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ORIGINAL ARTICLE

The mediating role of place attachment between nature connectedness and human well-being: perspectives from Japan

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Abstract
Previous studies have demonstrated the role of nature connectedness in promoting human well-being. However, recent studies put emphasis on understanding the underlying mechanism that drives the association between nature connectedness and well-being, mainly mental health. Place attachment is one of the place-based socio-psychological concepts that is believed to explain this association. Analysis of survey data collected from Japanese nationals ($N = 2203$) revealed place attachment to have a positive and significant mediating effect on the association. Place attachment contributes to 30% of the total effect of nature connectedness on the well-being of the studied population. Furthermore, the study also observed the relationship between nature connectedness and place attachment, and place attachment and human well-being to be direct and significant. Thus, the current research supports the fact that higher levels of well-being associated with nature connectedness are due to the sense of attachment to a place that nature provides.

Keywords Place attachment · Relational value · Nature connectedness · Eudaimonic well-being · Hedonic well-being · Mediation analysis

Introduction

The human–nature relationship has generated significant research interests over the past years and, in general, demonstrated the positive influence of nature connectedness and/or nature exposure on human health. The broad concept of nature connectedness extends from cognitive and affective affiliation with nature to personal learning and experiential encounters. Apart from better physical health, nature connectedness is observed to reduce morbidity, anxiety, stress, depression, and cardiovascular and respiratory diseases (James et al. 2016). Attention Restoration Theory (Kaplan 1995) and Stress Recovery Theory (Ulrich et al. 1991) attempt to explain the psycho-neuroendocrine mechanisms through which the restorative and recovery functions of nature exposure occur and how they affect physiological and psychological states (Hartig et al. 2014). Research by Nisbet et al. (2011) reported an increase in happiness and more sustainable behavior among individuals who are more nature-related. They term this change as "a happy path to sustainability". With increasing instances of mental illness and proven impacts of nature connectedness on two of the most studied psychological mechanisms, eudaimonism, and hedonism, it becomes important to understand the different socio-psychological pathways through which nature connectedness can improve human well-being. Despite a growing body of literature on the concept of nature connection and well-being, an increasing gap in research on the mechanisms that drive the nature connection—well-being association is observed (Cleary et al. 2017).

Place attachment is identified to be one of those underlying socio-psychological mechanisms that could help in explaining the relationship between nature connectedness and human well-being (Lewicka et al. 2011; Cleary et al. 2017; De Vos et al. 2018). Place attachment, as a broad construct, is defined as an emotional bond with a place (Low and Altman 1992; Manzo 2003). Studies reported

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an increase in individual place attachment as nature connectedness increases and their collective role in promoting pro-environmental behavior among individuals (Gosling and Williams 2010; Beery and Wolf-Watz 2014). Hence, it can be inferred that when a place gets disrupted, so does the connection to nature and attachment to that place. Place attachment is argued to motivate stewardship actions (West et al. 2018; Chapin III and Knapp 2015) which, in turn, foster the sustainability of a particular place (Chapin III and Knapp 2015). The connections between people, place, and nature also help us to understand social motivations, and identify and develop pathways towards sustainability (Brown et al. 2015; Jones et al. 2016). This notion got stronger with the conceptual development of relational values and studies that identified place attachment as one of the significant expressions of relational values that could aid in understanding the people–nature relation and its influence on well-being (Beery and Wolf-Watz 2014; Chan et al. 2016; Klain et al. 2017; De Vos et al. 2018). Relational values are also reported to include "eudaimonic" values which are associated with living a good life (Ryan and Deci 2001). Therefore, it will be fair to propose that place attachment not only improves the connection between human and nature, but also motivates individuals to live a responsible and good life.

McGilivray and Franklin (2015) proposed that a place-based approach to sustainability science largely focuses on context and requires, among other issues, a clear understanding of socio-environmental processes, the various dimensions that drive these processes, and the different mechanisms that regulate human–environment interactions in a context. In a similar tone, Wilbanks (2015) agreed on the fact that place-based focus helps in understanding the local impacts of global forces and plays a significant role in community sustainability. Though the present study does not attempt to measure sustainability aspects, it undertakes a place-based focus on understanding the complex relationship between place attachment, human well-being, and nature connectedness together. Though attempts have been made to understand the underlying mechanism behind the relation between nature connectedness and well-being, studies that have specifically tested the relative importance of the mediating properties of place attachment between nature connectedness and well-being are fewer and the evidence remains inconsistent.

Given that nature connectedness is predictive of well-being and place attachment is also predictive of well-being, we propose that the association between nature connectedness and human well-being (both hedonic and eudaimonic well-being) is mediated by place attachment. In addition, this study also aims to understand: (1) how a change in nature connectedness influences well-being directly, (2) how the change in nature connectedness may impact individual place attachment, and (3) how change in place attachment affects well-being of an individual. As mentioned earlier, understanding the mechanisms that drive human–environment interactions is one of the pre-requisites towards place-based approach to sustainability. Therefore, utilizing a place-based mechanism like place attachment to decipher the underlying mechanism of nature connectedness and human well-being will lead to local sustainability discourses. Given that the majority of nature connectedness and well-being studies are carried out in western cultures, Japan as a study area for the present study will assist in better understanding of the mediated relationship of nature connectedness and well-being among people from diverse, and varied cultural and natural settings.

Research framework

This section presents the hypothesized framework based on the literature review and specifies the research hypotheses adopted to test in the present study. Figure 1 illustrates the hypothesized research framework and the directions of causal relationships between three different latent variables, nature connectedness, place attachment, and well-being, used in this study.

