than others. It was this 'heart disease-prone personality' (type A) that they identified.

Suggestions for health maintenance and health behaviours for type A subjects were then brought forward, and there is a wealth of empirical research on their effectiveness. Thus, based on the type of subjects, health interventions for specific groups have significant implications and contribute to the development of intervention policies to promote health effects based on medical evidence.

On the other hand, indicators that have been confirmed by the accumulation of knowledge and evidence in Europe and the USA have been found to not always be reliable for citizens of other countries, including Japan, due to language issues (e.g. certain strict procedures for translation or modification from the original English) and questions not available in the social or educational language of that country.

There are also issues such as questions that are difficult for respondents to understand within their cultural context, and the inclusion of wording. In light of these issues, in Japan, where this study was conducted, Kwansei Gakuin University has developed its own index for type identification, which is widely available as an open index to encourage data collection and discussion among Japanese adult users (hereafter KG index) (Arao et al., 1994; Yamazaki et al., 1990). Song et al. (2013) used the KG index to discuss the health benefits of forest bathing for different types of subjects and to quantitatively compare the extent of and differences in the development of the benefits of forest bathing for different types of subjects.

However, the KG index has a large number of questions (55), which can be burdensome for respondents, and because of the priority given to overall balance, many of the questions are similar. Even the now-improved KG-3 version still has 44 questions, and how to design reliable measurements in collecting candid sensory values from the subjects has been discussed (Fuerst et al., 2007).

2.4.2 Scale of emotional intelligence (EI)

Unlike the type A approach, which defines and categorises a subject's behavioural patterns in terms of their association with a specific illness, this study focuses on the psychological and personality characteristics of each individual. This is considered to be effective in measuring co-operative behaviour within an organisation, and the operationalisation of the development of the scale has accumulated a large number of empirical studies.

The index for measuring emotional intelligence (EI) is known as the emotional intelligence quotient (EQ). This theory was first published in a paper in 1989 by Dr Peter Salovey of Yale University and Dr John Mayer of the University of New Hampshire. Later, journalist Daniel Goleman published 'Emotional Intelligence', which used the theory to raise the profile of EI considerably. Regarding EQ, Dr Salovey and Dr Meyer argue that EI is the ability to perceive emotional states, to approach emotions to aid thinking, to generate emotions, to understand emotions and emotional knowledge, and to understand emotional and intellectual It is argued that EI is the ability to thoughtfully regulate emotions so as to facilitate growth in aspects (Salovey & Mayer, 1997).

EQ is measured by multiple factors, which are said to be determined by three intelligence scales:

■ Self-concept: the ability to understand one's own state of mind.

■ Interpersonal intelligence (social skills): the ability to reach out to others appropriately and efficiently.

■ Situational intelligence (monitoring ability): the ability to recognise the state of oneself and others at the same time.

In particular, in the business sector, EI is used to understand a situation in a short period of time when faced with various issues and challenges in society and organisations, and to proactively communicate with diverse stakeholders to deal with the challenges (Gonzales, 2022). Hence, EI has a different origin from the logic and scope of research surrounding type A, which was developed with the aim of exploring the relationship with cardiovascular disease.

2.5 Design and piloting of the scale for behavioural types

As noted above, Dr Salovey of Yale University and Dr Mayer of the University of New Hampshire, USA stated that EI managing and using emotions well is one ability and that this ability has few inherent factors, such as genetics, and can be learned and, as claimed, it can be acquired and enhanced through training. It was systematised as EQ by Harvard psychologist Daniel Goleman and has become widely known throughout the world as an index of emotional behaviour.

One of the most established and globally reliable measures of emotional intelligence used by researchers to measure EI is the trait emotional intelligence questionnaire. Among them, the trait emotional intelligence questionnaire-short form (TEIQue-SF) is a well-known method that aims to simplify the questionnaire and reduce the burden on respondents. The short form (SF) has a total of 30 questions corresponding to the full version. SF question items are selected from the overall version based on their correlation with the total score of the corresponding element and have been shown to be useful in covering a broad sampling domain of constructs. The usefulness of the system is supported by a number of empirical studies.

The number of questions in this short version has been significantly reduced to 30, which makes it easy to use but, naturally, the wording of the original English questions is often unfamiliar to the Japanese way of life, and it is hoped that researchers and research institutions will develop and publish their own questionnaires so that data can be accumulated and the scale can be made more reliable. The examination of the potential of the system is being promoted in an open manner. One such indicator is the one that Japan Learning has been promoting the development of. Based on EQ theory, Japan EQ(R) is an assessment tool uniquely developed to suit the Japanese way of thinking and working. In the 25 years since its establishment, Japan Learning has been involved in the EQ development of more than 450,000 businesspeople and has been refining the indicators (Japan Learning Corporation, 2022). Similarly, Nippon Seeds, a company that builds human resource development and educational programmes, has developed and released its own questionnaire, and continues to widely attempt to revise and improve the scale through the implementation of experiments and data-checking work (Nippon Seeds, 2022).

The author's group rearranged and reorganised the questionnaire based on previous research outcomes, then collected data from eight pilot tests, which were classified into groups of questions for each of four themes through factor analysis and then reduced the total number of questions to 27. This 27-question index is named, for convenience, the OY-behavioural pattern index with the ID of the author's team, and it will be used in this paper.

On the other hand, the behaviour change effects of activities in digital space and interaction with digital nature (the subject of this study) are expected to provide actionable suggestions by comparing the effects of behavioural restriction by COVID-19 with those of staying in cyberspace and interacting with nature in subject groups with different emotional responsiveness.

2.6 Analytical framework with scale

This study will test a model using latent factors and its measures of the relationship between digital forest bathing, health effects and nature that was developed earlier. Respondents will then be classified using the OY-indicators developed by the study, and differences in the behavioural patterns of each group will be quantitatively examined.