Nature connectedness and well-being

The study of nature connectedness mainly refers to how people identify themselves within a natural environment and the relationships which they form with nature. There are plethora of studies that examined human-nature relationships using multiple terms like nature connectedness (Schulz 2002), nature relatedness (Nisbet et al. 2009), love and care for nature (Perkins 2010), the new ecological paradigm scale (Dunlap et al. 2000), emotional affinity toward nature (Kals et al. 1999), or inclusion of nature in the self (Schulz 2001). Though the scales claim to measure different aspects of connectedness to nature, they can be considered to address a broader concept (Restall and Conrad 2015). Studies suggest

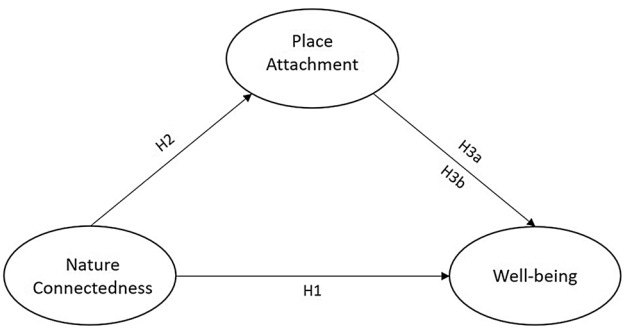

Fig. 1 Hypothesized research framework of the present study

considering nature connectedness as one broad and latent construct that encompasses these concepts and measures and determines well-being (Tam et al. 2013). In lieu of this, the current study makes no distinctions between these concepts and uses nature connectedness as an umbrella concept for all of them.

Several empirical studies corroborated the influence of Nature beyond physical health to psychological health, and not just the absence of or recovery from ill health, but differences in well-being (Nisbet et al. 2011; Biedenweg et al. 2017; Cleary et al. 2017). Well-being is an umbrella term presenting the theories of positive psychology and is mainly segregated into hedonic (e.g., feeling good and happy) and eudaimonic (e.g., living a fulfilled and purposeful life) well-being (Ryan and Deci 2001). Studies on positive relationship between connectedness to nature and eudaimonic well-being (often called psychological well-being) are part of several studies over the time (Trigwell et al. 2014; Zelenski and Nisbet 2014; Cleary et al. 2017). Similar to eudaimonic well-being, nature connectedness is found to strongly associate with hedonic well-being (often termed as subjective well-being) including life satisfaction, positive affect, and happiness (Mayer and Frantz 2004; Nisbet et al. 2011; Tam 2013; Capaldi et al. 2014), and are as significant of a contributor to subjective well-being as are more traditional variables associated with subjective well-being (such as marriage, education, and income). Even when other connections like family and culture are controlled, nature connectedness still significantly predicts happiness (Zelenski and Nisbet 2014). Despite the growing interest and increasing research on the relationship between nature connection and well-being, studies report a gap in in-depth work that explores the mechanisms by which nature connection could promote well-being (Cleary et al. 2017; Restall and Conrad 2015). Moreover, there is a lack of studies on this connection under varied nature-based settings or amongst diverse population groups. Consistent with the above-mentioned discussion, the following hypothesis is conferred:

H1 Nature connectedness has a significant effect on well-being.

Nature connectedness and place attachment

Place attachment is a multi-dimensional construct that includes different aspects of people–place bonding (Scannell and Gifford 2010). Broadly, it refers to the bonds, emotional, as well as functional bonds, that develop between individuals and their surrounding physical environment (Moore and Graefe 1994). Substantial research studied the different pathways through which this people–environment bond develops. The two-dimensional model of place dependence and place identity was the most common pathways to measure place attachment (Williams and Vaske 2003; Jorgensen and Stedman 2006; Brown and Raymond 2007). Several dimensions were added later and tested over time including social bonds (Kyle et al. 2005), place inherited, place relativity, and place discovered (Lewicka 2011) to assess place attachment. Scannell and Gifford (2010) also suggested the use of the multi-dimensional nature of place attachment to identify the variables that influence an individual's attachment or engagement to a place. The present study adopts the proposed model by Raymond et al. (2010) where place attachment is measured beyond just place dependence and identity, and social bonding or community attachment, bonding with surrounding nature, and family bonding are found to be equally important to assess an individual's place attachment (Raymond et al. 2010).

Nature connectedness and biospheric value orientations are found to closely relate to the sense of place in natural environments (Raymond et al. 2010). However, only a few studies on connectedness to nature have included a place as a key component in the form of place bonding or place attachment (Brown and Raymond 2007; Jorgensen and Stedman 2001; Stedman 2002). Beery and Wolf-Watz (2014) in their study on Swedish nationals regarding environment connectedness and pro-environmental behavior strongly proposed the inclusion of the relational concept of place to include the human domain of perceptions, values, and orientations into the environmental connectedness perspective. Interactions with nature tend to increase people's attachment to place and their willingness to act, to defend, or to protect those places. Gosling and William (2010) also reported a moderate yet significant correlation between nature connectedness and place attachment who are important drivers of environmentally significant actions and conservation behavior. On the contrary, Colley and Craig (2019) in their recent study in Scotland reported no significant interaction effect of nature connectedness on the relationship between wildness and place attachment. However, they emphasize on carrying out further studies using different dimensions and under different context to prove their claim. To further understand the relationship between nature connectedness and place attachment, this study hypothesizes that:

H2 Nature connectedness is significantly related to place attachment.

The mediating role of place attachment

A substantial amount of research agreed on the role of place attachment in augmenting the quality of life (Harris et al. 1995), better physical and mental health, better social relationships, and more pro-environmental behavior (Tartaglia 2013). Study with Canadian residents by Scannell and Gifford (2017) reported memory and sense of belonging to be

the two most common experienced benefits of place attachment. Attachment evokes memories attached to the specific place as well as develops a sense of belongingness not only to the family residing in the place but also to the surroundings. With positive emotions being identified as one of the direct outputs of place attachment, disruption in place can have negative implications for well-being (Scannell et al. 2016). Studies have proved that loss of place attachment either through environmental, economic, or technical disasters and/or due to forcible separation lead to trauma, feelings of grief, depression, anxiety, and undermined notions of self-identity (Ruiz and Hernandez 2014; Ellis and Albrecht 2017; Knez et al. 2018). Attachments to place and nature are thought to expand one's identity or self-definition, so does empathy and willingness to help (Mayer and Frantz 2004; Schultz et al. 2004). The present research provides additional experimental evidence on the processes and causal relations of place attachment and hypothesizes that:

H3a Place attachment has a significant positive relation with well-being.

Connectedness to the nature and behavior of humans in natural areas is influenced by complex psychological processes where different mediators influence their responses (Ojea and Loureiro 2007). Though a few mediators are identified that influence the pathway between nature connection and resulting well-being outcome (de Vries et al. 2013; Shanahan et al. 2015) like spirituality (Kamitsis and Francis 2013), mindfulness (Howell et al. 2011), and meaning in life (Howell et al. 2013), the studies are found to overlook often highly personal ways in people conceptualize, value, and connect to varied forms of nature like place attachment. Role of place attachment as a mediator is still in its infant stage in environment psychology literature (Chiesura 2004; Halpenny 2010; Buta et al. 2014; Restall and Conrad 2015), while empirical studies in tourism literature increased in recent years (Korpela and Staats 2014; Halpenny 2010). For instance, Ramkissoon and Mavondo (2015) reported a mediation relationship, moderated by gender, between pro-environmental behavioral intentions and place dependence, place identity, and place affect among visitors to a national park in Australia. The study clearly observed that increasing place satisfaction imbibes pro-environmental behaviors among the tourists which in turn increases their place attachment, dependence, and identity, but not place social bonding. In a similar study by Buta et al (2014) among villagers living near a national park in Romania, the mediating role of place attachment between community attachment and pro-environmental behavioral beliefs was assessed. The results highlight the role of place attachment in mobilizing civic engagement and public involvement in pro-environmental behaviors. Similar studies do exist which reported the role of place attachment in explaining pro-environmental behaviors through mediation analysis (Halpenny 2010; George and George 2004; Cheng and Wu 2015). However, as pointed by Restall and Conrad (2015) also, the relations between nature connections and concepts like place attachment and role of their combined construct as a predictor of environmental actions and well-being are still unclear. Place attachment which has positive impacts on human well-being and is shown to be experienced in and through a sense of connectedness with nature could be one mediating variable that could explain the complex relationship between nature connectedness and human well-being. This research, along with the reasoning presented in this article, highlights the importance of rethinking the general assumptions of the environmental connectedness perspective, in favor of the concept of place and its contribution to well-being. This study also broadens the frame of inquiry to mediating role of place attachment in enhancing well-being. Given the growing, but still limited body of work, we propose that this latter dimension needs more attention. Hence, the present study proposes the following hypothesis:

H3b Place attachment mediates the relationship between nature connectedness and well-being.

Methods

Study area and data collection

A national-scale assessment was carried out, as shown in Fig. 2. An online questionnaire survey was conducted in Japanese by an online research company to residents pre-registered in their web-based portal system. We asked the company to distribute the questionnaires randomly and to as many residents as possible across the country within the budgetary restrictions of the research. The survey was conducted for 2 weeks in March 2018. After careful data screening, 1957 samples were discarded out of a total of 4160 recorded respondents either due to missing data and/or inconsistency in time taken to complete the survey. Survey completion time or response time is one of the commonly used criteria to screen data collected through web-surveys (Meade and Craig 2012; Huang et al. 2012). Removing the respondents with excessively short completion times is often used to reduce noise (Ihme et al. 2009; Malhotra 2008; Keller et al. 2009). However, studies also agreed that a fast completion time does not always mean lower attention to the questionnaire (Malhotra 2008; Zhang and Conrad 2014), but may be due to the knowledgeable and strong attitude of the respondent. In the present study, time taken to complete the survey was found to be highly skewed and median is a better measure of central tendency. Therefore, the median value of