The empirical study utilized a comprehensive two-stage model. In the first stage, two factors were proposed as potential influential factors: (i) individuals' environment-related behaviour in digital space, and (ii) their connections with others in cyberspace. The study examined the direct effects of these factors on the elicitation of individuals' "environment-oriented behavior" (as depicted in Figure 2). Subsequently, as a mediating factor, participants were indirectly exposed to digital forest bathing, and a quantitative analysis was conducted to assess the extent to which the level of appreciation for digital forest bathing influenced individuals' behavioral change (as depicted in Figure 3).

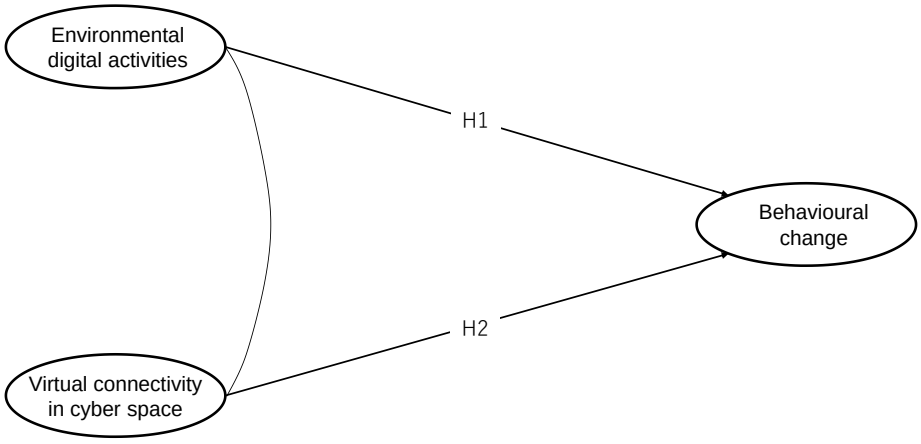

Figure 2. Conceptual framework of the direct model

Source: Authors' compilation.

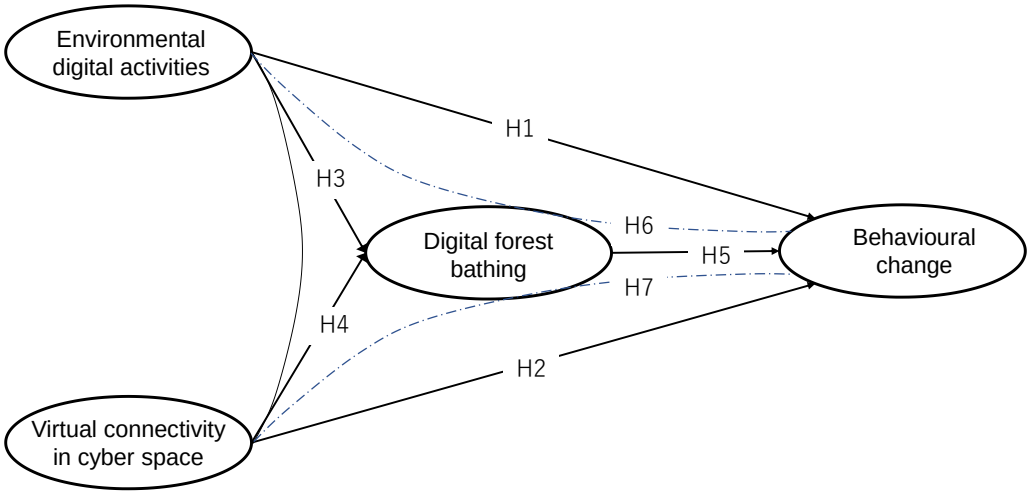

Figure 3. A framework model for the study

Source: Authors' compilation.

In addition, a thorough quantitative comparative analysis was conducted to examine the response tendencies of the two groups of respondents. To differentiate between the groups, the type-specific tendency index (OY-scale) described in the preceding section was employed for classification. This method enabled a comprehensive evaluation and comparison of the distinct patterns exhibited by each group. By utilizing the type-specific tendency index, the study aimed to gain insights into the unique characteristics and behaviors of individuals within each group, contributing to a deeper understanding of the research topic.

3. Methodology

3.1 Survey Development

For the study, a quantitative approach was conducted to examine the influence of digital space activities and digital forest bathing on behavior change among individuals. The hypothetical pathway was tested, as depicted in Figure 3, with the mediating variable being the relaxing effect of digital forest bathing. A total of 300 valid responses were collected for analysis, ensuring a balance in terms of gender, age groups, and other factors. In this study, the observational variables were created by referring to the questionnaire that have built up empirical evidence in previous studies of accumulated research; a five-point Likert scale was used to design the choices. (Nakano, 1995).

Questionnaires were distributed to individuals in Japan. While most digital forest bathing research has so far been based on datasets from mainly developed Western/European countries, this dataset was collected in Japan, the birthplace of forest bathing. There is limited literature on the specific topic of this study, which contributes to the geographical focus by collecting and analyzing data regarding the perceptions of individuals in Japan. Specifically, a random sampling method was used to select participants from the metropolitan area, including Tokyo. In this metropolitan area, the geographical distance to deep forests is significant, and accessing renowned forest bathing areas like Okutama Forest in the suburbs can take approximately two and a half hours, creating access challenges.

The questionnaire was first prepared in English and then translated into Japanese, with the assistance of two bilingual Japanese-English experts, who followed the recommended process to ensure that the two versions were equivalent in meaning by Brislin (1970). A pilot test involving three university professors and four volunteer Japanese citizens was conducted to refine the wording and improve the overall quality of the survey items. Ultimately, the survey obtained responses from 300 participants.

3.2 Measures

3.2.1 Independent Variables

The measurement scale developed by Shen et al. (2022) and Kryshtanovskaya and Lavrov (2022), comprising five items related to virtual activities and connectedness with others, was employed for the independent variables. The mediating variable 'digital forest bathing' was represented by two observed variables, following the discussion of Song et al. (2021). To assess reliability, Cronbach's alpha was employed, with each variable exhibiting a desirable value of 0.8 or higher, indicating strong internal consistency.

3.2.2 Dependent Variables

The dependent variables in the model measured the behavior change of the participants. This component consisted of two observed variables based on Oe and Yamaoka (2021). The latent factor demonstrated consistency and sufficient internal controls, as confirmed by the reliability analysis (Cronbach's $\alpha = 0.801$). Responses were captured on a five-point Likert scale ranging from 'strongly disagree = 1' to 'strongly agree = 5'.