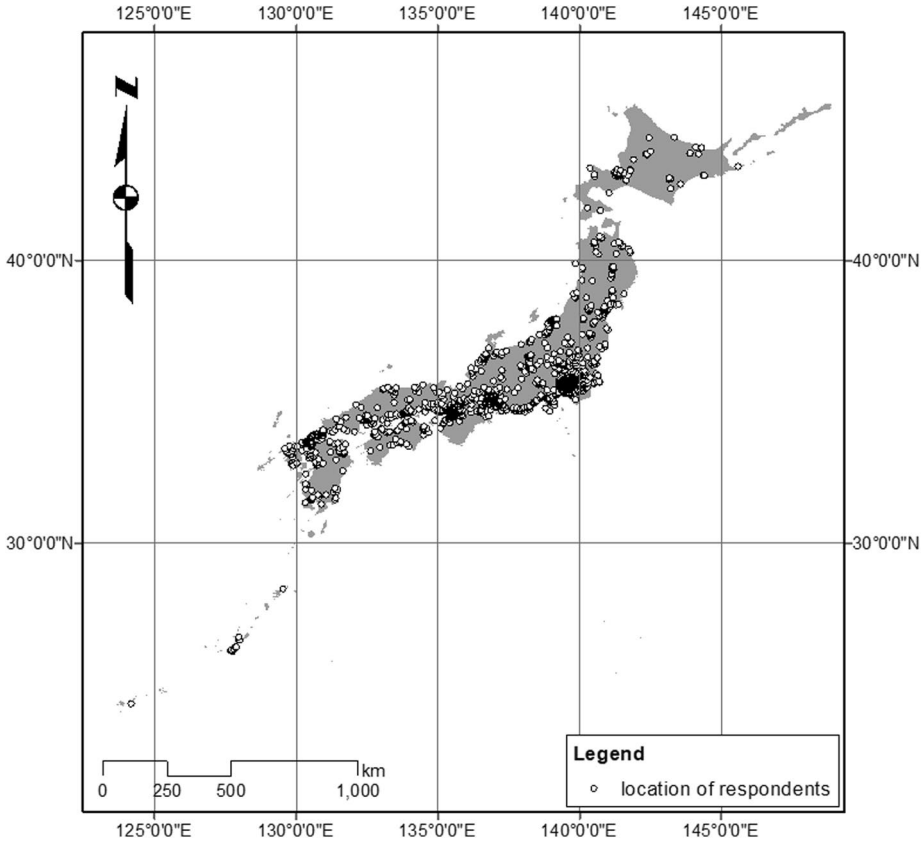

Fig. 2 Map showing the spatial distribution of respondents across Japan. Note: The format of Basic Grid Square of Japan, which divides the whole area of Japan into 30 × 45″ [latitude *X* longitude] geographical grid (about 1-km grid). Was used to identify the location of respondents. Each grid has a unique 8-digit number. Respondents were asked to fill in the 8-digit number that corresponds to their place of residence

12 min was adopted as threshold to screen the data based on survey completion time. Only samples that took ≥ 12 min ($N = 2203$) to complete the survey were considered for further analysis.

Out of the total sample under analysis ($N = 2203$), more than half of the questionnaires were responded by female participants (52.2%). The age of the majority of the respondents was found to lie in between 41 and 50 years (~ 25%) and nearly 43.6% of the respondents are university graduates. Occupation wise, almost 39% ($N = 859$) of the participants are reported to work as company employees. More than half of the respondents (~ 55%) are found to be living on that place for ≤ 20 years. Analyzing the impact of socio-demographic characteristics of the respondents on the hypothesized relationships is out of the scope of the present study and is considered as control variables.

Measures

Nature Connectedness Due to the different connectedness-related terms existing in the literature and a variety of measures used to evaluate them, four different measures were used in the present study to fully explore Nature Connectedness (NC, hereafter). Connectedness to Nature Scale (CNS; Mayer and Frantz 2004) measures the affective, experiential connection of an individual to nature using a 14-item scale like "I often feel a sense of oneness with the natural world around me". A 15-item scale of Love and Care for Nature (LCN; Perkins 2010) was included to analyze the intrinsic value of nature and individual sense of responsibility to protect it using statements like "I feel joy just being in nature". The 21-item Nature Relatedness (NR) scale evaluates the affective, cognitive, and physical relationships individuals have with the natural world (Nisbet et al. 2009). The environmental worldview was analyzed using 15 items from the revised New Ecological Paradigm (NEP) scale (Dunlap et al. 2000). The responses for all the above were recorded in a 5-point Likert scale with endpoints 1 = strongly disagree and 5 = strongly agree. 'Nature' for the present study mainly refers to everyday natural places in and around the residence of the respondents. This is in consistence with the previous studies where nature connectedness is examined with reference to everyday natural places than any particular form of natural landscape (Colley and Craig 2019; Trigwell et al. 2014; Howell et al. 2011, 2013).

Place Attachment The five-dimensional model of place attachment, developed by Raymond et al. (2010), used to measure Place Attachment (PA, hereafter) in the present study. The items in the questionnaire survey were rephrased to fit the present context. The 22-item scale was reported on a 5-point Likert scale where "1 = strongly disagree", "5 = strongly agree", and "3 = neither agree nor disagree".

W*ell-Being* Three measures were used to evaluate two components of well-being—hedonic and eudaimonic—in the present study. The traditional 5-item Satisfaction With Life Scale (SWLS; Diener 1985) and 12-item Scale of Positive And Negative Experience (SPANE; Diener et al. 2009) was used to evaluate the hedonic component of well-being. SWLS is intended to assess cognitive rather than an affective component of subjective well-being and was measured on a 5-point Likert scale. SWLS was reported to have strong internal reliability and moderate temporal stability (Diener 1985) and measure an individual's evaluation of satisfaction. SPANE includes 6 items to assess positive experiences and 6 items to assess negative experiences over last 30 days. Each SPANE item was scored on a scale ranging from 1 to 5, where 1 represents "very rarely or never'' and 5 represents "very often or always''. Linked to time-dependent responses, SPANE demonstrates a balance between memory accuracy and experience sampling, and shows high reliability and convergent validity (Diener et al. 2009). Psychological Well-Being scale or Flourishing scale (PWB; Diener et al. 2009) is a eudaimonic measure that asks the respondents to which extent they agree or disagree with a series of statements like "I lead a purposeful and meaningful life". The respondents presumably indicate their views now, but consider their past lives for an undefined period.