3.2.3 Data Analysis

Models were validated using semi-structural equation modelling with AMOS ver26. Two patterns of models were designed: a model that only assessed the direct effect (Figure 2) and a model that used participants' digital forest

bathing as a mediating effect (Figure 3). For each of these two patterns, the impact of antecedents on environmentally friendly behaviour change was analysed quantitatively.

Furthermore, utilizing the OY-index developed in this study as a measure of individuals' personality tendencies, the respondents were divided into two groups based on this index (above and below the median of the first factor). For the convenience of the study, these groups were classified as extroverted (index higher than the median) and introverted (index lower than the median), and the behavior patterns and consciousness phases of the two groups were compared.

4. Findings and analysis

4.1 Data Description

Before conducting a thorough analysis, it is essential to examine the characteristics of the obtained dataset. The data profile was assessed to ensure a balanced representation across different attributes, as depicted in Table 1.

Table 1. Demographic profile

Demographic profile	Frequency	Percent	Cumulative Percent
Gender			
Male	150	50.0	50.0
Female	150	50.0	100.0
Total	300	100.0	
Age			
20s	60	20.0	20.0
30s	60	20.0	40.0
40s	60	20.0	60.0
50s	60	20.0	80.0
60s	60	20.0	100.0
Total	300	100.0	
Married status			
Unmarried	147	49.0	49.0
Married	153	51.0	100.0
Total	300	100.0	
Education			
Grad School	11	3.7	3.7
University	149	49.7	53.3
College	66	22.0	75.3
High school or under	74	24.7	100.0
Total	300	100.0	
Income			
Under $20,000	138	46.0	46.0
$20,001 – 50,000	115	38.3	84.3
$50,001 – 90,000	34	11.3	95.7
Upper $90,001	13	4.3	100.0
Total	300	100.0	

Source: Authors' compilation.

4.2 Segmentation of behavioural types: Development of scales

Factor analysis and a validity check for personality were conducted. The results of the factor analysis were divided into four factors. Factor one was self-concept, factor two was social skills, factor three was monitoring skills and factor four was epicurean factors. The highest alpha was calculated for each. Factor one was 0.792 for the top five, factor two was 0.700 for four, factor three was 0.706 for four and factor four was 0.835 for three. The value of those alphas was more than 0.6, which is sufficiently reliable (Hair et al., 2010). Table 2 demonstrates the result of factor analysis leading to the scale development, which we named the OY-scale, for behaviour type segmentation.

Table 2. Factor analysis using OY-scale for behaviour type segmentations

No	Questionnaire	Components				Alpha
		1	2	3	4	
1	I like myself	0.715	-0.090	0.026	0.316	0.792
2	I get on well with others	0.695	0.183	-0.278	0.098	
3	I am in control of my emotions	0.691	-0.314	-0.154	0.081	
4	I adapt easily to my environment	0.689	-0.040	-0.164	0.238	
5	I am good at expressing myself	0.686	-0.178	-0.086	-0.045	
6	I can count my strengths	0.682	-0.113	0.086	0.361	
7	I am positive	0.668	0.106	-0.338	0.218	
8	I am considerate of others	0.647	-0.333	-0.026	-0.103	
9	I am good at negotiating with others	0.647	0.071	-0.320	0.067	
10	I like to interact with others	0.639	-0.147	-0.347	0.166	
11	I know how to relieve stress	0.527	-0.205	-0.260	0.351	
12	I am good at relaxing	0.524	0.205	-0.094	0.295	
13	I am misunderstood by others	0.110	0.745	0.005	-0.127	0.700
14	I have a lot of control over my emotions	-0.106	0.686	0.156	-0.168	
15	I do not know how to control my emotions	-0.179	0.571	0.397	0.088	
16	I cannot honestly express my love to my loved ones	-0.078	0.552	0.187	-0.288	
17	I am not good at relativising my feelings	-0.340	0.537	0.335	0.294	
18	I change my mind a lot	0.041	0.535	0.346	-0.123	
19	I am not good at controlling other people's emotions	-0.289	0.122	0.720	0.024	0.797
20	I often find it difficult to get on with people, even close friends	-0.165	0.233	0.673	-0.169	
21	I lack confidence in my ability to manage my life well	-0.082	0.329	0.608	-0.254	
22	I find it difficult to stay motivated	-0.292	0.375	0.551	-0.209	
23	I always have regrets	-0.091	0.483	0.495	-0.023	
24	I am generally happy	0.408	-0.099	-0.102	0.676	0.835
25	Life is hard for me	-0.202	0.384	0.239	-0.666	
26	I can be happy	0.528	-0.115	-0.117	0.586	
27	I am generally pessimistic about my life	-0.234	0.375	0.431	-0.449	

Source: Authors' compilation.

Four factors were generated by the personality classification, of which the present study attempted to classify the respondents using the first factor. After segmenting the respondents using the OY-indicator, the subsequent comparative analysis will be conducted using two groups of data sets classified on the basis of the first factor.

That is, the respondents were sorted according to the order of scores of the first factor and divided into extravert and introvert (above and below the mean or median). The first factor was self-concept, classified as upper = extrovert and lower = introvert (Table 3).

Table 3. Segmentation of behaviour type

	Frequency	Percent	Cumulative Percent
Introvert	142	47.3	47.3
Extrovert	158	52.7	100.0
Total	300	100.0	

Source: Authors' compilation.

4.3 Verification of hypothesis

4.3.1 Variables validation

After finalizing the indicators used to classify respondents based on their personality and confirming the procedures, it is now appropriate to proceed with hypothesis testing. First, the consistency and validity of the factors included in the model with respect to the data set is checked. To do so, a factor analysis is applied to the set of observed variables that comprise the explained behaviour change factor and the antecedents that define it. Table 4 presents the findings from a descriptive analysis of the dataset.

Table 4. Descriptive analysis

	N	Min	Max	Mean	Std. Deviation
EDA 1: I spend more time surfing the internet, YouTube and social networking sites than I used to	300	1	5	2,98	1,251
EDA 2: I spend more time playing online games than I used to	300	1	5	2,14	1,219
EDA 3: During the lockdown, I watch more environment-related videos	300	1	5	2,05	1,129
VCC 1: I have become more active in virtual socialising, e.g. ZOOM, online events	300	1	5	1,96	1,103
VCC2: I enjoy more virtual connectedness and communication in cyberspace than before COVID	300	1	5	2,92	1,123
DFB 1: Watching the nature video helps me to relax	300	1	5	3,43	1,034
DFB 2: Seeing beautiful nature photos or listening to the forest sounds make me feel better	300	1	5	3,54	0,941
BC 1: I felt like going to the forest or the mountains.	300	1	5	3,33	1,115
BF2: I felt that we need to take care of the forest and nature.	300	1	5	3,59	0,958

Source: Authors' compilation.

Table 5 shows non-parametric test results with the Mann-Whitney test. The grouping variable was used in the first factor, which was introvert and extrovert, and four factors: EDA, VCC, DFB and BC. There are significant differences among the four variables ($p < 0.001$).

With this, it was concluded that the classification of respondents by the OY-indicator is a good representation of the respondent's propensity to respond and is a valid indicator for typology.

Table 5. Non-parametric test result

First Factor		N	Mean Rank	Sum of Ranks
EDA	Introvert	142	130.95	18595.50
	Extrovert	158	168.07	26554.50
	Total	300		
VCC	Introvert	142	126.39	17947.00
	Extrovert	158	172.17	27203.00
	Total	300		
DFB	Introvert	142	131.26	18639.50
	Extrovert	158	167.79	26510.50
	Total	300		
BC	Introvert	142	130.85	18580.50
	Extrovert	158	168.16	26569.50
	Total	300		
Test Statistics				
	EDA	VCC	DFB	BC
Mann-Whitney U	8442.500	7794.000	8486.500	8427.500
Wilcoxon W	18595.500	17947.000	18639.500	18580.500
Z	-3.735	-4.661	-3.715	-3.788
Asymp. Sig. (two-tailed)	0.000	0.000	0.000	0.000
Grouping Variable: First Factor				

Source: Authors' compilation.

A comprehensive factor analysis was conducted to categorize the results into four distinct factors, namely Environmental Digital Activities (EDA), Digital Forest Bathing (DFB), Virtual Connectivity in Cyber Space (VCC), and Behavioral Change (BC). The outcomes of the factor analysis are presented in Table 6.

Table 6. Factor analysis

	Component			
	1	2	3	4
EDA1	0.835	0.107	0.029	0.375
EDA2	0.760	0.079	0.221	0.158
EDA3	0.710	0.134	0.087	0.213
DFB1	0.007	0.939	0.055	0.037
DFB2	0.044	0.935	0.070	0.016
VCC1	0.012	0.046	0.910	0.933
VCC2	0.397	0.087	0.616	0.027
BC1	0.034	0.043	0.082	0.823
BC2	0.085	0.046	0.025	0.812
Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalisation.				
Rotation converged in four iterations.				

Source: Authors' compilation.

A comprehensive factor analysis was conducted to categorize the results into four distinct factors, namely Environmental Digital Activities (EDA), Digital Forest Bathing (DFB), Virtual Connectivity in Cyber Space (VCC), and Behavioral Change (BC). The outcomes of the factor analysis are presented in Table 6.

Following the completion of the process to determine the explanatory power of each item for its respective construct, the next step involved assessing the validity and reliability of the constructs. Composite reliabilities (CRs) and average variance extracted (AVE) were computed using established statistical procedures (Fornell & Larcker, 1981) and are reported in Table 7. The majority of the computed values exceed the minimum acceptable thresholds for CR and AVE, which are 0.7 (Urbach & Ahlemann, 2010) and 0.5 (Leontitsis & Pagge, 2007), respectively.

To confirm discriminant validity, a test was conducted by comparing the square root of the AVE for each construct (known as average variance, AV) with the Pearson correlation coefficients between constructs. If the AV is greater than the correlation coefficient, it indicates discriminant validity. The AVs and Pearson correlation coefficients were computed, demonstrating that discriminant validity is confirmed. Moreover, the Cronbach's alpha coefficients for each construct surpassed the minimum acceptable value of 0.6 (Hair et al., 2010), indicating a high level of internal consistency.

Furthermore, correlation analysis was performed to identify any covariation among the relevant factors in the structural equation modeling (SEM). It is important to note that correlation coefficients should ideally not exceed 0.7 to avoid issues of multicollinearity (Ratner, 2009). In this study, all correlation coefficients satisfied this criterion, reinforcing the reliability, consistency, and validity of the identified constructs (Fornell & Larcker, 1981). As presented in Table 7, the factors have demonstrated suitability for SEM analysis.

Table 7. Convergent and discriminant validity test

	N	Mean	SD	CA	CR	AVE	EDA	DFB	VCC	BC
EDA	300	2.389	0.884	0.799	0.813	0.593	**0.770**			
DFB	300	2.442	0.833	0.813	0.746	0.604	0.100	**0.777**		
VCC	300	3.385	0.908	0.711	0.935	0.878	0.563**	0.177**	**0.937**	
BC	300	3.460	0.929	0.747	0.801	0.668	0.066	0.621**	0.136*	**0.817**
Values bold on the main diagonal are the square rooted of AVEs; SD is standard deviation; CA is Cronbach alpha; CR is composite reliability; AVE is average variance standard. **p < 0.01, *p < 0.05										

Source: Authors' compilation.

4.3.2 No-mediation Model

To examine the mediating effect, three distinct models were constructed: the no-mediation model, partial mediation model, and full mediation model. The estimation process also incorporated control variables, including paths to the mediator and dependent variables, following the guidelines of Hayes (2015) and Jyoti & Ranis (2019).