Data analyses

Individual items were first examined using Confirmatory Factor Analysis (CFA) in SPSS (v.22.0). Initial CFA outputs were used to screen the items based on Eigen values of factors and factor loadings. Then, the model fit test was carried out using AMOS (v.22.0) and the modification indices were used to further refine the derived factors until all the fit indices are achieved. Chi-square was used as the first fit index. As Chi-square is sensitive to large sample size and nearly always reject the model when large samples are used (Byrne and Vijver 2010), other fit indices were included in the study. This includes goodness-of-fit (GFI), adjusted goodness-of-fit index (AGFI), comparative fit index (CFI), and Tucker Lewis Index (TLI) range from 0 to 1, with values closer to 1.00 indicating a good model fit (Hair et al. 2010; Mulaik et al. 1989). The factor loadings and factor scores from the final measurement model were retained for further analysis.

To test how well the retained factors (hereafter, constructs) capture the latent variables (i.e., nature connectedness, place attachment, and well-being in the present study), reliability and validity tests were carried out using the factor loadings. Cronbach's alpha was used to test internal consistency reliability and construct validity. Composite reliability (CR) and average variance extracted (AVE) were used to measure convergent validity, while intercorrelations among latent constructs were used to estimate discriminant validity.

These steps were followed by the Structural Equation Model (SEM) evaluation to test the hypothesized relationships between the latent variables under study using AMOS (v.22.0). The Maximum-Likelihood Method of estimation was applied to derive the structural model (Anderson and Gerbing 1988). To test the mediated relationships suggested in hypotheses H3b, bootstrapping approach was used. The assumption of normality of sampling distribution is not imposed in this method, thus reducing the likelihood of Type 1 error (Preacher and Hayes 2008). Also, latent variables are used to test the mediation hypothesis, thus reducing measurement error and bias in the estimation of indirect effect (Hayes et al. 2011). In this study, 5000 bootstrap samples were used to obtain estimates for indirect relationships. Point estimates (B) and bias-corrected and accelerated (BCa) 95% confidence intervals are derived to assess the significance of the 'effects'.

Results

Measurement model

Confirmatory Factor Analysis was conducted to examine individual constructs and their items. After initial CFA, 32 survey items from nature connectedness (nine NEP, seven CNS, eleven NR, and five LCN items) and one item from place attachment (one from friend bonding item) were dropped from the model due to low (<0.4) factor loading. Items with significant ($p<0.001$) factor loading (λ) ≥ 0.40 and Eigenvalues ≥ 1.0 (Hammit et al. 2006) were retained for further analysis. Model fit test of the measurement model was carried out in AMOS, and modification indices were checked and used to get the best fit model. Elimination of two-place attachment constructs (family bonding and friend bonding) and three nature connectedness constructs due to their low loading, led to a model that fits the data satisfactorily well (χ^2 (98) = 335.35, $p = 0.000$, GFI = 0.964, CFI = 0.965, TLI = 0.943, RMSEA = 0.076). Table 1 shows the model specifications for all the constructs and their items. As studies suggest, the AVE should be 0.5 or higher and composite reliability should be higher than 0.6 (Bagozzi et al. 1994). However, Fornell and Larcker (1981) suggested that if AVE is less than 0.5, but composite reliability is higher than 0.6, the convergent validity of the construct is still acceptable. As shown in Table 1, the AVE for nature connectedness constructs do not meet the AVE threshold. Still, we retain them for further analysis as their composite reliability and internal consistency reliability (Cronbach's α) meets the suggested criteria. Also, as the model fits well, measurement error is already considered with the use of latent variables. In addition, all intercorrelations among latent constructs are less than the suggested threshold of

Table 1 Summary results of measurement model

Constructs and items	Mean	SD	λ	α	CR	AVE
Place attachment						
Place dependence and place identity[a]				0.94	0.932	0.560
This area is a special place for me	3.08	1.11	0.88			
This area is a great place for me	3.03	1.06	0.76			
I feel a very strong attachment to this area	2.99	1.11	0.86			
I feel a strong sense of unity in this area	3.36	1.04	0.73			
Living in this area often shows me who I am	3.13	1.00	0.72			
I feel this area is part of me	3.29	1.04	0.71			
There is no place to compare with this area	3.47	1.05	0.70			
I am satisfied with my life in this area than I live in any other place	3.03	1.05	0.88			
It is meaningful to have my life and activities done in this area	3.42	1.03	0.63			
This area is the best place to do what I want to do	3.20	1.03	0.75			
My relationship with my family in this area is very important for me	2.83	1.09	0.54			
Nature bonding				0.90	0.859	0.551
When you interact with nature in this area, you learn a deep openness to nature	3.19	1.03	0.83			
If the area's nature is lost, attachment to this area will also weaken	3.10	1.03	0.73			
In contact with nature in this area, we often re-recognize ourselves	3.31	1.03	0.70			
I feel a strong attachment to the nature in this area	3.11	1.07	0.64			
When you touch nature in this area, your mind is relaxed	2.95	1.06	0.79			
Well-being						
Psychological Well-being and Satisfaction with life				0.93	0.916	0.482
In most ways my life is close to my ideal	3.40	1.06	0.82			
The conditions of my life are excellent	2.90	1.07	0.70			
I am satisfied with my life	3.01	1.12	0.69			
So far, I have gotten the important things I want in life	3.22	1.05	0.78			
If I could live my life over, I would change almost nothing	3.35	1.09	0.62			
I lead a purposeful and meaningful life	3.05	1.01	0.73			
My social relationships are supportive and rewarding	2.91	1.02	0.64			
I am engaged and interested in my daily activities	2.89	0.97	0.61			
I actively contribute to the happiness and well-being of others	3.13	0.96	0.68			
I am a good person and live a good life	3.12	1.00	0.77			
I am optimistic about my future	3.15	1.11	0.46			
People respect me	3.50	0.96	0.74			
Negative Affect Measures (R)[b]				0.89	0.888	0.570
Negative	2.75	0.98	0.74			
Bad	2.89	0.91	0.80			
Unpleasant	2.93	0.91	0.77			
Sad	3.24	0.99	0.74			
Afraid	2.78	1.03	0.78			
Angry	3.02	0.97	0.69			
Positive Affect Measures [b]				0.93	0.916	0.648
Positive	2.79	0.96	0.63			
Good	2.69	0.85	0.80			
Pleasant	2.60	0.84	0.91			
Happy	2.72	0.94	0.82			
Joyful	2.76	0.88	0.85			
Contented	2.84	0.93	0.78			
Nature connectedness						
Physical and emotional affinity				0.87	0.856	0.337
I feel joy just being in Nature	2.65	0.96	0.74			