Figure 4 illustrates the results of the no-mediation model in the structural equation modeling (SEM), which comprises three dependent variables: Environmental Digital Activity (EDA), Virtual Connectivity in Cyberspace (VCC), and Behavioral Change (BC). The findings revealed that the standard regression coefficient for the path between EDA and BC was 0.152 ($p<0.05$), indicating a significant relationship. However, the path between VCC and BC had a coefficient of 0.031 ($p>0.05$), suggesting that this path is not statistically significant. The goodness-of-fit index (GFI) for this SEM model was calculated as 0.979, surpassing the threshold of 0.9, which means this analytical model has an ideal fit (Hair et al., 2010). Additionally, Table 8 presents the path coefficient of the direct model. In this particular model, hypothesis H1 was supported, while H2 was not confirmed.

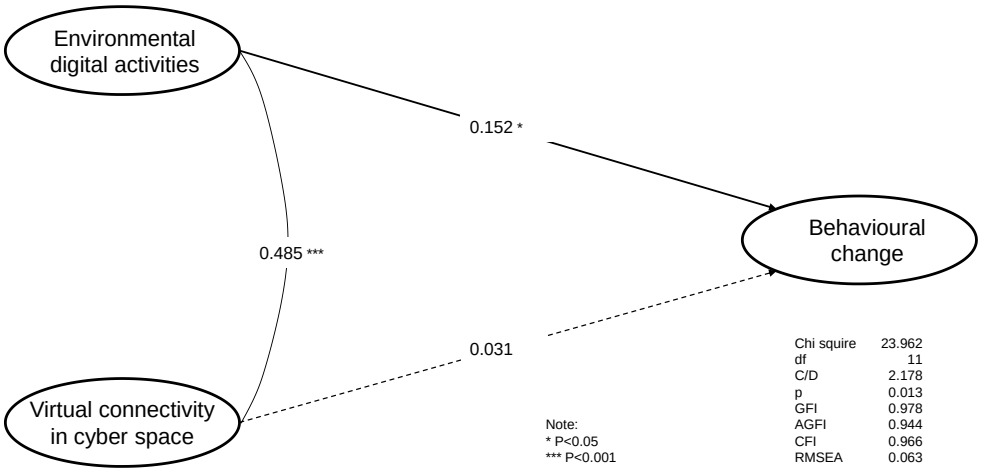

Figure 4. SEM result of the direct model

Source: Authors' compilation.

Table 8. Path coefficient of the direct model

To		From	Std. Regression Weights	p
BhaviorChg	<---	EnvDigAct	0.152	*
BhaviorChg	<---	VirtualConCyber	0.031	0.546
EnvDigAct	<-->	VirtualConCyber	0.485	***

Source: Authors' compilation.

4.3.3 Model of partial mediation

Figure 5 shows the SEM research model of the mediating effect with all samples. The digital forest bathing factor is placed in the centre of the diagram as a mediating variable. It is hereafter referred to by its initials as DFB. The results of this analysis showed that the path coefficient for EDA→DFB showed a significant relationship (0.634, $p<0.001$). Furthermore, the path coefficient for VCC→DFB was also highly significant (0.465, $p<0.001$). Next, the DFB to BC path was 0.872 ($p<0.001$), and these results support hypotheses H3, H4 and H5.

However, the path from EDA to DFB was 0.036 ($p>0.05$) and from VCC to DFB was 0.043 ($p>0.05$). The results were validated for H1 and H2, but the respective paths did not show a significant relationship. In other words, H1 and H2 were rejected.

4.3.4 Fully mediation model

A recent study by Yu et al. (2022) tested the direct effects using SEM. In this regard, this study tested the direct effects of EDA and VCC on BC using DFB. Figure 5 shows the SEM model used in the analysis. A bootstrap sample of 5,000 was constructed for the perceived direct effects. Table 9 displays the standardised regression weights, p-values and 95% percentile confidence levels (PC) for all direct and indirect paths. The indirect effect for path EDA → DFB → BC is 0.533 ($p<0.001$, PC=0.343-0.788), while VCC → DFB → BC shows 0.405 ($p<0.001$, PC=0.161, 0.653). This means that both paths are significant. H6 and H7 were therefore supported.

Figure 5 shows the goodness of fit of the SEM research model, which indicates the goodness of fit index (GFI) was 0.968 (>0.9) and the adjusted goodness of fit index (AGFI) was 0.935. The root mean square approximation error (RMSEA) is 0.044 (<0.10), which means that the model is good and fit for the dataset (Hair et al., 2010; Hayes, 2015). In summary, the model fit is excellent.

4.4 Comparative analysis of two types of participants: Extrovert and introvert

4.4.1. Extrovert

The SEM model for the extrovert sample of 'digital environment model of mediating effect' demonstrated a good fit with a chi-square/degrees of freedom of 2.297 (chi-square = 50.581, df = 22), while the other indices were also above the recommended level of >0.90 (GFI = 0.935, AGFI = 0.868 and CFI = 0.932) and <0.10 (RMSEA = 0.091). Moreover, the BC's R2 value was relatively high, at 0.690. The coefficients of indirect pathways from the two factors EDA → BC was 0.583 ** (95% PC = -0.388, 1.201) and VCC → BC was 0.605 ** (95% PC = -0.326, 1.394), respectively. Meanwhile, the path between VCC and BC is higher than in all other sample models. This data means that extroverted people were more likely than the overall sample to be familiar with 'virtual connectivity in cyber space' on a regular basis. This means that they are more likely to be linked to behaviour change through digital forest bathing.

The data shows that extroverted people are more likely than the overall sample to feel closer to 'virtual connections in cyberspace', which is likely to lead to behaviour change through digital forest bathing.

4.4.2. Introvert

The SEM model for the introvert sample of 'digital environment model of mediating effect' demonstrated a good fit with a chi-square/degrees of freedom of 1.274 (chi-square = 28.03, df = 22), while the other indices were also above the recommended level of >0.90 (GFI = 0.960, AGFI = 0.914 and CFI = 0.985) and <0.10 (RMSEA = 0.044). Moreover, the BC's R2 value was relatively high, at 0.816. The coefficients of indirect pathways from the two factors EDA → BC was 0.770 ** (95% PC = -0.282, 1.466) and VCC → BC was 0.299 ** (95% PC = -1067, 0.995), respectively. Meanwhile, the path between EDA → BC was higher than in all other sample models. This data means that introverted people were more likely than the overall sample to be familiar with 'environmental digital activities' on a regular basis. This means that they are more likely to be linked to behaviour change through digital forest bathing.