Table 1 (continued)

Constructs and items	Mean	SD	λ	α	CR	AVE
I feel content and somehow at home when I am in unspoilt nature	2.58	0.97	0.70			
My ideal vacation spot would be a remote, wilderness area	3.12	1.00	0.53			
I feel that closeness to nature is important for my wellbeing	2.66	0.93	0.65			
I enjoy learning about nature	2.91	0.96	0.49			
I enjoy digging in the earth and getting dirt on my hands	2.89	1.11	0.48			
When in natural settings I feel emotionally close to nature	2.26	0.89	0.62			
When I am close to nature, I feel a real sense of oneness with nature	2.61	0.92	0.58			
When I spend time in unspoilt nature I feel that my day-to-day worries seem to dwindle away in the face of the wonder of nature	2.85	0.97	0.46			
I feel a deep love for nature	2.70	0.92	0.51			
I often feel emotionally close to nature	2.75	0.95	0.50			
I do not often go out in nature (R)	3.22	1.05	0.62			
Actions and awareness				0.85	0.821	0.438
I think a lot about the suffering of animals	3.20	1.04	0.57			
I take notice of wildlife wherever I am	3.34	1.01	0.63			
I often feel a strong sense of care towards the natural environment	2.99	0.93	0.58			
I always think about how my actions affect the environment	3.26	0.92	0.81			
I am very aware of environmental issues	3.28	0.95	0.72			
I have a deep understanding of how my actions affect the natural world	3.08	0.87	0.62			
Oneness with nature				0.91	0.625	0.363
I am not separate from nature, but a part of nature	2.59	0.92	0.54			
When I think of my life, I imagine myself to be part of a larger cyclical process of living	2.79	0.98	0.51			
Like a tree can be part of a forest, I feel embedded within the broader natural world	2.71	1.00	0.73			

[a]Place in the present study refers to the place of dwelling and the surrounding neighborhood of the respondent

[b]The question asked was: How frequent did you feel the following affect measure in last 30 days?

R: The items are reverse coded.

SD standard deviation, λ factor loading of the items under a construct, α Cronbach's alpha, *CR* composite reliability, *AVE* average variance extracted

Table 2 Standardized regression weights between all the hypothesized relationships

Endogenous variables	Exogenous variables	Estimates	SE
Place attachment	Nature connectedness	0.633***	0.032
Well-being	Nature connectedness	0.276***	0.040
Well-being	Place attachment	0.204***	0.034

***$p < 0.05$

0.85 (Kline 2015), thus providing strong evidence of discriminant validity.

Hypothesis model testing

Structural equation modeling (SEM) was used to examine the proposed hypotheses of the present study. Table 2 shows the regression weights and standard error of the hypothesized relationships proposed in this study. H1 proposes a significant effect of nature connectedness on well-being. The model finding demonstrates a significant effect ($\beta = 0.276$, $p < 0.001$), and therefore, H1 is supported. H2 which hypothesized that nature connectedness has a significant positive relation with place attachment is also supported ($\beta = 0.633$, $p < 0.001$) in the present study. Place attachment is also found to be significantly related to well-being ($\beta = 0.204$, $p < 0.001$), hence supporting H3a.

H3b involves mediation testing with place attachment as the mediator between nature connectedness and well-being. In this analysis, bias-corrected bootstrapping p values were evaluated to generate the mediating effects. The outputs of the regression analysis show that the paths between each pair of variables involved are statistically significant. The bootstrap mediation analysis results are demonstrated in Table 3. The 'total effect' between nature connectedness and well-being is positive and significant ($B = 0.542$; BCa 95% CI is between 0.46 and 0.62; the interval does not include zero, $p < 0.05$). The size of the 'indirect effect' from nature connectedness to well-being is $B = 0.173$ and is found to be statistically significant (BCa 95% CI is between 0.11 and 0.25, $p < 0.05$). The

Table 3 The bootstrap point estimates (unstandardized regression coefficients *B*), their standard errors (SE), and 95% confidence intervals (CI, lower and upper bounds) for all the 'effects' of the mediation model between nature connectedness and well-being through place attachment ($N = 2203$; 5000 bootstrap samples)

Effects	Point estimate, *B*	SE	Bias corrected and accelerated (BCa) 95% CI (confidence interval) of the coefficients	
			Lower	Upper
Indirect effect	0.173	0.035	0.108	0.246
Direct effect	0.369	0.051	0.272	0.471
Total effect	0.542	0.043	0.456	0.622

When the confidence interval does not include a value = 0, the coefficient is significantly different from 0

estimate of the 'direct effect' from nature connectedness to well-being is found to be positive and significant ($B = 0.369$; BCa 95% CI is between 0.27 and 0.47, $p < 0.05$). The significant 'indirect effect' demonstrates the existence of mediation in the model and the significant 'direct effect' illustrates the presence of partial mediation (Preacher and Hayes 2004). This illustrates that some but not all of the effects of nature connectedness on well-being are carried through place attachment, hence supporting H3b. Combining all these information, it can be inferred that of the 0.542 unit difference in well-being to one unit difference in nature connectedness ('total effect'), 0.173 of it is the result of the effect of nature connectedness on place attachment ('indirect effect'), which in turn influences well-being of the survey respondents. The remaining 0.369 is direct and/or attributable to other indirect effects not explicitly modeled in the present study.