The data shows that introverted people are more likely than the overall sample to feel closer to 'environmental digital behaviour', which is likely to lead to behaviour change through digital forest bathing.

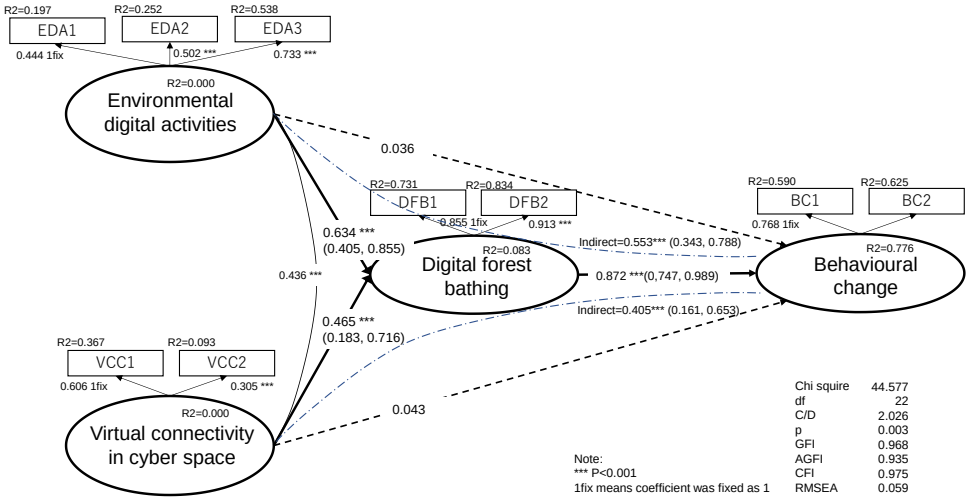

Figure 5. SEM with a mediating effect (all samples)

Source: Authors' compilation.

Table 9. SEM analysis outcome

To		From	All Samples			Extrovert			Introvert		
			Std. Regression Weights	p	95% PC	Std. Regression Weights	p	95% PC	Std. Regression Weights	p	95% PC
DFB	<--	EDA	0.634	***	0.405, 0.855	0.691	**	0.342, 1.049	0.413	**	0.203, 0.671
DFB	<--	VCC	0.465	***	0.716, 0.183	0.716	**	0.315, 1.060	0.175	0.105	-3.241, 1.939
BC	<--	DFB	0.872	***	0.747, 0.989	0.844	**	0.672, 1.020	0.880	**	0.694, 1.136
BC	<--	EDA	0.036	0.924	-0.588, 0.679	0.112	0.853	-1.857, 3.658	0.067	0.525	0.404, 0.798
BC	<--	VCC	0.043	0.881	-0.590, 0.572	0.118	0.838	-3.645, 1.864	0.079	0.328	-2.546, 1.648
EDA1	<--	EDA	0.444	***	0.290, 0.570	0.446	**	0.251, 0.639	0.315	**	0.174, 0.519
EDA2	<--	EDA	0.502	***	0.365, 0.644	0.504	**	0.348, 0.658	0.469	**	0.272, 0.635
EDA3	<--	EDA	0.733	***	0.626, 0.844	0.759	**	0.583, 0.899	0.686	**	0.433, 0.836
VCC1	<--	VCC	0.606	***	0.430, 0.774	0.617	**	0.399, 0.791	0.499	**	0.264, 0.647
VCC2	<--	VCC	0.305	***	0.167, 0.409	0.260	**	0.047, 0.479	0.291	**	0.051, 0.499
DFB1	<--	DFB	0.855	***	0.763, 0.920	0.801	**	0.711, 0.878	0.875	**	0.775, 0.903
DFB2	<--	DFB	0.913	***	0.858, 0.955	0.907	**	0.831, 0.984	0.924	**	0.855, 0.992
BC1	<--	BC	0.768	***	0.681, 0.847	0.789	**	0.687, 0.882	0.717	**	0.632, 0.819
BC2	<--	BC	0.791	***	0.702, 0.880	0.804	**	0.698, 0.886	0.784	**	0.657, 0.846
VCC	<-->	EDA	0.436	***	0.270, 0.574	0.427	**	0.211, 0.632	0.250	**	0.068, 0.428
			Indirect effects			Indirect effects			Indirect effects		
BC	<--	EDA	0.553	***	0.343, 0.788	0.583	**	-0.388, 1.201	0.770	**	-0.282, 1.466
BC	<--	VCC	0.405	***	0.161, 0.653	0.605	**	-0.326, 1.394	0.299	**	-1.067, 0.995
R2		EDA	0.000			0.000			0.000		
		VCC	0.000			0.000			0.000		

Table 9 (cont.). SEM analysis outcome

	DFB	0.083			0.074			0.022		
	BC	0.776			0.690			0.816		
	EDA1	0.197			0.198			0.099		
	EDA2	0.252			0.254			0.220		
	EDA3	0.538			0.575			0.470		
	VCC1	0.367			0.380			0.249		
	VCC2	0.093			0.068			0.085		
	DFB1	0.731			0.642			0.766		
	DFB2	0.834			0.822			0.853		
	BC1	0.590			0.623			0.514		
	BC2	0.625			0.646			0.615		
Fit Indexes	Chi squire	44.577			50.518			28.030		
	df	22			22			22		
	C/D	2.026			2.296			1.274		
	p	0.003			0.000			0.017		
	GFI	0.968			0.935			0.960		
	AGFI	0.935			0.868			0.914		
	CFI	0.975			0.932			0.985		
	RMSEA	0.059			0.091			0.044		

Source: Authors' compilation.