Though a few approaches are developed to examine how much of a variable's effect is due to the mediation process, there is no universally agreed-upon approach (Hayes et al. 2011). One approach is estimating the ratio of the indirect effect to the total effect to assess the proportion of total effect that is mediated. This approach is reported to be useful for individual mediators (Mascha et al. 2013; Hayes et al. 2011), but the ratio is not always easy to interpret when there are multiple mediators. In the present study, this ratio is 0.173/0.542 = 0.320. Therefore, it can be interpreted that nearly 32% of the total effect of nature connectedness on well-being is due to its indirect effect through place attachment.

Discussion

The main aim of this study was to explore the relationship between place attachment with nature connectedness and well-being, and specifically, to examine the role of place attachment as a mediator of the nature connectedness—well-being relationship. The research findings demonstrated a significant positive relationship among all the constructs under study. Constructs like physical and emotional affinity to nature explained through statements like "My ideal vacation spot would be a remote wilderness area" and "I often feel emotionally close to nature", awareness about non-human species (e.g. "I take notice of wildlife wherever I am") and pro-environmental actions, as well as the sense of embeddedness with nature (e.g. "Like a tree can be part of a forest, I feel embedded within the broader natural world") are found to explain the nature connectedness of the studied individuals significantly. As different scales were used to measure nature connectedness in this study, items from different scales but with a similar underlying meaning were found to load in the same construct (or, factor). For example, "I always think about how my actions affect the environment" from Nature Relatedness scale and "I have a deep understanding of how my actions affect the natural world" from Connected to Nature scale loaded on a single factor termed in this study as "Actions and Awareness". These results ensure that irrespective of measuring different aspects of nature connectedness, the scales evaluate a common underlying concept. Humans are reported to be inseparable from nature according to Buddhist philosophy (Takemura 2008) and spirituality is reported to be an integral part of human–nature relationships in Japan, referring nature as "God (Kami)" (Yuhki 2008). Connectedness, embeddedness, or rootedness to nature is evident from many Japanese works of literature including the concepts of *satoyama* and *satoumi* which combines *Sato* (village) with *Yama* (mountain) and *Umi* (coastal sea) illustrating the appreciation of Japanese people for the traditional cultural landscape embodying human and nature (Takeuchi 2003; Yoshida 2011; Chakraborty and Gasparatos 2019). In a recent study on undergraduate students in Tokyo metropolis, Soga et al (2016) reported that people identify natural environments and their associated wildlife even when they are living in city center. Findings of the present study are consistent with the previous research reports and illustrate the existing nature connectedness trait in Japanese people.

Out of the three different scales used to measure well-being in this study, satisfaction with life scale is found to load together with the psychological well-being scale in single construct. Human well-being is one of the most important benefits derived from connection to nature. Several studies have reported the association between nature connectedness and well-being (Howell et al. 2011, 2013; Nisbet and Zelenski 2013; Capaldi et al. 2014; Passmore and Howell 2014), and suggest that nature connectedness is associated with the extent to which people are happy and flourishing in their lives (Keyes 2005). In Japan, nature contact is found to be beneficial to health and relieve stress which

leads to the modern Japanese practice of "shinrinyoku'' (forest bathing) (Tsunetsugu et al. 2010). Capaldi et al. (2017) also reported similar findings with their study on Japanese University students where nature connectedness is reported to contribute to higher levels of emotional, social, and psychological well-being. In consistence with these studies, the studied well-being measures, including both hedonic and eudaimonic well-being scales, are observed to be significantly associated with nature connectedness. This finding partly agrees with the findings of Howell et al. (2011) who reported a significant association between eudaimonic well-being and nature connectedness but a less-reliable association between nature connectedness and positive affect or life satisfaction. Nisbet et al. (2011), on the other hand, reported a positive correlation between nature connectedness, measured using connected to nature scale, and well-being measures like positive affect, satisfaction with life, and psychological well-being.

Out of the five dimensions proposed by Raymond et al. (2010), the present research findings demonstrated that place dependence, place identity, and nature bonding are significantly measuring place attachment of the studied population. Whereas, family bonding and friend bonding were found to have no influence on place attachment which is inconsistent with the findings of previous studies (Raymond et al. 2010; Scannell and Gifford 2010). One probable reason could be due to declining social bonds in Japan. As per the Cabinet office survey on human relationships (Cabinet Office 2004, as cited in Hashimoto 2007), two out of three Japanese people do not have strong ties or relationships with their neighbors. The rural population, on the contrary, is still found to have a relatively closer bond with their neighbors compared to their urban counterparts. Figure 2 demonstrates an overview of sample distribution showing substantial number of respondents from the "Taiheiyo Belt", extending from Tokyo region to Fukuoka, which is reported to be the most industrialized region with largest urban population in Japan (Weinstock 2013). This demonstrates the urban characteristics of most of the respondents. As nature may not be in high supply in urban areas, it is possible that urban residents bond socially with friends and family in non-nature settings.

Place attachment is found to have significant relationships with both nature connectedness and well-being, thus supporting the proposed hypotheses H2 and H3a in the present study. The positive and significant relation between nature connectedness and place attachment demonstrates a directly proportional relationship between the two constructs which means that higher cognitive, emotional, and experiential connection with nature increases place dependence and develops place identity as well as strong nature bonding in the studied population. Similarly, as place attachment becomes strong, positive emotions and satisfaction with life increases and psychological well-being becomes higher. Though detailed causal pathways among each construct are not evaluated, the reported empirical evidences are a significant contribution to the place attachment—well-being and place attachment-nature connectedness literature.

In a study by López-Mosquera and Sánchez (2013), place dependence was reported to significantly mediate the relationship between benefits derived from a natural area and loyalty to visit it again. Similarly, place attachment was found to mediate the relation between desired benefits and attained benefits, and future visit intentions among visitors in a national forest in USA (Kil et al. 2012). Song and Soopramanien (2019) observed social bonding to a place to have a higher influence on the relationship between the length of residence and pro-environmental behavior than personal place attachment measured using place dependence and identity. Among the attempts that have been made to understand the potential of place attachment as a mediator, most of them are found contributing to the tourism literature. Our hypothesis (H3b) regarding place attachment functioning as a mediator of the relationship between nature connectedness and well-being was supported and the research finding makes a significant unique contribution in the field of environmental psychology. These findings indicate that nature-connected individuals might experience greater well-being, because they derive place attachment from their relation to nature. Place attachment is found to function as a mediator in relations that aid the human way of life like identity formation, cognitive affection, and life satisfaction. Though the mediated effect is reported to be partial, since both the indirect effect and direct effect are found to significant and point in the same directions, the mechanism can be referred as complementary mediation. Considering the wide multi-dimensional construct of nature connectedness and its dynamic relation to well-being, place attachment might not be the only mediator influencing this relationship. There must be other mediators, which need to be examined, thus explaining the partial mediation effect of place attachment. For instance, spirituality was found to have a significant mediation effect on the relationship between both nature exposure and nature connectedness, and psychological well-being (Kamitsis and Francis 2013). This signifies that human well-being is deeply connected to spirituality that individuals derive through their connection with nature. The current research findings also contribute significantly to the relational value literature where place attachment demonstrates the relational values that emerge from the relationship between nature connectedness and its association with well-being. There has been growing attention within the policy arena to increase exposure to nature as with Sustainable Development Goal 11.7. However, simply increasing the provision of and/or access to nature may not deliver the intended health outcomes without understanding the mechanisms like place attachment at play. The findings

of the present study enhance the efficiency of programs on nature connection including the school education programs by helping to explain how and why different individuals and cultural groups are able (or otherwise) to connect with their living environments, in what ways, and to what extent (if at all) such experiences enhance eudaimonic well-being. Similarly, reorientation of the focus to increased nature connectedness through lived experiences of individuals will help in designing effective mental health awareness programs.

Our study is not exempt from limitations. First, the use of self-reported measures can be recognized as a potential limitation of this study. The use of self-reports is reported to be questionable with some studies doubting their validity (Homburg and Stolberg 2006), while others demonstrate their usability in providing valid research outputs (Kaiser et al. 2003). Finally, this research has some limitations which provide interesting directions for future research. The present study just provides the primary empirical evidence, and hence, more in-depth case studies are required to explore the formation and effects of place attachment in promoting human well-being. Sociodemographic characteristics of the survey respondents are considered as control variables in the present study. However, it will be interesting to evaluate how the proposed relationships change with change in socio-demographic characteristics of survey respondents. Future research may try to identify and include the potential moderators and test their role in the suggested model. The association of nature connectedness and well-being is well established, but as discussed in this paper and various other studies, it is time to analyze how this association is made and how it works. Several pathways are already proved (like spirituality, meaning of life), but we need future studies that would explore the other possible socio-psychological pathways that moderate and/or mediate the relationship between nature connectedness and human well-being. Also, analyzing and discussing the implications for sustainability are not included in the present paper, but presents an interesting avenue for future research. It is not difficult to understand how the nature connectedness—place attachment—well-being nexus will be contributing to localized sustainability which might have global impacts. The sustainability discourse of the present study extends from how nature connectedness could imbibe change in sustainable environmental behavior and promote in maintaining a sustainable lifestyle to living a happy and satisfied life in coordination with nature. Nature connectedness leads to sustainability (Nisbet et al. 2011) and promotes well-being, while place-based discourses for attaining sustainability gained attention with emergence of 'sustainability science' over the last decade (Wilbanks 2015; Chapin III and Knapp 2015; Potschin and Haines-young 2013). Hence, discourse on sustainability, regarding the present study, is to be analyzed and is an important arena for future research.

Conclusions

The current study provides direct empirical support for a relationship between nature connectedness and place attachment, making a significant contribution to the environmental psychology literature. This study provides a more specific avenue for place attachment in policy intervention. That is, planning authorities can identify which specific place attachment policy intervention will be more impactful. In addition, the role of place attachment as a potential mediator of the nature connectedness–well-being relationship across various well-being dimensions is empirically proved. This is also one of the first attempts that try to examine the mediating role of place attachment in the association between nature connectedness and well-being, as per the recent knowledge of the authors. Gaining a deeper understanding of the mechanism(s) responsible for the well-being outcomes from nature connection will help in the implementation of targeted policies and enable interventions to promote well-being. This will help to move the application of nature and health research towards more tailored, targeted, and effective solutions. Furthermore, the implementation of the study in an Asian country like Japan, apart from westernized cultures, better resonates the nature connection, place attachment, and well-being among people from diverse cultural and social settings, thus fulfilling another highlighted research gap in this arena.

Finally, further research is needed to test this suggested model in other settings and to further understand the causal relationship between nature connectedness, place attachment, and well-being.

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