Notes: 1: df: degree of freedom, C/D: Chi-square/df, p: provability, GFI: Goodness of fit index, AGFI: Adjusted goodness of fit index, CFI: Comparative fit index, RMSEA: Root mean square error of approximation. 2: Squared multiple correlations (SMC) in SPSS AMOS was used as R2. 3: *** means $p<0.001$; ** means $p<0.01$. 4: 1 fix means coefficient was fixed as 1. 5: 95% PC means percentile confidence level of 95%.

4.5 Discussion

This study focused on the results of the analysis of the Digital Environment Mediated Effects Model in the two groups of introverts and extroverts. The GFI of the model, including the chi-square/degrees of freedom, showed a suitable level of value for consideration, meaning that the model used in the analysis was consistent with the data set and consisted of reliable measures.

The results of the analysis and comparison of the behavioural patterns of the respondents, who were classified into two groups using the OY-indicator, according to the said model, suggest interesting results. Namely, for the introverted group, both the coefficient of the indirect path from EDA → BC and the path from VCC → BC are significant, while the path between EDA and BC exceeds the values measured in all sample models. This result means that introverts are more likely to be familiar with 'environmental digital activities' on a regular basis. In other words, the results suggest that the likelihood of behaviour change due to digital forest bathing is higher in introverts. Thus, the results of this study suggest that introverts are more likely than extroverts to feel closer to 'environmental digital behaviour'. They are more familiar with it and do it more regularly and thus have a higher likelihood of triggering a nature-friendly behaviour change through their enjoyment of forest bathing without forests.

5. Conclusion

5.1 Theoretical contribution

This study paid particular attention to the impact of people's behaviour and interactions in cyberspace on evoking pro-environmental behaviour towards nature in the real world, with a particular focus on the mediating effects of digital forest bathing. This is an extremely novel research topic: during the COVID-19 pandemic period, when people were restricted in their behaviour and unable to go out, they tended to be more familiar with digital nature and felt happier for it. The greatest contribution of this study is that it quantified the pathways through which people's environmentally-oriented behaviour in digital spaces and digital forest bathing is brought about, and proposed practical scales and models.

Furthermore, this study focused on the differences in people's personalities (introverted and extroverted), which have rarely been studied, and conducted a detailed examination of which types of people are more likely to bring

about behaviour change through the digital environment, and the mediating effects of digital forest bathing on this process. In the process, the OY-indicators were developed as a new method of classifying behavioural personality patterns and were used as a contribution to future research.

5.2 Practical contributions

The results of the analysis showed that digital forest bathing has a mediating effect on evoking environmentally oriented behaviour in people and that people with stronger introversion tendencies are significantly more active in digital spaces and interactions with others and are significantly more likely to change their behaviour. This is a rare research result showing the possibility that enjoying a forest bath can bring about a sense of well-being and stimulate environmentally oriented behaviour even in the absence of forests. The study provides concrete suggestions for improving their health and subjective well-being, given the expected increase in the number of lonely people living alone, elderly people who have difficulty getting out and about, and people with disabilities who have mobility problems in an ageing society.

5.3 Limitations and further research opportunities

Although this study includes theoretical and practical contributions, as described above, the authors recognise several limitations. First, the size of the data set used in the analysis is limited to 300. Although balanced data according to demographic attributes have been collected, the present study was a comparative study based solely on each individual's introverted and extraverted tendencies, and it was not possible to examine trends by other attributes in detail. Therefore, in the future, we intend to confirm the reproducibility of the analytical model and measures proposed in this study with larger-scale data.

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References

1. Amankwah-Amoah, J., Khan, Z., Wood, G., & Knight, G. (2021). COVID-19 and digitalization: The great acceleration. *Journal of Business Research, 136,* 602-611. [CrossRef].
2. Arao, M., Itoh, M., Itoh, T., Iwata, H., & Fukaya, M. (1994). A Preliminary Report on the Applications of the Jenkins Activity Survey for Psychosomatic Patients of the Oral Region. *Japanese Journal of Psychosomatic Dentistry, 9*(1), 63-68. [Link].
3. Brislin, R. W. (1970). Back-translation for cross-cultural research. Journal of cross-cultural psychology, 1(3), 185-216. [CrossRef].
4. Burr, C., Taddeo, M., & Floridi, L. (2020). The ethics of digital well-being: A thematic review. *Science and engineering ethics, 26*(4), 2313-2343. [CrossRef].
5. Fornell, C.; & Larcker, D.F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *J. Mark. Res, 18,* 39–50. [CrossRef].
6. Fuerst, D. R., Gallinat, J., & Boutros, N. N. (2007). Range of sensory gating values and test–retest reliability in normal subjects. *Psychophysiology, 44*(4), 620-626. [CrossRef].
7. Gonzales, M. (2022). *How to Boost Your Emotional Intelligence. In Emotional Intelligence for Students, Parents, Teachers and School Leaders* (pp. 73-90). Springer, Singapore. [CrossRef].
8. Gunasekeran, D. V., Tseng, R. M. W. W., Tham, Y. C., & Wong, T. Y. (2021). Applications of digital health for public health responses to COVID-19: a systematic scoping review of artificial intelligence, telehealth and related technologies. *NPJ digital medicine, 4*(1), 1-6. [CrossRef].
9. Hair, J.F.; Jr Black, W.C.; Babin, B.J.; Anderson, R.E. (2010). *Multivariate Data Analysis;* Prentice Hall: Upper Saddle River, NJ, USA. [Link].

10. Hayes, A. F. (2015). An index and test of linear moderated mediation. *Multivariate Behavioral Research*, 50, 1–22. [CrossRef].
11. Japan Learning Corporation（2022）Notice of the signing of a joint research agreement with the University of Tsukuba on the use of EQ in modern society, Available at [Link]. [Accessed 3 march 2022]
12. Jyoti, J., & Rani, A. (2019). Role of burnout and mentoring between high performance work system and intention to leave: Moderated mediation model. *Journal of Business Research, 98*, 166–176. [CrossRef].
13. Kryshtanovskaya, O. V., Chernavin, Y. A., & Lavrov, I. A. (2022). *Digital Generation: Mechanisms of Socialization and Social Prospects.* In Proceedings of the International Scientific Conference "Smart Nations: Global Trends In The Digital Economy" (pp. 346-354). Springer, Cham. [CrossRef].
14. Leontitsis, A. & Pagge, J. (2007). A Simulation Approach on Cronbach0s Alpha Statistical Significance. *Mathematics Computer. Simulation, 73*, 336–340. [CrossRef].
15. Mathews, S. C., McShea, M. J., Hanley, C. L., Ravitz, A., Labrique, A. B., & Cohen, A. B. (2019). Digital health: a path to validation. *NPJ digital medicine*, *2*(1), 1-9. [CrossRef].
16. Mostajeran, F., Krzikawski, J., Steinicke, F., & Kühn, S. (2021). Effects of exposure to immersive videos and photo slideshows of forest and urban environments. *Scientific Reports*, *11*(1), 1-14. [CrossRef].
17. Nakano, K. (1995) A measurement scale for the Type A behavior pattern in women; The development of the Everyday Behavior Questionnaire, *The Japanese Journal of Psychology*, *66*(2), 121-126. [CrossRef].
18. Nippon Seeds (2022) Aptitude Test, Available at: [Link]. [Accessed 3 March 2022]
19. Oe, H. (2020). Discussion of digital gaming's impact on players' well-being during the COVID-19 lockdown. arXiv preprint arXiv:2005.00594. [Link].
20. Oe, H., & Yamaoka, Y. (2021). Discussion of citizen behavioural change using the nudge effect: a perspective based on social policy interventions. *International Journal of Sociology and Social Policy*. [CrossRef].
21. Orr, D. W. (1993). *Love it or lose it: The coming biophilia revolution. St. R. Kellert and EO Wilson (Eds.)*, The Biophilia Hypothesis, Washington (Island Press) 414-440. [Link].
22. Prati, G., & Mancini, A. D. (2021). The psychological impact of COVID-19 pandemic lockdowns: a review and meta-analysis of longitudinal studies and natural experiments. *Psychological medicine*, *51*(2), 201-211. [CrossRef].
23. Quirk, M. A. (2021). Island Time in Lockdown: Animal Crossing: New Horizons' Slow Culture and Its Shinto Source. *Journal of Religion, Media and Digital Culture*, *10*(3), 428-444. [CrossRef].
24. Ratner, B. (2009). The Correlation Coefficient: Its Values Range between +1/-1, or Do They? *Journal of Target. Meas. Anal. Mark, 17*, 139–142. [CrossRef].
25. Reyes-Riveros, R., Altamirano, A., De la Barrera, F., Rozas-Vasquez, D., Vieli, L., & Meli, P. (2021). Linking public urban green spaces and human well-being: A systematic review. *Urban Forestry & Urban Greening*, *61*, 127105. [CrossRef].
26. Schiebel, T., Gallinat, J., & Kühn, S. (2022). Testing the Biophilia theory: Automatic approach tendencies towards nature. *Journal of Environmental Psychology*, *79*, 101725. [CrossRef].
27. Shaw, W. S., & Dimsdale, J. E. (2010). Type A Personality, Type B. Stress consequences: *Mental, neuropsychological and socioeconomic*, 72-76. [Link].
28. Shen, X., MacDonald, M., Logan, S. W., Parkinson, C., Gorrell, L., & Hatfield, B. E. (2022). Leisure Engagement during COVID-19 and Its Association with Mental Health and Wellbeing in US Adults. *International Journal of Environmental Research and Public Health*, *19*(3), 1081. [CrossRef].
29. Song, C., Ikei, H., Lee, J., Park, B. J., Kagawa, T., & Miyazaki, Y. (2013). Individual differences in the physiological effects of forest therapy based on Type A and Type B behavior patterns. *Journal of physiological anthropology*, *32*(1), 1-7. [CrossRef].
30. Song, C., Ikei, H., & Miyazaki, Y. (2021). Effects of forest-derived visual, auditory, and combined stimuli. *Urban Forestry & Urban Greening*, *64*, 127253. [CrossRef].
31. Stankov, U., & Gretzel, U. (2021). Digital well-being in the tourism domain: mapping new roles and responsibilities. *Information Technology & Tourism*, *23*(1), 5-17. [CrossRef].
32. Sandifer, P. A., Sutton-Grier, A. E., & Ward, B. P. (2015). Exploring connections among nature, biodiversity, ecosystem services, and human health and well-being: Opportunities to enhance health and biodiversity conservation. *Ecosystem services*, *12*, 1-15. [CrossRef].
33. Urbach, N., & Ahlemann, F. (2010). Structural Equation Modeling in Information System Research Using Partial Least Squares. *Journal of Information Technology Theory Application*, *11*, 5–40. [Link].

34. van Houwelingen-Snippe, J., van Rompay, T. J., de Jong, M. D., & Ben Allouch, S. (2020). Does digital nature enhance social aspirations? An experimental study. *International journal of environmental research and public health, 17*(4), 1454. [Link].
35. van Houwelingen-Snippe, J., Allouch, S. B., & van Rompay, T. J. (2022). 'That is a place where I would want to go': investigating digital nature to enhance social wellbeing among older adults. *Ageing & Society*, 1-24. [CrossRef].
36. Wilson, E. O. (1984). *Biophilia*. Harvard University Press. [CrossRef].
37. Yamazaki, K., Tanaka, Y. and Miyata, Y. (1990). Development of a Japanese version of the Type A test for adults: Determination of items and examination of reliability. Proceedings of the 54th Annual Convention of the Japanese Psychological Association, 122. [Link].
38. Yu, C., Wang, Y., Li, T., & Lin, C. (2022). Do top management teams' expectations and support drive management innovation in small and medium-sized enterprises? *Journal of Business Research, 142*, 88-99. [CrossRef].
39. Zhao, J., Xu, W., & Ye, L. (2018). Effects of auditory-visual combinations on perceived restorative potential of urban green space. *Applied Acoustics, 141*, 169-177. [CrossRef].
40. Zhang, Y., Mavoa, S., Zhao, J., Raphael, D., & Smith, M. (2020). The association between green space and adolescents' mental well-being: a systematic review. *International journal of environmental research and public health, 17*(18), 6640. [CrossRef].